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The Logic of Escalation
Investigating the Role of Stakes in Trade Disputes
as a Lens to Conflict Processes

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Summary

This study investigates the determinants and dynamics of conflict escalation in international trade relations. There is extensive research on conflict behavior across disciplines, including in the scholarship on labor disputes, legal disputes, and war. However, escalation processes, which underlie and eventually bring about open conflict, are not yet clearly understood. The micro-mechanism that ultimately drives conflict behavior, therefore, remains opaque. As a result, it remains difficult to explain when and why conflicts escalate or to predict the larger pattern of conflict activity. The present dissertation seeks to contribute to filling this gap by studying escalation processes in the comparatively structured, transparent, and empirically accessible context of international trade relations.

The study develops a bargaining theory of conflict that explicitly focuses on the logic of escalation dynamics and the role of parties' stakes as a key factor in driving these dynamics. This theory highlights the deeper motivation of escalation behavior and allows predictions about both the pattern and outcome of such behavior. Specifically, it identifies the conditions under which high-stakes parties have incentives to provoke mutually and increasingly costly situations in an effort to obtain larger concessions at an earlier point in time. It further points out what agreements can actually be expected to result from conflicts that escalate.

In order to test the theory, it is necessary to acquire detailed data on conflict intensity and escalation behavior as well as to measure the stakes of the concerned parties. The focus on international trade makes it possible to satisfy these requirements. To observe escalation processes in the area of international trade, the study focuses on industry-level disputes and disagreements over trade policies between the United States and its trade partners. In this context, a custom-programmed automated content analysis procedure is developed to compile an extensive new dataset from annual U.S. trade reports. This procedure allows a detailed reconstruction of thousands of bilateral product-level dispute histories over time. A substantial part of the empirical work of the study is devoted to measuring parties' stakes. Based on international trade theory, it is shown how parties' stakes arise in international trade relations, what is required to measure these stakes, and how the method proposed to do so can be implemented.

The results of the empirical analysis suggest that not the *observable* industry-level trade flows, but the interaction of the parties' stakes, i.e., the *counterfactual* loss and gain potentials that can be expected to arise from trade barrier reductions, drive dispute escalation in international trade relations. The results further suggest that the United States succeeds in extracting limited concessions from its trade partner in costly disputes – yet not because escalation is inherently useful, but because the United States selectively initiates the disputes it expects to 'win'. Lastly, the results suggest that because costly disputes eventually require both sides to compromise, the variability in outcomes is more constrained after more intense disputes than after milder disagreements. This

suggests that both the largest gains and the largest losses for both sides are realized at low levels of escalation.

With these results, the theoretical treatment of escalation processes, the methodology to measure parties' stakes in international trade relations, and several data contributions, this study enables an increased understanding of conflict processes in international trade. The results further suggest a number of policy implications for dispute mitigation in international trade. However, the contribution of this dissertation reaches beyond the field of international trade. The theory and findings presented also hold important insights for the study on bargaining and conflict more generally and may facilitate further research on these important phenomena.

Zusammenfassung

Diese Arbeit untersucht die Ursachen von Konflikt- und Eskalationsprozessen in Handelsstreitigkeiten. Eine umfangreiche Literatur in verschiedenen Disziplinen beschäftigt sich mit Konfliktverhalten in bezug auf Phänomene wie Arbeitskampf und Streiks, Rechtsstreits oder Krieg. Trotz dieser Anstrengungen sind Eskalationsdynamiken, die letztendlich in offenem Konflikt münden, unzureichend verstanden. Der spezifische Mechanismus, der Konfliktverhalten zugrunde liegt, bleibt im Dunkeln. In der Folge gelingt es oft nur eingeschränkt, das Auftreten von Konflikten in Einzelfällen zu erklären oder das Muster von Konfliktverhalten in einer grösseren Population von Fällen vorherzusagen. Ziel der vorliegenden Arbeit ist es, dazu beizutragen, diese Erkenntnislücke zu schliessen. Die inhaltliche Fokussierung auf den vergleichsweise strukturierten, transparenten und empirisch zugänglichen Bereich des internationalen Handels ist dabei äusserst hilfreich.

Die Arbeit entwickelt einen theoretischen Ansatz, der Konfliktverhalten als Verhandlungsprozess versteht und dabei explizit Eskalationsdynamiken in den Mittelpunkt der Betrachtung stellt. Durch die Berücksichtigung der subjektiven Interessen der Parteien in potentiellen Konfliktsituationen unterstreicht dieser Ansatz die Rolle der tieferliegenden Motivation der Parteien, auf konflikthafte Verhandlungsstrategien zurückzugreifen. Insbesondere zeigt der Ansatz auf, unter welchen Bedingungen Parteien mit starken subjektiven Interessen einen Anreiz haben, durch Eskalationsverhalten Situationen herbeizuführen, die für beide Seiten gleichermassen kostspielig sind, um grössere Zugeständnisse des Gegenübers zu einem früheren Zeitpunkt zu erwirken. Der Ansatz zeigt weiter auf, welche Art von Verhandlungsergebnissen vom Einsatz solcher Strategien tatsächlich zu erwarten sind.

Um diese Vorhersagen, die sich aus der theoretischen Arbeit ableiten lassen, empirisch zu überprüfen, bedarf es detaillierter Informationen sowohl über Konfliktverhalten als auch über die jeweiligen Interessen der Parteien. Der Fokus auf Handelbeziehungen ermöglicht dies. Die Arbeit betrachtet dafür Eskalationsprozesse in produktspezifischen Handelsstreitigkeiten zwischen den USA und ihren Handelspartnern. Durch die Entwicklung und Anwendung eines Verfahrens zur Automatisierten Inhaltsanalyse von Textdateien wird zunächst ein neuer Datensatz erstellt, der sich aus jährlichen Berichten der U.S. Handelsagentur speist. Auf Grundlage dieses Verfahrens ist es möglich, den detaillierten Verlauf tausender bilateraler, produkt-spezifischer Streitigkeiten über Zeit zu rekonstruieren. Ein Grossteil der empirischen Arbeit ist der Messung der Interessenskonstellationen der Handelspartner gewidmet. Basierend auf ökonomischen Handelstheorien zeigt die Arbeit, woraus sich die Interessen der Parteien in Handelskonflikten speisen und welche Schritte vonnöten sind, um diese Interessen letztlich zu messen.

Die Ergebnisse der empirischen Analyse legen nahe, dass Eskalationsverhalten in Handelsstreitigkeiten weniger von der Grösse direkt beobachtbarer Handelsflüsse getrieben ist, als vielmehr von der Interaktion der hypothetisch zu erwartenden Gewinne und Verluste der Parteien, die von

einer Reduzierung von Handelshemmnissen zu erwarten ist. Die Ergebnisse legen zudem nahe, dass die USA als Initiator der beobachteten Streitigkeiten in der Lage sind, durch Konflikteskalation eingeschränkte Zugeständnisse von ihren Handelspartnern zu erwirken. Dies deutet jedoch nicht notwendigerweise darauf hin, dass sich Konfliktverhalten unmittelbar auszahlt. Näher liegt, dass die USA selektiv solche Streitigkeiten bevorzugen, bei denen sie sich bessere Erfolgschancen ausrechnen. Weiterhin deuten die Ergebnisse darauf hin, dass die letztlich erzielten Einigungen nach intensiveren, weiter eskalierten Konflikten näher beieinanderliegen als nach weniger intensiven Disputen. Dies spricht dafür, dass beiden Parteien in intensiveren Disputen zusehends bereit sind Zugeständnisse zu machen, so dass sich die Kompromissvorschläge einander annähern. Eine Implikation dieses Ergebnisses ist, dass die Partien sowohl die grössten Verluste als auch die grössten Gewinne nach äusserlich unauffälligen, wenig intensiven Konflikten erzielen.

Mit den beschriebenen Ergebnissen, der theoretische Analyse, der entwickelten Methode zur Messung von subjektiven Interessen in Handelsstreitigkeiten, sowie den bereitgestellten Datensätzen trägt diese Arbeit zu einem erweiterten Verständnis von Konflikten in Handelsstreits dar. Die Befunde der Arbeit sind zudem von Relevanz für angewandte Fragen der Konfliktbearbeitung in Handelsstreitigkeiten. Auch jenseits der internationalen Handelspolitik sind die Ergebnisse von Relevanz, da sie auf generell gültige Gesetzmässigkeiten in Verhandlungs- und Konfliktsituationen hindeuten und somit die weitere Forschung zu diesen Themen vorantreiben können.

Table of Contents

List of Figures vii
List of Tables viii
Abbreviations ix
Acknowledgments x

Introduction 1
1. The Bargaining Literature on Conflict Processes: Strikes, Litigation, and War 21
    1.1. Labor Disputes and Strikes 28
    1.2. Legal Disputes and Litigation 33
    1.3. International Conflict and War 39
2. The Literature on Trade Disputes and the Economics of Trade 49
    2.1. Conflict in International Trade Relations: Trade Disputes 50
    2.2. International Trade Theory and the Political Economy of Trade Policy 61
    2.3. Motivation of the Study: Bargaining Theory and International Trade 74
3. A Theory of Escalation: The Role of Costs and Stakes in Conflict Processes 81
    3.1. Escalation Dynamics in a Bilateral Bargaining Framework 84
    3.2. Extension I: Limited Uncertainty and Anticipation 99
    3.3. Extension II: Asymmetries induced by the Multilateral Trade Network 106
4. Measuring Dispute Escalation: U.S. Trade Relations and Trade Enforcement 117
    4.1. Automated Content Analysis of the U.S. National Trade Estimate (NTE) Reports 118
    4.2. Setup and Implementation of the Automated Content Analysis 123
    4.3. Results, Discussion, and Validation 133
5. Measuring Stakes – Prerequisite I: Estimating Trade Elasticities 139
    5.1. Simultaneous Price Determination and the Identification Problem 141
    5.2. Estimation Strategy: Structural Estimation of Elasticities 144
    5.3. Trade Elasticities: Data, Estimation, and Results 150
6. Measuring Stakes II: Estimating the Size of Non-Tariff Barriers to Trade (NTBs) 157
    6.1. Quantifying Observable Trade Frictions: The Gravity Model of Trade 160
    6.2. Estimation Strategy: 'Reverse Engineering' the Size of Non-Tariff Barriers 163
    6.3. Non-Tariff Barriers: Data, Estimation, and Results 167
7. From Stakes to Escalation: Trade Barriers, Trade Patterns, and Trade Disputes 183
    7.1. Measuring Stakes: Counterfactual Gain and Loss Shares from Trade Liberalization 183
    7.2. Explaining Escalation: The Role of Stakes in U.S. Trade Disputes 194
    7.3. Explaining Outcomes: Dispute Escalation and Implied Trade Concessions 207

Conclusion 213

Annex I – Automated Content Analysis: Industry Classification and Dictionaries. 229
Annex II – Automated Content Analysis: Full Set of Validation Plots..273
Annex III – Non-Tariff-Barriers: Full List of Product-Level Estimates..285
Annex IV – Explaining Escalation: Additional Estimates..289

References..293

List of Figures

Figure I.1: Combining strong theories of conflict with the strong empirical field of international 6
Figure I.2: Trade elasticities and their implications for the effectiveness of trade barriers 12
Figure I.3: Inferring unknown trade barriers from elasticities and observable trade frictions............14
Figure I.4: Stakes – hypothetical trade barrier reductions and the resulting gains and losses 15
Figure 3.1: The bargaining sequence under one-sided incomplete information..................................89
Figure 3.2: The bargaining sequence under two-sided incomplete information..................................90
Figure 3.3: The equilibrium path of the two-sided incomplete information game over time..............92
Figure 3.4: The flow of payoffs from bargaining and escalation over time..97
Figure 3.5: (A)symmetry and anticipation under maximum und limited uncertainty.......................102
Figure 3.6: Expected levels of escalation under limited uncertainty..103
Figure 3.7: Asymmetric stakes resulting from the multilateral nature of trade relations...................108
Figure 3.8: The exporter's self-selection and the pattern of changes in bargaining outcomes...........113
Figure 4.1: Comparison of ACA results to manual coding – Top 10 U.S. exports to Japan................135
Figure 5.1: Simultaneity bias in supply and demand systems...141
Figure 5.2: Identification strategy due to Feenstra (1994) 144
Figure 5.3: Estimates of σ compared to Rauch (1999) categories – conservative classification..........152
Figure 5.4: Estimates of σ plotted against dispersion in import prices 154
Figure 7.1: Dependent variables derived from industry-specific dispute histories, 1988 – 2012.......193
Figure 7.2: Interaction surface derived from the Linear model with DV I. maximum escalation.....202
Figure 7.3: Conditional slope estimates from the Linear model with DV I. maximum escalation ...203
Figure 7.4: Implied trade concessions captured in $\Delta Trade_{USjk}$ plotted against escalation levels.....205
Figure C.1: Contributions of the study organized along the different sets of literatures....................216

List of Tables

Table I.1: Roadmap of the study and overview of the main functions of the individual chapters.....17
Table 2.1: Comparing theory status, data structure, and observability across subject-areas...............76
Table 4.1: NTEs – dimensions of interest and relevant dictionaries 123
Table 4.2: NTE automated content analysis dictionary – Trade barriers (selection)...........................124
Table 4.3: NTE automated content analysis dictionary – Products (selection) 126
Table 4.4: NTE automated content analysis dictionary – U.S. actions (selection) 127
Table 5.1: Highest and lowest estimates of σ for products with trade above US$ 1 bn in 2005.........150
Table 6.1: Exemplary gravity estimates for Brazil's pork and photographic equipment imports 168
Table 6.2: Gravity results assessing previously estimated NTBs on world and U.S. trade 175
Table 6.3: Estimated NTB ad valorem equivalents – trade-weighted averages (selection) 177
Table 7.1: The coding of the maximum escalation dependent variable 197
Table 7.2: Relating maximum escalation levels counterfactual gain and loss shares (stakes) 198
Table 7.3: Variance function regression results...209

Abbreviations

AD	Antidumping
ACA	Automated Content Analysis
ACWL	Advisory Centre on WTO Law
ATS	Actual type space
AVE	Ad valorem equivalent
CAP	Common Agricultural Policy
CPI	Consumer Price Index
CVD	Countervailing Duty
DSU	Dispute Settlement Understanding
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
GE	General equilibrium
LDC	Least developed country
MFN	Most Favored Nation
NTB	Non-tariff barrier
NTE	National Trade Estimate
NTM	Non-tariff measure
OECD	Organization for Economic Cooperation and Development
PE	Partial equilibrium
PPI	Producer Price Index
PTS	Potential type space
SPS	Sanitary and phytosanitary measures
STC	Specific trade concerns
TBT	Technical barriers to trade
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
USTR	United States Trade Representative
UV	Unit value
WTO	World Trade Organization

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Introduction

Parties to a conflict invest scarce resources into a process that is unproductive at best and devastating at worst. As a result, conflict creates aggregate social costs that reduce overall welfare. At the same time, conflict is a persistent feature of human interactions. It permeates social life across a wide range of situations and contexts, ranging from interpersonal disputes to large-scale organized violence and war. The dual question of why conflict arises and how it can be controlled or avoided has been the subject of philosophical inquiry, political thinking, as well as ethical and moral debate for millennia. In this regard, it is worth recalling that the social and political organization of societies through formal institutions, legal rules, and social norms on both the domestic and the international levels is in large part intended to channel and reduce conflictive behavior.

Understanding the fundamental drivers of conflict dynamics is therefore key to effective institutional design and conflict management more generally, irrespective of the specific setting in which conflicts arise. Yet while various aspects of conflict dynamics are by now well understood, explaining specific patterns of observable conflictive behavior or making accurate predictions remains difficult. This inability to successfully translate existing theoretical knowledge into workable explanations of real-world behavior suggests that important characteristics of conflict processes remain obscure. The present study seeks to extend on existing research by focusing attention on the logic of escalation – a process that lies at the heart of just about any conflict but has received disproportionately little attention in academic research on conflict behavior.

The basic idea of this study is to view conflict not as a distinct phenomenon that is either absent or present. Rather, it looks at conflict as the result of a gradual selection process, which is driven by a whole series of deliberate escalation decisions by the parties involved. Conflict is thus seen as the observed interaction that progressively emerges from a conflictive bargaining process. By focusing on the intimate connection between bargaining, escalation as a bargaining strategy, and ensuing conflict the study extends on previous work on bargaining and conflict by zooming in on the micro-mechanism that eventually brings about observed conflict dynamics. In doing so, the study highlights the structural differences of *potential* conflict situations as opposed to situations that will not spur conflict, even if parties have strictly opposed interests. It also highlights the role of parties' ability to partially anticipate conflict outcomes in the face of mutual uncertainty – including the implications this has for empirical research.

As a central point, the study also points out why parties' *stakes* are more relevant for explaining escalation dynamics than either *power* relations or the parties' *costs* of conflict, which have been the primary focus of the existing literature. With this proposition, this study suggests that the least heeded conceptual explanation for conflict may in fact be the most important one. By focusing particular attention on stakes, the study makes an explicit effort to take parties' preferences more seriously in the study of conflict and implicitly advocates a shift of attention 'from power to preferences' in both theoretical and empirical work on conflict. In detailing how stakes play into the parties' decision-making process, how they arise, and how they can be measured, the study contributes to better understanding this important concept.

Building on formal theoretical work on conflict from different literatures, the empirical focus of the study lies on trade disputes – that is, conflicts that arise in international trade relations.

Bargaining and Conflict: Current Theoretical Knowledge and Research Gaps

In recent decades, research in the modern social sciences has made substantial progress in highlighting and clarifying important aspects of conflict situations. In particular, advances in economics in modeling empirically observed inefficiencies in both market behavior (Akerlof 1970, Spence 1973, Stiglitz 1975, Rothschild and Stiglitz 1976) and bargaining theory (Rubinstein 1982, Grossmann and Perry 1986, Admati and Perry 1987) have highlighted how informational asymmetries between actors can produce individually rational behavior that results in collectively adverse outcomes. These insights have stimulated a vibrant research agenda and the more or less parallel development of a body of game-theoretic bargaining models of conflict across disciplines.

Three subject-areas, in particular, have seen a flurry of research along these lines. Labor economists have developed formal models of labor disputes and strikes to explain why strikes occur despite the fact that they are costly to both sides (e.g., Kennan 1986, Cramton and Tracy 1992, 2003, Kennan and Wilson 1993). Legal scholars have modeled pretrial bargaining and litigation decisions to explain why cases proceed to trial although both sides could be made better off with an out-of-court settlement that avoids the trial costs (e.g., P'ng 1983, Bebchuk 1984, Spier 1992, 2007). And political scientists have developed models of international conflict and war to explain why states end up in violent conflict despite the substantial costs associated with this choice (e.g., Fearon 1995, Powell 1996, Filson and Werner 2002, Slantchev 2003a, Smith and Stam 2004).

In all three fields of research, asymmetric information models have made it possible for the first time to explain conflictive behavior on the basis of strictly rational considerations on the part of the concerned parties (rather than on the basis of cognitive or emotional biases, misperceptions, or errors of judgment). The crucial insight is that *if* parties had complete information about each other, they *would* immediately agree to a bargaining outcome (e.g., a wage level, a compensation payment, a territorial division) that reflects their relative bargaining position in the absence of conflict – and thus save their unproductive investment into conflict behavior in the first place. If, in contrast, parties are uncertain about key parameters of the situation that affect the relative bargaining position, they cannot be sure that a proposed agreement is actually in their best interest. In these situations, conflict can result from rational behavior as the parties strategically navigate their options.

Existing models of conflict in all three fields fall into two broad groups. The first generation of models explains conflict through a risk-return tradeoff in a one-shot take-it-or-leave-it framework (e.g., Kennan 1986, Bebchuk 1984, Fearon 1995). These static models of one-sided incomplete information entail the risk of conflict as an unwanted side-effect when parties balance their demands against the risk of conflict in the presence of uncertainty over the other sides bargaining position. Weak opponents accept higher demands than stronger ones who may choose to reject a demand they consider too high. Rejection in turn triggers a costly conflict through which parties learn their relative strength and therefore arrive at the appropriate bargaining outcome (minus the costs of conflict). Higher demands promise larger gains if the opponent agrees – but at the same time reduce the probability that this will be the case. The optimal strategy in this situation typically involves a certain amount of risk-taking.

The second generation of models extends this logic by allowing for more complex interactions. In these models, bargaining takes place *during* conflict in a dynamic, temporally richer setting (e.g., Kennan and Wilson 1993, Spier 1992, Slantchev 2003a). These dynamic bargaining models view conflict as an information transmission mechanism in which parties – again in the presence of one-sided incomplete information – gradually learn about their characteristics (i.e., their strength or bargaining position) and then come to an agreement that reflects these characteristics. Opponents that are in a weaker bargaining position accept higher demands early on, while stronger opponents remain in the game longer. By accepting costly delay, these types of opponents demonstrate their better bargaining position and thus receive gradually more attractive offers.

Yet, whereas these models provide deep insights into the general relationship between uncertainty and conflict, it remains unclear how these insights connect back to empirical reality. Clearly, there is no binary risk-return trade-off in real-life conflict situations, as assumed by the first generation models. Consequently, parties are unlikely to end up in high levels of conflict by mere accident. At the same time, conflict is not simply a background condition of constant intensity that is present while parties exchange offers, as assumed by the second generation models. These latter models make predictions about behavior *during* conflict as it plays out at a static, non-changing, and exogenously determined level of intensity. Despite their higher complexity, therefore, these models have no more to say about why parties choose to engage in conflict than their predecessors.

In reality, conflict is no side-effect of, or background condition to, parties' strategic interactions. Conflict intensity is a factor that is squarely within the parties' control. Conflicts are gradually intensifying dynamic processes that escalate to varying degrees of intensity. But it remains unclear what drives this dynamic. Existing models of conflict neither explain why both sides to a dispute continue to consciously intensify conflictive behavior in the face of mounting costs nor why this pattern is so persistent in empirically observable conflicts. In other words, existing models do not capture the logic of escalation processes and therefore do not satisfactorily explain why conflict ensues in the first place. This not only makes it difficult to match theoretical models to empirical observations, it also is an impediment to a deeper understanding of the micro-foundations of conflict behavior.

One reason why existing theoretical models of conflict in the subject-areas of strikes, litigation, and war do not achieve a closer fit between theoretical mechanisms and real-world events is likely that, empirically, conflict processes and the factors that drive these processes are difficult to observe in these subject-areas. These difficulties begin with fundamental definitional questions. It is often not even clear what the potential sets of actors and issues are that define the population of cases to study. Consequently, it is difficult to identify the strategically relevant characteristics of these actors including the preferences they have over given issues. These empirical complexities make it hard to collect and structure empirical observations and to measure relevant concepts. Ultimately, these difficulties hamper the iterative back and forth between theoretical reasoning and empirical reality and thus put limits on the further refinement of otherwise powerful theoretical tools.

Research Strategy: Transition to The Empirical Field of International Trade

The present study seeks to overcome these challenges by constructively evading the empirical difficulties just noted. The starting point of this endeavor is to transfer the general theoretical insights about conflict behavior from the above fields with well-developed theoretical literatures but difficult empirical contexts to a field with less well-developed theories but a substantially more transparent empirical context – namely, disputes over international trade and, in particular, disputes between the United States and its trade partners over industry-level import barriers. For historical reasons, existing research on trade disputes has not seen the development of strong theoretical approaches to conflict and has mostly disregarded the strategic nature of these interactions. At the same time, the wider field of international trade is a research area with one of the best empirical settings in the observational social sciences.

The attractiveness of international trade as a research area is due to two factors. First, international trade lends itself to observation and measurement more naturally than most other fields of research. The simple fact that trade is measured in monetary units and reported in clearly defined industry classifications alone results in almost immediate comparability of existing data and facilitates empirical work to a degree that is difficult to imagine in many other areas. Second, and at least equally important, some two-hundred years of work in international trade theory have produced a well-developed body of knowledge about fundamental mechanisms governing international trade relations. Thus, although there exist no formal theories of trade disputes, trade itself is well understood. This provides a strong foundation for the conceptualization and operationalization of abstract concepts and thus of more closely integrating theoretical thinking with empirical data.

Given that trade disputes are a prime example of conflict interactions and that they occur in an unusually research-friendly empirical setting, they are ideal study objects for scholars interested in conflict processes. This opportunity has so far not been realized. Unlike the empirical scholarship on strikes, litigation, and war, which is firmly built around the theoretical work in these fields, the scholarship on trade disputes has traditionally had a more applied outlook. Although this can be a strength, it has resulted in important omissions, in particular, with regard to an openness for relevant academic research and available theoretical knowledge. This is not only true for existing theoretical knowledge on conflict. It also applies to the insights provided by international trade theory.

Another feature of the literature on trade disputes is its focus on a small number of heterogeneous cases that are most visible to the international trade policy community – the disputes that have been brought before the World Trade Organization's (WTO) dispute settlement body. However, it is difficult to distill general insights about conflict processes from a diverse and non-representative set of cases, particularly in the absence of systematic theoretical guidance. For this reason, the insights from the literature on trade disputes mostly concern policy issues around specific cases or relate to individual country-pairs or industries. These insights are due primarily to the qualitative literature (e.g., Vogel and Rugman 1997, Room and West 1998, Hoberg and Howe 1999, Kastner and Pawsey 2002, Pavcnik 2002, Petersmann and Pollack 2003, Perdikis and Read 2005, Bown and Pauwelyn 2010). Many of these studies also discuss legal questions relating to the application and potential reform of international trade law.

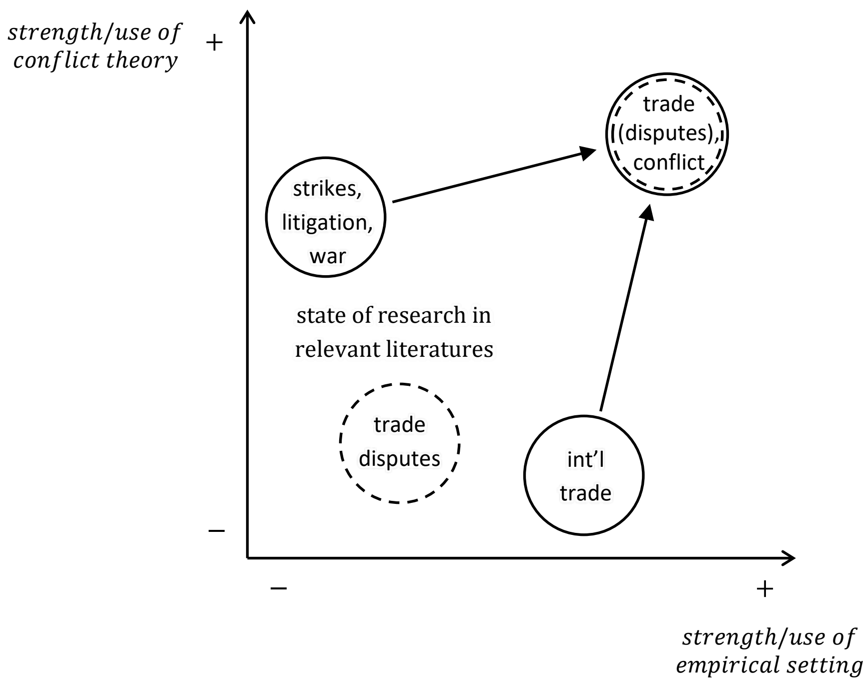
Most of the quantitative literature on trade disputes is concerned with the question of fairness of participation in the WTO Dispute Settlement procedure (e.g., Horn et al. 1999, Bown 2005, Guzman and Simmons 2005, Francois et al. 2008, Kim 2008, Sattler and Bernauer 2011; Hoekman 2006, Nordstrom and Schaffer 2008, and Shaffer 2009). In particular, the debate centers on whether the WTO dispute settlement mechanism implicitly discriminates against developing countries. This question has received increased attention in the trade community following the transition from the GATT to the WTO in 1994 and the reform of the dispute settlement mechanism that accompanied this transition. Despite the undisputed relevance of the issue, the above-mentioned omissions have tended to slow down progress. As a result, no agreement or clear tendency has as yet emerged in the literature.

The literature on trade disputes currently lags behind its full potential not only in providing answers to immediate policy questions. It also forgoes the opportunity to provide more fundamental (and ultimately related) insights into the logic of conflictive interactions that underlies both trade disputes and conflicts more generally. Building on the theoretical knowledge on both conflict and international trade that the existing literature on trade disputes leaves unexploited, the present study seeks to fill this gap.

Figure I.1 summarizes this approach graphically. The figure locates the above-mentioned literatures in a two-dimensional space according to their state of development in terms of conflict theory and the degree to which they have been able to draw on the amenability of their subject-area to empirical research. The vertical axis captures the degree to which the literatures have developed a unified theoretical approach to analyzing conflict processes (i.e., *strength/use of conflict theory*). The horizontal axis captures the amenability of the empirical field in which the literatures operate – or the degree to which this amenability has been exploited in the literature (i.e., *strength/use of empirical setting*).

The literatures on strikes, litigation, and war are placed high in terms of theoretical development but low in terms of empirical amenability. This is due to their strong theoretical focus and their observationally challenging subject-areas. Conversely, the theoretical literature on international trade is placed low in terms of theoretical development (regarding conflict processes) but high in terms of empirical amenability. This is because this literature is not concerned with conflict but works in an empirically strong field that is further opened up by the knowledge accumulation in the literature itself. The literature on trade disputes is placed relatively low on both dimensions because it has not developed or adopted a strong theoretical approach to conflict and at the same time makes incomplete use of the empirical potential of its subject-area.

Figure I.1: Combining strong theories of conflict with the strong empirical field of international trade



The circle in the top-right corner of Figure I.1 signifies the insights this study seeks to produce. The indicated move to the *north-west* implies these insights as relating to the study of both trade disputes and the understanding of conflict processes in a wider sense. Dashed lines indicate the relationship between related fields, i.e., trade disputes. Solid lines and arrows indicate the so far unrelated literatures that the present study draws on directly. The word 'disputes' is put in brackets because the study – as a side-effect – also makes a contribution to the trade literature by providing a comprehensive dataset on world-wide industry-level trade barriers. In the following, these points are discussed in more detail.

Guiding Questions, General Relevance, and Theoretical Argument

The main point of the previous section is that the existence of strong theories of conflict alongside the qualities of international trade as an empirical field holds a huge and so far untapped potential for gaining deeper insights into conflict dynamics. Using bargaining theory as a lens to trade disputes and trade disputes as a lens to conflict processes, this study is guided by two broad questions on two different levels of abstraction. First, what can be learned from this approach about the drivers and patterns of trade disputes? And second, what can be inferred, deduced, or extrapolated about the drivers and patterns of conflict more generally?

Given the research strategy just outlined, it is naturally the case that the first question will receive a more direct and more immediate set of answers than the second. In particular, the second question can, by design, receive no empirical treatment. Since trade disputes are the empirical subject of the study and the field of research opened up to bargaining theories of conflict, this is where the most direct contribution necessarily lies. On the theoretical and conceptual level, however, broader implications can be derived from the study of trade disputes that have the potential to inform thinking about conflict processes in subject-areas outside of international trade. These implications at times follow directly from the greater observability and structure of trade compared to other areas of conflict.

Escalation dynamics – a central focus of this study – are in no way unique to trade disputes. But they are potentially more visible in the context of trade disputes than in other areas. Any focus on escalation dynamics requires information on conflict behavior down to low levels of intensity. Such information is, however, difficult to systematically collect or even to cursorily perceive in other subject-areas. This prompts an emphasis on binary outcome measures in quantitative empirical and theoretical work that abstracts from the micro-logic of conflict behavior and obscures important aspects of conflict. Theorizing about escalation processes in trade disputes may thus provide valuable input for theoretical work in other areas, where direct subject-area specific empirical input is more difficult to acquire.

This is true, in particular, because studying escalation processes in the context of trade disputes holds the potential to isolate the essence of escalation processes in the absence of additional complexities that potentially play into these dynamics especially in the context of international conflict. This latter field has seen considerable work on escalatory processes in the context of arms races, military build-ups, or alliance formation and counter-balancing (e.g., Wallace 1979, Downs et al. 1985, Vasquez 1987, 1993, Brito and Intriligator 1995, Zartman and Faure 2005). It is import to note, however, that these kinds of escalatory dynamics are runaway processes that are driven by *changes* in the parties' technologies or alliance structures that may affect future prospects of conflict. This then triggers a cycle of actions and reactions that is not fully under the parties' control.

However, this perspective on escalation as a process that spirals out of hand obscures a deeper logic of escalation dynamics that is more widespread (both within and beyond international politics), not dependent on the specific preconditions required for arms race scenarios to emerge, and at the same time less well understood. In fact, the spiral analogy, which suggests that parties are caught up in a largely uncontrollable and hard-to-stop process has become almost synonymous with escalation in everyday parlance as well as in the academic debate. By focusing on the escalation processes observable in trade disputes, this study seeks to provide deeper insights into the logic of escalation that permeates conflict processes almost universally. In contrast to the usual understanding of escalation, this study points to how these deeper escalation processes, although inefficient, are fully under the parties' control and shows how escalation dynamics emerge under asymmetric information in a bargaining context.

An important aspect in this approach to modeling escalation and conflict processes is the role of the information structure one assumes parties to have. The vast majority of existing models of conflict are designed as models of one-sided incomplete information (i.e., one-sided uncertainty). This assumes that one party is fully informed about the entire structure of the bargaining situation and that the relevant information asymmetries therefore flow in only one direction. While this simplification is useful for reducing the complexity of resulting models, it also dangerous in the sense that the assumptions of one-sided uncertainty, by design, results in a skewed representation of reality. This makes direct interpretations of model predictions problematic and can lead to incorrect inferences and conclusions about conflict behavior. By explicitly modeling escalation processes under two-sided incomplete information, this study averts these issues and points to some of the important differences in model predictions that result from this more realistic set of assumptions.

Furthermore, stakes – that is, parties' subjective issue valuations – are almost guaranteed to be a significant factor in any conflict regardless of the subject-area. Stakes are a core concept throughout this study and a key factor in explaining escalation dynamics in both the theoretical and empirical work that follows. At the same time, the concept of stakes plays almost no role in existing bargaining models of conflict. However, this study makes the point that parties' stakes are the most important driver of conflict processes but remain the most disregarded and least understood concept in the literature. This is likely due, at least in part, to the fact that stakes are a particularly elusive concept. After all, it is typically challenging to observe or infer parties' subjective preferences in empirical work. The centrality of stakes in trade disputes may (and should) nonetheless draw closer attention to parties' preferences in theoretical work on conflict in other subject-areas.

That stakes matter in conflict situations is intuitively clear and has long been recognized (e.g., Mansbach and Vasquez 1981, Diehl 1992, Vasquez 1993, Paul 1994). What is less clear, however, is how much they matter, why and in what way they matter (i.e., through which mechanism they feed into parties' decision-processes), and what stakes really are beyond the abstract conceptual level on which they signify 'something like importance.' This study addresses these questions. It makes the point that stakes are theoretically more important in explaining conflict than other concepts. It presents a mechanism that demonstrates why stakes matter and how they enter parties' decision-making process. And it defines what stakes are beyond the conceptual level in the context of international trade, where this study shows how they arise, how they can be measured and that they are substantively important in prediction escalation behavior.

Of particular relevance in this context is that parties' stakes are naturally bound to an individual issue. This notion contrasts with concepts such as *power* or the parties' *costs* of conflict that play a prominent role in existing models of conflict. Unlike stakes, these latter concepts are bound to an actor. Stakes are thus an issue-level concept while *power* and *costs* of the parties are actor-level concepts. This has profound implications for the explanatory power of these concepts. Parties' stakes will vary from issue to issue. At the same time, their power relations and conflict costs remain constant across issues. Because any pair of actors can typically engage in conflict over a large number of potential issues, stakes are necessarily a more specific and therefore more explanatorily powerful concept than actor-level concepts relating to the parties' *power* and *costs* (note that technically speaking *stakes* are actor-issue-level concepts – they are bound to an issue in different ways *for each actor*; for simplicity, I will retain the shorter issue-level wording in the following).

Specifically, actor-level concepts cannot explain within-dyad variation in conflict behavior. In international conflict, for instance, a mere focus on power relations cannot explain why two parties engage in conflict over one issue but not over another given that power relations are identical across all issues over which the parties might disagree. A similar logic applies to the parties' costs of conflict. The costs of conflict by definition rise with the level of escalation. At any given level of escalation, larger and more affluent parties will be able to absorb these costs more readily. That is, parties differ in the degree to which conflict is costly to them *relative* to their overall assets. However, this relationship holds irrespective of the particular issue at hand. The ability of parties to absorb a given amount of costs is an actor-level property and therefore cannot explain issue-level variation in conflict patterns. The costs of conflict are only meaningful *in combination* with an issue-level appreciation of parties' stakes.

The dual emphasis of this study on escalation dynamics as the micro-mechanism underlying conflict behavior and stakes as the central issue-level driver of these dynamics contributes to gaining a more detailed understanding of general aspects of conflict. The study thereby works towards closing the gap between theoretical analysis and empirical reality. Although this disaggregation and refinement of the theoretical focus is driven and enabled by the study of trade disputes, it is not limited to this area in its application. This is directly reflected in the central theoretical framework of this study. The overall presentation of this framework remains on the general concept level for most of the discussion before focusing on the specific context of trade relations later on.

On this level of abstraction, the key theoretical argument is that escalation dynamics are ultimately rooted in the parties' ability to manipulate cost structure of their interaction. Strategic situations where a cost-creation option is structurally embedded in the bargaining context, and parties therefore have the ability to generate costs, are *potential* conflict situations. Since higher stakes make parties' more cost-tolerant and vice versa, an option to generate costs creates an incentive for high-stakes parties to deliberately provoke costly situations through escalation behavior in an attempt *both* to extract larger concessions from their opponent and to shorten the time to agreement. Bargaining thus escalates into conflict as the concerned parties attempt to manipulate each other's costs of continued disagreement – conflict then occurs not *despite* it is costly but exactly *because* it is costly.

Empirical Work: Escalation and Stakes in the Context of Trade Disputes

In its empirical work, the study zooms in to empirically test the predictions derived from the theoretical discussion of escalation dynamics in the context of international trade relations. This part of the study primarily addresses the first of the above guiding questions. It thus seeks to directly provide deeper insights into the driving forces underlying trade disputes. Nonetheless, because substantiating theoretical predictions in the context of international trade underpins the overall validity of the theoretical argument, this empirical work has indirect implications for the more general points just discussed.

Empirically investigating escalation dynamics requires data on the conflictiveness of parties' interactions over their trade relations that capture these dynamics. The only readily available source of data on trade disputes, however, relates to the set of a few hundred WTO disputes. Apart from the narrow coverage and heterogeneous nature of these data, a central limitation for the purpose of this study is that the WTO cases exhibit insufficient variation in escalation levels. Trade disputes that are brought before the WTO belong to the high-escalation end of the spectrum. This renders any investigation in the determinants of conflict escalation difficult at best. An alternative approach is therefore needed. Ideally, one would like to have an at the same time more extensive and less heterogeneous dataset that contains fine-grained information on escalation across the entire range of possible levels.

The first part of the empirical work of this study consists of compiling such a dataset. Specifically, the data are collected by performing an automated content analysis (ACA) on the U.S. National Trade Estimate reports (NTEs) over the 1988 – 2012 period. The NTEs are annual reports published by the U.S. trade enforcement agency USTR that describe in considerable detail the foreign trade barriers to industry-level U.S. exports as well as the specific actions taken by the U.S. to have these barriers reduced or eliminated. These actions cover the entire spectrum of escalation levels and range from inaction and passive complaints to high-level trade enforcement activities on the basis of U.S. trade laws or before the WTO. Although narrower in scope than the WTO data (i.e., not covering the entire world trade network), the resulting dataset is significantly more dense and detailed, containing some 50,000 observations on annual, trade-partner-specific, industry-level U.S. trade enforcement efforts. Based on these data, it is possible to reconstruct the escalation levels dispute histories of U.S. trade disputes at a considerable level of detail for around 300 different industries.

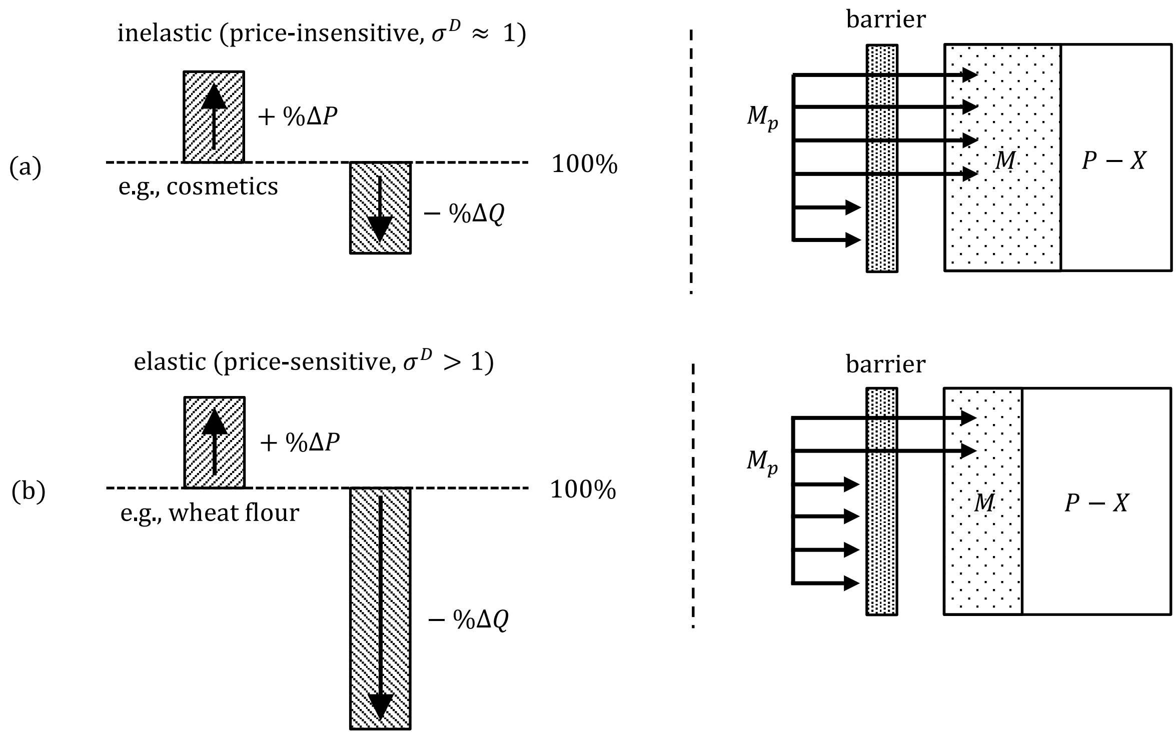
As a next step, it is necessary to acquire corresponding data on the concerned parties' stakes for each of the particular dispute histories. This demands moving beyond the conceptual level. In particular, it requires a concrete understanding of what the concept of stakes actually *means* in the context of international trade relations. In other words, it requires an understanding of how stakes arise in international trade. Although doing so is possible, it is far from trivial and dependent on the existence of well-developed theoretical knowledge about key mechanisms that govern international trade. For this reason, a considerable share of the empirical part of this study is devoted to accomplishing the task of measuring parties' stakes over industry-level trade flows.

Trade disputes are typically about protectionist trade policies that serve to shield domestic producers from foreign import competition. These protectionist policies take the form of trade barriers that directly or indirectly increase the price of imports relative to domestic products. Trade barriers are thus government-controlled price wedges that interfere in the market mechanism by manipulating consumer demand. Both the importer government and the exporter government (with the latter always being the U.S. government in the present context) typically seek to increase the market access of their respective producers. Broadly speaking, the importer prefers higher trade barriers and loses from a reduction of these barriers, while the exporter (i.e., the United States) prefers lower barriers and gains from reduction. These gains and losses can be seen as the conceptual basis for parties' stakes in the particular setting of international trade relations.

In order to actually measure these stakes, however, one needs to be able to quantify the expected gains and losses for both the United States' and its trade partners' industries that would result from a hypothetical barrier reduction. This requires information on currently applied trade barriers as well as information on how demand for imported goods changes as trade barriers are reduced (i.e., prices fall). Because none of this information is readily available, either on a sufficient level of disaggregation or generally, the empirical procedure aimed at measuring parties' stakes consists of three consecutive steps: estimating trade elasticities that govern how price changes translate into quantity changes, estimating the size of applied trade barriers, and calculating the parties' hypothetical gains and losses from trade liberalization. This procedure essentially relies on theoretical knowledge about the functioning of trade markets to infer unobserved quantities from observable implications of these quantities.

Step 1 consists of estimating industry-level trade elasticities. These parameters are needed as input information for both the estimation of trade barriers in step 2 and the calculation of the effect of hypothetical trade barrier reductions in step 3. Without going into greater technical detail at this stage, Figure I.2 graphically illustrates the logic of (trade) elasticities as well as the implications that these elasticities have for the effectiveness of trade barriers. The figure uses the example of the import demand elasticity for two different products, cosmetics in panel (a) and wheat flour in panel (b), for some national import market. In effect, the import demand elasticity can be thought of as reflecting the degree of substitutability between domestic and imported varieties of a product. The left sides of the panels illustrate the general logic, the right sides indicate the implications of this logic for the effectiveness of trade barriers.

Figure I.2: Trade elasticities and their implications for the effectiveness of trade barriers



Notes: Broadly speaking, elasticities are ratios of percent changes in the form of $|\%\Delta Q/\%\Delta P|$, where the vertical bars indicate that elasticities are typically reported in absolute values. Assume an import price increase of five percent for both cosmetics and wheat flour, $\%\Delta P = 5$, as well as corresponding decreases in quantities demanded of $\%\Delta Q = -5$ for cosmetics and of $\%\Delta Q = -35$ for wheat flour. From this it follows that σ^D is equal to $|-5/5| = 1$ for cosmetics and to $|-35/5| = 7$ for wheat flour. The higher elasticity for wheat flour reflects the larger drop in consumer demand and implies a larger substitution effect away from imported varieties of wheat flour and towards flour from domestic production.

The left sides of panels (a) and (b) graphically represent the idea of elasticities. Intuitively, elasticities capture the price-sensitivity of consumers towards a product by describing how quantities demanded change as prices change. This price-sensitivity typically depends on the degree to which the product is homogeneous or differentiated. Consumers tend to be less price-sensitive towards differentiated products that are specialized, branded, or both and therefore difficult to substitute with other varieties of the same product (e.g., cosmetics). Conversely, consumers tend to be more price-sensitive towards homogenous products that are essentially the same regardless of their supplier and therefore easy to substitute with other varieties of that product (e.g., wheat flour). For any given increase in import price, the corresponding decrease in quantity demanded is therefore going to be smaller for differentiated than for homogeneous products. From this follows directly that demand for differentiated products is less price-elastic than demand for homogenous products, that is, elasticities for differentiated products are lower (see the notes to Figure I.2 for a numerical example of this relationship).

The right sides of panels (a) and (b) depict the implications of this relationship for the effectiveness of trade barriers. M_p indicates the *potential* size of imports that would be possible under free-trade as reflected by the entire set of arrows. M indicates actually realized imports in the presence of a trade barrier as reflected by the long arrows, $P - X$ is domestic production minus exports. The area of the entire square $M + P - X$ is domestic consumption, i.e., the total size of the domestic market for each of the two products.

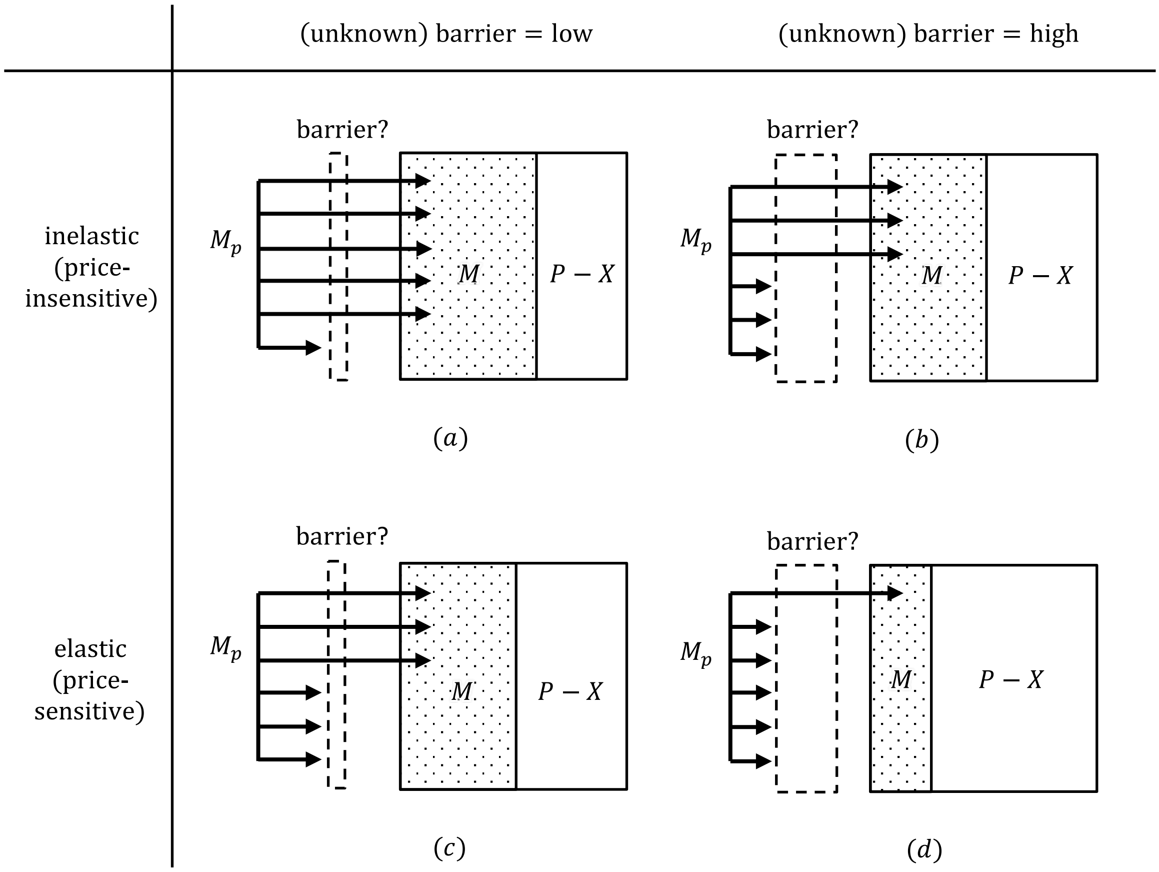
The key point is that for a trade barrier of the same size (say, a tariff equivalent of 50 percent, which makes imports 1,5 times as expensive compared to free-trade conditions), demand for products with low elasticities (cosmetics) declines less strongly that demand for products with high elasticities (wheat flour). Accordingly, products for which demand is less price-elastic (cosmetics) are imported in relatively larger quantities despite the identical size of the trade barrier. This is important for the estimation of trade barriers in step 2. Also note that if the trade barrier were to be reduced, imports of products for which demand is more price-elastic (wheat flour) would increase more strongly. This is important for the calculation of the parties' stakes in step 3.

The estimation strategy employed to estimate the required elasticities follows directly from the logic of elasticities. That is, it relates observed changes in prices to observed changes in imported quantities and reconstructs the implied elasticities on the basis of this information. In practice, this procedure is complicated by the fact that prices and quantities are interrelated. Because prices rise as quantity demanded increases and quantity demanded falls as prices rise, neither of the two can be thought of as being a 'dependent' and 'independent' variable in a standard single-equation regression setup. I therefore employ a structural estimation procedure where the relationship between prices and quantities is estimated in a system of equations. Because identification in this approach is achieved through the effects of supply shocks from the set of exporters to a given market, the method works in the absence of information on trade barriers.

Step 2 is then concerned with determining the size of applied trade barriers based. An important limitation to the study of international trade is that reliable data on industry-level trade barriers does not exist. This is true, in particular, for so-called non-tariff barriers (NTBs), which – although they make up the bulk of applied trade protection measures – are not systematically recorded. For this reason, it is necessary to indirectly estimate the size of these trade barriers from observable trade frictions. In this context, information on elasticities is a necessary input that makes it possible to uniquely relate observed trade frictions to unobserved but implied trade barriers.

Figure I.3 graphically represents the intuition behind this procedure. The figure presents four scenarios based on the possible combinations of low and high elasticities with low and high trade barriers. The size of trade barriers is unknown. However, existing trade frictions are observed. These trade frictions are indicated by the number of (short) arrows that do not 'pass' the unobserved trade barrier and by the size of imports (area M) relative to the size of domestically produced and consumed goods (area $P - X$). This latter representation reflects the way trade frictions are measured when implementing the method. Specifically, this is done by comparing the size of cross-border trade flows between countries to domestic trade within countries (i.e., $P - X$) net of the effect of a range of physical trade cost factors.

Figure I.3: Inferring unknown trade barriers from elasticities and observable trade frictions

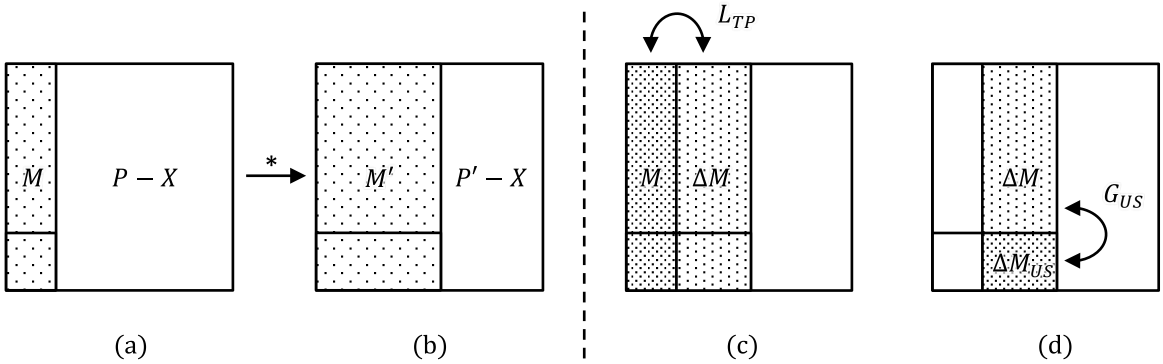


On the basis of this information on directly observed trade frictions in combination with the previously established information on trade elasticities, it is then possible to infer the size of applied trade barriers. This is the case because for any given barrier size (i.e., price-increases relative to free-trade), different elasticities (i.e., price-sensitivities) imply clearly defined levels of resulting trade frictions. Working backwards, knowledge of this relationship permits the calculation of underlying trade barriers. Note, for example, that panels (b) and (c) of Figure I.3 indicate the same level of observed trade frictions. Because price-insensitive goods – panel (b) – require stiffer trade barriers in order to achieve the same amount of observed trade frictions than price-sensitive goods – panel (c) – the trade barrier in panel (b) must be higher than that in panel (c). In the actual application of this method below, the implied trade barriers are assigned specific numerical values in terms of tariff-equivalents.

Step 3, finally, performs the calculation of the parties' stakes. This calculation is then done based on a theoretical trade policy simulation model. Using the freshly obtained trade barrier data as well as the estimated elasticities as inputs, this simulation makes it possible to approximate the total change in industry-level imports that *would* result from a given trade barrier reduction on the side of the importer. Figure I.4 illustrates this logic. Panel (a) and (b) represent the *before* and *after* scenarios of the simulation. Panel (a) reflects current trade relations as they are observed given the estimated trade barrier from step 2 (not shown graphically). Panel (b) shows the result from simulating a reduction of this trade barrier whilst taking into account the product-specific elasticity.

The '*' indicates the theoretical mechanism that translates the hypothetical change in the trade barrier and the effect of the corresponding elasticity estimate into a predicted higher level of imports, from M to M'. This predicted increase in imports simultaneously implies a reduction in the size of the domestic market controlled by domestic producers ($P' - X$). These changes form the basis for the calculation of the parties' stakes. To see this more clearly consider panels (c) and (d) of Figure I.4. The figures in both panels stack panels (a) and (b) on top of each other to make the predicted changes more explicit. In particular, ΔM is the predicted increase in imports resulting from the trade barrier reduction (note that $M' = M + \Delta M$ and that $P' - X = P - X - \Delta M$).

Figure I.4: Stakes – hypothetical trade barrier reductions and the resulting gains and losses



By relating the increase in imports following the barrier reduction to the observed value of imports prior to the barrier reduction (i.e., $\Delta M/M$) as shown in panel (c), it is then possible to arrive at an estimate of the importer's counterfactual losses (in terms of increased foreign competition) relative to the status quo. The quantity $\Delta M/M$ can be seen as the importer's loss share and thus a measure of the importer's stakes. Because the importer is always the United States' trade partner in the application, this loss share is denoted by L_{TP}. It is shown in the main part of the study that this quantity is equal to the percent change in import competition faced by the trade partner in consequence of the barrier reduction.

The discussion so far has concerned the trade partner's total imports of a product from all exporters. This setup assumes that any trade barrier reduction implemented by the traded partner will apply to all exporters to this market – in conformity with the Most-Favored-Nation (MFN) non-discrimination clause of international trade law. Zooming in and following a similar logic on the exporter-specific level, it is possible to arrive at an estimate of the United States' counterfactual gains relative to the gains of all other exporters (i.e., $\Delta M_{US}/\Delta M$) as shown in panel (d). This quantity reflects how much of the trade partner's losses from trade liberalization the United States is likely to capture. This quantity, which for an MFN-style barrier reduction is proportional to the U.S. market share prior to the reduction, can be seen as the United States' gain share, G_{US}, and thus a measure of the United States' stakes.

A particular advantage of the simulation-based approach to calculating the parties' stakes is that the resulting measures rest on *potential* gains and losses. They can therefore be assumed to reflect important aspects of the strategic option-weighing and decision-making process of the parties. Such forms of counterfactual reasoning will almost certainly play a role in informing the parties' considerations and, ultimately, in guiding their behavior – which is what one seeks to explain. By incorporating theoretical knowledge of underlying market mechanisms (which the parties themselves have access to as well), the counterfactual measures of stakes contain a deeper layer of information that goes beyond mere observations of the status quo and makes it possible to approximate the parties' wider understanding of the situation. This ultimately makes it possible for researchers to get a grasp on parties' otherwise unobservable valuations and strategic considerations.

The results of the analysis suggest that, in line with theoretical predictions, the *interaction* of both parties' stakes – measured according to the above definitions – is strongly associated with dispute escalation. That is, the combination of high counterfactual losses for the importer and high counterfactual losses for the United States is a strong predictor of high levels of escalation in trade disputes. Thus, the described stakes measures structure the observed data on dispute escalation on a fine-grained industry-level. The analysis thus clearly supports the notion that parties' stakes are a central factor in explaining detailed issue-level variation in dispute escalation that cannot be explained by dyad-level predictors. These results underline the argument that stakes should receive greater attention.

Also in line with theoretical predictions, the results of a supplementary analysis further suggest that the United States – because it can strategically 'pick its fights' – has an initiator advantage. That is, the United States seems, on average, to be able to extract concessions from its trade partners. This holds despite the fact that the network structure of international trade induces a defender advantage for importer that arises from the fact that the importer seeks to protect its market against imports from all sources, whereas the United States only seeks to open the market for its own exports. Lastly, a third prediction is supported by the data in that the variation in bargaining outcomes declines with increased escalation levels. This can be interpreted as reflecting the proposition that bargaining outcomes tend to close in to compromise agreements as disputes wear on. These results lend further support to the theoretical arguments of the study and underpin the overall approach pursued in this study.

Overview and Outlook

The main body of this study is structured into seven chapters. Table I.1 presents the purpose and key massage of each chapter in condensed form. It seeks both to provide a roadmap of how the study proceeds and to convey an idea of how the individual chapters fit into the larger scheme of the study.

Table I.1: Roadmap of the study and overview of the main functions of the individual chapters

Section	Description	Purpose/Message
Literature		
Ch. 1	*Bargaining and conflict*	• Makes the point that bargaining models of conflict as developed in research on strikes, litigation, and war are strong analytical tools to understand conflict • Nonetheless concludes that these models remain behind their potential because the conflict processes they seek to explain are difficult to observe empirically in their respective subject-areas • Argues that this masks important aspects of conflict dynamics and thereby hampers empirical testing and, ultimately, empirically informed refinement of existing models
Ch. 2	*Trade disputes and trade theory*	• Makes the point that the existing literature on trade disputes underutilizes the potential of international trade as a field of empirical investigation because it does take into account neither bargaining theories of conflict nor empirical trade theory • Motivates the study by arguing that progress in understanding both trade disputes and conflict processes is possible by combining strong theoretical approaches to conflict developed in the context of strikes, litigation, and war with the strong empirical field of international trade • Holds, in particular, that doing so allows a deeper understanding of escalation processes, which are central to the micro-logic of conflict behavior; also highlights the role of parties' stakes
Theory		
Ch. 3	*Conflict, escalation, and stakes*	• Presents a bargaining theory of conflict that focuses on the micro-logic of escalation processes and the role of stakes as a central driver underlying these processes • Argues that escalation behavior is possible in bargaining contexts in which parties have control over the cost structure of their interaction in the form of a cost-creation option • Argues that escalation behavior is driven by the attempts of high-stakes parties to a) extract additional concessions from their opponent as well as to b) shorten the time to agreement

		• Points out how stakes arise in the context of international trade relations, how these stakes can be measured, indicates the information required to do so, and derives testable hypotheses
Empirics		
Ch. 4	*Escalation (DV): U.S. NTEs*	• Presents the strategy for compiling data on escalation behavior in trade disputes – the dependent variable of the empirical analysis • Introduces the U.S. National Trade Estimate (NTE) reports as the textual data source from which this information is extracted • Describes the automated content analysis (ACA) and validation strategy employed to extract this data and presents the results
Ch. 5	*Stakes (IV): Elasticities*	• Presents the methodology employed to estimate trade elasticities that are required both for inferring the size of applied trade barriers and for calculating the trade effect of a hypothetical trade barrier reduction – information on elasticities is the first prerequisite to measure parties' stakes concerning their trade relations • Presents the results of the estimation procedure and validations
Ch. 6	*Stakes (IV): Trade barriers*	• Presents the methodology to estimate the size of unobserved trade barriers from observed trade frictions and information on trade elasticities – information on trade barriers is the second prerequisite to measure parties' stakes concerning their trade relations • Presents the results of the estimation procedure and validations
Ch. 7	*Stakes (IV): Loss/Gain shares; statistical analysis*	• Calculates the stakes measure suggested in Chapter 3 as the parties loss and gain shares from a hypothetical trade barrier reduction based on the now available information on trade elasticities and trade barriers using a trade simulation method • Employs these measures – specifically, the interaction of these measures – as central predictor of escalation behavior • Presents and discusses the results that suggest a substantial positive effect of a high trade partner loss share in combination with a high U.S. gain share on dispute escalation • Also presents the results of a supplementary analysis that sheds light on additional aspects of conflictive bargaining processes and lends additional support to the theoretical argument

Notes: DV = dependent variable, IV = independent variable(s).

Following the seven chapters summarized in Table I.1, a concluding section discusses the contributions of the study in the wider context of the existing literature. This discussion is structured in three parts relating to the three sets of literatures referenced in Figure I.1, first, the theoretical literature on conflict in subject-areas outside of international trade, second, the literature on trade disputes, and third, the literature in international trade more generally. The first part highlights the wider implications of the study for the understanding of conflict processes more generally. This part points in particular to the theoretical and conceptional work on escalation dynamics and the role and nature of stakes and indicates how the existing work on strikes, litigation, and war might build on these ideas.

The second part discusses the immediate contributions of the study to the literature on trade disputes. It points out how – beyond the wider theoretical understanding of escalation processes – the methodology employed in this study to measure parties' stakes is directly applicable to other work on trade disputes – including case study work that seeks some additional quantitative grounding of in-depth analyses of individual disputes. Scholars working on trade disputes can also directly draw on the novel data on parties' stakes as provided by this study. The section further points out how the newly created dataset on U.S. trade enforcement behavior has the potential to open up an entire new branch of research on trade disputes. After all, almost the entire quantitative literature to date has relied on a few hundred cases of WTO disputes to study this phenomenon. The extensive and considerably more detailed information of the U.S. data opens up a whole new range of options for scholars working on trade disputes.

The third part of the section addresses the contributions to the empirical literature in international trade more generally. This part highlights the potential uses of the data on trade barriers this study provides. This data is likely to be of considerable interest to a wider audience of scholars working on international trade, given the lack of adequate information on trade policies and applied policy barriers. Beyond the data itself, the method employed to estimate this data may be of interest to scholars working in the field – either to re-estimate data on barriers in other industry classifications or for other time horizons, or with an interest in further extending and refining the methodology.

1 The Bargaining Literature on Conflict Processes: Strikes, Litigation, and War

Conflict is a persistent aspect of human interactions – in international politics and elsewhere. But why do conflicts arise? Why do actors consciously choose to engage in inefficient, costly, and potentially destructive behavior? And what shapes the observable pattern of conflictive interactions? These questions have long occupied scholars across disciplines and theoretical traditions and the insights gained by this work strongly feed into the present study. This chapter reviews the existing literature on conflict behavior across disciplines. The predominant focus in both the remainder of the chapter and the study as a whole is on a broad class of rational-choice-based explanations for conflictive behavior that rest on the presence of incomplete information – that is, uncertainty – among the interacting parties (although I will refer to other approaches if these play, or have played, a prominent role in the academic debate).

In particular, the focus of this chapter is on formal theoretical approaches that model conflict interactions as a bargaining process. Beginning in the 1970s and 1980s, these models have been developed in parallel or close succession in three different literatures following substantial progress made at the time in game theory and information economics: In the field of labor economics, scholars have developed models that seek to explain the occurrence of strikes in the context of wage bargaining between a union and a firm. In the field of law and economics, a related set of models has been developed to explain dynamics of pre-trial bargaining and litigation. Finally, in International Relations, scholars have employed related approaches to model interstate bargaining and war.

The discussion in the remainder of this chapter provides an overview of the origins and the current theoretical knowledge in these fields. It further flashes out the key insights offered by this work as well as aspects of the above questions that remain open. The chapter also demonstrates that these models, despite their subject-specific particularities, point to a general logic that underlies conflictive bargaining processes more generally. The results of this discussion are taken up again in Section 2.3, which motivates the study as a whole, and points, among other things, to the fact that none of the models introduced below captures the logic of escalation processes. The results of the discussion are further reflected in the theoretical approach developed in Chapter 3, which presents a bargaining theory of conflict that explicitly models escalation behavior. The chapter also addresses a range of additional questions about conflictive bargaining process in general that existing theoretical models leave unaddressed.

The present chapter additionally emphasizes the interplay between existing theoretical models of strikes, litigation, and war and the empirical work in these areas. This discussion points to the at times considerable difficulties that empirical researchers encounter in these fields. These difficulties arise from limited observability of bargaining and conflict activity and limited measurability of key concepts or data structures unfavorable to quantitative research. These limitations have presented considerable challenges to empirical testing and verification of theoretical predictions in all three fields – although to different degrees. The review of the empirical work on strikes, litigation, and war provides the basis for the discussion in Chapter 2, which contrasts the empirical conditions in the three fields with the empirical setting in international trade. Together, Chapter 1 and 2 motivate this study. They point to the unused potential stemming from the non-existence of bargaining approaches to conflict in the study of trade disputes – despite the unrivaled empirical possibilities in the subject-area of international trade.

As a background to the discussion of the theoretical and empirical literature on conflictive bargaining in the form of strikes, litigation, and war, the following section serves as an extended introduction. It first briefly sketches the rationale for focusing on asymmetric-information-based rational choice explanations to conflict. The bulk of the section then introduces the concepts of signaling and screening that underlie modern bargaining theory and presents the general logic of game theoretic models of bargaining in the simplest context of buyer-seller interactions. Section 1.1 then discusses the literature on strikes, Section 1.2 discusses the literature in litigation, and Section 1.3 is concerned with the literature on war. Each section first introduces the theoretical literature and then turns to the empirical work. The chapter concludes with a short discussion that points to some of the key differences between conflictive and non-conflictive bargaining.

Background: Signaling, screening, and bargaining under incomplete information

The focus on informational asymmetries in this chapter and the study in general is not arbitrary. While a range of factors have been suggested as drivers of conflict processes, I argue that uncertainty-based rational choice accounts provide in a certain sense the most generally applicable explanations for conflict. In the rational choice tradition, the two common alternative explanations for conflict are issue indivisibility and dynamic commitment problems (e.g., Fearon 1995). Issue indivisibility limits the ability of parties to find compromise agreements that are mutually preferable to conflict. This point has already been discussed by Mnookin and Kornhauser (1979) in the context of pre-trial bargaining over child custody in divorce cases. Hassner (2003) discusses the role of the Temple Mount in the Israeli-Palestinian conflict in this context. Guzman and Simmons (2002) suggest that safety and health regulations might have an indivisible character in trade policy litigation at the WTO.

Dynamic commitment problems, as discussed in the international conflict literature, arise from incentives to wage preventive or preemptive war in the light of expected rapid power shifts in favor of an adversary (Powell 2002 for a survey, also see: Powell 2006). Commitment problems have also been discussed in the context of civil wars and, in particular, as an explanation of prolonged fighting (e.g., Fearon 2004). Depending on the context, therefore, both issue indivisibility and dynamic commitment problems are potentially important. However, they require very specific conditions, either concerning the nature of the issue or concerning expected future events. Commitment problems, in particular, appear to be relevant mostly to violent conflict. These explanations are therefore less widely applicable than uncertainty-based approaches – given that uncertainty is present in virtually any social interaction.

Beyond rational choice approaches, numerous explanations for conflict have been suggested that are beyond the scope of this text to review in depth. Such explanation focus, for instance, on the role of organizational factors and psychological or cognitive biases (see: Reiter 2003 for an overview with regard to international conflict). To the extent that these explanations depend on particular organizational structures and/or may be more relevant as explanations for protracted violent conflicts or conflict recurrence than as initial causes of conflict in general, a similar argument as above may be made concerning a context-specific applicability. In addition, psychological biases are often only recognized as such in deviation from a rational benchmark. Insofar, the uncertainty-based perspective taken here – although by far not the only determinant of conflict – may be seen as a natural starting point for the analysis.

It is worth noting in this context that mutual optimism, which has been suggested as an alternative explanation for conflictive bargaining in both the literature on litigation (see: Spier 2007, p. 277-8 for a survey) and war (Fey and Ramsey 2007, Slantchev and Tarar 2011) is consistent with the two-sided incomplete information framework presented in Chapter 2.

The common basis for all models discussed in the remainder of this chapter – irrespective of their substantive application to strikes, litigation, or war – is provided by advances in information economics that have made it possible to model inefficiencies in a variety of market and bargaining situations (Akerlof 1970, Spence 1973, Stiglitz 1975, Rothschild and Stiglitz 1976, Gul, Sonnenschein, and Wilson 1986, Rubinstein 1982, Grossmann and Perry 1986, Admati and Perry 1987). These contributions pioneered the development of signaling and screening under incomplete information and their application to sequential bargaining games that underlie modern models of conflict behavior (see: Riley 2001 for a comprehensive survey of the literature on signaling and screening).

The distinction between signaling and screening is typically made on the basis of whether, under one-sided incomplete information, the informed or the uninformed party moves first. Intuitively, the general problem is similar in both setups. For concreteness, consider the classic example of job market signaling/screening (Spence 1973, Stiglitz 1975). A firm seeks to hire a new employee and is willing to pay a higher wage to individuals with higher innate ability (to learn, etc.). Innate ability, however, is unobservable and so the firm does not know which type of applicant it is facing (i.e., the firm has incomplete information about the type of the applicant). In the absence of further information, therefore, the firm is only willing to offer the wage appropriate for an applicant of average ability. Because low-ability applicants have no incentive to disclose their type in this situation, high-ability applicants receive unattractive wage offers given their actual ability.

The fundamental problem in this situation is that verbal communication alone is costless and manipulable. High-ability types of applicants cannot simply claim to have high ability because low-ability types have an incentive to imitate these claims. Yet if all types claim high ability, this communicates no information to the firm, which has therefore no reason to change its wage offer. The crucial insight of Spence (1973) is that, if costless communication is ineffective in transmitting information, costly actions are not. As long as such actions are sufficiently less costly for high-ability types than for low-ability types (i.e., there is an inverse relationship between unobservable ability and the cost of performing the observable action), credible communication is possible.

Spence argues that education can serve as a costly signal because acquiring a certain level of education can be assumed to be significantly easier for high-ability individuals. On the basis of this assumption, Spence shows that obtaining an education can be desirable for high-ability individuals even if that education was otherwise completely useless in terms of productivity gains, personal satisfaction, and the like. Put differently, Spence identifies a benefit of education that goes beyond the gains from education usually discussed and has nothing to do with the actual process or outcome of learning. In this view, obtaining an education enables high-ability applicants to credibly signal their type to the firm (because low-ability types find the costs of imitation prohibitive) and thus to receive a higher wage offer. Signaling is thus a costly but credible communication device that allows players to make their inherently unobservable characteristics (i.e., their type) indirectly observable through their actions.

In a screening context, education fulfills the same function only that the firm moves first by offering employment contracts with wage levels conditional on education. The applicant, after having obtained his or her type-specific level of education, then chooses the appropriate contract. In both signaling and screening behavior, therefore, strong types of the informed party (high-ability applicants in the above example) undertake an action that is intended to convey information about their type to the uninformed party (the firm). In the case of signaling, the strong types take a costly action in order to induce an appropriate offer by the uninformed party. In the case of screening, strong types are induced to take a costly action (i.e., to produce a signal) by the uninformed party's conditional agreement offers.

Such actions are a credible mechanism to eliminate pre-existing uncertainty and to prevent weak types from free-riding. Signaling and screening are therefore essentially devices to rule out bluffing. Signaling behavior allows strong types to secure better deals. As long as the cost of sending the signal is sufficiently low to be more than offset by the more attractive agreement, the investment pays off. On the whole, however, signaling and screening mechanisms are inefficient. While strong types are better off than they would be under uncertainty, weak types are worse off. But because strong types also incur the cost required to produce the signal, the overall balance is negative. This signaling cost can be interpreted as the efficiency loss resulting from the presence of uncertainty.

Following the early work referred to above, signaling and screening mechanisms have been used to study a large number of phenomena. In economics, dividends of firms listed in the stock market have been interpreted as signals to investors (Bhattacharya 1979). Advertising and warranties were modeled as signals for product quality (Nelson 1974, Milgrom and Roberts 1986). Rothschild and Stiglitz (1976) investigate insurance markets and the screening of costumers for individual risks. Outside of economics, applications range from electoral competition (Banks 1991, Prat 2002), to social norms (Bernheim 1994, Fang 2001, Austen-Smith and Fryer 2005), through to animal signals in biology (see: Smith and Harper 2003, for a survey).

Of particular relevance for the purposes of this study is the application of signaling and screening processes to bargaining. Bargaining is a particular form of strategic interaction that differs from many other strategic situations in that is includes a cooperative element and requires mutual agreement of the parties concerned in order to reap the benefits of cooperation. Essentially, "[a] *bargaining situation* is a situation in which two *players* have a common interest to co-operate, but have conflicting interests over exactly how to co-operate" (Muthoo 1999, p. 1). In bargaining games, players therefore seek to arrive at an *agreement* about how to divide whatever 'pie' the bargaining is about. The particularity of the bargaining situation lies in that a large number of agreements – reflecting the various ways in which the pie can be partitioned – are typically feasible. The bargaining problem then consists of arriving at a partition that both sides agree to.

This contrasts with most other strategic situations (i.e., interactive decision problems that arise between two or more players whose actions are interdependent), in which players take the actions of other players into account, when considering their optimal strategy but do not require their consent. The result of such an interactive decision problem is the outcome realized by the interplay of the players' strategically conditioned actions. That is, the outcome is determined by the set of all individual decisions and comes about in the absence of any explicit agreement. Typical applications of 'non-bargaining game theory' pertain, for instance, to strategic spending and investment decisions including in auctions, advertising, research and development, and political campaign spending. Others concern, duopoly interactions, entry deterrence, or voting behavior, but also to evolutionary biology and to distributed computing (e.g., Fudenberg and Tirole 1991, Myerson 1991, Auman 2008).

The classical bargaining scenario is that of a buyer and a seller bargaining over the price of an object (Rubinstein 1985, Grossmann and Perry 1986, Admati and Perry 1987, Gul and Sonnenschein 1988, Cramton 1992; see: Kennan and Wilson 1993, and Ausubel et al. 2002 for reviews). The starting point of these models is the assumption that for the given buyer-seller pair, the buyer values the seller's object more than the seller does. This assumption states that gains from trade exist (i.e., that there is a pie to bargain about). Otherwise there would be nothing to bargain over. The buyer and seller therefore really bargain over how to divide the *difference* between their respective valuations (the seller's valuation is therefore often normalized to zero in bargaining games of one-sided incomplete information where the seller's valuation is assumed to be common knowledge and uncertainty is only over the buyer's valuation). This difference in valuations is the cooperation gain the players seek to realize. In order to do so, they need to reach an agreement about the price given conflicting preferences over this price.

This work combines the logic of signaling/screening with Rubinstein's (1982) groundbreaking work on bargaining under complete information that is discussed in greater detail in Chapter 2 (Rubinstein shows that under standard discounting assumptions, players agree on a split that tends towards equality but includes a first-mover advantage). The defining feature of incomplete information bargaining models is that the signaling cost is introduced through delay (typically because it is assumed that players discount the future and therefore lose from delay to agreement). This makes the interaction in these games dynamic, with more patient types of buyers (stronger types) delaying agreement sufficiently long in order to separate from less patient (weaker) types and thus to achieve a better deal. Buyer types are more patient (i.e., stronger) in these games if they have lower valuations and hence demand a lower price. The reason is that lower buyer valuations reduce the gains from trade. Because discounting is multiplicative, with $0 < \delta < 1$, buyers with lower valuations lose less through delay, in absolute terms, than buyers with high valuations. Because the price agreed with the seller is always in absolute terms, low valuation buyers are more willing to accept delay to obtain a lower price.

In bargaining models that allow alternating offers (instead of one side making all the offers), the distinction between signaling and screening becomes somewhat blurry (a tendency that is even more pronounced in settings with two-sided incomplete information as discussed in Chapter 2). Admati and Perry (1987) present a bargaining game of one-sided incomplete information in which the main focus is on signaling behavior. In their model, the time between offers is determined endogenously and serves as the signaling device. After an initial offer by the seller (which is essentially as screening offer to select out impatient types of buyers), the remaining types of buyer delay their counteroffer just long enough to credibly signal their strong type and hereby secure a lower price from the seller. Because the length of the delay identifies the buyer's type, the seller accepts the counteroffer.

Grossmann and Perry (1986) present a game of one-sided incomplete information in which the focus is on screening. In their model, the players alternate making offers at discrete and exogenously given time intervals ($t = 1, 2, 3, \ldots$). This way, the seller screens the buyer for his type by making continuously lower (i.e., in the buyer's eyes more attractive) offers over time. However, when it is the buyer's move, a patient type of buyer that requires longer delay to credibly communicate his strength provides a 'partial signal' by making an unacceptably low offer that invariably leads to further delay but does not suffice to unequivocally identify the buyer's type. The signal is 'partial' because an unacceptable offer in the current period provides no information concerning the buyer's play in the future.

One thing to note about buyer-seller bargaining is that it arises from a particular market structure typically referred to as 'bilateral monopoly'. In buyer-seller interactions as introduced above, there is by assumption only one buyer and one seller. Given that the buyer values the seller's object more than the seller so that there are gains from trade, this bilateral monopoly results in a situation in which both parties have market power. This differs markedly from a monopoly-style situation, in which there are many buyers interested in the seller's object. In this case, the seller can exploit her market power and trade with the buyer that is willing to pay the highest price. The price that the highest-valuation buyer is willing to pay essentially constitutes an outside option for the seller in her interaction with all other buyers. In effect, the availability of a more attractive outside option eliminates the gains from trade between the seller and low-valuation buyers.

The reverse setting occurs in a monopsony-style situation in which there are many sellers and only one buyer. In this case, the buyer can exploit his market power and trade with the seller that is willing to accept the lowest price. Lastly, if there are many sellers and many buyers (and the usual set of assumptions holds), then the market interaction transforms into a perfect competition setting, were each market participant is a price-taker with no market power. In this case, the mutual availability of various outside options reduces the bilateral gains from trade from both sides and thus approaches competitive equilibrium conditions (an interesting discussion on these issues can be found in Kreps (1990, p. 92-5); also see: Serrano 2008 for a review of the relevant literature and a discussion of the conditions under which the competitive equilibrium can result from the direct interaction of market participants).

Thus, bargaining can only occur in non-perfectly competitive markets because in perfectly competitive markets there is no surplus to distribute and therefore nothing to bargain over (Kennan (2008) makes the same point with regard to labor markets). An implication of the above considerations is that in buyer-seller bargaining, the least favorable outcome for either side is that no trade occurs. This happens when there is no bargaining range (i.e., no pie to distribute) – either because there are generally no gains from trade if the seller valuation of the object exceeds the buyer valuation, or because one side has a more attractive outside option. In each of these cases, the players are implicitly assumed to have a walk-away option, that is, the players are mobile and can choose to interact or not depending on whether their interaction promises to be fruitful. In all other cases, when a bargaining range exists, it is always in both sides' interest to engage in bargaining because the procedure results in mutual gains.

The remainder of this chapter reviews the variants of bargaining models that have been developed with regard to contexts in which bargaining has a conflictive component or is taking place in the presence of conflictive interactions (i.e., strikes, litigation, and war). Note that the above bargaining models are conflictive in the wider sense that the bargainers have strictly opposed preferences. As the following discussion highlights, bargaining models that are applied to conflictive situations in a stricter sense are typically characterized by the availability of additional enforcement options and/or the presence of costs that originate from sources other than mere impatience. Furthermore, these models tend to represent situations in which the mutual gains from agreement that the bargainers seek to partition is considerably less pronounced than in the buyer-seller case. In particular, bargaining is often not over how to partition mutual gains but over how to partition some form of mutual costs. Moreover, in most cases of conflictive bargaining, the parties are not mobile in the sense that they can simply walk away from bargaining with each other. Often the parties are bound to interact even if it is not in their mutual interest.

Along with the theoretical work, I discuss the empirical evidence for existing models of conflictive bargaining as well as the challenges to empirical work that arise in the respective subject-areas. At the end of the chapter, I will summarize and extend on a range of general points that are relevant across the different subject-areas, both theoretically and empirically, and relate the discussion to the subject-area of international trade.

1.1 Labor Disputes and Strikes

Explaining why strikes occur in the context of labor-management relations has long posed considerable challenges for labor economists. It appeared illogical that strikes occur since – irrespective of the terms of the eventual agreement – *both* sides would *always* be better off had they reached the same agreement and saved the costs imposed by the strike. Just as in the case of conflictive bargaining in legal settings or world politics, initial conjectures as to why such inefficiencies occur centered around biases and misperceptions (Hicks 1932) or organizational complexities related to diverging goals within trade unions (Ross 1948, Ashenfelter and Johnson 1969). The development of incomplete information bargaining models had a strong influence on the understanding of strikes; and strikes where among the earliest substantive applications of bargaining theory (see: Kennan 1986 for an early review of this literature, also see: Cramton and Tracey 2003, Kennan 2008).

Kennan (2008) presents a simple example of a strike model. In the context of the above discussion, this model can be thought of as a one-round screening game in which only one offer is made by each side. In the game, a union and a firm bargain over the wage level for a contract period of length T (for instance, one year). The union is assumed to be uncertain about the firm's financial situation and its resulting ability to pay higher wages. This uncertainty encourages the firm to downplay its actual standing to justify paying lower wages. Determining the wage level is thus essentially a question of how the firm's operating surplus is distributed between the employer and the employees. This is directly analogous to the partition of the gains from trade in the buyer-seller game. The total discounted value of the firm's operating surplus over the contract period determines the size of the pie and the aggregate wage payments over that time constitute the employees' share of that pie. A strike is a tool for the union to separate low-profit firms that cannot afford paying higher wages from those that only pretend to make low profits to avoid wage increases.

The cost of delay in the one-period game thus takes the form of a strike that takes as long as the union can afford to strike (that is, as long as its strike fund lasts). Unlike in the buyer-seller game, therefore, the delay cost is concentrated on a finite time interval. During a strike, production stops, so the firm's income stream is interrupted. At the same time, workers do not receive their wage (Several model variants allow for non-total strike costs for both sides. These cost attenuations may arise from the firm's ability to hire replacement workers and the union member's ability to find temporary employment elsewhere. These cost reduction strategies, if available, improve the bargaining position of the respective side, see: Kennan and Wilson (1993) and Cramton and Tracy (2003) for an overview). For simplicity, the model assumes that there are only two types of firms with high and low surpluses.

The union makes the first offer (i.e., a demand for either a high or a low wage level). Facing a high wage demand, low profit firms always reject, thereby prompting the union to call a strike. By rejecting, the low-profit firm signals its type by accepting costly delay in the strike. Due to the low stream of surplus during the strike, this form of delay is less costly for low-profit types of firms than giving in to the high wage demand and suffering from the increased payroll for the remainder of the contract period. If the union is relatively sure that the firm has low operating surpluses, it exercises restraint and demands a low wage, which is accepted by either type of firm. The reason is that the probability of obtaining a higher wage from a highly profitable firm (which is low given the union's information in this scenario) does not suffice to balance the strike costs that arise if, more probably, the high wage demand is rejected by a low-profit type of firm.

However, if the union is sufficiently convinced that the firm is profitable, it demands a higher wage which high-profit firms accept. Because low profit firms always reject such offers, there is a residual risk that strike occurs. A strike, in this model, thus occurs if the union expects to be facing a profitable firm that will give in to its high wage demand, but it turns out that the union's expectation was incorrect. In the simple setup of this game, the union's high wage offer screens out firms in financially healthy conditions while the remaining firms rejection leads to a strike of maximum duration. More complex versions of this game (e.g., Kennan 1986, Kennan and Wilson 1993), in which the screening process is extended across multiple periods, exhibit bargaining dynamics similar to

the buyer-seller game in Grossman and Perry (1986). In these games, one observes the typical negatively sloped 'wage concession function' – i.e., a string of declining wage demands by the union over time. An interesting feature of these models is that the length to which the union can uphold the strike limits the cost of the strike to the firm and, consequently, influences the wage concessions the union can extract from the firm.

Cramton and Tracy (1992; 2003) present a signaling model of strikes. In their model, the strike does not follow from a rejected offer by the firm, but is chosen by the union at the outset. It is assumed that the union cannot revise its decision after the initial period and that the strike, if chosen, will be in effect until agreement is reached. The model has a continuum of firm types. Furthermore, bargaining is essentially over a pay raise (rather than the total wage). The height of this pay raise depends positively on both the delay costs incurred during bargaining and the profitability of the firm. If the union chooses not to strike, bargaining is over the exact nature of a moderate pay raise. The union makes an initial non-strike demand that screens out the highest-profit types of firms, analogously to Admati and Perry (1987), the remaining firm types then delay their counteroffer just long enough to signal their profitability, with lower-profit firm making lower-wage offers after longer delay times.

If the union chooses to strike, both the union and the firm incur larger costs. Because, all types of firms see their flow of profits diminished during the strike, all types are willing to agree to a larger pay raise than under the non-strike condition in order to have normal production flow restored. The union's strike therefore essentially makes the firm more impatient. The bargaining sequence takes the same form as in the absence of the strike with the difference that all wage offers (and all costs) are higher. Thus, before its first offer, the union in effect choses between playing two variants of the same game that are identical, apart from their payoff structure. The decision of which game to choose is based on the union's expectation over each of the two games. That is, before moving, the union calculates the average value of each option given its uncertainty and then decides whether to strike or not.

Cramton and Tracy (2003) show that the union only strikes if its baseline wage is so low that its strike losses (i.e., no wage payments during the strike) are moderate. Thus, the union's initial decision to strike or not determines its wage demand, which, in the strike-game, leads to a net gain only if the firm turns out to be profitable. This is the reverse order but same effect as in Kennan's (2008) model, where the union first chooses the size of its demand, which then, depending on the firm type, either results in favorable agreement or a costly strike. One advantage of infinite-horizon screening models as in Kennan and Wilson (1993) is that these models allow the union to revise its demands (downward) as it gradually learns about the firm's bargaining position. In all models of incomplete information, this induces inefficiency. In either of these models, a strike, if it occurs, is *ex post* inefficient just as delay is in buyer-seller bargaining. In the presence of uncertainty, however, the strike serves as an "*ex ante*-efficient bargaining tool" (McConnell 1989).[1]

[1] Another type of model that has occasionally been applied to strikes is the 'war of attrition' game (e.g., Card and Olson 1995). Because this class of models has the unrealistic property to allow only binary results (either the union's or the firm's maximum demand is realized in the end) I do not discuss them any further here (see: Kennan and Wilson 1989; 1993, and Ausubel et al. 2002 for a longer discussion).

Strikes: The empirical landscape

Empirically, a number of studies have investigated strike data in order to test the predictions of the theoretical work against the empirical record (for an overview, see: Card 1990a, Ausubel et al. 2001, Cramton and Tracy 2003, Borjas 2013). This work relies almost exclusively on North American (i.e., U.S. and Canadian) data. The primary reason is that, in these countries, unions and firms tend to negotiate agreements with well-defined contract durations. This has the considerable advantage that the set of potential strikes is known and the strike incidence rate can be computed.

The first insight that emerges from this data is that strikes are relatively rare compared to the number of negotiations. The typical finding is that, although there is considerable variation across industries, about 15 percent of contract negotiations between large 'bargaining units' (firms with a workforce of 1,000 or more) involve a strike (Tracey 1986, Card 1990a) and that this number is considerably lower for smaller bargaining units (Kennan and Wilson 1989). Considering the overall ratio of strikes to regular work time in the economy highlights the additional facts that strikes are short compared to contract periods (Card (1990a) reports mean values of 40 to 50 days in the U.S.) and that not all sectors of the economy engage in organized wage negotiations. As Kennan notes, also regarding the U.S., "idleness due to strikes never exceeded 0.5 per cent of total working days in any year during the period 1948–2005; the average loss was 0.1 per cent per year" (2008, p. 2).

Another observation is that strike activity has generally declined over time. Borjas (2013) reports figures from the U.S. Bureau of the Census indicating a considerable drop in strike activity over the last five decades. As he notes, "[i]n 2009, only 13,000 workers were involved in a strike that lasted more than one day. The fraction of work time lost to strike activity was less than a hundredth of 1 percent!" (2013, p. 442). Kennan (2008) reports figures from the International Labour Organization (ILO), indicating that this trend is generally apparent across developed countries. He raises the interesting point that the dawn of the communication age may have resulted in a general drop in the uncertainty surrounding wage negotiations: "It is undeniable that information costs have fallen sharply as computers have improved, and it is tempting to conclude that this is the reason for the decline in strike activity" (Kennan 2008, p. 2). A negative relationship between the degree of uncertainty and bargaining frictions is a natural prediction that, almost by definition, flows from all incomplete information bargaining models. After all, these models explain bargaining inefficiencies through the presence of uncertainty.

As soon as the focus moves beyond the above descriptive facts, it becomes more difficult to condense the results of existing empirical work on strikes. Ideally, empirical studies would relate *ex ante* measures of the firm's profitability and the union's strike costs to observable aspects of strike activity such as incidence, duration, and wage outcomes. Based on the theoretical models, one would expect to observe union-firm pairs whose available surplus is larger to experience fewer and shorter strikes. The same holds for pairs in which the union has higher strike costs. One-sided incomplete information models would furthermore predict lower wages after longer strikes because of the downward slowing union concession function (McConnell, 1989). This latter hypothesis is, however, strongly dependent on the information structure and does not hold under two-sided uncertainty where the firm would have an upward sloping concession function and wage outcomes would *on average* be unaffected by strike duration (the effects of two-sided incomplete information are discussed at length in Chapter 2).

Tracy (1986; 1987) conducts two studies that are consistent with the incomplete information perspective on strike activity. He uses the volatility of a firm's stock return as proxy for the union's uncertainty over the form's profitability and finds that this measure is positively related to strike incidence and duration. Nonetheless, the evidence from stock market data is far from conclusive and in part contradictory (see: Cramton and Tracey 2003, p. 105). The large majority of studies on strike activity focus on business cycle effects rather than stock market data. Theoretically, one would expect strike activity (i.e., both incidence and duration) to be counter-cyclical and thus rare during boom periods when the firm's profitability is higher. The general empirical pattern in the data, however, suggests that strike incidence is pro-cyclical while strike duration is counter-cyclical (Kennan 1986, Kennan and Wilson 1989, Ausubel et al. 2001). These results are difficult to reconcile with theoretical predictions.

However, it is far from established whether these results reflect true systematic relationships. "As with strike incidence, the time-series variation in strike duration has been traditionally explained by reference to the business cycle. And, as with strike incidence, the evidence on the cyclicality of strike durations is unclear" (Card 1990a). It has also been difficult to find a stable relationship between strike duration and wage outcomes. McConnell (1989) finds a weak negative relationship in U.S. data, Card (1990b) finds no relationship in Canadian data. Kennan and Wilson note that "[t]he relationship between wage settlements and strike duration is tenuous" (1989, p. 93; also see Slantchev 2004 for the test of a similar hypothesis in the context of international conflict). Somewhat more suggestive is the evidence on the union's costs of striking. Several studies suggest that uncompensated inflation in the previous contract period increases the likelihood of strikes (e.g., Vroman 1989, Cramton and Tracy 1994, Cramton et al. 1999). This is consistent with the strike selection model by Cramton and Tracy (2003).

Overall, the picture that emerges from the empirical literature on strikes is difficult to interpret. One problem certainly lies in the difficulty to observe key variables of interest. As Cramton and Tracey point out, "[t]he central feature of non-cooperative bargaining models of labor disputes is the role of private information that creates uncertainty surrounding key issues in the negotiations. [...] Ideally, this should be the focus of empirical tests of private information models. However, almost by definition, this is the most difficult test to carry out in the data" (2003, p. 104). Similarly, Ausubel et al., note that "theory predicts how ex post outcomes depend on realizations of private information, yet the researcher typically is unable to observe private information variables, even ex post" (2001, p. 42). These statements point towards the interesting question what kind of information external observers may *at all* be able to collect on bargaining processes that take place in the presence of incomplete information (Section 3.2 discusses this point in more detail).

Another problem potentially lies in the data structure that researchers encounter. An inherent feature of wage negotiations is that each firm-union pair negotiates a new contract only every few years. Because there is considerable heterogeneity not only across industries but also across bargaining pairs, pooling such observations (as several of the older studies do) may lead to misleading inferences. Yet if bargaining pair-specific fixed-effects are included in empirical models, the remaining time series is often short and subject to various complexities. For instance, it is well known that there are time dependencies in successive contract negotiations because a high wage agreement in one contract reduces strike probability in the following contract negotiation and vice versa (e.g., McConnell 1989). Similarly, wages agreed on in one contract negotiation will likely affect contract negotiations between other bargaining pairs in the same industry (Kuhn and Gu 1998). In combination with difficulties to satisfactorily observe key variables of interest, these factors present considerable challenges for empirical work. In Section 2.1, I will take up these issues again.

1.2 Legal Disputes and Litigation

As with strikes above (and wars below), scholars have long had difficulties in finding satisfactory explanations for why parties pursue costly litigation. Like calling a strike, going to court is *ex post* inefficient and thus Pareto suboptimal. Assume there are two parties, a plaintiff and a defendant. The plaintiff seeks compensation for injuries potentially resulting from the defendant's actions. Bargaining is over the size of the compensation payment. If the case proceeds to trial, the court imposes a settlement. Because litigation is costly, there are always out-of-court settlements that are Pareto superior to any decision imposed by the court. This holds irrespective of whether the court follows the American Rule according to which each litigant pays its own fees or the English Rule which shifts all litigation costs to the party losing in court (I will focus on the American Rule which facilitates comparisons to conflictive bargaining in labor disputes and world politics; for implications of the English Rule, see: Spier 2008).

Because of the inefficiencies of legal proceedings, Gross and Syverud (1991) refer to a trial as a failure. They vividly describe the difficulties that researchers face in explaining "[w]hy [...] these failures occur? One answer is obvious. For every trial, there is at least one person – an attorney, a client, a claims manager – who said 'no' to a settlement. Who said no, and why? We asked lawyers and we received a wide range of answers: 'The client was stubborn'; 'The plaintiff wanted too much'; 'We didn't think their case had any merit'; 'They just wouldn't pay anything'; 'It was a family feud and a matter of pride'; and so on. Everyone seems to agree that these vetoes are not Random, but a great deal more is needed to explain why few disputes are tried while the great majority are not." (Gross and Syverud 1991, p. 320-21).

The predominant focus in the older literature was, as with strikes, on misperceptions and incorrect assessments on part of the litigants or their lawyers in order to provide a rationale for the occurrence of lawsuits. This literature emphasized the presence of mutual optimism resulting from 'divergent' or 'non-common priors' as the primary reason for why disputes proceed to court (e.g., Landes 1971, Gould 1973, Posner 1973, Priest and Klein 1984, Loewenstein et al., 1993). With the development of asymmetric information bargaining models, uncertainty-based explanations complemented and gradually displaced the mutual optimism framework (for reviews of the literature on the 'economics of litigation', see: Cooter and Rubinfeld 1989, Kennan and Wilson 1993, Hay and Spier 1997, Waldfogel 1998, Daughety 2000, and Spier 2007; 2008).

Although the particular context is very different, pre-trial bargaining between two litigants exhibits interesting similarities to union-firm interactions in wage bargaining. Hay and Spier (1997) discuss a simple one-round screening game, which is similar in structure to Kennan's (2008) wage bargaining model. In this model, the plaintiff has private information about her level of damages. As a result, the defendant is uncertain about the plaintiff's type. The plaintiff's type is assumed to be either weak or strong with equal probability, depending on whether the plaintiff's damages are low or high. For concreteness, Hay and Spier assume that low and high damages result in the court mandating compensation payments of \$50,000 or \$100,000 respectively if the case goes to trial. Should the litigants end up in court, each side faces trial costs of \$10,000. In the simple game structure of the model, the defendant makes a single take-it-or-leave-it offer to screen the defendant types. If the defendant's offer is rejected, it is assumed that the case goes to court.

Compared to Kennan's (2008) model, this is exactly analogous to the union's wage demand that leads to a strike in case of the firm's rejection. Also analogously to the strike model, the equal probability that the defendant assigns to the plaintiff's types, makes him sufficiently confident that the plaintiff is weak to not want to offer high compensation in the pre-trial period (which would avert court proceedings for sure). To see this, consider that a strong plaintiff would accept no offer below \$90,000, which equals the compensation mandated by the court minus the trial costs. Such an offer would be accepted by both types of plaintiffs. However, there is a fair chance (namely fifty percent) that the plaintiff is weak and would accept an offer of \$40,000.

Accordingly, the defendant's expected value from making this low offer is \$40,000/2 + \$110,000/2 = \$75,000 because there is a fifty percent chance that the low offer will be accepted and a fifty percent chance that the offer will be rejected and the worst-case scenario occurs with the case ending in court. Yet, since \$75,000 are less than \$90,000, the defendant (assuming risk-neutrality) choses the risky scenario. Thus, cases involving strong plaintiffs end up in the Pareto suboptimal litigation scenario because, under the assumed information structure, the defendant's risky screening option is individually superior to the socially desirable non-litigation outcome that maximizes total welfare by avoiding friction costs.

The Hay and Spier (1997) model is a variant of a model initially presented by Bebchuk (1984). Together with P'ng (1983), this work initiated the application of incomplete information games to the study of legal disputes. The comparison of the two model variants is interesting, first because it highlights the effects of different model assumptions on the resulting model predictions, and second because it demonstrates the intimate relationship between the different types of models employed in the study of strikes, litigation, and armed conflict. Bebchuk (1984) also uses a one-period take-it-or-leave-it framework to analyze the effect of incomplete information on the litigants' behavior. Instead of assuming that the defendant is uncertain about the plaintiff's damages, however, he assumes that the plaintiff is uncertain about the defendant's liability.

To keep with the above setting, I translate Bebchuk's more general model into a simpler numerical example. The level of damages, say again \$100,000, is now assumed to be common knowledge but the plaintiff does not know whether the court will find the defendant liable for her damages (note that in the Hay and Spier (1997) example the implicit assumption was that the court would find the defendant liable with a probability of 1 once the case is litigated). The defendant knows whether he is liable, but if he is not, his assurances cannot be believed by the plaintiff because each type of defendant would want to make these assurances. Assume there are two types of defendants, liable (weak) and not liable (strong), that may be realized with equal probability. Thus, the plaintiff does not know the defendant's type but she knows that the defendant will be found liable with a probability of $p = .5$, so that p captures the plaintiff's probability assessment of her winning in court. Because the court acts as an external enforcement option the recurrence to which is both costly and uncertain, pre-trial bargaining is sometimes referred to as bargaining 'in the shadow of the law' (e.g., Mnookin and Kornhauser 1979, Cooter et al. 1982, Stevenson and Wolfers 2006).

In the Hay and Spier (1997) example, the defendant was interested in keeping his compensatory payments as low as possible. In the Bebchuk model, the plaintiff is interested in obtaining the maximum amount possible. Given that there are only two types of defendant, the plaintiff will want to tailor her demand to one or the other of the two types. Tailoring her demand to the strong type (that is not liable) is equivalent to dropping the case. In this scenario, the plaintiff is guaranteed to save the litigation costs but will also receive no compensation payment for sure. Given her probability assessment, however, the plaintiff is sufficiently confident to not drop the case. She therefore demands just below \$110,000 from the defendant, which the weak type will accept (because he can do no better in court). Strong types, on the other hand, will reject so that the case goes to court and both sides pay \$10,000 in legal fees to have the court confirm the defendant's strong type. Accordingly, no compensation payment is made. In this scenario both sides lose and no side gains. However, because \$110,000/2 + –\$10,000/2 = \$50,000, which is the plaintiff's expected gain from demanding compensation, is larger than \$0, the known outcome from dropping the case, the plaintiff's decision is *ex ante* optimal.

It should be apparent from the two numerical examples how the optimal strategies of the party that makes the take-it-or-leave-it offer changes as the parameters of the model change. For instance, if the plaintiff's probability assessment that the defendant would be found liable in court was p = .05, dropping the case would become the optimal strategy. Similar variations can be done with other parameters. Also note that in both versions of the game, the party that makes the take-it-or-leave-it offer can extract the entire value of the litigation costs from the other side. This is a typical characteristic of bargaining games in which delay costs take the form of fixed-costs rather than discounting (the properties of these types of costs are discussed in greater detail in Chapter 2).

Now suppose the defendant, instead of having only two types, has a range of types distributed on a known interval, as in the original game by Bebchuk (1984). In this case, the plaintiff can no longer tailor her demand to one specific type but rather chooses an optimal demand that screens the defendant types into two groups. One group of weaker types accepts the demand while the other rejects it, thereby provoking the case to move to court. The plaintiff's optimization problem now is to find demand that produces the optimal cutoff point for this split. As Bebchuk notes, "[i]n choosing a settlement demand a party will balance two considerations: on the one hand, increasing [the] demand will be beneficial if the demand is accepted; on the other hand, increasing [the] demand will reduce the likelihood that the demand will be accepted" (1984, p. 405). As a result of this strategy, there are always some cases in which the plaintiff's demand is rejected and the case proceeds to trial.

To see why this is, assume the plaintiff would demand the maximum compensation payment that only the weakest type of defendant would be willing to pay. If she did, all but the weakest type of defendant would be better off by going to court than by accepting the plaintiff's demand. Because the probability that the weakest type is realized on a continuous interval is technically zero, essentially all cases would go to court. The plaintiff's demand would thus never be accepted. Having the case litigated, however, reduces the plaintiff's maximum possible payoff by \$20,000 (\$10,000 for her own fees and \$10,000 that could be extracted from weak defendants). The optimal demand is sufficiently low to induce enough weak defendants to accept an out-of-court settlement that allows the plaintiff to save/extract the litigation costs, but not so low that the loss in compensation payments outweighs the gains of this strategy. In the other extreme, if the plaintiff were to demand the minimal amount of compensation that even the strongest type of defendant would accept and no case would go to trial, the plaintiff would forego significant payments.

As with strikes, more complex dynamic models of pre-trial bargaining have been developed (e.g., Reinganum and Wilde 1986, Schweizer 1989, Daughety and Reinganum 1994). Spier (1992) presents a screening variant of the Bebchuk (1984) model in which a sequence of offers can be made before the case goes to trial. The model is strongly related the dynamic bargaining models discussed above but differs in two important features. The first feature results from the above logic that the defendant wants the compensation payment to be as low as possible, while the plaintiff wants it to be as high as possible. Because unlike in regular bargaining, the size of the pie has a negative sign for the defendant (bargaining for the defendant is about limiting loss, not about maximizing gain), the effect of time discounting that becomes relevant in dynamic models is attenuated. In particular, because the defendant wishes to minimize his payment, he *prefers* delay. The time preferences of the litigants therefore offset each other and exert no pressure to come to agreement early as, for instance, in Grossman and Perry (1986).

Second, Spier (1992) assumes that there is a fixed trial date to reflect the common case in pre-trial bargaining that the parties interact while knowing that an appointment in court is approaching. This upsets the infinite-horizon logic that typically characterizes dynamic bargaining games and induces a deadline effect. The combination of these two elements results in a bargaining dynamic in which almost the entire action takes place "on the courthouse steps" (Spier 1992, p. 93). Because the plaintiff makes all the offers in Spier's model, she can always wait until the last moment before trial and then make the optimal take-it-or-leave-it offer, just as in the Bebchuk (1984) game, to extract the maximum possible amount of rents. Apart from the fixed cost effect mentioned above, this primarily reflects the last-mover advantage that is typical for finite-horizon bargaining games.

Some caution is therefore required when interpreting these results, because they are at least in part a consequence of the (unrealistic) assumption that the plaintiff makes all the offers. Spier (2007) herself discusses how, in a similar context, Randomization of last-offer opportunities can alleviate such concerns and make the model more realistic. Essentially, such Randomization eliminates the last-mover advantage and reduces the plaintiff's expected gain from dragging the case to the courthouse. Spier (1992) also shows that the deadline effect is attenuated in model variants that (also more realistically) involve fixed bargaining costs prior to the trial date. These costs then constitute proper incentives to agree early because, unlike discounting, fixed costs negatively affect both parties. Such costs are likely to arise in the context of pre-trial proceedings and discovery and may in fact be substantial. For instance, Salop and White (1988) estimate, based on a collection of U.S. antitrust cases, that the legal costs of cases settled before trial are on average 75 percent of the costs of cases that were decided in court.

The existence of fixed bargaining costs prior to trial has important implications for the interpretation of Spier's model because it suggests that the logic of pre-trial bargaining can considerably reduce or even eliminate the strategic importance of the court as an external enforcement option. To see this, consider the case in which pretrial costs are significant compared to the value of the plaintiff's damages and the trial date is still some time ahead. In such a case, the deadline effect may completely vanish because neither side will want to continue bargaining long enough to actually end up on the courthouse steps. The game then effectively fades into an 'infinite-horizon' game that is more similar in its bargaining dynamics to the buyer-seller models discussed above than to the original version by Spier (1992).

Litigation: The empirical landscape

Despite the interesting hypotheses that can be derived from the above models, empirical work on bargaining behavior in the context of legal disputes is sparse to say the least. A number of descriptive facts are comparatively clear or can at least be safely assumed. As Spier notes: "In practice, the vast majority of cases that are filed ultimately settle before trial and countless others are settled before a case is filed at all. Less than 4 percent of civil cases that are filed in the U.S. State Courts go to trial. In the U.S. Federal Courts, only about 2 percent of civil cases go to trial" (2007, p. 268). Of the antitrust cases collected by Salop and White (1988), less than six percent went to trial. For the U.S., similar picture emerges from data reported by Ostrom, Kauder, and LaFountain (2001), and the annual Judicial Business Reports of the U.S. Courts that are available online.

However, the available data are often insufficient to provide a basis for systematic empirical investigations of bargaining dynamics in legal disputes. Gross and Syverud note that "[t]he absence of data on pretrial negotiations has handicapped development of this topic" (1991, p. 321). In a similar vein, Cooter and Rubinfeld point out that "the further along the litigation process the dispute has gone, the better the available empirical evidence. The steep slope of the 'dispute pyramid' and the relative superiority of data describing the top as opposed to the bottom make the empirical study of the litigation process especially difficult." (Cooter and Rubinfeld 1989, p. 1070-71). The authors go on to state that "empirical research has lagged woefully behind theoretical advances" (Cooter and Rubinfeld 1989, p. 1094).

It may thus not be surprising that Kennan and Wilson note in an early review that "[t]here have been virtually no empirical applications of legal bargaining models with private information" (1993, p. 99). Several years later, Waldfogel notes that "[a]lthough the [asymmetric information] model is the starting point for much theoretical work on litigation [...], it has received relatively little empirical scrutiny" (1998, p. 423). Waldfogel discusses the studies of Froeb (1993) and Hylton (1993) that set out to test some of the implications of the theoretical work based on 'win rates' but concludes that "[w]hile intriguing this evidence remains inconclusive. [...] The empirical study of the selection of cases for trial, and litigation generally, is in its early stages" (Waldfogel 1998, p. 424, also see: Fournier and Zuehlke 1996). Spier (2007), in an extensive eighty-four page review on litigation, only cites six empirical studies published in the 2000s, none of which is primarily concerned with testing aspects of bargaining theories.

1.3 International Conflict and War

A third field that has seen a surge of theoretical and empirical work based on the advances in bargaining theory is the study of international conflict. In world politics, an important aspect of the strategic interaction between parties is that this interaction takes place 'in the shadow of power' (Powell 1996). The similarity in wording with the litigation literature (in the shadow of the law) hints at the conceptual similarity, namely, that bargaining occurs in presence of an enforcement option. In political science, this enforcement option is typically interpreted as taking the form military power (although various other forms of power such as economic, diplomatic, etc. are debated as well). Since states have military capabilities at their disposal, these capabilities may be used to (try to) impose a favorable settlement. However, because both sides have such capabilities, the degree to which enforcement is feasible depends on both sides' capabilities and necessarily also involves costs for both sides.

Compared to 'regular' buyer-seller bargaining, the presence of such power therefore alters the strategic environment in which parties interact. A primary objective of the bargaining literature on international conflict is to formally work out the relationship between power, bargaining, as well as war, and thereby to build and extend on earlier scholarship on the topic (e.g., Schelling 1960; 1966, Rosen 1972, Blainey 1973, Wittman 1979, Bueno de Mesquita 1981). In these models, war is seen as the result of parties' uncertainty in a similar way as strikes are in wage negotiations and lawsuits are in pre-trial bargaining. The cost of war, in this interpretation, is the 'efficiency loss' that results when parties bargain in the presence of uncertainty while simultaneously employing their costly enforcement option.

There are some remarkable similarities between the models developed in legal studies and international relations, in particular, because the enforcement option is modeled in very similar ways, namely as a 'probability of winning' that is associated with fixed costs. Another similarity to the study of settlement and litigation is that the bargaining literature on war has developed in two broad waves (see: Powell 2002, Reiter 2003, and Maoz and Siverson 2008 for reviews of this literature). Models of the first generation are often referred to as *costly lottery* models (Fearon 1995, Bueno de Mesquita et al. 1999, Powell 1999, Schultz 1999). This is a class of stylized models that explain the occurrence of conflict through a risk-return trade-off in a static take-it-or-leave-it framework.

Similar to the strike model presented by Kennan (2008) and, in particular, the litigation model by Bebchuk (1984), these models are essentially one-shot screening games in which bargaining takes only one round because the game structure allows only a single offer to be made. In a typical game of this kind, bargaining is assumed to be over some resource, say territory, the value of which is normalized to 1. The effect of power is modeled as the parties' respective probabilities of winning an all-out war, p and $1-p$. The parameter p, in turn, is assumed to reflect the parties' relative military capabilities (essentially $p = m_1/(m_1+m_2)$), where m_1 and m_2 are the parties' absolute capabilities). It is further assumed that one party, say state A, has positive expected utility from fighting because its probability of winning is sufficiently large to outweigh the costs of war, should it ensue. The idea here is that the status quo distribution of territory does not adequately reflect the current power balance between the parties. As a consequence, state A is said to be 'dissatisfied' with the status quo.

Within the mathematical logic, this assumption serves the same purpose as the assumption underlying buyer-seller models that the buyer values the seller's object more than the seller does. In the buyer-seller setting, this feature makes both sides willing to bargain, so bargaining occurs. In the conflict setting, this feature makes one side willing to make a demand, so bargaining occurs. Similarly, in pre-trial bargaining, the plaintiff is 'dissatisfied' as a result of the damages she has suffered and the possibility to receive compensation for these damages enforced by the court. In the strike model of Cramton and Tracy (1992; 2003) the union chooses to strike if it is dissatisfied with its baseline wage.

State A then makes a demand for concessions in the presence of uncertainty over state B's type (where the uncertainty can be either over B's capabilities or its costs of using these capabilities). Under complete information, state A would demand a territorial transfer that leaves B just indifferent between accepting and going to war. Under incomplete information, however, A does not know what the optimal demand is. If A demands too little given B's type, it gives up claims unnecessarily. However, if it asks too much, B will in expectation be better off by fighting a war than by giving in to A's demand. In this case, A's demand triggers a costly war in which each side gains the entire territory with probability p and $1 - p$, respectively. The trade-off inherent in the situation is that low demands result in low gains while ensuring a low risk of war, whereas high demands promise large gains while entailing a higher risk of war. As a consequence, conflict occurs with positive probability because "the optimal solution to this trade-off is not to 'buy' zero risk" (Powell 2002, 11). This is the same trade-off that the plaintiff makes in Bebchuk's litigation game.

The development of costly lottery models is considered an important step in the study of international conflict because these models provide an explanation, although on a very abstract level and given fairly strong assumptions, for why war might arise *at all* between rational actors. After all, war – if it occurs in the above model – is a suboptimal outcome for both parties. Insofar, the formal treatment of strategic interaction under uncertainty suggests misperceptions and psychological biases (e.g., Lebow 1981, Jervis 1976, Larson 1985) need not be present in order to have actors engage in costly conflict (note that is it always possible to include an additional bias term into the utility functions of states A and B above that would have them fight under any condition. On a theoretical level, it is considerably more difficult to explain conflict in the absence of biases than in their presence).

Nonetheless, costly lottery models have clear limitations – and in models of war possibly more evidently so than in models of conflict in other subject-areas. One aspect that scholars were uncomfortable with in particular is that war is modeled as a "game-ending move" (Powell 2004, p. 344). Once bargaining fails to produce an acceptable solution, relations automatically break down into a war in which parties fight to the end and no more interaction is possible. As Reiter states, "it is apolitical that the models allow for no bargaining within war, interpreting the war-fighting process as fundamentally mechanical rather than strategic or instrumental" (2003, p. 29). Since most wars, especially in the modern era, end in negotiated agreements (i.e., peace treaties) rather than in conquest and submission, the all-or-nothing character of the costly lottery approach is unsatisfactory.

These concerns have prompted the development of a second generation of models that build on the same type of intertemporal screening mechanism as the buyer-seller models discussed above (Filson and Werner 2002, Slantchev 2003a, Powell 2004, Smith and Stam 2004). These models, which are often referred to as *costly process* models, allow for bargaining to occur during conflict in a dynamic process. Thus, instead of making a single nonrevisable demand, the uninformed side screens the other for its strength (which again depends either the opponent's capabilities or its costs of war). Weak types of opponents accept higher demands (i.e., less attractive offers) early on, while stronger types remain in the game longer – thereby demonstrating their strength and receiving increasingly attractive offers.

As a result, the one-shot lottery of the older models is disaggregated into a process that splits the war into sequential episodes and allows for non-binary outcomes. The war-fighting process in these models takes the role of delay in the buyer-seller setting. Costly conflict serves as an information transmission mechanism through which the uninformed side gradually learns about its opponent's type. The parties finally come to an agreement that reflects their relative strength although, in most cases, only after various periods of costly war. Some of these models incorporate additional features that are supposed to capture different aspects of war fighting. In Slantchev (2003a), the informed party learns not only from delay but also from the Random draw that decides period-wise battlefield outcomes. In Smith and Stam (2004), the opponents conquer 'forts', of which a minimum is required to resist total defeat. In Filson and Werner (2002), the parties may experience resource depletion.

Thus, the second generation of bargaining models of war is considerably more elaborate than the first. These models capture important features of war such as dynamic bargaining during conflict with varying durations, gradual reduction of uncertainty, and non-binary settlement outcomes. Nonetheless, the models leave important questions unaddressed. In particular, the 'mechanical' nature of the war fighting process that was found unsatisfactory about the costly lottery models characterizes the costly process models as well (although less obviously so). Note, however, that in any of the above models, war breaks out immediately if the party making the first offer underestimates the strength of its opponent. Furthermore, and also just as in the costly lottery setup, war is a binary event. As soon as war breaks out, the parties fight an all-out war in which both sides employ their entire capabilities at any point in time. The fighting then continues until the parties reach agreement or either side is defeated.

The dynamic nature of the bargaining setup in costly process models thus disaggregates the war in time, but not in intensity. It is this feature that gives all bargaining models of war this 'Hobbesian feel' that is more reminiscent of the interactions of medieval chiefdoms than those of modern states (this situation is not significantly altered in Leventoglu and Tarar (2008) who present a variant of Powell's (2004) model in which more than one offer can be exchanged before parties engage in full-scale war). Assuming that parties immediately employ their entire military capabilities in all circumstances that could not be resolved by mere verbal exchanges, however, is not only irreconcilable with the historical record. It is also an assumption that has far-reaching implications for the predictions derived from these models.

The primary problem, I would argue, lies in the models' strong focus on *power* itself. To a considerable degree, the formal modeling literature on war has inherited this focus from previous scholarship that has extensively debated the relationship between military power constellations and war (e.g., Wright 1965, Morgenthau 1967, Blainey 1973, Organski and Kugler 1980, Mearsheimer 1990). Bargaining models of war are usually interpreted as supporting the view that power parity increases the likelihood of war because such parity magnifies the effect of uncertainty (e.g., Reed 2003, Slantchev 2004, also: Reiter 2003, but see: Powell 2004; 2006). Yet while military capabilities are a necessary part of any violent interaction between states, they are unlikely to be its root cause. Typically, military capabilities are regarded as a means to an end. When analyzing militarized conflict, therefore, the principal focus should be on the 'end' rather than on the 'means'.

To see this more clearly, it is instructive to compare the different bargaining models discussed in this chapter in terms of what the uninformed party is typically assumed to be uncertain about. In buyer-seller bargaining, uncertainty is about one side's valuation of the *object* to be sold. In strikes, uncertainty is about the appropriate *wage* level. In legal disputes, uncertainty is about the merits of the *case*. In each case, the focus is on the particular issue that the parties bargain about. In the models on war, in contrast, the uncertainty is about the other party itself, i.e., its capabilities or cost of using these capabilities, while the contested issue plays a subordinate role. Thus, while all other bargaining models typically focus on the issue that the parties bargain over, bargaining models of war focus in the characteristics of the parties themselves. This is unconvincing, however, because there are *many* issues that any two parties in international relations might disagree and bargain over.

Given a multiplicity of issues, however, power constellations cannot explain within-dyad variation across different issues because power constellations are constant across all these issues. In other words, power would have to explain at the same time why parties engage in war about one issue but not about some other issue. It may not be surprising therefore, that although "[t]here are islands of empirical support for the bargaining model" (Reiter 2003, p. 32), empirical tests have overall tended to produce mixed results (also see: Allan and Dupont 1999, Werner 1999, Reed 2003, Reed et al. 2008, Hwang 2010, Braithwaite and Lemke 2011). In particular, "it has been very difficult to find any stable empirical relation between the distribution of power and the likelihood of war" (Powell 2004, p. 344).

Bargaining models of war do, of course, assume that parties bargain over *an* issue (such as territory). But this issue is not the primary focus of the analysis. Rather, existing bargaining models implicitly assume that both parties value this issue a) identically and b) sufficiently much that both sides are willing to employ their entire capabilities in a war about this issue. If these assumptions hold, then power relations may be expected to be decisive. The above-mentioned 'chiefdom scenario' may, for instance, be adequately captured in this manner. Here, political entities essentially care about only one issue that is at the same time of vital (and therefore equal) importance. However, in the vast majority of interactions between modern states the above assumptions are likely to be violated. Even if a given issue is valued equally, as soon as one assumes that it was not worth fighting an all-out war over this issue, it would no longer be obvious what the above bargaining models would predict about the parties' behavior.

Given that the military capabilities of modern states are often extensive – and that there is a strong defense and/or deterrence component underlying these capabilities – most issues are simply not worth fighting an all-out war over. Yet in this case, the parties' relative power, defined as the probability of winning such a war, loses much of its analytical relevance. If a substantial part of the motivation behind maintaining large military forces for most states is defensive and therefore intended to *avoid* conflict, then it is no surprise that total military capabilities are not very useful in explaining the occurrence of conflict. To a considerable degree, therefore, military power appears be primarily an enabling condition for conflict rather than its source – an assessment that is also more in line with the observation that, empirically, most wars are of limited intensity. Thus, a stronger emphasis on the issue-level might be desirable in analyses of international conflict.

The case for focusing attention on the issue level is further strengthened by the existence of another concept besides *power* that is prominent in international relations – namely parties' *stakes*. It has long been noticed that parties' stakes – that is, their subjective and potentially diverging issue valuations – play a crucial role in international conflicts. This point has, for instance, regularly been discussed in the context of qualitative and/or empirical work on deterrence and asymmetric warfare (i.e., Mack 1975, Vasquez 1987, 1993, Paul 1994, Danilovic 2002, Sullivan 2007). In this context, parties' stakes are typically interpreted as a factor that conditions the effect of power relations (in the older literature the term 'resolve' is frequent which hints at the behavioral consequences of stakes rather than stakes as such). A similar view is expressed by some formal theorists. Slantchev, for instance, notes that "[t]he relationship between the distribution of power and the risk of war depends crucially on the distribution of interests" (2011, 176). In light of the above considerations, however, the focus should ideally be the other way round.

The important aspect about stakes is that, unlike power, stakes are an issue-level concept. Parties' stakes are directly linked to the specific issue at hand, while their capabilities are not. As a consequence, stakes (both in absolute and relative terms) will almost certainly be more relevant for any effort to explain conflict between two parties than these parties' relative power. However, the implementation of this insight is complicated by the fact that stakes are not straightforward to observe and measure in world politics. In addition, the difficulty of observing stakes points to an even more severe challenge in analyses of international conflict – namely, the definition of what an issue is at all. While this is not so much a problem in the study of individual cases where the particular issue is obvious, it is a major challenge for comparative work and work on the causes of war that requires knowledge of 'non-cases' (i.e., cases without open conflict).

Researchers in international relations thus face the double-challenge of 'stakes assignment' and 'issue delineation'. First, assessing the stakes of governments in world politics is difficult even in observed cases. One reason is that countries' stakes often stem from various sources (strategic, historical, ideological, domestic political, etc.). These sources are likely to differ across countries and issues and may furthermore in each individual case be non-stable over time. Stakes cannot simply be identified on the basis of objective and readily observable issue characteristics. Insofar, assigning stakes to particular issues requires extensive qualitative research, which is time-consuming and impracticable for large numbers of cases. Nonetheless, the ICOW project is an effort of this kind (see: Hensel et al. 2008, Hensel and Mitchel 2015, Bryan et al. 2017). Other researchers have used the nature of initiator's war aim (regime change, territory, policy change, peace keeping, etc.) as a proxy measure for stakes (Sullivan 2007, also: Slantchev 2004).

Yet because war aims are only known for wars that actually occurred, such aims and the stakes inferred from them may be used to study differences *within* the given set of wars. But are of no help in explaining why these particular wars occurred while others did not. As Hensel and Mitchel clearly note: "The most important problem in collecting conflict data is identifying potential cases. Unlike projects coding details of a known population of treaties or political characteristics of states, conflict datasets face a nearly infinite set of possible disputes to investigate" (2015, p. 116). It is very often simply not clear what such a potential case would even be. In territorial disputes, the disputed territory is clearly identifiable, but what do non-disputed territories look like? And how many of these territories exist? Similarly, for disputes over policy, there is a large range of policies that any one country could pursue that strongly interfere with other countries' interests.

But what these potential policies are, and why they are not pursued in most cases is a question that essentially cannot be answered. Yet in order to analyze why states in international relations select into wars (and therefore to understand why individual interactions escalate into violent conflict), knowledge of potential issues and the stakes that countries have or do not have in these issues is indispensable. This difficulty in international relations of observing potential issues and their associated stakes may be one reason for the strong focus on power as an actor-level characteristic in the study of international conflict. After all, on the actor level, non-cases are readily observable, because the set of actors in international relations is clearly delineated. On the actor level, incidence rates can be calculated (just as in the case of strikes where the contract periods are known) and conflict onsets studied. But the abstraction from the issue level, which is needed to do so, raises the problems just discussed.

Key differences between conflictive and non-conflictive bargaining across subject-areas

The chapter thus far has highlighted the strong similarities and particular differences between theoretical models of (conflictive) bargaining in the very different contexts of buyer-seller interactions, wage negotiations, pre-trial bargaining, and international relations. It has further summarized the empirical work in these areas and pointed to various challenges arising from difficulties to systematically observe and measure key aspects of the situation. The following paragraphs highlight a number of additional implications of what has been said so far and distill the main theoretical and empirical insights from the above. The discussion also lays the basis for the remainder of this study by pointing out aspects of conflictive bargaining that existing models leave unaddressed and by drawing the parallels to an application of a strategic bargaining approach to disagreements in international trade. Both theoretical and empirical points are discussed in this context.

On the theoretical level, a number of points were raised above that distinguish *conflictive* bargaining from classic buyer-seller bargaining. First, conflictive bargaining is often characterized by additional cost and/or enforcement options. Second, conflictive bargaining is often not strictly cooperative (in the sense that real mutual gains are materialized) but rather tends to be about the distribution of mutual costs. Third, parties can often not simply 'walk away' from bargaining in the same sense as buyers and sellers can in the market place. At this point, it is useful to make a few additional remarks that further clarify these differences and their deeper sources. I discuss the three points just mentioned in reverse order with a particular focus on the parties' lack of a walk-away option.

Although the above points are related, the parties' inability to walk away from bargaining potentially has the most far-reaching consequences (because it has implications for the status quo condition that parties' start bargaining from and because it means that parties can 'force' bargaining onto each other). The condition is a direct result of the respective contexts in which the parties interact. In buyer-seller bargaining, as noted earlier, the market participants are mobile in that they are generally free to choose their bargaining partner or to decline bargaining should it not be in their interest. In this context, bargaining is a mutual decision to engage in an advantageous one-time interaction over the particular object for sale. The parties' relationship (with respect to the given object) thus begins with their decision to start bargaining and ends once the transaction is concluded. The parties may or may not interact again in the future. And if they do, this future bargaining will be about another object, and will only take place if both sides once more agree to interact.

This loose and temporally limited relation between buyer and seller has important implications for the interpretation of the status quo (i.e., the initial condition) that defines the parties' interaction. Because it is always the case that the seller possesses the object at the outset, the status quo can be characterized in this way. As noted above, however, when bargaining over the price, a buyer and a seller actually bargain over the difference between their respective valuations of the object rather than over the value of the objet itself (which is why the seller's valuation can be normalized to zero under one-sided incomplete information). In effect, therefore, the parties bargain over a pie that is only 'created' by their agreement to trade. The pie is the additional value generated by the parties' transaction. This implies that prior to agreement neither party possesses the pie, so that the status quo is reflected by the payoff vector $(0, 0)$. From this status quo, any partition of the pie (irrespective of the delay costs may be incurred while bargaining) results in a win-win outcome.

This differs markedly from the situation that parties encounter in wage bargaining, legal disputes, or international relations. In these subject-areas, the parties are typically bound to each other and cannot evade interactions or opt to deal with more attractive partners. The union and the firm, for example, are intimately linked by the nature of their relationship. Similarly, the plaintiff and the defendant are connected by the prior event that caused the plaintiff's injuries. Countries in international relations interact with many other countries on a wide range of issues, but each specific pair of countries concerning each specific issue in the bilateral relationship cannot simply dissolve the relationship and deal with other partners instead. In labor relations and in the international arena, the parties' interactions typically take the form of long-term relationships that pre-existed prior to their current interactions over the issue at hand (again it is the issue-level that matters here, not the actor-level).

In each case, therefore, the parties' relationship with respect to the given issue has a history – and therefore an *existing* status quo distribution. In wage bargaining, the status quo effectively is the wage level under the previous contract. In legal disputes it is the plaintiff's damage (reflecting the fact that the total value of the pie in legal disputes is negative). In world politics, it may be the current territorial distribution or some other pre-existing division of a given resource.

The existence of a given status quo distribution has profound implications – because it removes the value creation option that bargaining promises in the buyer-seller scenario. If the pie is already distributed between the parties, then (renewed) bargaining can only lead to a *re*-distribution of the pie, which (unless the pie grows for some reason) necessarily implies a win-lose outcome as the best possible result.

This condition naturally amplifies the conflictive character of the situation to the degree that the win-lose component dominates the win-win component. However, bargaining can be conflictive even if the status quo does not prohibit win-win outcomes. This can best be seen from the example of wage bargaining, which generally has the most commonalities with 'pure' buyer-seller bargaining. Note, that wage bargaining is perhaps most adequately interpreted in the sense that in each new contract period, the parties enter into a bargaining episode about a *new* pie (namely, the firm's total expected income stream over the upcoming contract period). Because the firm continues to make profits, renewed win-win bargaining is possible. In this interpretation, the effect of the prior status quo wage is significantly mitigated (although the range of possible agreements may be limited due to 'wage precedents' from the previous contract, for instance, because in real-world contexts wages are typically sticky and wage *de*creases will rarely be an option). However, the union's option to force a costly strike on the firm still is a conflictive element that sets wage bargaining apart from buyer-seller interactions.

In all three subject-areas it is thus the case that, because neither of the parties has a walk-away option while the situational context enables the leveraging of cost or enforcement options, the side that expects to win through renegotiations can essentially drag the other side to the bargaining table. It is under these circumstances that bargaining is no longer simply about dividing mutual gains from cooperation in a mutually agreed upon interaction, but partly or completely about dividing the costs that are saved by avoiding conflict in an imposed interaction. Thus, the inability to avoid interaction, the availability of bargaining strategies that are costly beyond mere delay, and the potentially limited *real* gains from cooperation make bargaining conflictive. If this kind of bargaining fails in the presence of uncertainty, the various forms of open conflict discussed above – strikes, litigation, or war – are expected to result.

Overall, the discussion in this chapter has highlighted the considerable potential that bargaining theories of conflict offer in analyzing and understanding conflictive interactions in different subject-areas. At the same time, the chapter has pointed to a range of open theoretical questions and to the in part substantial difficulties in empirical tests of theoretical predictions. These results form an important input into the motivation of this study, which is explicitly derived in Section 2.3 below, following the discussion of the literature on trade disputes and on international trade theory. The above insights also form the basis for the theoretical framework developed in Chapter 3, which serves as the basis for the empirical work in this study and moreover points to a number of possible answers to some of the open questions in existing theoretical work.

2 The Literature on Trade Disputes and the Economics of Trade

This chapter continues the review of the relevant literature for this study. It shifts the focus away from theoretical approaches to conflict towards the subject-area of international trade. The chapter complements the previous discussion and lays the basis for the remainder of this study – which analyzes trade disputes from a bargaining perspective on conflict. As previously noted, the study of trade disputes has to date not seen an application of such theoretical approaches. In general, conflictive trade relations have rarely been discussed from a formal theoretical and/or strategically-focused point of view. For lack of a theoretical literature on trade disputes, the overview focuses on the empirical literature and the theoretical arguments made in this context.

This overview is provided in Section 2.1 which presents both the qualitative and the quantitative empirical literature on trade disputes – both of which strongly focus on the WTO dispute settlement mechanism. The discussion in this section points to a number of issues, both theoretical and empirical, that present challenges, in particular, for the quantitative for the work in this field. One key difficulty is the lack of available data on trade barriers. Another difficulty stems from the central focus in the literature – namely the question of fairness of participation in the WTO dispute settlement proceedings – that has tended to divert attention from the underlying economics of the phenomenon. As a result, neither the economic and political factors that create pressures for trade protection, nor the market mechanisms that govern the effects of protectionist trade policies receive particular attention.

However, this leaves unused the great advantages that trade offers as an empirical field. These advantages go beyond the general transparency and quantifiability of trade relations and the favorable multi-dyad and multi-product time-series cross-sectional data structure. They also include the existence of a well-developed economic theory of trade. This theoretical knowledge greatly facilitates the navigation of the empirical field and allows inferences to be made about quantities of interest – such as trade barriers – that are not directly observable. Section 2.2 provides an overview over the theoretic literature on trade and trade policy that provides the toolset employed in the empirical chapters below. The section also provides a brief preview of how this toolset is employed.

The final section of this chapter then condenses the key insights from the entire discussion in Chapters 1 and 2. As noted previously, this section motivates the present study more generally. It reiterates the difficulties that empirical researchers investigating strikes, litigation, or war face when testing the predictions made by theoretical work in their field. Based largely on the discussion in Section 2.2, it also reiterates the various advantages that the subject-area of international trade holds for empirical studies. On this basis, the section concludes by pointing to the untapped potential for gaining new insights into trade disputes and escalation processes more generally by combining the potent theoretical approach of bargaining theory with the with the research-friendly empirical field of international trade.

2.1 Conflict in International Trade Relations: Trade Disputes

Unlike much of the trade literature, which is the subject of Section 2.2, the existing literature on trade *disputes* has a strong empirical focus. A considerable fraction of this work has an applied or policy perspective or is directly motivated by policy questions. Another strand of the literature approaches the topic from a legal point of view. These latter studies evaluate and interpret trade disputes in the light of international trade law. In terms of study design, the literature falls into two broad groups and the present section will be structured along these lines. The first group consists of qualitative case studies. These studies typically focus on major disputes and are overwhelmingly concerned with the United States or the European Union, and regularly with US-EU disputes directly. Most of the cases analyzed in this literature concern disputes that have been brought before the WTO dispute settlement body, while some studies are concerned with cases of unilateral U.S. market opening policies.

The second group also focuses on the GATT/WTO dispute settlement procedure but consists of quantitative studies. The bulk of this literature is motivated not so much by the question of why and when trade disputes arise but by the question of whether WTO dispute settlement allows equal participation of developing countries. This question was debated already under the GATT and has gained renewed attention with the reform of the dispute settlement mechanism that accompanied the inception of the WTO. Both the qualitative and the quantitative literatures are not primarily concerned with questions of conflictive bargaining and strategic interaction in a similar way as the above literatures on strikes, litigation, and war are. Consequently, the results of this work are in a certain sense further removed from the purpose of this study despite the much closer substantive fit. However, these literatures provide insights into international trade and trade policy issues, the policy and academic debate, and the empirical conditions in the field – all of which are of relevance for this study.

The case study literature on trade disputes in the WTO and beyond

In the case study literature, the work that is perhaps closest in its empirical focus to the subject addressed here is the book-length study of Bayard and Elliot (1994). The authors investigate U.S. trade enforcement activities based on various U.S. trade laws and, in particular, the so-called Section 301 of the Trade Act of 1974 and related legislation. This piece of legislation provides the legal basis for the U.S. government's use of unilaterally retaliatory action against foreign trade barriers (although since the inception of the WTO, the unilateral use of these measures by the U.S. government has increasingly diminished and has been at least complemented or in many cases fully replaced by the use of the WTO dispute settlement mechanism (a more detailed discussion on this issue can be found in Chapter 4).

The book reviews the policy debate around the use of these tools as well as the historical context and development of the legislation and its uses since the mid-1970s. It provides a list of all past cases as well as twelve in-depth case studies. The primary focus is not on the question of what motivates the use of such tools and under what conditions this occurs. Rather, the focus is – in a more policy-oriented approach – on the effectiveness of the measures. Bayard and Elliot conclude that although there have been some positive results, in most cases "section 301 [...] approaches are likely to be ineffective and may be counterproductive" (1994, p. 327). A primary reason for this conclusion is the author's evaluation that unilateral trade enforcement, in contrast to the more recent WTO proceedings, has generally been perceived by most U.S. trade partners as illegitimate.

Relatedly, Taylor (1997) investigates the U.S. use of Section 301 enforcement policies and considers the implications of the newly created WTO for U.S. market opening policies. Similar to Bayard and Elliot (1994), the study maintains that the effectiveness of Section 301 policies is limited. It further notes the legal problems that surround the unilateral use of U.S. trade laws due to potential inconsistencies with (or violations of) GATT law. The author "concludes that the United States needs to resume multilateralism as the primary way to pursue trade liberalization and to use the more legitimate and equitable World Trade Organization Dispute Settlement System, established under the Uruguay Round, to address U.S. trade problems" (1997, p. 209; on the question of legitimacy also see the quantitative study by Pelc (2010) that compares the effectiveness of Section 301 cases to U.S. GATT/WTO cases and finds the latter to yield more substantial results; Grinols and Perrelli (2006) provide a comparison of the durations of Section 301 and U.S. WTO cases).

Several edited volumes and individual studies look at WTO disputes between the U.S. and the EU (e.g., Petersmann and Pollack 2003, Perdikis and Read 2005, Kastner and Pawsey 2002, Pavcnik 2002). Kastner and Pawsey (2002), for instance, investigate the US-EU beef hormone dispute in the context of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS). The authors point to the possibility that the prolonged dispute between the transatlantic partners may undermine the WTO's regulatory harmonization goals in the area of agricultural trade. The contributions in Perdikis and Read (2005) discuss both individual disputes (such as the dispute over U.S. trade contingency measures in the steel industry in the early 2000s) as well as horizontal topics (such as the EU's Common Agricultural Policy (CAP) and disagreement over the regulation of trade in genetically modified foods) that create tensions in transatlantic trade relations.

Pavcnik (2002) traces the dispute over subsidies in the civil aircraft industry and discusses how inconsistencies between WTO regulations and bilateral agreements may have contributed to the sustained disagreement between the U.S. and the EU in this area. The volume by Petersmann and Pollack (2003) addresses US-EU disputes in the WTO from a legal point of view. Besides a number of case studies on individual disputes that approach the cases from a 'lessons-learned' perspective, the contributions discuss potential dispute prevention, management and early-warning mechanisms. The final section of the book presents policy recommendations for legal and regulatory reforms.

Another set of studies investigates trade disputes between the U.S. and Canada (e.g., Vogel and Rugman 1997, Room and West 1998, Hoberg and Howe 1999). Vogel and Rugman (1997) analyze a set of ten environmentally related disputes on such issues as sea food, lumber, or dairy products. The authors are particularly interested in uncovering potential 'implicit coalitions' between environmentalists and industry lobbyists who may both, although for very different reasons, favor limitations to the free flow of cross-border trade. Vogel and Rugman (1997) report to find indications for such coalitions in the majority of their cases. Room and West (1998) consider the specific problems involved in trade in alcoholic beverages and the disagreements arising therefrom. Hoberg and Howe (1999) investigate the U.S.-Canada lumber dispute. Their study is on NAFTA rather than the WTO and the effectiveness of a bilateral dispute settlement panels created under the free trade agreement's provisions. The author's seek to demonstrate that factual evidence can dominate the effects or the panel members' nationality in such panels.

A third set of studies examines disputes between the U.S. and its trade partners in Asia, in particular, Japan and China. Baron (1997) investigates the Kodak-Fujifilm dispute between the U.S. and Japan in light of non-reciprocal market access conditions introduced by alleged anti-competitive practices and distribution restrictions in the Japanese market. Zeng (2013) provides a trend analysis of U.S.-China trade disputes before the WTO and discusses the effect of pro- and anti-protection interest groups on both sides on policy formulation. A book-length study by Hufbauer et al. (2006) discusses U.S.-China trade relations in a wider context of the bilateral (economic) relationship. The study investigates sectoral questions, for instance, in the field of textiles or semi-conductors as well as cross-cutting issues such as the debate over China's exchange rate regime or the protection of intellectual property rights.

A number of studies focus on the European Union (e.g., Luo 2007, Kong 2012, Thies 2013). Luo (2007) uses the example of China-EU trade disputes to trace how China is gradually building up experience, expertise and the ability of leveraging private sector resources and information to effectively participate in WTO dispute settlement proceedings. Kong (2012) investigates the history of EU-China disputes with a particular focus on past dispute management and lessons that can be drawn from this experience for potential future disputes. Thies (2013) investigates the additional legal complications that arise from the EU's supranational character when the European Union is a respondant in WTO disputes.

Lastly, a number of extensive studies deal with the WTO dispute settlement more generally. A volume edited by Bown and Pauwelyn (2010), for instance, investigates the legal and practical aspects of the retaliation procedure envisaged by the WTO dispute settlement system. The contributions discuss individual experiences of countries with the retaliation mechanism. One focus in this context is on the question of how such policies are designed. Another volume by Shaffer and Meléndez-Ortiz (2010) focuses particularly on the experiences of developing countries with the WTO dispute settlement framework. This volume is part of the larger debate on the fairness of the current trade arbitration regime that also motivates much of the quantitative literature discussed below. I will discuss a number of these studies in the next sub-section along with the quantitative literature to avoid repetitions.

This brief review of the case study literature indicates the richness of topics and perspectives that the study of trade disputes permits. Questions of legal design in dispute settlement procedures as well as questions of legitimacy and effectiveness are discussed. The investigated disputes cases arise in individual industries or sectors as well as horizontally. These cases further relate to various international agreements and regulations and concern a broad range of policy measures including environmental, SPS or technical standards, trade contingency measures, subsidies, or exchange rate policies. Undoubtedly, the complexity of the legal, economic, and political landscape necessitates in-depth studies such as the above and the insights gained from these studies provide important inputs into the policy process.

At the same time, much of the above literature only indirectly concerns the subject of this study. The goal pursued here is to identify broad but general factors that concern the wider logic of strategic interactions in international trade relations and that affect the overall pattern of disputes and non-disputes at all levels of conflictiveness. Most of the above literature provides little guidance in this context. On the surface, this is largely because the literature typically addresses fundamentally different questions. The deeper reason may well be that the detailed within-case approach of the qualitative literature does not fit well with the objective of identifying general patterns across a wide range of cases. This is the case not least because the question of appropriately treating non-cases (as discussed above) is particularly difficult to address in case study work.

The quantitative literature on GATT/WTO dispute settlement – general outlook

The rest of this section presents the quantitative literature on the GATT/WTO dispute settlement (DS) procedure. As a result of their central role in international trade governance, the GATT and WTO have attracted considerable scholarly attention. This is true not least for the dispute settlement understanding. The DS mechanism has witnessed substantial reforms in the transition from the GATT to the WTO that sparked much discussion over the adequacy and fairness of the system (in the following, I will therefore concentrate on the larger and more recent WTO literature). Moreover, the dispute settlement system has the convenient side-effect of naturally generating quantitative data that make statistical analysis feasible. The collection of GATT/WTO cases has so far been essentially the only readily available source of data on trade disputes. In combination, these factors have resulted in a sizeable quantitative literature on trade disputes in the system.

As Horn and Mavroidis note in a comprehensive review of the literature, "[a] frequent allegation in the policy debate over the working of the DSU is that participation in the DS mechanism is biased to the disadvantage of poorer/smaller countries. [...] There is an empirical literature that seeks to examine the correctness of these claims, and that attempts to highlight the determinants of participation in the DS system more generally" (2006, p. 13; for an overview also see: Shaffer 2009). Since the filing of a DS case is a strong indication for a highly escalated trade dispute, a literature that investigates the reasons for participation in such disputes is interesting in the present context and holds the potential to provide relevant insights into the drivers of trade disputes.

The most widespread debate in the literature concerns the reasons for which developing countries may be disadvantaged in the WTO DS system. The two primary factors advanced in the debate concern the partiers' 'legal capacity' and their 'power' (e.g., Horn et al. 1999, Francois et al. 2008, Kim 2008, Sattler and Bernauer 2011). The legal capacity hypotheses suggests that developing countries are underrepresented in the dispute settlement system either because they do not have the capacity to detect potentially illegal barriers by other countries, or because they lack the legal expertise to successfully administer a case at the WTO. The power hypotheses suggests that developing countries are underrepresented either because they cannot afford the costs associated with the arbitration procedure, or because they cannot retaliate once the WTO authorizes such retaliation, or because they fear various forms of inofficial counter-retaliation and reprisals by more powerful respondents.

While both these hypotheses, in their various manifestations, appear plausible, is has proven difficult to find strong cumulative support for or against either of the two. The legal capacity hypothesis is usually tested by using GDP per capita or the personnel size of countries' WTO delegations as proxies for their ability to handle WTO disputes. Horn et al. (1999) report a weak but unstable positive association between of countries' legal capacity, as proxied by the number of their WTO delegates, and the number of
disputes they bring before the WTO. Using the same measure on a different subset of the data, Bown (2005) finds no such association. Sattler and Bernauer (2011) also find no evidence that the size of the Geneva mission is related to dispute initiation. However, they report a negative relationship between GDP per capita (of both the complainant and respondant) and dispute initiation. This result contradicts the capacity hypotheses and instead suggests that poorer countries participate in relatively more disputes than richer ones.

Similarly, Francois et al. 2008 use a World Bank government efficiency indicator to proxy for legal capacity and find a negative association with dispute initiation for the importer but no statistically significant association for the exporter, that is, for the country that actually files the dispute. Using an indirect approach to test the legal capacity hypothesis, Kim (2008) compares the inclination of developing countries to file disputes under the old GATT and the new WTO DS system. The study finds lower participation rates in the WTO system and attributes this to the higher complexity stemming from the increased legalization of the DS procedure under the WTO (also see: Busch and Reinhardt 2003a). Allee (2008), however, reports the opposite result in his study.

Guzman and Simmons (2005) again employ a different strategy for testing the capacity hypotheses. They use the respondent's GPD as the dependent variable and report a clear negative association between this measure and both the complainant's GDP per capita and its mission size in Geneva. The authors see this as supporting their argument that because poor countries cannot afford as many disputes as other WTO members, they target more rich/large respondents to make up for the higher opportunity costs of pursuing a case. Guzman and Simmons (2005) claim their results provide considerable support for the legal capacity hypothesis.

One reason for the inconsistent pattern of results lies in the crudeness of the proxies used to measure legal capacity (also see: Horn and Mavroidis 2006, p. 29 on this point). This is the case, in particular, for the 'WTO mission size' variable, which is highly correlated with GDP (the standard proxy for 'power') as well as with overall trade volumes – to name just the two most obvious examples. Horn et al. explicitly acknowledge this "multicollinearity problem" (1999, p. 17, also see: Francois et al. 2008, p. 20). It is highly questionable whether a GDP- and trade-adjusted mission size measure contains any information on the legal ability and expertise of countries. At the same time, it is by no means clear that countries with a higher GDP per capita necessarily profit much from better 'in-house' legal expertise, because these countries in particular tend to extensively hire external law firms when pursuing disputes. But the ability to do so likely depends on GDP in absolute terms as well as on GDP per capita.

Accordingly, 'powerful' countries buy legal capacity. This raises the question of how legal capacity is defined at all, and how exactly it differs from power. These questions are insufficiently addressed – both on the conceptual and on the measurement level – in the quantitative literature on WTO dispute settlement. Bernauer et al. note in a recent assessment of the literature that "[t]he results of this research, thus far, do not offer any robust evidence for a legal capacity bias in WTO dispute initiation" (2010, p. 10). The perhaps strongest support to date in favor of the legal capacity hypothesis is presented by Busch et al. who conduct extensive interviews among WTO members that "suggest that legal capacity is the main constraint limiting their access to dispute settlement, and that more legal capacity would help them participate in all aspects of WTO dispute settlement" (2009, p. 576). Qualitative studies by Bown and Hoekman (2006), Nordstrom and Schaffer (2008), and Shaffer (2009) point in a similar direction.

A key argument in these studies is that the start-up costs of WTO arbitration simply make the process too expensive to pay off when small trade volumes are concerned. Yet while this argument is convincing as such, it remains unclear in the context of the academic debate whether it should be seen as supporting the legal capacity hypothesis or the power hypothesis – or whether it should be seen as inherently discriminatory at all. After all, small trade volumes tend to make it equally unprofitable for any respondent, irrespective of legal capacity or power status, to engage in high level arbitration over a minor issue. One can then ask whether or not it is more appropriate to take this issue into account when debating potential participation bias in the WTO.

Tests of the power hypothesis, too, have generated widely differing results. Horn et al. (1999) compare differences in GDP levels of WTO DS participants and find that although rich/large countries use the WTO mechanism more frequently they appear to do so mostly among each other. The authors conclude therefore that "the model and the data do not support the claim that power-based factors are important" (Horn et al. 1999, p. 19). Guzman and Simmons (2005), in contrast, report a negative relationship between complainant and respondant GPD and interpret this as evidence against the power hypothesis. Sattler and Bernauer "find inconsistent evidence for relative power", as measured by relative share of the complainant's GPD in a dyads total GDP, on dispute initiation (2007, p. 24). Using absolute differences in the countries' GDP, however, the authors report a 'power preponderance effect', which "suggests that more powerful countries may obtain concessions from less powerful countries outside the WTO, and/or that less powerful countries may abstain from formal WTO litigation for fear of reprisals" (Sattler and Bernauer 2011, p. 144).

Bown (2005) uses two measures unrelated to GDP to examine the power hypothesis. One is the respondent's trade dependence on an exporter that might choose to file a complaint (as measured by the share of the respondent's exports shipped to the potential complainant). This measure is supposed to capture the retaliatory capacity of the latter. Bown reports a strong positive relationship between this variable and an exporter's participation in the WTO DS process. At the same time, Bown (2005) finds that the respondent's aid dependence on the exporter is negatively related to the exporter's litigation decision, thus, suggesting a reverse relationship than for trade dependence (i.e., that – inconsistent with the power hypothesis – exporters litigate more against less aid dependent countries). However, both Zejan and Bartels (2006) and Francois et al. (2008), report findings that exporters litigate less against potential respondents if these exporters are themselves more aid dependent on the latter.

As with the legal capacity, part of the difficulty in assessing the potential effect of 'power' on participation in WTO dispute initiation is related to the definition and measurement of the concept, which remains "extremely vague" (Francois et al. 2008, p. 9). Moreover, power in international trade – both in the sense of being able to afford procedural costs and in the sense of being able to retaliate – is likely to be an enabling condition in the same sense as in international conflict. A trade dispute only costs a certain amount of money and the central question should not be whether a country is able to pay that sum but whether it is willing to do so given the issue at hand and its strategic assessment of its trade partner's willingness to do so (see: Chapter 3). The same logic holds for retaliation. If the U.S. and the E.U. are engaged in a trade dispute, neither side will ever close its entire market in retaliation for anything. WTO-authorized retaliation is always proportionate to the estimated effect of the discriminatory policy under consideration.

The quantitative literature on GATT/WTO dispute settlement – additional challenges

The literature faces a number of even deeper challenges that complicate efforts to stabilize empirical results. Part of the difficulty is that the WTO dispute settlement cases represent only a tiny fraction of the disagreements that arise between countries over trade issues. An additional problem in this context is that WTO cases are characterized by considerable heterogeneity on a number of dimensions. Finally, because the literature is primarily motivated by policy concerns relating to the equitable participation *by member states* in the DS system, it is strongly focused on country characteristics. This results in an actor-level focus very similar to that in the literature on war – and with many of the same consequences for statistical analyses.

The small number of WTO cases typically results in two sets of study designs. Either the focus is only on the set of positive WTO cases (e.g., Guzman and Simons 2005, Busch and Reinhardt 2003a). This means, however, that only the comparatively very limited variation in dispute progression within the WTO arbitration process can be studied (rather than actual initiation decisions), or makes it necessary to rely on correlational patterns among participant characteristics. Alternatively, the data used to study dispute initiation is highly zero-inflated. Sattler and Bernauer (2011), for instance, have 230 WTO cases in a dataset containing 63,833 dyad-year observations. Francois et al. (2008) report a 319/192,720 positive to total case ratio. In Reinhardt (1999), who investigates the entire set of GATT and WTO disputes, this ratio is 603/329,194.

If the focus in these studies was on the detailed product-level, the number of non-cases would, depending on the exact level of disaggregation, lie in the range of tens or even hundreds of millions). These imbalances are particularly worrisome in light of the heterogeneity of positive WTO cases discussed below and because a considerable share of the non-WTO cases are, in fact, cases in which trade frictions arise in other forms that may still escalate highly but may not end up before the WTO for various reasons (the discussion in Chapter 4 provides a clearer picture of what these frictions look like). In the absence of further information on the nature of these 'non-cases', results on WTO dispute initiation may at best be attenuated and at worst misleading (also see: Horn and Mavroidis 2006, p. 30).

Some studies (notably, Bown 2005, but also Allee 2008) seek to address these difficulties directly in their study design. Bown (2005) focuses on a small number of discriminatory policies that were ruled as being illegal by the WTO and then compares the characteristics of the actual complainants to characteristics of countries that Bown identified as potential complainants (that were also affected by the policies) but only participated in the dispute as interested third parties or not at all. Allee (2008) uses a dataset on trade contingency measures – anti-dumping (AD) measures and countervailing duties (CVD) – imposed by GATT/WTO members between 1979 and 2001 and examines the likelihood that such measures are challenged at the WTO depending on country characteristics.

While these latter studies take a more thoughtful approach towards study design, all studies on the WTO are confronted with the problem of the extreme heterogeneity of cases. This problems begins with defining what a case is in the first place. A substantial fraction of WTO cases involve more than two countries, more than one product (often at different levels of aggregation), very different trade barriers (permanent vs. temporary, affecting all or selected countries, concerning exports or imports, etc.), or involve repeated filings on the same issue. Often, these disputes are simply split into country-pair disputes and treated as if they were separate bilateral cases. Horn and Mavroidis comment on this issue by stating that, "we are not aware of any study that seriously contemplates what is 'one' issue in a complaint. [...] More generally, we are not aware of any attempt to derive the definition of 'one' dispute from any underlying theory. At the same time, we add up numbers and seek to draw inferences on the basis of these numbers. In our view, this problem is sufficiently severe to lead us to seriously question the meaningfulness of the whole literature on 'bias' in participation" (2006, p. 28-9).

Further heterogeneity is introduced into the set of WTO cases by a range of additional factors. For one, there is a clear pattern in WTO rulings in favor the complainant. On average, the WTO agrees with the complainant(s) in more than two thirds of the claims involved in a dispute (also see: Davis 2012, p.18). This indicates that complainants select potential cases strategically depending on the strength of the case (which is unobservable to the researcher). It also suggests that potential respondents will attempt to design their trade barriers in such a way that any violations of legal standard are difficult to establish (which is also unobservable). Thus, one can expect substantial selection effects on purely legal grounds and should therefore also expect that a considerable number of economically equally structured cases do not end up at the WTO for this reason alone. WTO cases are therefore likely to be non-representative of the larger set of trade disputes even (on this point, also see: Busch and Reinhardt 2003b, Horn and Mavroidis 2006, Elsig and Stucki 2012).

In addition, Pelc (2014) presents an argument that countries may occasionally initiate disputes at the WTO to set (informal) precedents. Lee (2012) as well as Davis and Pelc (2012) present evidence suggesting that macro-economic conditions influence countries' propensities to seek WTO arbitration. Davis and Bermeo (2009) hold that earlier dispute experience increases the participation rates of countries in later cases (Davis and Bermeo 2009). Reinhardt (2000) and Bown (2002, 2004a, 2004b) suggest that countries do in fact file retaliatory disputes, that is, they are more likely to file against countries that previously filed a dispute against them (Busch and Reinhardt 2002, p. 464, present a list of cases they suspect to be retaliatory in nature). Together, these points indicate that there are potential cross-linkages and temporal dependencies underlying the set of WTO disputes that can pose additional challenges for statistical analyses that, if they do not model these dependencies in some form, implicitly assume independence across the existing set of cases.

Lastly, the focus in the literature on WTO disputes on actor-level characteristics – although understandable from the legitimate research interest in whether developing countries are disadvantaged in the WTO – has diverted attention from a more detailed product-level analysis of trade relations. As indicated, this strongly parallels the situation in international conflict research because the attention is not focused on the *issue* because of which a trade dispute arises. In fact, as Sattler and Bernauer point out, "[w]ith very few exceptions [...], existing studies do not examine the effect of trade on trade disputes" (2007, p. 5). What is even more consequential, Bown (2005) and Allee (2008) are essentially alone in making an effort to take trade *barriers* into account – although both studies by design only consider a small number of cases and a non-complete set of barriers without an assessment of the economic effects of these barriers on trade flows.

No single study, however, relates comprehensive data on trade barriers to the occurrence of trade disputes. Because no such data has been available to date (Chapters 5 and 6 are devoted to the task of estimating this data), no study has been able to assess the stiffness of these barriers that would allow a quantification of their trade depressing effect. As a consequence, and directly analogous to the study of war, it has so far not been possible to systematically assess countries' stakes in their trade relations. In other words, the root causes of trade disputes have so far played no role in the study of this phenomenon. In the absence of systematic information on trade barriers, Horn et al. (1999), pioneered efforts to approximate the expected frequency with which countries may impose or encounter illegal trade barriers in an attempt to arrive at an 'unbiased benchmark' against which the legal capacity and power hypotheses can be tested.

The principle idea behind this unbiased benchmark is that Horn et al. (1999) assume that disputable trade barriers are distributed equally across all importers and markets and that, therefore, all exporters face such barriers proportional to the diversity and value of their exports. Accordingly, the authors expect one country that exports twice as much as another country to experience twice as many trade barriers than the second country, regardless of the two countries' composition of export products and destination markets. The authors then calculate a count of expected trade barriers for each country and assume that, all else equal, countries should file complaints at the WTO proportionally to this count. In other words, "[t]he purpose is to compare the total number of actual complaints per country with the number that would be 'unbiased' as suggested by the model" (Horn et al. 1999, p. 11)

While Horn et al. (1999) model this benchmark explicitly, subsequent studies have tended to incorporate aggregate trade volumes as a covariate to produce a similar effect. Overall, the authors find that their benchmark prediction "explains fairly well the dispute pattern" but note that their "conclusions rest on a number of restrictive assumptions" (Horn et al. 1999, p. 1 and p. 26). Generally, "studies have found substantial evidence that countries of greater economic size and with stronger trade flows are more likely to become involved in trade disputes, both as complainants and defendants" (Bernauer et al. 2010, p. 9; also see: Sattler and Bernauer 2011, Francois et al. 2008, Wilckens 2009).

These results are certainly in line with what one would expect as an aggregate tendency. Nonetheless, it is almost guaranteed that a benchmark constructed in this manner will not be 'unbiased'. After all, it is well-known that different countries protect different markets to very different degrees depending on a multitude of factors including their particular economic structure, their industry composition and competitiveness, as well as on general country-level factors stemming from the openness of the political system for lobbying and the like. Accordingly, exporters will face varying numbers and intensities of barriers depending on their respective trade pattern. A proportional benchmark cannot correct these non-proportionalities. Under this condition, therefore, assessing the effect of countries' legal capacity or power on the number of complaints they file is unlikely to lead to unbiased results. The assumption of a proportional benchmark is very similar in effect to the assumption of equal stakes in the context of international conflict and war and therefore leads to very similar problems. The lack of information on the pattern and severity of trade barriers is a missing data problem that cannot simply be assumed away.

These difficulties are further aggravated by the fact that – because legal capacity and power are country-level characteristics (or, in the case of relative power, dyad-level characteristics) – researchers are prevented from accounting for unobserved heterogeneity on the country- and dyad-level that goes beyond trade barriers. Yet all else equal, a country's propensity to file disputes (on the aggregate level of counts per country or country-year) is likely to be influenced by factors such as the government's concentration on trade relative to its wider political agenda or by the country's overall economic structure. A predominantly agrarian producer may be expected to face more trade barriers in its exports than a manufacturer of specialized high-tech goods. Similarly, trade barriers may systematically vary across economic sector in the degree to which they are litigable at the WTO because of different sector-specific rules and agreements and the legal leverage these agreements provide in the arbitration process.

Furthermore, countries are likely to differ systematically in the degree to which they file complaints towards different trade partners beyond those partners' legal capacity and power. Potentially relevant factors in this dyadic context are not only the quality of the overall political relationship but also the question of whether the two countries are currently engaged in a larger set of negotiations (be it over a free trade agreement or over an issue entirely unrelated to trade) and want to avoid additional complications. Since many of these factors are not observed and none of the above studies employs a model specification that is suitable to mitigate the resulting concerns (fixed effects, instrumental variables, etc.), the problem of unobserved heterogeneity is likely to contribute to the large variability of results reported in the literature. In sum, the above points make it difficult to arrive at a conclusion about the participatory fairness of the WTO dispute settlement system based on the existing literature. As Horn and Mavroidis note, there are "a number of problems in this literature that need to be resolved in order for the findings to become more than just suggestive" (2006, p. 28).

As a more general remark besides the various methodological issues discussed above, one could also ask whether it makes sense at all to inquire whether developing countries are disadvantaged in participating in the WTO *dispute resolution* system. One could at least make the point that developing countries face the more severe disadvantages in the general setup of the international trade system in which industrialized countries have had greater leverage in pushing their agendas. In the agricultural and textiles sectors, in particular, developing countries face severe entry barriers to industrialized country markets. Yet these barriers are the results of previous multilateral trade negotiations and therefore not inconsistent with international trade law.

Accordingly, these barriers are also not actionable under the WTO dispute settlement system – although they are potentially the most important hurdles to the free flow of exports for a considerable number of developing countries. Yet it is entirely unclear what fair participation in dispute settlement implies under these conditions or whether it is possible at all. These considerations are one more reason why the legalized context of WTO arbitration is likely to induce potentially severe and systematic selection effects that make an exclusive focus on WTO cases problematic and that cannot be separated from other country-level factors.

In general, the strong focus in the quantitative literature on the WTO dispute settlement system, and on country-level determinants of participation in this system, has left unexploited the great potential that the empirical field of international trade offers to study trade disputes (and conflictive bargaining processes) more broadly. As will be discussed at greater length in Section 2.3, however, is it possible in international trade to measure countries' stakes on the product-level and to observe dispute escalation on that level. This enables an analysis of variations in dispute characteristics on the industry-level while holding aggregate country- and dyad-level factors constant (because multiple industry-level trade relations are nested within each dyad). Yet this option is available only if the focus of the analysis moves from the aggregate country-level to the disaggregate industry-level.

Doing so can shed light on the logic of conflictive bargaining that goes beyond the effects of country characteristics, which are difficult to isolate and substantiate. In particular, focusing on the sub-country level allows insights into the specific structural conditions that affect why a given pair of countries may experience more frictions in one industry than in another. In other words, it allows insights into what drives the particular industry pattern of disagreements and disputes within a dyad. Thus a much more detailed picture emerges of the determinants of trade disputes and potentially a better understanding of conflictive bargaining more generally.

2.2 International Trade Theory and the Political Economy of Trade Policy

This study is based on the conviction that the subject-area of international trade holds considerable potential for the analysis of strategic interactions and escalation processes. Section 2.1 has reviewed the existing literature on trade disputes in the context of WTO dispute settlement and has argued that this literature has, for various reasons, not exploited this potential. As noted, one key difficulty in this literature is the lack of adequate information on trade barriers, which almost by definition are the root causes of trade disputes. An important goal of this study is to move the analysis of trade disputes forward by focusing explicitly on the role of trade barriers and the implications of these barriers for the loss and gain options of the concerned parties. In order to do so, one has to zoom deeper into the logic that drives trade policy and trade policy responses (i.e., trade enforcement efforts).

This section serves as an introduction to the extensive literature on the determinants of trade, trade policy, and the political economy of protection that this study heavily draws on. The insights from this literature form the basis for the estimation of trade barriers and the subsequent measurement of parties' stakes through simulated industry-level trade policy changes in Chapters 5 through 7. Each of these chapters contains separate overviews over the specific literatures underlying the approaches and methods employed at each stage. For this reason, the present section focuses on presenting the overarching issues in trade theory and trade policy. It also introduces the general framework that forms the common theoretical basis that underpins the empirical methods applied throughout these chapters – the so-called Armington model of international trade.

The backdrop for any analysis of trade policy is the familiar economic and political tension between pressures for trade liberalization and trade protection and the resulting mixed set of incentives that governments face in formulating trade policies. Generally, the last decades have seen an unprecedented opening and integration of the world economy. Reductions in trade barriers and transport costs and a shift towards an international division of labor, outsourcing, and global supply chains have transformed global trade and production patterns. These changes have gone in tandem with political efforts towards a liberalization of international trade. A series of multilateral trade rounds in the post-World War II era has resulted in large-scale reductions of tariffs and substantial increases in global trade volumes. These developments have been accompanied by a considerable, though uneven, growth in world GPD.

The gains from trade (and its distributional consequences)

A large literature in international economics points to the various sources of gains from trade – the aggregate welfare gains that can be realized through trade (for an accessible introduction, see: Krugman et al. 2012, for a more technical treatment, see: Feenstra 2016). In traditional comparative advantage theory, trade is driven by inherent differences in countries' production possibilities. In the Ricardian approach, trade – including the resulting gains – is driven by differences in productivity (for instance, because of differences in technology) between countries (Ricardo 1817, for modern treatments and developments, see: McKenzie 1954, Jones 1961, Dornbusch et al. 1977). In the Heckscher-Ohlin model, trade results from differences in countries' resources or factor endowments more generally (Ohlin 1933, Samuelson 1948; 1949, Jones 1956; 1965).

In these models, it is thus either a higher factor efficiency (due to higher productivity of existing factors of production in the Ricardo model) or a lower factor price (due to greater abundance of factors in the Heckscher-Ohlin model) that results in a comparative production advantage. Because comparative advantage is a relative property, no country can be relatively good at producing everything. Consequently, all countries have a comparative advantage in producing some good. Specialization (Ricardo) or partial specialization (Heckscher-Ohlin) then make it possible to produce an overall larger amount of goods and then trade these goods to satisfy domestic demand at a higher welfare level than would be possible in the absence of trade. Each country exports the good(s) in which it has a comparative advantage and imports the good(s) in which it has a comparative disadvantage. Trade in final goods is thus an indirect way to reallocate factors of production to achieve optimal output.

Both the Ricardo and Heckscher-Ohlin models and their variants are perfect competition models of trade in homogeneous (i.e., identical) goods that operate on the assumption of constant returns to scale. More recent firm-level models of trade in differentiated goods add the option of gains from trade through economies of scale (Krugman 1980) and within industry efficiency gains (Melitz 2003). In the Krugman (1980) model, domestic firms in different countries produce firm-specific varieties of differentiated goods. So there are as many product varieties as firms. Each national market can only support a certain number of firms producing at a given scale. The key point of the Krugman model is that, in an integrated market between two countries, each country can specialize in producing a smaller number of varieties at a larger scale and then exchange these varieties through trade – resulting in both lower prices and a larger number of varieties available to consumers in each country.

Thus, unlike in the Ricardo and Heckscher-Ohlin models, where gains from trade are driven by 'inherent' differences in productivity or endowments *across* industries, the Krugman model allows gains from trade to arise from 'artificial' differentiation *within* industries independent of differences in production conditions. Melitz (2003) further extends this analysis by allowing firms to differ in their productivity. In this context of firm heterogeneity, Melitz demonstrates how trade liberalization induces efficiency gains through within-industry selection of firms. Essentially, trade liberalization leads more productive firms in each country A to export more. The higher export profits then induce entry of new domestic firms. At the same time, productive firms from country B export more to country A. The double pressure of increased domestic entry and increased import competition drives the least productive firms out of the market, leading to higher average industry productivity.

The central point to note about the above models is that, in each case, trade is driven by some sort of production-relevant differences between countries. Trade liberalization is the result of a reciprocal linkage agreement that allows countries to exploit these differences. Under free trade, countries concentrate their production on a smaller number of goods or varieties in which they either have a direct comparative advantage (Ricardo, Heckscher-Ohlin) or that they can produce more economically once open markets allow them to specialize (Krugman, Melitz). In effect, therefore, trade liberalization allows countries to shift their production patterns to maximize efficiency in specific products or varieties. The resulting efficiency gains and the availability of foreign products through trade then allow consumers to select among an equally large or larger selection of products or varieties at lower prices.

Importantly, however, the fact that countries specialize in producing a particular set of products or varieties necessarily also implies that countries *stop* producing some products or varieties as a result of opening up to trade. In particular, the efficiency improvements from trade directly imply that industries or firms that are comparatively disadvantaged are driven out of business. Countries stop producing what they are relatively bad at. After all, this consolidation effect is the source of the aggregate welfare gains from trade. This means that business owners and workers in industries that are comparatively disadvantaged are threatened by trade liberalization and stand to lose from free trade. These hardships that accompany the production-side structural changes resulting from trade liberalization are at the center of the persistent controversies over trade and trade policy. Trade not only creates aggregate gains, it also leads to a redistribution of income among societal groups.

The so-called specific factors model (Jones 1971, Samuelson 1971, Mussa 1974), an extension of the Ricardian model, is explicitly designed to capture these ambiguous distributional effects of trade. In the original Ricardo and Heckscher-Ohlin models, the detrimental effects of trade are assumed away because both models presuppose perfect factor mobility. This allows an immediate and frictionless migration of labor and capital to the comparative advantage industries and therefore imposes no transition costs. The specific factors model relaxes this assumption and shows that owners of immobile factors – that are 'specific' to a disadvantaged industry – are hurt by trade liberalization. In the Melitz (2003) model, the analogous effect is immediately apparent from the exit of non-productive firms. Thus, the individual domestic industries and firms that are hurt by trade liberalization suffer net losses from the larger linkage strategy that creates aggregate welfare gains.

Dixit and Norman (1980) present a formal argument to show that, in theory, it is always possible for a government to redistribute the gains from trade to make everyone better off. This is perhaps not surprising if trade creates aggregate welfare gains. The difficulty, of course, is that in praxis such transfers will tend to be politically challenging to implement. For instance, industries profiting from trade will hardly agree to cross-subsidize what they see as an anachronistic or mismanaged economic sector. At the same time, most workers that cannot be immediately retrained for a new job will likely prefer to continue working in their old industry rather than receiving unemployment benefits while staying home. How trade liberalization works to the detriment of an import competing industry is therefore most clearly seen from the partial equilibrium models used for trade policy analysis (e.g., Krugman et al. 2012 Chapter 9, Feenstra 2016 Chapters 8, 9), which focus on only one industry and in which the larger general equilibrium linkage structure and the possibility of transfer payments is ignored by design.

The political struggle for trade policy formulation

In the domestic political struggle over trade policy formulation, therefore, there are three main sets of actors: *consumers*, *producers*, and the *government*. A direct implication of the gains from trade logic outlined above is that aggregate consumer gains through lower prices outweigh aggregate producer losses that result from industry consolidation. Nonetheless, consumers are often disadvantaged vis-à-vis producers in shaping government policies effectively. Olson (1965) made the important point that large, dispersed groups (consumers) are in a much worse situation to effectively coordinate pressure on the government than small, well-organized groups (industries). The Olsonian argument rests on the collective action problem that consumers face. Because the group of consumers is so large, the gain each individual consumer can hope to realize from organizing effective pressure on the government will never be large enough to justify the personal political effort on a mere cost-benefit basis.

This problem can be overcome much more easily in small groups. Krugman et al. (2012) illustrate this point using the example of the U.S. sugar industry. As they point out, "[t]he reason that a policy like the sugar quota can happen is that the sugar producers form a relatively small, well-organized group that is well aware of the size of the implicit subsidy members receive, while sugar consumers [who pay higher prices for sugar as a result of the quota] are a huge population that does not even perceive itself as an interest group." (Krugman et al. 2012, p. 262). This situation is further aggravated because sugar consumers are simultaneously also consumers of large numbers of other products, that they would potentially have an interest in lobbying lower prices. In contrast, sugar producers only care about a single industry. This constellation provides a general explanation for why producers typically have so much more political leverage in trade policy than consumers.

Grossman and Helpman (1994) develop this argument further with a specific focus on trade by pointing to the deeper political process that governs protectionist policies in democracies. Because consumers outnumber capital owners and industry workers at the ballot box, the democratic process would by default be expected to favor the consumer side. However, because a successful campaign requires considerable financial backing for travelling, polling, advertising, or mobilizing supporters, advocating a popular position on trade policy alone will not suffice to win an election if the politician is invisible to the majority of voters. This situation incentivizes politicians to 'sell protection' to industry groups in exchange for campaign contributions. The idea is that if the increased financial leverage is sufficiently large to increase the politician's overall visibility and reputation in the wider public, this might be worth the loss in votes resulting from taking an unpopular stance on trade policy, about which most voters have no overly strong feelings. Political leaders thus will not only care about maximizing aggregate national welfare, but also about securing the 'political currency' that is central for bringing or holding them in office.

While important, this form of blatant lobby influence is, of course, not the only reason for protectionist tendencies. In many cases, protectionist pressures will take more subtle forms and various arguments can be (and have been) made in favor of protection. Protectionist policies may, for instance, mitigate social costs if they allow structural changes in a declining industry to take place in an orderly fashion. Relatedly, with the Safeguards Agreement, international trade law provides an option for countries to protect their domestic producers from unexpected import surges if these 'cause or threaten to cause serious injury to the domestic industry'. Cultural identify arguments are at times brought forward especially with regard to arts and media consumption (i.e., national content quotas in broadcasting). Similarly, health, labor, or environmental concerns may justify policies that effectively restrict imports. Such policies are generally in line with international law as long as they are non-discriminatory in nature and equally apply to domestic industries.

With regard to developing countries, the so-called infant industry argument is often made. The basic idea is that initial protection of manufacturing industries (i.e., 'import substitution') may be necessary to allow these industries to gain experience and compete in international markets. Shafaeddin (1998), for instance, presents a historical study on early trade policy in Great Britain, the United States, Germany, and France. His study "indicates that it is a fallacy that early industrializers could have developed their industrial sector without infant industry protection. Indeed in all cases, to develop their industries, they went through an infant industry protection phase and heavy government intervention in the foreign sector." Krugman's 'new trade theory' is sometimes interpreted as supporting these arguments because the model shows how specialization can lead to a lock-in effect (also see: Krugman et al. 2012 Chapter 7 and 10 on these points).

A general difficulty with many of these arguments is, of course, that there typically exists a considerable grey area in interpreting the correctness of the conditions that are cited as justifications for protectionist policies. In particular, it is presumably the rule rather than the exception, at least in democratic and developed countries, that a government will be confronted with a mixture of industry lobbyism of the Grossman and Helpman (1994) variant and very differently motivated pressures for restrictive import policies. The 'implicit coalitions' between environmentalists and industry interests that Vogel and Rugman (1997) investigate in the context of U.S.–Canada trade disputes may thus be expected to be examples of a much more general phenomenon.

In these situations, it is of course difficult to assess where potentially legitimate substantial concerns end and lobbyism begins. This intertwined nature of trade policy interests has the additional effect that governments can always (try to) justify protectionist policies on substantial grounds even if a significant or even predominant part of the motivation is protectionist. As discussed in more detail in Chapter 6, the majority of trade restrictive measures in modern trade policy take to form of ambiguous measures (standards, regulations, requirements, etc.) that can typically be presented as entailing trade restrictions only as a 'side-effect'. Consequently, it is also often difficult to assess the conformity or non-conformity of existing trade measures with international trade law – a condition that leads to much of the controversy surrounding trade policy in general and trade disputes in particular.

The price effects of trade policies

Regardless of why any given protectionist trade policy may result from the political process, its economic effects will be the same. In particular, trade policies intervene in the market mechanism by manipulating prices. This holds irrespective of the exact nature of the trade policy instrument used. While different trade policy instruments (such as tariffs, quotas, or various other non-tariff measures) differ in how exactly they affect the market mechanism, all these instruments, in effect, drive a wedge between the prices of domestic and imported products. The magnitude of this *price wedge* can be re-expressed in terms of ad valorem tariff equivalents (as is done in Chapter 6), which reflect the de facto price increase resulting from a trade barrier as a percentage of the value of the imported products.

Thus, in the triangular relationship between consumers, producers, and the government, protectionist trade policies are government interventions in the market that, by making imports more expensive, induce consumers to buy a larger share of domestically produced products than they otherwise would. Because imports are more expensive in the presence of trade barriers, domestic producers can, in the presence of artificially reduced foreign competition, not only sell larger quantities but also charge higher prices for their products. Protectionist policies, therefore, reverse the 'gains from trade effect' discussed above by impeding trade and restricting the availability of superior and/or cheaper products. Protectionism thus constitutes a quasi-redistribution of income from consumers to producers – yet not in the sense suggested by Dixit and Norman (1980) in which the gains from trade would be redistributed, but in the sense that the gains from trade are eliminated (or diminished), thereby preventing the (full) distributional consequences that benefit consumers and hurt import competing producers.

By implementing protectionist policies, however, governments not only intervene in the domestic distribution of wealth. They automatically also create repercussions for their trade partners' export industries. Protectionist policies, by definition, restrict market access and thus result in reduced or lost sales potential for foreign producers. The imposition of a trade barrier therefore also implies a one-sided revocation of the linkage agreement that is at the heart of larger bilateral and multilateral efforts to improve overall welfare through trade liberalization. Part of the linkage agreements in this context is that each side bears some of the hardship that results from trade-induced structural change in exchange for cheaper prices (on the consumer side) and increased export opportunities for competitive industries (on the producer side).

In terms of domestic 'political currency', therefore, a government that reneges on earlier agreements by pursuing protectionist policies thus benefits twice – once by opening foreign markets for competitive domestic industries by means of the initial agreements, and a second time by subsequently closing its domestic market to protect less competitive domestic producers from foreign imports. Naturally, this results in a situation where the government of affected trade partners lose twice in terms of their own domestic political currency – once by exposing domestic industries to increased foreign competition by concluding the initial agreements, and a second time by seeing its competitive export industries unable to reap the promised benefits of increased access to foreign markets. This imbalance in the distribution of politically relevant costs and benefits, which is induced by unilateral protectionist policies, undermines the reciprocal nature of larger trade liberalization efforts.

It is not surprising that such 'unfair' trade practices have the potential to result in trade disputes as the affected partners push back against protectionist policies in an effort to enforce existing agreements. These trade enforcement policies seek to revert or prevent protectionist import policies in order to enable their domestic producers to freely export to other markets. The overall pattern of political friction and disputes that arise over trade policies is then determined on several levels. The first and broadest level concerns the direction of trade (exports versus imports), the second concerns industry characteristics, and the third and most detailed level concerns specific dyad-industry factors.

Regarding the direction of trade, it is perhaps not surprising, given the above discussion, that trade disputes are overwhelmingly about import policies. After all, import competition in the domestic market is a potentially vital threat to the survival of an industry. Consequently, governments will generally be more willing to risk breaching international agreements over import policies than over export policies. In this study, the attention is therefore exclusively on trade disputes over import policies. Regarding industry characteristics, it is well-known that there are also considerable differences in the general (i.e., average) propensity of individual industries to be affected by protectionist pressures and thus to witness disagreements and disputes between governments. The agricultural sector is the prime example. This point is discussed in the following paragraphs. Lastly, the overall pattern of disputes on the detailed dyad-industry level is the subject of this study and will be dealt with at length in the following chapters (and briefly discussed in the next subsection). Broadly speaking, this pattern is determined to a considerable degree by the specific trade and production structures of the countries involved and the strategic interactions between the respective governments.

A key factor in shaping the propensity of an industry to experience pressures for protection is the degree of homogeneity or differentiation of its products. The logic is as follows: The more homogeneous a product is, the less distinguishable are varieties of this product that are sourced from different supplier countries. Commodities such as wheat, salt, or petrol are examples of homogenous products. Since different 'national varieties' of such products have very few inherent characteristics that might affect consumers' purchase decisions, these decisions will be driven almost entirely by price. For domestic producers, the availability of cheap imports from competitive foreign suppliers then implies severe import competition that drives down prices and reduces market shares. This is the perfect competition scenario in which different varieties of a product are perfect substitutes. In the extreme, free trade in these products results in the complete elimination of the domestic industry.

By contrast, if products are highly differentiated, consumption decisions will to a considerable degree depend on various other product characteristics (such as design, branding, or functionality) and therefore less on price. Automobiles, consumer electronics, or sportswear are examples of differentiated products. Because different varieties of these products are imperfect substitutes, price competition in the industry is less pronounced. Moreover, product differentiation allows intra-industry trade (IIT), that is, two-way trade within the same industry. Since product varieties differ between countries, it is possible for each country to be both an exporter *and* an importer of the same product even if the two countries differ in their productivity. This has a second important implication beyond the reduced price competition in the domestic market – namely that even a relatively less productive national industry can still export its products to external markets, thereby increasing the industries' breathing room.

From a trade policy perspective, therefore, the degree of product differentiation plays a crucial role in defining the trade policy stance of the respective industry. Producers of homogenous products, if they are at a comparative disadvantage, face potentially disastrous import competition while having no hope of exporting any of their output to foreign markets even under conditions of free trade. At the same time, relatively unproductive producers of differentiated products experience both these problems in strongly reduced form. They are less under pressure at home and may still benefit from the availability of potential export markets (on his point, also see: Thies and Peterson 2016, p. 7).

This combination of factors goes a long way in explaining why trade liberalization in manufactures (which tend to be highly differentiated) has been so much more successful than trade liberalization in agricultural products (which are typically much less differentiated).[1] For exactly the same reasons, the political pressures for protection – and consequently for a potential unilateral violation of earlier agreements – is much less pronounced in the manufacturing sector than it is in the agricultural sector.

Furthermore, the *effectiveness* of protectionist trade policies decreases as the degree of product differentiation increases. This follows directly from the fact that consumption decisions for differentiated products do not exclusively depend on prices. Yet since trade policies are instruments to manipulate prices, such price manipulations carry less weight when applied to differentiated products. Or put differently, compared to homogenous products, governments would have to imple-

[1] Another reason certainly lies in the greater dependency on global supply chains of manufacturing industries and the resulting preference for open markets for various production inputs.

ment considerably stiffer measures to achieve the same amount of import protection for differentiated products. This consideration plays an important role in Chapter 6, where a method for estimating trade barriers from observed trade frictions is presented. In this context, the same degree of observed trade frictions implies higher trade barriers for more differentiated products.

Measuring trade policy effects – the Armington model of international trade

A number of observations follow from the discussion so far. First, protectionist trade policies are government-directed market interventions aimed at shifting consumer demand away from imported and towards domestically produced products. Second, these policy barriers to trade effectively operate via import price manipulations that move the market equilibrium in the desired direction. Third, such policy barriers benefit non-competitive domestic producers at the expense of competitive foreign producers. Fourth, these kinds of conflicting interests hold the potential for trade disputes to arise between the respective governments. Fifth, both the domestic pressure for protection and the potential for ensuing disputes are more pronounced in industries that produce homogenous goods. This holds because in these industries, consumers are more price-sensitive, which makes import competition stiffer and trade barriers more effective.

Section 2.1 has pointed out that one key difficulty in the literature on WTO dispute settlement is the lack of information on trade barriers. In the absence of detailed country- and industry-level data on protection, it is not possible to adequately assess countries' stakes in a given industry-specific trade flow and consequently it is not possible to form an appropriate expectation over their bargaining and dispute behavior. Obtaining detailed data on applied levels of protection is therefore key for any analysis of disagreements and disputes over trade policy. As described in more detail in Section 3.3, the applied level of protection directly affects what the importer stands to lose from a reduction of existing trade barriers – and it indirectly affects what any particular exporter stands to gain.

Information on applied protection levels has the additional advantage of immediately reflecting the combined effect of protectionist pressures on the government and the government's ability to withstand these pressures. Protection levels, therefore, capture and condense information on a host of upstream factors such as industry competitiveness, lobby effectiveness, particular industry-government affiliations, and a host of other idiosyncratic elements that affect the details of policy formulation across industries and countries. Because comprehensive and reliable protection data is not available, it is necessary to indirectly measure applied levels of protection (the question of data availability in protection data is discussed in more detail in the introduction to Chapter 6).

The key to measuring applied protection is to combine the theoretical knowledge laid out above with the available empirical data on trade and known trade cost factors in order to infer implied trade barriers. Doing so requires a formal framework that captures the above intuition and imposes the necessary structure on the data. The Armington model provides such a framework. Armington (1969) was the first to introduce the idea of product differentiation within a trade model (for useful discussions of the Armington model, its properties, and its relation to other trade models, see: Lloyd and Zhang 2006, Jomini et al. 2009, Dixon and Rimmer 2011, Balistreri and Rutherford 2013). Specifically, Armington assumed that products are differentiated by country of origin. This so-called Armington assumption of national product differentiation made it possible, for the first time, to account for the high degree of intra-industry trade that characterizes modern trade relations.

Each country is then assumed to produce a distinct variety of a given product. These differentiated products are imperfect substitutes for each other and the degree of substitutability between national varieties in each market is governed by a product-specific elasticity of substitution. The elasticity of substitution is a key parameter in modern trade theory. By capturing the substitutability of product varieties, it is a measure of the price-sensitivity of consumers. In the two-goods case, it is defined as the percentage change in relative quantity demanded of two goods in response to a percentage change in their relative prices. Higher elasticities imply higher price-sensitivity because a small change in relative prices results in a larger change in relative quantity demanded. Less differentiated products are therefore associated with higher elasticities of substitution.

A direct consequence of the assumption of product differentiation is that the different varieties of a product can differ in price. In other words, contrary to perfect competition models of trade in homogeneous goods, trade in differentiated goods implies that there is no one 'world price'. The logic of this follows directly from the above statements that differentiated goods differ on consumption-relevant characteristics other than price. Particularly, one would expect the variability of prices in the world market to increase as the elasticity of substitution decreases (i.e., products become more differentiated and consumers less price-sensitive). This hypothesized relationship will be employed directly in Section 5.3 as a plausibility test for the estimated elasticities of substitution.

In order to keep the analysis tractable, a number of simplifying assumptions are made in Armington (and other) models of international trade. First, it is typically assumed that the elasticity of substitution is the same for all varieties of a given product. That is, changes in the prices of different national varieties result in identical changes in quantities demanded. Second, it is assumed that consumers' utility functions exhibit constant elasticity of substitution. In other words, a given percent change in relative prices is assumed to result in the same percent change in relative quantity demanded irrespective of the initial level of prices or quantities consumed. This assumption allows the elasticity of substitution to be a constant or scalar (rather than a function). It permits different products to have different elasticities of substation, but it requires these elasticities to be non-variable for each individual product.

Lastly, it is assumed that, while different national varieties of the same product are substitutable, different products are not. For example, wheat from country A is assumed to be substitutable by wheat from country B, but wheat is generally assumed not to be substitutable by, say, corn or rice.

This assumption is sometimes referred to as weak separability. This results in a nested two-tier utility structure that implies that consumers decide on budget allocation (i.e., income spending) in such a way that they first decide how much to spent on each product (top-tier) and only afterwards allocate budget on different varieties based on prices and elasticities (lower-tier). This form of assumed two-stage budgeting makes it possible to treat different products as independent. It thus allows product-wise analysis (focus on main area of action) without having to consider the details of cross-product linkages that in the real world create ripples in the wider economy ('higher-order effects').

The Armington model differs from the trade models introduced above in that it does not explicitly rely on supply-side gains from trade. In other words, the model is not directly based on production side efficiency gains as the driving force for trade. Rather, trade is driven by consumer gains from variety and thus by demand-side factors. Consumers are assumed to favor variety, i.e., a unit of a new variety is valued more than an additional unit of an already consumed variety. This is essentially a diminishing marginal utility logic. In this setup, larger variety from trade leads to higher consumer utility. If one was to assume perfect symmetry between two countries (including consumer demand and price-sensitivity), this would imply that trade flows in both directions were symmetrical as well. Hence, all trade would be intra-industry trade (i.e., the value of exports would equal the value of imports in both countries).

However, the Armington model can match any pattern of trade as long as one is willing to be agnostic about the nature of the supply-side drivers of trade. As Balistreri and Rutherford state, "[o]nce we consider that bilateral trade has an inherent idiosyncratic demand component, we can accommodate the observed pattern of international trade without taking a hard stance on the underlying motivations for trade" (2013, p. 1514). This may be unsatisfactory if one wishes to analyze how supply-side factors determine the observed pattern of trade. It works very well, however, if one seeks to analyze what the observed pattern of trade conveys about unobservable trade barriers. In the latter case, it is irrelevant what exactly drives trade in the first place. The same logic holds for many other applied problems. As a consequence of its flexibility and its relative simplicity, the Armington model has been at the center of the vast majority of applied trade analyses for the last five decades.

Moreover, despite its disregard for explicit supply-side motivations for trade, the Armington model relates in various ways to the trade models presented above. Lloyd and Zhang (2006) point out that the Armington model can accommodate (and is in fact compatible with) the comparative advantage-based Ricardo or Heckscher-Ohlin models that are characterized by extreme asymmetries in trade. Specifically, both these models only allow one-way trade. This is because both models assume perfectly homogenous products – so that the price of these products is the only relevant product characteristic. Minimal price advantages then suffice to result in complete trade specialization. Each country exports only those products, in which it has a comparative advantage. Thus, there is only *inter*-industry trade. If one assumes differences in comparative advantage between the countries in an Armington framework and further assumes that the elasticity of substitution for the product at hand is infinite (i.e., products are homogeneous and consumers therefore extremely price-sensitive), then the inter-industry trade outcome of the comparative advantage models emerges as a special case in the Armington setup.

Lastly, if products are assumed to be differentiated rather than homogenous while countries differ in their comparative advantage, one expects to observe a mix of intra-industry and inter-industry trade even when there is perfect symmetry in consumer demand and price-sensitivities. As Lloyd and Zhang note, therefore, "[i]n the Armington model there are three causes of trade – differences in endowments, differences in technology and product differentiation. If both the endowments and the technologies are identical across all countries, product differentiation alone is sufficient to cause trade. By comparison, under these conditions, there would be no trade in a Heckscher-Ohlin model" (2006, p. 19). The pattern of trade then depends on the elasticity of substitution and the direction of the comparative advantage between the two countries.

Furthermore, the consumer gains from variety that drive trade in the Armington model also feature in the Krugman (1980) model. In fact, the Armington (1969), Krugman (1980), and Melitz (2003) models are nested within each other, with the latter being generalizations of the former (see: Jomini et al. for a formal derivation; also see: Feenstra 2010; Arkolakis et al. 2012). The Krugman model adds supply-side gains from trade through increasing returns to scale to the Armington set-up. The Melitz model further adds gains from trade through competitive firm selection. Krugman's returns to scale model has been so successful, in particular, because it allows an explicit supply-side gains-from-trade explanation while simultaneously accounting for intra-industry trade. The particular relevance of the Melitz model is that it most accurately reflects the micro-structure of trade in the real world, where only the largest and most productive firms engage in export activities. Both the Krugman and the Melitz models therefore constitute important theoretical advances.

The key difficulty with the Krugman and Melitz models in applied empirical work lies in their greater complexity and more demanding data requirements. Because both models operate on the firm-level, working with these models requires either firm-level data or further assumptions to be made (in the latter case, the models make aggregate country level predictions). In either case, the models contain a larger set of parameters that need to be estimated and interpreted. It has furthermore been pointed out that an Armington setup can approximate the aggregate behavior of the Krugman and/or Melitz models (Francois and Shiells 1994, Jomini et al. 2009, Dixon and Rimmer 2011). Since the latter models predict inherently larger gains from trade, their "solutions can be calculated in an Armington model with extra shocks to productivity and preferences" (Dixon et al. 2013, p. 36).

The Armington framework, therefore, provides a very useful guide to the empirical work of this study. It provides the necessary features to model the key aspects of international trade while directly matching the dyad-industry level granularity of available trade data. In particular, Chapter 5 is concerned with estimating industry-specific elasticities of substitution from observed trade data. Chapter 6 employs a gravity model approach to estimating applied trade barriers from observed trade frictions. The elasticities from Chapter 5 are important in this context because, as indicated above, varying price-sensitivities imply varying levels of protection. Chapter 7 then builds on both the elasticity and the trade barrier data in order to simulate counterfactual trade barrier reductions and thus to assess the gains and losses that the concerned parties could expect from such a policy change. These estimates then serve as the basis for calculating countries' stakes in industry-level trade flows.

2.3 Motivation of the Study: Bargaining Theory and International Trade

So far, Chapters 1 and 2 have presented the current state of knowledge in the different research areas that this study builds on. Chapter 1 has introduced the theoretical literature on bargaining under asymmetric information that has been employed to explain conflict processes in labor relations, legal disputes, and world politics. The chapter has further reviewed the empirical literature in these fields. Overall, the discussion has highlighted the important contributions in these areas but has also pointed to some open theoretical questions and, in particular, to the various empirical challenges in these fields. The first two sections of Chapter 2 have presented the existing empirical literature on trade disputes as well as the economic literature on international trade and trade policy.

The present section serves to condense the discussion up to this point and to motivate the remainder of the study. As noted earlier, the primary idea behind this study is to combine the particular strength of modern bargaining theory as a theory of conflict with the exceptional empirical field of international trade. In this context, the section highlights the potential of this approach. On the one hand, it indicates how several of the open theoretical questions pointed to in Chapter 1 may be addressed. On the other hand, the section contrasts the empirical realities in the study of strikes, litigation, and war with the empirical possibilities in international trade. The section summarizes the huge potential that lies in the empirical fields of international trade and argues that this potential has not yet been exploited.

The presentation in Chapter 1 has demonstrated that the literatures on strikes, litigation, and war – and the comparisons between these literatures – allow deep insights into the driving forces conflict. At the same time, the discussion has pointed to a number of issues that existing theoretical models leave unaddressed. Because theoretical models are always abstractions from reality, this is unsurprising as such. In fact, it is usually neither possible nor desirable to build models that are very close descriptive accounts of specific events. Insofar, all models necessarily leave aspects of reality unaddressed. Nonetheless, abstractions are made for various reasons, including mathematical convenience, empirical observability, or a particular focus in the respective discipline. As a consequence, some important aspects of conflictive bargaining are systematically underrepresented or disregarded in existing models.

For one, all of the bargaining models presented in Chapter 1 assume that the parties value the pie they are bargaining about to identical extents. That is, the models do not take into account parties' stakes. This point has been discussed at length in the context of bargaining models of war but it applies to models in other subject-areas as well. In the legal literature, the importance of stakes is occasionally acknowledged. Spier (2007) mentions the possibility that stakes may play a role, although only in passing. Priest and Klein (1984) explicitly model parties' stakes in the context of the mutual optimism framework that preceded asymmetric information models in the study of litigation. Differing stakes are even applicable to the baseline case of buyer-seller bargaining and might, for instance, be modeled as the diminishing marginal utility of income if one assumes bargaining between a wealthy seller and a poor buyer, or vice versa (note that the differences in valuation of the object that create the bargaining space do *not* capture the parties' stakes; what matters is how much importance the parties attach to the value-added that results from agreement). Taking stakes seriously is a generalization and logical continuation of the issue-level focus that most bargaining models have.

Furthermore, none of the models discussed so far allows varying, non-binary levels of conflict intensity. This is related to but goes beyond the question raised above in relation to the 'maximum capabilities' assumption made in the bargaining literature on war. The primary point is that none of the above models allows for a gradual escalation process. This is unsatisfactory in a number of respects. It means that conflictive bargaining remains a gamble and that open conflict, whatever form it takes in the respective subject-area , is a residual category that automatically results when bargaining fails. It is perfectly clear from observation and experience, however, that in the majority of cases, conflicts gradually intensify as the parties increase conflictive behavior over time. Thus, while existing models demonstrate how bargaining can *break down* into conflict, these models do not actually show how bargaining *evolves* into conflict.

In Chapter 3, I argue that observable conflict should be seen as the result of a continuous selection process during which the parties consciously escalate their dispute by provoking increasingly larger costs. Such an approach is useful – not only because it removes the gamble-aspect from conflictive bargaining and can provide insights into the micro-logic of the escalation process – but also because it makes it possible to generate model predictions that more closely mirror observable conflict patterns. In particular, an escalation model of conflict that puts an emphasizes on selection naturally results in a gradual variation in conflict intensities as they occur in real world interactions. Moreover, a selection approach to conflict is particularly well-suited to explain the fact that actual conflict is exceedingly rare. If most bargaining pairs select out at some point in the escalation process, it is a logical consequence that only very few cases escalate to the highest levels of conflict.

This is in contrast to the models presented above, which – depending on the particular model and the range of parameter values used in numerical evaluations – will result in conflict in a substantial fraction of the cases. In many of the process models of war, for instance, war is the predominant outcome in most cases, because it begins as soon as the first demand is rejected. Similarly, Spier (1992) presents numerical evaluations that result in litigation in thirty-five to fifty percent of the time. These predictions are far away from the frequency with which these phenomena occur empirically as discussed above. Because of the binary nature of the outcome, the results also do not match well with the 'dispute pyramid' that Cooter and Rubinfeld (1989), as cited above, point to when discussing the data availability problems in the context of legal disputes. The phrase is a clear reference to the gradual escalation and selection process that characterizes pre-trial bargaining.

Apart from allowing a better fit with empirical patterns of conflict intensity, a focus on gradual conflict escalation also implies that models of conflict that include an enforcement option (that is, the models of litigation and war) tend to overstate the relevance of this option for conflictive bargaining at lower levels of escalation. This is so because this option, although a defining element of full-scale conflict in these areas, only becomes relevant as an ultimate tool once bargaining has escalated to a considerable degree. At lower levels of escalation, however, at which the majority of cases terminates, the costs of legal or military action might be more decisive than the question of who would be to win if the conflict escalated that far. Put differently, 'the shadow of the law' or 'the shadow of power' may not be long enough to affect the early stages of bargaining at the base of the dispute pyramid.

The discussion in Chapter 3 outlines a bargaining framework that directly focuses on the points just discussed. It presents the logic of conflictive bargaining under two-sided incomplete information that explicitly focuses on selection and escalation dynamics in the absence of an enforcement option while allowing parties' to have diverging stakes in the issue at hand. The presence of two-sided uncertainty, in this context, not only provides the basis for the proposed escalation mechanism but also enables a more realistic pattern of offers and counter-offers by allowing both parties to have a 'concession function'. Without going into more detail at this point, this feature has the advantage of allowing genuine compromises to evolve rather than having one party (such as the union in screening models of wage bargaining) make successive concessions.

Although Chapter 3 is largely geared towards disputes in international trade – the primary focus of this study – various aspects of the discussion are potentially insightful and/or transferrable to labor disputes, pre-trial bargaining, or international conflict. The framework in Chapter 3 can be seen as complementing existing models of conflictive bargaining. It abstracts from detailed characteristics of high-intensity conflict (including enforcement options and their properties, e.g., resource depletion) that become important late in any particular conflict and instead focuses attention on the gradual escalation and selection logic that is present from the beginning. One key motivation for this focus is to more closely align theoretical predictions with the empirically observed pattern of conflict – and thereby to get a better grasp not only on why bargaining erupts into conflict but also on which particular bargaining episodes are likely to see bargaining escalate.

On the empirical level, the above discussion has emphasized the considerable challenges in testing theoretical predictions against the empirical record in the different subject-areas. This study is based on the conviction that new insights into escalation and conflict processes can be gained by combining the powerful analytical tool of bargaining theory with the well-structured and transparent empirical field of international trade. Trade disputes are a prime example of strategic interactions in a conflictive bargaining context. As noted in Section 2.1, however, the strategic component of these interactions has received little systematic attention in the literature. Table 2.1 contrasts various important aspects of the data structure and empirical observability in the study of strikes, litigation, wars, and trade disputes. The trade disputes category is split. The row labeled WTO DS refers to the literature on WTO dispute settlement. The bottom row refers to the U.S. trade enforcement activities analyzed in this study. The information contained in the table condenses the reviews of the empirical literatures discussed above and motivates the empirical work of this study as described below.

Table 2.1: Comparing theory status, data structure, and observability across subject-areas

Subject-area	Full set of actors	Full set of issues	Multiple obs./dyad-y	Bargaining theory	Escalation observable	Stakes measurable	Testa-bility
Strikes	(y)	y	n	y	(n)	(n)	o
Litigation	n	n	(n)	y	n	n	–
War	y	n	(n)	y	y	(n)	o
WTO DS	y	n	(n)	n	n	n	–
US Trade disp.	y	y	y	Ch3	Ch4	Ch5-7	+

Notes: y = observable/available/measurable; n = not observable/available/measurable; () = partially; –, o, + = very difficult, challenging, good; Ch3-7 = contributions of this study with reference to relevant chapter.

The first two columns indicate whether the full set of actors and/or issues is observable in the respective subject-areas. Only if both these sets are observed can the population of observations be adequately identified. This is crucial for the delineation of non-cases that, as mentioned above, form the baseline comparison category in any study of conflict. Without knowledge of both of these cases, the relative frequencies of conflict (i.e., incidence) cannot be determined, the full variation in outcomes remains unobserved, and consequently the observed data suffers from selection bias, aggregation bias, or both. This is true regardless of whether the eventual analysis is performed directly on the population data or on a sample from this data. In both cases the population needs to be clearly defined.

In labor disputes, both these quantities are in general observable, at least in the U.S. and Canada where contracts have fixed durations. However, because none of the available strike data is based on an extensive listing of firms, smaller firms are systematically underrepresented in the data. Typically strike data contains information on several hundred firms, which is clearly well below the total number of relevant entities in either the U.S. or Canada (see: Tracy 1986, McConnell 1989, and Card 1990b for detailed data descriptions). In legal disputes, the difficulties are much more pronounced because any pair of legal persons can hypothetically get involved in a legal disputes about any potential issue – with higher or lower probability given the quality and intensity of the pair's relationship and the nature of the issue. Because all these aspects cannot be systematically observed ex ante, observed legal disputes are necessarily very small and unrepresentative subset of the population. A similar logic applies to the WTO dispute settlement cases for reasons discussed above.

In the context of international conflict, the set of actors is perfectly well observable, i.e., the set of all countries. The problems in this area arise from the non-observability of issues that has been discussed at length above. The only subject-area in which both sets are readily observable is international trade. For the set of actors, the situation is the same as in international conflict. Importantly, however, the full set of potential issues that any given country pair may disagree over is known as well in international trade because these issues are defined by exhaustive and mutually exclusive product categories. In combination with the known set of actors, these product categories ensure that it is always possible to identify the complete population of potential disputes at any given time (this holds regardless of the particular industry classification used to demarcate these product categories; the choice of the most appropriate industry classification is discussed in more detail in Chapter 4).

The third column of Table 2.1 captures a related point, namely the question of whether it is possible in the given subject-area to have multiple observations of a dyad at a given point in time (typically per year), where an observation is understood here as a dyad-issue combination. This is clearly not the case in wage bargaining because there is always only one contract (re-)negotiated at any point in time between a given union-firm pair. In legal disputes, it is theoretically possible but practically highly unlikely for any two pairs of litigants to pursue more than one legal case at once. In international conflict, a similar reasoning holds. In both legal disputes and international conflict, the difficulty stems both from the low frequency of disputes relative to the number of dyads and the invisibility of non-cases.

In trade relations, in contrast, the data structure directly results in as many observations per dyad as there are product categories in the employed industry-classification. The great advantage of such an additional dimension in the data is that it provides additional leverage to hold either actor- or issue-level characteristics constant in an econometric analysis. This makes it possible, for instance, to analyze the effects of industry-characteristics *within* dyads, thereby holding all observed and unobserved dyad-level characteristics constant by design (i.e., the standard fixed-effects logic). A particular advantage of this setup is that it allows the analyst to circumvent the various time-dependencies and intertemporal dynamics of conflictive bargaining that make the use of 'regular' over-time variation less credible in bargaining contexts (see: Chapter 7 for a more extensive discussion of this point). In the context of WTO disputes, however, this advantageous feature of trade relations cannot effectively be employed because the extremely small number of WTO cases results in minimal within-dyad variation.

Column four indicates whether the respective subject-area has been investigated from the perspective of bargaining theory. This is the case for the three subject-areas that have been discussed – for that reason – in Chapter 1. The study of trade disputes has not yet seen an equivalent analysis. As noted above, Chapter 3 lays out a theoretical framework that works towards closing this gap with a theoretical focus on the role of stakes in conflictive bargaining.

Columns five and six of Table 2.1 concern the observability or measurability of key variables of interest. The fifth column indicates how well the degree of conflictiveness in the parties' interactions is observable in the various fields. In the context of strikes, observing escalation is potentially possible but difficult and would likely require intense data gathering efforts. Basically, one would want to know what fraction of the workforce participated in the strike, whether most sensitive branches of firm operations were affected as well, and so forth. In legal disputes the general problem of observability is aggravated by data protection and privacy concerns as well as by the subjectivity and potentially sensitivity of the individuals involved. In international conflict, observability of conflict intensity is generally given due to information contained in existing data and extensive news coverage.

In international trade, observability of escalation is generally not trivial, because no previous data on low level disputes exist and news coverage is spotty. This problem is noted repeatedly in Section 2.1. However, the automated content analysis of the U.S. National Trade Estimate (NTE) reports, described in Chapter 4, addresses this problem. The resulting dataset contains highly detailed information about disagreements and disputes over trade policy issues between the United States and its trade partners. It spans the entire range of escalation from very mild references to full-scale trade enforcement activities and trade retaliation.

The sixth column shows how well parties' stakes are measurable in the individual subject-areas. As noted above, stakes are a key concept in any analysis of conflictive bargaining. However, measuring stakes is difficult almost by definition because it involves the systematic quantification of parties' subjective valuations. In the context of strikes, litigation, and wars, it is in most cases possible at best to arrive at an estimate of parties' stakes once a given dispute has erupted. That is, ex post assessments may be possible to some degree, but anything else will likely be difficult. This is true, in particular, in the legal and international conflict arenas where the observation of issues constitutes an 'upstream problem'. Since stakes are an issue-level concept, any attempt to measure stakes is dependent on the knowledge of the underlying issue. In international trade, measuring stakes is challenging but possible. The procedure to do so is laid out in Section 3.3 and implemented in Chapters 5 through 7.

Column seven – in combination with column four – summarizes the constellation that is a primary motivation for this study. Column seven captures the overall implications from the above discussion for the suitability of the respective subject-areas for the empirical testing of theoretical predictions. As is well apparent from columns four and seven, international trade is the only subject-area in which bargaining theories to conflict have not been developed. At the same time, for the reasons discussed at length in Section 2.2, international trade exhibits by far the best empirical conditions to test and potentially refine such theories. The remainder of this study is dedicated to doing so.

3 A Theory of Escalation: The Role of Costs and Stakes in Conflict Processes

By investigating the pattern of escalation in international trade relations through the lens of a strategic bargaining approach, this study seeks to contribute to a deeper understanding of both trade disputes and conflict processes more generally. The previous two chapters have made the point that new insights can be gained by combining well-developed theoretical approaches to conflict from subject-areas such as war, strikes, and litigation with the transparent and structured empirical landscape of international trade. This chapter serves to demonstrate in greater detail how these insights can be gained. As part of this effort, it also seeks to more closely link abstract theoretical thinking to concrete empirical reality by filling in the gaps between these poles. On one end of the spectrum, the discussion seeks to arrive at a more detailed theoretical understanding of escalation and conflict processes that may be more generally applicable across different subject-areas. On the other end, it seeks to enable a better empirical handle on such processes in the area of international trade.

Specifically, this chapter discusses 1) the role of escalation as the micro-mechanism that leads up to open conflict in the context of bargaining theory, 2) the role of parties' stakes as a key driver of escalation processes on the conceptual level, and 3) the concrete empirical conditions that determine parties' stakes in the context of international trade relations. I make the point that escalation processes are driven by the ability of parties to affect the cost structure of their interaction. Because stakes affect parties' resistance to costs, the option to generate costs creates incentives for high-stakes parties to drag both sides into increasingly costly situations. This strategy is motivated by an expectation to obtain additional concessions from the other side as well as to shorten the time to agreement. I further discuss how this logic translates from general but abstract theoretical setting to the concrete empirical application of trade policy. In this context, I suggest how potential gains and losses, resulting from counterfactual simulations of trade barrier reductions in the multilateral trade network, can be used to empirically assess countries' stakes in their industry-level trade relations.

All three points listed above serve, on different levels of abstraction, to increase the fit between theoretical analysis and empirical reality. First, focusing on escalation processes makes it possible to zoom into the mechanism that eventually brings about observable conflict. This allows a more detailed appreciation of the logic that ultimately drives conflict behavior. In particular, I argue that escalation is a selection process that links apparently non-conflictive bargaining to open conflict. In other words, observable conflict is the result of a stepwise selection process rather than a distinct phenomenon. Focusing on escalation makes it possible, therefore, to get an idea of why some bargaining episodes erupt into different levels of conflictiveness while others do not. By explicitly analyzing escalation processes in the context of two-sided incomplete information, i.e., mutual uncertainty, the study not only presents a detailed analysis of the micro-logic of escalation processes, but does so in a richer and more realistic information structure than is usually assumed in theoretical work on conflict.

The discussion in the preceding chapters has highlighted that existing theoretical approaches to conflict leave escalation-based selection processes unmodeled. As a consequence, the predictions of these models remain difficult to link to real world events. In particular, existing models are neither well-suited to explain the empirical pattern of conflict (which cases escalate?) nor the considerable variation in empirically observed conflict intensities (to what degree do these cases escalate?). In contrast, the explicit focus on escalation processes in this chapter allows for more detailed predictions of both the pattern and the degree of observable conflictive interactions. The further discussion presents a mechanism that builds on existing bargaining models as discussed in Chapter 1 but explicitly allows escalation behavior to different levels of conflict intensity to occur. This pattern reflects the gradual nature of conflict processes in the real world.

Second, I maintain that substantial theoretical leverage can be gained by taking parties' preferences – their *stakes in* or *subjective valuation of* an issue – more seriously. As noted above, I maintain that stakes are essential for explaining escalation processes because, unlike power and other actor-level concepts, stakes operate on the issue-level. Since escalation and conflict are issue-level phenomena (i.e., they arise because the parties disagree over a certain issue not simply because of the intrinsic properties of the parties themselves), variations in stakes can explain variations in the degree of conflict escalation. The same is not true for actor-level concepts, which cannot explain within-dyad variation in conflictiveness. Because actor-level factors are constant across all issues two parties may disagree over, they cannot explain why the parties enter into conflict over one issue but continue perfectly normal relations with regard to another. Because stakes are a more specific concept, they carry considerably more explanatory weight and should therefore be the focus of theoretical thinking.

Third, despite the fact that parties' stakes are a comparatively specific concept, they remain an abstraction from reality. The concept of *stakes* is a place-holder in theoretical analyses for anything that affects how strongly parties in the real world care about an issue. In order to successfully translate theoretically informed predictions about the effect of parties' stakes into empirically testable hypotheses, it is therefore necessary to further specify how stakes arise and how they can be measured in any given empirical context. In a move towards operationalization, this chapter proposes a trade-specific (low-level) theory that complements the more general (high-level) theory concerning escalation processes and conflict. In most applications, the underlying root causes of parties' stakes are notoriously difficult to assess. The trade-specific part of the chapter draws on the well-structured nature of international trade relations and on established knowledge in economic theory to develop an understanding of what leads parties to have varying stakes in their trade relations.

This chapter outlines the logic of a theoretical modeling approach based on bargaining under two-sided incomplete information (i.e., each player faces uncertainty about a relevant feature of the bargaining setup). The discussion moves from the general to the specific (i.e., from high-level to low-level theory) and proceeds in three steps. Section 3.1 forms the basis of the chapter and derives the primary escalation mechanism in the simplest possible bargaining setup as a basis for the further discussion in Sections 3.2 and 3.3 that extend this logic. The parties' uncertainty is assumed to be maximal and to cover the full range of possible values, that is, parties are assumed to be fully uninformed about each other. Furthermore, all interactions are assumed to be purely bilateral, so network effects that arise in multilateral settings are ignored for the moment.

Note that – in order to be able to derive the larger argument from the existing literature – Section 3.1 is framed in terms of costs rather than stakes (i.e., parties' costs vary due to the presence of uncertainty while their stakes are held constant and equal; it is assumed that parties' stakes are both equal to 1). This may at first appear to contradict the statement made earlier that parties' *stakes* rather than their *costs* of conflict should be the focus of the analysis. To see the validity of this approach, it is important to distinguish between the theoretical model itself and the application of the model to reality: Any model always only simulates a single case at a time. That is, a model implicitly assumes that the parties bargain over exactly one issue. As a consequence, there is a one-to-one relationship between actor-level and issue-level properties *within the model*. This property implies a one-to-one relationship within the model between parties' stakes and their costs, which makes it possible to derive the argument in terms of costs in keeping with the literature, before recasting the analysis in terms of stakes.

The model itself, therefore, does not reflect the fact that in reality a large set of issues is likely to be nested within the bilateral actor-relationship. Recognition of this fact is to a considerable degree a matter of interpretation and application. However, it is impossible to keep this relationship in mind when devising a theoretical relationship. Incidentally, assuming that parties' stakes are equal to 1 makes these stakes invisible in the model itself. This is why implicit assumptions in theoretical models can fully mask the real-world importance of parameters such as stakes – note that all models discussed in Chapter 1 implicitly assume parties stakes to be equal to 1. By explicitly making this assumption, Section 3.1 makes it possible to link back the derivation of the argument to the wider literature while at the same time allowing for a relaxation of the assumption in Sections 3.2 and 3.3.

These two sections extend the analysis by moving the baseline theory from Section 3.1 towards more closely mirroring real-world applications. The sections thereby also lay the basis for the empirical part of the study. Section 3.2 undertakes the first step towards more closely approximating real-world situations by relaxing the assumption that parties' stakes equal 1. More specifically, the section switches the focus from costs to stakes (i.e., parties' stakes vary while their costs are held constant and equal). As I will argue in more detail below, this set of assumptions is not only generally more natural, but particularly useful for an application to international trade. The section furthermore relaxes the assumption of maximum uncertainty, which allows parties to partly anticipate bargaining outcomes. From a researcher point of view, this modification also makes it possible to assess which aspects of the mechanism can be empirically observed and which cannot – given that the researcher face similar uncertainty constraints about real-life conditions than the parties involved.

Section 3.3 then relaxes the assumption of a purely bilateral bargaining setup and discusses the effects induced by the network structure of the international trade system. The discussion in this section thus lays the basis for the empirical strategy in Chapters 5 through 7 that is based on the calculation of counterfactual gains and losses from simulated trade barrier reductions. It shows how the multilateral international trade system creates structurally induced variations in parties' stakes that exist irrespective of particular industry, country, or dyad characteristics and thus allow a general and systematic analysis. The section further derives a set of three testable hypotheses from the theoretical discussion. These hypotheses make predictions both about the degree to which disputes are expected to escalate and about the pattern of outcomes (i.e., eventual agreements) as a function of escalation levels.

3.1 Escalation Dynamics in a Bilateral Bargaining Framework

In international trade and elsewhere, conflictive interactions do not simply occur – they evolve. Conflicts are dynamic processes that gradually evolve as the parties choose to intensify their conflictive behavior in the presence of increasing costs. Conflicts usually end in compromise agreements that follow an intense exchange of offers between the parties that only gradually converge from opposite starting points. The following discussion outlines how escalation processes that closely mirror these important elements of conflictive interactions can be recreated in a bargaining game. The game presented in this section is located at the concept-level and lays the basis for the more detailed trade-specific adaptions in the following sections. As noted above, the discussion is based on cost differences and assumes that parties have constant and equal stakes.

In the proposed game, conflict intensity is an endogenous variable, i.e., players choose whether to escalate a conflict to a higher level or not. Escalation is almost always an equilibrium move in the early stages of the game. That is, players who have an escalation option use it. Over the course of the game, players select into increasingly conflictive situations while exchanging offers that eventually result in a compromise agreement. The discussion highlights how parties can potentially gain through the exploitation of cost differences between them and how this feature creates incentives to escalate. In the process, observed interactions transform from ordinary bargaining to open conflict. The discussion suggests that conflicts escalate *because* of the costs associated with this process.

Like all incomplete information bargaining games, the game proposed below is based on a complete information base-game. Before introducing uncertainty into the situation, the following paragraphs discuss this base-game. To subsume both non-conflictive and conflictive bargaining behavior within the same setup and to model the gradual transition from one to the other, the framework exhibits two different types of costs. The first type of costs takes the form of multiplicative time-discounting and is taken to be exogenously determined, while the second type of costs enters as additive per-period fixed-costs and forms the basis for the endogenous escalation choice.

The base-game thus combines features of a pure discounting model with the features of a pure fixed-cost model. Both pure models are due to Rubinstein (1982) and have separately served as base-games in a large number of applications as discussed in Chapter 1. The discounting model, in particular, has received widespread attention and has, for instance, been at the heart of efforts to capture buyer-seller interactions (e.g., Grossman and Perry 1986), while the fixed-cost model has featured prominently in the screening models of international conflict (e.g., Powell 2004). Individually, the two models show very different equilibrium patterns. While the discounting model tends towards equal splits between the parties as long as discount factors are approximately equal and not too small, the fixed-cost model awards (almost) the entire share of the pie to the side with the lower per-period costs.

The two base-games differ so markedly because multiplicative discounting and additive fixed-costs have very different strategic implications. Except for the type of costs the players incur both games have the same elements. Two players bargain over the partition of a pie of size 1 (this implies that players' have no differing subjective issue valuations. Both sides perceive the pie as having the same fixed size: the players' stakes are equal and constant). There is no incomplete information – all aspects of the game are common knowledge. The players make alternating offers, i.e., player 1 makes offers in uneven periods (1, 3, 5, etc.) while player 2 makes offers in even periods (2, 4, 6 etc.). Each offer consists of a proposed split of the pie (x_1, x_2), with the sum of the shares x_1 and x_2 adding up to 1. The sequence of offers and counter-offers continues until one player accepts the other's offer, that is, there is an infinite time-horizon. Finally, delay is costly and takes the form of either time-discounting or fixed-costs.

In the discounting version of the game, a one-period delay to agreement reduces the players' payoffs by a factor of δ, where $0 < \delta < 1$. Because δ is strictly larger than zero, neither player's payoff can ever become zero or negative, irrespective of how long bargaining continues. But because δ is strictly smaller than 1 both players lose by delaying agreement. This incentivizes players to agree early. Because there is no uncertainty about any feature of the model, players can calculate ahead and arrive at the optimal solution without costly delay. Rubinstein (1982) has shown that there is a unique solution of the game under complete information in which players will immediately agree on

$$x_1 = \frac{1-\delta}{1-\delta^2} = \frac{1}{1+\delta} \tag{1}$$

where x_1 is the first mover's share of the pie. The share of the second player, x_2, then equals $1 - x_1 = \delta/(1+\delta)$. Shaked and Sutton (1984) have shown that the solution to the bargaining game with discounting is equal to the sum of the geometric series of offers that players would exchange if the game were to continue forever. Note that if the players become more patient so that $\delta \rightarrow 1$, the pie is split equally – otherwise, if players are impatient, there is a first-mover advantage. If players have different discount factors, the first-mover advantage continues to hold but is complemented by the effect of different discount rates that works to the advantage of the more patient player. Player 1's share then becomes $x_1 = (1 - \delta_2)/(1 - \delta_1 \delta_2)$.

The discounting version of the Rubinstein (1982) game has become the canonical bargaining model in the literature because of its intuitive features that match many aspects of real-life bargaining situations. These include, in particular, the existence of advantages to moving first and to being more patient if delay costs are positive as well as the tendency towards equal splits as delay costs approach zero. If two-sided uncertainty were to be introduced into this setup in a fashion similar to the approach described below, the model would capture the typical bazaar-style interaction between a buyer and seller in which players, in the absence of conflictive bargaining strategies, exchange offers over time until they eventually agree on a deal that reflects their relative patience.

The fact that neither player's payoff can ever become negative in the discounting version of the game gives no side any absolute leverage over the other – even if discount factors differ widely. The game that players anticipate, and that incentivizes both sides to agree immediately, could theoretically continue forever. The solution technique by Shaked and Sutton (1984) is directly based on the fact in each uneven period the game is exactly identical to the game two periods ago except that the pie has shrunk by a factor of δ^2. This implies that the payoff distribution of the game remains constant over time, which allows the players to split the pie according to this distribution.

The situation is very different in the fixed-cost version of the Rubinstein (1982) game. Here, as time passes, the game continuously 'tilts' to the disadvantage of the player with the higher costs. As these costs accumulate, they eventually eat up the entire value of the pie because in every round the same constant cost is subtracted from the players' payoffs. In the fixed-cost version of the game, players can therefore potentially incur negative payoffs. The lower-cost player can use this fact to delay agreement long enough to drive her opponent into ruin and keep the entire pie to himself. Recognizing this, the higher-cost player gives up his or her share in the first period of the game. This leaves the high-cost player with either a share of 0 if the low-cost player moves first (who then gets 1), or with a share of *c*2 (the low-cost player's per-period cost) if low-cost player moves second. If both players have identical per-period costs, there is no unique solution to the game. From the first-mover perspective the payoffs are:

$$x_1 = \begin{cases} 1, & if\ c_1 < c_2 \\ c_2 \leq x_1 \leq 1, & if\ c_1 = c_2 \\ c_2, & if\ c_1 > c_2 \end{cases} \tag{2}$$

The fixed-cost version of the Rubinstein (1982) game has a number of features that at first make it seem less appealing compared to the discounting model. This concerns, in particular, the noncontinuities in the predicted bargaining outcomes for gradual changes in the players' costs. If initially $c_1 = c_2$, then minimal changes in one side's costs in either direction lead to dramatic jumps in allocated shares. This appears unintuitive both in the complete information model as well as in its implications for a model with two-sided incomplete information. In the latter case, one would want offers from both sides to switch back and forth across the range of potential bargaining outcomes while gradually converging to a compromise solution. The non-continuous allocation of shares, however, inhibits this gradual convergence of offers and thus leads to model predictions that are at odds with intuitive conceptions of bargaining behavior. Similarly, the non-uniqueness of results if the players' costs are identical is a problematic feature in applications (both these features are less of a problem in process models of one-sided incomplete information because in these models it is known a priori which side has the lower costs so that the cost equality threshold is never crossed).

Nonetheless, the 'extortion logic' of the fixed-cost model captures an important aspect of bargaining. This feature becomes most readily apparent in the combined version of the two pure games that forms the basis for the further discussion (and which has the additional advantage of exhibiting unique and continuously changing bargaining outcomes in almost all cases). The game with both time-discounting and fixed-costs occupies a middle position between the two pure Rubinstein versions that, depending on the weight of the fixed-cost terms relative to the discount factors, tends more towards the one or the other pure model. Assuming that players discount the future at the same rate, the combined model allocates the following share to the player moving first (Cramton 1991; also see: Rasmusen 2008):

$$x_1 = \frac{1 - \delta + c_2 - \delta c_1}{1 - \delta^2}, \tag{3}$$

where x_1 is constraint to lie in the interval $[c_2, 1]$, that is, $x_1 = max(min(x_1, 1), c_2)$. To begin with, note that equation (3) reduces to the pure time-discounting model of equation (1) if the cost terms are zero for both players or if $c_2 = \delta c_1$. Further note that equation (3) reduces to the pure fixed-cost model of equation (2) as $\delta \to 1$. To see this, first consider the numerator of equation (3). Since the term $1 - \delta$ approaches 0 as δ approaches 1, the entire numerator approaches $c_2 - c_1$, which is positive if $c_2 > c_1$ and negative otherwise. Because the denominator approaches 0 as δ approaches 1, the entire fraction tends towards either positive or negative infinity in the limit, depending on whether $c_2 - c_1$ is positive or negative. The above-mentioned 'tilting' of the pure fixed-cost game originates from this. Because in the context of the bargaining game, player 1 cannot obtain more than the entire pie, the maximum obtainable value is 1. Because, player 1 can always secure at least player 2's per-period cost, the minimum obtainable value is c_2. The more patient the players are, the more weight carry the fixed-costs in determining the bargaining outcome. If δ is very close to 1, minimal differences in the players' per-period costs suffice to create the one or the other result. If players are perfectly patient, the entire result is driven by the fixed-costs as in equation (2).

The most interesting situation for the present purpose ensues if the mixed model does not reduce to any of the two pure models so that both time-discounting and per-period fixed-costs enter the players' strategic calculus. The key feature of the mixed model is that player 1's share, x_1, increases as c_2 gets larger relative to c_1 and decreases otherwise. If c_2 is larger than δc_1 so that the difference of the cost terms, $c_2 - \delta c_1$, is positive, player 1 gets a better deal than in the pure discounting model. Conversely, if the difference of the cost terms is negative, player 1 gets a worse deal. As long as the weight of the discount factor relative to the fixed-costs is sufficiently large, the effect of cost differences on bargaining outcomes is fully gradual so that no dis-continuities ensue. The key point is that larger absolute differences in the player's fixed-costs result in more favorable divisions of the pie for the player with the lower costs (for a similar effect of cost differences on bargaining outcomes in a different setup, see: Busch and Wen 1995, Slantchev 2003b; for an early informal discussion see: Schelling 1966).

Thus, in the mixed model, the lower-cost player profits from the presence of cost differences between the two sides. In the complete information base-game, the respective outcome is realized immediately. In a setup in which both sides have incomplete information about each other's fixed-costs, however, such cost differences form the basic behavioral incentive that drives escalation dynamics. The following discussion is intended to demonstrate how the potential gains from an exploitation of cost differences motivate players to actively seek costs and how escalation may be the best bargaining strategy players have if they are given this option. Because an escalation option gives the players control over the cost structure of the game, the players can use this control in an effort to extract larger concessions from their opponent than would be the case if bargaining took place in the absence of an escalation option. The availability of an escalation choice transforms cost creation into a strategic move.

The further discussion proceeds in two steps that build on the base-game in equation (3). Step one discusses the effects of introducing one-sided and two-sided incomplete information while keeping players costs exogenous. In particular, it will be assumed that incomplete information stems from the players' uncertainty over each other's fixed costs. Step two introduces the escalation option that endogenizes the size of players' costs by allowing cost creation. As a basis for this discussion, I start by briefly reviewing the idea behind incomplete information bargaining games.

Introducing incomplete information

Recall from the discussion in Chapter 1 that when at least one player has incomplete information about the other's type, bargaining becomes dynamic. That is, agreement is typically no longer reached immediately (except with the weakest types of opponents) but only after one or more periods of bargaining. Because delay serves as a signaling/screening device, this sort of dynamic interaction is a general feature of incomplete information bargaining models. It occurs irrespective of whether incomplete information is one-sided or two-sided, although bargaining dynamics are richer and enable more realistic interactions under two-sided incomplete information. The logic is generally similar but more complex. The following discussion therefore starts by introducing one-sided incomplete information in a screening setup similar to the one used in Grossman and Perry (1986) and then extends the framework to two-sided incomplete information in a second step.

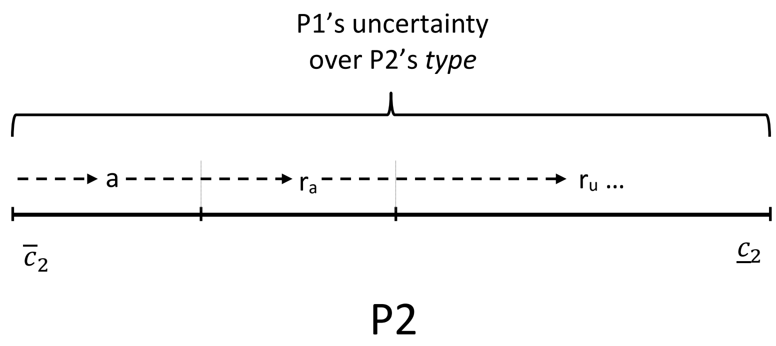
As noted above, a central feature of bargaining models of incomplete information is that they are based on their complete information equivalents. These complete information games form the base-game of the larger incomplete information game. If parties had complete information about each other, they would immediately agree on the solution to the complete information bargaining game. Because this game adequately reflects the players' respective bargaining positions they could not do better otherwise. Under incomplete information, in contrast, players who are in a strong bargaining position need to credibly communicate (i.e., to signal) their strength to the other player by incurring delay costs that weaker types would not be willing to incur. By incurring such costs, strong types are then able to secure better deals. But exactly because stronger types are stronger, delay is less costly to them and thus preferable to agreeing to worse deals in the absence of the delay. The players then earn the complete information base-game payoffs minus their delay costs.

To begin with, consider the one-sided incomplete information version of the base-game in equation (3) with continuous types. Assume that player 1 has incomplete information about player 2's costs, c_2, which are drawn from a commonly known probability density function $f(c_2)$ with support $[\,\overline{c}_2,\ \underline{c}_2]$. Player 1's costs, c_1, are common knowledge. The players bargain over the partition of an equally valued pie of size one as in the complete information setup. Also as above, the players make alternating offers in discrete time. The type of player 2 with the highest costs $\overline{c}_2$ is in the weakest bargaining position. This type would consequently get the least attractive terms of agreement in the complete information base-game. The reverse is true for the type of player 2 with the lowest costs $\underline{c}_2$. Because player 1 does not know player 2's type, dynamic bargaining ensues.

Figure 3.1 schematically depicts the equilibrium behavior of that game. Because the type space is continuous, the alternation of moves between the players at discrete time intervals induces a series of cut-off point that partitions the continuum of types into discrete subsets. This is completely analogous to the situation in Grossman and Perry (1986) where the base game is equation (1) and uncertainty is over the buyer's reservation price. In her first move, player 1 makes an offer that strikes a balance between offering a sufficiently attractive partition of the pie to have some types of player 2 accept without further delay but one that is not so attractive that too many weak types would get an overly attractive deal. (Note that in the continuous type version, some types will do better than in the complete information setting, because offers lump together types within a certain interval). If the realized type of player 2 is among the weakest types with the highest per-period costs, player 2 will accept (a) this rather unattractive first offer. In contrast, stronger types of player 2 will reject the offer (r).

In the second period, if player 2 has rejected player 1's first period offer but belongs to the weaker of the remaining types, this type counters with a – from player 2's perspective – somewhat more attractive offer. This counter-offer is sufficiently moderate to be acceptable to player 1 (r_a). Player 1 accepts this offer because, given player 2's moderation and the costliness of further delay, player 1 cannot do better. In contrast, if the realized type of player 2 is among the strongest types with the lowest per-period costs, player 2 counters with an unacceptable offer (r_u) to signal this strong bargaining position. Player 1 then rejects this unacceptable offer and the process starts over with player 1 making a renewed offer in the next round (I define a round as comprising two periods, one for each player).

Figure 3.1: The bargaining sequence under one-sided incomplete information

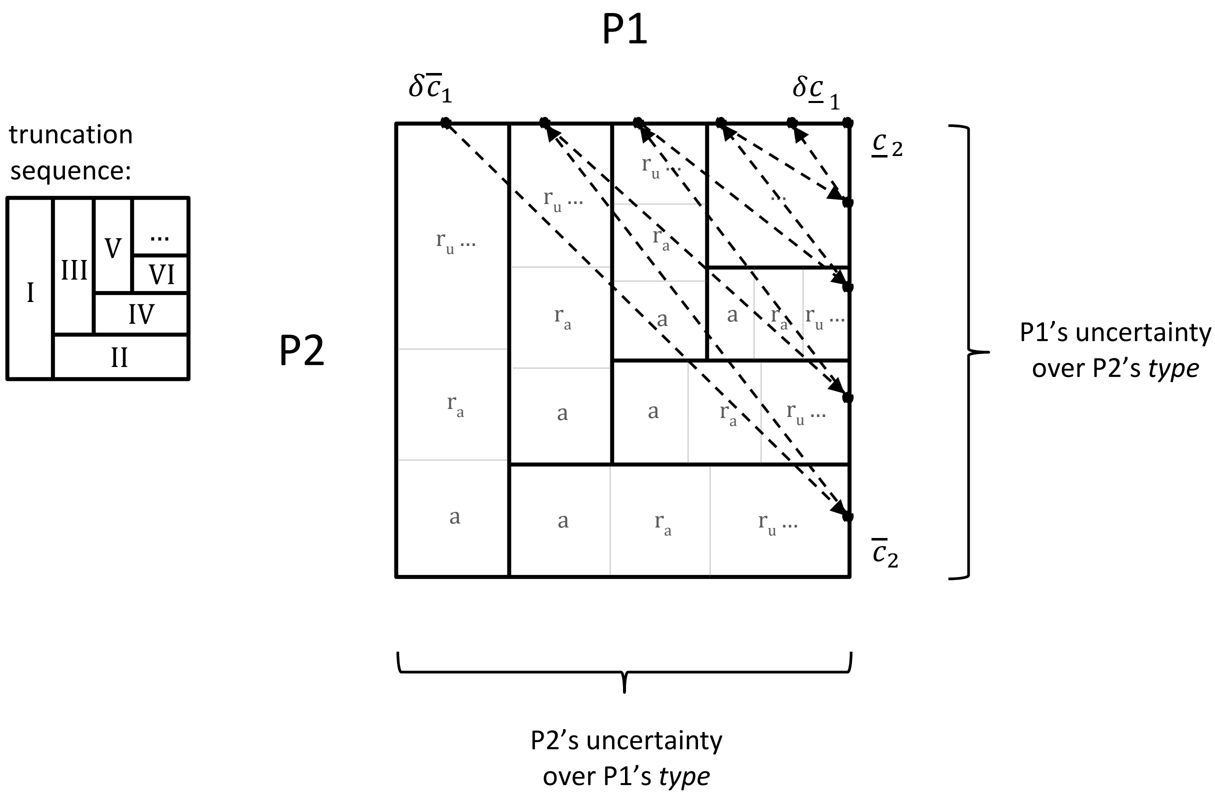


At this time, the type space has shrunk (i.e., player 1 has learned something about player 2's type) because player 1 would already have reached agreement with the weaker types. When entering the second round, therefore, player 1 has updated her beliefs about player 2's possible types and therefore makes more appealing offers. This procedure captures the general dynamic of signaling equilibria in the context of one-sided uncertainty. As time passes, weaker types get screened out and uncertainty is gradually reduced. Stronger types that stay in the game longer suffer larger signaling costs, which are, however, offset by an increasingly attractive string of offers and counteroffers. That is, player 1 makes progressively larger concessions as the game continues.

Bargaining models with one-sided incomplete information capture a number of important aspects of conflict situations by pointing to how uncertainty produces inefficiency and delay to agreement and how conflict serves as a means to reduce uncertainty. However, other aspects of bargaining and conflict are captured less well by models with one-sided private information. In particular, the unidirectional concession process neither captures the typical back and forth (haggling) that characterizes real world bargaining situations, nor does it allow the possibility to strike genuine compromises. One-sided incomplete information models therefore retain a somewhat artificial feel. More importantly, they have limitations in capturing more complex dynamics such as escalation processes as discussed further below. Two-sided incomplete information models make it possible to uncover these features.

Figure 3.2 depicts the type space of the game with two-sided uncertainty. The figure shows the same situation as before but adds a continuum of types for player 1 that, in the same way as for player 2, range from high cost types to low cost types (the multiplication of player 1's costs by δ captures the effect of the first-mover advantage and facilitates the interpretation, as will become apparent shortly). Each player knows his or her own type but is uncertain about the realized type of the other player. Figure 3.1 is contained in Figure 3.2 (turned 90° counterclockwise) as the right vertical boundary of the type space. Throughout this section, I will assume that the two players' type distributions are identical in all aspects.

Figure 3.2: The bargaining sequence under two-sided incomplete information



It is interesting in this context to compare the type spaces of the models discussed so far: In the complete information base-game in equation (3), the 'type space' is a *point*, reflecting the fact that there is no uncertainty present in the situation. That is, both players know their respective type. In the game of one-sided incomplete information, the type space is a *line* along which player 2 is screened for the realized version of his type (the interval [$\overline{c}_2$, $\underline{c}_2$] shown in Figure 3.1). Finally, in the two-sided incomplete information game, the type space is a *plane* as shown in Figure 3.2. The realized combination of the two players' types can lie anywhere within the rectangular area. This two-dimensional type space reflects the fact that now both sides are uncertain about a strategically relevant characteristic of the other.

As before, the equilibrium outcome follows directly from the complete information equilibrium payoffs of the underlying base-game (minus the signaling costs incurred in the sequential bargaining process). Unlike before, however, there are now multiple type combinations that result in the same equilibrium partition of the pie. This is due to the fact that in models of two-sided incomplete information, the type space is of higher dimensionality (two dimensions) than the outcome space (one dimension). To see this, recall that the complete information base-game in equation (3) reduces to the simpler time-discounting model in equation (1) whenever $c_2 = \delta c_1$. This condition is met for all type combinations that lie on the imaginary line from the lower left corner of the type space in Figure 3.2 to the upper right corner. All these type combinations end up agreeing on the standard Rubinstein shares – that is, $x_1 = 1/(1+\delta)$ and $x_2 = \delta/(1+\delta)$ – but only after varying rounds of costly bargaining. Due to this delay, the size of the pie, $x_1 + x_2$, has diminished in the meantime. The same logic applies to type combinations on other imaginary 45 degree lines parallel to the $c_2 = \delta c_1$ line.

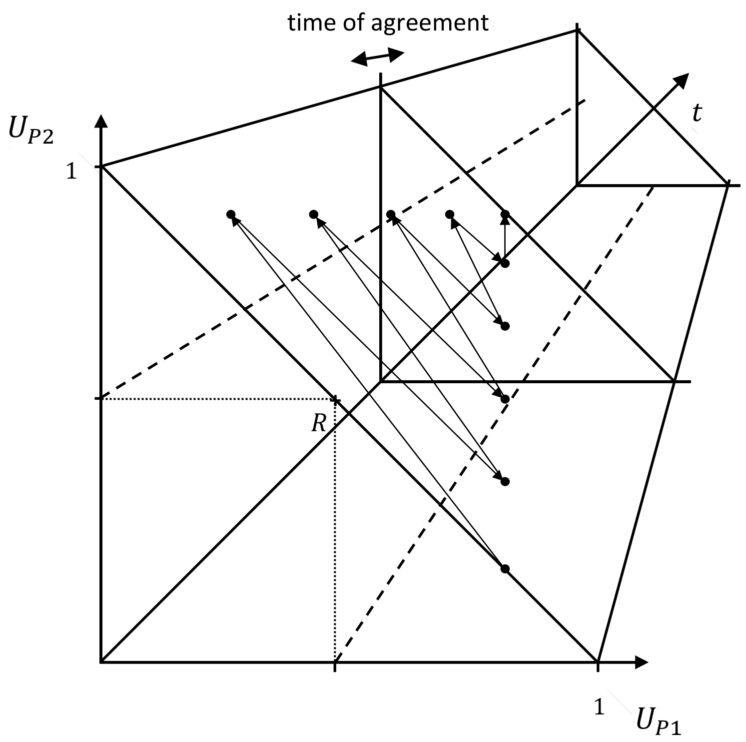
This feature of the model enables offers to go back and forth between the players over time and thus create the typical haggling behavior that is commonly observed in real world bargaining situations (for models with two-sided incomplete information in which one side makes all the offers, see: Cho 1990, Cramton 1984). This dynamic is indicated in Figure 3.2 by the set of arrows over the type space that represents the equilibrium path between two low-cost types that keep on bargaining until all other types of both sides have been screened out and finally come to an agreement that mirrors their relative strength. Initially both sides start with offers favoring themselves in the hope of bargaining with a weaker high-cost opponent. Over time, however, offers become more attractive to the other side until eventually the bargainers meet in the middle. This compromise solution is the result of their equally strong bargaining position. This compromise results in the same partition that two weak types would have agreed on right away. Yet both sides had to go through this process to convince each other of their strength.

Figure 3.3 shows the same equilibrium path in a different representation. The horizontal and vertical axes plot player 1's and player 2's utilities (U) from any given partition of the pie of initial size 1. The third dimension shows the time axis. The black dots represent the gradually converging offers. The figure also shows a reference partition according to the Rubinstein game in equation (1) with close to equal shares.

A general feature of the game is that the type space is truncated over time through a series of offers and counteroffers which are based on the calculation of optimal cut-off points, just as in the one-sided incomplete information setting. However, due to the two-sided nature of incomplete information in this game an *additional signaling behavior* emerges. It takes the form of strong types making a string of unacceptable offers from the beginning in order to separate from weaker types.

An important property of these unacceptable offers is that all types who are sufficiently strong to make such an offer remain *indistinguishable* with respect to their exact strength. That is, an unacceptable offer in any given period reveals nothing about whether the player making that offer will agree to a slightly more attractive counteroffer in the next period or stay in the game until the very end.[1]

Figure 3.3: The equilibrium path of the two-sided incomplete information game over time



In each period, the weaker of the remaining types (of the player whose turn it is to move) reveal themselves and the higher types all make an indistinguishable unacceptable offer. This additional signaling behavior of the two-sided incomplete information setup is at the heart of the escalation dynamics outlined below. The game following an unacceptable offer continues to be played under two-sided incomplete information. The game following a revealing offer by one player, in contrast, always reduces to the one-sided incomplete information variant of the game – with uncertainty remaining only over the remaining types of the other (non-revealed) player.

[1] Such an unacceptable offer could be infinite in the same way as the unacceptable offer in the one-sided incomplete information game could be zero (as in Grossman and Perry 1986) because its only intention is to signal a strong bargaining position (also see: Cramton 1984). It could more realistically be taken to be the lowest clearly unacceptable offer available, namely the one between the strongest type of the player that is making the offer and the weakest remaining type of his or her opponent. This extreme offer will not be acceptable to any type of either side because it violates the optimal cutoff point strategy of the game (namely that cutoff points lie *within* the remaining type space, not at its borders).

To see this more clearly, consider Figure 3.2 again. In the simplest scenario, the game involves the weakest types of player 1. In this case, the realized type combinations of the players lie within the upright box at the right side of the type space in Figure 3.2 – as marked by the Roman numeral I in the box that indicates the truncation sequence of the type space. Because of their high costs and resulting weak bargaining position, the types of player 1 at this end of the continuum avoid costly delay by instantly revealing themselves as weak types at t_0. This immediately reduces the game to the one-sided incomplete information version of the game as depicted in Figure 3.1. After the revealing move, player 1's type is common knowledge and the remaining game is about determining player 2's type and the appropriate partition of the pie given player 1's weak type and player 2's type. Since player 1 is weak, the partition of the pie will almost always tend to favor player 2 (unless player 2 happens to be weak as well). The remaining game thus serves to determine the exact size of player 1's concessions.

In an alternative scenario, however, if the realized type of player 1 is not contained in the weakest part of the continuum, player 1 needs to separate from the weaker types that reveal themselves at t_0. This is done by making an unacceptable offer. As noted above, this unacceptable offer only reveals to player 2 that player 1 is not among the weakest types but does not convey any information about which of the remaining types player 1 might be. These types remain indistinguishable from the perspective of player 2 (any offer that is sufficiently unattractive to be unacceptable has the same effect. In other words, beyond the acceptability threshold the exact nature of the offer is arbitrary. As a consequence, the type space is truncated). The region marked by I in Figure 3.2 is no longer part of player 2's uncertainty over player 1's type. Player 1's first unacceptable offer is indicated in Figure 3.2 as the first (top left) black dot from which the arrow sequence begins. This starts the period in which player 2 makes his first offer.

Analogously, if player 2's realized type is among the weakest types with the highest costs, player 2 makes a revealing offer. Afterwards, player 2's type is common knowledge and the remaining game is about determining player 1's type and the appropriate partition of the pie given player 2's weak type and the remaining types of player 1's after the first truncation. Again, the game reduces to a one-sided incomplete information game. Alternatively, if player 2 is not among the weakest types, player 2 also makes an unacceptable offer. Consequently, player 1 learns that player 2's type is not among the weakest group and updates her beliefs accordingly. As a result, the region of the type space marked by II in Figure 3.2 is truncated as well.

As only the stronger types remain in the game, the type space for both players is increasingly truncated from both sides. The game continues to be one of two-sided incomplete information, however, until one side reveals itself and a final agreement is offered and accepted. The earlier this happens, the larger are the potential gains for the non-revealed player. The size and direction of gains and concessions in such cases depend on the specific combination of types (that reflect the size of players' costs) but can go in either direction. Importantly, the size of concessions is always determined in a one-sided incomplete information setup after the weaker of both players has revealed him- or herself. This implies that in any game of one-sided incomplete information, including those discussed in Chapter 1, the player whose type is common knowledge is always the weaker of the two players (i.e., the direction of concessions is predetermined by assumption). This important feature is not readily apparent from the definition of the one-sided incomplete information games alone and has far-reaching implications for the modeling of escalation dynamics that, in the proposed setup, occur only in the context of two-sided uncertainty.

Adding an escalation option

From this point in the discussion, it is only a matter of a few additional modifications to create escalation dynamics. In an escalation context, the same general result as above emerges but with more pronounced outcomes in either direction. So far, the players incurred fixed per-period bargaining costs that did not change over time (i.e., in each period the players paid the same costs) and that could not be influenced by either side. The introduction of fixed-costs changes the terms of agreement, but does not in itself create conflictive interactions. Fixed-costs are present in any bargaining situation in which parties have running expenses while bargaining. Any delegation, for instance, produces fixed-costs. In order to create escalation dynamics, however, there needs to be an option to increase these costs. That is, the costliness of the bargaining context needs to be an endogenous choice variable that can be influenced as part of the strategic interaction of the game. The availability of an escalation option is a precondition for conflict to arise (conversely, the absence of an escalation option inhibits conflict processes even if parties have strictly opposed interests). A well-specified escalation option defines who can use it, under which conditions, and to what degree.

First, I define escalation as a one-sided option to be used only by the first moving party, i.e., player 1. This player can then escalate every time she moves. Although this choice may seem surprising at first, it reflects the structure of conflict situations in the real world rather well because most conflicts are directed-dyadic. That is, one side initiates the conflict in an attempt to obtain a more favorable outcome than could otherwise be expected. Legal disputes, for instance, involve a plaintiff and a defendant, with the former seeking compensation from the latter while threatening a lawsuit. In labor-management relations, unions demand higher wages while threating a strike. In international crises, one state may ask another to stop some policy while threatening diplomatic, economic, or military consequences. In trade disputes, one country's import restrictions hinder another's exports, with the latter threatening trade enforcement or WTO litigation. In all these instances, only one side actively escalates the conflict by taking some action to move the conflict to a higher level of intensity. However, the other side implicitly escalates along by reciprocating the escalation decision with a refusal to compromise (i.e., refusing to accept an offer and making an unacceptable counter-offer). By implication, accepting an offer or making an acceptable counter-offer is the natural way out of the situation.

Second, escalation as a cost creation strategy cannot be had for free. In other words, the escalating player cannot increase the opponent's costs while leaving her own costs unaffected. Rather, I assume that both sides' costs increase by same the factor as the result of an escalation choice. This reflects the fact that escalating a conflict situation almost always forces both sides into a more costly situation than would otherwise be the case. It is difficult to imagine a conflict situation that would not negatively affect both parties in some way. However, as the base-game in equation (3) suggests, incurring such costs can be worthwhile as long as the opponent's costs are so much larger that the resulting agreement offsets the primary costs incurred during a conflictive bargaining episode.

Third, and most importantly, there has to be a restriction on the maximum speed with which escalation can occur. To see why, recall from the above discussion that the entire signaling strategy of all but the weakest types in the two-sided incomplete information setting rests on the fact that these types all make an *indistinguishable* unacceptable offer. 'Indistinguishable' in this context means that an unacceptable offer reveals nothing about the type making this offer other than that this type is not among the lowest remaining types in the game who would make an acceptable offer instead. The same is required in the presence of an escalation option. In this case, players combine their unacceptable offer with an escalation choice. Just as the offer itself, however, the escalation choice needs to allow for the set of stronger player to remain indistinguishable. This is important because otherwise the opponent would be able to learn about the nature of stronger types before these types gradually select out over time, thereby upsetting the cut-off point equilibrium strategies.[2]

Fortunately, the assumption that escalation speed is limited is neither very strong nor unrealistic. A restriction on escalation speed does not imply that escalation needs to be particularly slow. It simply requires that it takes longer to escalate than to exchange offers so that various offers can be exchanged before complete conflict escalation has occurred. This is likely to be the case in virtually all contexts because physical factors reduce the maximum possible escalation rate. In legal disputes, for instance, hiring lawyers, preparing for trial, filling a suit, and going along with the procedures takes time no matter how low the plaintiff's costs are. In labor relations, organizing a strike requires preparation and coordination. In all international disputes, the bureaucracies that administer these disputes move slowly and if a conflict escalates up to the military level, the mobilization and

[2] The strongest types of players with the lowest costs cannot be allowed to escalate a conflict faster than less strong types that however also make an indistinguishable offer. If, say, medium-cost and low-cost types were free to escalate at different rates, the opponent could infer their type from their first-period escalation decision. In the second period, the opponent could then make an appropriate offer to exactly match the type of his opponent, thus ending all bargaining with the second move. Put differently, if different types of player 1 were able to escalate at different rates, this would introduce a different kind of signaling mechanism into the game. Such a game would result in the same equilibrium agreements, but would never last longer than two periods and upset the temporal dynamics that typically characterize escalation processes in the real world.

movement of troops takes time as well. These factors make it possible for middle types to pool with the strongest types in the earlier stages of a conflict and to thus signal their strength without giving themselves away.

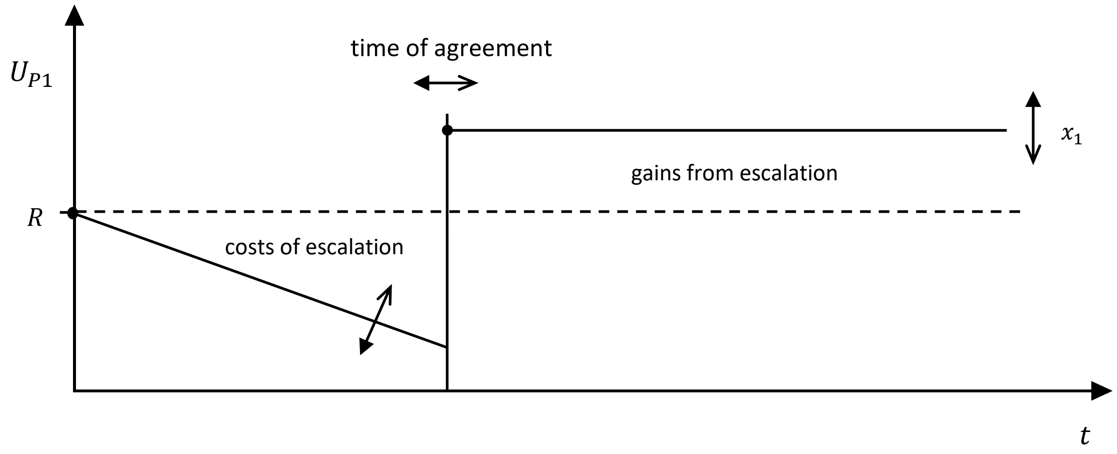
The key point of this section is that, if an escalation option is available in the game, all but the weakest types of players will use it because escalation promises higher expected gains from bargaining. That is to say, in the presence of uncertainty, escalation will *in expectation* generate gains for players whose realized type exceeds a certain threshold strength (which is dependent on the shapes of the two type distributions, the size of the first-mover advantage induced by the discount factor δ, the value of the pie relative to the baseline per-period costs of the players, and the speed with which escalation is possible). These types of players can then expect on average to benefit from conflict escalation. The motivation lies in the hope of being paired up with a weaker opponent. In this case, escalation promises additional gains relative to non-conflictive bargaining strategies. This situation is shown in Figure 3.4. The figure is a two-dimensional adaptation of Figure 3.3 and shows player 1's flow payoffs over time.

This depiction allows for a more detailed analysis of the logic of escalation as a cost creation mechanism. It has been discussed above (with regard to the base-game in equation (3) how players can profit from situations that impose static costs on both sides – as long as their opponent's costs are larger. Considering the dynamic logic of conflict escalation under uncertainty reveals further aspects of the strategic rationale behind escalation decisions: Because actively increasing the costliness of the bargaining environment increases a player's payoffs from conflict (given that the cost differences work to this player's advantage), and because escalation selects out weak types of the opponent at a higher rate than regular bargaining, escalation promises a *better deal earlier on*.

Figure 3.4 shows how player 1's share x_1 changes in such a situation relative to the reference Rubinstein solution from equation (1) that would ensue in the absence of escalation-induced costs. The closed and filled arrowheads indicate the direction of changes resulting from bolder escalation choices. The open arrowheads indicate the changes resulting from milder escalation choices. It is apparent from the figure that bolder escalation choices result in an earlier agreement at more favorable terms. This leads to both a larger share of the pie after agreement and a longer period of time for which this share is held. As a consequence, the flow of payoffs after an earlier agreement is not only higher and but also prolonged compared to what could have been achieved in the absence of escalation.

As long as pie is sufficiently valuable relative to the costs of conflict (so that the costs of escalation do not outweigh the gains from escalation), players with good subjective success prospects (i.e., low-cost types) have every incentive to escalate quickly in order to obtain more favorable agreements. For example, consider a plaintiff and a defendant who are bargaining over the terms of an out-of-court settlement while preparing for trial. As the parties prepare for the legal procedure, fixed-costs rise. Yet if the plaintiff rightly assumes she can afford this procedure more easily than the defendant, pushing the case will ensure a more favorable agreement. A similar reasoning applies in other areas as well.

Figure 3.4: The flow of payoffs from bargaining and escalation over time



Importantly, however, escalation is a risky strategy that can backfire and result in net losses. These potential losses are larger than the ones that result from comparable delay to agreement in the absence of escalation. Just as in the game without an escalation option discussed above, the two-sided incomplete information context involves the inherent risk of two low-cost players confronting each other. In this case, maximum conflict ensues but players end up agreeing on the Rubinstein partition of the pie – the mutually least satisfactory outcome. In this scenario, the gains from escalation relative to the Rubinstein outcome as shown in Figure 3.4 are equal to zero, while the costs of escalation are maximal.

Maximum conflict (along with maximum losses) therefore occurs when 1) a player whose type is strong 2) escalates in the hope that her opponent's type is weak 3) but then finds out that this hope was misplaced. The possibility that this adverse scenario materializes is always given under two-sided incomplete information as long as the overall expectation of escalation is positive (which is a precondition for escalation to occur at all). Consequently, escalation is a strategy that increases both the mean and the variance of expected bargaining payoffs. In expectation, escalation strategies promise more favorable agreements at earlier points in time. In the worst case, however, escalation results in maximum possible losses. In this respect, conflict escalation is not unlike a risky investment strategy.

The discussion so far has presented a general bargaining framework under two-sided incomplete information that enables escalation behavior to emerge endogenously. This framework allows an analysis of both the drivers and outcomes of conflict behavior and goes beyond existing approaches to modeling conflict processes in several respects. For one, the bargaining dynamics described above capture various aspects of real world interactions quite well. The framework allows bargaining to end with concessions going in both directions as well as with genuine compromise agreements that follow an intense exchange of offers between the players rather than a string of concessions from one side.

Most importantly, the framework captures the gradual and conscious escalation decisions through which players continuously select into increasing levels of conflict. This is a clear departure from the way existing process models are constructed because, in these models, per-period costs are constant just as conflict intensity is constant and players have no control over these costs. Note that, in the context of the two-sided incomplete information framework, the escalation decisions are taken *before* either of the players reveal themselves as being (relatively) weak. This explains why one-sided incomplete information models of conflict bargaining during conflict do not capture this process. To see this, recall that, in the above framework, the situation transforms into a game of one-sided incomplete information with the weaker type screening the stronger type for appropriate terms of settlement only *after* a revealing move has been made by either side.

At this stage, the situation resembles the dynamics of the one-sided incomplete information 'costly process' models. Note, however, that at this point the conflict modeled under two-sided incomplete information is already more than half over and that the remaining procedure under one-sided incomplete information only serves to determine the exact terms of an agreement at the *constant* escalation level that has been reached at this point. The logic of 'costly process' models is thus embedded in the game structure of the two-sided incomplete information setup. They do not, however, account for the most interesting aspects of conflict. The entire escalation dynamic, including the decision to select into conflict in the first place, is not captured in the context of one-sided incomplete information. By reflecting this important dynamic, the framework under two-sided incomplete information also highlights the strong continuity between bargaining and conflict.[3]

3.2 Extension I: Limited Uncertainty and Anticipation

The preceding section has outlined the primary analytical framework of this study. Based on the existing game theoretic literature, it has derived the general logic of escalation processes in a context of a bargaining setup with varying costs and constant and equal issue valuations (i.e., constant and equal stakes). This discussion has zoomed into the escalation process that leads from bargaining to conflict and has thereby provided a first step towards closing the gap between theoretical reasoning

[3] It is also worth noting that the adverse outcome, in which conflict is entirely inefficient for both sides, can only occur under two-sided incomplete information. As noted above, in the context of one-sided incomplete information it is already known by assumption that the informed player is in the better bargaining position. In the game starting from this point, therefore, this player always gains. Further note that the choice of the base-game in equation (3) makes it possible to model the entire escalation dynamic in the absence of a power-based enforcement option. That is, neither player in the above framework has the ability to unilaterally impose a settlement. All outcomes rest on mutual agreements. Such an option could be added to the setup, but it is not necessary to drive the results.

and empirical observations. As noted in the introduction to this chapter, the framework at the above level of abstraction may be informative about conflict processes in various subject-areas – provided appropriate context-dependent interpretations and concept specifications.

The purpose of this and the following section is to demonstrate how the above framework can be used to inform the empirical analysis of escalation processes in the specific context of international trade relations and in particular with respect to U.S. trade enforcement policies. To this end, the present section serves to convert the structure of the bargaining setup from a focus on costs to a focus on stakes. It then limits the degree of uncertainty players face over each other's stakes. As the discussion will show, both of these adaptations allow a closer link to the empirical realities in the area of international trade relations and set the stage for the operationalization and measurement of relevant concepts.

The conversion from costs to stakes is based on the consideration that the costs parties face in the context of disagreements or disputes over trade policies (administrative, legal, or otherwise) exhibit considerably less variation than parties' stakes. Industry-specific bilateral trade flows between pairs of countries range from zero to hundreds of millions or even billions of U.S. dollars, depending on the product classification used to demarcate industries. Applied levels of protection, expressed in ad valorem tariff equivalents, vary from essentially zero to many hundred percent. Market shares and export dependencies vary from zero to close to hundred percent. The fact that all these factors, and many others, overlap further increases this variability.

In contrast, the administrative and bureaucratic costs of handling trade-related disagreements are likely to be constrained within a much more limited range. The infrastructure and personnel required for diplomatic exchanges or legal proceedings, although not constant, is fairly similar across potential issues and countries. This view is supported by in-depth studies on the legal costs of WTO dispute settlement proceedings. As Shaffer points out, "[l]egal costs are relatively fixed for WTO complaints in comparison to trading stakes that vary considerably among members" (2005, p. 21). Shaffer (2003, 2005) reports the costs for the average WTO claim to lie in the range of $300,000 to $400,000 and cites costs of $400,000 and $2,000,000 for two individual disputes.

Similar figures are stated by Bohl (2009) who reports costs for hiring private law firms to range from $100,000 to $1,000,000 based on interviews with employees of such firms. Gosset (2015) presents figures for the costs of legal advice provided by the Advisory Centre for WTO Law (ACWL), a Geneva-based organization established with the aim of improving developing countries' access to legal consulting. The ACWL provides subsidized legal support to developing countries. According to Gosset, such cost still amount to $140,000 to $200,000 for a typical case and are substantially lower only for least developed country (LDC) clients. Only the most extreme cases such as the U.S.-EU Boeing-Airbus dispute or the U.S.-Japan Kodak-Fuji case are reported to exceed the $10,000,000 threshold (Bohl 2009, Shaffer 2005).

Thus, the costs of handling a trade dispute vary by around a factor of 10 for all but the most extreme cases and it appears plausible to expect the variability of costs at lower levels of escalation to lie in a similar range. At the same time, it is the rule rather than the exception that the monetary value at stake in trade relations varies by many orders of magnitude. In theoretical terms, it is therefore appropriate to switch assumptions from a setup with varying costs and constant and equal stakes to a setup with constant and equal costs and varying stakes to better accommodate the empirical context. This implies a corresponding empirical strategy that focuses primarily on measuring parties' stakes rather than their costs.[4]

The shift from costs to stakes also implies a slightly different interpretation of what it means to escalate a dispute. In Section 3.1, parties were bargaining about the partition of an equally valued resource while escalation imposed different costs on each side. Such a situation might arise in the context of wage negotiations in labor management relations, where relative costs of a strike might be reduced by the availability of a large strike fund (from the union's perspective) or the possibility to hire replacement workers (from the firm's perspective). In the context of international conflict, differences in military technology might result in considerable variation of the ability to create costs for the opponent.[5] In the varying-stakes setup, by contrast, escalation occurs by one party dragging both sides into an equally costly situation given different subjective valuations of the issue at hand.

It is instructive to consider how the switch of attention from costs to stakes alters the base-game in equation (3). Intuitively, costs and stakes may be thought of as being inversely related. In the context of equal *absolute* costs, a player with higher stakes faces lower *relative* costs compared to the subjective value of the pie. Formally, a slight additional complication arises because the pie over which the parties bargain has now two different subjective valuations. It is useful, therefore, to normalize the value of the pie to an objective value of 1. In this setting, the objective value of player 1's share is

$$x_1 = \frac{1 - \delta + \frac{c}{s_2} - \frac{\delta c}{s_1}}{1 - \delta^2}, \tag{4}$$

where $s_1 \geq 1$ and $s_2 \geq 1$ represent the players' stakes. If one player values the pie twice as much as the other, his or her stakes will be twice as high. Note that the cost term c has no subscripts since it is identical for both players. In the normalized version, the division of the cost term by the subjective valuations rescales the player's costs. If both players have high stakes, this downscales the costs for both sides, thereby making conflict less costly relative to the subjective valuations of the pie. To

[4] This strategy does not imply that parties' costs are assumed constant in the empirical part of this study. Existing cost differences are to a considerable degree accounted for by the empirical model specifications in Chapter 7.

[5] In this case, however, 'costs' would be an actor-level concept since the quality of military equipment is independent of the disputed issue. In an empirical context, this results in the difficulties discussed in Chapter 1.

obtain player 1's subjective valuation, multiply the entire equation by s_1. This recovers the actual non-scaled per-period costs δc as well as the subjective valuation $s_1 x_1$. Finally, note that the cost terms $c_1$and c_2 in equation (3) above were implicitly divided by $s_1 = s_2 = 1$, reflecting the fact that throughout the discussion in Section 3.1 the players' stakes were held constant and equal by assumption.

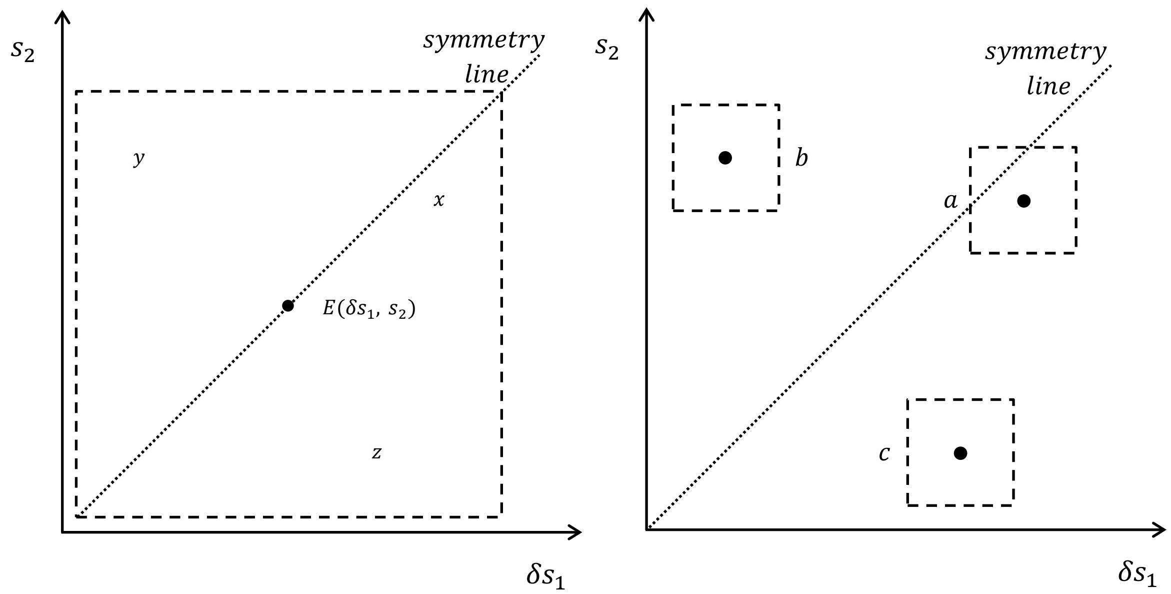
I now turn to the second adaption introduced in this section: The reduction of the players' uncertainty over each other's stakes is based on the consideration that parties do not face maximum uncertainty about each other in the real world. Although actors in the area of international trade – as well as in virtually any other context – will almost never have an exact understanding of their strategic environment, they will usually have a fairly accurate estimate. This makes it possible for parties to look ahead and partly anticipate events. Otherwise (i.e., if uncertainty was in fact complete), actors would be unable to assess their opponent in any way before bargaining begins. They would thus be entirely 'blind' and would consequently have to solely rely on (conflictive) bargaining as an inefficient uncertainty reduction mechanism in all interactions with other parties.

The discussion in Section 3.1 was implicitly based on the assumption that players face maximum uncertainty. From a theoretical perspective, this assumption is useful because it allows the derivation of the general logic of escalation dynamics in the absence of additional complexities. With a view to empirical applications, however, it is necessary to relax this assumption – not only in order to develop an understanding of what parties in the real world can foresee and how this affects their actions, but also to recognize what external third parties (and, in particular, researchers) can and cannot hope to observe. The remainder of this section discusses how a partial uncertainty reduction in the theoretical framework affects the predicted behavior of players in the model, how this relates to the behavior of parties in the real world, and what this implies for empirical research on bargaining and conflict processes.

Figure 3.5 shows several scenarios of the distribution of the players' stakes under maximum and reduced uncertainty. First consider the left panel of Figure 3.5. The dashed square denotes the bivariate distribution that reflects the players' uncertainty over each other's type. This square should be thought of as the outer contour of the type space that is gradually truncated during the bargaining and escalation process as shown in Figure 3.2. The point at the center of the type space represents the expectation of the players' type distribution, $E(\delta s_1, s_2)$, and therefore the players' average types. The letters x, y, and z are examples of hypothetically realized type combinations drawn from this distribution.

The type space in the left panel of Figure 3.5 occupies the entire possible set of values that the players' types may assume – indicating that the player's uncertainty is at its maximum. In this case, the players' *actual* type space (ATS) completely overlaps with their *potential* type space (PTS). The latter can be thought of a being determined by the range of generally plausible values for the player's types in a given application. In international trade, for instance, parties' stakes will never be negative, or range in the order of trillions of U.S. dollars, irrespective of the parties and products concerned. It is immediately apparent from this example that parties in the real world will never have such little information about each other as to be fully incapable of assessing the approximate value an issue has for their opponent.

Figure 3.5: (A)symmetry and anticipation under maximum und limited uncertainty



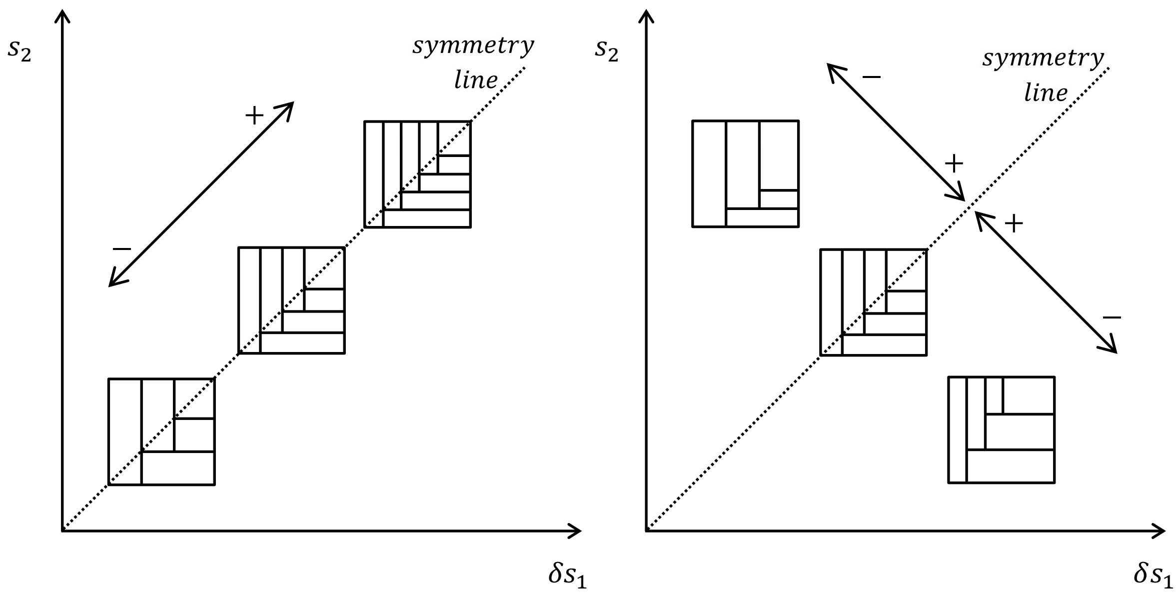
If uncertainty in the context of the theoretical framework is allowed to be limited, the players will be able to mimic the ability of real world actors to partly assess their situation. This is reflected in the right panel of Figure 3.5 by the possibility that the players' ATS can lie in different regions of the PTS. The three squares show different scenarios a, b, and c in which the players approximately know their opponent's type but remain uncertain about its exact nature. Note that under maximum uncertainty the ATS is can only take a single position that is identical with the PTS. If the PTS is assumed to cover the same range of values for each player, the ATS is also symmetric.

Under limited uncertainty, by contrast, the ATS can lie anywhere along the symmetry line and it can furthermore lie anywhere above or below the line – indicating that the players have asymmetric type distributions. This means that the players can anticipate asymmetric bargaining outcomes. The players in scenario b, for instance, know in advance that they will end up agreeing on a partition of the pie favoring player 2. This partition will be similar to the partition that the players in the maximum uncertainty scenarios would end up with if their realized type combination was to be represented by the y in the left panel of Figure 3.5 (and analogously for the other scenarios). The players still need to bargain over the exact terms of the agreement. But because they can partly foresee the eventual bargaining outcome they can adapt their claims at the outset by making initial offers that reflect this insight.

By knowing their approximate location in the PTS, the players thus have an additional source of information *prior to* bargaining. This information has the same effect as the information that parties in the real world have, based on factual knowledge, economic understanding, policy analyses, and the like. In the theoretical context, partial prior knowledge releases the players from the need to acquire all the information they need to arrive at an agreement *through* bargaining. At the same time, the information contained in the location of the players' ATS in the PTS makes it possible to arrive at an assessment of the most likely bargaining and escalation outcome – an assessment that is not possible in the same way in the maximum uncertainty scenario.

This has crucial implications for what external observers can expect to hypothesize about the players' behavior and the degree to which their interaction will escalate into conflict. First note that in maximum uncertainty scenario, it is impossible for outside observers to form any meaningful hypothesis about the eventual bargaining outcome *ex ante*. Because the players know their own type, each individual player has better information than an external observer. Consequently, each player can form an expectation over possible bargaining and escalation outcomes conditional on the other player's type. A strong type, for instance can either expect to extract a considerable share of the pie from a weak opponent, or to end up with an expensive compromise with a strong opponent (or anything in between). Similarly, a weak type can, at best, expect an equal split when paired up with another weak type or, at worst, a very unattractive agreement when paired up with a strong opponent.

Figure 3.6: Expected levels of escalation under limited uncertainty



From the perspective of an external observer, who knows neither player's type, all outcomes are possible and nothing can be said that goes beyond statements about the average outcome over all potential type combinations. This changes under conditions of limited uncertainty. To see this, consider Figure 3.6. The left panel of the figure shows how the bargaining and escalation process changes as the ATS shifts along the symmetry line. The right panel shows the effects of a shift orthogonal to the symmetry line. In both panels, the amount of uncertainty is assumed to be constant, that is, the size of the ATS remains the same in all scenarios. The plus and minus signs indicate expected change in the degree to which bargaining escalates as the position of the ATS changes.

In the left panel, the expected degree of escalation increases with the players' expected (absolute) stakes. This is not surprising because, for a given amount of uncertainty, players with higher stakes face lower relative escalation costs relative to their subjective valuations of the pie. These players are therefore willing to stay in the game longer given accumulating costs and therefore select out at a lower rate. This is indicated by the increasing number of segmentations of the ATSs as players' stakes increase. It reflects the fact that higher stakes pairs of players require more rounds of bargaining and escalation until their type space is fully truncated and all types of players finally agree on a partition of the pie.

In the right panel, the expected degree of escalation increases as the players' type distributions become more symmetric (i.e., as their expected relative stakes approach unity). This is less obvious but follows from a similar logic. In the top left scenario, player 2 has high stakes, while player 1 has low stakes. Hence, player 1 faces higher escalation costs relative to her valuation of the pie than player 2 does. Player 1's types are therefore selected out at a higher rate than player 2's. The exact opposite is true in the bottom right scenario. In this case, player 2 faces higher costs relative to his valuation of the pie. Accordingly, player 2's types select out at a higher rate.

In the symmetric scenario, by contrast, both players have stakes that are neither low nor high but lie in an intermediate range. These players are expected to bargain the longest and escalate the furthest despite the fact that neither side has particularly high stakes. The reason is that, at the same time, neither side has particularly low stakes. Thus, neither player's types select out at a higher rate than the other's – thereby ending the game. The lower stakes player therefore determines the maximum expected duration of bargaining and the maximum expected level of escalation.

It is worth noting that these results only hold under the condition of limited uncertainty. Under maximum uncertainty, the above-mentioned unpredictability of outcomes ensues. Under complete certainty, in contrast, perfect anticipation on part of the players results in immediate agreements in the absence of any observable escalation behavior irrespective of what the players' stakes are. It is also worth noting that under limited uncertainty it is still not possible to determine the exact bargaining and escalation outcomes. All the above predictions are expectations over the given ATSs. For instance, it is always possible that the realized types of two high-stakes players in the top right scenario in the left panel of Figure 3.6 happen to lie at the low end of their type space and thus reach an agreement very early.

However, the fact that, in the context of limited uncertainty, the locations of the players' type spaces (and therefore the *expectations* of their realized types) are observable, suffices to form *expectations* about the likely bargaining and escalation outcomes. This forms the necessary precondition for the measurement and operationalization strategy described in the following section that addresses the question of how players' stakes arise in the context of international trade relations.

3.3 Extension II: Asymmetries induced by the Multilateral Trade Network

So far, the discussion in this chapter has treated stakes on a conceptual level, that is, it has not specified what stakes actually are beyond a general measure of importance. This sort of abstraction is useful because it allows a simplified and more general analysis of theoretical relationships and mechanisms. In order to be useful to guide empirical work, however, further specification is required. The purpose of this section is to discuss in more detail how countries' stakes arise in the specific context of industry-level import policies in the multilateral setting of international trade relations and, consequently, how stakes can be observed and measured in a way that allows predictions derived from the above theoretical considerations to be tested against real world data.

Specifically, the first part of the section describes how counterfactual loss and gain shares that result from hypothetical trade liberalization scenarios can be calculated for the concerned trade partners. The objective of the discussion is to derive a theoretically grounded sub-concept definition of parties' stakes in the area of international trade and to link the possible bilateral constellations of these measures to theoretical expectations concerning dispute escalation. Based on the foregoing considerations, the second part of the section then derives further hypotheses about the relationship between observed escalation levels and expected bargaining outcomes. Overall, the discussion lays the basis for the subsequent empirical implementation and serves as the link between the theoretical and empirical part of this study.

The nature and effect of stakes in international trade relations

It is intuitively clear (and apparent from various parts of the discussion so far) that parties' stakes in international trade are intimately related to the monetary value of the trade flows concerned. This is unsurprising. Higher trade volumes are, all else equal, expected to be more important to national governments than lower trade volumes. However, the objective of this section is to go beyond this intuitive but crude understanding of importance. In fact, the primary goal here is not to focus on trade volumes while holding all else constant, but to focus on the systematic component of 'all else' while holding trade volumes constant. The statistical analysis in Chapter 7 investigates the effect of stakes, as defined below, conditional on the absolute monetary value of trade – thus the analysis decomposes the parties' stakes by separating out the effect of the 'raw' trade value.

One point I intend to highlight in this section is that very different stakes can be associated with the same monetary trade value and that the absolute volume of trade thus represents only a rough estimate of these underlying stakes. The question then arises how parties' stakes *in* a given trade flow are determined. The starting point for the measurement and operationalization strategy suggested here is that trade disputes are not actually about existing trade flows but about trade barriers that inhibit *additional* trade flows. This implies that the monetary value at stake in such a dispute is not the value of the actually existing trade flow but the difference in value between the existing trade flow and the counterfactual trade flow that would materialize if current trade barriers were to be reduced or removed.

While the value of existing and counterfactual trade flows is generally related, this relationship is far from perfect. Existing and counterfactual trade volumes are related because for any given level of import protection, a hypothetical elimination of current protectionist policies will result in higher counterfactual trade increases for higher existing trade flows. However, since applied levels of protection vary widely across countries and industries, counterfactual scenarios from the elimination of existing import barriers also vary considerably. In the one extreme, if existing trade barriers are close to prohibitive, current reported trade values will be low while the expected increase in trade flows from counterfactual liberalization might be substantial. In the other extreme, if existing trade barriers are minimal, even a complete elimination of the remaining barriers will not increase existing trade volumes by large amounts.

The first step in the measurement and operationalization of parties' stakes therefore consists of obtaining systematic data on industry-level trade flows and, crucially, applied levels of import protection. While data on trade flows are readily available, obtaining data on the effects of policy barriers is far from straightforward. Because such data do not exist, a considerable share of the empirical work of this study, in particular all of Chapter 6, is devoted to estimating the level of applied trade protection from observable trade frictions. I will not go any deeper into the technical aspects of the procedure at this point. It is worth mentioning, however, that the approach has the particular advantage that it indirectly captures the effects of various country- and industry-specific factors that affect a government's inclination to implement protectionist policies in the first place and that are otherwise extremely difficult to measure on a large scale across importers and industries (i.e., lobby strength, the effects of structural change, various aspects of industry competitiveness or the lack thereof, and so forth).

Given the data on current trade flows and applied protection levels (as well as knowledge of the relevant trade elasticities), it is then possible to calculate the expected increase in total imports that would result from a hypothetical reduction of existing trade barriers. This estimate can then be used to derive the importer's *counterfactual loss share* from such trade liberalization, that is, the ratio of the hypothetical rise in imports to the current level of imports of the industry at hand. This share then serves as the measure for the *importer's stakes* by capturing the percentage by which imports would increase as a result of trade liberalization. Because this measure, by definition, ranges between zero and one, it is unrelated to the actual trade flow and thus allows the decomposition of these two aspects of the importer's stakes.

The second step required to complete the operationalization of the parties' stakes is to arrive at an appropriate estimate of the exporter's stakes in the given bilateral industry-level trade flow. In the empirical application in Chapter 7, the exporter is always the United States. Since this need not be the case, I keep the discussion general at this point. The important point to note in this context is that the vast majority of trade barriers are applied on an MFN basis. That is, an importing country's trade barriers typically affect *all* exporters that ship their goods to this market (this holds, in particular, for non-tariff barriers to trade such as quantitative restrictions, product standards, customs procedures, import licensing requirements, and the like that make up the vast majority of existing trade protection policies; also see: Bacchetta et al. 2012).

This point is import because it means that protectionist trade policies are clustered by importing country for each product, while trade flows differ for each individual exporter that ships these products to a given importer. This implies that trade disputes cannot be interpreted as being strictly bilateral in nature. Rather, they are strongly affected by the network structure of the international trade system. Because each country typically imports goods from a large number of exporters, each individual exporter has much less to gain from trade liberalization than the importer has to lose. In multilateral trade negotiations, this effect is offset by the possibility to exploit issue linkages and to implement reciprocal trade liberalization so that the imbalances concerning individual trade flows cancel out. In disagreements and disputes over specific trade policies by individual importers, however, this option does not exist. Consequently, trade disputes are almost always asymmetric.

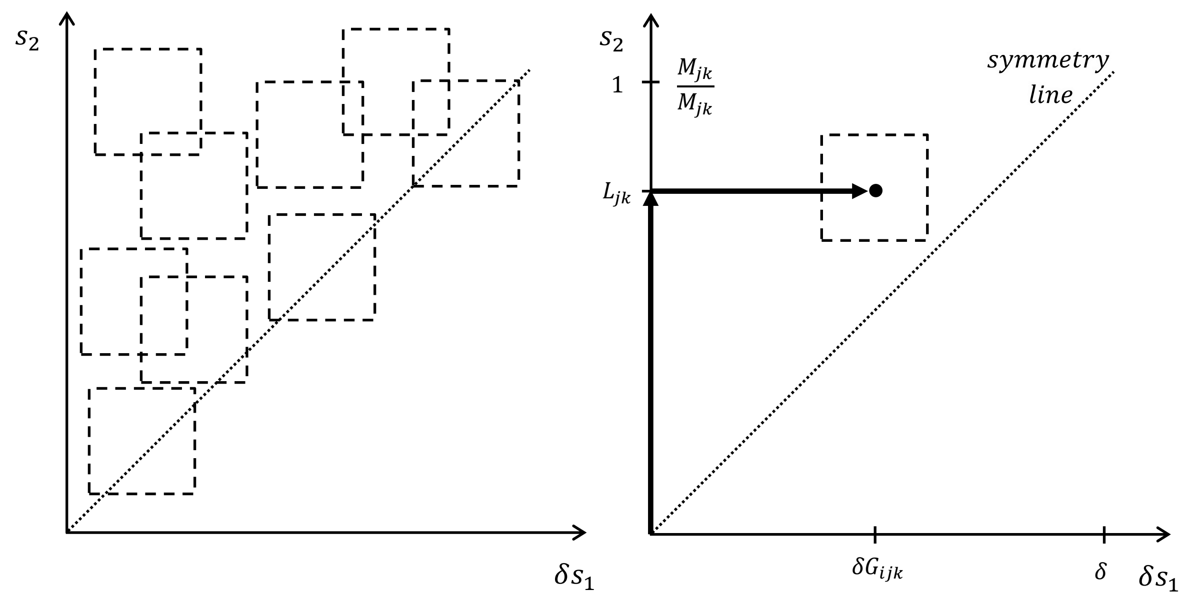
Specifically, if trade disputes are expected to lead to an MFN-based reduction in trade barriers, *all* exporters benefit from this policy reform. The scenario of MFN-based reductions should be expected, given that selective reductions for single exporters would be inconsistent with international trade law. This holds despite the fact that the barrier itself might not be consistent with existing legal standards because this circumstance is unlikely to be known or officially confirmed (for instance, by WTO arbitration) prior to a dispute arising. Once the issue has been raised, however, and a policy reform is agreed on, selective reductions for individual exporters should generally be considered the exception rather than the rule.

For each individual exporter that considers engaging in a disagreement or trade dispute over the policy in question, this constellation is disadvantageous. After all, an across-the-board reduction in trade barriers for all exporters will lead to an aggregate surge in imports into the importer's market. An individual exporter would then have to overcome a higher resistance from the importer than would be the case in a purely bilateral setting. At the same time, the trade increase resulting from a potential trade barrier reduction will benefit an individual exporter only partially. More precisely, when abstracting from the effect of shipping costs, an MFN-based trade barrier reduction will benefit each exporter proportional to its current market share under the given policy.

In effect, therefore, the importer has a *defender advantage* against each individual exporter that is affected by a protectionist policy. This advantage holds as long as exporters act individually and do not form coalitions to counterbalance the importer's position. The further argument rests on the assumption that coalition building is unlikely to take place on a significant scale. The reasoning is that appreciable coalition building scenarios are simply ruled out by the prohibitive transaction costs that would ensue from coordinating the multilateral response. Suppose only twenty countries were affected by a given trade barrier. Then, in coordinating their action, there would be $(20^2 - 20)/2 = 190$ exporter pair combinations that would have to communicate in some form or another. With fifty concerned exporters, this figure would rise to 1,225 and with hundred exporters it would rise to 4,950.

Even if there were multilateral coordination rounds that would reduce these figures, and clear rules of procedure, there would still remain an immense coordination effort to find out each party's exact interests in each case. Furthermore, if countries were practicing the coalition building scenario to any appreciable degree, they would have to interact over not only one import policy pursued by one importer in one industry but concerning hundreds or thousands of industry-specific policies pursued by dozens of importing countries. Even in the most extreme cases, such as in the WTO where coalitions do exist, these coalitions tend to be very small, typically comprising no more than a handful of complainants. Similarly, the National Trade Estimate reports (NTEs) that form the basis for the escalation measure as discussed in Chapter 4, only very rarely refer to situations in which the U.S. coordinated its trade enforcement efforts with other affected exporters.

Figure 3.7: Asymmetric stakes resulting from the multilateral nature of trade relations



Given that coalitions are unlikely to form and there is indeed a defender advantage in international trade relations, the next step is to bind this constellation back to the larger theoretical considerations outlined above. Essentially, the defender advantage stems from the fact that – due to the asymmetries introduced by the network structure of international trade relations – the importer will almost always have higher *stakes* than any individual exporter that is not the sole (i.e., 'monopolistic') supplier to the importer's market. In the language introduced in Section 3.2, this implies that all actual type spaces (ATSs) in the context of disagreements over import policies in international trade lie on or above the *symmetry line* – thereby tending to favor the importer (i.e., player 2). This situation is schematically depicted in the left panel of Figure 3.7.

It follows from the previous discussion that the higher the exporter's market share, the more symmetric the stakes balance with the importer likely is. I therefore define exporter i's and importer j's stakes over trade relations in industry k as

$$stakes_{jk} \equiv L_{jk} = \frac{\Delta M_{jk}}{M_{jk}} \tag{5}$$

and

$$stakes_{ijk} \equiv G_{ijk} = \frac{\Delta M_{ijk}}{\Delta M_{jk}} \approx \left(\frac{M_{ijk}}{M_{jk}} \Delta M_{jk}\right) / \Delta M_{jk} = \frac{M_{ijk}}{M_{jk}}. \tag{6}$$

Equation (5) represents the importer's *counterfactual loss share* from liberalization as described above. It is the fraction of the increase in imports due to a given reduction in current trade barriers, say by 10 percent, relative to the total value of current imports. Equation (6) represents the exporter's *counterfactual gain share*, which captures the fraction of the importer's loss share that would accrue to the exporter's industry (equation (6) also shows how the exporter's gains share is roughly equivalent to the exporter's market share). Thus, the importer's loss share captures what the importer loses from trade liberalization in terms of its total imports in the given industry. The exporter's gain share captures how much of this loss the exporter would gain.

The importer's loss share thus sets a benchmark for the larger analysis because it defines the importer's expected losses relative to the overall value of total imports under the current trade policy. This is shown in the right panel of Figure 3.7. Note that since $L_{jk} = \Delta M_{jk}/M_{jk}$ and $M_{jk}/M_{jk} = 1$, L_{jk} will be less than one as long as ΔM_{jk} is smaller than M_{jk}, which will generally be the case. The fraction L_{jk} therefore defines the position of the ATS along the vertical axis. Similarly, the fraction G_{ijk} defines the position of the ATS along the horizontal axis. These movements are indicated by the two bold arrows. Because $G_{ijk} = \Delta M_{ijk}/\Delta M_{jk} \leq 1$ by definition, the parties' ATS always lies on or above the symmetry line – indicating the importer's defender advantage.

The definition of L_{jk} anchors the parties' stakes in the absolute trade value at stake. This effectively decouples the parties' relative stakes from the absolute value of trade in question (i.e., the absolute stakes). As a consequence, it is possible to separately analyze the effects of parties' relative and absolute stakes. Note that the calculation of the parties' *counterfactual loss* and *gain shares* directly follows the intuition outlined in the introduction to this study. The procedure is fully described in Chapter 7, where it is also shown that the importer's loss share, L_{jk}, is equivalent to the percentage increase in import competition (following the usual definition) that results from trade liberalization. From this setup, four extreme cases can be constructed:

a) if $G_{jk} = 0$, and $L_{ijk} = 0 \implies 0$
b) if $G_{jk} = 1$, and $L_{ijk} = 0 \implies 0$
c) if $G_{jk} = 0$, and $L_{ijk} = 1 \implies 0$
d) if $G_{jk} = 1$, and $L_{ijk} = 1 \implies 1$

In words, if importer j has no trade barriers in place (i.e., $L_{jk} = 0$), its counterfactual loss share is equal to zero because no further reduction is possible. Therefore, no further increase in imports can occur as a result of such a reduction. This is the free trade case that is most often approximated in the manufacturing and high-tech sector of developed countries. Whenever $L_{jk} = 0$, that is in cases a) and c), no trade dispute will arise between countries j and i in industry k as indicated by the zeros in the last column. Similarly, whenever $G_{ijk} = 0$, as in cases a) and b), the exporter's market share is equal to zero – indicating that exporter i's industry k does not ship any goods to market j. Again, no dispute will arise. However, if importer j suffered extreme losses from trade policy reform that would exclusively benefit exporter i, as in case d), then both sides would have significant stakes in the trade relationship and a dispute is expected.

This logic immediately extends to intermediate cases. Note that he larger G_{ijk}, the closer the parties' ATS will be to the symmetry line in Figure 3.7. Furthermore, conditioning on the reported trade flow value will shift all ATSs to a region of equal distance from the origin in Figure 3.7, thereby accounting for the higher stakes induced simply because of larger observed trade flows. These considerations suggest the following interaction hypothesis:

> *H1: The interaction of the importer's stakes, as measured by the importer's* counterfactual loss share, *and the exporter's stakes, as measured by the exporter's* counterfactual gain share, *and conditional on the observed trade flow value should be associated with higher levels of dispute escalation between the two trade partners.*

This hypothesis reflects the overall relationship between the role of parties' stakes in disagreements over trade policy questions and observable escalation processes. It captures the core relationship between parties' stakes and dispute escalation based on a thorough understanding of how these stakes arise in the first place. The measurement and simulation procedure employed to arrive at the parties' stakes is the subject of Section 7.1, the statistical implementation and testing of the above hypothesis is the subject of Section 7.2.

The relationship between the level of dispute escalation and dispute outcomes

Given an expectation of how the combination of parties' stakes are related to dispute escalation, it is natural to ask how the agreed outcomes of such disputes may be expected to vary with their level of escalation. This question addresses a more subtle aspect of the conflictive bargaining process. To see this, note that the above discussion derives a prediction about dispute escalation based on the location of the parties' actual type space (ATS) within the potential type space (PTS). That is, the expectation of how far disputes are likely to escalate is based on the large-scale pattern of the parties' stakes constellation. By contrast, deriving predictions about dispute outcomes amounts to making statements about the details of the parties' interaction *within* the ATS – given that the ATS's position in the wider PTS is known. Although the presence of uncertainty within the ATS makes point predictions for individual cases impossible, it is possible to derive expectations over the summary statistics of these outcomes as a function of observed escalation levels.

A central point made above is that, unless the exporter has a market share of hundred percent, there is an importer advantage inherent in the structure of international trade relations. The following discussion introduces an additional effect that, on a different level, works in the opposite direction and counteracts the importer's defender advantage in important ways. This reverse effect thus works to the advantage of the exporter. This effect is rooted in the combination of two factors: first, the fact that the exporter initiates the bargaining and escalation process, and second, the pre-existence of a status quo that forms the basis for the parties' interaction.

To see this, note that countries usually have a pre-existing bargaining and/or dispute relationship over their industry-level trade flows. The parties' past interactions therefore play an important role in defining the nature of the current status quo (this is in contrast to the discussion so far, which has assumed that the parties bargain over a 'new pie' that is as yet undistributed). The existence of a status quo merely reflects the fact that the parties' relations are dynamic and that current disagreements are not independent of previous ones. Theoretically speaking, one can think of the parties' ATS, their mutual uncertainty space, at the end of the previous bargaining episode as being a single point. This follows from the general notion that (conflictive) bargaining serves as an uncertainty reduction mechanism that allows parties' to learn about each other in order to come to an agreement that reflects their bargaining positions. Since, at the time of agreement, all uncertainty is reduced, the ATS shrinks down to a point.

This state of affairs is only temporary, however. As time goes by, relevant characteristics that play into the parties' strategic relationship change. This relates, in particular, to the underlying economic structure that affects the parties' stakes and costs. As a consequence, uncertainty, and therefore the parties' ATS, grows again around the agreement point. Due to this dynamic nature of the larger system, the previously gained information gradually becomes outdated. The parties can no longer rely on this information to assess whether the status quo is still in their best interest. This situation then creates the precondition for a renewed bargaining or dispute episode.

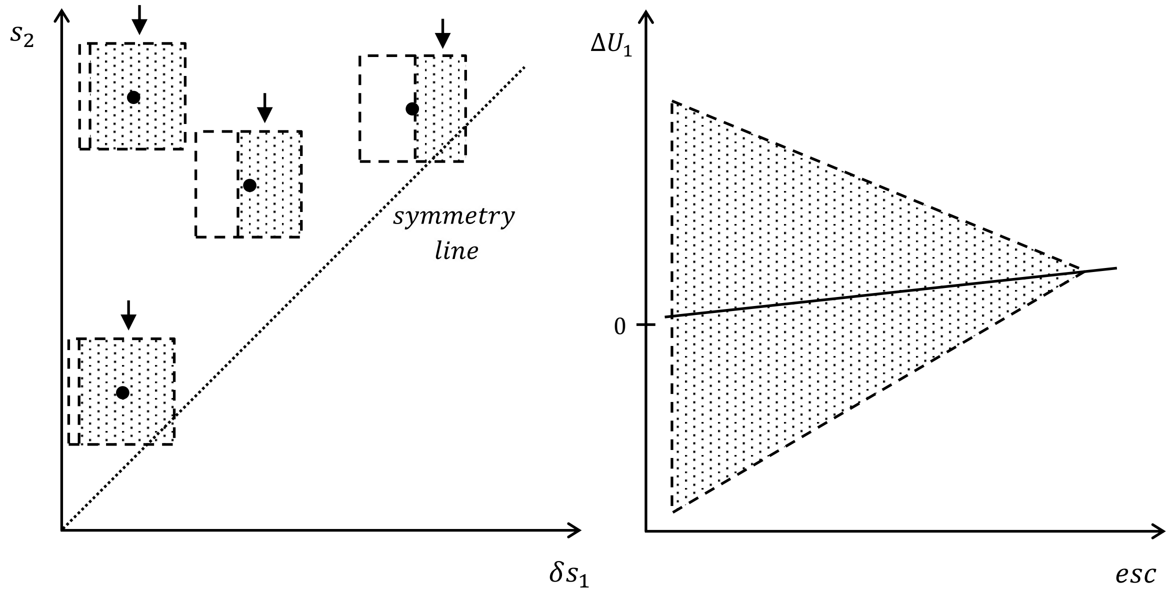
An important feature of this renewed episode is that it starts out from the terms of the previous agreement. The renewed bargaining episode therefore is not about negotiating a new agreement from scratch but about re-negotiating an existing agreement. This implies an additional role of parties' stakes in determining the eventual bargaining outcome. Essentially, what counts for the *change* in agreement that results from this re-negotiation procedure is not so much the *current level* of parties' stakes but the *change* in their stakes relative to the *previous level* that determined the preceding agreement. Irrespective of the level, this change can go in either direction for either trade partner. For instance, this change can favor the exporter, even if the previous agreement did not. In other words, an unattractive agreement resulting from the previous episode does in no way preclude an improvement in the exporter's bargaining position over time. Similarly, the exporter's bargaining position can deteriorate as well.

Because the exporter chooses whether to initiate a new bargaining episode, it can abstain from doing so if it expects the endeavor to be fruitless and overly costly. For this reason, the exporter has an *initiator advantage* in re-negotiation episodes. This initiator advantage can locally (i.e., around the pre-existing status quo) outweigh the globally dominant defender advantage that plays into determining the overall nature of this initial status quo. Essentially, the fact that the exporter can pick its fights induces a second selection effect *prior to* any observable interaction that is likely to tilt the bargaining position in observable disputes in the exporters favor. This selection effect is likely prevalent, in particular, in situations where the exporter anticipates high dispute costs in combination with insufficient improvements in the eventual agreement.

This is why *observationally* the exporter's initiator advantage can be expected to partially trump the importer's defender advantage in re-negotiation contexts. The basis for this reasoning is depicted in the left panel of Figure 3.8., where four different scenarios are shown that represent the parties' renewed uncertainty space, their regrown ATS, around an initial status quo. This status quo is indicated by the dots in the centers of the ATSs. As in Sections 3.1 and 3.2, the horizontal dimension of the ATS reflects the importer's (player 2's) uncertainty over the exporter's stakes (player 1). Similarly, the vertical dimension of the ATS reflects the exporter's uncertainty over the importer's stakes. The shaded areas indicate the types of exporters that are expected to initiate a dispute. The arrows indicate the average exporter type that initiates.

Note that the initiating types of exporters, vary with the position of the ATS in the larger PTS, which determines the overall expected level of escalation in accordance with Hypothesis 1. The further the ATS moves into a position that indicates mutually high stakes, the more only those exporters initiate whose stakes have increased since the previous bargaining episode. Thus, the shaded areas move further to the right of the ATS, as the ATS moves towards the top-right corner of the PTS. This implies that exporters become more cautious in initiating disputes that are prone to high levels of escalation. After all, exporters are well aware of the overall proneness to escalation because they know the position of the ATS within the PTS. Consequently, exporters are able to approximately anticipate the dispute costs that would arise from a re-negotiation episode they initiate.

Figure 3.8: The exporter's self-selection and the pattern of changes in bargaining outcomes



The higher the anticipated dispute costs are, the more confidence the exporter will want in its ability to obtain an improved agreement that makes up for these costs. This confidence can be increased by more selective dispute initiation. In any case, dispute initiation remains based on a probabilistic assessment of whether this strategy will result in the expected outcome, because the exporter is uncertain about change in the importer's type. By only initiating if its own stakes have increased, the exporter can boost its chances of success. The exporter then knows that its own stakes have increased, while the importer's stakes have either increased or decreased – which promises an average gain.

This sort of self-selection is more important in contexts where both sides have high stakes, than in other contexts. Assume all types of exporters were to initiate a dispute in a mutually high stakes scenario. This would imply that there are equally many exporter types whose stakes have increased as there are exporter types whose stakes have decreased. Because the same holds for the importer types, this implies that the average change in agreement that the exporter can expect to secure is equal to zero. When subtracting from this the substantial costs that arise in highly escalated disputes, which are incurred in any case, the exporter ends up with a net loss. For this reason, high-stakes exporters whose stakes have decreased will likely think twice before engaging in substantial re-negotiations with a high-stakes trade partner following an earlier dispute.

This situation looks different in contexts in which at least one party has low stakes so that both dispute escalation and dispute costs are expected to be low. Here, self-selection is less relevant, because the related bargaining costs are much lower and the potential for net losses is limited. An exporter who has relatively low stakes, for instance, may generally consider uttering a complaint towards a trade partner who just increased a trade barrier. Because the cost of uttering the complaint is close to zero, the self-selection pressure for low-stakes disagreements is expected to be lower than for contexts in which parties have mutually high stakes. Therefore, exporters should be expected to act more prudently in initiating disputes that are expected to escalate further. That is, disputes should be initiated selectively and only in cases where the exporter's assessment of successful re-negotiation and improved terms of agreement is particularly high. This suggests the following hypothesis:

> *H2: The exporter should, on average, be seen to secure larger reductions in trade barriers and thus larger relative increases in trade flows after disputes that have escalated further, compared to disputes that have escalated less far.*

This statement captures the essence of the exporter's initiator advantage. The proposed relationship is shown in the right panel of Figure 3.8. The upward sloping solid line denotes the overall trend of the exporter's relative increase in trade volumes as a function of the observed escalation level. It should be noted, in this context, that the statement does not suggest that dispute escalation is inherently useful for achieving more beneficial outcomes. After all, it applies only to *observed* outcomes that are the result of a systematic selection effect. The exporter's initiator advantage, therefore, is an advantage only in the *empirically observed* set of disputes. In particular, those cases where the exporter does not initiate are likely to exhibit the reverse relationship, which is to the exporter's disadvantage.

Hypothesis 2 makes a statement about observable trends in mean bargaining outcomes as a function of dispute escalation. It is also possible to derive an expectation about the variability in observed dispute outcomes as a function of dispute escalation. First note that high escalation levels imply the interaction of two high-stakes parties. Given that a high-stakes exporter initiates a dispute towards a high-stakes importer, arriving at a bargaining outcome requires concessions from either side, even if this compromise tends to favor the exporter in observed cases for the abovementioned reasons. The strong insistence from both sides and the resulting compromise agreement, therefore, constrain the range of possible outcomes. This is true both in the presence and in the absence of an initiator advantage or a defender advantage and directly follows from the discussion in Sections 3.1 and 3.2. The further the dispute escalates, the further the parties' offers converge from opposite directions. This implies that that there is relatively low variation in agreed outcomes after highly escalated disputes.

By contrast, at low levels of escalation, the variability in outcomes is considerably larger. This is the case because a large set of bilateral type combinations is consistent with low level disputes. While high-level disputes require both sides to have high stakes, low-level disputes are observed as soon as one side has low stakes. Thus, there is only a single combination of the parties' types that is consistent with high escalation levels. At the same time, there is a large set of type combinations consistent with low escalation levels: either the exporter has low stakes, which implies that disputes will not escalate far irrespective of the importer's stakes; or the importer has low stakes, which implies that disputes will not escalate far irrespective of the exporter's stakes.

Importantly, however, although all these type combinations are associated with low escalation levels, they result in very different bargaining outcomes. A high-stakes exporter that is bargaining with a low-stakes importer will obtain a favorable agreement. Conversely, a low-stakes exporter that is bargaining with a high-stakes importer will receive an unfavorable agreement. This relationship directly extends to the variability in changes that can be expected in a re-negotiation setting. Because in the set of type combinations that result in low observed levels of escalation, at least one side has low stakes and therefore does not insist very strongly, low escalation scenarios should be associated with a considerably larger variability in trade policy changes (and thus trade flow changes) in either direction. These considerations suggest the following hypothesis:

> *H3: The variability in bargaining outcomes and thus the relative changes in trade flows should decrease as disputes escalate further.*

Given that the different scenarios are approximately equally likely, the average change should furthermore be close to zero. In other words, if – in the context of low-stakes disputes – there are roughly as many increases in trade barriers as there are decreases, these changes would cancel out in the aggregate. The relationship is represented in the right panel of Figure 3.8 by the shape of the dashed triangle. Together, Hypotheses 2 and 3 therefore state that higher levels of escalation should be associated with an increase in the mean and a decrease in the variance of observable changes in trade flows. These predictions are tested empirically in Section 7.3.

As noted previously, the exporter will always be the United States in the empirical part of this study that begins in the following with Chapter 4. This chapter presents the procedure to extract the information about the United States trade enforcement actions from the above mentioned NTE reports. This information serves as the measure of escalation that is the dependent variable in the main analysis in Chapter 7. Chapters 5 and 6 estimate the elasticities and trade barriers, respectively, that are required for the calculation of the counterfactual loss and gain shares just described. These shares then serve as the primary independent variables in Chapter 7.

4 Measuring Dispute Escalation: U.S. Trade Relations and Trade Enforcement

A necessary precondition for investigating the conflictive behavior surrounding international trade relations is to acquire detailed and systematic information on relevant trade negotiations and trade disputes. The purpose of this chapter is to improve on the currently limited data availability on these interactions by describing a procedure used to compile a new dataset on U.S. trade disputes and trade enforcement activities over the past three decades. The dataset captures the interactions between the United States and its trade partners in disagreements over trade policy issues in a fine-grained product classification and down to low levels of conflictiveness. By spanning the entire range of dispute intensity from passive complaints to full-blown trade disputes, this data allow, for the first time, a detailed and analysis of escalation processes in international trade relations.

Trade disputes – and more generally, disagreements about national trade policies – have always been an integral part of international trade relations. At the same time, the political frictions that surround these relations are not easily observed, recorded, or quantified in a systematic and comparable manner. Negotiations on trade policy issues are constantly held between countries in different bilateral or multilateral fora at different levels of the administrative hierarchy. Often such meetings take place behind closed doors. Even if they do not, press reportings and media coverage are unlikely to convey a representative picture of the full sets of events. Several methodological concerns arise in this context. For instance, the most extreme cases are likely going to be over-reported, reportings will be nationally or regionally (and therefore also linguistically) fragmented, and reports about factual events will be intertwined with political rhetoric and normative and/or opinionated statements.

Against this backdrop, it comes as no surprise that the vast majority of scholarly studies on trade disputes are either qualitative case-studies or quantitative analyses of the WTO dispute settlement cases. Case-studies avoid the above-mentioned problems by focusing attention in a 'narrow-but-deep' approach on one or a small number of cases. This makes it possible to gather very detailed information on the individual cases under consideration. At the same time, however, it is not immediately obvious to what degree the results thus obtained generalize to a larger set of cases. The literature on WTO dispute settlement also avoids the data gathering problem, because the WTO cases are a natural set of observations that are easily demarcated and on which structured information is available. However, WTO disputes, too, represent only a tiny fraction of the sum of all disagreements related to trade policy.

First of all, the WTO dispute settlement cases are the 'tip of the iceberg' of trade-related disagreements. Yet even when taking this into account, WTO cases are extremely rare. Since the inception of the WTO in 1994, some 520 cases have been brought before the WTO's Dispute Settlement Body. This yields an average of 23 cases per year. However, the WTO has by now more than 160 members, which implies that there are more than 25,440 (160 times 159) directed dyads, all of which could potentially be in disagreement about each other's trade policies at any given point in time.

That is, there is on average around one case per 1000 dyads each year. What is more, these potential disagreements could relate to any one of hundreds or even thousands of different products (depending on the product classification and the intensity of the bilateral trade relationship). Lastly, the WTO cases are not limited to disagreements about import policies, but also include disputes over export policies or horizontal measures affecting all imports (such as general customs procedures). As already noted in Chapter 1, there are hundreds of millions potential cases. The WTO cases thus are "the tip of the tip of the iceberg" (Horn and Mavroidis 2006, p. 30), representing only a tiny fraction of the set of all potential disputes.

In a certain sense, therefore, the WTO data is on the extreme 'broad-but-shallow' end of the spectrum. The data potentially cover trade interactions between all possible countries but only capture a small share of each of these interactions. This raises the question to what degree these cases can be meaningfully contrasted with the set of non-WTO cases in the context of an analysis that focuses on the underlying determinants of dispute escalation. One problem is that the 'residual category' of non-cases makes up virtually the entire data set of trade relations. Another, related problem is that the variation in this residual category is enormous and cannot be separated out any further, given the absence of additional information on non-WTO trade bargaining and enforcement behavior.

The following sections present the automated content analysis (ACA) method employed to compile an alternative dataset on U.S. trade disputes and disagreement over trade policies that is less prone to the above criticisms. Section 4.1 presents the U.S. National Trade Estimate (NTE) reports that serve as the textual input data for the procedure and highlights why the NTEs are particularly well-suited for an ACA approach. Section 4.2 introduces the details of the ACA procedure and goes through the sequential processing steps that are implemented to transform the textual information into data. Section 4.3 then presents the resulting data along with evidence that corroborates the validity of these data.

4.1 Automated Content Analysis of the U.S. National Trade Estimate (NTE) Reports

In light of the above considerations, the purpose of this chapter is to present a new dataset on product-specific U.S. trade negotiation and enforcement activities over the 1988 to 2015 period that is designed to address these concerns. The dataset results from an automated content analysis of the National Trade Estimate (NTE) reports that are compiled on an annual basis by the Office of the United States Trade Representative (USTR). It covers interactions with more than eighty trade partners on trade barriers concerning almost three-hundred different products. A particularly interesting feature of the data is that it covers the entire range of possible activities from inaction, over various forms of diplomatic exchanges to the imposition of sanctions and retaliatory action. It thus provides a nuanced picture of the pattern of conflictiveness surrounding U.S. trade relations.

The data plays a crucial role in the context of this study as it forms the basis for the statistical analysis in Chapter 7 by providing the necessary information on dispute escalation as the outcome to be explained. Furthermore, the dataset is interesting in its own right and contains a host of additional information well beyond the immediate requirements of this study. Because the entire information in the dataset is drawn from a series of twenty-eight NTE reports (one report per year between 1988 – 2015), it is helpful to first provide a clearer picture of the nature of these reports and the kind of information they contain. To this end, I give a brief overview over the role of USTR in U.S. trade policy formulation and execution process and the intention and purpose of the NTE reports before going into the details of the automated content analysis.

USTR is a United States government agency that is part of the Executive Office of the President and takes the lead role in coordinating, formulating and implementing U.S. trade policy. In this role, USTR also oversees ongoing trade-related negotiations between various other U.S. departments and agencies and foreign governments and is in regular contact with representatives from domestic industries. Its head, the U.S. Trade Representative, is a member of the President's Cabinet and as such formally on equal footing with the secretaries of U.S. government departments such as the Department of Commerce or the Department of State. The U.S. Trade Representative serves as the primary advisor to the President on trade issues and is the United States' chief trade negotiator.

USTR has the lead role in implementing U.S. trade enforcement policies. This includes various forms of direct negotiations with foreign governments as well as the administration of WTO disputes through its Geneva Office and the application of relevant U.S. trade laws. The prime example of the latter is the Section 301 (of the Trade Act of 1974), which details the procedures for retaliatory trade action against trade partners.

Each year in spring, USTR submits to Congress a report on significant foreign trade barriers and the actions taken over the previous year to reduce or eliminate these barriers – the National Trade Estimate. The NTE reports combine information from USTR's own sources as well as additional information provided by relevant U.S. government departments (such as Agriculture or Commerce), other U.S. agencies, and U.S. embassies. The NTEs also contain information provided by the private sector through various channels including direct complaints filed by industry representatives to U.S. government agencies. The National Trade Estimate reports are thus a rich and condensed source of information on U.S. trade negotiation and enforcement policies.

Naturally, the NTEs do not provide impartial or objective information but reflects U.S. interests and preferences. This would be a major methodological concern if the objective of using the information contained in the reports was to get a systematic and accurate overview over other countries' trade policies. The NTEs do not provide a neutral and well-balanced overview of this kind – and obtaining impartial information on national trade policies is the subject of Chapter 6. Rather, the reports present a selective picture of international trade barriers as seen through the lens of U.S.

trade interests. Specifically, one would expect the reports to systematically neglect information on national trade policies that do not meaningfully affect U.S. trade flows.

However, the focus of this chapter is not on countries' trade policies *per se* but on U.S. actions (or in-actions) towards these policies. There is good reason to expect that these actions are reported accurately: On the one hand, USTR has no incentive to *under*state its actions (or actions of any other segment of the U.S. government). In the NTEs, USTR publically lists the U.S. government's efforts to strengthen U.S. trade interests abroad. These actions demonstrate the commitment of the government towards 'the national interest.' Greater market access abroad is generally seen as beneficial for industries and workers alike because it increases export sales and secures employment. Unlike import policies – that typically have redistributive effects and create domestic winners and losers – export relations are therefore politically uncontroversial.

On the other hand, USTR also cannot realistically *over*state U.S. government actions. The NTEs are subject to critical scrutiny of Congress and it is implausible to expect misrepresentations or exaggerations to go unnoticed or unchallenged. After all, the publication of the NTE can legitimately be seen as part of an accountability exercise, the purpose of which is to review the work of USTR and other U.S. government entities in the area of trade negotiations and enforcement. Put another way, the NTEs do not provide a balanced picture of other countries' trade policies because these policies are only mentioned along with reports about U.S. trade actions. If no such actions are reported, it is not clear what form these policies take – but it is quite clear that the U.S. government is not acting on them. Thus, even if the NTE reports are a biased source of information on foreign trade barriers, they can be expected to provide a clear picture of U.S. actions.

To convey a more concrete idea of the information the NTEs contain, the paragraphs below show three representative text samples from the country sections on Argentina, Colombia, and Korea in different reports:

```
Argentina (NTE 1997):

In December 1996, the Argentine Congress passed a data exclusivity law
for firms seeking approval to market a pharmaceutical product. Howev-
er, the law fails to protect pharmaceuticals adequately from unauthor-
ized use by third parties the data submitted to health authorities. In
January 1997, during a Special 301 out-of-cycle review (OCR), the U.S.
Government announced the suspension of 50 percent of Argentina's GSP
benefits effective in April 1997 because of Argentina's lack of patent
protection for pharmaceuticals. U.S. officials continue to urge Argen-
tina to improve its patent and data exclusivity regimes.

Colombia (NTE 2000):

Two agricultural products that have been subject to more restrictive
import licensing requirements are fresh/frozen poultry parts and pow-
dered milk. If the import licensing requirement for chicken and turkey
parts were eliminated, the U.S. industry estimates that its annual ex-
ports would increase by approximately $10 million.
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Korea (NTE 2003):

The U.S. Government also remains concerned with continued Korean
statements that its rice policies are non-negotiable in the current
WTO agriculture negotiations. Such statements serve to undermine Ko-
rea’s broader goals and initiatives within the WTO’s Doha Development
Agenda negotiations. The United States will continue to actively en-
gage Korea to ensure its full compliance with its WTO obligations on
rice and to press for further liberalization.
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It is apparent from these quotes that the NTE reports contain very detailed information on U.S. negotiation and enforcement behavior that can be linked to specific products, trade barriers and various other contextual conditions. Together, the set of NTE reports that have been published over the last three decades fill well over 10,000 pages of detailed accounts of this kind.

To systematically extract the information from the NTE reports, I implement a dictionary-based automated content analysis (ACA) routine that is specifically designed to match the structure and content of the NTE reports. Dictionary-based approaches to automated contend analysis structure the verbal information of the input documents by reducing a diverse set of individual words, phrases, or expressions down to a limited number of pre-defined, mutually exclusive, hierarchical categories (for an overview see: Liu and Zhang 2012; for an example of an application in political science see: Schrodt 2006).

Text-analysis procedures that rely on dictionaries have both advantages and disadvantages. The primary disadvantage is that the creation of dictionaries is a labor-intense task that additionally requires considerable domain-level knowledge about the nature and content of the textual sources. For this reason, dictionary methods do not scale well, i.e., they are not easily transferred to applications other than those for which they were originally designed. At the same time, the primary advantage of dictionary-based methods is that they allow detailed text analysis at the sub-document level. If applied with care, dictionary methods can be tailored to extract fine-grained information from the documents of interest. These features reflect a trade-off between specificity and generality. Methods that tend to scale better face the same trade-off but solve it in the reverse direction. These approaches mostly rely on statistical methods to uncover latent constructs such as the overall tone/sentiment or the general topic from a broader set of documents. Such methods use document-level summary statistics such as word frequencies and word distributions to infer these properties. Yet this comes at the price of sacrificing within-document structure and precludes the extraction of detailed information (for a recent review see: Stewart and Grimmer 2013).

In the present context, a key objective is to retain the considerable level of detail the NTE reports provide on products, barriers, actions and so forth. The dictionary approach I employ makes it possible to extract this subdocument-level inform. The use of dictionaries serves to reduce the complexity of the raw textual information and to organize this information along a manageable number of meaningful dimensions. The ACA procedure is a text-to-data transformation that extracts the central elements of the textual information form the NTE reports and restructures this information in a systematic data format. The NTE reports lend themselves to automated data analysis as a result of their well-demarcated subject-matter, their clear structure and their stylized wording. All three of these features greatly facilitate the task at hand because they reduce or eliminate problems typically encountered in ACA routines. The following paragraphs discuss these points.

A first favorable feature of the NTE reports is that the information they contain is fully congruent with the information requirements of the present study. The reports provide an account of U.S. trade negotiation and trade enforcement actions towards foreign trade barriers across all products and relevant trade partners – and they do so exhaustively and exclusively. Thus, the reports neither cover a selective set of actions (a subset of U.S. trade enforcement actions concerning products, intensity, etc.) nor do they cover a wider range of negotiations that is unrelated to enforcement efforts. The strong congruency between the text source and the information requirement is helpful because it removes the need for separating out irrelevant input information and thus eliminates a potentially severe source of error.

Second, the structure of the reports further simplifies the ACA procedure. Two aspects are worth mentioning in particular – the annual publication format, and the division of the reports into country chapters. This structure immediately identifies two key dimensions of the resulting data, namely the year and the trade partner. Specifically, the NTE reports, by design, cover events that happened over the previous calendar year since the last report was published (for instance, the 2010 NTE that appeared in March 2010 covers the year 2009). Consequently, the vast majority of events recounted is attributable to that year. The only deviations from this pattern occur when background information about an ongoing negotiation is provided. However, these reporting-lags do usually not exceed one or two years and rarely affect the aggregate coding output noticeably. A similar logic applies to the trade partners. Virtually all the coverage in the chapters concerns the respective trade partner and cross-references to other partners are isolated exceptions. Thus, the year and partner dimension can be identified directly via the report titles and the chapter headings – thereby eliminating further sources of error.

Together, the above features ensure that the entire information contained in a given country chapter relates to trade barriers of the given country in a given year. What remains, therefore, is to correctly identify the individual products concerned and the respective U.S. actions (as well as the different barriers for the disaggregated version of the dataset). This task is further aided by a third feature of the NTE reports, namely their structured and standardized language. The structured use of language increases the precision of the ACA routine because it makes the dictionaries vastly more effective than would otherwise be possible. In particular, the repetitive and situation-specific use of language limits the overall length of the dictionaries and increases the fit of the search terms. One particularly helpful aspect in this context is that the vocabulary used to describe U.S. actions differs strongly from that used to describe trade partner actions. For instance, words and phrases such as *point out*, *urge*, or *work with* are almost exclusively used to describe U.S. actions toward a trade partner. On the other hand, words or phrases such as *restrict*, *hinder*, or *improve* are almost exclusively used to describe trade partner actions. As a consequence, separating out and correctly attributing these actions in intertwined descriptive passages is a manageable task. Another beneficial feature of the reports is that U.S. actions, the primary dimension of interest, are almost exclusively framed in simple proactive sentence structures, which makes particle-based corrections largely unnecessary. All these aspects minimize the ambiguity and context dependency of words and phrases.

4.2 Setup and Implementation of the Automated Content Analysis

The following section presents the automated content analysis routine I implement in detail. The ACA procedure transforms textual input into data quantitative data. This transformation procedure involves a number of distinct processing steps. First, a structure recognition is run on each annual report to mark off country chapters, headings, and subheadings, as well as to identify introductory and concluding paragraphs and sentences. Second, the raw text is tagged (or annotated).[1] based on dictionaries that reflect the key dimensions of interest (trade barriers, products, actors, actions, and context). Third, qualifying expressions such as negations, conditionals and modifiers are recognized and annotations adapted accordingly. Fourth, the annotated text is translated into quantitative data on a sentence-by-sentence basis. Fifth, sentence-level data generated from longer text passages on the same topic or repeated references in different sections of the text are aggregated into a single observation on the partner-product-year(-barrier) level.

The first of the above steps is straightforward and will therefore not be discussed in more detail. The first part of the discussion below will focus on the definition and content of the individual dictionaries and the annotation procedure (processing step two). The dictionaries not only determine the structure and granularity of the resulting dataset, they also reflect the conceptual dimensions underlying the entire exercise and are thus an integral part of the ACA procedure. The second half of the discussion will then address the adaption, extraction and aggregation procedure (processing steps three to five).

Table 4.1 provides an overview of the central dimensions of interest with respect to the information extraction task. The first column presents the relevant dimensions in abstract form. The goal of the text analysis procedure is to recognize and to link the information provided in the documents in such a way that a stylized but representative picture of the verbally recounted events can be reconstructed from the extracted data. On an abstract level, this requires information on issues, actors, actions, time, and space. In the setting of the NTE reports, these abstract dimensions have more concrete situation-specific analogues that are listed in the second column of Table 4.1. These NTE-centered dimensions directly affect the definition and structure of the dictionaries as listed in

[1] I use these terms interchangeably.

the third column. Only the trade partner and year dimensions are not represented by a separate dictionary because – as mentioned above – information on these dimensions is implicit in the structure of the NTE reports. One additional dictionary that is required for the subsequent processing steps contains particles indicating negations, conditionals, and modifiers and does therefore not relate to any of the conceptual dimension of interest.

Table 4.1: NTEs – dimensions of interest and relevant dictionaries

Dimensions	Dimensions (NTE analogues)	Derived dictionaries
Why	a) Trade barriers >>	(1) Barriers
(issues)	b) Products	(2) Products
Who	c) U.S. government (+ industry)	(3) U.S. actors
(actors)	d) Trade partner government (+ industry)	(*) -
What	e) U.S. >> trade partner (enforcement)	(4) U.S. actions
(actions)	f) Trade partner >> barriers (trade policy)	(5) Trade partner (re-)actions
When	g) Year	(*) -
(time)		
Where	h) Negotiation context (forum)	(6) Context
(space)		
-	-	(7) Grammar/Particles

Note: The symbols >> signify '*affects*' or '*acts on*', an * indicates dimensions that are implicitly identified through the structure of the NTEs and therefore require no separate dictionary.

The procedure thus relies on a set of seven different dictionaries: (1) the reported trade barriers, (2) the products affected by these barriers, (3) U.S. government or industry actors mentioned in this context, (4) their reported actions, (5) the actions or re-actions of the trade partner, (6) the larger bi- or multilateral negotiation context of the reported interactions, and (7) the separate dictionary for negations, conditionals, and modifiers. All dictionaries are provided in full length in Appendix I.

The annotation process is based on POSIX-style regular expressions (regex) and is thus a typical string recognition task. In the annotation phase, regular expressions are used to recognize search terms from the dictionaries and place unambiguously identifiable markers next to each search term. In the present implementation, annotations – irrespective of the particular dictionary – are placed in square brackets '[...]'. Since these characters are not used in the original reports, they distinctly identify the set of all annotations. Each of the six dimensions of interest is then identified by an additional special character. For instance, all trade barriers are market with an '*', so that trade barrier tags take the form '[*...*]'. Within each of the six categories, differences in type or intensity are then marked by specific codes representing these sub-dimensions. To demonstrate this logic more clearly, I present short selections of three dictionaries below. Table 4.2 shows a short selection of the (1) *trade barriers* dictionary.

The search term examples presented in the right column of Table 4.2 represent the original regex terms (that are shown in Appendix I) in the form of more general Boolean expressions that abstract from the specific implementation language but reflect the same underlying logic. The search algorithm identifies word combinations that meet the specified criteria. For instance, it searches for the word *quality* and then verifies whether variations of any of the words *license*, *control*, or *inspection* are located in the vicinity of *quality*. Vicinity is defined in this context by sentence boundaries and maximum word distance tolerances that vary by dictionary. For the trade barriers dictionary, for instance, I set the tolerance to five words. As a consequence, the algorithm annotates the text if *quality* and any of the other search term components co-occur in the same sentence and are not further than five words apart. A similar logic applies if the search terms are connected by a Boolean NOT as in the first example of Table 4.2. The first term is *approval* and the second is *investment*. Because investment approvals are part of a different trade barrier category, they are excluded from the *conformity assessment* category. The algorithm then annotates the text only if the words *approval* and *investment* are placed further than five words apart and/or not in the same sentence.

Table 4.2: NTE automated content analysis dictionary – Trade barriers (selection)

Code	Description	Example search terms
B8	Conformity assessment related to technical barriers to trade (TBT)	approval NOT investment* certification NOT (origin OR safety) conformity assessment* quality AND (licens* OR control* OR inspection* OR ...) testing ...
F7	Internal taxes and charges levied on imports	charge* NOT import excise AND tax* levy* OR levi* tax* NOT (sales OR excise OR value added) value added AND tax* ...
H9	Measures affecting competition, n.e.s.	anti-competitive AND (activit* OR practice*) buy national competition AND (polic* OR affecting) import* AND substitution monopol* ...

Notes: 'Code' refers to UNCTAD Non-Tariff Measures (NTMs) classification, see: UNCTAD (2013, 2015) for details. AND, NOT, and OR are Boolean connectives, * is a 'wildcard' character.

For all positive search results from category B8, the algorithm then places a tag of the form '[*B8*]' in front of the first search term component – and equivalently for the remaining trade barrier codes. The annotation procedure thus simplifies and systematizes the raw textual information by inserting markers that link a large set of individual expressions to a smaller number of conceptually meaningful categories. In the case of the last example, this hierarchy is '*approval* NOT *investment**' < '[*B8*]' < '[*...*]' < '[...]', where < signifies 'is part of'. In words, non-investment approval procedures are a type of conformity assessment which is a type of trade barrier which is one the dimensions of interest in the overall analysis.

The codes used for the annotation of trade barriers are based on the 2-digit level non-tariff measure classification developed by UNCTAD (2013, 2015). For a range of barriers, the UNCTAD classification contains more detailed sub-classifications at higher-digit levels (such as B81, B81, and so forth) that I do not separately record. I complement the UNCTAD classification by adding a category T for tariffs. I further split the category N concerning intellectual property rights into three subcategories N1, N2, and N3, for patents, copyrights, and trademarks, respectively. Overall, this level of detail corresponds best with the verbal references in the NTE reports. A total of fifty-seven barrier types are distinguished.

The logic for the remaining five dictionaries is largely analogous. For this reason, I will discuss most of these only briefly and only go into some more detail with regard to the (2) *products* and the (3) *U.S. actions* dictionaries. The products dictionary is particular of interest because it defines the granularity at which data are coded and is thus also determines the level of detail at which the main analysis in Chapter 7 is conducted. The *U.S. actions* dictionary is also central for the analysis in Chapter 7 because it forms the basis for constructing the required measure of dispute intensity or escalation (i.e., the dependent variable).

A brief selection of the (2) *products* dictionary is shown in Table 4.3. The table lists three examples of a total of 279 industries and is intended to provide an intuition about the level at which products are delineated in the analysis. The product codes are based on a mixed industry classification. This mixed classification combines Harmonized System (HS) 4-digit categories for agricultural products with International Standard Industrial Classification (ISIC Rev.3) 4-digit categories for manufacturing and services. For each product code, the prefix H indicates HS codes whereas the prefix I indicates ISIC codes. This level of detail is chosen because it matches best with the verbal descriptions in the NTE reports. First, the ISIC classification provides only a handful of agricultural sector categories (for instance, 'growing of cereals and other crops') that group a large number of products together. Second, the HS classification does not include services. In the manufacturing sector, the ISIC categories clearly fit better overall.

The (3) *actors* dictionary serves the primary purpose to identify U.S. government actors in order to correctly attribute U.S. government actions. One of the advantages of the country chapter structure of the NTE reports is that trade partners are identified implicitly (that is, through the chapter heading) and therefore do not require a separate dictionary. I further discuss this point below. Search terms in the *actors* dictionary include *the United States*, *the Administration*, *USTR*, *we*, *our*, *us*, or combinations of *U.S.* and words such as *delegation*, *department*, *officials*, and so forth.

The *actors* dictionary further serves to identify references made to U.S. or foreign industries. Relevant search terms in this category are mostly combinations of either *U.S.* or *foreign* and words such as *business*, *industry*, *company*, or more specifically *automakers*, *airlines*, *insurers* and the like.

Table 4.3: NTE automated content analysis dictionary – Products (selection)

Code	Description	Example search terms
H_0805	Citrus fruit	citrus grapefruit* lemon* mandarin* orange* ...
I_2924	Machinery for mining & construction	bulldozer* construction AND (machinery OR equipment) earth moving extraction AND equipment oil AND equipment ...
I_6200	Air transport	airline* airways carrier* AND (air OR aero) civil aviation NOT fleet space launch ...

Notes: Product codes beginning with 'H' refer to the HS classification; codes beginning with 'I' refer to the ISIC rev. 3 classification. AND, NOT, and OR are Boolean connectives, * is a 'wildcard' character.

The (4) *U.S. actions* dictionary is of key interest for investigating dispute and escalation behavior. Due to its importance, I present a slightly more extended selection of this dictionary in Table 4.4. The set of possible U.S. actions is grouped into six different categories that reflect increasing levels of intensity.[2] The Boolean search term combinations in this dictionary now mostly link verbally expressed actions to U.S. government tags that are already placed in the text from the previous annotation round based on the *actors* dictionary. This not only simplifies the dictionary structure but also enhances the precision of the attribution of actions to the correct source.

At the lowest level of intensity, actions of level 1 capture passive expressions of concern in various forms that do not imply any direct diplomatic contact between U.S. and trade partner officials. Typical phrases that often appear in the reports are '*the United States is worried that ...*' or '*the U.S. government will continue to watch ...*'. Level 2 actions capture low level diplomatic interactions as suggested by the selected search terms. Typical phrases falling into this category are '*The United States has raised this issue with the government of ...*' or '*U.S. officials have stressed that ...*'. Level 3 actions are more severe in tone and indicate that the U.S. is actively opposing a given policy and/or exerting pressure on the trade partner's government. Search words such as *push*, *press*, or *urge* are representative of the kind of vocabulary used in this context.

[2] The dictionary also contains a U.S. industry section covering private sector actions. This section is contained in the full dictionary list in Appendix I. I do not discuss it here.

The second half of the table then captures the more robust interactions. Level 4 essentially captures threats to active trade enforcement and retaliatory action. When not accompanied by any of the level search terms of levels 5 or 6, references to the dispute resolution articles of the NAFTA treaty (Chapter 19 and 20) or the GATT/WTO (Article XXII) are often made in the prospective form, for instance, '*the United States retains its right to seek resolution under Article XXII of the GATT*'. Statements about the intention to *review* a country's status under the General System of Preferences (GSP) also fall into this category. Lastly, as noted above, Section 301 is the United States' primary trade law section for retaliatory action. However, U.S. industries can file a petition under Section 301 to have a certain issue investigated by USTR. In combination with these search terms, therefore, the reference to Section 301 implies merely that USTR is considering to open such an investigation.

Level 5 captures explicit references to trade enforcement actions at the WTO, under Section 301 or a range of other U.S. trade laws. Finally, level 6 actions involve the actual implementation of sanctions or other forms of retaliatory action. The search terms in this category – such as *suspension*, *withdrawal*, or *retaliation* – are indicative of the typical vocabulary used to describe these actions in the reports.

Table 4.4: NTE automated content analysis dictionary – U.S. actions (selection)

Code	Description	Example search terms
G-Act-1	U.S. Gov. escalation level 1	concern* AND <USG> hope* AND <USG> monitor* AND <USG> watch* AND <USG> (worri* OR worry*) AND <USG> ...
G-Act-2	U.S. Gov. escalation level 2	rais* AND <USG> seek* AND <USG> stress* AND <USG> talks AND (<USG> OR experts OR held OR hold* OR ...) technical consultation* AND <USG> ...
G-Act-3	U.S. Gov. escalation level 3	oppos* AND <USG> push* AND <USG> (to press OR pressur*) AND <USG> trade law* AND <USG> (urge* OR urging) AND <USG> ...
G-Act-4	U.S. Gov. escalation level 4	Article XXII AND (WTO OR GATT) NAFTA AND (Chapter 19 OR Chapter 20) review AND (concession* OR GSP) Section 301 AND (file* OR petition*) WTO consultations AND <USG> ...

G-Act-5	U.S. Gov. escalation level 5	appellate AND (body OR report OR find* OR found OR ...) panel AND (NAFTA OR WTO OR request* OR proceed* OR ...) request* AND establishment Section 301 AND <USG> WTO ruling ...
G-Act-6	U.S. Gov. escalation level 6	sanctions AND (<USG> OR WTO) Section 301 AND sanctions suspend* tariff reduction AND <USG> retaliat* AND (<USG> OR WTO) withdrew *'s benefits AND <USG> ...

Notes: AND, NOT, and OR are Boolean connectives, * is a 'wildcard' character, <> refers to the set of all tags from a different annotation category, so <USG> refers to all previously set tags on U.S. government actors.

The (5) *trade partner (re-)actions* dictionary covers actions or re-actions of the respective trade partner and captures the effects – as seen from the U.S. point of view – of the partners trade policies and changes in these policies. The dictionary has two sections with three categories each. The first section covers negative statements about these policies, whereas the second section covers positive statements. Similar to the U.S. actions search terms that are linked through Boolean connectives to U.S. actors, the search terms in this dictionary are often linked to trade barrier tags (if they are adjectives) or to the country name of the trade partner (if they are verbs) to ensure their correct assignment.

The mildest category of negative statements includes references to policies that are adverse to U.S. interests but not referred to as intentional. Typical examples refer to procedures or requirements as *arbitrary*, *burdensome,* or *time-consuming*. The second negative category captures statements that imply willful and more severe measures. References to distortions of trade, the preclusion of market access, or the protection of domestic industries fall into this class. The third negative category covers policies with severe effects that for instance *ban/block* imports, or *inhibit/deny* market access. In the positive section, the mildest category contains smaller reforms or pledges for reforms. Examples for search terms are *revise*, *simplify,* or *promise*. The second positive category captures references to tangible *progress*, *reductions* of barriers, or the fulfillment of commitments. The most positive category refers to the barriers that have been *lifted*, *abolished,* or *removed*, markets that have been *opened* or problems that have been *resolved*.

The (6) *context* dictionary contains search terms that provide additional background information about the specific circumstances in which negotiations take place. It contains four categories: First, bilateral single-issue negotiation, which is the default category and refers to product specific negotiations between the U.S. and the respective trade partner. Second, bilateral multi-issue negotiations – typically references to free-trade agreement negotiations. Third, multilateral single-issue negotiations that involve *other governments* or take place *in the WTO* or other multilateral forums but concern a specific product. Fourth, multilateral multi-issue negotiations such as WTO accession talks or Trade Rounds.

Lastly, the (7) *particle* dictionary contains a set of negations (*no*, *not*, *neither*, *nor*, *without*, etc.), conditionals (*could*, *if*, *may*, *might*, etc.), qualifiers (*few*, *less*, *partial*, *slight*, etc.), and intensifiers (*considerable*, *severe*, *substantial*, etc.). This dictionary is targeted mostly, although not exclusively, at annotations resulting from the *trade partner (re-)actions* dictionary because these annotations are often expressed in combinations with these particles. Ignoring this information can easily lead to inaccurate results. For example, a statement that Korea has lowered its tariffs for a given product is very different in meaning from a statement that Korea has *not* lowered its tariffs for that product. These concerns are much less prevalent with regard to the U.S. action dimension – simply because references to U.S. actions tend not to be negated or qualified in the NTE reports. From a technical point of view, the particle-based corrections are an interesting part of the ACA procedure. The adaption of the raw annotations on the basis of the identified particles and a range of other syntax-based rules is the first processing step following the iterative annotations. Because the main focus in the context of this study is on U.S. actions, however, I do not discuss this issue in great detail.

With all annotations placed and adapted, the next step in the ACA procedure is to read out the quantitative data. As a result of the annotation procedure, the high degree of complexity of the raw verbal statements in the text has been reduced to a small number of dimensions along which the central information can be collected. The primary objective is to combine this information so that the resulting output consists of unique partner-product-year(-barrier) combinations. These combinations define the structure and the number of observations (i.e., rows) of the resulting dataset. The combined information on actions and context-factors relating each of these observations is then stored in additional data vectors (i.e., columns). This requires the structured information from the annotations to be first collected and then aggregated to match the desired partner-product-year(-barrier) format.

To make the exposition more concrete, the following paragraphs show the annotated versions of the plain text segments introduced above:

```
Argentina (NTE 1997):

In December 1996, the Argentine Congress passed a data exclusivity law
for firms seeking approval to market a [:I_2423:] pharmaceutical prod-
uct. However, the law [-neg2-] fails to [+pos0+] protect [:I_2423:]
pharmaceuticals [+pos0+] adequately from unauthorized use by third
parties the data submitted to health authorities. In January 1997,
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during a [$G-Act-3$] Special 301 out-of-cycle [$G-Act-4$] review (OCR), the [USG] U.S. Government announced the [$G-Act-6$] suspension of 50 percent of Argentina’s GSP benefits effective in April 1997 because of Argentina's [-neg2-] lack of [*N1*] patent [+pos0+] protection for [:I_2423:] pharmaceuticals. [USG] U.S. officials continue to [$G-Act-3$] urge Argentina to [+pos0+] improve its [*N1*] patent and data exclusivity regimes.

Colombia (NTE 2000):

Two agricultural products that have been [-neg1-] subject to [°+l°] more [-NEG3-] restrictive [*E1*] import licensing [-neg2-] requirements are fresh/frozen [:H_0207:] poultry parts and powdered [:H_0401:] milk. [°=0°] If the [*E1*] import licensing [-neg0-] requirement for [:H_0207:] chicken and turkey parts were [+pos0+] eliminated, the [USI] U.S. industry [$I-Act-3$] estimates that its annual exports would increase by approximately $10 million.

Korea (NTE 2003):

The [USG] U.S. Government also remains [$G-Act-1$] [-neg2-] concerned with continued Korean statements that its [:H_1006:] rice policies are non-negotiable in the current ['cxt-4'] WTO agriculture negotiations. Such statements serve to [-neg2-] undermine Korea’s broader goals and initiatives ['cxt-4'] within the ['cxt-4'] WTO’s Doha Development Agenda negotiations. The [USG] United States will continue to actively [$G-Act-2$] engage Korea to ensure its full compliance with its WTO obligations on [:H_1006:] rice and to press for further [+pos0+] liberalization.

All tags are placed in front of the primary word they refer to. Product codes from the *products* dictionary are enclosed in ‘[: ... :]’ such as [:I_2423:] for pharmaceutical products in the first sentence. Tags in ‘[-...-]’ or ‘[+...+]’ refer to negative and positive trade partner (re-)actions. The digits behind the enclosed codes signify the level of these actions. In the given example, *fail to* is a negative action of level 2. The positive tags for *protecting* and *adequate* are set to zero. This is part of the syntax and particle-based correction procedure and follows the simple logic that ‘failing to do something positive’ is not ‘something positive’. The same logic applies in similar contexts where actions of reverse signs occur together, such as in the third sentence of the same paragraph, or if a trade partner is reported to be ‘*unwilling to resume free trade*’ or to have ‘*lifted a ban*’. All ‘[$G-Act..$]’ annotations refer to U.S. government actions of the indicated intensity, as taken from the *U.S. actions* dictionary. The ‘[*N1*]’ tag is from the *trade barriers* dictionary and refers to matters of patent protection. The ‘[+pos0+]’ tag in the last sentence of the first paragraph is set to zero. This is another aspect of the syntax-based corrections. This correction is implemented because positive terms that co-occur with references to the U.S. government and low-level U.S. actions are almost always used in a prospective/normative meaning that does not reflect actual events.

In the second paragraph, all ‘[°...°]’ tags refer to negations and modifiers. In the first sentence, the ‘[°+l°]’ intensifier changes the tag on ‘restrictive’ from level 2 to level 3 on the negative scale. In the second sentence, the ‘[°=0°]’ annotation marks the conditional nature of the sentence. As a result all actions are set to zero. The paragraph also references U.S. industry and U.S. industry actions. In the last paragraph, the '['cxt-4']' refers to the multilateral multi-issue negotiation context.

When reading out the information contained in the annotations into the desired data format, the words that make up the original text are ignored.[3] However, the larger structure of the reports is not ignored. The sentence, paragraph, and heading structures continue to provide important information. To see this, consider the first of the three text examples on Argentina. The information that flows into the aggregation procedure consists of the year (from the report heading), the trade partner (from the chapter heading), potentially, but not in this case, the product or barrier primarily concerned from the section heading, and the information directly contained in the paragraph/sentence structure along with the annotations themselves. For the given example:

```
1997
ARG

[:I_2423:].
[-neg2-][+pos0+][:I_2423:][+pos0+].
[$G-Act-3$][$G-Act-4$][$USG$][$G-Act-6$][-neg2-][*N1*][+pos0+][:I_2423:].
[$USG$][$G-Act-3$][+pos0+][*N1*].
```

This collection of abbreviations represents the information that the method I use can extract from the paragraph under consideration. Translated back into plain language:

```
In 1997,
concerning Argentina...

Pharmaceuticals are mentioned.
Argentine policies on pharmaceuticals are problematic.
The U.S. imposes sanctions on Argentina regarding pharmaceutical pa-
tents.
The U.S. is active on the patent issue.
```

Words in italics refer to clear-cut categories as defined by the dictionary entries. It is apparent from the four sentences that not all sentences contain all parts of the relevant information. For instance, only the last two sentences refer to patent issues but it is clear from context that the whole paragraph is devoted to this topic. Using the information contained in the document structure makes it possible to recognize these kinds of implied dependencies between sentences in the aggregation procedure. In particular, I implement a number of aggregation rules that use this structure. In the present example, there is only one product and one barrier type mentioned in the whole paragraph and there is a good degree of overlap in similar annotations be-

[3] This reflects the split nature of the information extraction process. First, the verbal text forms the basis for the placement of the annotations that condense and structure the key information contained in the reports. Second, this condensed information is extracted and aggregated appropriately.

tween the sentences. In such cases, all the information in the paragraph is attributed to the given product-barrier combination. The result of the procedure is a single row of data that takes the following form (plus some additional variables that I list below):

```
Partner     Year     Product     Barrier   Par. Action  U.S. Action
ARG         1997     I_2423      N1        -2           6
```

For the U.S. Action category the aggregation procedure selects the maximum of the reported actions. This result appears to be in line with what a manual coding of the paragraph would yield.

It also happens frequently that several products are mentioned in a single paragraph, as in the second example, which refers to Colombia. In these cases, the aggregation process becomes more sensitive and moves towards sentence-wise attribution of information. For instance, the reference to U.S. industry in that paragraph would be attributed to the observation on poultry, but not to that on milk. Further, if several products are listed within a single sentence, the information is attributed to all products. In the other extreme, if several paragraphs cover a single product, the information is aggregated across paragraphs. Information contained in headings is given additional weight. If, for instance, a particular barrier is mentioned in a heading, then this barrier is coded as the primary issue of concern. Finally, if product-(barrier) combinations are mentioned in separate sections of a partner country chapter, the resulting observations are aggregated as well so that the partner-product-year(-barrier) ensues.

4.3 Results, Discussion, and Validation

The result of the automated content analysis procedure is a detailed dataset that captures the central aspects of U.S. trade negotiation and enforcement activities over the period from 1988 to 2015. The data extracted from the reports cover U.S. trade negotiation and enforcement activities towards 81 U.S. trade partners in 279 different products groups and relating to 57 different types of trade barriers over a period of 28 years. The dataset comes in two versions – with barrier types either disaggregated or collapsed into a single partner-product-year observation reflecting the overall product-level interactions between the U.S. and its trade partners. The two versions of the dataset have 103,585 and 51,503 non-zero observations, respectively (i.e., U.S. trade partners are on average reported to have, for each product, roughly two different trade barriers in place). A particularly interesting feature of the data is that it covers the entire range of possible activities from inaction, over various forms of diplomatic exchanges, to the imposition of sanctions and retaliatory action. As a consequence, the dataset provides a nuanced picture of the pattern of conflictiveness surrounding U.S. trade relations.

As a result, the data present a detailed picture of the bilateral interactions surrounding trade-related disagreements. This is apparent in direct comparison to the WTO data. Suppose the WTO data were organized to correspond to the same 279 product categories as the U.S. dataset. Then the U.S. data would contain roughly 100 times (51,503 observations/520 observations) more observations. Yet since these observations relate only to the U.S. as 'complainant' and not to the entire trade network, these observations pertain to roughly 150 times (160 partners/25,440 partners) fewer potential cases. This implies that the U.S. data is about 15,000 times denser than the WTO data.

The U.S. trade negotiation and enforcement data I present here can be seen as covering a middle ground in terms of breadth and depth between case studies and WTO focused analysis. By covering a large number of trade partners and products, it is sufficiently broad to allow structured and systematic comparisons. At the same time it, is sufficiently deep to retain important nuances also at very low levels of conflictive interaction while avoiding the focus on the most extreme cases that both case studies and WTO-related analysis tend to have.

Besides the information on the core dimensions of interest (partner, product, year, barrier type, partner action, and U.S. action), the dataset contains supplementary information of various kinds. In particular, a number of variables indicate whether a product is mentioned at all, whether it is mentioned in a heading, and how much space is attributed to the discussion of the product (i.e., the aggregated word count of the relevant sections). A second set of variables concern references to industry interests and actions. These capture whether foreign or U.S. industries are mentioned, and in the case of U.S. industry, what action these industries take (see Appendix I for details). One variable indicates whether the United States or the U.S. government is mentioned irrespective of whether an action is reported. A set of dummy variables separately indicate WTO disputes, Section 301 action, or the application of other U.S. trade laws. A last variable contains the information on the negotiation context based on the corresponding dictionary as described above.

Nonetheless, the general comprehensiveness and level of detail of the dataset are only one aspect in assessing its value. The quality and accuracy of the data are a second aspect of crucial importance in any application. For this reason, I have invested considerable effort in setting up and improving the procedure. The dictionaries have undergone extensive fine-tuning in order to minimize both false positives and false negatives in the annotation stage. The processing and aggregation procedure addresses further sources of error. In particular, the sentence-based data extraction procedure results in repeated sets of information on the same event and reduces the likelihood that events are overlooked. Especially in longer sections, the retrieved information is often repetitive. The sentence-level data extraction thus adds additional robustness to the aggregation process and reduces the occurrence of false negatives. Complete omissions of reportings are likely to occur only with regard to events that are near the reporting threshold and only mentioned in passing.

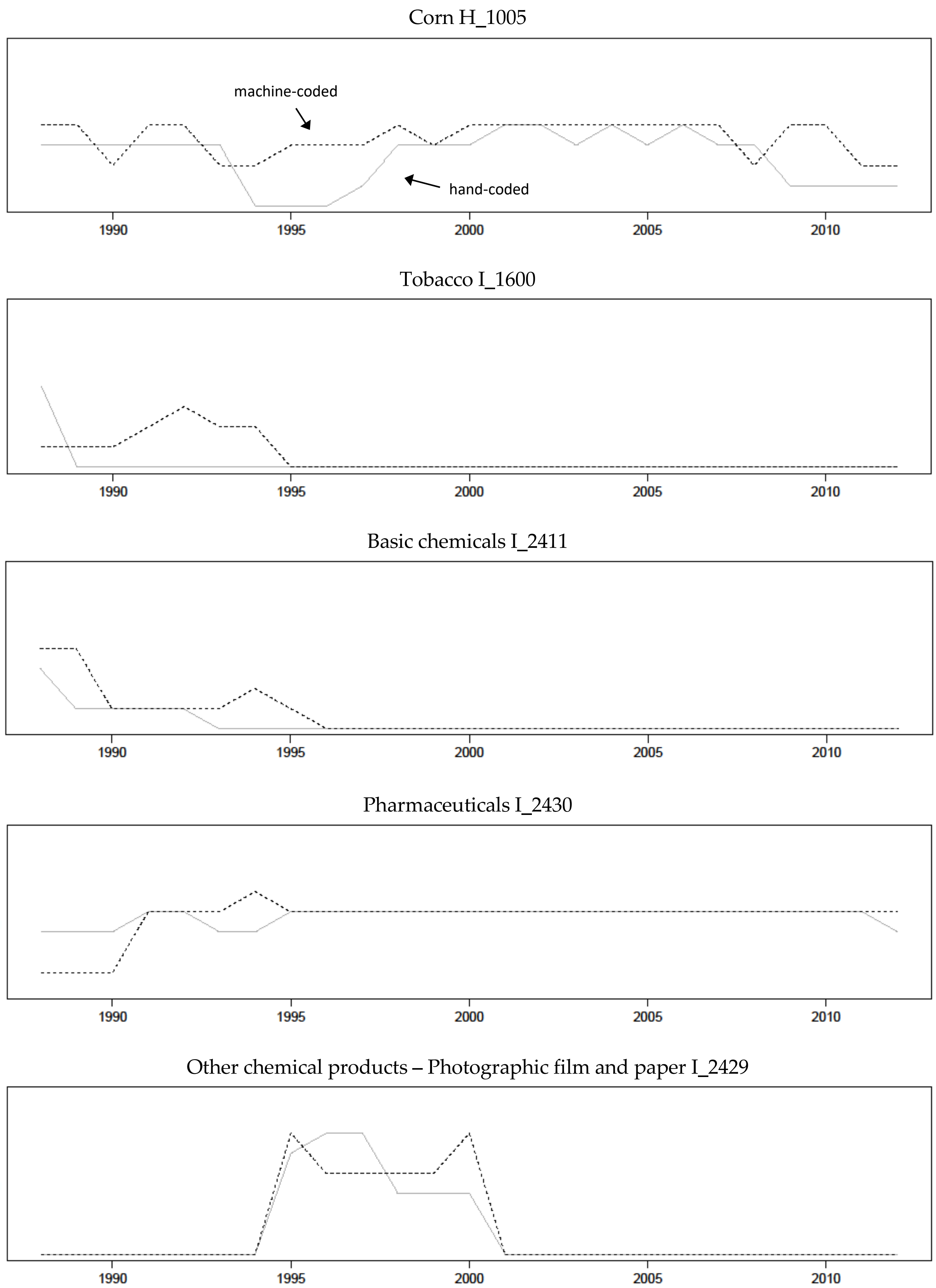
Like the dictionaries, the aggregation rules have gone through various rounds of adjustment to ensure the most accurate results. One important consequence of these efforts is that the attribution of actions to products (and barriers) works well. In combination with the year and partner information retrieved from the report structure, this ensures a considerable degree of accuracy in the final partner-product-year-(barrier) data format and the correct attribution of U.S. actions.

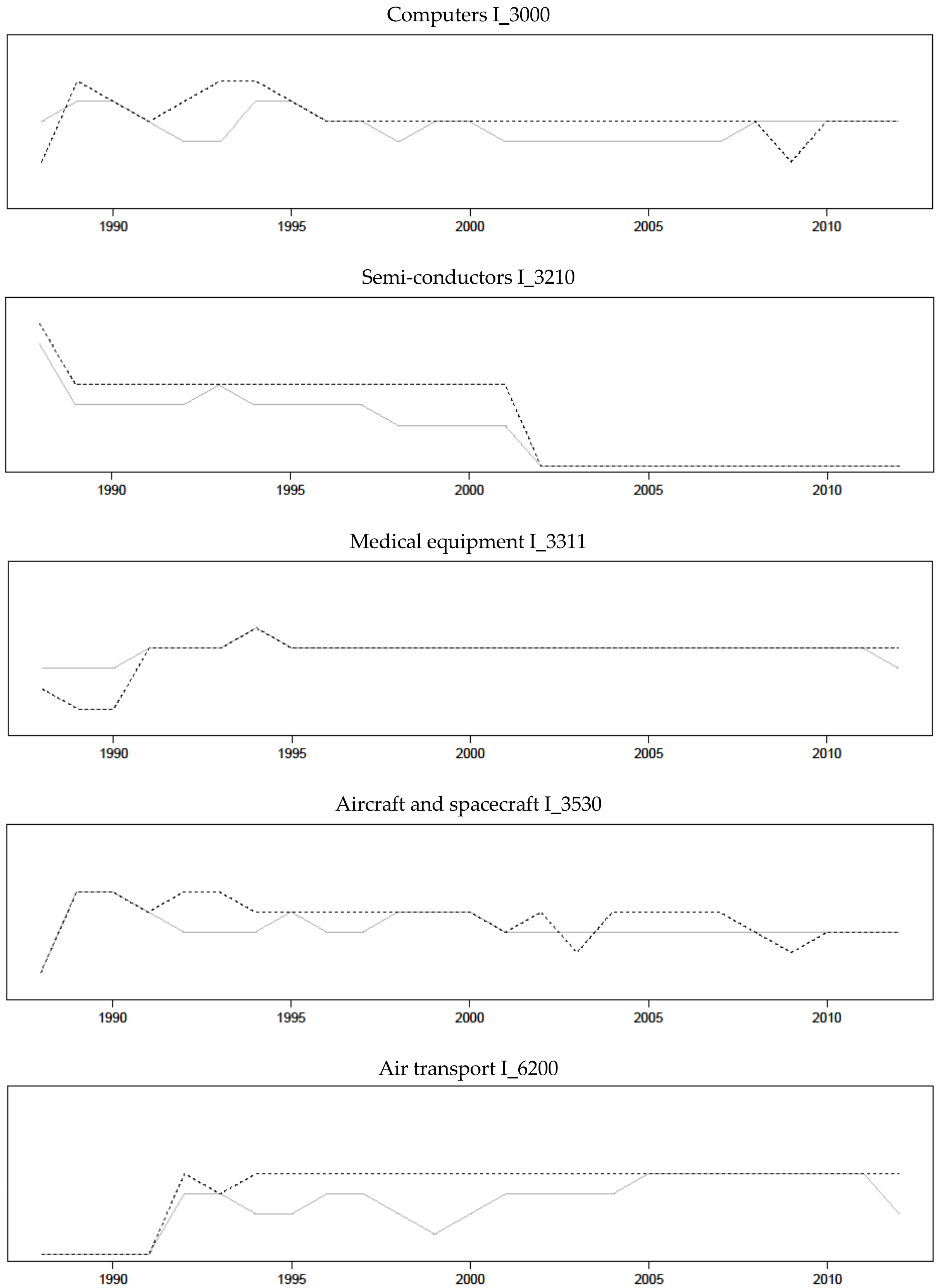
To further increase the data quality, I have compared the results of the automated coding procedure against external information on WTO disputes and Section 301 cases initiated by the U.S. (the former taken from the WTO website, the latter from USTR). This procedure ensures that all observations in the data with U.S. enforcement actions of level 4, 5, and 6 (as defined in the second half of Table 4.4) are complete and correct.

To further validate the procedure, I hand-coded the chapters on Japan (the United States' on average largest, non-NAFTA, WTO trade partner over the regarded time period) across all NTE reports to enable a direct comparison between the ACA results and human coding. I focus on the U.S. action dimension which of primary relevance for the further analysis. To capture the complete range of U.S. efforts from complete in-action to high-level enforcement, I construct a composite measure on a 0 to 8 scale. For any given product, the measure is equal to zero if no reference at all is made to that product in a given year. If the product is mentioned but no reference to the U.S. is made, the measure takes on a value of one. If the product is mentioned and a general reference is made either to the United States or the U.S. government, but no explicit action is reported, the measure takes on a value of two. If further references are made to U.S. actions, the scores from the 1-6 scale of the U.S. actions dictionary are added to this value of two. Thus, references to the U.S. government being worried (a level 1 action) receive a value of three, and so forth. Thus, the treatment and discussion of a product-related barrier in the NTE is interpreted as the first sign of U.S. activity on the issue. The U.S. is therefore seen as completely inactive concerning a given product only if no reference of any kind is made towards that product.

The automatically and manually coded data series both cover the full range of products over twenty-eight years and contain close to 8000 observations. For each product, the data show the intensity of U.S. activities over time and therefore represent the 'enforcement history' relating to that product. To get a first idea of how well the two series correspond, I compute the average level of U.S. activity for each product over time and calculate the correlation between these averages. The correlation is 0.73, when the median is used to calculate the time-averages, and 0.76 when the mean is used. These values suggest that there is considerable correspondence between the results from the ACA procedure and the data obtained via manual coding. To get a more tangible impression of how the two series relate, Figure 4.1 shows plots of the entire 'enforcement histories' of the ten most important U.S. export products to Japan in the period under consideration. The ranking is based on the deflated time-average U.S. export flows per industry over the twenty-eight year period. Appendix II contains the plots for all products. It is apparent from these plots that although the correspondence is not perfect, the machine-coded and hand-coded data series extract the same signal in both intensity and timing. Taken together, therefore, the ACA data seem sufficiently valid in capturing U.S. actions towards its trade partners.

Figure 4.1: Comparison of ACA results to manual coding – Top 10 U.S. exports to Japan





Note: The black dashed line shows the auto-coded data and the gray solid line shows the manually-coded data.

5 Measuring Stakes – Prerequisite I: Estimating Trade Elasticities

Trade barriers create *price wedges* between domestic and imported varieties of products. The present chapter begins to introduce the procedure to actually quantify the effects of these price wedges. Because they reflect the price-sensitivity of consumers, elasticities – and in particular the elasticity of substitution, which measures the price-sensitivity of consumers with respect to these products – provide crucial information for any assessment of the effects of trade barriers on actual trade flows. This is true both for assessing the severity of existing trade barriers and for assessing the effects on trade flows if those existing barriers were to be relaxed or removed. In other words, elasticities are important inputs both for the estimation of non-tariff barriers to trade (NTBs), as described in Chapter 6, as well as for the operationalization of parties' stakes in the trade relations affected by these NTBs in Chapter 7.

This chapter introduces the logic and importance of trade elasticities and their role in the larger context of this study in some more detail. The primary purpose of the chapter is then to introduce the methodology employed in actually estimating these elasticities along with a discussion the methodological issues that arise in this context. In general, elasticities measure the degree to which the quantities demanded and supplied of traded goods and services react to changes in prices – they are thus a measure of price-responsiveness. As such, they reflect the underlying price-sensitivity of market participants with respect to a particular good or service. Elasticities are typically expressed in terms of relative percent changes. In a market context, they answer questions such as 'by how many percent does the quantity demanded of a good change as the price of that good increases by one percent?' Depending on exactly which two variables one relates to each other, various different kinds of elasticities can be defined.

Of primary importance with respect to international trade is the so-called elasticity of substitution – commonly designated with the Greek letter sigma (σ). Within an Armington framework, the elasticity of substitution measures by how much the *relative* quantities demanded of different national varieties of a product change as the *relative* prices of these varieties change. It captures relative as opposed to absolute changes and is thus a measure of substitutability of different product varieties in the eyes of consumers. In line with most of the literature, I assume that consumers treat domestic and foreign varieties alike, so that the elasticity of substitution is also the 'import demand elasticity' that governs the substitutability between domestic and imported varieties (otherwise, the two-tier utility structure of consumers, as mentioned in Section 2.2., would turn into a three-tier structure with separate budgeting allocations a) between products, b) between domestic and the set of foreign varieties of these products, and c) between the different foreign varieties).

As also noted in Section 2.2, higher elasticities of substitution indicate more homogenous products. The elasticity of substitution can thus be interpreted as an "inverse index of product differentiation" (Head and Mayer 2004, p. 2617). Consumers of homogenous (i.e., non-differentiated) products such as natural gas or palm oil should be expected to be relatively price-sensitive. Those products therefore have high elasticities of substitution. The logic is that if the relative price of, say, palm oil from Indonesia rises even slightly, then this should result in a comparatively large decrease in relative demand for Indonesian palm oil because am equivalent variety is available for a lower price from another source, such as the Philippines or Malaysia. For instance, a two percent rise in price may lead to a 12 percent drop in quantity demanded. This would imply an elasticity of substitution of 6 (i.e., $\sigma = 12\%/2\% = 6$).

Conversely, consumers of highly differentiated goods such as specialized machinery parts or branded goods such footwear or (alcoholic) beverages are expected to be much less price-sensitive. Even if the price of these products rises noticeably, alternative varieties cannot replace the original as easily because consumers assess these products not only in terms of price but also in terms of non-price characteristics. Such products should therefore exhibit a lower elasticity of substitution. It might, for instance, be the case that a two percent price increase leads to a 5 percent drop in quantity demanded. This would imply an elasticity of substitution of 2.5 (i.e., $\sigma = 5\%/2\% = 2.5$).

Another elasticity that is relevant in the context of international trade is the so-called export supply elasticity. Unlike the elasticity of substitution (and the import demand elasticity) the export supply elasticity is a supply side parameter and describes producer reactions to changes in relative prices (rather than consumer reactions). The estimation method described below allows for estimating both the elasticity of substitution and the export supply elasticity. The discussion in that context will go into some more detail on the role of the export supply elasticity. The export supply elasticity is discussed again in the context of the counterfactual simulations described in Chapter 7.

Elasticities are thus important because they provide a crucial link between prices and the market reactions to such prices. Without this information the transmission mechanism that connects the behavior of market participants remains unspecified. In particular, elasticities are a key ingredient for simulation studies that are performed both within national trade departments and by researchers who seek to assess the (potential) effects of various policies (or any other shocks to demand and supply such as changes in consumer income, exchange rates, business cycle effects, or government policies). The central role of elasticities is exemplified by Hillberry and Hummels who call the elasticity of substitution "the most important parameter in modern trade theory" (2013, p. 1217).

Because trade policies manipulate prices, elasticities are an essential ingredient to assess the actual or potential effects of such policies. Again, because policy barriers to trade drive wedges between the prices of domestic and imported varieties of a product, the price-sensitivity of consumers with respect to the given product has important implications for the effectiveness of trade barriers. This relationship also holds in reverse. As the discussion in chapter 6 demonstrates, knowledge of observed trade frictions in combination with estimates of product specific elasticities makes it possible to infer the stiffness of trade barriers.

The chapter proceeds in three steps. Section 5.1 introduces the particular difficulties that arise in any effort to estimate elasticities. It discusses the underlying problem of the simultaneous determination of quantities and prices in the market place and the resulting identification problem. Section 5.2 then presents the method employed to address these difficulties. Specifically, the section presents a procedure to estimate the required elasticities in a simultaneous equations system. Section 5.3 describes the data requirements and implementation details of the method and presents the results of the estimation procedure. The section further presents evidence that substantiate the validity of the results.

5.1 Simultaneous Price Determination and the Identification Problem

When estimating elasticities, one seeks to quantify the percentage by which quantity demanded changes as the result of a given percentage change in price. Two problems typically arise in this context. The first problem is the standard problem of simultaneity in regression. The second problem is the lack of appropriate instruments – by means of which the simultaneity problem is usually addressed – in the context of global product-specific trade relations. The following section discusses these issues in turn. The simultaneity problem is discussed at some length because it is key to the estimation procedure presented below.

If it could reasonably be assumed that price was an exogenous factor that is in itself not affected by changes in demand, this goal would be straightforward to achieve by regressing the quantity demanded of a good on the price of that good. The simultaneity problem stems from the fact that in demand and supply systems, (changes in) quantities and prices are not exogenous to each other but are simultaneously determined in the market. This sort of problem typically arises in situations in which the observed outcomes – that is, our data – result from an equilibrium mechanism. As a consequence, 'quantity' cannot be treated as being the dependent variable and 'price' as being the independent variable in a regression setup. To see why this leads to simultaneity bias, consider the following system of equations

$$q_t^D = \alpha_0 - \alpha_1 p_t + u_t \tag{1}$$

$$q_t^S = \beta_0 + \beta_1 p_t + v_t, \tag{2}$$

where the first equation is the demand function, the second equation is the supply function, q_t^D is quantity demanded, q_t^S is quantity supplied, p_t is price, and u_t and v_t are exogenous shocks to demand and supply, all at time t. The parameters of interest are α_1 which is the slope of the demand 'curve' and β_1 which is the slope of the supply 'curve'.[1] As indicated by the signs of the coefficients,

[1] To interpret these parameters as elasticities, the equations would have to be specified in log-log form. For expositional ease, I present the discussion in this section in terms of linear demand and supply functions. In logged form, α_1 would be the elasticity of substitution (σ) and β_1 would be the export supply elasticity.

demand is expected to be negatively related to price and supply to be positively related to price. The equations are depicted by the D and S lines in the panel a) of Figure 5.1.

One would like to estimate the slopes of the respective curves but all one sees is a cloud of equilibrium points with the distribution of the points created by movement of the curves (not depicted) due to random unobserved shocks that hit over time. Because in equilibrium

$$q_t^D = q_t^S = q_t, \tag{3}$$

the demand and supply curves cannot move independently of each other. In fact, the two equations have exactly the same form, so without further information it is impossible to tell them apart. In other words, if one were to regress quantity on price, it would not be clear whether one was estimating the demand curve or the supply curve because they look identical – only that the demand curve has a negative price coefficient while the supply curve has a positive price coefficient. If the absolute values of the price coefficients happened to be of the same size and the same was true for the random supply and demand shocks, then the quantity effects of changes in price would cancel out. In this case, any regression estimate of the price coefficient would be close to zero.

Other scenarios are possible as well. Suppose that, for some reason, only the supply curve has moved during a given time period while there have been no shocks to demand, as depicted in the panel b) of Figure 5.1. In this case, the observed price-quantity pairs that make up our data would line up exactly along the demand curve (indicated by the dots at the intersections of the curves). Because there are no changes to the demand schedule[2] in this scenario, no such changes can feed back into the market mechanism and affect the supply side. In this case, the simultaneity bias would not be a concern.

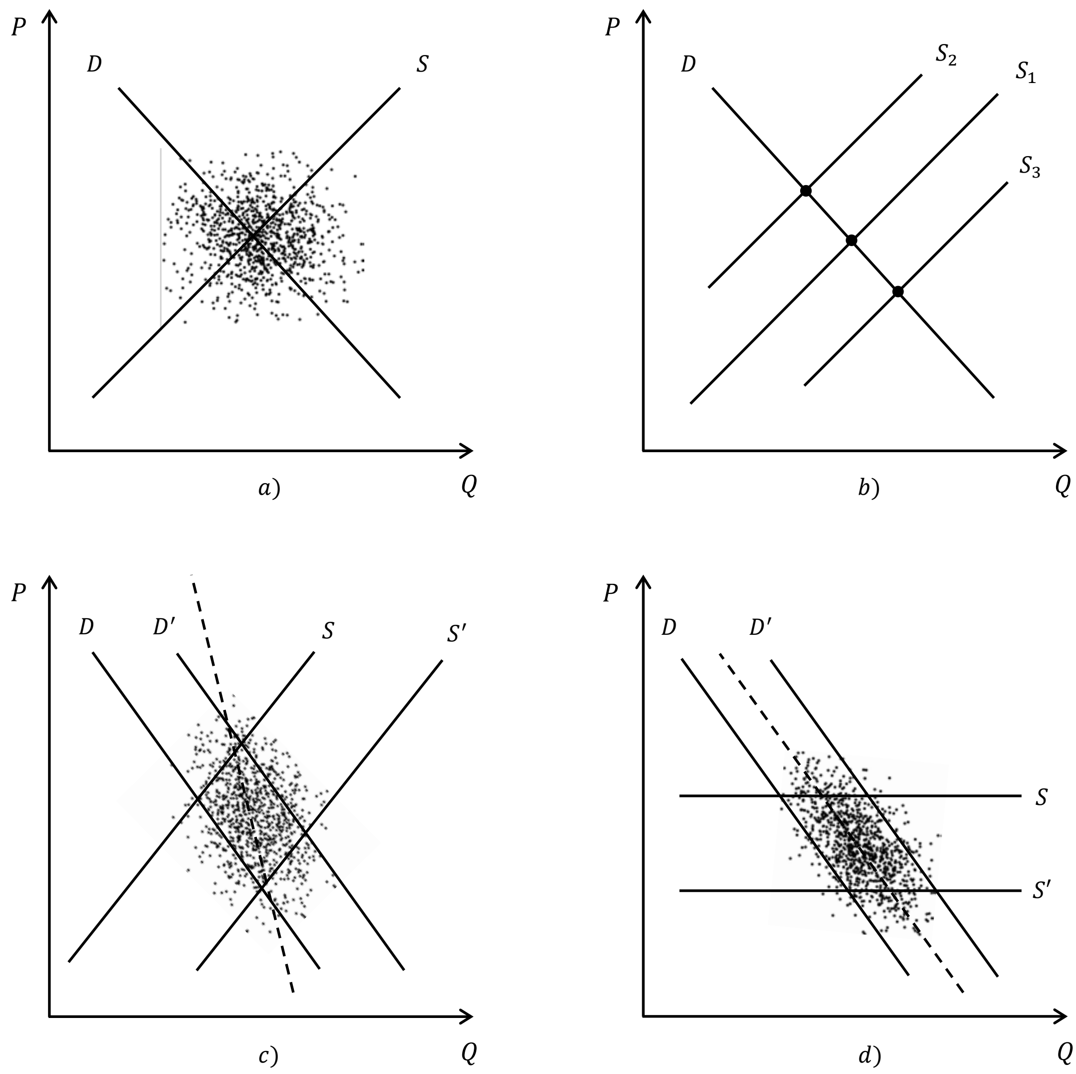
An intermediate case would occur if the demand curve shifted along with the supply curve, but to a lesser extent. This situation is represented in the panel c) of Figure 5.1, where the distances between D and D' and between S and S' are intended to represent the relative size of the shocks that generate the underlying data cloud (this representation is adapted from Leamer and Stern 2009, Ch. 3). In this case, a regression of quantity on price would result in an estimate – indicated by the dashed line – that 'leans towards' the demand curve but is clearly biased towards zero (note that since quantity, which is the 'dependent' variable in this context, is plotted on the horizontal axis in Figure 5.1, an estimate of zero would be a vertical line – not a horizontal line as in usual X-Y plots).

Lastly, the situation could be such that there are shocks to both demand and supply, but export supply is infinitely elastic as represented by the horizontal lines S and S' in the panel d) of Figure 5.1. If export supply is perfectly elastic so that producers are able to supply any additional quantity demanded at no extra cost, then the increase in quantity demanded does not 'pull up' the price and

[2] I use the terms *schedule* and *function* as equivalent in the context of demand and supply.

the change does not feed back into the market mechanism.[3] Again, there would be no simultaneity bias – but not because there are no demand shocks as in the case above, but because the demand shocks that occur have no effect on price.

Figure 5.1: Simultaneity bias in supply and demand systems



Thus, the size and direction of a potential bias depends on two factors. First, the movement of the demand and supply curves due to the relative size of the respective shocks (i.e., the variation in u_t and v_t), and second, the movement of the demand and supply curves due to their responsiveness to these shocks (i.e., the absolute values of α_1 and β_1). Depending on which particular combination

[3] Note that in the introduction section to this chapter, elasticities were interpreted as the responsiveness of quantity demanded to changes in price. In this context, high elasticities imply large quantity reactions to small price changes. The same logic holds the other way around, however. High elasticities also imply small price changes in reaction to large quantity changes. The latter logic applies in the present context.

of these factors is realized in a given market, a linear regression of quantity on price will tend to yield an estimate that lies somewhere between the true values of the slopes of the supply and demand curves.

The sign on the coefficient would provide some information about whether one has obtained an attenuated estimate of the demand curve (as in the panel c) of Figure 5.1) or an attenuated estimate of the supply curve. In theory, it might even be the case that one of the curves is estimated accurately – either because the estimated curve did not experience any shocks or because the other curve is horizontal. In either of these cases, the simultaneity effect vanishes, the two-equation-system reduces to a standard regression equation and OLS would be an appropriate estimation technique.

The problem is, however, that even if one was lucky enough to be able to obtain an unbiased estimate via OLS, one would not be able to verify this. Because u_t and v_t are unobserved by definition and α_1 and $\beta_1$are unknown as well – after all, estimating these parameters is the purpose of the entire undertaking – there is no way to assess the size of the bias absent further information. On average, estimates in either direction would be too small. This problem has long been known (see: Orcutt 1950, for an early discussion) and has often led to estimates that were implausibly small both theoretically and compared to studies that use detailed freight cost data to identify price shocks in specific markets (i.e., Hummels 1999, and Hertel et al. 2007; a comprehensive review can be found in Hillberry and Hummels 2013).

The standard solution to this type of problem is to resort to instrumental variables (IV) estimation. If valid instruments are available, one can simply estimate the demand and supply equations separately via Two-Stage-Least Squares (2SLS). For instance, if one was interested in a single market for an agricultural product such as coffee, weather data could be used as an instrument for the supply price. Assuming that the weather is an important factor in determining coffee output but has no direct effect on the demand for coffee, variations in weather conditions are supply shocks that shift the supply curve around without affecting the demand curve. This would resemble the situation depicted in the panel b) of Figure 5.1 and it would be possible to obtain unbiased estimates of the slope of the supply curve.

However, it is difficult at best to find viable and sufficiently strong instruments that work for a large number of different industries as well as across countries. This severely limits the applicability of standard instrumental variables approaches in estimating trade elasticities.

5.2 Estimation Strategy: Structural Estimation of Elasticities

To get around the identification problem when estimating elasticities, I follow a method devised by Feenstra (1994) and extended by Broda and Weinstein (2006). The approach requires no data other than trade data on values and quantities and makes use of the fact that international trade data is characterized by the availability of multiple data series (over time) for a given import market and product. For instance, if the focus was on the U.S. market for electronics parts and one was interested in estimating the price-sensitivity of U.S. importers and the export supply elasticity they face, then there would be as many data series on U.S. electronics parts imports available as there are countries that export these goods to the United States.

By exploiting differences in the variation of these exporter-specific data series, Feenstra (1994) shows how the parameters of a demand and supply system can be identified in the absence of traditional instruments. The key insight underlying this method dates back to Leamer (1981) who demonstrates that – given an individual data series – the variance-covariance structure of the data can be used to create bounds on the set of possible parameter values even if no single value can be exactly identified. Suppose that in a given data series, both demand and supply shocks are present but the supply shocks dominate – similar to the situation in panel c) of Figure 5.1.

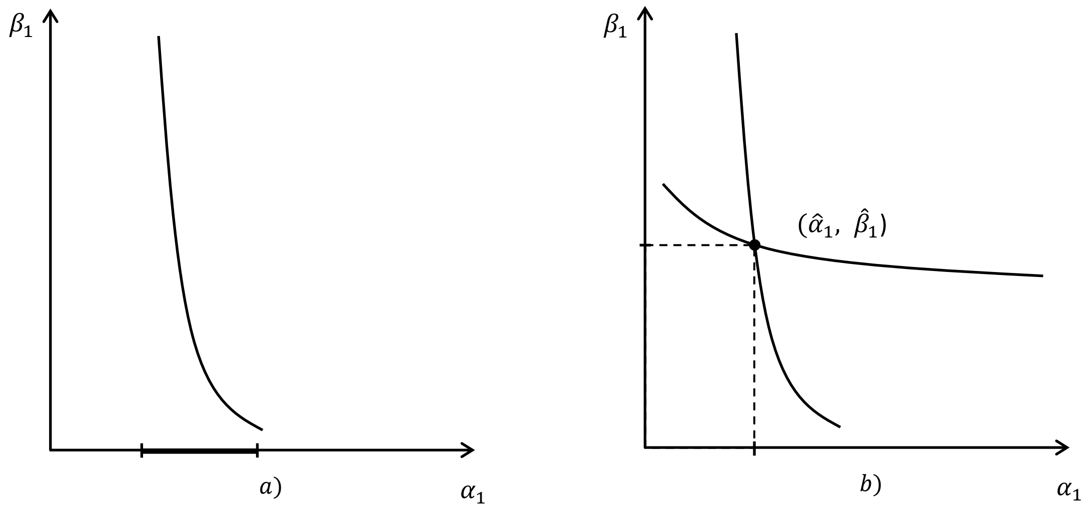
Leamer (1981) shows that while this provides very little information on the supply schedule, this information can be used to put restrictions on the possible values of the true underlying demand schedule. This situation is graphically depicted in panel a) of Figure 5.2 below. The figure shows the possible combinations of estimates for α_1 and β_1 that would be consistent with the data. The fact that these combinations are not unique (i.e., they lie on a line and not on a single point) constitutes an identification problem. It is apparent from the figure, however, that the data do contain *some* information about the possible values for α_1 that are bound in a relatively narrow range.

In particular, Leamer (1981) shows that the range of possible true values for α_1 is bounded between the attenuated estimate that can be obtained by a standard regression of quantity on price and the inverse of the reverse regression estimate of price on quantity. Thus, instead of taking the biased point estimates at face value, Leamer uses these estimates to infer the possible intervals in which the true parameter values can lie.

To see this more clearly, first suppose that the entire variation in the data was due to supply shocks as in panel b) of Figure 5.1 and suppose further that the slope of the demand curve was –3. The reverse regression would yield a slope estimate of –1/3, the inverse of which is also –3. The true value of the demand schedule would thus be bounded 'between' –3 and –3 and therefore be perfectly identified. At the same time, these estimates contain no information on the slope of the supply curve. As a consequence, the curve in panel a) of Figure 5.2 would be a vertical line at $\alpha_1 = -3$. As soon as there are shocks to the demand schedule as well, the data become less informative about the value of α_1 and the interval widens. If demand shocks are dominant in the data, the bound on the supply schedule becomes narrower and the data provides information about β_1.

The crucial insight of Feenstra (1994) is that given multiple such data series that experience different shocks and therefore exhibit different patterns of variation, this information can be used to infer the slopes of both the demand and the supply curves simultaneously. Panel b) of Figure 5.2 shows a situation in which there are two data series – one in which supply shocks dominate that provide some information about the demand schedule, and one in which demand shocks dominate and provide information about the supply schedule. Combining the information of these data series, it is then possible to uniquely identify the underlying parameters as indicated by the dot at the intersection of the two curves in panel b) of Figure 5.2.

Figure 5.2: Identification strategy due to Feenstra (1994)



To convey the logic of the method as well as the underlying assumptions in more detail, it is useful to go through the implementation procedure step by step. The starting point is a set of demand and supply equations similar to the ones above, but subject to a number of transformations, given by:

$$\Delta \ln s_{it} = \phi_t - (\sigma - 1)\Delta \ln p_{it} + \varepsilon_{it} \tag{4}$$

$$\Delta \ln p_{it} = \psi_t + \frac{\omega}{1+\omega}\Delta \ln s_{it} + \delta_{it}. \tag{5}$$

The system is now in log-log form so that the parameters are interpretable as elasticities. As a consequence σ, the elasticity of substitution, takes the place of α_1. The supply equation is solved for the price p_{it}, so that ω is the inverse elasticity of export supply and equivalent to $1/\beta_1$ (this is where the reverse regression logic of Leamer (1981) comes into play – this point will be taken up again in the discussion below). The equations are converted into first differences, indicated by the Δ symbols, to eliminate time-invariant unobserved factors. As a result, the demand and supply schedules are expressed in terms of in changes over time.

Furthermore, the quantity variable q_t is no longer expressed in terms of physical quantities but in terms of market shares (s_{it}). The reason for this transformation is that data on physical quantities is particularly prone to measurement error (because reporting on quantities is typically less accurate than reporting on values). The use of market shares alleviates this concern. But because market shares are in value terms (i.e., price times quantity rather than quantity alone), this change involves multiplying both sides to the equations by p_{it} and collecting terms – which results in the somewhat unwieldy forms of the coefficients, i.e., $(\sigma - 1)$ and $\omega/(1 + \omega)$. Also note that there is now an additional subscript i because the data consists of the various time-series for all exporters to a given market per product (the estimation is done separately for each importer and product as detailed below).

Finally, random shocks are represented as two separate components in each equation. First, the term ϕ_t in the demand equation captures random shocks to consumption that vary over time but are common across exporters, including changes in tastes and quality, while ψ_t in the supply equation captures random shocks to production that vary over time but are common across exporters. Second, ε_{it} and δ_{it} are random shocks to consumption and production that vary both over time and export-varieties. These errors are assumed to be independent of each other.

The next step is to perform a second differencing transformation – this time not over time but cross-sectionally. In particular, the data is differenced with respect to a reference country k. That is, the value of country k at time t is subtracted from the value of each country $i \neq k$ at time t for both prices and market shares. Reference differencing the above equations and solving for the error terms (explained below) yields the following set of equations

$$(\Delta\ln s_{it} - \Delta\ln s_{kt}) + (\sigma - 1)(\Delta\ln p_{it} - \Delta\ln p_{kt}) = \tilde{\varepsilon}_{it} \tag{6}$$

$$(\Delta\ln p_{it} - \Delta\ln p_{kt}) - \frac{\omega}{1 + \omega}(\Delta\ln s_{it} - \Delta\ln s_{kt}) = \tilde{\delta}_{it} \tag{7}$$

where $\tilde{\varepsilon}_{it} = \varepsilon_{it} - \varepsilon_{kt}$ and $\tilde{\delta}_{it} = \delta_{it} - \delta_{kt}$. The procedure eliminates the ϕ_t and ψ_t terms because these are identical across exporters. That is, the effects of shocks experienced by all exporters are removed from the data. As a result, the remaining variation in the data captures the over-time variation induced by exporter-specific (and therefore variety-specific) shocks to prices and market shares.[4]

The data thus obtained can now be used to manually construct the variance-covariance structure of the prices and market shares. To see this, first note that the reference differencing procedure has an effect very similar to normal de-meaning. That is, it eliminates level effects and re-expresses the data in terms of its deviation from a given baseline – only that this variation is not centered around the mean but defined with respect to a reference country.[5]

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[4] The procedure also eliminates the data series for the reference country k, so that data on N – 1 exporter-varieties remains.

[5] The general logic of the method would carry over directly if the data were de-meaned instead of reference differenced. However, because the mean is calculated from the entire data, its value is sensitive to changes in data availability over time. In unbalanced panels, the mean is therefore likely to exhibit variation that is merely an artifact of the

The central step in implementing the method is then to multiply the two equations together. That is, one multiplies the left-hand side of the demand equation by the left-hand side of the supply equation. Similarly, one multiplies the error terms on the right-hand sides of the equations. Doing so yields a single estimable equation, which – after dividing by $(\sigma - 1)$ to simplify the resulting expressions and rearranging – takes the form of

$$Y_{it} = \theta_1 X_{1it} + \theta_2 X_{2it} + u_{it}, \tag{8}$$

where

$$Y_{it} = (\Delta \ln p_{it} - \Delta \ln p_{kt})^2 \tag{9}$$

$$X_{1it} = (\Delta \ln s_{it} - \Delta \ln s_{kt})^2 \tag{10}$$

$$X_{2it} = (\Delta \ln p_{it} - \Delta \ln p_{kt})(\Delta \ln s_{it} - \Delta \ln s_{kt}) \tag{11}$$

$$u_{it} = \tilde{\varepsilon}_{it}\tilde{\delta}_{it}/(\sigma - 1) \tag{12}$$

$$\theta_1 = \frac{\omega}{(\sigma - 1)(1 + \omega)} \tag{13}$$

$$\theta_2 = \frac{1 - \omega(\sigma - 2)}{(\sigma - 1)(1 + \omega)}. \tag{14}$$

Note that averaging the variables Y_{it}, X_{1it}, and X_{2it} over time produces – for each exporter – the variance of prices, the variance of market shares, and the covariance of prices and market shares that is induced by exporter-specific shocks over the time period under consideration. Thus, the time-averaged version of equation (8) is equivalent to

$$\mathrm{Var}(p_i) = \theta_1 \mathrm{Var}(s_i) + \theta_2 \mathrm{Cov}(p_i s_i) + \overline{u}_i. \tag{15}$$

To see how this connects back to the idea of Leamer (1981), note that in the usual OLS setup the slope of a regression of price on market shares is calculated as $\mathrm{Cov}(p_i s_i)/\mathrm{Var}(s_i)$, while the slope of the reverse regression market shares on price is calculated as $\mathrm{Cov}(p_i s_i)/\mathrm{Var}(p_i)$. Soderbery (2015) covers this issue in more detail. Thus, the Feenstra (1994) method combines the information of both the direct and the reverse Leamer (1981) regressions in a single equation for all exporters in the data.

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data. This problem can be avoided by choosing a reference country that has data available for all years covered by the data. Further, by choosing a reference country that has high absolute trade values (i.e., typically an OECD country), it is possible to further reduce concerns relating to measurement error, because the idiosyncratic component in the reporting of small trade flows tends to be greater than that in the reporting of large flows (see: Mohler 2009).

Feenstra (1994) implements the method econometrically in an instrumental variable framework by running Two-Stage Least Squares on equation (8) where he uses exporter dummies as instruments. That is, in the first stage, both X_{1it} and X_{2it} are regressed separately on the set of country dummies. In the absence of other regressors, this is equivalent to time-averaging X_{1it} and X_{2it} as discussed above. The country dummies in this setup serve as what Rigobon calls "*probabilistic* instruments" for unobserved exporter-specific demand and supply shocks (2003, p. 777). This differs from the use of traditional instruments in the sense that the resulting estimates $\hat{X}_{1it} = \overline{X}_{1i}$ and $\hat{X}_{2it} = \overline{X}_{2i}$ do not fully identify the second stage parameters but only constrain the range of possible values as discussed above.

The second stage then regresses Y_{it} on $\hat{X}_{1it}$ and $\hat{X}_{2it}$. This goal of this stage essentially is to 'find the intersection point' of the curves plotted in panel b) of Figure 5.2 (because with more than two countries there is no reason to expect that all curves intersect at the exact same point, the method actually minimizes squared distance between the solutions implied by the curves). In other words, the second stage combines the information on the various constraints extracted from the multiple data series of the set of exporting countries to further limit the parameter estimates to a unique solution – thereby completing the identification procedure.

Because the coefficients of interest, σ and ω, have undergone the same transformations as the data, it is possible to trace back the effects of exporter-specific shocks on the original underlying demand and supply elasticities. As long as $\theta_1 > 0$ (because otherwise one would have to take the square root of a negative number), σ and ω can be solved for from $\theta_1$and θ_2:

$$\sigma = 1 + \frac{\theta_2 + \sqrt{4\theta_1 + \theta_2^2}}{2\theta_1} \tag{16}$$

$$\omega = \frac{\theta_2}{2} + \sqrt{4\theta_1 + \theta_2^2} \tag{17}$$

For the method to function properly, several assumptions need to be satisfied. In particular, exporter-specific shocks to demand and supply over time need to actually exists as well as to differ across exporters. As Hillberry and Hummels (2013) note, these requirements are likely to be met for the demand schedule – that is, for the elasticity of substitution – which requires shocks to supply to be identified. Examples of such supply shocks are changes in, for instance, exchange rates, trade costs, factor prices, and productivity, which are likely to induce ample variation across exporters.

The situation is slightly more difficult for the supply schedule – that is, for the export supply elasticity – which requires shocks to demand to be identified. Because these need to vary across exporters, common demand shifters such as income in the importing country do not qualify because they affect all exporters alike (thus, these shocks are eliminated in the reference country differencing procedure). As a result, the variation needs to be due to changes in the design, quality, or general attractiveness of national product varieties that affect demand but are themselves not correlated with price. Although this is not unconceivable, it is certainly a tougher requirement.

These theoretical considerations are mirrored in the results of Monte-Carlo simulations by Soderbery (2010). The simulation results suggest that estimates of the elasticity of substitution quickly converge to the true values, while estimates of the export supply elasticity tend to be less precise. This issue is of no greater concern in the context of the present study, however. Because the focus of the study is on import policies, the key parameter of interest is the elasticity of substitution whereas the export supply elasticity is of secondary importance.

A last set of assumptions underlying the method is that the estimated elasticities are constant over time and the same across exporting countries. The over-time part of the assumption is required for the construction of the variance-covariance structure (the first IV stage). The cross-sectional part of the assumption is required to determine the unique estimates from this variance-covariance structure (the second IV stage). In other words, the method averages over any actually existing differences in the elasticities faced by individual exporters.

5.3 Trade Elasticities: Data, Estimation, and Results

The data requirements for implementing the method are moderate, as noted above. Because demand and supply shocks are captured by exporter-dummies, only data on trade flows (to calculate market shares) and prices (i.e., unit-values) are needed. These data come from two different sources. For trade volumes, I use data from the UN Comtrade database. Because information on trade prices is not available in the form of price indices as they are constructed by national statistical offices, trade prices are typically proxied by unit values. These are calculated by dividing trade volumes (that are in 'price times quantity' terms) by trade quantities, and by therefore approximating the prices in value-per-unit terms. Because the UN Comtrade database provides information on traded quantities as well as on traded volumes, unit-values could be constructed from the Comtrade data.

Instead, however, I take information on unit-values from the 'Trade Unit Values Database' (TUV) provided by the 'Centre d'Études Prospectives et d'Informations Internationales (CEPII)' (Berthou and Emlinger 2011). This has two main advantages. First, quantities reported in Comtrade come in various different units. For instance, bulk grains are typically reported in kilograms, footwear in pairs, automobiles in items, textiles in meters, liquids in liters, and so forth. This would be unproblematic if each product was consistently reported in only one of these categories. However, this is not always the case in Comtrade. However, if a country reports, say, automobile imports in items for the first half of a time-series and in kilograms for the second, this would imply a drop in price by a factor of roughly 1000 (if one assumes that a car weighs around a ton) that is purely an artifact of the change in reporting units. By converting all quantities into comparable units (tons), Berthou and Emlinger (2011) provide a solution to this problem.

Second, a well-known problem with trade reportings is that quantities are not recorded as accurately as volumes. One reason is that tariffs are typically applied on an *ad valorem* basis, meaning that the recording of trade values is necessary for the collection of tariff revenues while the recording of quantities is not. The same problem applies to export reportings, but is more pronounced with respect to quantities – and especially problematic for developing countries where capacity constraints further aggravate the problem. As a result, quantities are often misreported and are mostly too small. This is problematic in particular because the calculation of unit-values involves dividing volumes by quantities – and division by small numbers produces large results. This can at times lead to extreme values for derived unit-values that are far removed from any plausible range of actual prices. Berthou and Emlinger (2011) perform a range of plausibility checks aimed at detecting and removing extreme cases of misreporting from the data, thereby significantly reducing concerns related to measurement error.

All data is at Harmonized System (HS) 6-digit-level of aggregation covering 5,053 different products over the years 2000–2014. The time-period is limited to 15 years because the TUV data is only available from 2000 onwards. I implement the above procedure for 173 importing countries. In accordance with formal treatment, the estimation is done separately for each importer-product combination. That is, in each iteration, the data consist of the set of imports of one country from all its trade partners over time – as in the example of U.S. electronics parts given above. This results in a total of two times 149,765 individual elasticity estimates (σ and ω for 173 importers and a varying number of products depending on data availability).

Thus, there are up to 173 different elasticity estimates for each product. However, the primary interest of this study is on the product level. After all, the purpose of this chapter is to obtain an estimate of the general substitutability of products as a result of their degree of differentiation. For this reason, it is useful to average across the individual importer estimates to obtain a single estimate of the world average elasticities for each product.[6] This average then reflects intrinsic product characteristics and aggregates across all cross-country variation that is not the focus of the analysis. Because the estimates are already averaged across exporters and years as a result of the estimation technique itself, averaging results in two times 5,053 elasticities at the HS 6-level level.

The remainder of this section is devoted to presenting the results of the estimation and evaluating the plausibility of the estimated elasticities. I will focus the discussion on the results obtained for the elasticity of substitution because this is the parameter of interest in the present context. Instead of reporting a regression output which is impractical for tens of thousands of individual analyses, I present a range of summary statistics as well as a number of plausibility tests aimed at as-

[6] Because the distribution of the estimates has a long right tail, I calculate the median rather than the mean.

sessing whether the estimated elasticities relate to alternative information on product differentiation in expected ways.

Overall, the estimates range between 1.04 and 54.40 with a median of 3.36, so very high values are the exception. This corresponds with the results obtained by Broda and Weinstein (2006) who – focusing only on the U.S. – obtain a median estimate of 3.5. More interesting is whether the estimates contain systematic information about the expected substitutability of products. In particular, one would expect homogenous products to be easily substitutable and therefore have high elasticities, while highly differentiated products should be less substitutable and therefore have low elasticities.

To get a first idea of whether the estimates reflect this kind of reasoning, 5.1 reports the 15 highest and lowest elasticity estimates for products with a total world trade volume of more than US$ 1 billion in 2005, which thus represent a significant fraction of international trade. As expected, the top group of products with high estimates of σ consists of relatively simple products such as basic chemicals, liquefied natural gas (LNG), and basic metal products. In contrast, the group of products with low elasticity estimates consists of much more complex and refined products including specialized transportation equipment such as ships and tramways, electrical and electronic products, precision engineered goods such as watches, or specialized machinery. One might not have expected electrical energy to be part of the list, but given the low levels of competition in many national energy markets, it may not be too surprising that electric power is located at the price-insensitive end of the product spectrum.

Table 5.1: Highest and lowest estimates of σ for products with trade above US$ 1 bn in 2005

HS Code	$\hat{\sigma}$	Product description
290321	20.4	Vinyl chloride (chloroethylene)
271111	15.3	Petroleum gases, liquefied natural gas (LNG)
760110	10.4	Aluminum, unwrought, (not alloyed)
290315	10.1	1,2 dichloroethane (ethylene dichloride)
760120	9.8	Aluminum, unwrought, alloys
290270	9.8	Cyclic hydrocarbons, cumene
480253	9.2	Kraft paper and paperboard, in rolls or sheets, n.e.s.
470329	8.7	Chemical wood pulp, bleached or semi-bleached
291532	8.5	Vinyl acetate
381512	8.4	Catalysts, reaction initiators, reaction accelerators
721070	8.4	Iron or non-alloy steel, flat-rolled, width 600mm or more
890520	8.3	Floating or submersible drilling or production platforms
721633	8.2	Iron or non-alloy steel, H sections, hot-rolled, hot-drawn
721012	8.1	Iron or non-alloy steel, flat-rolled, width 600mm or more
720838	7.9	Iron or non-alloy steel, in coils, without patterns in relief
⋮	⋮	⋮
911490	2.2	Clock and watch parts, n.e.s.
890400	2.2	Vessels specially designed for towing, tugs and pusher craft

851680	2.2	Electric heating resistors
710391	2.2	Rubies, sapphires and emeralds, worked
853939	2.2	Discharge lamps, other than ultra-violet
841122	2.1	Turbo-propellers, of a power exceeding 1100kW
910121	2.1	Wrist-watches, case of precious metal
292149	2.0	Amine-function compounds
293340	2.0	Other heterocyclic compounds nucleic acids
271600	2.9	Electrical energy
890120	1.9	Tankers
840130	1.8	Nuclear reactor fuel elements (cartridges), nonirradiated
860310	1.7	Railway & tramway coaches, vans, trucks etc.
710231	1.6	Diamonds, non-industrial
845691	1.5	Machine tools for working metals by electronic processes

Although this cursory inspection is encouraging, it is desirable to assess the plausibility of the results in a more systematic manner. One way to do this is to compare the estimates to the product categorization by Rauch (1999). Based on an extensive qualitative research effort, Rauch divided goods into three broad groups depending on whether they are exchange-traded, reference-priced, or differentiated. The exchange-traded category consists of goods for which organized markets exist in which "specialized traders [...] centralize price information" (Rauch 1999, p. 9). Goods falling into this category are typically commodities such as wheat or iron ore. Because these goods are highly fungible and centrally traded, there will be something close to a 'world price'. Goods in this category should have the highest elasticities since even small deviations from the world price would lead buyers to switch to essentially identical competitor varieties. Small changes in price thus result in large changes in traded quantities.

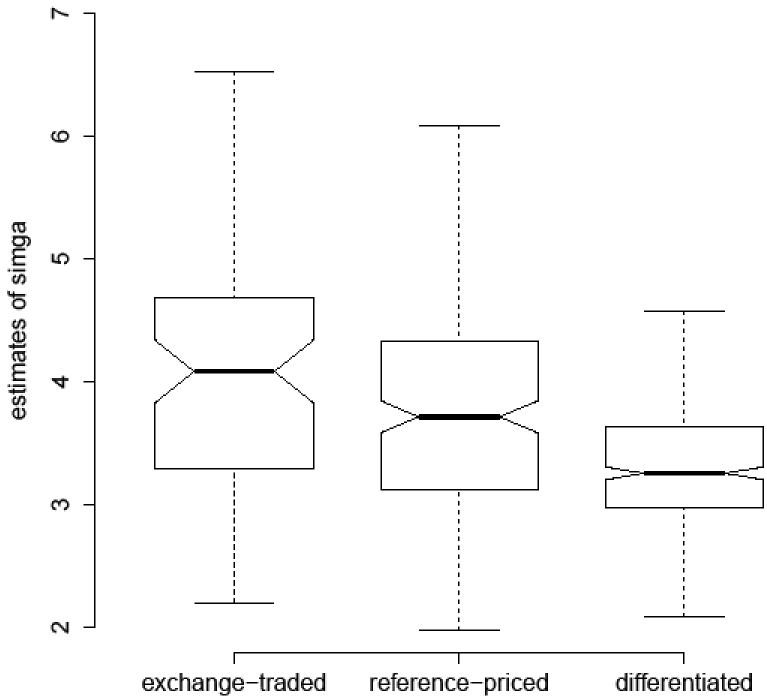
The next category contains goods that are not exchange traded but for which informal reference prices exist that are published in specialized trade journals and other industry publications. For instance, various intermediate chemical products fall into this category. These types of goods should be expected to have somewhat higher elasticities. Lastly, differentiated products are goods that are neither exchange-traded (such as unwrought metals) nor reference-priced (such as chemical precursors). This type of goods is the 'residual category' in Rauch's classification scheme and should have the lowest elasticities.

Figure 5.3 shows boxplots of the estimated elasticities for each of the three Rauch categories.[7] The plot shows the expected pattern: the exchange-traded category is associated with highest average elasticity estimates and the differentiated category with the lowest.

[7] Rauch (1999) makes his data available in two versions that he refers to as conservative and liberal. In the conservative version, all goods that Rauch could not clearly place into one of the categories are placed in the more differentiated one. In the liberal version, the opposite is true. The results presented here change only marginally across the two versions.

Welsh t-tests for differences in means between the categories confirm the impression gained through visual inspection. For the difference between exchange-traded (mean = 4.14) and reference-priced (mean = 3.82), the results are t = 2.13, df = 105.2, p-value = 0.03. For the difference between reference-priced (mean = 3.82) and differentiated (mean = 3.35), the results are t = 6.54, df = 313.8, and p-value = 0.00.[8]

Figure 5.3: Estimates of σ compared to Rauch (1999) categories – conservative classification



Another way to assess how the estimated elasticities correspond to prior expectations about product differentiation is to directly consider the trade price dispersion of these products. Basically, one expects different varieties of non-differentiated, homogenous products (such as bulk grains, crude oil, or pot-ash) to be largely similar to each other. One therefore further expects them to be easily substitutable and therefore more price-sensitive. The price-sensitivity of these goods should then be reflected in the dispersion of prices for which they are traded. The more price-sensitive a product, the more tightly clustered should the (trade) prices of its varieties be. In the extreme, these prices would converge to a single world price. Conversely, for highly differentiated goods, the prices for individual varieties may be widely dispersed. Because the varieties of differentiated products, by definition, have distinct features that set them apart from other varieties of the same product, price

[8] Because the Rauch data come in the SITC 2 industry classification (685 industries in the sample), I aggregate the HS-6-digit estimates to match this format. The aggregation reduces the range of the elasticities - as is apparent from the scale on the axis of Figure 5.3 – because the high values in the long right tail of the distribution are averaged together with more frequently occurring values.

is no longer the sole determinant of consumption decisions. As a result, very differently-priced varieties of a good can be sold in the same market as long as other characteristics balance the price differences in the eyes of consumers.

To test this supposition, I calculate a measure of import price dispersion from the TUV database by Berthou and Emlinger (2011). This is the same data used for the estimation of the elasticities but now used in a very different way. The interest is in how widely dispersed the import prices (as proxied by unit values) in a given import market are across different source country varieties of a product. For instance, how similar or dissimilar are the Korean import prices for apples or men's suits from different source countries?

Because price variability in absolute terms is larger for higher prices, dispersion measures such as the standard deviation are misleading. A natural alternative is to calculate the coefficient of variation – which is simply the standard deviation divided by the mean. Intuitively, because men's suits are more expensive than apples, the 'expectation of the squared deviation around the mean' as given by the standard deviation is going to be larger for suits than for apples even if the prices of both products vary in a range of plus/minus five percent around the mean. Division by the mean corrects for this.

Since the distribution of unit value data is strongly right-skewed, the mean typically lies far in the right tail of the distribution. The median is a more appropriate measure of central tendency for non-symmetrically distributed data than the mean. For this reason, I calculate the median analogue of the coefficient of variation, which is the median absolute deviation (MAD) divided by the median of the import prices:

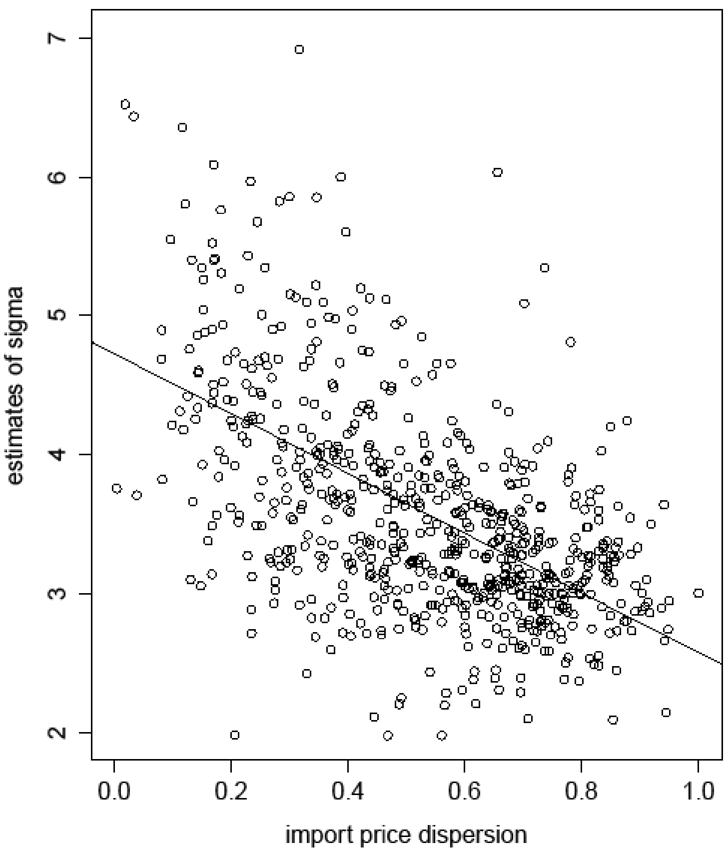
$$import\ price\ dispersion \equiv \frac{median(|p_i - median(p_i)|)}{median(p_i)},$$

where the index i represents the trade partners from which imports are sourced. I calculate the above measure for each importer, product and year in the data and then take the median over importers and years to get a single value for each product that is comparable to the estimated elasticities. Figure 5.4 plots the estimated elasticities against the averaged import price dispersion measure (which is normalized for convenience). Higher values indicate a larger dispersion of import prices.

Again, the pattern is readily apparent and shows the expected relationship. Lower levels of price dispersion that suggest low levels of product differentiation are associated with higher estimates of the elasticity of substitution. Conversely, higher levels of price dispersion that point towards high degrees of product differentiation are associated with higher estimates of the elasticity of substitution. A simple univariate regression of the estimated elasticities on price dispersion yields a β-estimate of –2.02 (0.13), with a p-value of 0.00, and an R-squared of 0.26.[9]

[9] The results are similar when I calculate the coefficient of variation after log-transforming the data.

Figure 5.4: Estimates of σ plotted against dispersion in import prices



Taken together, the above results establish that the estimated elasticities are systematically related to several facets of product differentiation in ways that match prior expectations both qualitatively and quantitatively. Thus, with plausible estimates of the elasticity of substitution in hand, it is now possible to proceed to the estimation of tariff-equivalents of non-tariff barriers (NTBs).

6 Measuring Stakes II: Estimating the Size of Non-Tariff Barriers to Trade (NTBs)

Any study with the aim of relating the occurrence and intensity of trade disputes to the distributional effects induced by policy barriers to trade is dependent on reliable empirical information on the size and pattern of these barriers. Perhaps surprisingly, this kind of information is not available in a systematic and comprehensive manner. This is true in particular for non-tariff barriers (NTBs). To provide a better picture of the general role of trade costs in international trade and the significance of NTBs, in particular, this introduction provides a brief overview over the various kinds of barriers and trade cost factors that matter in international trade (including non-policy barriers) and reviews the existing sources of information on NTBs and their limitations. The main part of the chapter then describes the strategy employed to obtain credible estimates of NTBs.

Trade barriers, in a general sense, are all factors that impede trade flows by making it costly to move goods from their location of production to their location of consumption. Because these costs will eventually have to be added to the final price of the goods, producers facing higher trade costs than their competitors are disadvantaged in any given market. Impediments to trade can be grouped into two large categories: First, physical or structural barriers to trade, and second, policy barriers (Anderson and van Wincoop (2004) provide an extensive review of the various cost components in trade and the related literature).

Physical barriers to trade are cost factors that can have significant adverse effects on trade but that governments have virtually no influence over. As a consequence, no trade dispute arises as a result of their presence. Because they need to be accounted for when assessing the effect of policy barriers, however, they cannot be ignored in this context. The prime example is geographical distance, which directly affects shipping costs. Similarly, the absence of a common land border between trade partners is found to impede trade. Cultural and language differences create costs through the need for alternative or additional advertising and branding strategies or the general degree to which the produced variety of one country matches the particular tastes in another. Further, the quality of infrastructure (ports, roads, etc.) in both the exporting and importing countries affects trade costs, as do factors such as the legal and political stability.

Policy barriers, in contrast, are by definition the result of government policies and can therefore be seen as artificial barriers to trade that induce additional trade costs above and beyond those inevitably created by physical and structural conditions. These types of barriers can roughly be subdivided into tariffs and non-tariff-barriers (NTBs). These two groups of policy barriers differ in several ways. One is that the available data on tariffs are, if not comparable in coverage to trade data, still strongly indicative of the pattern of tariff protection across countries, industries, and over time – a statement that does not hold for data on NTBs, as I will discuss in more detail below. This situation is particularly unfortunate given the increasingly subordinate role of tariffs in modern trade relations relative to NTBs (i.e., Bacchetta et al. 2012).

Two recent book-length reports published by the WTO and the World Bank, respectively, are devoted to the problem of non-tariff measures in modern trade relations and treat the issues of lacking transparency and insufficient documentation at length (WTO 2012a, Cadot and Malouche 2012). There are various reasons for the poor quality of available data on NTBs. First, tariffs were historically the primary instrument of trade policy, until consecutive trade rounds throughout the second half of the twentieth century and the resulting agreements increasingly tied the hands of governments with respect to using tariffs to influence import levels. For this reason, NTBs have come into focus later than tariffs and efforts to try and record these measures systematically have only started to pick up in the mid-1990s.

Second, whereas tariffs are clearly defined import taxes, non-tariff barriers are a heterogeneous set of policies comprising technical standards, quarantine restrictions, various kinds of quotas, licensing requirements, and so on. These measures are not easily comparable or even readily observable. Tariffs are straightforward to record, because they are paid at the port of landing and there are established and comparatively regulated customs procedures involved in the process. In contrast, non-tariff barriers may affect imports not only at the border, but at various stages of the 'trade route' (including search and adaption costs, costs involved in complying with regulations during production, or restrictions on distribution and post-sales services). Relatedly, because tariffs are reported in percentage terms charged on the import price, it is also clear from the size of a tariff how severe its effect is going to be. A two percent tariff is something else than a 100 percent tariff. It is much harder to systematically assess the stiffness of non-tariff measures such as safety regulations or labeling requirements.

Third, various policies that adversely affect trade serve legitimate purposes such as ensuring environmental protection, worker's rights, or consumer health. It is often difficult to distinguish valid concerns from protectionist intentions. In theory, the distinction is rather clear. As long as such regulations do not discriminate against imports but are equally binding for domestic producers, such policies are in conformity with WTO rules. In this regard, a distinction is often made between non-tariff measures (NTMs) and non-tariff barriers (NTBs). The problem in practice is, of course, that the two variants are very difficult to tell apart. This problem does not arise with respect to tariffs that are discriminatory by definition. This makes NTBs attractive policy tools for governments wishing to shield domestic industries in a context where tariff rates are largely bound by multilateral trade obligations and where overt protectism is an unattractive policy option.

Before I turn to the main part of the chapter, I provide a brief overview of the existing sources of information on NTMs/NTBs. One of the earliest attempts to collect information on NTMs/NTBs was undertaken by UNCTAD with the non-tariff branch of the TRAINS database. The database is large in terms of observations, but has long been known to suffer from severe inconsistencies. It is also extremely unbalanced both cross-sectionally and over time. In fact, the project has been lying more or less dormant since the late 1990s as a result of these problems. Only in 2012 has UNCTAD published a new classification of NTMs and revamped its data collection efforts. The new data (mostly for the years 2012, 2013, and 2014) continue to be severely unbalanced however (for instance, there are over 40.000 entries for Argentina and close to zero for South Korea), and only come in binary form per HS 6-digit product (indicating whether a product is covered by some regulation or not), so no information on the severity of the measures is provided.

The second large database on NTMs comes from the WTO (accessible through the WTO's new I-TIP portal) and contains measures that member states have notified to the WTO in accordance with their notification 'requirements'. Because there is no enforcement mechanism aimed at ensuring compliance with these requirements, however, these data, too, are problematic at best. The WTO itself points out that "[n]otifications provide an incomplete and sometimes misleading account of the incidence of non-tariff measures" (WTO 2012a, p. 98). The quasi-voluntary nature of these requirements allows governments to report innocent measures (NTMs) and while withholding information on their more discriminatory policies (NTBs). This is in line with the assessment of Bacchetta et al. (2012) who state that "compliance appears to be generally low, except where Members have an own interest in complying" (p. 42).

Two other sources of NTMs/NTBs information have recently been made available by the WTO. The first concerns so-called specific trade concerns (STCs) voiced by member states. These are 'reverse notification' and may therefore be seen as more credible. The main problem of these datasets is that they are extremely limited in scope – on average containing only a handful of concerns per importer and relating only to sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT). Furthermore, because there are various other channels through which governments may raise such concerns, these data "may provide a distorted picture of the trade-restrictive or trade-distortive effects of TBT and SPS measures" (WTO 2012a, p. 100).

A last source of information on NTMs/NTBs is the recently published WTO Trade Monitoring database, which is coded from qualitative information taken from the WTO's Trade Monitoring Reports since 2008. The database covers a larger number of different measures but, as with the STCs data, its overall coverage is far from comprehensive. It cannot provide a systematic picture of the use of non-tariff protection on a global scale.

Two additional concerns with all of the above sources are that considerable difficulties exist in a) assigning the correct HS product codes to qualitative information drawn from regulations, notifications, and reports, and b) identifying whether measures that used to be in force at some point have been terminated or not (also see: Bacchetta et al. 2012). These difficulties are understandable and perhaps inevitable given the size and complexity of the task. But they nonetheless raise additional doubts about the quality of the data thus obtained.

In combination, the above issues lead to a situation in which the available "data on NTMs is very fragmentary" (Cadot and Malouche 2012, p. 3). Similarly, Anderson and van Wincoop (2004) note that "[t]he grossly incomplete and inaccurate information on policy barriers available to researchers is a scandal and a puzzle" (p. 693). These problems are also reflected in gravity estimates in which the above data (in various combinations) are included as a predictor for trade flows. One would expect a clear negative association between NTBs and trade volumes. Instead, coefficient estimates are generally small, mostly statistically insignificant and occasionally positive. In light of the above discussion – and given that NTBs are 1) widely recognized as important impediments to trade, 2) the subject of the vast majority of WTO disputes, and 3) the primary focus of USTR's National Trade Estimates discussed in Chapter 4 – this is unlikely to accurately reflect the true significance of these measures in the context of modern trade relations.

To remedy this situation, the following sections present a procedure to obtain information on NTBs in the absence of directly available data. To this end, section 6.1 discusses theoretical and conceptual considerations underlying the setup in which the estimation is carried out. The section introduces the gravity model of trade and discusses the underlying theory and assumptions. Section 6.2 then describes the estimation strategy in detail and illustrates how a gravity approach can be used to estimate the size of NTBs on the basis of information on trade flows, domestic production data, and data on elasticities. Finally, section 6.2 describes the data and presents the results of the exercise. The section further provides several validation procedures and in this context also introduces part of the data setup that is used in the analysis in Chapter 7.

6.1 Quantifying Observable Trade Frictions: The Gravity Model of Trade

Considering the lack of suitable direct data on non-tariff barriers, I indirectly infer the size and pattern of NTBs from observable trade frictions using a gravity approach. Conceptually, the idea is to deduce the size of these barriers for any given importer and product from the ratio of international to domestic trade – net of the effect of other trade cost factors such as distance or tariffs and of the effect of the elasticity of substitution. Put differently, if X_{ij} are exports from i to j in a given product category and X_{ii} are 'exports' from i to itself (i.e., domestically produced varieties that are also sold domestically), then – after accounting for other trade cost factors – the ratio of X_{ij} to X_{ii} will reflect any additional trade frictions associated with exports to destination j. From these observed frictions and knowledge of the price-sensitivity of consumers, it is then possible to 'reverse engineer' the size of NTBs in country j. The gravity equation makes it possible to implement this intuition econometrically and to re-express implied non-tariff barriers in ad valorem equivalents (AVEs) – i.e., as percentage increases in price.

Gravity models have traditionally been used to quantify the effects of observed trade cost factors on trade flows (typically using on data on international trade). However, the reverse use of inferring unobserved trade costs from trade flows, so-called 'border effects', has become wide-spread practice since the pioneering work of McCallum (1995). McCallum's goal was to assess the effect of the U.S.-Canada border on trade flows by comparing trade among only U.S. States or only Canadian Provinces to cross-border trade flows. While McCallum (1995) used subnational data on inter-state and inter-provincial trade, it has subsequently become common practice to calculate domestic trade as production minus total exports following Wei (1996). This is the approach I employ as well, as is discussed in more detail in the data section below.

It is useful to consider the theoretical underpinnings of the gravity model before dealing with the implementation and estimation details (for a very useful discussion of both the theoretical and empirical aspects of the gravity model, see: Head and Mayer 2014). The gravity model makes it possible to estimate the effect of trade frictions, because it provides a "frictionless benchmark" (Anderson 2010, p. 4) against which observed data can be compared. To see this, consider the theoretical formulation of the gravity model due to Anderson and van Wincoop (2003):

$$X_{ij} = \frac{Y_i E_j}{Y_w} \left(\frac{t_{ij}}{\Pi_i \mathrm{P}_j} \right)^{1-\sigma}. \tag{1}$$

Without product and time subscripts, which are omitted for simplicity, the model can be thought of as representing total trade in a given year. Then X_{ij} are aggregate trade flows from country i, the exporter, to country j, the importer. Y_i is total exporter production, E_j is total importer production proxying total expenditure, and Y_w is world total production. Next, t_{ij} is the sum of all bilateral trade costs (to be separated out below) expressed as a multiplicative factor. That is, if the sum of all trade costs amounted to 25 percent of the factory gate export price, then $t_{ij} = 1.25$. The terms Π_i and P_j are 'multilateral resistance' (MR) indices that relate bilateral trade costs t_{ij} to the weighted average of all other trade costs the countries face. These terms are discussed in some more detail below. Lastly, σ is the elasticity of substitution.

To see where the 'frictionless benchmark' comes in, consider the model only with the first term on the right-hand side of equation (1), $Y_i E_j / Y_w$, and ignore the second term. Further assume that country i and country j were the only countries in the world and that each country's total production was equal to 50 units in some currency. So, $X_{ij} = Y_i E_j / Y_w = 50 \times 50/100 = 2500/100 = 25$. The model would predict exports 25 currency units from country i to country j. Because in this set-up the model is symmetric, the reverse prediction would equal 25 currency units as well. Thus, the two countries consume half of their production at home and exchange the other half – just as if they were one large country and goods would be shipped back and forth at random. This logic extends to worlds populated with larger numbers of differently sized countries.[1]

[1] Note that the model also makes convincing predictions concerning the relationship between trade openness and economic size. It is well known that small countries tend to be more open to trade than large countries trade because the latter trade more domestically simply as a result of their size. Consider a situation with two asymmetrically sized countries: $X_{ij} = Y_i E_j / Y_w = 80 \times 20/100 = 1600/100 = 16$. In the absence of trade costs the reverse prediction remains identical. So, the large country is predicted to export and import much less ($16/80 = 20\%$) relative to its over-

Next, consider the full model including the second term. The second term captures to what degree trade costs lead to deviations from the frictionless scenario just discussed. The first thing to note is the prominent role played by the elasticity of substitution. Because the elasticity of substitution is restricted to be greater than one (to rule out complement relationships between varieties), the exponent as a whole cannot exceed zero, i.e., $(1-\sigma) \leq 0$. In practice, this means the exponent is negative. Because the ratio in brackets – the 'network-adjusted' trade costs – will typically be greater than one, the second term as a whole will be bounded between zero and one. Thus, due to the multiplicative relationship between the two, the second term revises downward the frictionless benchmark prediction of the first term as a function of the elasticity of substitution and the sum of all trade costs.

For concreteness, consider some numerical examples. Suppose relative trade costs, the fraction inside the brackets of the second term, were equal to 2. This implies that factory gate export prices of country i producers double as a result of trade costs. The degree to which this increase in price dampens demand on the side of country j consumers crucially depends on the elasticity of substitution. Supposing σ was equal to 3 so that $(1-\sigma) = -2$. Thus, the second term would equal 2^{-2}, which is the same as $1/2^2$. The trade cost term would therefore be equal .25 and predicted trade flows would equal one quarter of the frictionless benchmark. Now suppose, consumers were much more price-sensitive and the elasticity of substation was 6 instead of 3. Then, $(1-\sigma) = -5$, and because trade costs still equal 2, the second term becomes $2^{-5} = 1/2^5 = 1/32 \approx .03$. Consequently, predicted trade flows amount to merely three percent of the frictionless benchmark scenario. Thus, identical trade costs can have very different effects depending on the price-sensitivity of consumers.

Note that the second term approaches one – and the frictionless benchmark is recovered – under two different circumstances. First, if the fraction inside the brackets approaches one, then the entire term approaches one because one to the power of anything is always one. This is not surprising, and indicates that trade costs that are absent should have no influence on trade flows (although the correct interpretation is a little more subtle given the ratio formulation of the bilateral and multilateral trade cost components). Second, if the elasticity of substitution approaches one, then the exponent approaches zero and anything raised to the power of zero also equals one. Put differently, if consumers are willing to pay any price for a given variety of a product, then trade costs have no effect on trade flows either.

To conclude the discussion, a brief consideration of the multilateral resistance indices, Π_i and P_j is in order. Essentially, these terms reflect the larger network effects of international trade relations that go beyond the ij link. Intuitively, if the sum of bilateral trade costs t_{ij} takes on some intermedi-

all production, compared to the small country (16/20 = 80%). Naturally, in a parameterized regression framework these relationships are more flexible and there is no need for the coefficients on the production variables to equal one, as implied by the theoretical model. It is all the more interesting in this context that estimated coefficients in gravity models are well known to converge to values close to one.

ate value, but both countries face considerably higher trade costs with all their remaining trade partners – for instance, because they are neighboring remote island states – then their multilateral resistance terms are large. As a result, the fraction $t_{ij}/\Pi_i P_j$ becomes smaller, implying higher predicted trade flows X_{ij} than would be expected by considering t_{ij} in isolation. The same logic applies in reverse, for instance, when both countries have strong economic integration agreements with other partners but not with each other. The MR terms thus capture part of the 'general-equilibrium' component of international trade. They reflect the insight that, on a global scale, *relative* trade costs shape empirically observed trade patterns.

6.2 Estimation Strategy: 'Reverse Engineering' the Size of Non-Tariff Barriers

The above considerations carry over directly into the empirical specification of the model. Since the theoretical gravity equation is in multiplicative form, it needs to be transformed into a setup more suitable for estimation. Taking the logarithm of both sides of equation (1) makes it possible to re-express the theoretical model in linear-additive form. I further add time-subscripts and convert the trade and production variables to lower case (to reflect the fact that, as with the elasticities in Chapter 5, estimation is done on the disaggregated level and separately for each product). The resulting product-level equation takes the following form:

$$\ln x_{ijt} = -\ln y_{wt} + \ln y_{it} + \ln y_{jt} + (1-\sigma)\ln t_{ijt} - (1-\sigma)\ln \Pi_{it} - (1-\sigma)\ln P_{jt}, \qquad (2)$$

where now x_{ijt} are product-level exports from country i to j at time t, y_{it} and y_{jt} are industry-level production in i to j at time t, Π_{it} and P_{jt} are the multilateral resistance indices as above. The trade cost term, $\ln t_{ijt}$, can be further specified as

$$\ln t_{ijt} = \ln dist_{ij} + contig_{ij} + lang_{ij} + \ln tar_{ijt} + b_{ij\neq k} + b_{ij=k}. \qquad (3)$$

These are the dyadic trade cost factors that will be explicitly included in the empirical model presented below. The first three terms of equation (3) capture physical trade cost factors. In particular, $dist_{ij}$ is the distance between countries i and j in kilometers, $contig_{ij}$ is a dummy variable taking on a value of one if the countries share a common border and zero otherwise, and $lang_{ij}$ is a dummy indicating whether i and j share an official language. These factors only vary across country pairs but not over time. Next, tar_{ijt} is the bilateral tariff rate in a given year. The exact nature of these variables and the data sources are discussed in more detail below.

The primary variables of interest in the present context are the two border indicators $b_{ij\neq k}$ and $b_{ij=k}$. Because the data contain observations of domestic trade in which $i = j$, not all recorded trade flows cross international borders. If collapsed into a single variable, b_{ij}, would take on a value of one if the recorded flow pertains to cross-border trade between two countries and zero if the recorded flow pertains to domestic trade within a single country. The split version of b_{ij} as contained in the trade cost equation (3) simply separates the international component into two parts: $b_{ij\neq k}$ takes on a value of one if the recorded flow pertains to any cross-border trade between two countries – except for exports to country $j = k$. Similarly, $b_{ij=k}$ takes on a value of one *only* if the recorded flow pertains to cross-border trade that involves country k as a destination. That is, the variable $b_{ij=k}$ separates out all trade flows that are vulnerable to country k's import policies concerning the product under consideration; $b_{ij=k}$ can, therefore, be used to obtain an estimate of the stringency of these policies. Specifically, this can be done by estimating

$$\ln x_{ijt} = \alpha_0 + \alpha_1(1-\sigma)\ln dist_{ij} + \cdots + \alpha_5(1-\sigma)b_{ij\neq k} + \underbrace{\beta(1-\sigma)}_{\tilde{\beta}}b_{ij=k} + \gamma_{it} + \gamma_{jt} + \varepsilon_{ijt}, \qquad (4)$$

where α_0 is an intercept, α_1 through α_5 and β are regression coefficients, γ_{it} and γ_{jt} are time-varying exporter and importer fixed effects and ε_{ijt} is an error term that is assumed to be log-normal. Equation (4) follows directly from (2) and (3). To see this, note that the production variables and the multilateral resistance terms are monadic country-year level predictors and are therefore contained within the two time-varying country fixed effects. As a result, only the dyadic trade cost factors from (3) remain as explicit variables in the model. This is fortunate, in particular, because the fixed effects specification is by far the most convenient way around a host of observational and modeling problems related to treatment of the multilateral resistance indices (as well as other forms of unobserved heterogeneity).

It is worth noting, however, that until fairly recently the computational implementation of multi-way fixed effects (that is, fixed effects for more than one group such as exporters and importers in the current example) created considerable problems when working with larger datasets. Essentially, because the de-meaning procedure through which one-way fixed effects are implemented in statistical packages does directly extend to multi-way fixed effects, the latter could only be estimated by explicitly including dummy variables into the model formulation. In typical trade datasets, however, this implies estimating tens of thousands of dummy variables, which is simply not feasible in standard software packages. Recent advances in computational statistics (McCaffrey et al. 2012, Gaure 2013) have solved this problem.

Before the multi-way fixed effect option was available, different strategies were employed to deal with the MR terms. The original approach by Anderson and van Wincoop (2003) was to model the MR indices explicitly. Because these indices are nonlinear functions depending not only on all bilateral trade cost factors but also on each other, this requires the structural estimation of a system of three equations, which Anderson and van Wincoop (2003) implement using non-linear least squares (NLS). Because this is not straightforward, various alternatives were developed to circumvent the MR terms.

Baier and Bergstrand (2009, 2010) develop a linear approximation procedure for the MR terms based on a first-order Taylor series expansion that makes it possible to directly model the MR correction for each trade cost variable, subtract this correction from the raw data, and then estimate by OLS. Implementing this strategy is comparatively simple. However, as Head and Mayer (2014) show in simulation studies, because both the Anderson and van Wincoop as well as the Baier and Bergstrand approaches require actual data to model the MR terms, missing data issues in unbalanced data sets can lead to considerable biases in the estimated coefficients.

The maybe most widely used approach to dealing with the MR indices consists of analyzing average non-directed trade flows between countries i and j rather than two sets of directed flows (i.e., from i to j and from j to i). This setup makes it possible to arrange the bi-directional gravity equation in such a way that the MR terms cancel out (see for instance: Head and Ries 2001, Head and Mayer 2004, Chen and Novy 2011, 2012, Jacks et al. 2008). The primary disadvantage of this approach is that it only allows the estimation of average non-tariff barriers between countries. This may be tolerable when one focuses on obtaining a general impression of the trade restrictiveness between relatively similar countries such as the U.S. and Canada (Head and Ries 2001) or among the EU15 members (Chen and Novy 2011).

However, this strategy is clearly misplaced when the goal of the estimation procedure is to obtain detailed information on the import policies of *individual* countries. Researchers interested in such estimates (i.e., Winchester 2009) were therefore often forced to resort to simple OLS procedures that, unfortunately, raise various concerns both with the MR terms and with other unobserved factors. It is worth noting in this context that the Anderson van Wincoop (2003) version of the gravity model with multilateral resistance indices was only developed in response to implausible findings of McCallum (1995) that were based on an OLS specification.

The fixed effects specification I use has the additional advantage of accounting for other forms of unobserved heterogeneity that is clustered at the country-year level. Several of the trade cost factors listed in the introduction to this chapter – such as the state of transport infrastructure, the quality of the legal system, or the political stability in the importing country – are appropriately dealt with in this way. The same is true for importer-specific shocks to tastes or income, and exporter-specific production shocks. The explicitly included dyadic variables capture further important aspects. Apart from accounting for physical trade cost determinants, the distance, contiguity, and language variables are expected to account for important cultural differences as well because both physical and linguistic proximity are likely to be related to cultural proximity.

With tariffs as an observable policy barrier component also accounted for, it is therefore reasonable to expect that a considerable share of any remaining international trade frictions is attributable to non-tariff policy barriers (one limitation of the method is that the separate product-by-product estimation setup makes it impossible to account for characteristics that only vary *between* products – in particular, the relative transportability of products. I come back to this point below). The size of these NTBs then can be inferred from the estimated coefficients on the border indicator $b_{ij=k}$. Conceptually, the coefficient on the border indicator picks up the residual deviation from the theoretical baseline prediction of the gravity model as discussed above after accounting for a host of other trade cost factors.

To see how this works in detail, first consider once more the case when the two border dummies are collapsed into a single variable b_{ij}. Because this variable is equal to one if trade flows cross an international border and zero otherwise, the estimated coefficient is equal to $\ln x_{b_{ij}=1} - \ln x_{b_{ij}=0}$, which is equivalent to $\ln(x_{b_{ij}=1}/x_{b_{ij}=0})$. Exponentiating thus provides the time- and importer-averaged ratio of the size of international to domestic trade flows of a given product after accounting for the other factors discussed above. The coefficient, therefore, can be interpreted as a conditional average reflecting how large international trade is relative to domestic trade for a given product, all else equal. It can be seen as a measure of the general restrictiveness of the international trade network to trade in the given product.

The same logic applies to the importer-specific variable $b_{ij=k}$ only that in this case the coefficient reflects the specific trade restrictiveness of importer k – while the average restrictiveness of all remaining countries is reflected by the coefficient on $b_{ij\neq k}$. For instance, if the estimated coefficient on $b_{ij=k}$ was equal to –2, then because $\exp(-2) \approx 0.13$, this would imply that the amount of goods other countries export to country k is on average equal to 13 percent of what these countries trade domestically.

The important point to note in this respect, however, is that any empirically observed trade frictions cannot be directly used to infer the size of non-tariff barriers in a given country k. The reason is that observed trade frictions are not only determined by policy barriers, but also by the price-sensitivity of consumers. Intuitively, if country k imposes high NTBs on a given product but consumers in country k are willing to pay high prices for different imported varieties of that product, then observed trade frictions should be moderate. Conversely, if country k maintains only very moderate NTBs but consumers are extremely price-sensitive, then observed trade frictions should be large despite the moderately-sized policy barriers. Thus, observed trade frictions alone do not provide sufficient information to assess the intrinsic severity of policy barriers because the effectiveness of policy barriers depends not only on the barriers themselves but also on the substitutability between domestic and foreign product varieties.

This problem is readily apparent from equation (4) and directly follows from the theoretical formulation of the gravity model discussed in section 6.1. In this setup, the parameter of interest is β, but the parameter resulting from the actual estimation is $\tilde{\beta} = \beta(1-\sigma)$ because observed trade frictions depend on both the underlying NTBs and the price-sensitivity of consumers. In a certain sense, therefore, the coefficient estimates on $b_{ij=k}$ are 'theoretically contaminated' because the estimates reflect the combined influence of two factors – the actual trade barrier and the elasticity of substitution. Given information on the elasticity of substitution, however, it is straightforward to obtain the parameter of interest (i.e., Anderson and van Wincoop 2003). In particular, the *ad valorem* equivalent of the underlying policy barrier can be calculated as

$$NTB\ \widehat{AVE_{J=k}}/100 \ = \ \exp(\beta) - 1 \ = \ \exp\left(\frac{\tilde{\beta}}{1-\sigma}\right) - 1. \tag{5}$$

The logic is as follows: if $\tilde{\beta} = -2$, as in the above example, and $\sigma = 4$, then $-2/(1-4) \approx 0.67$. This implies a trade cost factor of $\exp(0.67) \approx 1.95$. That is, the factory gate export price of a given product variety is in effect multiplied by 1.95 as a consequence of the non-tariff barrier and therefore results in an import price that is $1.95 - 1 = .95 = 95\%$ higher than the original export price. The implied *ad valorem* equivalent of the underlying trade barrier is therefore estimated to be 95 percent.

It is worth noting that, for a given level of observed trade frictions, $\tilde{\beta}$, *higher* values of the elasticity of substitution result in *lower* estimated NTBs, and vice versa. The intuition is that if consumers are extremely price-sensitive (i.e., high σ), then even a very moderate policy barrier will have a considerable effect on observed trade flows. On the other hand, if consumers are willing to pay almost any price (low σ) for foreign varieties of a product, then very stiff barriers are required to achieve the same level of observable trade frictions. It follows that for any given level of trade frictions, the higher the value of σ, the lower the implied NTBs.

6.3 Non-Tariff Barriers: Data, Estimation, and Results

In order to implement the above estimation procedure, data on trade, tariffs and production are required – all at the product level and over time – as well as dyadic data on distances, contiguity, and official languages. The following paragraphs briefly describe these data and the respective sources from which they are taken.

Trade data come from different sources. First, the bulk of the data on trade in the agricultural and manufacturing sectors is taken from the UN Comtrade database. Depending on data availability, Comtrade provides up to two reportings for each trade flow – the export flow x_{ij} as reported by exporter i, and the mirror import flow m_{ji} as reported by importer j. Second, the UNCTAD Trains database – from which the data on tariffs is taken – also reports import trade values for these sectors. While most of this data is taken from Comtrade and thus identical with the m_{ji} reporting, UNCTAD also occasionally reports data from the WTO IBD database. Third, data on trade in services is taken from the UN Service Trade database as well as from the OECD's 'Statistics on International Trade in Services' database.

As a result of the multiple data sources, there may be up to three different entries per trade flow. This is helpful to alleviate missing data concerns. At the same time, it raises the question of how to combine multiple reportings into a single figure. I follow the simple strategy of using the maximum value in cases where several entries for a single flow are available. The reasoning is that under-reporting seems likely to be a much more severe problem in trade statistics than over-reporting. Potential reasons for under-reporting include capacity constraints on the side of customs authorities as well as incentives of buyer and sellers to evade tariff and tax collection. In contrast, systematic reasons for over-reporting are much less evident.

Production data is required to derive the volume of domestic trade, which is calculated as the value of production minus the value of total exports in each product category, following Wei (1996) as noted above. Production data also come from different sources. Data on agricultural production is taken from the Food and Agricultural Organization's (FOA) 'Value of Agricultural Production' database. Data on manufacturing production comes from the INDSTAT4 2013 database compiled by the United Nations Industrial Development Organization (UNIDO). Finally, data on production in services comes from the OECD's 'Structural Analysis Statistics (STAN)' database.

The need for production data constrains the level of granularity at which the analysis can be carried out. Production data is simply not available at a level of aggregation similar to the HS 6-digit categories in which trade and tariff data is reported (i.e., more than five thousand product categories). To be more specific, data on agricultural production is on the HS 4-digit level, data on production in the manufacturing sector is on the ISIC Rev. 3 4-digit level, and data on service sector production is on the ISIC Rev. 3 2-digit level.[2] This corresponds to the classification scheme in which the National Trade Estimate reports are coded as described in Chapter 4. I therefore aggregate the trade and tariff data as well as the elasticity estimates from the previous chapter (which are all on the HS 6-digit level) to match this classification scheme.

The time coverage of the data ranges in theory from 1988 to 2012. However, as a result of a large share of missingness in the earlier years and sparse data coverage in the UNIDO data after 2010, the vast majority of observations span the second half of the 1990s and the 2000s.

Finally, the data on distances, geographic contiguities, and official languages come from the gravity datasets provided by CEPII (Head et al. 2010, Mayer and Zignago 2011). Because the estimation setup includes domestic trade, that is observations with $i = j$, it is necessary to have domestic analogues for all trade cost variables that are explicitly included in the model. This requires, in particular, a measure of distance that is comparable for domestic distances *within* countries and international distances *between* countries. This rules out the use of standard distance measures such as the distances between capital cities, if one does not want to implicitly assume that domestic trade costs related to distance are zero.

Fortunately, CEPII provide an appropriate measure that allows for consistent comparisons between domestic and international distances. Specifically, the measure is calculated as the population-weighted distance between major cities, where these cities serve as proxies for the economic

[2] Data on services is generally only available at a relatively coarse aggregation level. This is also true for data on trade in services.

centers between which goods are traded both domestically and internationally. This approach makes it possible to directly compare the average weighted distance between cities within a country to the average weighted distance between cities across countries (for a detailed description see: Head and Mayer 2002). The adaption of the contiguity and language variables is straightforward. A country is necessarily contiguous with itself, so the contiguity variable takes on a value of one for observations in which $i = j$. The same logic holds for official languages. Finally, domestic tariffs are equal to zero.[3]

The estimation is done separately by product to obtain product-specific results. Within each product category, I then iterate through countries k in order to get importer-product specific estimates for each importer. Thus, the estimation is repeated n times with changing constellations of the variables $b_{ij=k}$ and $b_{ij\neq k}$, where n is the number of importers in the product-specific subset of the data. Overall, the data contains information on 160 importing countries and 211 different products in the mixed HS-ISIC classification. Naturally, not all theoretically possible combinations are contained in the data, both because not all countries import all products and because the data is incomplete due to missingness. Nonetheless, the procedure results in a total of 11,563 estimated NTB *ad valorem* equivalents.

The estimated NTBs can be seen as over-time averages of importing countries' most-favored nation (MFN) non-tariff import policies.[4] In other words, the estimates reflect the general openness or restrictiveness of a country's product-specific import policies that affect all exporters alike.

Table 6.1 exemplarily shows the results of two of 11,563 analyses run to obtain these estimates. These results relate to Brazil's imports of pork (H_0203, with 0203 being the 4-digit HS code for pork) and photographic equipment (I_3320, with 3320 being the 4-digit ISIC Rev. 3 code for optical instruments and photographic equipment). The first column for each product category shows the global results with $b_{ij=k}$ and $b_{ij\neq k}$ collapsed into a single indicator b_{ij}, as indicated by the heading 'WLD' (for 'world'). The second set of columns shows the results for Brazil as country k.

The coefficient estimates of $b_{ij=k}$ that are of primary interest are reported at the bottom of the table. As one would expect, the overall pattern of the estimates changes only slightly with the change in the border indicator from the WLD to the BRA setting. As indicated by the much larger negative coefficients on the border indicators, pork trade (with pork being a typical agricultural product) appears to be considerably more restricted than trade in optical and photographic products (which

[3] Tariffs on service trade are equally set to zero. Tariffs do not apply to trade in services primarily because services do not pass through customs. Service barriers typically come in the form of investment restrictions and various domestic regulations. A detailed classification of service barriers can be found in: Borchert et al. 2012.

[4] In WTO parlance, MFN is the tariff rate that members grant to all other members equally (leaving aside preferential trade agreements). The concept is based on the idea of non-discrimination so that all WTO members are equally 'most-favored' by each other.

are sophisticated manufactures), both on the world scale and with respect to Brazil. This result is in line with expectations and also reflected in the coefficient estimates on the tariff variable.[5]

From the estimated coefficients, the implied Brazilian non-tariff barriers can be calculated as described above. The elasticities of substitution – as obtained from the procedure described in Chapter 5 – for pork and photographic equipment are 5.34 and 2.78, respectively. Consequently, for pork the estimate is $\exp(-5.78/(1-5.43)) - 1 = 2.79 = 279\%$, and for photographic equipment it is $\exp(-0.83/(1-2.78)) - 1 = 0.56 = 56\%$.[6]

Table 6.1: Exemplary gravity estimates for Brazil's pork and photographic equipment imports

	H_0203: Pork meat		I_3320: Opt. & photogr. equipment	
	WLD	BRA	WLD	BRA
$\ln dist_{ij}$	–0.326***	–0.325***	–0.955***	–0.951***
	(0.040)	(0.041)	(0.032)	(0.032)
$\ln(1 + tar_{ijt})$	–0.305***	–0.306***	0.007	0.013
	(0.041)	(0.041)	(0.031)	(0.031)
$contig_{ij}$	1.845***	1.846***	0.908***	0.894***
	(0.116)	(0.116)	(0.097)	(0.097)
$lang_{ij}$	0.458***	0.457***	0.973***	0.964***
	(0.079)	(0.079)	(0.056)	(0.056)
b_{ij}	–5.735***	–	–0.346	–
	(0.176)		(0.203)	
$b_{ij\neq k}$	–	–5.734***	–	–0.320
		(0.177)		(0.209)
$b_{ij=k}$	–	–5.780***	–	–0.831**
		(0.445)		(0.270)
$Fixed\ effects$	it, jt	it, jt	it, jt	it, jt
$N * T$	12,365	12,365	16,800	16,800
R^2	0.724	0.799	0.791	0.810

Notes: The dependent variable is $\ln(1 + x_{ijt})$. The constant of 1 is added to avoid taking logarithms of zeros of which some are reported in the data; similarly for tariffs, where the prevalence of zeros is considerably more pronounced. The fixed effects are directional, i.e., there are two fixed effects per dyad-year; the intercept and fixed effects coefficients are not reported. Huber-White robust standard errors are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

[5] One thing to note in this context is that the coefficients on the global estimates for b_{ij} and $b_{ij\neq k}$ in the photographic equipment category are not statistically significant. However, the purpose here is not the test *whether* international trade volumes are different from domestic ones but to assess *how* the two relate and to use this information to infer trade frictions. For this reason, the p-value is not necessarily the relevant statistic to consider with respect to the border indicators. Basically, a precise coefficient estimate of exactly 0 would be highly informative (although not statistically significant) because it implies that international trade in the given product is just as open as domestic trade and therefore that implied NTBs are equal to zero – conditional on all other trade cost factors.

[6] As noted above, because higher elasticities imply lower barriers, these results would diverge more strongly if they were calculated using, say, the mean of the two elasticities.

The figures presented in Table 6.1 are representative of the overall results. The average R-squared across all analyses is slightly below 0.78 (which is no unusual value for gravity-type regressions). The average number of observations per product sub-dataset is 12,925 including the time-series, with the average number of years covered being 21.5 (although, as noted above, the early years are underrepresented, so there is no even coverage across these years). Overall, some 86 percent of estimated coefficients are statistically significant at the 5 percent level. When only considering the coefficients on the $b_{ij=k}$ indicator, this number drops to 64 percent. As noted in footnote 5, however, p-values may not be the most informative statistic in the present context. As the further discussion highlights, it is far from uncommon (at least in the manufacturing sector) that international and domestic trade are comparably open.

A descriptive overview of the estimated non-tariff-barriers

To give a more systematic overview of the results, Table 6.3 (which, due to its length, is appended at the end of this chapter) presents the trade-weighted average NTB *ad valorem* equivalents (based on import values) across all importers for an extended selection of products.[7] The complete list is provided in Appendix III.

Table 6.3 allows an assessment of the plausibility of the results by comparing the estimated NTBs to prior expectations about the restrictiveness of trade relations for different products. The table is split in three large segments relating to agricultural products, manufactures, and services. Two different versions of the estimates are provided. The first column gives the raw estimates as calculated following the procedure described above. However, it is fairly common in the manufacturing sector that goods are traded more intensively across international borders than domestically (conditional on trade costs). For this reason, I truncate these estimates at zero because not doing so would imply that countries actively subsidize imports. The interpretation therefore is that trade relations that are at least as open as domestic trade are considered free of policy barriers.

The second column provides an alternative measure, which simply rescales the raw estimates to a different benchmark. In doing so, I select for each product the importer with the lowest estimated NTBs and define this importer as the free-trader. I then rescale the estimates so that the free-trader has NTBs of zero and all other countries have NTBs larger than zero. This rescaling preserves the relative differences between the estimates and only leads to slight shifts in the overall weighted-average depending on how large the trade share of the free-trader is. The interpretation here is that the free-trader defines the product-specific standard of when trade is considered to be free. I refer to the first version as 'domestic-trade benchmarked' and to the second as 'free-trade benchmarked'.

[7] In the calculation of these averages, I discard a handful of estimates that are larger than 5000 percent. These estimates concern almost exclusively developing countries and appear to be mostly the result of reporting error in the production data.

The overall pattern of results is clear. It is readily apparent that the estimated NTBs in the manufacturing sector tend to be much lower than those in both the agricultural and services sectors. This is fully in line with prior expectations given that the agricultural sector is well-known to be strongly protected across countries and trade liberalization efforts in the services sector have only picked up speed comparatively recently. With respect to individual products, the results align with intuition as well. The only estimates that are unexpected concern coke oven products (I_2310), and cement and stone (I_2694, I_2695, I_2696). The estimates for these products appear overly high. This is a direct consequence of the very low weight-to-value ratios of these products, which drastically reduce their transportability. As noted above, the product-wise estimation procedure cannot account for these product-level characteristics. For products with more representative weight-to-value ratios, however, this issue appears to be of less concern.

In the transport sector, for instance, the estimated NTBs suggest that both shipbuilding (I_3511) and the railway industry (I_3520) are relatively closed. This mirrors prior knowledge suggesting that these industries (and the large national wharfs in particular) are much less internationally integrated than, for instance, the auto and aviation sectors. High NTBs are also estimated for nuclear fuel (I_2330) and weapons and ammunition (I_2927), which are clearly among the most strongly regulated manufacturing industries. Publishing and printing (I_2211, I_2221), both of which are strongly nationally-oriented industries, attain high estimates as well.

The implied levels of protection in the textile and apparel sector are potentially lower than one would expect. It should be kept in mind, however, that these products are already shielded by some of the highest tariffs among all manufacturing goods. In the services sector, the pattern of results conforms very well with intuition: By far the lowest estimates relate to air transport (I_6200), followed by research and development (I_7300), while the highest estimates concern construction (I_4500), and public administration and defense (I_7500). This is close to what one would expect.

When turning to importer-specific estimates, an intuitive pattern emerges as well. Japan, for instance, is known for its stringent rice (H_1006) import policies. The country's NTBs for rice are estimated at 742 percent (using the domestic-trade benchmark). Similar figures are obtained for other large rice producers such as India (746 percent), or Indonesia (570 percent). This compares to estimates of 246 percent for Mexico, 55 percent for Italy, 57 percent for Argentina, or 6 percent for Australia. The picture looks much different for corn (H_1005). Here Japan's estimated NTBs are zero percent (truncated), while Mexico's are 925 percent. Similarly, Argentina's NTB estimate for soy beans (H_1201) is at 958 percent, while the estimate for the European Union is 263 percent. Conversely, when considering rape seed (H_1205), the oilseed variant dominant in Europe, the reverse result is found with an estimated 330 percent for Argentina and 586 percent for the EU.[8]

[8] Estimates for the European Union are obtained by calculating the trade-weighted averages for all member states. Imports are summed over time before transforming them into weights. This makes it possible to take into account

The overall pattern that emerges from these comparisons is that in the agricultural sector, large producers tend to have high estimated NTBs. In contrast, the opposite pattern is discernable in manufacturing trade. Here, large producers tend to be most open to trade. This general picture corresponds directly with theoretical expectations and prior knowledge about the dynamics of agricultural and manufacturing trade: In the agricultural sector, where producers face direct competition from very similar imported product varieties, lobbying for protection is strong. On contrast, in the manufacturing sector, where producers sell differentiated products in segmented markets and global supply chains are of major importance, calls for protection are much less frequent.

It is worth pointing out that the data resulting from the above estimation results constitute the most comprehensive and detailed information on NTBs that is currently available. This is true for the amount of detail on the product level as well as for the country coverage.

Systematically assessing the trade depressing effect of policy barriers to trade

This subsection discusses a set of additional gravity estimates that substantiate the trade depressing effect captured by the estimated NTBs. Instead of indirectly estimating NTBs as above, the following analysis presents results for gravity estimates that directly include the acquired NTBs as a predictor. The section thereby also demonstrates the solid empirical basis for the simulation exercise presented in the following chapter, which seeks to capture countries' stakes by calculating the effects of hypothetical trade barrier reductions on existing trade flows. Given that the NTB estimates and their hypothetical reductions are at the heart of the operationalization strategy employed to capture countries' stakes in a given industry-level trade relationship, this demonstration serves to substantiate the appropriateness of the operationalization procedure described in the following chapter.

Prior to presenting the estimation results, the subsection discusses the data structure used in the analysis and explains the rationale behind the data setup and research design choices made. These choices are of particular interest because they also apply to the analysis presented in Chapter 7. The most far-reaching of these choices is to collapse the twenty-five year time-series data, ranging from 1988 to 2012, into a cross-section. This is done for two independent but equally important reasons. First, the data on NTBs come as a cross-section as a result of the above estimation strategy. Since the over-time variation, along with the variation across exporters, has been used to estimate the NTBs, the resulting data are on the importer-industry level. Consequently, the NTB estimates do not vary over time. Therefore, they cannot be adequately matched with the U.S. trade enforcement data or the trade data to be used in a time-series cross-sectional analysis unless one is willing to repeat the same barrier estimate for each year and then perform a pooled analysis. The second reason for col-

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the changing composition of the EU. Members that joined the EU later receive lower weights because their imports are summed over shorter time-periods.

lapsing the data into a cross-section is unrelated to the present purpose, because it has to do with the temporal bargaining dynamics surrounding trade disputes. This point is, therefore, discussed in the next chapter.

The following briefly presents the more technical details of the aggregation procedure. The data that need to be aggregated for the analysis below are the time-varying economic data on trade and GDP. A feature of economic data is that these data are measured in monetary units (i.e., in U.S. dollars). Such data are customarily reported in *current* rather than *constant* U.S. dollars and thus reflect the nominal currency values of the respective reporting year. As a result, current U.S. dollar time-series data include the effect of price inflation. The data shows an increasing trend that is due not only to economic growth but also to inflation. It is therefore necessary to inflation-adjust the data prior to calculating time-averages in order to translate all data in comparable *constant* U.S. dollar terms.

To do so, I use GDP deflators taken from the World Bank's World Development Indicators database to inflation-adjust the current data value series. Thus, all price-adjustments are made using general economy-wide inflation-measures for each country, irrespective of whether the series concern aggregated data (such as total trade or production) or disaggregated data (such as industry-level trade or production). Ideally, one would want to adjust all data-series with disaggregated deflators because prices for different products do not necessarily move in parallel within an economy. Possible alternatives to GDP deflators that allow more disaggregated price-adjustments are consumer and producer price indices (CPIs and PPIs) and trade unit values (UVs). However, both of these options have considerable disadvantages compared to GDP deflators.

While national statistical offices in many developed countries provide relatively detailed consumer and producer price indices (CPIs and PPIs), such indices are typically not available for developing countries. Moreover, national price indices differ in classifications and level of detail, leading to considerable comparability issues. The OECD provides a set of harmonized CPIs and PPIs for member states based on individual national versions of these indices. However, because harmonization makes it necessary to considerably aggregate all national indices to find the 'smallest common denominator' of the respective product groupings, the resulting indices typically only include a handful of product groups. In addition, the OECD indices do not cover developing countries and are therefore not globally applicable.

Trade unit values have the advantage of being available at highly disaggregated product-levels. At the same time, however, they are an unreliable measure of price developments due to considerable measurement error. The issue of measurement errors is much more important in the context of price deflation than in the context of estimating elasticities. In the latter setting, UVs are used in a statistical context so that some of the measurement errors may cancel out or are stabilized in the statistical averaging procedure. In contrast, when used for price-deflation of, say, product-level trade data, each individual UV is matched with a single corresponding dyad-product-year observation.

Accordingly, the entire measurement error is fully propagated into the 'price-adjusted' trade value. This can lead to severe biases especially for developing countries for which measurement error in UVs is most pronounced.

The above considerations significantly lower the attractiveness of CPIs/PPIs and UVs relative to GDP deflators. The latter have the great advantage of being available for all countries and fully reliable on average, that is, they adequately reflect general country-specific price movements over time. This is a sufficient property for the current purpose which simply seeks to construct reasonably valid over-time averages that do not depend on getting precise annual estimates. In contrast, if one would like to investigate the details of say production growth in a given country-industry over time (for instance as function of industry investments or R&D activities, or in relation to unemployment rates), the specific year-to-year changes would be of direct interest. In the former case, individual annual changes matter much less than the general price trend, which in turn is likely to be adequately captured by GDP deflators.

Additional processing is required to construct data for the European Union. Because Brussels is responsible for EU trade policy, the European Union as such rather than individual member states is the political entity of interest. This is also reflected in the U.S. trade enforcement data extracted from the NTE reports, where the EU is treated as a single actor. Trade, production, and GDP data, where not directly available, are aggregated by summing the individual annual figures for all member states prior to the above deflation and averaging procedure. In this context, the varying membership of the EU over time is taken into account. NTB data is calculated as the trade-weighted average of individual member state estimates as described in footnote 8.

With these aggregation procedures implemented, it is possible to proceed to the statistical analysis. This analysis serves to establish the trade depressing effect of the estimated NTB measures. Demonstrating this effect is important, because the NTB data (together with the elasticity estimates and the observed trade data) is at the heart of the operationalization strategy that aims to measure parties' stakes in the following chapter. Put differently, the NTB data need to demonstrably depress trade, because otherwise a reduction in trade barriers cannot necessarily be assumed to result in increased imports and adequately measures *gain* and *loss shares*.

The general gravity model structure is similar to the setup employed above. That is, I estimate a log-log regression of trade on a set of gravity and trade cost variables and a set of up to three fixed-effects that takes the form

$$\ln x_{ijk} = \alpha_0 + \alpha_1 \ln(1 + y_{jk}) + \tilde{\beta}_{1-4} \ln t_{ijk} + \gamma_1 + \gamma_2 + \gamma_3 + \varepsilon_{ijk}, \tag{6}$$

where x_{ijk} are deflated time-averaged exports in industry k from exporter i to importer j, y_{jk} is deflated time-averaged production in industry k in country j, α_0 is an intercept, α_1 and $\tilde{\beta}_1$ through $\tilde{\beta}_4$ are regression coefficients (as before, the tilde indicates the composite coefficient that includes the elasticity of substitution), γ_1, γ_2, and γ_3 are a differing set of fixed-effects to be specified more precisely below, and ε_{ijk} is an error term that is assumed to be log-normal. Lastly, the trade cost term, $\ln t_{ijk}$, is

$$\ln t_{ijk} = \ln(1 + barrier_{jk}) + \ln dist_{ij} + contig_{ij} + lang_{ij}. \quad (7)$$

Despite the similarity to the model in equation (4), there are a number of differences. First, data contain information on all industries. Thus, a joint model is estimated instead of estimating separate models for each industry. The industry classification remains the same as before (see: Appendix I for details). Second, unlike in the setup above, where observations relating to countries' domestic trade were included, the data now only contains information on *international* trade. Since the purpose is to estimate the effect of an (now) observed measure of trade barriers on international trade – rather than to compare domestic to international trade in order to indirectly infer the size of implied trade barriers – this choice is natural. As a direct consequence, all trade flows in the data refer to flows that cross national borders so that no border indicators are included in the model.

The trade cost term now contains a new variable, $barrier_{jk}$, which is the sum of the NTB *ad valorem* estimate for industry country j in industry k and the corresponding tariff (if available), which is in *ad valorem* terms by definition (I use the 'free-trade benchmark' version of the NTB data; this choice is inconsequential as results with the domestic benchmark data are very similar). The variable thus captures the total *ad valorem* policy barrier a country implements in any given industry. The combination of the NTBs and tariff data into a single barrier measure reflects the theoretical consideration that the two kinds of measures in tandem form the politically imposed trade cost component that matters in the context of trade disputes (this is also the measure that serves as the basis for the trade policy simulations described below). Practically, however, the NTB data by far outweigh the trade depressing effect of tariffs as discussed more extensively below.

The $dist_{ij}$, $contig_{ij}$, and $lang_{ij}$ variables that measure geographical distance, land contiguity, and common official language are defined as before. The only difference relates to the distance measure for the European Union. Because the available gravity datasets (Head et al. 2010, Mayer and Zignago 2011) do not contain distance measures for the EU, I approximate these distances by calculating the trade-weighted distance of non-EU countries to the EU-15 member states. The EU-15 is chosen in order to capture representative distances to the 'average EU' in the time-averaged cross section.

Table 6.2 presents the results of the analysis in a number of different specifications. The first two columns show estimates for the entire world trade network, that is, for trade between all countries in each direction. Columns three and four show estimates only for the subset of unidirectional trade from the United States to its trade partners, i.e., U.S. exports. This is the subset of data that is of primary interest and that forms the basis for the further analyses below. The two specifications (a and b) for each of the two sets of data differ only in the form of the included fixed-effects. Because the estimated NTBs that form the basis for the $barrier_{jk}$ variable are on the importer-industry level, I cannot include industry-varying importer effects, γ_{jk} , in any of the models.

Table 6.2: Gravity results assessing previously estimated NTBs on world and U.S. trade

	World Trade Network		U.S. Exports	
	Model 1a	Model 1b	Model 2a	Model 2b
$\ln(1 + y_{jk})$	0.371***	0.102***	0.448***	0.108***
	(0.002)	(0.003)	(0.010)	(0.016)
$\ln(1 + barrier_{jk})$	–0.421***	–0.330***	–0.616***	–0.304***
	(0.004)	(0.005)	(0.024)	(0.028)
$\ln dist_{ij}$	–1.028***	–1.160***	–1.001***	–
	(0.006)	(0.006)	(0.062)	
$contig_{ij}$	0.633***	0.499***	1.017***	–
	(0.020)	(0.020)	(0.156)	
$lang_{ij}$	0.621***	0.365***	0.225***	–
	(0.012)	(0.013)	(0.056)	
$Fixed\ effects$	$ik, j_{WB}k$	ik, k, j	$j_{WB}k$	$k, j = ij$
N	222,139	222,139	4,758	4,758
R^2	0.702	0.723	0.814	0. 859

Notes: The dependent variable is logged industry-level trade, $\ln(1 + x_{kij})$. The constant of 1 is added to avoid taking logarithms of zeros of which some are reported in the data; similarly for policy barriers. Industry (k) and importer World Bank income group (j_{WB}) or importer/dyad (ij) fixed-effects are included as indicated; the intercept and fixed-effects coefficients are not reported. Huber-White robust standard errors are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

In order to partially account for unobserved heterogeneity at these levels, I either specify separate industry and importer effects γ_k and γ_j , or alternatively use industry-varying importer income group effects, $\gamma_{j_{WB}k}$, where income groups are defined based on the World Bank's classification of countries according to high, upper middle, lower middle, and low income groups. The rational in the latter case is to account for product-specific unobserved heterogeneity that is related to development status and to thereby capture an important aspect of relevant importer characteristics. Also, as a result of the inability to specify industry-varying importer effects, I include industry-specific importer production, y_{jk}, as a gravity variable (while industry-specific exporter production, y_{ik}, is soaked up in the γ_{ik} in the world model and γ_k in the U.S. exports model). Because the U.S. exports model only has one exporter, namely the United States, importer effects y_j are equivalent to dyad effect y_{ij} in this context.

The estimates in Table 6.2 show that policy barriers are a significant hurdle to trade in general and to U.S. exports in particular. Because, unlike before, the focus is not on inferring unobserved trade barriers from observed frictions, the coefficient interpretation follows the standard logic of interpreting log-log regression models. In approximation, the coefficient estimates for continuous predictors can be interpreted as the percentage change in trade in response to a given percent change in the predictors. That is, a δ percent change in x implies a $\beta\delta$ percent change in y. Similarly, for dummy variables the coefficients are approximately interpreted as the percentage change in trade in response to a switch of the dummy from zero to one. That is, change from zero to one in x implies a β percent change in y. This approximation is intuitively graspable and sufficiently exact for small changes in the predictors of, say, ten percent or less.

For completeness, the exact interpretation follows directly from the functional form of the exponentiated version of the model but is less straightforward and requires additional calculations. Omitting all subscripts, a simple model with a (logged) continuous predictor x and a dummy variable D takes the form of $\ln(y) = \beta_1 \ln(x) + \beta_2 D + \varepsilon$. Exponentiation yields the unlogged model $y = x^{\beta_1} \times \exp(\beta_2 D) \times \epsilon$. Thus, when x is multiplied by a factor $(1 + c)$, i.e., x increases by $100c$ percent, y is multiplied by $(1 + c)^{\beta_1}$. For instance, if x increases by fifty percent, y increases by 1.5^{β_1}. The change in y then is $\Delta y = (1 + c)^{\beta_1} - 1$, which, multiplied by 100, gives the corresponding percent change. Similarly when $D = 1$ y is multiplied by $\exp(\beta_2)$ with the corresponding change in y of $\Delta y = \exp(\beta_2) - 1$. Otherwise, when $D = 0$ y is multiplied by $\exp(0) = 1$ with an implied change of 0.

Based on these interpretations, it is apparent from Table 6.2 that a given increase in policy barriers of say ten percent implies an average decrease in trade of around three to six percent depending on the model specification. Model 2b, for instance, implies that an increase in representative foreign trade barriers by ten percent depresses U.S. exports by approximately 3.04 percent (the exact value being $1.1^{-3.04} - 1 = -0.0285 = 2.85$ percent. Similarly, a decrease in foreign trade barriers by ten percent would result in an increase of U.S. exports of around 3 percent (the exact value being 3.25 percent)). These are substantial effects especially given that the data include a considerable share of trade relationships that are relatively open to trade. This implies that policy barriers in heavily protected industries can be considerably greater impediments to trade. For instance, subsetting the U.S. data to include only agricultural products results in estimates for the coefficients on the barrier variable of –0.721 (0.057) for Model 2a and –0.434 (0.057) for Model 2b.

To demonstrate that the trade depressing effect of policy barriers is driven primarily by NTBs as opposed to tariffs, I also estimate the models with the NTB data only. For these variants of the models, coefficient estimates and standard errors on the barrier variable are –0.321 (0.004) and –0.269 (0.004) for Models 1a and 1b, respectively, as well as –0.486 (0.021) and –0.234 (0.021) for Models 2a and 2b (the coefficient estimates for the other variables are substantively unchanged, which is why I do not report the results in full). Thus, coefficient estimates decrease only slightly. All estimates continue to be statistically significant at the .001 level. Very similar results are obtained for model specifications in which NTB and tariff data are both entered separately. In these cases, the estimated coefficients for tariffs turn out to be of small magnitude and much less stable then the NTB estimates. In sum, the results presented above substantiate the methodological validity and the practical importance of the estimated NTBs and thereby set the scene for the further analysis.

Table 6.3: Estimated NTB ad valorem equivalents – trade-weighted averages (selection)

Code	Category	Product description	AVEs.dm	AVEs.ft
H_0201	Meats	Meat of bovine animals	213.8	260.4
H_0203		Meat of swine	271.3	219.5
H_0204		Meat of sheep or goats	297.3	314.0
H_0205		Meat, of horses, asses, mules or hinnies	228.9	229.2
H_0207		Meat and edible offal of poultry	229.1	236.4
H_0701	Vegetables	Potatoes	392.7	442.4
H_0702		Tomatoes	42.6	94.7
H_0703		Onions, shallots, garlic, leeks	242.3	304.8
H_0704		Cabbages, cauliflowers, kohlrabi, kale	143.3	216.6
H_0705		Lettuce	78.3	167.2
H_0706		Carrots, turnips, salad beetroot, etc.	229.8	313.3
H_0707		Cucumbers and gherkins	77.3	169.5
H_0708		Leguminous vegetables	393.6	459.5
H_0801	Fruits & nuts	Coconuts, Brazil nuts, and cashew nuts	151.6	159.4
H_0802		Nuts other	91.5	145.9
H_0803		Bananas	22.4	100.4
H_0804		Dates, figs, pineapples, avocados, mangoes	151.2	210.9
H_0805		Citrus	91.1	124.1
H_0806		Grapes	224.5	306.7
H_0807		Melons and papayas	125.4	212.8
H_0808		Apples, pears, and quinces	109.8	177.2
H_0809		Apricots, cherries, peaches	65.5	113.6
H_1001	Grains	Wheat	277.8	325.6
H_1002		Rye	802.4	898.5
H_1003		Barley	385.4	425.8
H_1004		Oats	251.4	285.2
H_1005		Maize (corn)	251.9	343.4
H_1006		Rice	343.1	392.5
H_1007		Grain sorghum	726.5	823.4
H_1008		Buckwheat	664.6	737.8
H_1201	Oilseeds	Soya beans	425.4	487.1
H_1202		Ground-nuts	75.3	113.8
H_1204		Oil seeds, linseed	56.5	81.6
H_1205		Rape or colza seeds	592.9	668.4
H_1206		Sunflower seeds	378.8	427.3
I_1711	Textiles & apparel	Textile fiber preparation, textile weaving	0.0	74.6
I_1721		Finishing of textiles	0.0	49.4
I_1722		Made-up textile articles, except apparel	0.0	76.9
I_1723		Carpets and rugs	31.1	127.0
I_1729		Cordage, rope, twine and netting	0.0	41.9
I_1730		Knitted and crocheted fabrics and articles	0.0	24.1
I_1810		Wearing apparel, except fur apparel	0.0	28.8

I_1820		Dressing & dyeing of fur, processing of fur	98.2	175.4
I_1911		Tanning and dressing of leather	0.0	41.8
I_1912		Luggage, handbags, etc.	0.0	36.0
I_1920		Footwear	0.0	41.5
I_2010	Wood & paper	Sawmilling and planning of wood	62.9	149.4
I_2021		Veneer sheets, plywood, particle board, etc.	0.0	69.6
I_2022		Builders' carpentry and joinery	115.5	180.5
I_2023		Wooden containers	37.0	113.3
I_2029		Other wood products, articles of cork/straw	11.4	96.2
I_2101		Pulp, paper and paperboard	0.0	44.1
I_2102		Corrugated paper and paperboard	4.5	101.5
I_2109		Other articles of paper and paperboard	0.0	44.1
I_2211	Printing & publishing	Publishing of books and other publications	0.0	92.8
I_2212		Publishing of newspapers, journals, etc.	255.5	346.6
I_2213		Publishing of recorded media	0.0	26.3
I_2219		Other publishing	16.2	100.3
I_2221		Printing	155.1	237.5
I_2310	Minerals & chemicals	Coke oven products	1810.0	1793.6
I_2320		Refined petroleum products	0.0	69.8
I_2330		Processing of nuclear fuel	111.0	110.1
I_2411		Basic chemicals, except fertilizers	0.0	40.1
I_2412		Fertilizers and nitrogen compounds	99.5	187.3
I_2413		Plastics in primary forms, synthetic rubber	0.0	58.2
I_2421		Pesticides and other agro-chemical products	28.7	89.9
I_2422		Paints, varnishes, printing ink	2.0	99.2
I_2423		Pharmaceuticals, medicinal chemicals, etc.	0.0	78.4
I_2424		Soap, cleaning & cosmetic preparations	0.0	72.6
I_2429		Other chemical products n.e.c.	0.0	50.7
I_2430		Man-made fibers	0.0	65.0
I_2511		Rubber tires and tubes	0.0	67.6
I_2519		Other rubber products	0.0	57.5
I_2520		Plastic products	0.0	50.8
I_2610		Glass and glass products	0.0	61.2
I_2691		Pottery, china and earthenware	0.0	56.2
I_2692		Refractory ceramic products	47.2	132.8
I_2693		Non-refractory clay, ceramic products	72.7	166.1
I_2694		Cement, lime, and plaster	238.8	327.6
I_2695		Articles of concrete, cement and plaster	226.1	322.5
I_2696		Cutting, shaping & finishing of stone	168.5	249.3
I_2710	Metal & machinery	Basic iron and steel	0.0	51.4
I_2720		Basic precious and non-ferrous metals	0.0	56.8
I_2811		Structural metal products	17.4	111.0
I_2812		Tanks, reservoirs and containers of metal	31.7	123.2
I_2813		Steam generators	103.0	195.5
I_2893		Metal forging/pressing/stamping/roll-forming	0.0	80.1
I_2899		Treatment & coating of metals	0.0	36.8
I_2911		Engines & turbines (not for transport equipm.)	66.3	147.2
I_2912		Pumps, compressors, taps, and valves	0.0	28.8
I_2913		Bearings, gears, gearing & driving elements	0.0	48.6

I_2914		Ovens, furnaces and furnace burners	0.0	44.1
I_2915		Lifting and handling equipment	0.0	59.0
I_2921		Agricultural and forestry machinery	0.0	79.6
I_2922		Machine tools	0.0	69.7
I_2923		Machinery for metallurgy	8.2	91.4
I_2924		Machinery for mining & construction	0.0	53.1
I_2925		Food/beverage/tobacco processing machinery	0.0	76.6
I_2926		Machinery for textile, apparel and leather	0.0	36.9
I_2927		Weapons and ammunition	187.4	265.3
I_2930		Domestic appliances n.e.c.	0.0	51.7
I_3000	Electronics & prec. instr.	Office, accounting and computing machinery	0.0	41.6
I_3110		Electric motors, generators and transformers	0.0	74.1
I_3120		Electricity distribution & control apparatus	0.0	52.3
I_3130		Insulated wire and cable	0.0	50.9
I_3140		Accumulators, primary cells, and batteries	0.0	66.2
I_3150		Lighting equipment and electric lamps	0.0	41.5
I_3210		Electronic valves, tubes, etc.	0.0	41.4
I_3220		TV/radio transmitters, line comm. apparatus	0.0	46.6
I_3230		TV and radio receivers and associated goods	0.0	82.0
I_3311		Medical, surgical and orthopedic equipment	0.0	58.6
I_3312		Measuring/testing/navigating appliances, etc.	0.0	55.4
I_3313		Industrial process control equipment	0.0	71.8
I_3320		Optical instruments & photographic equipment	0.0	43.2
I_3330		Watches and clocks	0.0	36.9
I_3410	Transport equipment	Motor vehicles	0.0	58.1
I_3420		Automobile bodies, trailers & semi-trailers	0.0	82.5
I_3430		Parts/accessories for automobiles	0.0	39.6
I_3511		Building and repairing of ships	94.5	173.2
I_3512		Building/repairing of pleasure/sport. boats	7.4	96.3
I_3520		Railway/tramway locomotives & rolling stock	59.6	141.1
I_3530		Aircraft and spacecraft	0.0	75.4
I_3591		Motorcycles	51.0	121.5
I_3592		Bicycles and invalid carriages	15.3	84.0
I_4500	Services	Construction	707.9	585.4
I_6200		Air transport	57.0	84.2
I_6500		Financial intermediation	285.6	362.9
I_6600		Insurance and pension funding	251.2	229.2
I_7200		Computer and related activities	264.5	279.2
I_7300		Research and development	146.9	136.2
I_7500		Public administration and defense	613.3	237.6
I_9200		Recreational, cultural and sporting activities	335.5	304.6

Note: Product codes beginning with 'H' refer to the HS classification; codes beginning with 'I' refer to the ISIC rev. 3 classification. The NTB *ad valorem* equivalents are reported in percent.

7 From Stakes to Escalation: Trade Barriers, Trade Patterns, and Trade Disputes

At this stage, the preparatory empirical work presented in the preceding chapters is completed and the necessary preconditions for empirically investigating the escalation patterns of trade disputes are met. This chapter thus presents the culmination of the present study. It brings together theoretical reasoning about conflict and prior theoretical knowledge about the economics of trade with data on U.S. trade and trade enforcement actions, trade elasticities, and trade barriers. In combination, these ingredients provide the basis for proceeding to empirically testing the hypotheses derived in Section 3.3 in the context of the United States' trade enforcement policies towards its trade partners.

Doing so implies relating observed measures of dispute escalation to the measures of parties' stakes. Recall that, in the context of international trade, these stakes were defined as the gains and losses parties *would* make, if the importer were to reduce its trade barriers. A central aspect of the present chapter is to implement this definition of stakes by simulating the parties' *counterfactual gain* and *loss shares* resulting from such a hypothetical trade barrier reduction. Using now-available industry-level data on trade barriers (NTBs) in combination with information on elasticities and the observed pattern of trade, this calculation can be performed. As I argue in more detail below, the sort of counterfactual reasoning reflected in this simulation can be thought of as realistically capturing the strategic thought process that shapes parties' decision-making in the context of conflictive bargaining.

The chapter proceeds in three steps. Section 7.1 sets the stage for the analyses of escalation processes in Sections 7.2 and 7.3. The section introduces the simulation procedure employed to assess the effects of hypothetical importer-specific industry-level trade barrier reductions, which enables the calculation of the parties' counterfactual *loss* and *gain shares*. In this context, the section first provides a discussion of the value of simulation studies for approximating the counterfactual reasoning and option weighing process that parties are likely to perform in real-world decision-making.

Sections 7.2 and 7.3 Section then proceed to actually testing Hypotheses 1 through 3 as presented above. Section 7.2 constitutes the central section of this chapter. It is concerned with Hypothesis 1, which states that the interaction of high counterfactual importer *loss shares* and high counterfactual exporter *gain shares* is likely to result in higher levels of dispute escalation. The section discusses the data and estimation procedure and presents the results of the subsequent statistical analysis. Section 7.3 then proceeds to test Hypotheses 2 and 3 that are concerned with the form of the bargaining outcome (i.e., the eventual agreement and the implied changes in observed trade flows resulting therefrom) of the escalation episode.

7.1 Measuring Stakes: Counterfactual Gain and Loss Shares from Trade Liberalization

This section introduces a theoretical framework for simulating changes in trade barriers that builds on a standard partial equilibrium framework for trade policy analysis. The framework is then used to calculate the total expected increase in import volumes for a given decrease in trade barriers for each industry in each importing country. The ratio of the size of the respective industry-level import increase to the original industry-level trade flow as currently observed is then defined as the importer's loss share. As discussed formally below, this share relates the size of current trade barriers, the trade elasticities, and the observed trade flows in order to approximate the hypothetical costs to domestic producers of trade liberalization in terms of domestic market share loss.

The advantages of trade policy simulations as an analytical tool in analyzing strategic behavior

In the spirit of the discussion on trade policy in Section 2.2, this loss to domestic producers is assumed to be passed on to the importer's government in the domestic political process, thus generating the importer government's stakes in the issue at hand. The exporter *gain share* – reflecting the stakes of the U.S. government – is similarly based on the simulated total expected increase in import volumes resulting from the hypothetical trade barrier reduction – although in a different manner. Unlike the importer's *loss share*, which relates the total increase in imports to prior import volumes, the U.S. *gain share* captures the fraction of the importer's loss that U.S. industry will capture. Because the simulation exercise, for simplicity, abstracts away from physical trade cost factors such as distance in the calculation of the counterfactuals, these gains shares are essentially proportional to current market shares.

One of the most appealing features of simulation studies of the kind employed here is that measuring stakes in the form of *potential* gains and losses most likely reflects central aspects of the underlying decision-making process of the parties. Weighing options that have not yet been realized or acted upon forms an integral part of many if not all forms of future-oriented decision-making. By basing explanations for strategic behavior on counterfactual measures of gain and loss, it is possible to approximate unobservable decision-relevant considerations that are not directly apparent from observed data alone and thus perform the analysis 'from the point of view of the concerned parties'.

Trade policy is one of a large number of political and social situations in which actors ponder a set of possible options. At the same time, trade policy is a subject-area in which extensive theoretical knowledge about fundamental market and policy mechanisms is available. A particular advantage is that this knowledge is accessible for and appreciated by policy-makers and scholars alike – making it possible for the latter to anticipate the thinking of the former much better than is the case in most other contexts.

In other words, strong prior knowledge about underlying economic relationships provides both policy-makers and scholars with a powerful tool to analyze and to reflect their environment or object of study. Because this knowledge is the same for both sides, one can expect that the counterfactuals calculated below capture important aspects of the counterfactuals that enter the cognitive process of decision-makers. In fact, results from trade policy simulations routinely serve as inputs into in global and bilateral trade negotiations and national policy-making processes – provided both by external or in-house advisors. Moreover, the World Bank provides two different trade policy simulation tools called SMART and TRIST in order to analyze trade policy and assist countries in trade policy formulation and as tools for policy analysis more generally. The UNCTAD has developed a general simulation model called TPSM as well as a specialized sub-model geared particularly at agricultural trade policy called ATPSM (see: Laird and Yeats 1986 and WTO 2012b for and overview and comparison).

In the United States, various Departments and agencies have built up their own simulation capacities. The U.S. International Trade Commission, for instance, regularly conducts simulation studies (Rivera 2003) and the U.S. Department of agriculture developed its own 'Static World Policy Simulation Model' (SWOPSIM) (see: Piermartini and The 2005, p. 5). A considerable theoretical and applied literature deals with trade policy simulations and welfare analysis (Laird and Yeats 1986, Roningen et al. 1991, Francois and Reinert 1997, Francois and Hall 2003, Jammes and Olarreaga 2005, Cadot 2010, Bowen et al. 2012). Many of the authors of these studies also provide input to national governments and act as consultants in trade policy issues.

Because simulation studies are a form of *ex ante* analysis, the policy choices investigated by this approach need not have materialized at the time of investigation. This sets them apart from *ex post* regression approaches that are based on historical data. Simulation studies offer advantages, for instance, because they enable decision-makers to hypothetically 'pre-test' the effect of potential policy choices in a large range of contexts before deciding in favor of or against a given policy. Simulation studies are a principled way to conduct counterfactual reasoning. They inform decision-making and shape real world actions in the absence of the need to actually implement and evaluate potential policies.

Similarly, such studies offer advantages in the analysis of strategic interactions, where the eventual outcome depends on the actions of at least two actors. In such a context, simulations enable concerned parties as well as external observers to arrive at an understanding of what outcome would result if one side were to succeed in getting its will – and thus to evaluate to what degree pursuing a costly dispute may be worthwhile even if the eventual dispute outcome is likely partial rather than complete. Simulation studies thus capture the logic of strategic evaluation processes as outlined in Chapter 3 much better than ex-post evaluations could.

Simulation studies can be partial equilibrium (PE) or general equilibrium (GE) in nature (see: Piermartini and The 2005, and WTO 2012b for a more extensive discussion on this topic). In the former case, the simulation exercise focuses on simulating the effects of policy changes in a single market – such as the reduction of a policy barrier by a given importer for a given product. In the latter case, the simulation takes the cross-linkages between different markets into account and explicitly models dependencies between these markets. This makes it possible to assess the economy-wide effects of specific policies and to impose general budget and production constraints. While these are attractive features of GE models, a considerable disadvantage of these models is their high complexity, the need for a large set of estimated or assumed parameters, and the need for various macro-economic data. In combination, these requirements make GE models unwieldy, typically prohibiting an analysis at high levels of disaggregation.

The reverse is true for PE models. These approaches abstract away from economy-wide ripple effects and macro-economic background conditions and analyze a particular market in isolation – hence the term 'partial equilibrium'. The considerable advantage of these approaches is their tractability and flexibility. In particular, PE studies can be conducted at any level of detail and are straightforward to interpret. This is clearly appropriate if one is only interested in an individual market, but can potentially lead to inconsistencies if applied to a large number of markets at the same time. A reduction of a policy barrier for a specific good will not only have effects on the consumption of the good itself, but also on the consumption of complements (positively) and substitutes (negatively) as well as on consumer income – through lower prices. Similar adaption will occur on the production side of the economy. If one pre-specifies counterfactuals for all industries in a PE context, the scenarios are unlikely to lead to compatible outcomes across different markets if GE adjustments are ignored. In the case of comprehensive free-trade negotiations or multilateral trade rounds, therefore, PE simulations may be problematic and lead to incorrect assessments.

However, given that in the strategic context of trade disputes, the vast majority of cases select out early or end in compromises, one would expect that these disputes will mostly not result in substantial changes in trade policy. For this reason, observation-specific PE trade policy analysis can be assumed to deliver valid and meaningful results even if done on an economy-wide basis. The fact that most of the counterfactual policy changes is likely to remain unrealized, legitimizes this approach. The remainder of this section presents the details of the PE approach used to construct the industry-level *counterfactual gain* and *loss shares* of the United States and its trade partners in order to capture what, on the conceptual level, amounts to the parties stakes in these respective trade relationships.

Calculating parties' stakes: Assessing counterfactual gains and losses through trade policy simulation

The first step in assessing two countries' respective stakes in a given product-level trade relationship is to arrive at an approximation of the potential increase in imports following a reduction of the importer's policy barriers to trade. To arrive at such an approximation, I follow the methodology presented by Jammes and Olarreaga (2005) and also discussed in WTO (2012b) that serves as the basis for the World Bank's SMART model. The great advantage of this trade policy simulation tool is that it is both simple and intuitive while simultaneously capturing the core aspects of interest.

The key ingredients required for the simulation exercise are data on existing trade flows, as well as on trade elasticities and policy barriers. These data requirements are now satisfied.

The SMART model generally captures two different effects of trade policy changes – trade creation and trade diversion. Trade creation measures the increase in trade that directly results from a trade barrier reduction. Trade diversion measures the additional trade effects that result if trade barrier reductions are implemented on a preferential basis (that is, benefitting only one or a few exporters) rather than on an MFN basis (benefitting all exporters alike). Trade diversion effects play a prominent role in policy analyses that investigate the (potential) effects of preferential trade agreements, where the members of the eventual agreement lower their trade barriers towards each other, but not towards non-members of the agreement.

These sorts of preferential trade policy changes necessarily increase the gap between the prices of goods imported from members and non-members of the agreement. As a consequence, the baseline trade creation effect of the reduction of bilateral policy barriers is further augmented by additional substitution effects. These substitution effects result from *relative* price changes for imports from different source countries. Essentially, the bilateral barrier reduction between members makes products imported from non-members relatively more expensive than those imported from members of the agreement and thereby reinforces the trade creation effect. Trade creation thus is an absolute price effect, while trade diversion is a relative price effect.

For the trade policy simulations below, I focus exclusively on the trade creation effect because, in the context of trade disputes, trade diversion can be expected to play a peripheral role. The reason is that international trade law generally requires trade policy to be formulated on an MFN basis. It thus allows selective discriminatory treatment only under strongly limited circumstances. In particular, preferential treatment – i.e., positive discrimination – is allowed only in the context of comprehensive free trade agreements, or in order to grant developing countries preferential market access. Negative discrimination – the termination of which would result in trade creation and diversion effects – is subject to even more stringent conditions. Such polices are restricted to tackling unfair trade practices by individual trade partners (anti-dumping (AD) and countervailing duty (CVD) cases) or to combating the spread of diseases and pests relating to sanitary and phytosanitary (SPS) concerns over agricultural products.

Outside of these very specific contexts, one can expect any actual or hypothetical trade policy adjustment to be in line with the MFN principle. This explicitly includes the vast majority of policy adjustments resulting from trade disputes that are unrelated to AD/CVD and some SPS concerns. An exporter pressing for trade liberalization in the context of a trade dispute, although acting in its own interest, essentially provides a public good by pressing for policy changes that, if implemented, benefit all exporters. Because any MFN-consistent trade barrier reduction reduces overall import prices but leaves *relative* import prices unaffected, such a reduction results in trade creation but not in trade diversion.

The amount of trade creation induced by a given reduction in trade barriers can be directly derived from the definition of the import demand elasticity – which, in turn, is closely related to the elasticity of substitution. Recall that the elasticity of substitution for different national varieties of a product measures by how much the *relative* quantities imported of a national variety change as the *relative* prices of these varieties change. The elasticity of substitution therefore relates the percent change in relative quantities imported to the percent change in relative prices. Formally, the full definition of the elasticity of substitution for a given importer j, exporters i and l, and product k is given by

$$\sigma_{iljk} = \frac{\Delta\left(\frac{M_{ijk}}{M_{ljk}}\right)\Big/\frac{M_{ijk}}{M_{ljk}}}{\Delta\left(\frac{P_{ijk}}{P_{ljk}}\right)\Big/\frac{P_{ijk}}{P_{ljk}}} = \frac{\%\Delta(M_{ijk}/M_{ljk})}{\%\Delta(P_{ijk}/P_{ljk})}, \tag{1}$$

where M_{ijk} are imports by j from i's variety of product k, P_{ijk} is the associated price, and analogously for all other terms. Note that the elasticity of substitution is comprised of three sets of nested ratios. The four 'innermost' ratios capture (changes in) relative import quantities and prices. Thus, $\Delta(M_{ijk}/M_{ljk})$ captures changes in relative import quantities, M_{ijk}/M_{ljk} captures relative import quantities in levels, and so forth. The two 'middle' ratios relating relative changes to relative levels essentially capture the percent changes in relative quantities and prices as indicated by the right-most expression. Lastly, the outer ratio relates these percent changes. Together, the entire expression thus captures how percent change in relative import quantities increase or decrease along with percent change in relative prices.

Since the interest here is in across-the-board trade barrier reductions on an MFN basis, relative prices for imports remain unaffected. Consequently, it is possible to consider imports of individual exporters separately. Similarly, it is possible to consider aggregate imports of product k by country j from all source countries i at once. Since no trade diversion occurs when import barriers are reduced on an MFN basis, the increase in aggregate imports is simply the sum of the increases of all imports from individual exporters. In both cases, the analysis of trade responses can be based on the import demand elasticity, which abstracts from substitution effects between different exporters and focuses on the relationship between imported quantities and corresponding import prices. The import demand elasticity therefore reflects the relationship of interest. For notational simplicity, the following discussion focuses on aggregate imports from all exporters thus omitting an additional subscript i for different exporters. The import demand elasticity for aggregate imports is given by

$$\sigma_{jk}^{D} = \frac{\Delta M_{jk}/M_{jk}}{\Delta P_{jk}/P_{jk}} = \frac{\%\Delta M_{jk}}{\%\Delta P_{jk}}, \tag{2}$$

where the superscript D signifies the total domestic demand for imported goods, M_{jk} are aggregate imports by j of all national varieties of product k, and P_{jk} are domestic prices inclusive of the tariff-equivalent effect of policy barriers to trade. Like the $barrier_{jk}$ variable in Section 6.3, policy barriers to trade are defined as the sum of estimated NTBs and reported tariffs. Thus,

$$P_{jk} = P_k^*(1 + t_{jk}), \tag{3}$$

where

$$t_{jk} = barrier_{jk}/100 \tag{4}$$

and P_k^* reflects international prices. That is, P_k^* should be interpreted as the world price of product k in case that this good is perfectly homogenous. Likewise, if product k is differentiated, P_k^* should be interpreted as the weighted average price of the different imported varieties. Note that the move from the elasticity of substitution to the import demand elasticity has resulted in the contraction of the 'innermost' ratios of equation (1) to the (changes in) levels and prices in aggregate (rather than relative) import quantities and prices. The import demand elasticity thus captures the percent change in imports in response to a percent change in domestic prices.

Given that domestic prices are a function of known trade barriers, the quantity response in imports – that is, the amount of trade creation – resulting from a given reduction in policy barriers can be computed directly from equation (2) by solving for ΔM_{jk}:

$$\Delta M_{jk} = \sigma_{jk}^D M_{jk} \frac{\Delta P_{jk}}{P_{jk}}. \tag{5}$$

In order to compute ΔM_{jk}, more information is needed on ΔP_{jk}. Assume for now that international prices P_k^* are unaffected by changes in P_{jk}. This is the so-called 'small country assumption', since small countries have little market power and are thus unable to influence international prices. This assumption, which will be relaxed below, is identical to assuming that the export supply facing importer j is infinitely elastic. Given infinitely elastic export supply, ΔP_{jk} is simply determined by the change in t_{jk}. Concretely, because $P_{jk} = P_k^*(1 + t_{jk}) = P_k^* + P_k^* t_{jk}$, it follows that $\Delta P_{jk} = (P_k^* + P_k^*(t_{jk} + \Delta t_{jk})) - (P_k^* + P_k^* t_{jk}) = P_k^* \Delta t_{jk}$. Using this result and the definition of P_{jk} from equation (3) and plugging both into equation (5), one gets

$$\Delta M_{jk} = \sigma_{jk}^D M_{jk} \frac{P_k^* \Delta t_{jk}}{P_k^*(1 + t_{jk})}, \tag{6}$$

which simplifies to

$$\Delta M_{jk} = \sigma_{jk}^D M_{jk} \frac{\Delta t_{jk}}{(1 + t_{jk})}. \tag{7}$$

Note that the international prices, P_k^*, cancel and the entire right-hand side is now expressed in terms of known quantities. As noted in Chapter 5, the import demand elasticity is equal to the elasticity of substitution by assumption (that is, $\sigma_{jk} = \sigma_{jk}^D$ implying that domestic-foreign substitution is assumed to be governed by the same behavioral parameter as foreign-foreign substitution for each product k). Total imports M_{jk} for industry k are directly observed. Policy barriers t_{jk} are known as a result of the procedure described in the previous chapter. Lastly, the change in these barriers Δt_{jk} is specified as part of the policy simulation.

The whole trick in the above derivation is that knowing both the value σ_{jk}^D as a result of previous estimations and the definition of σ_{jk}^D – in terms of other known quantities, M_{jk} and t_{jk}, as well as the unknown quantity of interest, ΔM_{jk} – it is possible to solve for and calculate ΔM_{jk}. As a consequence, equation (7) makes it possible to approximate the expected increase in total imports of product k into country j resulting from any given non-discriminatory reduction in existing trade barriers under the assumption of infinitely elastic export supply.

Generalizing the setup to allow for non-perfectly elastic export supply requires tracking the interrelation between changes in domestic and international prices. To do so, compute the total derivative of the definition of domestic prices from equation (3), which is given by

$$\frac{dP_{jk}}{dt_{jk}} = P_k^* + \frac{dP_k^*}{dt_{jk}}\left(1 + t_{jk}\right). \tag{8}$$

Equation describes the total direct and indirect (through P_k^*) change in P_{jk} resulting from a change in t_{jk}. Multiplying through by dt_{jk} and adapting notation to conform with the style used so far (i.e., replacing d with Δ), we have

$$\Delta P_{jk} = P_k^* \Delta t_{jk} + \Delta P_k^*\left(1 + t_{jk}\right), \tag{9}$$

which gives the total change in prices in response to changes in both t_{jk} and P_k^*. That is, P_k^* is no longer assumed to be unaffected by changes in P_{jk}. Consequently, changes in P_k^* feed back into P_{jk}. This is the so-called large country assumption. The idea is that large countries do have market power. Accordingly, a reduction of trade barriers by a large country noticeably increases international demand, which ultimately results in increased international prices. This bi-directional relationship between domestic and international prices attenuates the effect of the barrier reduction because the decrease in import prices from trade liberalization is in part offset by the increase in international prices. Note that equation (9) incorporates the small-country case. If P_k^* does not change as a result of trade liberalizations, the second term equals zero and equation (9) reduces to $\Delta P_{jk} = P_k^* \Delta t_{jk}$, just as above.

In order to determine by how much P_k^* changes in response to changes in trade barriers, one can use the definition of the elasticity of export supply analogously to before. The elasticity of export supply is given by

$$\omega_{jk} = \frac{\Delta X_{jk}}{X_{jk}} \Big/ \frac{\Delta P_k^*}{P_k^*}, \tag{10}$$

where X_{jk} refers to aggregate exports from all countries to importer j in industry k. Solving for ΔP_k^* and applying the normalization $P_k^* = 1$ yields

$$\Delta P_k^* = \frac{\Delta X_{jk}}{X_{jk}} / \omega_{jk}. \tag{11}$$

The normalization of P_k^* is helpful as this obviates the need to know the actual value of P_k^* and comes at no price because the relevant information is the relative difference between P_{jk} and P_k^* due to the policy barrier. Having done so, the same procedure as above can now be used based on the more complex expression for ΔP_{jk}. Plugging equation (9) and (3) into equation (5) gives

$$\Delta M_{jk} = \sigma_{jk}^D M_{jk} \frac{P_k^* \Delta t_{jk} + \Delta P_k^* (1 + t_{jk})}{P_k^* (1 + t_{jk})}. \tag{12}$$

Further substituting in the right-hand side of equation (11) for ΔP_k^*, once more applying the normalization $P_k^* = 1$, and recognizing that, by definition, $X_{jk} = M_{jk}$ yields

$$\Delta M_{jk} = \sigma_{jk}^D M_{jk} \frac{\Delta t_{jk} + \left(\frac{\Delta M_{jk}}{M_{jk}} / \omega_{jk}\right)(1 + t_{jk})}{(1 + t_{jk})}. \tag{13}$$

Simplifying and rearranging as well as imposing the constraints $\sigma_{jk}^D = \sigma_k^D$ and $\omega_{jk} = \omega_k$ – which reflect the assumption that trade elasticities are product characteristics and thus are the same for all importers of a given product k – gives

$$\Delta M_{jk} = \sigma_k^D M_{jk} \frac{\Delta t_{jk}}{(1 + t_{jk})} \left(\frac{1}{1 - \sigma_k^D / \omega_k}\right). \tag{14}$$

It is immediately apparent from equation (13) that the expression substituted for $\Delta P_k^* = 0$, if $\omega_{jk} = \infty$. Similarly, in equation (14), if $\omega_{jk} = \infty$, the ratio in brackets equals 1. In both cases, the equations reduce to equation (7) as one would expect.

It is instructive to go through the individual parts of equation (14) to see how changes in the parameters affect the predicted amount of trade creation ΔM_{jk}. To develop the main intuition, first assume that export supply is indeed infinitely elastic, and focus on the part of equation (14) that is identical to equation (7). Recall that σ_k^D is negative because the relationship between prices and imported quantities is negative: As prices fall, imported quantities increase and vice versa. Further note that M_{jk} and t_{jk} are both non-negative. Consequently, if Δt_{jk} is negative, ΔM_{jk} is positive and vice versa. In line with expectations, therefore, a reduction in trade barriers is predicted to result in an increase in trade flows and vice versa.

Now, assuming that Δt_{jk} is negative and the model is used to simulate the effects of a trade barrier reduction, several factors affect the *size* of the predicted increase in trade. First, ΔM_{jk} increases as the absolute value of σ_k^D increases. That is, the more homogenous (or the less differentiated) the affected product, the larger is the effect of a given barrier reduction. This reflects the fact that homogenous goods are more easily substitutable leading consumers to be more price-sensitive (in the case of MFN barrier reduction, the substitutability concerns domestic-foreign substitution). Thus, a fixed reduction in trade barriers and the associated reduction in import prices result in a larger increase in imports. In the extreme, if import demand is highly elastic, minimal reductions in barriers will result in strong import surges. On the other hand, if import demand is highly inelastic (the product concerned is highly differentiated), barrier reductions will only have a negligible effect on trade flows. As noted earlier, strong product differentiation implies that different varieties of a product are traded 'past each other' and that as a consequence both import competition and the effect of trade barriers is dramatically reduced.

Second, ΔM_{jk} increases in the baseline trade flow M_{jk}. This is straightforward. The larger the initial trade flow, the larger the value of the increase will be in absolute terms. Third, ΔM_{jk} increases in the degree to which the trade barrier is reduced, i.e., Δt_{ik}. The larger the reduction of the barrier, the larger the increase is in trade. Fourth, as long as Δt_{ik} is defined in relative terms, i.e., as a percent change relative to t_{ik}, ΔM_{jk} increases in t_{ik}. Intuitively, the higher the barrier is initially, the larger the effect of a barrier reduction by some factor. For instance, reducing a trade barrier with a tariff-equivalent of 100 percent to 50 percent will result in a larger increase in trade than a reduction of a 10 percent barrier to 5 percent. The reason is that in the latter case, trade prior to the reduction is much freer to start with, so that most of the existing trade potential is already realized anyways and the growth potential is therefore limited.

Now consider the extended version of equation (14). As noted above, the expression $1/(1 - \sigma_k^D/\omega_k)$ equals 1 if $\omega_{jk} = \infty$. If ω_{jk} is finite, however, the expression is smaller than 1. This means that as soon as export supply is no longer assumed to be infinitely elastic, the entire prediction from equation (7) is multiplied by a factor that is smaller than 1. Accordingly, the predicted increase in trade is smaller than under the assumption of infinitely elastic export supply. This makes sense, given that under the large country assumption of finitely elastic export supply, increased demand from a reduction in trade barriers results in rising international prices, which in turn attenuate the direct effect of the barrier reduction.

Generally, the expression $1/(1 - \sigma_k^D/\omega_k)$ will always range in the interval [0,1] and equal .5 if the absolute values of the two elasticities are the same. For instance, $1/(1-(-2)/2) = 1/(1+1) = .5$. The larger the elasticity of export supply is relative to the import demand elasticity, the larger ΔM_{jk} will be. The reason that the relative sizes of σ_k^D and ω_k are critical is the following: it is always true that for a given value of σ_k^D larger values of ω_k result in larger ΔM_{jk}. This is because, if export supply is more elastic, exporters will be able to more readily satisfy the increase in demand stemming from a given barrier reduction (thus averting a strong rise in international prices). However, if σ_k^D increases, the effect of a barrier reduction on demand increases as well. Consequently, supply needs to be more elastic than before in order for exporters to be able to satisfy the larger increase in demand. Otherwise, supply functions as a constraint on demand.

Based on the foregoing derivations, it is now possible to simulate the effects of hypothetical trade barrier reductions by importer j in industry k based on the known quantities of current trade flows, trade barriers, and trade elasticities – both under the assumption of infinitely and finitely elastic export supply. In the simulation, I assume a hypothetical trade barrier reduction by ten percent, i.e., $\Delta t_{ik} = -t_{ik}/10$. Thus, a barrier with a tariff-equivalent of 100 percent will be lowered to 90 percent, and so forth. From this it is straightforward to implement the calculation of the *counterfactual loss* and *gain shares* for importers and exporters. As noted, this calculation can be done both starting from aggregated trade flows M_{jk} and disaggregated exporter-specific flows M_{ijk}.

In the first case, one calculates ΔM_{jk} exactly as before and then infers each exporter's share in ΔM_{ijk} from the observed market shares in actually observed trade, M_{ijk}/M_{jk}. This is possible because, if barriers are reduced uniformly for all exporters on an MFN-basis, increases in trade are proportional to the market shares under current trade. In the second case, one calculates ΔM_{ijk} directly by applying the described procedure to disaggregated exporter-specific trade flows and then computes ΔM_{jk} by simply aggregating across all exporters i. In accordance with the derivation in Section 3.3, the importer's stakes as reflected in the *counterfactual loss share* and the exporter's stakes as reflected in the *counterfactual gain share* are computed as

$$stakes_{jk} \equiv L_{jk} = \frac{\Delta M_{jk}}{M_{jk}}. \tag{15}$$

and

$$stakes_{ijk} \equiv G_{ijk} = \frac{\Delta M_{ijk}}{\Delta M_{jk}} \approx \left(\frac{M_{ijk}}{M_{jk}} \Delta M_{jk}\right) / \Delta M_{jk} = \frac{M_{ijk}}{M_{jk}} \tag{16}$$

Thus, L_{jk} captures the surge in total imports that importer j would face relative to the current level of imports. It is thus a measure of the loss that j's domestic industry would be facing in its domestic market compared to the status quo. Put differently, L_{jk} measures the importer's loss resulting from a hypothetical trade liberalization – as the share of newly created imports, ΔM_{jk}, to the current level of imports. Similarly, G_{ijk} captures the *share* of the total amount of trade creation ΔM_{jk} in industry k that exporter i would gain if the counterfactual barrier reduction was implemented by importer j (the first expression shows the calculation based on disaggregated trade flows ΔM_{ijk}; the second and third expressions show the calculation based on aggregated trade flows and observed market shares). G_{ijk} thus measures the share of all newly created imports that are realized by exporter i.

Another way to interpret the quantities is to note that the importer's loss share implicitly captures the percent increase in import competition that the importer faces as a result of the trade barrier reduction. Import competition, according to the usual definition, is given by $impcomp\_t0_{jk} = M_{jk}/(M_{jk} + P_k - X_{jk})$, where P_k is domestic production in industry k and the calculation is assumed to refer to the status quo levels of imports before the barrier reduction. After the trade barrier reduction, this quantity changes to $impcomp\_t1_{jk} = (M_{jk} + \Delta M_{jk})/(M_{jk} + \Delta M_{jk} + P_k - \Delta M_{jk} - X_{jk})$. Given the usual calculation of percent changes as $\%\Delta = (t1 - t0)/|t1| \times 100$, the percent change in import competition is easily calculated. Plugging in the two expressions for the level of import competition before and after the policy change and simplifying yields $\%\Delta impcomp_{jk} = (\Delta M_{jk})/M_{jk} \times 100$, which is simply, the importer's loss share expressed in percentage terms, i.e., $L_{jk} \times 100$. In this interpretation, G_{ijk} reflects how much of the increase in import competition is due to exporter i, and thereby captures the share of the importer's loss that the exporter can secure.

Recall that the *gain* and *loss shares* calculated as described capture the notion of parties' stakes from a political economy perspective as outlined in Section 2.2 . That is, they reflect the gains and losses to domestic industries rather than to consumers or society as a whole. Thus, the quantities G_{ijk} and L_{jk} capture the political – not the economic – costs and benefits that can be expected to materialize if the hypothetical trade barrier reduction was in fact carried out. As such, the quantities serve to reflect the counterfactual reasoning employed by the concerned governments when weighing their options in the context of potential disputes over trade barriers.

7.2 Explaining Escalation: The Role of Stakes in U.S. Trade Disputes

This section is concerned with testing Hypothesis 1, which – to reiterate – states that: *The interaction of the importer's stakes, as measured by the importer's counterfactual loss share, and the exporter's stakes, as measured by the exporter's counterfactual gain share, and conditional on the observed trade flow value should be associated with higher levels of dispute escalation between the two trade partners.* The primary requirement for testing this hypothesis is the actual calculation of the *counterfactual gain* and *loss shares* defined conceptually in Section 3.3 and formally derived above. The importance of testing this hypothesis lies not only in corroborating that the interaction of parties' stakes is associated with dispute escalation, but also in substantiating the domain-specific considerations on how stakes arise in the first place in international trade relations and what stakes really mean in this context.

Research design choices and data setup

Before proceeding to the main analysis, this subsection discusses some important research design and data setup choices. The primary point to note in this context is that the data employed below are in the same format as the data presented in Section 6.3 that were used to demonstrate the validity of the acquired trade barrier estimates. That is, the data are aggregated into a cross-section. The discussion in Section 6.3 has presented one reason for this choice, namely, the non-time-varying nature of non-tariff barrier data. As noted, this data structure follows as a result of the estimation strategy employed in the previous chapter and precludes an appropriate use in a time-series cross-sectional setting. This consideration is also valid in the present context and the aggregation procedure for economic data discussed in this context applies here as well and is therefore not repeated. At the same time, there is a second reason for moving into a cross-sectional setting that is directly related to the temporal dynamics of trade disputes. The following paragraphs discuss this point and then describe the procedure for aggregating the non-economic data required in the statistical analysis, in particular, the escalation measures derived from the NTE reports.

Note that the bargaining dynamics in trade disputes usually play out between the concerned parties over the course of several years and may even span a decade or more. From a theoretical perspective (as discussed in detail in Section 3.3), disputes are likely to arise once a previous equilibrium is sufficiently disturbed by shifts in the underlying fundamentals that directly or indirectly affect the parties' stakes (such as changes in trade policies, changes in overall trade and production patterns, or related changes in supply and demand side factors including competiveness and/or production technology, or consumer tastes). These shifts re-introduce uncertainty about the continuing appropriateness of the current status quo and create incentives to re-negotiate in the hope of securing more favorable outcomes. The (possibly) conflictive bargaining process that follows then serves to arrive at a new equilibrium agreement that reflects the changed state of events. Consecutive bargaining episodes therefore introduce an uneven cyclicality into countries' bargaining and dispute dynamics.

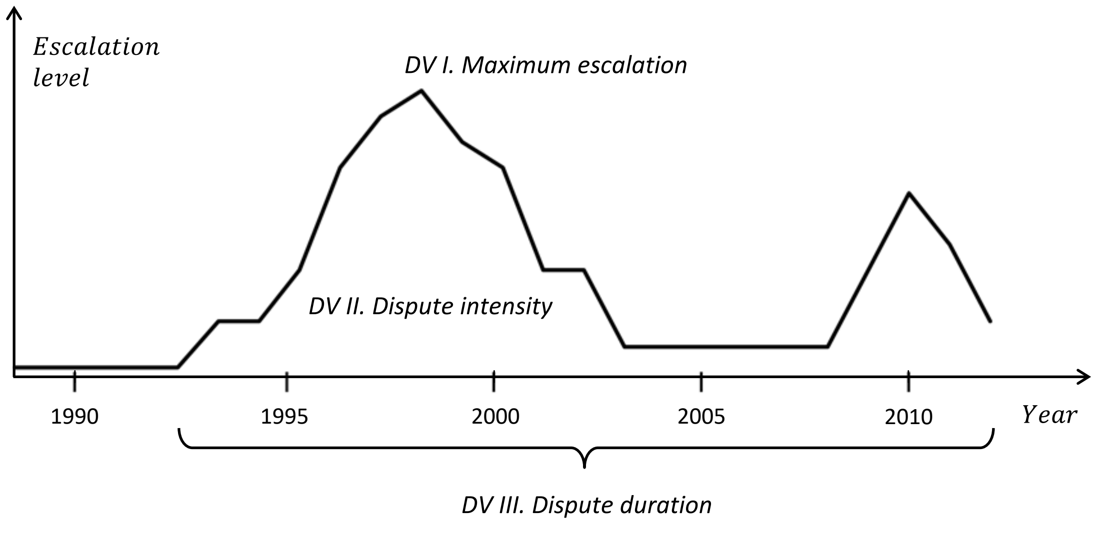
For the purpose of statistical analysis, it is important to note that this dispute process *decouples* the parties' interaction from the trend in the underlying economic fundamentals (which are the basis for evaluating the parties' stakes) that serve, in the context of statistical modeling, as the basis for explaining the parties' behavior. To see this more clearly, consider a typical application of time-series cross-sectional data for inferring the effects of changes in a predictor variable to changes in an outcome variable, such as the effects of tax policies on consumer spending in different countries. In such a context, one would like to use the over-time variation in tax policies *within* countries to infer the effects of such policies on consumer spending. This is the usual fixed-effects specification that serves to significantly reduce concerns about possible cross-country confounding. Essentially, the specification makes it possible to estimate the (presumably negative) effect of tax increases on consumer spending based on changes of tax rates within countries over time. By discarding *between* country variation, possibly faulty inferences are avoided that may result from confounding due to unobserved differences in consumption behavior across countries.

Crucially, however, for the over-time variation of tax rates to be informative about consumption behavior, there needs to be a more or less immediate impact (or at least a constant time-lag) between tax changes and spending behavior. Otherwise, establishing a statistical relationship between predictor and response will be difficult if not impossible, especially in the absence of detailed information on the temporal process at work. In the tax rate example, it is most likely appropriate to assume that there is a close to immediate effect of taxes on spending because a change in taxes directly affects consumer income and therefore consumption behavior.

In the setting of conflictive bargaining, in contrast, the relationship between dispute escalation dynamics and over-time changes in relevant economic fundamentals will likely be considerably more complex. Because of the comparatively long durations of the bargaining process, the varying time horizons, and the considerable variations in conflict intensity that – once initiated – are subject to their own strategic dynamics, the expected changes in relevant economic fundamentals and observed dispute behavior are likely to drift apart over time. Similarly, eventual agreements are likely to display some degree of 'stickiness' before eventual dispute recurrences are observed. Aggregation of data into a cross-section solves these difficulties by making it possible to compare average economic conditions to aggregate dispute behavior.

Thus, although aggregating over the time-dimension results in a loss of information, the benefits of doing so outweigh the costs because the aggregation procedure obviates the need to explicitly model complex temporal dependencies. The costs are limited, in particular, because the detailed structure of multilateral industry-level data still allows for fixed-effects specifications that rely on the trade partner and industry dimensions. These questions are taken up again and discussed in more detail below. At this point, I briefly present the details of the aggregation procedure.

Figure 7.1: Dependent variables derived from industry-specific dispute histories, 1988 – 2012



While the aggregation procedure for economic data involved inflation-adjustment and averaging, the aggregation procedure for non-economic data differs. Specifically, I calculate three different sets of summary statistics from the dynamic bargaining data extracted from the NTE reports – namely, the *maximum escalation* level, the overall *dispute intensity*, and the *dispute duration*. Figure 7.1 shows a hypothetical industry-specific dispute history that indicates the escalation level over the 1988 to 2012 time-period (similar to the validation plots presented in Figure 4.1). The figure illustrates the three measures graphically. The *maximum escalation* measure is straightforward as it simply reflects the highest escalation level of a dispute between the Unites States and a given trade partner over the partner's import policies for a given product within the twenty-five year time frame under consideration.

The *dispute intensity* measure captures the overall intensity of dispute activity over the 1988 – 2012 period. The measure sums the escalation levels over all twenty-five years. It can thus be thought of as the discrete version of the 'area under the curve' in Figure 7.1. The measure thus provides a more holistic summary of the overall dispute history by taking the entire information into account. Lastly, the *dispute duration* measure captures the length of the dispute activity in years. I define duration as the length in years of the continuous dispute episode with the highest escalation level. If there is only one dispute episode, I simply count the number of all active dispute years. If two episodes have identical escalation levels, I define the dispute duration as the length of the longer episode.

All three measures serve as dependent variables in the analyses presented below, where they are also discussed in some more detail. While each of the three measures describes an important aspect of the dispute history, it is clear that in light of this study's interest in escalation processes, the more relevant statistic are the *maximum escalation* level and the *dispute intensity* measure, whereas the *dispute duration* is only of secondary interest. The reason is that the first two measures directly capture the escalation content of a dispute (a move along the y-axis in Figure 7.1 in either the most escalated or in all years). In contrast, the latter measure only captures the time-dimension of a dispute (a move along the x-axis), which is likely to pick up the fact that higher escalated disputes tend to take longer because it takes parties a certain amount of time to escalate bargaining into a high-level dispute. However, low-level negotiations may also go on for a considerable amount of time. Thus, while higher escalation implies a certain duration, longer durations do not necessarily imply high escalation.

Statistical analysis and results

The remainder of this section is devoted to testing Hypothesis 1 based on information on the parties' stakes derived from the procedure described in Section 7.1. In all of the following analyses, exporter i will always be the United States. That is, the data employed for calculating the parties' stakes measures above will be subsetted from the entire trade network to the U.S. export network (the fact that the data on the larger international trade network are required to calculate the above shares underlines how strongly the overall structure of international trade patterns play into bilateral interactions). Doing so makes it possible to match the data on U.S. trade enforcement policies with the quantities L_{jk} and $G_{ijk} = G_{USjk}$.

Recall that both G_{USjk} and L_{jk} range between 0 and 1. The fact that the two stakes measures are bounded between 0 and 1 naturally gives rise to the interaction hypothesis developed in Section 3.3. Essentially, only if both G_{USjk} or L_{jk} are relatively large, do both sides have sufficiently high stakes – and are therefore sufficiently cost-tolerant – to be willing to accept continued dispute escalation. Also note that the calculation of G_{USjk} or L_{jk} in terms of shares is unrelated to the current trade values $M_{ijk} = M_{USjk}$ and M_{jk} in absolute terms.

This means that G_{USjk} and L_{jk} decouple the bilateral stakes constellation from the size of the underlying trade value, which amounts to decomposing the parties' stakes into absolute (M_{USjk} and M_{jk}) and relative stakes (G_{USjk} and L_{jk}) in accordance with the discussion in Chapter 3. Because $G_{USjk} = \Delta M_{USjk}/\Delta M_{jk}$ and $L_{jk} = \Delta M_{jk}/M_{jk}$, are a set of 'nested ratios' – that is, ΔM_{jk} is the denominator in the first and the numerator in the second ratio – with M_{jk} as the only non-simulated quantity, M_{jk} is the relevant 'anchor' value in absolute value terms (note that M_{USjk} is implicitly contained in the formulation of equations (15) and (16) because, by equation (16), $M_{USjk} \approx G_{USjk}M_{jk}$).

For this reason, G_{USjk}, L_{jk}, and M_{jk} are the theoretically relevant quantities of interest in the specification of the empirical model. Specifically, I fit a range of models of the general form

$$Esc_{USjk1-3} = g_{1-4}\big(\alpha + \underbrace{\beta_1 G_{USjk} + \beta_2 L_{jk} + \beta_3 G_{USjk} L_{jk}}_{s_{rel}} + \underbrace{\delta M_{jk}}_{s_{abs}} + \underbrace{\gamma_1 + \gamma_2}_{u} + \varepsilon_{USjk}\big), \qquad (17)$$

where Esc_{USjk} is one of the three possible dependent variables as discussed earlier – *maximum dispute escalation*, overall *dispute intensity*, or *dispute duration* between the United States and a trade partner j in industry k. Next, inside the function $g(.)$, α is an intercept. The terms enclosed by the first horizontal bracket denoted by s_{rel} specify the interaction logic of Hypothesis 1 including the respective constituent terms. The coefficient β_3 on the multiplicative term $G_{USjk}L_{jk}$ is the parameter of primary interest. The interaction specification captures the logic of relative stakes as discussed above. In contrast, the term M_{jk} and its coefficient δ capture the logic of absolute stakes. The exact definitions of these variables will be given below.

Next, γ_1 and γ_2 are two sets of importer/dyad and product fixed-effects that account for unobserved heterogeneity at the dyad and product levels (as in model 2b above, dyad and importer effects are identical in the subset of the data that contains only the U.S. as an exporter). The first set of fixed-effects accounts for importer and dyad-specific factors. In particular, the importer/dyad effects accounts for the parties' relative power and the parties' relative cost absorption capacities. This serves to make sure that the actor-level explanations for conflict that the existing literature has primarily focused on are fully included in the model.

The importer/dyad effects further account for factors such as economic structure and development, and the quality of bilateral political relations. In two of the twelve models reported below, importer income group effects were used instead of importer/dyad effects because convergence issues in the maximum likelihood estimation precluded the use of importer/dyad effects. The second set of fixed-effects accounts for product/industry-specific factors such as overall size and productivity of the industry, or industry-specific differences in lobby strength.

Lastly, $g(.)$ represents a set of link functions for four generalized linear models (GLMs), while ε_{USjk} represents an error term with the corresponding error structure. The four models are the Linear (), the Tobit (probit/identity link), the Ordered Logit (generalized logit link), and the Poisson (log link) models. Since all three dependent variables, Esc_{USjk}, are non-negative, contain relatively many categories, have right-skewed distributions, and are (except for the duration variable) non-interval-scaled, there is no model that perfectly fits all aspects of the data, but the above selection may reflect natural candidates. Given the nature of the dependent variables, it appears logical to specify the Linear model in log-level form, i.e., with a logged dependent variable. However, for easier interpretability and direct comparison to the Tobit model, I enter the dependent variables in levels (the non-reported results for the log-level specifications tend to be very similar, although expectedly slightly better in terms of model fit).

The Tobit model for censored regression is a natural choice if one assumes that dispute escalation is left-censored. This appears to be plausible given that dispute activity cannot be negative but that there is a range of stakes values (at the lower end of the spectrum) for which non-action is the observed outcome, irrespective of the actual value of the parties' stakes. In other words, if both mutually low and mutually very low stakes produce the same outcome of zero dispute escalation, the Tobit model is well-equipped to deal with this kind of data structure. At the same time, the Tobit model, like the linear model and the Poisson model, assumes interval scaled dependent variables. Only the duration variable is interval scaled, but not the maximum escalation and conflict intensity variables.

For this reason, the Ordered Logit model appears attractive, because it allows for an ordinal scale of the dependent variable, that is, ordered but non-equally spaced categories. From this point of view, the Ordered Logit is probably the best choice for the fitting the model with the *maximum escalation* measure as the dependent variable, which unlike the *intensity* and *duration* variables has relatively few categories but is on the ordinal rather than interval scale. Lastly, the Poisson model, which is usually used to model count data may serve as an additional option. One feature of count data is that they have a natural zero point and only take on integer values – just as the three escalation measures considered here. However, counts are non-ordinal. Furthermore, the Poisson distribution assumes that counted events occur independently at a fixed rate – a feature that is less in line with the structure of the three dependent variables considered here.

Table 7.2 below reports the results for all combinations of the three dependent variables and four models. Before discussing the results in depth, the relevant variables need to be defined more specifically. The top third of the table reports the results for the dependent variable *maximum escalation* during the 1988-2012 period shown in Figure 7.1. This variable ranges on a 9-point scale from 0 to 8 with higher numbers indicating higher maximum levels of escalation. The levels of the variable follow directly from Table 4.4, which describes the categorization of U.S. actions in Chapter 4. The only difference is that the scale is extended by three non-action categories at the lower end of the spectrum. These categories pertain to the cases when: products are mentioned in the NTE reports and there is a reference to U.S. industry or export interests but no reference to U.S. government action (escalation level 2), products are mentioned without an explicit reference to U.S. interests (escalation level 1), and products are not mentioned at all (escalation level 0).

Table 7.1: The coding of the 'maximum escalation' dependent variable

Escalation level	Product referenced	U.S. interests referenced	U.S. action referenced	As coded in Ch. 4	Type of U.S. action	Example action
8	+	+	+	6	robust3	"sanctions"
7	+	+	+	5	robust2	"sues"
6	+	+	+	4	robust1	"threatens"
5	+	+	+	3	active2	"presses"
4	+	+	+	2	active1	"seeks"
3	+	+	+	1	passive	"is concerned"
2	+	+	−	n/a	none	none
1	+	−	−	n/a	none	none
0	−	−	−	n/a	none	none

Table 7.1 gives an overview over this coding scheme and briefly reiterates the definition of the U.S. action categories from Chapter 4. As noted above, the *dispute intensity* variable, the second dependent variable, is a combination of the maximum escalation variable and a duration measure that sums the maximum escalation levels over all years of the 1988-2012 period. It ranges from 0 to 132 in the data (the maximum possible level would be $8 \times 25 = 200$). Results for this variable are reported in the middle third of Table 7.2. Lastly, the third dependent variable is *dispute duration* in years as defined above. Results for this measure are reported in the lower third of Table 7.2.

The calculations for parties' stakes, $G_{USjk}$and L_{jk}, are based on a hypothetical reduction of existing trade barriers t_{jk} by twenty-five percent, i.e., $\Delta t_{jk} = -.25$, by each importer j in each industry k based on equation (14) – that is, assuming that export supply is not infinitely elastic. The value of twenty-five percent is arbitrary but inconsequential for the pattern of results because the choice of other values induces changes that are proportional in relative size. The values for t_{jk} are taken from the estimation procedure described in Chapter 6. The values for the export supply elasticity, ω_k, are taken from the estimation procedure described in Chapter 5 along with the values for σ_k^D.

Table 7.2: Relating maximum escalation levels counterfactual gain and loss shares (stakes)

	DV: I. Maximum Escalation			
	Linear	Tobit	Ologit	Poisson
G_{USjk}	–1.789***	–1.717	–1.405	–0.636
	(0.484)	(0.987)	(0.821)	(0.348)
L_{jk}	–0.745	–1.980	–1.555	–0.949
	(0.684)	(1.414)	(1.181)	(0.561)
$G_{USjk} \times L_{jk}$	8.823***	9.995***	8.156***	3.011***
	(1.580)	(2.688)	(2.228)	(0.887)
M_{jk}	0.044***	0.025*	0.029**	0.002
	(0.008)	(0.012)	(0.010)	(0.002)
Log Sigma	–	0.773***	–	–
		(0.017)		
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	$k, j = ij$	$k, j = ij$
R^2	0.525	–	–	–
Log-likelihood	–	–5264.1	–4507.8	–
	DV: II. Dispute Intensity			
	Linear	Tobit	Ologit	Poisson
G_{USjk}	–10.504	–22.623**	–0.749	0.142
	(5.623)	(7.546)	(0.804)	(0.448)
L_{jk}	4.327	–33.323**	–0.308	0.449
	(5.415)	(10.596)	(1.166)	(0.681)
$G_{USjk} \times L_{jk}$	74.007***	128.933***	8.572***	2.227*
	(17.145)	(22.417)	(2.185)	(1.111)
M_{jk}	0.657***	1.117***	0.041***	0.008**
	(0.130)	(0.010)	(0.009)	(0.003)
Log Sigma	–	2.975***	–	–
		(0.017)		
$Fixed\ effects$	$k, j = ij$	k, j_{WB}	$k, j = ij$	$k, j = ij$
R^2	0.507	–	–	–
Log-likelihood	–	–9636.3	–8496.2	–
	DV: III. Dispute Duration			
	Linear	Tobit	Ologit	Poisson
G_{USjk}	–1.212	–3.131	–0.379	0.777
	(1.106)	(2.065)	(0.933)	(0.525)
L_{jk}	–0.329	–10.047***	–1.214	–0.304
	(1.026)	(3.049)	(1.434)	(0.986)
$G_{USjk} \times L_{jk}$	9.735**	25.027***	6.510**	0.279
	(3.204)	(6.020)	(2.479)	(1.280)
M_{jk}	0.093***	0.208***	0.030**	0.010**
	(0.019)	(0.024)	(0.010)	(0.003)
Log Sigma	–	1.558***	–	–
		(0.023)		
$Fixed\ effects$	$k, j = ij$	k, j_{WB}	$k, j = ij$	$k, j = ij$
R^2	0.375	–	–	–
Log-likelihood	–	–4362.4	–3597.4	–

Notes: Importer/dyad ($j = ij$), importer income group (j_{WB}), and industry (k) fixed-effects are included as indicated; intercept and fixed-effects coefficients are not reported. Huber-White robust standard errors for Linear and Poisson models and regular standard errors for Tobit and Ordered Logit models are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively. $N = 4{,}758$ in all cases.

Appendix IV reports results based on the assumption of infinite export supply, i.e., calculations from equation (7), which show the same pattern as the estimates below at similar levels of significance and model fit, although with lower coefficient estimates. M_{jk}denotes total imports by importer j in each industry k measured in billion (10^9) US$ for meaningful coefficient interpretation.

With regard to the interpretation of the results, a number of points are worth mentioning. First, and most importantly, the results clearly support the interaction logic formulated in Hypothesis 1. With the exception of the Poisson model of *dispute duration*, the coefficient of interest on the interaction term $G_{USjk} \times L_{jk}$ is substantively and statistically significant in all cases – suggesting substantial increases in escalation levels for mutual increases in the parties' stakes. Across all models, the usual interpretation of interaction terms applies. That is, the implied slope of the regression line for each variable G_{USjk} and L_{jk} depends on two coefficients rather than just one – the coefficient on the respective constituent term G_{USjk} or L_{jk} *and* the coefficient on the interaction of the two stakes variables $G_{USjk} \times L_{jk}$.

The slopes for each of the two stakes variables are thus conditional on (and therefore change with) the value of the respective other variable, which is equivalent to saying that the usual *ceteris paribus* interpretation of additive regression models does not apply. It is the defining feature of an interaction effect that the slope of one constituent term depends on the value of the other constituent term. Specifically, the slope of the G_{USjk} is given by $\hat{\beta}_1 G_{USjk} + \hat{\beta}_3 G_{USjk} L_{jk} = (\hat{\beta}_1 + \hat{\beta}_3 L_{jk}) G_{USjk}$, where $(\hat{\beta}_1 + \hat{\beta}_3 L_{jk})$ is the composite coefficient on G_{USjk} that changes with the level of L_{jk}. By analogy, the composite coefficient on L_{jk} is $(\hat{\beta}_2 + \hat{\beta}_3 G_{USjk})$ that changes with the level of G_{USjk}.

From these considerations, it is directly apparent that the individual coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$ on the constituent terms G_{USjk} and L_{jk} only describe the implied slopes of the regression line for each term if the respective other term equals zero. That is, $(\hat{\beta}_1 + \hat{\beta}_3 0) = \hat{\beta}_1$ and $(\hat{\beta}_2 + \hat{\beta}_3 0) = \hat{\beta}_2$. It is important to note in this context that the coefficients on constituent terms G_{USjk} and L_{jk} tend to be much smaller in absolute size than the coefficient on the interaction term and are mostly insignificant across the twelve models (plus typically negative). Based on the theoretical considerations outlined in Chapter 3, one would expect these coefficients to be close to zero and therefore tending to be statistically insignificant, because one would not expect any dispute escalation if either of the two parties has no stakes in an issue.

The fact that most coefficient estimates on the constituent terms are slightly negative should not be over-interpreted given the mostly relatively large standard errors and resulting low levels of statistical significance. In principle, the negative slopes of the regression lines conditional on the trade partner's stakes being equal to zero are consistent with the idea of anticipation effects that make dispute escalation particularly unlikely in the context of extreme asymmetries in parties' stakes. In any case, however, these effects are small and quickly overwhelmed by the strong increase in predicted escalation levels resulting from a mutual rise in stakes.

The quantitative interpretation of the coefficient estimates depends on both the units in which the variables are measured and the link function of the model. These factors define what a one-unit change in the predictors means, and through which functional relationship this change translates into a change in different independent variables. Because the key predictors of interest, G_{USjk} and L_{jk}, are shares and thus range between 0 to 1, the one-unit change in these quantities implies a change from 0 to 1 – the theoretical minimum and maximum of the parties' stakes. For the three Linear models in the first column of Table 7.2, this means that a mutual shift from 0 to 1 in both G_{USjk} and L_{jk}, indicates an predicted increase in *maximum escalation* of (–1.789) + (–0.745) + 8.823 = 6.289 levels, an increase in *dispute intensity* of (–10.504) + 4.327 + 74.007 = 67.83 points, and an increase in *dispute duration* of (–1.212) + (–0.329) + 9.735 = 8.194 years while holding all other factors constant.

These results clearly suggest a substantial shift through large fractions of the scale of the respective escalation measures for a mutual increase in stakes from 0 to 1. Although it needs to be kept in mind that the non-interval-scaled *maximum escalation* and *dispute intensity* variables mean that these figures should be seen as approximations, the general trend is readily apparent and substantial. A similar picture emerges from the other models. The results for the Tobit model have a similar interpretation as the Linear model, with the exception that the coefficient estimates pertain to the censored latent escalation variable rather than to the actual dependent variable. Because the Tobit model allows the censored latent variable to be negative, it allows steeper slopes, which are reflected in the larger coefficient estimates.

In contrast to the Linear and Tobit models, the coefficients for the Ordered Logit and Poisson models are less straightforward to interpret. The exponentiated Ordered Logit coefficients are proportional odds ratios (ORs). These proportional ORs indicate the factor by which the odds of being above rather than below any one cut-point on the dependent variable – say, below 0-4 vs. above 5-8, or below 0-6 vs. above 7-8 – are multiplied for a one-unit change in the respective predictor. Because odds ratios are the ratio of two odds which in turn are the ratio of two probabilities, their interpretation is quite unintuitive and I will not go through the exercise in detail. For a meaningful interpretation of the Ordered Logit model, an in-depth calculation of predicted probabilities for hypothetical cases would be required. Given that the Ordered Logit model is only one of four models considered here, I leave it at noting that the large size and statistical significance of the Ordered Logit coefficients suggest predicted shifts in escalation on a similar scale than the Linear and Tobit models.

The exponentiated Poisson coefficients are interpreted as the multiplicative (rather than additive) term used to calculate the estimated values of the dependent variables for a one-unit change in the respective predictor. For instance, for the case where the dependent variable is the *maximum escalation* level, the model indicates an increase in escalation level by a factor of $\exp(-0.636) \times \exp(-0.949) \times \exp(3.011) = 0.529 \times 0.387 \times 20.308 = 4.162$. Calculations for the other two models follow the same logic and yield factors of 16.743 and 2.121 for the *dispute intensity* and the *dispute duration* models, respectively.

Second, regarding the estimates across the three dependent variables, it is interesting to note that the *maximum escalation* and *dispute intensity* models appear to fit the data better than the *dispute duration* model. This is indicated both by the smaller standard errors across all models and the higher R-squared values of the Linear models. This supports the notion that the two former measures are more direct measures of escalation than *dispute duration*, which is instead connected more intimately to the driving forces of dispute escalation. The fact that this pattern is apparent from the above results as one would expect on theoretical grounds lends further support to the results overall.

Third, the coefficient estimates for on M_{jk} follow the same logic of interpretation as the coefficients on the stakes variables G_{USjk} and L_{jk} with the only difference that a one-unit change now implies a change in M_{jk} by US$ 1 billion. Thus, for the Linear model a one-billion increase in trade is predicted to increase *maximum escalation* by 0.044 levels. Increases on a similar scale are suggested by the other models. Although the coefficient on the trade variable is significant in almost all cases, an increase on this scale appears not to be particularly pronounced given that US$ 1 billion is a sizable amount of trade (the mean trade volume in the data is US$ 0.774 billion, the maximum is US$ 117 billion).

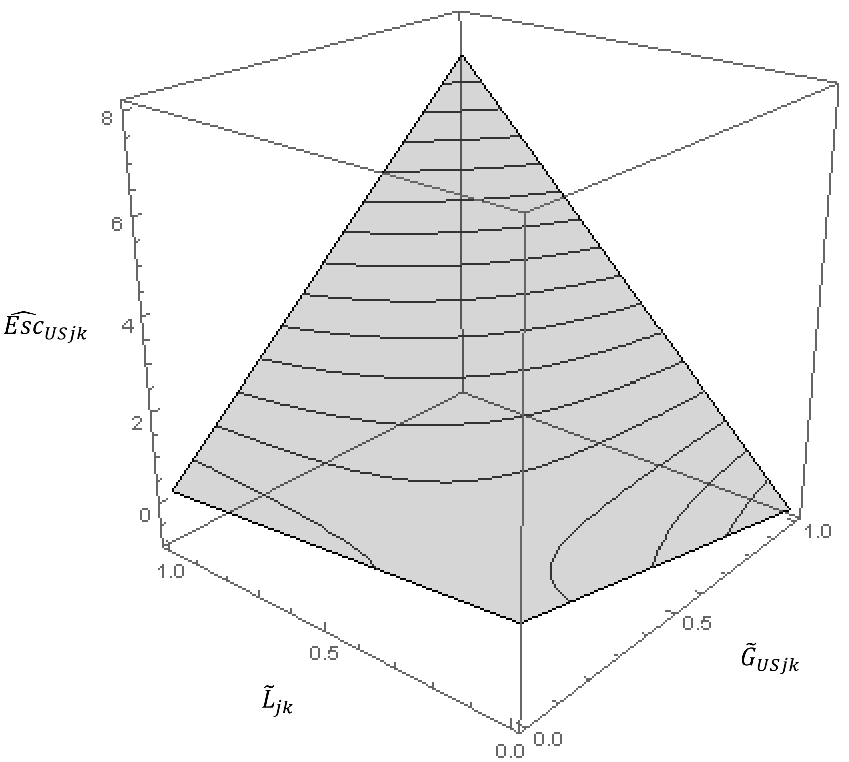
This strongly suggests that the (absolute) trade volume as such is much less relevant for dispute escalation than the parties' (relative) stakes in the given trade relationship. This finding further supports the argument that mutual stakes constellations are a crucial driver for dispute behavior. Note further that alternative specifications with M_{USjk} instead of M_{jk} or both M_{USjk} and M_{jk} included in the models do not substantively affect these pattern of results. In accordance with the theoretical considerations made at the beginning of this subsection, M_{jk} is the 'stronger' predictor that increases model fit compared to M_{USjk} and dominates if both variables are included (in which case, M_{USjk} is insignificant).

To provide some more tangible feel for the nature of the results, Figure 7.2 graphically represents the interaction surface of the two stakes variables G_{USjk} and L_{jk}. Based on the results for the Linear model and the *maximum escalation* dependent variable, it shows the composite slopes for the two variables derived from the estimated coefficients for the constituent terms, $\hat{\beta}_1$ and $\hat{\beta}_2$, and the estimated coefficient for the interaction, $\hat{\beta}_3$, across the range of possible values for both variables while holding all other variables constant. Specifically, it is calculated as

$$\widehat{Esc}_{USjk} = \left(\hat{\alpha} + \overline{\gamma}_1 + \overline{\gamma}_2\right) + \hat{\beta}_1 \tilde{G}_{USjk} + \hat{\beta}_2 \tilde{L}_{jk} + \hat{\beta}_3 \tilde{G}_{USjk} \tilde{L}_{jk} + \hat{\delta} \overline{M}_{ik}, \tag{18}$$

where $\widehat{Esc}_{USjk}$ is the predicted regression plane as shown by the gray area, which is composed of the constant values $\hat{\alpha} + \overline{\gamma}_1 + \overline{\gamma}_2$, which represent the estimated intercept and the means (indicated by the overbars) of the two sets of importer/dyad and product fixed-effects. The term $\hat{\delta}\overline{M}_{ik}$ at the end represents the mean trade flow value multiplied by its corresponding coefficient estimate. For the purpose of plotting, all these factors are treated as constants and, as a sum, determine the 'intercept' offset when both of the stakes variables are equal to zero. The averaging over these quantities implies that the plot in Figure 7.2 shows the predicted escalation levels for an average importer/dyad in terms of dispute proclivity, an average product in terms of dispute proclivity, and averagely-sized trade volumes. This means that as trade flows change or different industries or trade partners are concerned, the entire surface shifts up or down while the form of the overall relationship remains the same.

Figure 7.2: Interaction surface derived from the Linear model with DV I. maximum escalation



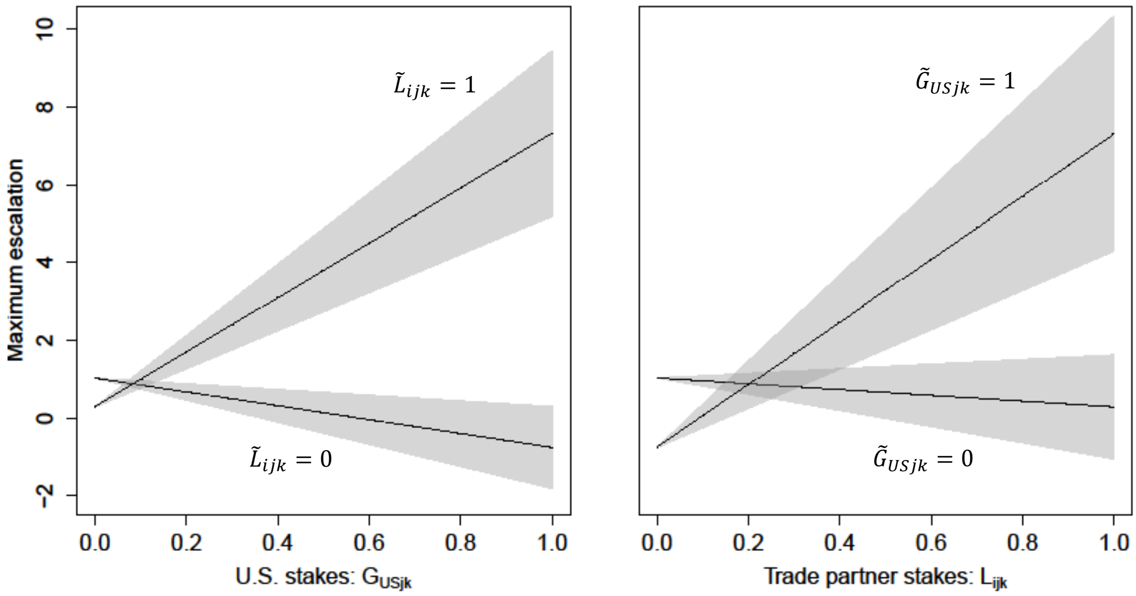
The estimated coefficients of interest are $\hat{\beta}_1$, $\hat{\beta}_2$ and $\hat{\beta}_3$. The variables of interest are $\tilde{G}_{USjk}$ and $\tilde{L}_{jk}$, where the tilde indicates that the quantities are simulated across the range of possible values, that is, in the range {0,1}. Plugging in the corresponding values into the right-hand side of equation (18) gives

$$(0.995) + (-1.789)\{\tilde{G}_{USjk}; 0,1\} + (-0.745)\{\tilde{L}_{jk}; 0,1\} + 8.823\{\tilde{G}_{USjk}; 0,1\}\{\tilde{L}_{jk}; 0,1\} + 0.044 \times 0.774,$$

which – evaluated at the set of possible combinations of values for $\tilde{G}_{USjk}$ and $\tilde{L}_{jk}$ – describes the interaction surface as plotted in Figure 7.2. As is apparent from the figure, the regression plane rises steeply as both stakes increase, and remains at low levels if either or both variables take on low values. Insofar, the plot condenses the essence of Hypothesis 1 as derived from empirical estimates and thus demonstrates the strong alignment of theoretical prediction and empirical results.

Another way to interpret the interaction logic is to note how the plot shows the conditional nature of the relationship between maximum escalation levels and the values of $\tilde{G}_{USjk}$ and $\tilde{L}_{jk}$. For different values of, say $\tilde{L}_{jk}$, the steepness of the slope describing the relationship between $\widehat{Esc}_{USjk}$ and $\tilde{G}_{USjk}$, i.e., $(\hat{\beta}_1 + \hat{\beta}_3 \tilde{L}_{jk})$, changes considerably. The same holds the other way round. Figure 7.3 illustrates these shifts in slopes for the two extreme cases where the respective other variable switches from 0 to 1. The figure essentially combines the four vertical faces into two panels. The left panel describes how the composite slope for $\tilde{G}_{USjk}$ changes as $\tilde{L}_{jk}$ moves from 0 to 1. The right panel describes the reverse situation. The figure also shows the 95 percent confidence intervals around the slope estimates, which are calculated following Friedrich (1982).

Figure 7.3: Conditional slope estimates from the Linear model with DV I. maximum escalation



Once more, the key point to note about these plots is how, in each case, the predicted effect of one stakes variable on maximum escalation levels switches from slightly negative to strongly positive as the second stakes variable shifts from zero to one. Another way of interpreting the plot is to note that, in each case, if the trade partner's stakes equal 0, even a shift to very high stakes levels of .8 or 1 for the U.S. is not predicted to lead to an increase in escalation, and vice versa. On the other hand, if the trade partner's stakes equal 1, each increase in stakes for the U.S. is predicted to increase escalation levels noticeably, and vice versa.

In sum, the above results provide considerable evidence in support of Hypothesis 1. This suggests not only that the larger theoretical reasoning behind the hypothesis is valid. It also substantiates the validity of the overall strategy to measure parties' stakes in the context of international trade relations, which has been presented over the last chapters.

7.3 Explaining Outcomes: Dispute Escalation and Implied Trade Concessions

This section is concerned with jointly testing Hypotheses 2 and 3. Hypothesis 2 states that *the United States should, on average, be seen to secure larger reductions in trade barriers and thus larger relative increases in trade flows after disputes that have escalated further, compared to disputes that have escalated less far.* Hypothesis 3 states that *the variability in bargaining outcomes and thus the relative changes in trade flows should decrease as disputes escalate further.* Thus, the two hypotheses make statements about the relationship between the overall trend (mean) and variability (variance) of changes in trade flows as a function of the level of dispute escalation.

Testing these hypotheses requires a statistical technique that, unlike regular regression methods, explicitly allows modeling not only the mean but also the variance of an outcome variable as a function of a set of predictors. A *variance function regression* is the appropriate tool for this purpose (Western and Bloome 2009; also see: Nelder and Lee 1991, Aitkin 1987, Harvey 1976). By allowing for changes in the variance of the dependent variable as a function of the predictors, a variance function regression is essentially a method to directly model heterogeneity in the residual variance of a regression. Thus, "the residual variance is treated as a target for analysis" (Western and Bloome 2009, p. 293). This differs from standard regression settings, where the residual variance is viewed as unexplained. Moreover, since residual heterogeneity is a consequence of heteroskedasticity, it is usually treated as a nuisance in statistical applications because it leads to violation of traditional regression assumptions. In the present context, however, the residual variance of the dependent variable is of substantive interest.

The first requirement to implement the technique is to calculate the changes in trade flows that correspond to the timing of the dispute history in each case. After all, the idea is to assess whether there is a relationship between dispute escalation and implied trade concessions, which should be reflected in observed trade flows. To do so, I begin by calculating the average value of U.S. exports in industry k to trade partner j at two time windows. The first time window consists of the three years prior to the first dispute year. The second time window consists of the three years following the last year in which the maximum escalation level for each dispute was reached. Averaging over the time windows is done to mitigate measurement error in trade reportings for individual years. These calculations are performed on the inflation-adjusted trade data *before* collapsing the data into the cross-section, which was used in Section 6.3 and Section 7.2 above.

The choice of the time windows is based on the assumed bargaining activities of the parties. I assume the first window captures trade flows under a relatively new or existing trade barrier before the trade partner can make any concession that becomes effective while the parties are bargaining. This window might not capture the effect of barriers that were imposed or stiffened just before the United States initiated bargaining, but this cannot be averted since moving into the bargaining phase would not only lead to overlaps with early concessions, but also to overlaps with the second time window for short disputes. The choice for the second time window is based on the assumption that, consistent with theoretical predictions, the parties reach agreement at the end of the highest escalation period. This implies that the implementation of such an agreement, i.e., a potential trade barrier reduction, would become effective at the beginning of this window.

With the trade flow averages over both time windows, I calculate the quantity of interest, namely the change in trade from the first to the second time period as follows:

$$\Delta Trade_{USjk} = log\left(\frac{Trade\_t1_{USjk}}{Trade\_t0_{USjk}}\right). \tag{19}$$

Equation (19) thus defines the change in trade flows as the logged ratio of the average trade value in the second time period divided by the average trade value in the first time window. The logarithm ensures that changes are symmetric in both directions. For instance, if trade after the dispute is four times larger than before the dispute, the ratio inside the brackets equals $4/1 = 4$. By contrast, if trade after the dispute is four times smaller than before the dispute, the ratio inside the brackets equals $1/4 = .25$. In other words, if trade increases, the ratio can range anywhere between one and infinity, while if trade decreases, the ratio ranges anywhere between zero and one. The logarithm allows expressing these changes in a balanced manner. Thus, the logarithm of 4 to base 10 equals roughly .6, while the logarithm of $1/4$ to base 10 equals roughly $-.6$. Because the logarithm of 1 is zero, this transformation allows a natural interpretation of changes in both directions.

Figure 7.4: Implied trade concessions captured in $\Delta Trade_{USjk}$ plotted against escalation levels

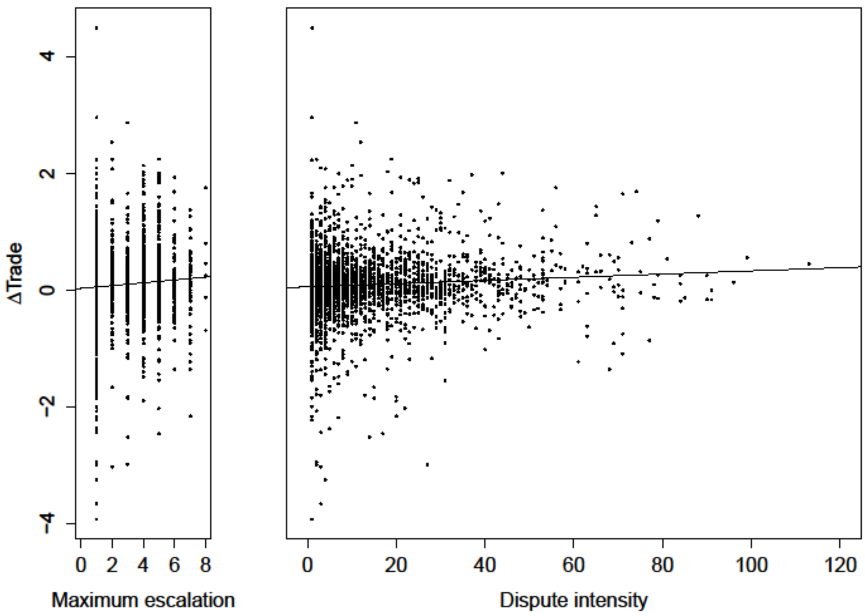


Figure 7.4 presents descriptive plots of the $\Delta Trade_{USjk}$ against the *maximum escalation* and the *dispute intensity* measures, as defined in Section 7.2, to provide an intuition of what the transformed data look like. Visual inspection suggests that there is indeed an upward trend in mean and a downward trend in variances as escalation levels increase. Although the upward trend in means is more pronounced in the left panel and the downward trend in variances is more pronounced in the right panel, the overall pattern is discernable. In the following, the newly obtained $\Delta Trade_{USjk}$ data will serve as the dependent variable while the escalation measures will serve as the primary independent variables of interest.

In implementing the variance function regression, I follow the iterative maximum likelihood procedure described by Western and Bloome (2009). While this approach works through an iterative optimization algorithm, the basic logic of the method can be understood by considering the first two implementation steps. The first step relates the predictors to the mean of the dependent variable, thereby producing initial estimates of the first set of coefficients of interest. The second step relates the predictors to the variance of the dependent variable, resulting in initial estimates of the second set of relevant coefficients. All further steps serve to obtain efficient estimates and correct standard errors that cannot be immediately obtained in the first iteration of the procedure. The first implementation step consists of fitting a simple OLS regression. Specifically, I specify the model as

$$\Delta Trade_{USjk} = \beta_0 + \beta_1 Esc_{USjk1-2} + \beta_2 Fyr_{USjk} + \beta_3 Dur_{USjk} + \varepsilon_{USjk}, \qquad (20)$$

where β_0 is an intercept, β_1 through β_3 are regression coefficients that capture the relationship between the change in the mean of the dependent variable associated with changes in the predictors, and ε_{USjt} is an error term that is assumed to be normally distributed. Further, $\Delta Trade_{USjk}$ is taken from equation (19). $Esc_{USjk1-2}$ is either *maximum escalation* or *dispute intensity*. These are the right-hand-side variables of primary interest. The procedure is run separately for each of these variables. Two additional variables are added to model the time dependencies in the data. Namely, Fyr_{USjk}, which is the first dispute year, and Dur_{USjk}, which is the duration of the dispute measured as the time distance between the middle years of the two time windows.

Because the right-hand-side variables are identical throughout the entire procedure, it is useful to discuss this model specification before proceeding to the second implementation step. First note that I do not consider *dispute duration* (the third summary statistic of dispute activity derived above) in this part of the analysis because the overlap with the Dur_{USjk} variable makes an interpretation of this measure difficult. Unlike in Section 7.2, the measures are now on the right-hand-side of the regression equation. Second, the Fyr_{USjk} variable is intended to capture shocks to trade flows that are associated with a given year, such as the effects of the dotcom crisis or the 2008 financial crisis. The Dur_{USjk} variable is intended to capture the effects of the general drift in trade volumes over time. In particular, trade flows typically increase over time due to economic growth. This implies that longer durations between time windows are naturally associated with increases in trade volumes, irrespective of escalation processes. The variable is therefore important to account for this source of export growth.

Lastly, also because of the time dependencies in the data, I include no dyad and industry fixed-effects in the model. The reasoning behind this choice lies in the somewhat unusual data structure that results from calculating changes in trade volumes over time-intervals of differing lengths. Recall that fixed-effects introduce a single intercept offset for each individual dyad and industry. This upsets the logic of the estimation procedure in a setting where disputes involving the *same* country or the *same* industry have *different* durations. Intuitively, a fixed-effect for a given dyad or industry results in the same offset, irrespective of whether a dispute relating to that dyad or industry takes one year or twenty years. This offset then throws the variance structure of the data off balance. The inclusion of fixed-effects would thus lead to non-interpretable results. At the same time, of course, the omission of fixed-effects makes the analysis vulnerable to the usual confounding issues. The following analysis should, therefore, be interpreted with greater caution than the results presented in the previous section.

Estimating equation (20) by OLS yields an initial set of coefficient estimates that capture the relationship between the predictors and the mean of the dependent variable. It furthermore allows the calculation of the residuals, as a precondition for the second implementation step. Easily calculated as observed minus predicted values, first compute the predicted values as

$$\Delta \widehat{Trade}_{USjk} = \hat{\alpha} + \hat{\beta} Esc_{USjk} + \hat{\delta}_1 Fyr_{USjk} + \hat{\delta}_2 Dur_{USjk} \tag{21}$$

to obtain the residuals from

$$\hat{\varepsilon}_{USjk} = \Delta Trade_{USjk} - \Delta \widehat{Trade}_{USjk}. \tag{22}$$

For each observation, the residuals specify, in units of the dependent variable, how far away the observed values in the data are from the predicted regression plane. Hypothesis 3 suggests that the residual variance decreases with increasing levels of escalation. If this was true, one would expect residuals for observations associated with higher levels of escalation to be smaller, on average, than those associated with lower levels of escalation. That is, one would expect the residuals to be spread out further at lower levels of escalation.

This proposition can directly be tested. Using a gamma regression with a log link function, one simply regresses the squared residuals obtained from equation (20) on the same set of predictors as before. This gives a regression equation of the form

$$\hat{\varepsilon}^2_{USjk} = g(\lambda_0 + \lambda_1 Esc_{USjk} + \lambda_2 Fyr_{USjk} + \lambda_3 Dur_{USjk} + \vartheta_{USjk}), \tag{23}$$

where λ_0 is an intercept, λ_1 through λ_3 are regression coefficients that capture the relationship between the change in the size of the squared residuals associated with changes in the predictors, $g(.)$ is the log link function of the gamma regression and ϑ_{USjk} is the associated error term. The residuals from equation (20) are squared because the interest is in the absolute size of the residual rather than its direction (note that here the symmetry imposed by the log-ratio specification of the trade flow changes from equation (19) is useful). The squared residuals are necessarily non-negative while their distribution will be right-skewed. The gamma regression is a method appropriate for dependent variables of this type.

After step two of the procedure, initial estimates for the sets of mean and variance coefficients $\widehat{\boldsymbol{\beta}}$ and $\widehat{\boldsymbol{\lambda}}$ are obtained. The remainder of the procedure serves to correct two problems. First, the standard errors for the second stage do not take into account the uncertainty from the first stage. Second, the estimates of the first stage are inefficient as a result of the heteroskedasticity in $\Delta Trade_{USjk}$. To address these issues, the following iterative procedure is employed. First, obtain fitted values from the gamma regression as

$$\hat{\sigma}^2_{USjk} = exp(\hat{\lambda}_0 + \hat{\lambda}_1 Esc_{USjk} + \hat{\lambda}_2 Fyr_{USjk} + \hat{\lambda}_3 Dur_{USjk} + \hat{\vartheta}_{USjk}). \tag{24}$$

Next, estimate a weighted linear squares (WLS) regression of $\Delta Trade_{USjk}$ on the set of predictors, using $1/\hat{\sigma}^2_{USjk}$ as weights. This step is in effect a re-estimation of step one and serves to mitigate the effects of heteroskedasticity by down-weighting the influence of observations that have larger residuals. From the WLS regression, one obtains updated estimates for $\widehat{\boldsymbol{\beta}}$ and $\hat{\varepsilon}_{USjk}$. The new estimates of $\hat{\varepsilon}^2_{USjk}$ are then used as the dependent variables in the gamma regression just as in step two. This allows the calculation of updated estimates of $\hat{\sigma}^2_{USjk}$.

The estimates of $\hat{\varepsilon}_{USjk}$ and $\hat{\sigma}^2_{USjk}$ are then used in the joint maximum likelihood estimation of $\widehat{\boldsymbol{\beta}}$ and $\widehat{\boldsymbol{\lambda}}$ by iterating the weighted least squares and gamma regressions. Following Harvey (1976) and Aitkin (1687), the kernel of the log-likelihood for the normal distribution underlying the least squares stage is given by

$$l(\boldsymbol{\beta}, \boldsymbol{\lambda}) = -\frac{1}{2}\left[\ln\left(\hat{\sigma}^2_{USjk}\right) + \hat{\varepsilon}^2_{USjk}/\hat{\sigma}^2_{USjk}\right]. \tag{25}$$

The iterative procedure consists of evaluating the log-likelihood after each round of updating and assessing the difference between the new and the old value of the log-likelihood. The procedure is repeated until convergence, that is, until the difference between the new and old values falls below a previously specified threshold. At this stage, the standard errors for both models are correct.

Table 7.3 reports the results of the procedure for the two models with the *maximum escalation* and the *dispute intensity* measures as alternative predictors. The columns marked by $\hat{\beta}$ and $\hat{\lambda}$ report the estimated mean and variance coefficients, respectively. As can be seen, the $\hat{\beta}$ coefficient on the Esc_{USjk} variable is *positive* and statistically significant in both the *maximum escalation* and the *dispute intensity* models. With the above caveats due to the omission of fixed- effects in mind, these results support Hypothesis 2, which predicts larger *increases* in export volumes for the United States following disputes that have escalated further.

Table 7.3: Variance function regression results

	Esc_{USjk} = *Maximum Escalation*		Esc_{USjk} = *Dispute Intensity*	
	$\hat{\beta}$	$\hat{\lambda}$	$\hat{\beta}$	$\hat{\lambda}$
$Intercept$	0.087***	–1.252***	0.087***	–1.255***
	(0.010)	(0.061)	(0.010)	(0.061)
Esc_{USjk}	0.030**	–0.138*	0.026*	–0.210**
	(0.011)	(0.070)	(0.011)	(0.080)
Fyr_{USjk}	0.007	–0.026	0.003	–0.017
	(0.011)	(0.064)	(0.010)	(0.063)
Dur_{USjk}	0.026	0.154	0.021	0.233**
	(0.014)	(0.069)	(0.015)	(0.079)
N	2767	2767	2767	2767

Notes: The dependent variable is $\Delta Trade_{USjk}$as defined in equation (19). The columns with $\hat{\beta}$ and $\hat{\lambda}$ report the estimated mean and variance coefficients, respectively. Both sets of coefficients are given for standardized predictor variables; $\hat{\beta}$ and $\hat{\lambda}$ therefore capture the average changes in the mean and the variance of the dependent variable associated with changes in the predictors by one standard deviation. N is smaller here than for the results reported in Table 7.2., because not all dispute histories have trade reported at both time windows and because no time windows can be calculated for non-cases that have no start and end dates; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

At the same time, the $\hat{\lambda}$ coefficient on the Esc_{USjk} variable is *negative* and statistically significant in both the *maximum escalation* and the *dispute intensity* models. These results support Hypothesis 3, which states that the variability in implied trade concessions *decreases* as disputes escalate further. These negative coefficient estimates are therefore consistent with the idea that more intense disputes are associated larger compromises from both sides. Overall, the results presented in this section, therefore, present evidence in support of Hypotheses 2 and 3 and thus lend further credence to the larger theoretical mechanism that has been proposed to underlie escalation behavior. The concluding section that follows discusses these results in the larger context of both the study as a whole and the wider literature.

Conclusion

Escalation processes are a defining element of almost any conflict – regardless of the subject matter or the nature of the parties involved. Escalation occurs in the context of strikes, legal disputes, armed conflict, and trade disputes as well as in many other private and professional settings; and it occurs following purposeful decisions taken by individuals or organizations such as labor unions, private companies, armed groups, or states. In either case, the decision to escalate draws the parties deeper into a mutually costly interaction that eventually leads up to open and observable conflict between the concerned parties. Yet given this centrality of escalation processes in the emergence and conduct of conflict, surprisingly little is known about the logic of escalation and the strategic rationale and underlying considerations that drive this process.

The preceding chapters have sought to work towards filling this gap by zooming deeper into the micro-mechanism that underlies escalation behavior. In doing so, the study has pursued a research strategy that draws on, and speaks, to a diverse set of literatures. Starting from theoretical work on conflict processes that has been developed in the literatures on strikes, litigation and war, the study has shifted the focus of attention to the investigation of trade disputes. This strategy of transferring well-developed theories of conflict from subject-areas with challenging empirical landscapes to a subject-area with a favorable empirical landscape but less developed theories of conflict, has laid the basis for the further work. Building on this basis, the study has sought to refine and extend theoretical ideas about escalation and conflict in the light of empirical work on trade disputes.

A focus in this context has been on the importance of parties' stakes and the role these stakes play in driving escalation behavior. Specifically, the study has made the point that parties' stakes are the most relevant driving force underlying escalation dynamics. The study has argued that the role of parties' preferences has nevertheless not been as widely appreciated in important parts of the theoretical and empirical literatures on conflict as the importance of the concept would command. This tendency is likely rooted, at least in part, in the fact that *stakes* are harder to observe, and thus also to theorize, than parties' *power* relations or their overall ability to absorb *costs*. This study has sought to demonstrate that an investigation of the role of parties' stakes in escalation processes through the powerful analytical lens of bargaining theory makes it possible to generate new insights and further progress in understanding conflict behavior.

Specifically, the results of this study suggest a number of theoretical and conceptual implications for research on conflict processes across different subject-areas. The study further provides a range of empirical and methodological contributions as well as a collection of novel datasets for scholars working on trade and trade disputes. In the following, I briefly summarize the key results of the study, including its data output. Thereafter, I discuss how these results relate and contribute to the existing literature and highlight their implications for future research as well as for policy-related questions concerning conflict prevention and management.

Summary of Key Results

The main results of the study can be grouped according to whether they are theoretical, conceptual, or sub-conceptual and empirical in nature. The study's theoretical results relate directly to the proposed micro-mechanism of escalation behavior and the insights that can be derived therefrom. The conceptual results concern the points made regarding the relationship between and relevance of the theoretical core concepts of stakes, power, and costs in terms of their analytical power. Finally, the sub-conceptual and empirical results pertain to the empirical work on trade disputes. This set of results includes the domain-specific theoretical work on measuring stakes in trade relations, the novel data compiled and provided by this study, as well as the results of the statistical analysis.

Theory: Escalation as the micro-mechanism underlying conflict processes

Given that observed conflict almost invariably emerges from the sequential escalation decisions taken by the concerned parties, understanding the drivers of escalation behavior is likely key to understanding conflict as a whole. This study has offered a theoretical mechanism that is able to recreate this kind of behavior and may therefore reveal important aspects of the deeper logic of escalation and conflict processes. This proposed mechanism makes explicit and highlights a number of important factors that play into escalation behavior and shape the terms of agreement resulting from such behavior. Based on this mechanism, it is therefore possible to systematically analyze how key characteristics of the parties (such as their stakes) as well as important contextual factors (such as the wider bargaining and information structure) affect the dynamics and outcome of the parties' interaction.

A central point of the study is that escalation dynamics are driven by the efforts of parties to manipulate the costliness of their mutual bargaining environment. The starting point is that higher stakes in an issue have an affect analogous to reducing parties' costs of conflict *for that particular issue*. Because higher stakes make parties more cost-tolerant, high-stakes parties profit (in expectation) by intentionally creating *additional* costs through escalation behavior. These additional costs serve the double purpose of extracting larger concessions from the opponent while simultaneously shortening the time to agreement – thereby prolonging the flow of rents from a favorable agreement. This logic introduces a selection process that ultimately defines the degree of escalation and the nature of the agreement.

It is crucial to note that this process is critically dependent on the introduction of two-sided uncertainty. This study highlights the importance of an appropriate information structure in theoretical work on conflict as a prerequisite for realistic theoretical predictions that are sufficiently rich to be immediately interpretable. In particular, the study departs from the usual one-sided uncertainty approach in the literature, where *one* party is assumed to be *fully* uncertain about a relevant characteristic of the other. Instead, the study builds on the more realistic assumption of *two*-sided but *lim-*

ited uncertainty. It thus allows both sides to be uncertain while simultaneously being able to *partially* anticipate bargaining outcomes (i.e., there is mutual asymmetric information but the parties are not fully 'blind'). This not only forms the basis of the proposed escalation mechanism, but also allows an appreciation of what external observers can and cannot hope to observe about the determinants of conflict.

In the presence of mutual uncertainty, conflict then gradually emerges from non-conflictive bargaining (in the sense that the parties find themselves in a potentially *conflictive* bargaining situation in which no conflict behavior is initially observable). This study has discussed how, as conflict intensifies, weaker (lower-stakes) types of parties sequentially select out of the escalation process. This selection perspective highlights the close connection between bargaining, escalation as a bargaining strategy, and conflict as the ultimate result of this process. Because either side can end the escalation process any time it moves, combinations involving at least one low-stake party are not expected to escalate from bargaining into open conflict. Only combinations of the jointly strongest (high-stakes) types select all the way into high-level conflict. This scenario is associated with mutually high costs and compromise agreements. Because both sides are required to make concessions in these agreements, highly escalated conflicts are generally associated with large costs and at best moderate gains for either side. It has also been discussed that this general tendency is retained even if the first moving party can choose whether it wishes to initiate conflictive interactions – that is, if the first mover can 'pick its fights'. In particular, it has been discussed how the gains attainable in this way result from the initiator's pre-selection into the most promising cases rather than from the effectiveness of conflict as a bargaining strategy per se.

The two-sided uncertainty structure has important implications not only in defining the eventual level of escalation but also for the predicted bargaining outcomes (i.e., the eventual agreements). These outcomes differ strongly from those predicted by models of one-sided uncertainty, which exhibit the typical unilateral concession functions. This not only constrains the set of possible outcomes but also means that model predictions cannot be directly applied and need careful interpretation (because the models implicitly presuppose that the non-conceding side is stronger and that its strength is known). In contrast, the mechanism proposed here can produce the entire set of bargaining outcomes from complete loss to complete gain for each side – including the possibility of genuine compromise. These predictions match the set of observed bargaining outcomes, are immediately interpretable, and can directly be used to generate hypotheses to be tested in empirical work.

As an additional point, the study has highlighted that a necessary precondition for escalation – and therefore conflict – to occur is that parties have a cost-creation option, that is, that they have the ability to escalate. This is by no means necessarily the case. In fact, the presence of an escalation option is the defining feature of (potentially) *conflictive* bargaining situations as encountered in strikes, litigation, war, or trade disputes. This contrasts with *regular* bargaining situations in which parties have no cost creation option (i.e., buyer-seller bargaining). Note that the former type of bargaining *need not* become openly conflictive (typically, if either or both of the parties have low stakes), but that the latter type of bargaining *cannot* become conflictive (no matter what the parties' stakes). This consideration is useful to analytically differentiate observationally equivalent situations.

Concepts: Why stakes *are more important, and elusive, than* power *or* costs

On the conceptual level, the study has highlighted the particular role of parties' stakes as drivers of conflict processes. While the insight that parties' stakes matter in conflict situations is not new, this study has explicitly made the point that stakes are a *more specific* and therefore also a *more important* explanatory factor than the parties' power relations or their costs of conflict. The main argument for the central role of parties' stakes rests on the fact that stakes are an issue-level concept, while the parties' power and their costs of conflict are actor-level concepts. Because any pair of actors can typically engage in conflict over a large number of issues and actor/dyad-level factors remain constant across all these issues, only parties' stakes have the potential to explain within-dyad-variation in conflict outcomes.

Specifically, the parties' *costs* of conflict are only meaningful for explaining conflict outcomes when considered *in combination* with their stakes. This is because the parties' costs of conflict simply cannot be evaluated in the absence of information on the parties' stakes in the issue at hand. Because the costs of conflict are, by definition, dependent on the level of escalation but not on the issue (mobilizing a given number of troops always costs the same, no matter why the mobilizations occurs), parties' subjective issue valuations are crucial information. Without knowing the value parties attach to an issue, it is impossible to judge whether they perceive the costs of conflict to be negligible or prohibitive.

A similar argument further applies to the parties' *power* – typically understood as the maximum level of enforcement leverage a party can muster. This concerns, for instance, the parties' retaliatory capacity in trade disputes (the overall size of one parties' market for the other's exports), or the parties' total military capabilities in international conflict. However, the size of parties' total military capabilities is largely irrelevant as an analytical concept for all conflicts that remain below the level of an all-out war (that is, almost any conflict). The same holds for the case of trade disputes, where it basically never occurs that one side closes its entire market for the other's products. For this reason, *power* should only be seen as an enabling condition (or, depending on the perspective, as a limiting condition) for conflict rather than as a root cause.

One of the challenges with parties' stakes in applied research is that, in many cases, these stakes are not well observable. This difficulty is even more pronounced with regard to non-cases that are required in comparative and statistical work on the determinants of conflict. With regard to non-cases, it is often not even possible to identify and properly delineate the potential underlying issue.

(What is the set of issues that parties do not litigate? And what is the set of territories over which countries do not engage in some form of open disagreement or conflict?). This tends to be different with actor-level concepts such as power and costs, because these concepts are bound to an actor, which is mostly readily observable. Actor-level information is thus easier to obtain. The above considerations therefore suggest that parties' *stakes* are an as elusive concept in research on conflict as they are an important driver of conflict behavior

Empirics: The analysis of escalation processes in the context of trade disputes

In its empirical work, the study has focused on disagreements and disputes between the United States and its trade partners. This focus on the area of international trade has been motivated by an effort to make the relevant building blocks of the theoretical mechanism – including parties' stakes – empirically observable and measureable. Creating this sort of visibility is a necessary precondition to link theoretical concepts to empirical analogues and to eventually test predictions derived from theoretical considerations. This work has culminated in a statistical analysis that substantiates the proposed hypotheses and thereby lends support to the theoretical argument presented. In addition to the immediate statistical results, the empirical work of the study has produced ample additional output. This pertains, in particular, to the domain-level theoretical work and the resulting methodology to measure parties' stakes as well as to the novel datasets that flow from the study.

The primary statistical result of the study, reported in Section 7.2, is that the *interaction* of parties' stakes – as measured by their respective counterfactual gain and loss shares – is a strong and robust predictor of dispute escalation. The flip-side of this relationship is that the weaker (lower-stakes) of the two parties to a dispute is the limiting factor in the escalation process. Because the weaker side selects out of the escalation process first, it defines the highest escalation level the parties reach. This is most visibly reflected in the fact that if one parties' stakes are close to zero, escalation levels are predicted to be minimal regardless of the second parties' stakes. The results further suggest that the interaction of parties' relative stakes, as measured by their gain and loss shares, is a more important predictor of escalation than the level of absolute stakes, as measured by the overall trade value. These results are fully in line with theory: if one cannot gain or lose from the reduction of a trade barrier, then the currently observed trade value should have no effect on dispute escalation. This line of reasoning corroborates the notion that parties' stakes arise due to expectations that are based on counterfactual reasoning. In other words, parties' stakes are not defined by the value of the status quo, but by the value of changes in this status quo.

The results of an additional analysis, reported in Section 7.3, shed additional light on the details of the conflictive bargaining procedure. This analysis has focused not on the pattern of escalation as a function of parties' stakes, but on the pattern of bargaining outcomes as a function of escalation levels. Bargaining outcomes were calculated as changes in observed trade levels after the dispute has climaxed relative to levels before the dispute has begun. This calculation served to approximate the size of implied trade concessions through observable quantities. In line with theoretical predictions, the results indicate that the United States does indeed 'pick its fights' and, therefore, on average, succeeds in extracting larger concessions from its trade partners as escalation levels rise. However, because theoretical reasoning suggests that these successes in observed disputes are a consequence of the biased sample that results from the United States choosing to initiate a dispute only in cases it expects to 'win'. The results of the analysis further indicate that the variation in bargaining outcomes decreases as escalation levels rise. This supports the notion that extreme gains and losses become rare as disputes wear on and that parties tend to strike compromise agreements at a higher frequency.

A range of intermediate steps, required in preparing the eventual statistical analysis, result in useful contributions in their own right. An important result of the study is to demonstrate how parties' stakes can be measured in international trade relations. Based on theoretical insights from trade theory, the study has developed a method to assess the counterfactual gains and losses that the parties can expect from a hypothetical trade barrier reduction. The implementation process requires information on both elasticities and trade barriers as a precondition for a trade policy simulation. A particular strength of the simulation approach lies in its hypothetical nature and in incorporating established theoretical knowledge about economic relationships and market mechanisms. This makes it possible to go beyond static observations of the status quo and to capture the kind of counterfactual reasoning and forward-looking assessments that parties necessarily make when pondering options. Overall, the method offers the opportunity to arrive at an understanding of what *makes* parties *have* particular stakes in an issue and to infer these stakes from known information.

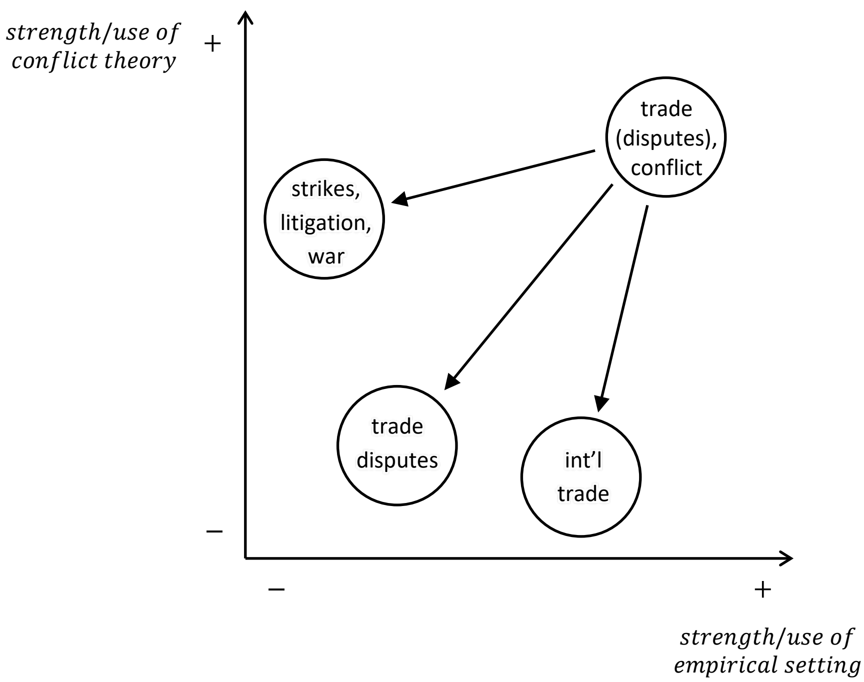
In terms of data work, the study results in two detailed datasets that have many potential uses beyond the scope of this study, as explained in the following section. A first dataset captures bargaining and escalation dynamics in trade disputes. A fully custom-developed automated content analysis (ACA) routine was used to extract information from the U.S. National Trade Estimate (NTE) reports. The resulting data provide rich information on the evolution and history of disagreements and disputes between the United States and its trade partners concerning many thousands of industry-level trade relations. The dataset is the most extensive and detailed collections of data on trade disputes available.

The study further compiled the most extensive set of data on applied trade barriers currently available. Specifically, it provides world-wide industry-level data on applied non-tariff-barriers to trade (NTBs). Due to the indirect method used in the estimation process, these data are not affected by the self-selection and coverage problems that plague existing data sources on NTBs. Unlike existing data on trade barriers, therefore, the data are useful in predicting and explaining empirical trade patterns and capture substantial trade depressing effects. These trade depressing effects have been documented in a separate set of statistical analyses both for the world-wide trade network and for U.S. exports alone.

Contributions to the Literature and Directions for Future Research

The above results reflect the wider approach of this study to zoom deeper into the logic of conflict processes. This manifests itself in several ways. The focus on the logic of escalation dynamics presents an effort to disaggregate conflict processes in their intensity and to highlight how, why, and under which conditions conflict emerges from bargaining situations. The focus on two-sided but limited uncertainty is motivated by an attempt to more closely approximate real-world information structures. The focus on parties' stakes serves the purpose to shift attention to the most specific concept-level determinant of conflict. And the efforts made in further specifying, defining, and measuring these stakes in the area of international trade seek to fill the concept of stakes with concrete meaning beyond the abstract conceptual level. These efforts are a precondition for generating and testing more detailed theoretical predictions and the results presented arise from this effort.

Figure C.1: Contributions of the study organized along the different sets of literatures



The results of this study have the potential to add to a deeper understanding of conflict processes both in general terms and with regard to trade disputes. In the following, I discuss the results of the study, theoretical as well as empirical, in light of their contributions to and implications for the existing literature and possible avenues for future research. The discussion is structured along the different sets of literatures that this study draws on and speaks to, as shown in Figure C.1. The figure is a modified version of Figure I.1 from the introduction to the study. As before, the circle in the top-right corner represents the work of the present study. The move of the circle to the north-west is intended to indicate the contribution of this study. The arrows, instead of signifying 'draws on', should now be read as 'contributes to'. This shift in interpretation is intended to reflect the fact that this study would not have been possible without the large body of existing knowledge in the literature, while the study's results add to this knowledge and suggest priorities to focus on in future research.

The bargaining literature on strikes, litigation, and war

Several implications for the theoretical bargaining literature on strikes, litigation, and war flow from the theoretical and conceptual work of this study. In particular, by pointing to the driving forces of escalation dynamics in bargaining under asymmetric information, this study sheds light on a central aspect of conflict processes that existing models of conflict do not capture – namely the logic of escalation processes. Furthermore, the study stresses the decisive role that the assumed form of uncertainty (one-sided versus two-sided) plays in generating model predictions about the conduct and outcomes of conflict. It further shows how one-sided uncertainty structures can lead to incorrect inferences if not interpreted with care. Lastly, the argument that parties' stakes should be the primary concept of interest in analyses of conflict has wider implications for both the interpretation of existing and the construction of new theoretical models as well as for empirical work. With regard to empirical work, the results of the study point to the vital role of a domain-specific *theory of preference formation* that allows researchers to assess the sources of parties' stakes. This requires a transition from an abstract concept level definition (i.e., stakes) to a more concrete sub-concept level understanding of how stakes come about in a given subject-area such as international trade. Doing so, is a precondition for successful applications of bargaining theory to empirical research.

Bargaining theory is a powerful tool for analyzing conflict behavior that has generated a great deal of insight into these processes in the past and holds considerable potential for further research. A major achievement of bargaining theory is that it has highlighted the previously unrecognized role of asymmetric information as precondition for conflict among rational actors. Another strength of bargaining theory is its potential for detailed and transparent analyses of conflict behavior that goes beyond what verbal theories can hope to produce in the context of complex strategic interactions. In order to reap this potential, however, it is necessary to construct models that are sufficiently close to the phenomenon under study to generate meaningful predictions. Put another way, the general insight that asymmetric information is a crucial precondition for conflict holds regardless of the specific model structure. Yet the usefulness of the resulting predictions is strongly dependent on the specific model structure.

A precondition for exploiting the full potential of bargaining theory, therefore, is to approximate the phenomenon of interest sufficiently well. With its proposed escalation mechanism and the two-sided uncertainty structure, this study moves in this direction and suggests an option for the literature to adapt or build on this proposal. Existing bargaining models in the three subject of strikes, litigation, and war have so far not taken escalation processes into account but have regarded conflict in a binary fashion as being either absent or present. This choice restricts the fit between the model and reality not only because binary outcomes are usually difficult to reconcile with empirical observations. It also implies that whenever conflict occurs, it occurs as an explosive one-shot event that does not permit escalation dynamics to take place. This necessarily obscures the sequential decision-making process of the parties and therefore makes it difficult to arrive at a deeper understanding of the parties' strategic calculus that drives their escalation behavior.

The importance of model specification is particularly relevant for the assumed information structure because this structure directly affects the predicted conduct and outcome of bargaining. A particular difficulty is that bargaining outcomes predicted by models of one-sided uncertainty – as typically employed in the study of conflict – cannot be directly interpreted. This pertains, in particular, to the one-sided screening process that predicts a monotonically declining 'concession function' by one party – which is therefore always the party that is losing over time. However, this prediction is a direct consequence of the informational assumptions. One-sided uncertainty models implicitly assume that the party that is losing over time is the weaker of the two sides and that this is common knowledge. These models thus only capture very specific scenarios that typically do not exist in reality. The predictions of these models therefore cannot be immediately applied to reality where parties operate under mutual uncertainty.

However, such predictions have been made in the literatures on both strikes and war (where larger empirical literatures exist). In the former case, the hypothesis is that one expects lower wages after longer strikes. In the latter case, the hypothesis is that initiators tend to end up with less favorable settlements after longer wars. The theoretical analysis of this study illustrates that these kinds of predictions are a direct result of the (unrealistic) assumption of one-sided uncertainty. These predictions, therefore, have no analogue in the real world. The present study has offered an analysis that more readily carries over to empirical reality. Instead of a unidirectional concession process, the two-sided selection process that underlies the bargaining dynamics in this study encompasses the full range of possible scenarios and therefore produces the entire set of bargaining outcomes (i.e., agreements) from complete loss to complete gain including the possibility of genuine compromise. This study has demonstrated how under the assumption of two-sided uncertainty, the average outcome will not unequivocally favor one side over time because *both* sides make concessions from opposite directions as the conflict wears on.

Apart from pointing towards the role of escalation dynamics and two-sided uncertainty, this study suggests an additional starting point for bargaining models to further enhance their analytical weight – namely the explicit modeling of parties' stakes. It has been a central point of this study that stakes matter in explaining conflict – and that they matter more than the concepts of *power* and *costs*. Conflict never arises simply because of parties' power relations or the potential costs they could inflict on each other. Conflict always is *about* something. Any analysis of conflict, therefore, requires an understanding not only of what the contented issue is, but, in particular, how much this issue is valued by each party. Engaging in such a cost-benefit analysis, however, requires a reliable assessment of the size of the parties' costs and benefits.

An important step in this direction would be to make parties stakes explicit in theoretical models of conflict. This is currently not the case, since existing models across disciplines implicitly assume both parties' stakes to be equal to 1. This makes these stakes merge with the (assumed) objective value of the issue at hand and thus makes the parties' stakes invisible in the representation of the model. It is worth noting that the implications of these assumptions are not necessarily less pronounced in the case of models of strikes and litigation where many of the disputes (potentially all disputes in labor-management relations) are about an issue that can be quantified in monetary units. Absolute dollar values are not necessarily more likely to reveal and adequately reflect the full importance of an issue to any of the actors in these fields – similar to how absolute trade values alone do not reveal the stakes of parties in international trade relations.

To understand parties' subjective valuations of an issue, one needs to understand the objective value of the issue in the larger context of the parties' environment. This implies that the study of conflict in any subject-area should be built on a domain-specific *theory of preference formation*. Such a theory should capture what makes different issues more or less important to the parties. It could thus provide a deeper understanding of both the subject-area and the parties in itself and at the same time guide efforts geared towards operationalization and measurement as important inputs for empirical work. The present study has sought to provide such a theory for the study of trade disputes to arrive at an understanding of how parties' stakes arise in this context. While it is beyond the scope of this study to offer such a theory for other subject-areas, it may have demonstrated that the effort is worthwhile.

The literature on trade disputes

This study further makes a number of contributions to existing research on trade disputes. These contributions fall into different categories. A first set of contributions regards the theoretical work on bargaining and conflict behavior, which suggests a new analytical lens for the investigation of trade disputes, which has so far been absent from this field of research. In this context, some of the points discussed in the previous subsection apply here as well. A second set of contributions relates to the subject-area specific theoretical and methodological work that enables the measurement of parties' stakes in industry-level trade relations. Finally, a third set of contributions relates to the datasets the study provides. These datasets contain the data on parties' stakes, the data on applied trade barriers (discussed in the next sub-section), and the data on the dispute histories of U.S. trade disputes.

Concerning the first set of contributions, the study not only introduces to the field the theoretical analysis of conflict behavior based on bargaining theory, which has benefited the study of conflict in other subject-areas for up to three decades. It also provides a detailed theoretical formulation that goes in important ways beyond existing models of conflict in other subject-areas and allows a direct application to the study of trade disputes. With this the study also introduces a greater focus on the role of strategic interactions under uncertainty into a field that has traditionally put little emphasis on these aspects, despite their central role in the processes under study. This new theoretical perspective on trade disputes may stimulate further research in this direction. Such a research agenda may well have the potential to substantially move forward the study of conflict processes in international trade and elsewhere.

Furthermore, the study provides a blueprint for measuring parties stakes' in their bilateral industry-level trade relations. As described above, the study proposes a theory of preference formation and a methodology derived from this theory in the context of trade disputes (and directly provides the resulting data on parties' stakes in the industry classification employed). Assessing and quantifying the importance that parties attach to their various trade relations in a systematic, comparable, and theory-guided manner has so far not been possible. Insofar, the proposed method closes an important gap that has posed challenges for research on trade disputes for decades. The method and data may be used directly as well as to compute a variety of summary statistics. In particular, the method may be used by researchers investigating participation patterns in the WTO to more reliably approximate the 'unbiased benchmark' required to assess the fairness of the Dispute Settlement system. In essence, the idea behind this benchmark is to provide an assessment of how many disputes a country *could* file based on the number of trade barriers it faces. Only if this benchmark is known, can one hope to assess whether developing countries file relative fewer disputes at the WTO than their more developed counterparts. The method could thus directly feed into the existing research agenda in this area.

In addition, the study provides an entirely new dataset on trade disputes. This dataset, derived from the U.S. National Trade Estimate (NTE) reports, contains information on the histories of thousands of disagreements and disputes over industry-level trade issues between the United States and its trade partners. With these properties, it is the most extensive dataset on trade disputes available and has the potential to open up an entirely new field of research on trade disputes. Although less broad in coverage than the WTO data because it only covers the U.S. export network, it is substantially more detailed and evades many of the observational and selection problems associated with the existing WTO data. The U.S. trade disputes dataset therefore holds the potential to become a central point of reference in the study of trade disputes – irrespective of whether the specific research interest lies in the general determinants of such dispute (as in this study), in specific products or product groups, in individual bilateral relationships, or in developments over time. It is thus a potentially invaluable new resource for scholars in the areas of international trade and international political economy who work on trade disputes, trade policy, and trade bargaining. Due to its detailed record of bargaining and escalation dynamics, the dataset may further be of interest to scholars studying bargaining behavior and conflict more generally.

The wider literature on international trade

Lastly, the study makes a contribution to the wider field of international trade (including but going beyond the study of trade disputes) through the provision of an extensive world-wide dataset on industry-level non-tariff trade barriers (NTBs) that covers 160 countries and more than 200 industries. These data thus provide a comprehensive overview of the pattern of applied trade protection around the world. This constitutes an important step forward towards systematically investigating trade policies around the world, given that reliable data on applied protection levels are currently not available. This is true, in particular, for NTBs that make up the bulk of trade policy tools, given the increasingly tight regulations on tariffs through international trade agreements.

These data are an important requirement in any trade policy analysis and are therefore likely to be of interest to scholars and practitioners alike. Potential applications include assessing export growth and market potentials, conducting welfare analyses of trade policy choices, creating predictions and scenarios expected from possible policy changes, and setting of negotiation priorities. The usefulness of the data may also generate further interest in the use and refinement of the estimation method employed. Thus, the data can stimulate additional research on the detection and measurement of applied trade barriers.

Implications for Policy-Making and Conflict Management

The remainder of this concluding section offers a number of suggestions on how the results of this study may help to inform policy processes and contribute to effective conflict management. The sub-section focuses largely on disputes in the area of international trade but offers an outlook on implications for conflict in other areas. The discussion proceeds in several steps. It first briefly reviews the factors that affect conflict behavior based on the results of this study. It then indicates how knowledge of these factors can help foresee possible disputes and further asks which of these factors can be influenced to actively manage disputes. In this context, the discussion also identifies the, in part, conflicting interests of the immediately concerned countries and relevant third parties, such as international organizations. It points, in particular, to the options for third parties to anticipate, mitigate, and manage trade disputes. The discussion further highlights how these options may, in the long term, contribute to a more comprehensive reform of the rules for trade policy reporting.

Following the insights presented in this study, conflict intensity changes with a number of factors – given the general availability of an escalation option. First, conflict increases with (1) the lower of the parties' (relative) stakes. This is because the lower stakes party selects out of conflict first. Irrespective of which side does so, this ends the escalation process. Second, conflict increases with (2) the parties' absolute stakes, which anchors the parties' relative stakes on a fixed level of reference. In the context of trade disputes, this has been the total industry-level value of imports faced by the importer. Third, conflict decreases as (3) the costs of conflict increase relative to the combined effect of the parties' absolute and relative stakes. That is, higher relative escalation costs imply lower escalation levels – all else equal.

Fourth, conflict increases with (4) the level of uncertainty the parties face because under greater uncertainty, the parties take longer to come to an agreement. Lastly, by implication, conflict increases with (5) the rate of change in the parties' conflict-relevant characteristics and, in particular, their stakes. The rate of change matters for conflict behavior both because uncertainty will generally spread faster in quickly changing environments and because such environments are more likely to see parties' characteristics drift away from the status quo agreement. This then creates incentives to renegotiate in the context of uncertainty. Given that parties' stakes in international trade relations are strongly dependent on underlying economic fundamentals in the parties' respective domestic economic systems as well as in the international trade system, changes in these systems underlie changes in parties' stakes.

Adequate knowledge of these factors – both in terms of the mechanism through which they are connected and in terms of the values they take on in individual cases – is important to timely identify or mitigate emerging trade disputes as well as to effectively help alleviate disputes that have already erupted. International organizations such as the WTO and UNCTAD that work in the area of international trade could potentially play a more active role in this regard than is currently the case. However, such activities are already stalled by the widespread invisibility of applied trade barriers and the resulting difficulties in assessing countries' stakes. These difficulties are in large parts rooted in incentives of countries applying protectionist trade policy measures to reduce transparency to a minimum and thus make detection of such policies difficult. After all, the large variety and complexity of possible trade policy measures in combination with incentives to evade reporting and to obscure transparency is at the heart of the poor data quality on trade barriers and applied levels of protection (see: the discussion on these data sources, including the UNCTAD TRAINS database and the WTO Trade Monitoring Database, in Chapter 6).

Many developed countries, including the United States, have therefore implemented extensive monitoring schemes that rely on domestic industry reporting in order to identify foreign trade measures. Such schemes allow domestic exporters to provide information and file complaints relating to particular trade practices by other countries. However, these options are not available to international organizations (as well as to developing countries or the larger trade policy community). In order to be able to play an active role in dispute prevention and mitigation, international organizations need to be able to objectively and independently assess the size of applied trade barriers as well as the degree to which the underlying trade relations are prone to disagreements and open disputes.

The insights and methods presented in this study offer opportunities to increase the scope of action of international organizations in trade policy monitoring and dispute management – irrespective of existing budget and personnel constraints. These opportunities apply to both fact-finding and direct conflict management activities. Concerning the former, the methods to estimate the size of trade barriers and to assess the resulting trade interests of countries makes it possible to get an comprehensive overview of the international trade system in terms of broader risk levels. It is necessarily true that quantitative methods cannot replace case knowledge in policy contexts where issues are dealt with on a case-by-case basis. However, the methods provided allow for a systematic identification of priority areas and can efficiently guide case selection for further qualitative research and selective in-depth investigations. In combination with a regard to the rate of change in the relevant fundamentals, such efforts may hold the potential for building up a systematic monitoring and early warning system.

These fact-finding options largely rest on a subset of the factors affecting conflict intensity as listed above, namely on parties' stakes (factors 1 and 2) and on the rate of change (factor 5). These happen to be the factors that are observable but difficult to influence directly. In contrast, the degree of uncertainty surrounding the parties' interaction (factor 4) and the parties' costs (factor 3) are more difficult to observe but can – at least to some degree – be influenced. This provides the basis for a second set of opportunities for international trade organizations relating to active conflict prevention and management measures. Based on initial fact-finding results, the trade organizations could specifically request further information on individual trade policies, or promote and encourage active communication between countries on specific policies, or actively attempt to mediate in selected cases. These efforts would collectively serve the purpose to share information and increase transparency. Essentially, all these efforts would aim at reducing uncertainty by means other than conflict – and thus limit the potential for costly disputes to emerge or escalate. This would ultimately free resources that countries could dedicate to more productive goals.

Alternatively (or complementarily), fact-finding results could be used to unilaterally disseminate information on trade policies in a naming-and-shaming manner. This approach would aim at increasing countries' reputational and political costs associated with protectionist trade measures and thereby seek to discourage policies that may result in disputes. Note that instead of directly affecting parties' overall costs of conflict, costs resulting from this strategy would selectively increase the costs associated with the underlying industry-level policy. These costs affect the importer's decision-making rationale *prior to* conflict. A naming-and-shaming approach can therefore also be seen as an effort to *in*directly affect parties' stakes through the costs associated with the contentious policy (recall that the level of the importer's trade protection affect *both* parties' stakes).

In the long-term, these activities may support a wider reform of the international trade policy reporting system – away from the current voluntary registration scheme and towards a fully institutionalized and binding reporting mechanism. Such a system may still allow exceptions and reward transparency through legally sanctioned transitional periods and other escape clauses that have proved to be effective in previous efforts towards trade policy governance (e.g., tariff-binding schemes or the reporting and implementation rules for anti-dumping, countervailing duties, and safeguards). Ultimately, such a system would increase transparency and predictability and thus help reduce the incidence and severity of trade disputes.

The general idea of the conflict management process just outlined for trade disputes extends to other subject-areas as well. A precondition for successful management of conflict processes is a sound understanding of the mechanism underlying these processes. Based on theoretical knowledge of relevant factors and their interrelations, potential conflict managers can identify needs for additional information, perform risk assessments, and set priorities for direct involvement. This holds regardless of whether these conflict managers take the form of public officials who seek to facilitate agreement in labor disputes, legal experts who seek to help potential litigants to arrive at an out-of-court settlement, or third country representatives who seek to mediate in regional or international conflicts.

In any of these situations, theoretical knowledge enables conflict managers to *know where to look*. Once concrete cases for direct action are identified, theoretical knowledge also enables conflict managers to *know what can be tweaked*. This may not be obvious from the specific situation alone, where the intricate nature and idiosyncratic features of the case can obstruct the view on the aspects of greatest importance. Theoretical knowledge can help conflict managers to see through these complexities. In combination with subject-area specific knowledge, a profound theoretical understanding of conflict processes therefore provides an important precondition for both short-term conflict management and long-term institution-building and norm-setting efforts. In other words, theoretical knowledge is a precondition for mitigating circumstances that make it rational for parties to engage in conflict and thereby helps avoid the social costs associated with conflict. By adding to the theoretical knowledge of conflict processes, this study hopes to facilitate a development in this direction.

Appendix I – Automated Content Analysis: Industry Classification and Dictionaries

The following tables list the full set of dictionaries used in the automated content analysis (ACA) procedure as described in Chapter [?]. Unlike the selected dictionary entries presented in this chapter, the tables below show the search terms as the regular expressions (in POSIX format) as implemented in the procedure. The sequences _A_' and '_N_' represent the logical AND and NOT operators, '_A_' followed by blanks means 'AND anything' and is implemented in this fashion only to standardize the search term format. Further, '|' represents the logical OR operator, '^' and '$' mark the ends and beginnings or words and are 'reverse wildcards'. For instance, a regex search for 'ban' also finds 'banana' or 'broadband', while a search for '^ban$' does not.

In the *products* dictionary, the search terms record additional information about the fit of the verbal product description. This is reflected by the letters S, M, and L that are appended to the search terms. For instance, verbal references to *mandarins* are matched to the product category 'citrus', of which mandarins are only a small subset. Mandarins are therefore marked with the letter S. verbal references to 'grapes', in contrast, are matched to the equally named product category and marked with an M. Verbal references to 'textiles' concern more than one product category. The search term 'textiles' is therefore marked with an L. The number following the L indicates the number of product categories across which *textiles* are spread out. Ideally, all search terms would belong to the M category and perfectly match the theoretical/conceptual product classification. This objective generally not attainable when working with natural language text sources. However, as noted in chapter [?], the mixed product classification used in this study has been chosen primarily to maximize the fit between the level of detail in the verbal references of the NTE reports and the conceptual product categories used in the ACA routine.

Table A.I.1: NTE automated content analysis dictionary – Type of trade barrier

<table>
<tr><th>Code</th><th>Description</th><th>Search terms</th></tr>
<tr><td>T</td><td>Tariffs</td><td>^tariff$_N_quota|rebate|remission
tariffs_N_general$|rebate|remission
duties_N_counter|safe|rebate|remission
duty_N_counter|safe|free|rebate|remission</td></tr>
<tr><td>A5</td><td>Treatment for elimination of plant and animal pests and disease-causing organisms</td><td>fumigation_A_
irradiation_A_
fumigat_A_
irradiat_A_</td></tr>
<tr><td>AB1</td><td>Prohibitions/restrictions of imports for objectives set out in the SPS/TBT agreement</td><td>prohibition_A_
prohibits_A_
prohibited_A_
restriction_A_
ban$_A_
bans_A_
bann_A_</td></tr>
<tr><td>AB2</td><td>Tolerance limits for residues and restricted use of substances</td><td>tolarance_A_limit
ecolabel_A_
eco-label_A_
pesticide_A_residue
aftatoxin limits_A_
maximum_A_residue</td></tr>
</table>

		tolerance_A_
AB3	Labeling, marking and packaging requirements	label_A_requirement labels_A_ labeling_A_ labelling_A_ marking_A_ packag_A_require geographical_A_indications
AB4	Hygienic requirements	shelf-life_A_ shelf life_A_ shelflife_A_
AB7	Product-quality or -performance requirement	performance_A_require standards_A_product safety_A_regulation|standard|requirement|certificat|control
AB8	Conformity assessment related to SPS/TBT	inspection_N_pre-shipment|PSI quarantine_A_ testing_A_ tests_A_ certification_N_origin|safety certificate_N_origin|safety conformity assessment_A_ registration_A_ quality_A_license|control|inspection|assurance|standard approval_N_investment
C1	Pre-shipment inspection	pre-shipment_A_ PSI_A_ preshipment_A_
C2	Direct consignment requirement	direct consignment_A_
C3	Requirement to pass through specified port of customs	costums_A_handling costums_A_port
C4	Import-monitoring and -surveillance requirements and other automatic licensing	monitor_A_import
C9	Other formalities, n.e.s.	customs_A_barrier|practice|procedure|processing|clearance clearance_A_import documentation_A_require
D1	Antidumping measure	antidumping_A_ anti-dumping_A_ dumping_A_
D2	Countervailing measure	counterveiling_A_ countervail_A_ counterveiling duty_A_ counterveiling duties_A_ counterveiling levy_A_ counterveiling levies_A_ counterveiled_A_
D3	Safeguard measures	safeguard_A_ safe-guard_A_
E1	Non-automatic import-licensing procedures other than authorizations for SPS or TBT reasons	import_A_licens import_A_authorization import_A_permi import_A_control licens_A_requirement|system|policy|scheme
E2	Quotas	^quota_N_tariff-rate|TRQ|local
E3	Prohibitions other than for SPS and TBT reasons	prohibition_A_ prohibits_A_

		prohibited_A_ ban$_A_ bans_A_ ^bann_A_ restriction_N_quant|licens import restriction_N_licens
E6	Tariff-rate quotas (TRQ)	rate quota_A_ rate-quota_A_ TRQ_A_
E9	Quantity control measures, n.e.s.	negative_A_list quantitative restrictions_A_ QRs_A_ supply manage_A_
EC	Electronic commerce	commerce_A_electronic
F1	Administrative measures affecting customs value (Minimum import prices, reference prices, etc.)	minimum import_A_price|value minimum_A_price price_A_transparency import_A_price
F3	Variable charges	price band_A_ variable levies_A_ variable levy_A_ variable charge_A_
F4	Customs surcharges	customs charge_A_ customs surcharge_A_ customs valuation_N_decree import_A_surcharge import_A_charge customs_A_classification
F5	Seasonal duties	seasonal_A_duties|duty|tariff|charge
F6	Additional taxes and charges levied in connection to services provided by the government	^fee$_A_ ^fees$_A_
F7	Internal taxes and charges levied on imports	^tax_N_export|sales|excise|value added ^VAT$_A_ ^levy_A_ ^levies_N_tax charges_N_import$ sales_A_tax value-added_A_tax excise_A_tax value added_A_tax
F8	Decreed customs valuations	customs valuation_A_decree
F9	Price-control measures, n.e.s.	pricing_A_ reference price_A_ price_A_control
G3	Regulation on official foreign exchange allocation	control_A_exchange
H1	State-trading enterprises, for importing; other selective import channels	state trading_A_ state trading_A_enterprise STEs_A_ monopoly_A_import liquor board_A_ wheat board_A_ commodity board_A_ board_A_state trading
H9	Measures affecting competition, n.e.s.	anticompetitive activit_A_

		anticompetitive_A_practice anti-competitive_A_activit anti-competitive_A_practice buy national_A_ monopol_A_ import-substitution_A_ import_A_substitution anti-import_A_ competition_A_policy competition_A_affecting
I1	Local content measures	local_A_content content_A_quota|requirement performance_A_export
I2	Trade-balancing measures	trade_A_balancing
I2	Trade-balancing measures	trade_A_balancing
J1	Geographical restriction	distribution_A_
J2	Restriction on resellers	marketing_A_
L	Subsidies (excluding export subsidies under P7)	subsidies_N_export|code subsidy_N_export|code support_A_domestic|internal|government discounts_A_domestic industr
M	government procurement restrictions	government_A_procurement procurement_A_agencies|agency|ministry|federal state|practices
N1	Patents	patent$_A_ patents_A_
N2	Copyrights	copyright_A_
N3	Trademarks	trademark_A_
O	Rules of origin	rules_A_origin country_A_origin verification_A_origin certificate_A_origin
P1	Export-license, -quota, - prohibition and other quantitative restrictions	export restraint _A_ export control_A_ export quota_A_ export license_A_ export barrier_A_ export regulation_A_
P3	Export price-control measures	export_A_price control export price_A_control
P5	Export taxes and charges	export tax_N_differential export_A_charge
P7	Export subsidies	export_A_subsidies export_A_subsidy differential_A_export tax rebate_A_ remission_A_ export_A_incentive|facilitation|encourag export_A_promotion promot_A_exports
P8	Export credits	credit_A_export
P9	Export measures, n.e.s.	export_A_documentation
S	Service barriers	service_A_barrier

Notes: 'Code' refers to UNCTAD NTMs classification, see: UNCTAD (2013, 2015) for details. The T category for tariffs has been added; the N category has been split into three subcategories.

Table A.I.2: NTE automated content analysis dictionary – Products

Code	Description	Search terms
H_0101	Live horses, asses, mules and hinnies	live horses-M-1_A_
		^asses$-S-1_A_
		hinnies-S-1_A_
H_0102	Live bovine animals	cattle-M-1_A_
		live bovine animals-M-1_A_
H_0103	Live swine	live swine-M-1_A_
		swine-M-1_A_
		^hogs$-M-1_A_
H_0104	Live sheep and goats	live sheep-M-1_A_
		live goats-M-1_A_
H_0105	Live poultry	live poultry-M-1_A_
H_0106	Other live animals	live rabbits-M-1_A_
		live hares-M-1_A_
H_0201	Meat of bovine animals	beef-M-1_A_
		bovine-S-1_A_
H_0203	Meat of swine	pork-M-1_A_
H_0204	Meat of sheep or goats	goat meat-M-1_A_
		of goats-M-1_A_
		lamb-M-1_A_
		mutton-M-1_A_
H_0205	Meat of horses, asses, mules or hinnies	meat of horses-M-1_A_
H_0206	Edible offal of bovine animals, swine, sheep, goats, horses	offal-M-1_A_
		tongues-M-1_A_
		^liver$-M-1_A_
H_0207	Meat and edible offal of poultry	poultry-M-1_A_
		chicken-M-1_A_
		broiler-M-1_A_
		chicks-M-1_A_
		turkeys-S-1_A_
H_0208	Other meat and edible meat offal	meat-M-1_A_rabbit
		meat-M-1_A_^hares
		meat-M-1_A_^hare$
H_0209	Pig fat, free of lean meat, and poultry fat	pig fat-L-2_A_
		poultry fat-L-2_A_
H_0210	Meat and edible meat offal, salted	^ham$-M-1_A_
		^hams$-M-1_A_
		^bacon$-M-1_A_
H_0391	Salmon	salmon$-M-1_A_
		salmon\}-M-1_A_
		salmon,-M-1_A_
H_0392	Sardines	sardine-M-1_A_
		herring-M-1_A_
H_0393	Scallops	shellfish$-M-1_A_
		scallops-M-1_A_
H_0394	Shrimps	shrimp-M-1_A_
H_0395	Tuna	^tuna-M-1_A_
		bonito-M-1_A_
H_0401	Milk and cream	milk-M-1_A_
H_0402	Milk and cream, concentrated	cream-M-1_N_ice
		condensed milk-M-1_A_
H_0403	Buttermilk, curdled milk and cream, yogurt	yoghurt-M-1_A_
		yogurt-M-1_A_
H_0404	Whey, whether or not concentrated	whey-M-1_A_

<table>
<tr><td>H_0405</td><td>Butter and other fats and oils derived from milk</td><td>butter-M-1_A_</td></tr>
<tr><td>H_0406</td><td>Cheese and curd</td><td>cheese-M-1_A_
^curd$-M-1_A_</td></tr>
<tr><td>H_0407</td><td>Birds' eggs, in shell</td><td>^egg-L-2_A_</td></tr>
<tr><td>H_0408</td><td>Birds' eggs, not in shell</td><td>^egg-L-2_A_</td></tr>
<tr><td>H_0409</td><td>Natural honey</td><td>honey-M-1_A_</td></tr>
<tr><td>H_0701</td><td>Potatoes</td><td>potatoes-M-1_N_processed|preserved|prepared</td></tr>
<tr><td>H_0702</td><td>Tomatoes</td><td>tomatoes-M-1_A_
tomato fruit-M-1_A_</td></tr>
<tr><td>H_0703</td><td>Onions, shallots, garlic, leeks</td><td>garlic-M-1_A_
onion-M-1_A_
shallots-M-1_A_</td></tr>
<tr><td>H_0704</td><td>Cabbages, cauliflowers, kohlrabi, kale</td><td>cabbage-M-1_A_
cauliflower-M-1_A_
broccoli-M-1_A_</td></tr>
<tr><td>H_0705</td><td>Lettuce</td><td>lettuce-M-1_A_
salad-M-1_A_</td></tr>
<tr><td>H_0706</td><td>Carrots, turnips, salad beetroot, etc.</td><td>carrot-M-1_A_</td></tr>
<tr><td>H_0707</td><td>Cucumbers and gherkins</td><td>cucumber-M-1_A_</td></tr>
<tr><td>H_0708</td><td>Leguminous vegetables</td><td>peas-M-1_N_processed|preserved|prepared
^pulses-L-2_A_</td></tr>
<tr><td>H_0709</td><td>Other vegetables</td><td>aubergines-S-1_A_
asparagus-S-1_A_
eggplant-S-1_A_
mushrooms-S-1_A_
spinach-S-1_A_</td></tr>
<tr><td>H_0710</td><td>Vegetables (uncooked or cooked by steaming or boiling)</td><td>potatoes-M-1_A_processed|preserved|prepared
^beans$-M-1_A_processed|preserved|prepared
^peas$-M-1_A_processed|preserved|prepared</td></tr>
<tr><td>H_0711</td><td>Vegetables provisionally preserved</td><td>olives-M-1_A_
capers-M-1_A_
onions-M-1_A_processed|preserved</td></tr>
<tr><td>H_0712</td><td>Dried vegetables, whole, cut, sliced, broken or in powder</td><td>potatoes-M-1_A_^cut$|sliced
mushroom$-L-2_A_</td></tr>
<tr><td>H_0713</td><td>Dried leguminous vegetables</td><td>^beans-M-1_N_processed|preserved|prepared
lentils-M-1_A_
chickpea-M-1_A_
^pulses-L-2_A_</td></tr>
<tr><td>H_0714</td><td>Manioc, Jerusalem artichokes, sweet potato</td><td>manioc-M-1_A_
cassava-M-1_A_</td></tr>
<tr><td>H_0801</td><td>Coconuts, Brazil nuts and cashew nuts</td><td>coconut-M-1_A_
cashew-M-1_A_
^nuts-L-2_A_</td></tr>
<tr><td>H_0802</td><td>Other nuts</td><td>almond-M-1_A_
pistachio-M-1_A_
pecans-S-1_A_
hazelnut-S-1_A_
walnut-S-1_A_
^nuts-L-2_A_</td></tr>
<tr><td>H_0803</td><td>Bananas</td><td>banana-M-1_A_</td></tr>
<tr><td>H_0804</td><td>Dates, figs, pineapples, avocados, guavas, mangoes and mango</td><td>avocado-M-1_A_
mango-M-1_A_
pineapple-M-1_A_</td></tr>
<tr><td>H_0805</td><td>Citrus fruit</td><td>citrus-M-1_A_
orange-M-1_A_</td></tr>
</table>

		grapefruit-M-1_A_
		lemon-M-1_A_
		^limes-S-1_A_
		mandarins-S-1_A_
H_0806	Grapes	grapes-M-1_A_
		^raisin$-S-1_A_
		^raisins$-S-1_A_
H_0807	Melons, papayas	melons-M-1_A_
		papaya-M-1_A_
H_0808	Apples, pears and quinces	apple-M-1_A_
		^pear$-M-1_A_
		^pears-M-1_A_
H_0809	Apricots, cherries, peaches (including nectarines), plums an	stone fruit-M-1_A_
		stonefruit-M-1_A_
		apricot-M-1_A_
		cherries-M-1_A_
		cherry-M-1_A_
		peach-M-1_A_
		nectarine-M-1_A_
		clementine-S-1_A_
		plum-S-1_A_
H_0810	Other fruit	kiwi-M-1_A_
		berries-M-1_A_
H_0811	Fruit and nuts, uncooked or cooked	berries-M-1_A_frozen
		nuts-M-1_A_frozen
H_0813	Fruit, dried	dried fruit-M-1_A_
H_0901	Coffee	coffee-M-1_N_instant
H_0902	Tea	^tea$-M-1_A_
		^teas$-M-1_A_,
H_0903	Maté	^mate$-M-1_A_
H_0904	Pepper	red pepper-M-1_A_
H_0905	Vanilla	vanilla-M-1_A_
H_0906	Cinnamon	cinnamon-M-1_A_
H_0907	Cloves	cloves-M-1_A_
H_0908	Nutmeg, mace and cardamoms	nutmeg-M-1_A_
		^mace$-M-1_A_
		cardamoms-M-1_A_
H_0909	Seeds of anise, badian, fennel, coriander, cumin	anise-M-1_A_
		badian-S-1_A_
		fennel-S-1_A_
		coriander-M-1_A_
		^cumin-M-1_A_
H_0910	Ginger, saffron, turmeric (curcuma), thyme, etc.	ginger-M-1_A_
H_1001	Wheat and meslin	wheat-M-1_A_
H_1002	Rye	rye-M-1_A_
H_1003	Barley	barley-M-1_A_
H_1004	Oats	^oats-M-1_A_
H_1005	Maize (corn)	^corn$-M-1_N_grits|broom
		^com$-M-1_N_grits|broom
		^corn-S-1_A_grits
		^com$-S-1_A_grits
		maize-M-1_A_
H_1006	Rice	^rice-M-1_A_
		paddy-M-1_A_
H_1007	Grain sorghum	sorghum-M-1_A_

H_1008	Buckwheat	buckwheat-M-1_A_
H_1101	Wheat or meslin flour	wheat flour-M-1_A_ flour-M-1_N_potato|rice
H_1102	Cereal flours other than of wheat or meslin	rice flour-M-1_A_ corn flour-M-1_A_ maize flour-M-1_A_
H_1104	Cereal grains otherwise worked	cereal-M-1_N_breakfast
H_1105	Flour, meal, powder, flakes, granules and pellets of potatoes	potato$-M-1_A_flake potato$-M-1_A_meal potato$-M-1_A_flour
H_1106	Flour, meal and powder of dried leguminous vegetables	vegetable flour-M-1_A_
H_1108	Starches, inulin	starch-M-1_A_
H_1109	Wheat gluten	gluten-M-1_A_wheat
H_1201	Soya beans	soybeans-M-1_A_ soybean-M-1_N_meal|oil soya-M-1_A_
H_1202	Ground-nuts	groundnuts-M-1_A_ peanut-M-1_A_
H_1203	Copra	copra-M-1_A_
H_1204	Linseed	linseed-M-1_A_
H_1205	Rape or colza seeds	rapeseed-M-1_A_
H_1206	Sunflower seeds	sunflower seeds-M-1_A_
H_1207	Other oil seeds and oleaginous fruits	sesame seed-M-1_A_ mustard seed-M-1_A_ cotton seed-M-1_A_ poppy seed-M-1_A_
H_1208	Flours and meals of oil seeds or oleaginous fruits	soybean meal-M-1_A_ soybean-L-2_A_products
H_1404	Vegetable products not elsewhere specified	cotton linter-M-1_A_
H_1501	Pig fat (including lard) and poultry fat	pig fat-L-2_A_ poultry fat-L-2_A_
H_1502	Fats of bovine animals, sheep or goats	fats-M-1_A_bovine|sheep|goat
H_1503	Lard stearin, lard oil	tallow-L-2_A_ ^lard-M-1_A_ ^oleo-M-1_A_
H_1506	Other animal fats and oils and their fractions	tallow-L-2_A_
H_1507	Soya-bean oil and its fractions	soybean oil-M-1_A_ soyoil-M-1_A_ soybean-L-2_A_products
H_1508	Ground-nut oil and its fractions	groundnut oil-M-1_A_ peanut oil-M-1_A_
H_1509	Olive oil and its fractions	olive oil-L-2_A_
H_1510	Other oils and their fractions	olive oil-L-2_A_
H_1511	Palm oil and its fractions	palm oil-M-1_A_
H_1512	Sunflower-seed, safflower or cotton-seed oil	cotton seed oil-M-1_A_ cotton oil-M-1_A_ sunflower oil-M-1_A_ sunflower seed oil-M-1_A_
H_1513	Coconut (copra), palm kernel oil	palm oil-M-1_A_
H_1514	Rape, colza or mustard oil and fractions thereof	rapeseed oil-M-1_A_ colza oil-M-1_A_
H_1516	Animal or vegetable fats and oils	animal fats-M-1_A_

		vegetable fats-M-1_A_ vegetable and animal fats-M-1_A_ animal and vegetable fats-M-1_A_
H_1517	Margarine	margarine-M-1_A_
H_1522	Degras	degras-M-1_A_
H_1601	Sausages and similar products of meat	sausage-M-1_A_
H_1603	Extracts and juices of meat, fish or crustaceans	juices of fish-M-1_A_ juices of meat-M-1_A_
H_1701	Cane or beet sugar and chemically pure sucrose	sugar-M-1_A_^cane$\|^beet$
H_1703	Molasses	sugar-M-1_A_molasses
H_1704	Sugar confectionery (including white chocolate)	confectionary-M-1_A_ candy-M-1_A_ ^sweets$-M-1_A_ confectioneries-M-1_A_ confectionery-M-1_A_ confections-M-1_A_
H_1801	Cocoa beans	cocoa beans-M-1_A_
H_1803	Cocoa paste	cocoa paste-M-1_A_
H_1804	Cocoa butter, fat and oil	cocoa butter-M-1_A_
H_1805	Cocoa powder containing added sugar	cocoa powder-M-1_A_
H_1806	Chocolate and other food preparations containing cocoa	chocolate-M-1_A_
H_1903	Tapioca and substitutes therefore	tapioca-M-1_A_
H_1904	Prepared foods obtained by the swelling or roasting of cereals	breakfast cereals-M-1_A_
H_2001	Vegetables, fruit, nuts and other edible parts of plants, preserved	gherkins-M-1_A_
H_2002	Tomatoes prepared or preserved	tomato$-M-1_N_fruit
H_2003	Mushrooms and truffles, prepared or preserved	mushroom$-L-2_A_
H_2004	Other vegetables prepared or preserved	potato-M-1_A_frozen|prepared|preserved
H_2006	Vegetables, fruit, nuts, fruit-peel	fruit peel-M-1_A_
H_2007	Jams, fruit jellies, marmalades, fruit or nut purée	^jam-M-1_A_ jellies-M-1_A_ marmalade-M-1_A_
H_2008	Fruit, nuts and other edible parts of plants, otherwise prepared	fruit-M-1_A_processed|preserved|canned
H_2009	Fruit juices	orange juice-M-1_A_ apple juice-M-1_A_ grape juice-M-1_A_ juices-M-1_A_ juice$-M-1_N_orange|apple|grape
H_2101	Extracts, essences and concentrates, of coffee, tea or maté	coffee-M-1_A_instant
H_2103	Sauces and preparations therefore	sauce-M-1_A_ ketchup-M-1_A_ soya sauce-M-1_A_ mustard-M-1_N_seed|oil
H_2105	Ice cream	ice cream-M-1_A_
H_2106	Food preparations not elsewhere specified	protein concentrates-M-1_A_ protein-M-1_A_powder|shake
H_2301	Flours, meals and pellets, of meat or	meat flour-M-1_A_

<table>
<tr><td></td><td>meat offal</td><td>meals of meat-M-1_A_</td></tr>
<tr><td>H_2304</td><td>Oil-cake and other solid residues, etc.</td><td>oil cake-L-3_A_</td></tr>
<tr><td>H_2305</td><td>Oil-cake and other solid residues, etc.</td><td>oil cake-L-3_A_</td></tr>
<tr><td>H_2306</td><td>Oil-cake and other solid residues, etc.</td><td>oil cake-L-3_A_</td></tr>
<tr><td>H_3501</td><td>Casein</td><td>^casein-M-1_A_</td></tr>
<tr><td>H_3502</td><td>Albumins</td><td>albumins-M-1_A_</td></tr>
<tr><td>H_4101</td><td>Raw hides and skins of bovine or equine animals</td><td>hides and skins-M-1_A_
hides-M-1_N_hides and skins
skins-M-1_N_hides and skins</td></tr>
<tr><td>H_4102</td><td>Raw skins of sheep or lambs</td><td>hides and skins-M-1_A_lamb|sheep</td></tr>
<tr><td>H_5201</td><td>Cotton</td><td>cotton-M-1_N_seed|linter</td></tr>
<tr><td>I_0111</td><td>Growing of cereals and other crops</td><td>^grain$-M-1_N_rice|short|long|steel
oilseed-M-1_A_
oil seed-M-1_A_</td></tr>
<tr><td>I_0112</td><td>Growing of vegetables</td><td>vegetable-M-1_N_oil|juice|fat|processed|preserved</td></tr>
<tr><td>I_0113</td><td>Growing of fruit, nuts</td><td>^fruit-M-1_N_dried|stone|citrus|kiwi|juice|preserved|canned|dried|such|including|cocktail|tomato|fly|flies|worm|growers|industry|bore|bear</td></tr>
<tr><td>I_0121</td><td>Farming of cattle, sheep, goats</td><td>livestock-L-2_A_
live-stock-L-2_A_
live animals-L-2_A_
animal farming-L-2_A_</td></tr>
<tr><td>I_0122</td><td>Other animal farming</td><td>livestock-L-2_A_
live-stock-L-2_A_
live animals-L-2_A_
animal farming-L-2_A_</td></tr>
<tr><td>I_0200</td><td>Forestry, logging and related services</td><td>^logs-L-2_A_
logging-M-1_A_
lumber-L-2_A_
softwood-L-2_A_
wood-L-2_N_packag
timber-L-2_A_
forestry-M-1_A_
forest products-L-2_A_</td></tr>
<tr><td>I_0500</td><td>Fishing</td><td>fish$-L-2_A_
seafood-L-2_A_
aquaculture-L-2_A_
aqua-culture-L-2_A_
fishing-L-2_A_</td></tr>
<tr><td>I_1010</td><td>Mining and agglomeration of hard coal</td><td>coal$-M-1_A_</td></tr>
<tr><td>I_1020</td><td>Mining and agglomeration of lignite</td><td>lignite-M-1_A_</td></tr>
<tr><td>I_1030</td><td>Extraction and agglomeration of peat</td><td>^peat$-M-1_A_</td></tr>
<tr><td>I_1110</td><td>Extraction of crude petroleum</td><td>crude petroluem-M-1_A_
crude oil-M-1_A_
oil-M-1_A_gas$|petroleum|industr|sector|extraction|exploration|exploitation
gas$-M-1_A_oil|petroleum|natural|extraction|exploration|exploitation</td></tr>
<tr><td>I_1200</td><td>Mining of uranium and thorium ores</td><td>uranium-M-1_A_^mining</td></tr>
<tr><td>I_1310</td><td>Mining of iron ores</td><td>iron ore-M-1_A_</td></tr>
</table>

I_1320	Mining of non-ferrous metal ores	rare earth-M-1_A_ aluminum ore-M-1_A_ bauxite-S-1_A_ copper ore-S-1_A_ zinc ore-S-1_A_ lead ore-S-1_A_ nickel ore-S-1_A_ precious metals-M-1_A_ ^tin ore-S-1_A_
I_1410	Quarrying of stone, sand and clay	sand-M-1_A_^mining|quarry stone-M-1_A_^mining|quarry clay-M-1_A_^mining|quarry
I_1421	Mining of chemicals and fertilizer	suplhur-S-1_A_^mining|quarry guano-S-1_A_^mining|quarry baryte-S-1_A_^mining|quarry borate-S-1_A_^mining|quarry kieserite-S-1_A_^mining|quarry fluorspar-S-1_A_^mining|quarry
I_1422	Extraction of salt	salt-M-1_A_^mining|quarry
I_1429	Other mining and quarrying n.e.c.	diamond-M-1_A_^mining|quarry ^gem-M-1_A_^mining|quarry gems-M-1_A_^mining|quarry precious stone-M-1_A_^mining
I_1511	Processing/preserving of meat	meat-M-1_A_
I_1512	Processing/preserving of fish	fish$-L-2_A_ seafood-L-2_A_ fish product-M-1_A_ fish-M-1_A_prepar|preserved|canned
I_1513	Processing/preserving of fruit & vegetables	fruit-M-1_A_prepar vegetable-M-1_A_processed|preserved
I_1514	Vegetable and animal oils and fats	^edible oil-M-1_A_ vegetable oil-M-1_A_ animal oil-M-1_A_ vegetable fat-M-1_A_ animal fat-M-1_A_
I_1520	Dairy products	dairy-M-1_A_
I_1531	Grain mill products	grain product-M-1_A_ mill product-M-1_A_
I_1532	Starches and starch products	glocuse-M-1_A_pure|syrup corn oil-M-1_A_ ^inulin-M-1_A_
I_1533	Prepared animal feeds	animal feed-M-1_A_ pet food-M-1_A_ feed preparation-M-1_A_
I_1541	Bakery products	bakery-M-1_A_ baked-M-1_A_ bakeries-M-1_A_ biscuits-S-1_A_ ^bread-S-1_A_ cake-S-1_A_ cookies-S-1_A_ cracker-S-1_A_
I_1542	Sugar	sugar-M-1_A_
I_1543	Cocoa, chocolate and sugar confectionery	cocoa-M-1_N_paste|butter|powder|beans
I_1544	Macaroni, noodles & similar	macaroni-M-1_A_

<table>
<tr><td></td><td>products</td><td>pasta-M-1_A_</td></tr>
<tr><td></td><td></td><td>noodles-M-1_A_</td></tr>
<tr><td>I_1549</td><td>Other food products n.e.c.</td><td>soups-M-1_A_</td></tr>
<tr><td></td><td></td><td>pizza-M-1_A_</td></tr>
<tr><td></td><td></td><td>prepared meal-M-1_A_</td></tr>
<tr><td>I_1551</td><td>Distilling, rectifying & blending of spirits</td><td>distilled spirits-M-1_A_</td></tr>
<tr><td></td><td></td><td>spirits-M-1_N_disti</td></tr>
<tr><td></td><td></td><td>liquor-M-1_A_</td></tr>
<tr><td></td><td></td><td>liqueur-M-1_A_</td></tr>
<tr><td></td><td></td><td>whiskey-S-1_A_</td></tr>
<tr><td></td><td></td><td>whisky-S-1_A_</td></tr>
<tr><td></td><td></td><td>bourbon-S-1_A_</td></tr>
<tr><td></td><td></td><td>tequila-S-1_A_</td></tr>
<tr><td></td><td></td><td>cognac-S-1_A_</td></tr>
<tr><td></td><td></td><td>vodka-S-1_A_</td></tr>
<tr><td></td><td></td><td>^rum$-S-1_A_</td></tr>
<tr><td></td><td></td><td>^rum,-S-1_A_</td></tr>
<tr><td></td><td></td><td>^gin$-S-1_A_</td></tr>
<tr><td></td><td></td><td>^gin,-S-1_A_</td></tr>
<tr><td></td><td></td><td>brandies-S-1_A_</td></tr>
<tr><td></td><td></td><td>brandy-S-1_A_</td></tr>
<tr><td></td><td></td><td>beverage-L-3_A_alcoholic</td></tr>
<tr><td>I_1552</td><td>Wines</td><td>^wine-M-1_A_</td></tr>
<tr><td></td><td></td><td>champagne-M-1_A_</td></tr>
<tr><td></td><td></td><td>beverage-L-3_A_alcoholic</td></tr>
<tr><td>I_1553</td><td>Malt liquors and malt</td><td>beer-M-1_A_</td></tr>
<tr><td></td><td></td><td>malt liquor-M-1_A_</td></tr>
<tr><td></td><td></td><td>beverage-L-3_A_alcoholic</td></tr>
<tr><td>I_1554</td><td>Soft drinks; mineral waters</td><td>soft drink-M-1_A_</td></tr>
<tr><td></td><td></td><td>mineral water-M-1_A_</td></tr>
<tr><td></td><td></td><td>nonalcoholic-M-1_A_beverage</td></tr>
<tr><td></td><td></td><td>non-alcoholic-M-1_A_beverage</td></tr>
<tr><td></td><td></td><td>^cola-M-1_A_</td></tr>
<tr><td></td><td></td><td>energy drinks-M-1_A_</td></tr>
<tr><td></td><td></td><td>beverage-M-1_N_alcoholic|beer|wine|spirit</td></tr>
<tr><td>I_1600</td><td>Tobacco products</td><td>cigarette-M-1_A_</td></tr>
<tr><td></td><td></td><td>cigar-M-1_A_</td></tr>
<tr><td></td><td></td><td>tobacco-M-1_N_mold</td></tr>
<tr><td>I_1711</td><td>Textile fiber preparation; textile weaving</td><td>textile-L-7_A_sector|industr|product|good</td></tr>
<tr><td></td><td></td><td>textiles-L-7_A_</td></tr>
<tr><td></td><td></td><td>TCF-L-9_A_</td></tr>
<tr><td></td><td></td><td>yarn-M-1_A_</td></tr>
<tr><td></td><td></td><td>fibre-M-1_A_</td></tr>
<tr><td>I_1712</td><td>Finishing of textiles</td><td>textile-L-7_A_sector|industr|product|good</td></tr>
<tr><td></td><td></td><td>textiles-L-7_A_</td></tr>
<tr><td></td><td></td><td>TCF-L-9_A_</td></tr>
<tr><td></td><td></td><td>fabric-M-1_A_fiber|yarn|apparel|textile|woven</td></tr>
<tr><td></td><td></td><td>denim-S-1_A_</td></tr>
<tr><td>I_1721</td><td>Made-up textile articles, except apparel</td><td>textile-L-7_A_sector|industr|product|good</td></tr>
<tr><td></td><td></td><td>textiles-L-7_A_</td></tr>
<tr><td></td><td></td><td>TCF-L-9_A_</td></tr>
<tr><td></td><td></td><td>linen-M-1_A_</td></tr>
<tr><td></td><td></td><td>curtains-S-1_A_</td></tr>
<tr><td></td><td></td><td>sheet-M-1_A_textile|bed|fabric|woven|cotton</td></tr>
<tr><td>I_1722</td><td>Carpets and rugs</td><td>textile-L-7_A_sector|industr|product|good</td></tr>
<tr><td></td><td></td><td>textiles-L-7_A_</td></tr>
</table>

		TCF-L-9_A_ ^rugs-M-1_A_ carpets-M-1_A_
I_1723	Cordage, rope, twine and netting	textile-L-7_A_sector|industr|product|good textiles-L-7_A_ TCF-L-9_A_ ^rope$-M-1_A_ ^rope,-M-1_A_ ^ropes-M-1_A_
I_1729	Other textiles n.e.c.	textile-L-7_A_sector|industr|product|good textiles-L-7_A_ TCF-L-9_A_
I_1730	Knitted and crocheted fabrics and articles	textile-L-7_A_sector|industr|product|good textiles-L-7_A_ TCF-L-9_A_ textile-M-1_A_^knit$|knitted|crochet
I_1810	Wearing apparel, except fur apparel	apparel-M-1_A_ clothing-M-1_A_ clothes-M-1_A_ garment-M-1_A_ TCF-L-9_A_
I_1820	Dressing & dyeing of fur; processing of fur	^fur$-M-1_A_ ^furs-M-1_A_
I_1911	Tanning and dressing of leather	leather-M-1_A_
I_1912	Luggage, handbags, etc.; saddlery & harness	^bags-M-1_A_ purses-M-1_A_ backpacks-M-1_A_ upholstery-M-1_A_
I_1920	Footwear	footwear-M-1_A_ shoe-M-1_A_ footware-M-1_A_ TCF-L-8_A_
I_2010	Sawmilling and planning of wood	^logs-L-2_A_ lumber-L-2_A_ softwood-L-2_A_ wood-L-2_N_packag forest products-L-2_A_ building materials-M-1_A_ timber-L-2_A_ wood products-L-2_A_
I_2021	Veneer sheets, plywood, particle board, etc.	plywood-M-1_A_ veneer-M-1_A_ wood products-L-2_A_
I_2022	Builders' carpentry and joinery	carpentry-M-1_A_
I_2023	Wooden containers	wooden-M-1_A_boxes|container
I_2029	Other wood products; articles of cork/straw	cork-M-1_A_
I_2101	Pulp, paper and paperboard	^paper$-M-1_N_photograph|draft|discussion|white|reference|working|electronic|policy|consultation|propse|outlin|sketch|state ^paper,-M-1_N_draft|discussion|white|reference|working|electronic|policy|consultation|propse|outlin|sketch|state craft paper-M-1_A_ paper-M-1_A_product|good kraftpaper-M-1_A_

		kraft-paper-M-1_A_ kraft paper-M-1_A_
I_2102	Corrugated paper and paperboard	carton-M-1_A_ card board-M-1_A_ paper-board-M-1_A_ paperboard-M-1_A_ paper board-M-1_A_
I_2109	Other articles of paper and paperboard	post card-L-2_A_ postcard-L-2_A_ serviette-M-1_A_ napkins-M-1_A_
I_2211	Publishing of books and other publications	book-L-2_A_ literary-L-2_A_ printed material-L-2_A_ printed matter-L-2_A_ printed work-L-2_A_
I_2212	Publishing of newspapers, journals, etc.	magazine-L-2_A_ journals-L-2_A_ newspaper-L-2_A_ newsprint-L-2_A_ periodicals-L-2_A_ brochures-L-2_A_ print media-L-2_A_ printed material-L-2_A_ printed matter-L-2_A_ printed work-L-2_A_ publishing-L-2_A_media|print publications-L-2_N_official
I_2213	Publishing of recorded media	audio-L-2_N_equipment|service|broadcast music-L-2_N_equipment|instrument phonograph record-L-2_A_ sound record-L-2_A_ recording-L-2_N_sound|music|maintain|keep|produce compact-disc-L-2_A_ compact disc-L-2_A_ song-L-2_A_
I_2219	Other publishing	post card-L-2_A_ postcard-L-2_A_ art work-L-2_A_reprod artwork-L-2_A_reprod
I_2221	Printing	book-L-2_A_ literary-L-2_A_ printed material-L-2_A_ printed matter-L-2_A_ printed work-L-2_A_ magazine-L-2_A_ journals-L-2_A_ newspaper-L-2_A_ newsprint-L-2_A_ periodicals-L-2_A_ brochures-L-2_A_ print media-L-2_A_ printed material-L-2_A_ printed matter-L-2_A_ printed work-L-2_A_ publishing-L-2_A_media|print

		publications-L-2_N_official
I_2222	Service activities related to printing	printing service-M-1_A_
I_2230	Reproduction of recorded media	videocassettes-L-2_A_
		video-cassettes-L-2_A_
		video recording-L-2_A_
		videotape-L-2_A_
		video-tape-L-2_A_
		audio/visual-L-2_N_equipment|service|broadcast
		audio-visual-L-2_N_equipment|service|broadcast
		video-M-1_N_equipment|service
		audio-L-2_N_equipment|service|broadcast
		music-L-2_N_equipment|instrument
		phonograph record-L-2_A_
		sound record-L-2_A_
		recording-L-2_N_sound|music|maintain|keep|produce
		compact-disc-L-2_A_
		compact disc-L-2_A_
		song-L-2_A_
I_2310	Coke oven products	coke-M-1_A_
I_2320	Refined petroleum products	gasoline-M-1_A_
		petrochemical-M-1_A_
		petro-chemical-M-1_A_
		petroleum-M-1_A_
		refineries-M-1_A_
		fuel-M-1_A_
		gas products-M-1_A_
I_2330	Processing of nuclear fuel	nuclear fuel-M-1_A_
		reactor fuel-M-1_A_
		uranium-M-1_N_^mining
I_2411	Basic chemicals, except fertilizers	basic chemicals-M-1_A_
		soda-ash-S-1_A_
		soda ash-S-1_A_
I_2412	Fertilizers and nitrogen compounds	fertilizer-M-1_A_
		super-phosphate-M-1_A_
		super phosphate-M-1_A_
I_2413	Plastics in primary forms; synthetic rubber	plastic-M-1_A_resin|granule
		plastics-M-1_N_product
		rubber-M-1_N_product
I_2421	Pesticides and other agro-chemical products	agri-chemical-M-1_A_
		agrichemical-M-1_A_
		agricultural chemical-M-1_A_
		agricultural chemicals-M-1_A_
		agrochemical-M-1_A_
		agro-chemicals-M-1_A_
		pesticide-M-1_N_residue
		herbicides-M-1_N_residue
		fungicides-M-1_N_residue
		insecticide-M-1_N_residue
I_2422	Paints, varnishes, printing ink and mastics	paint-M-1_A_
		dyes-M-1_A_
		dye$-M-1_A_
		varnish-M-1_A_
I_2423	Pharmaceuticals, medicinal chemicals, etc.	pharmaceutical-M-1_A_
		medicines-M-1_A_
		drugs-M-1_A_
		vitamins-S-1_N_food

<table>
<tr><td></td><td></td><td>nutrition-S-1_A_supplements</td></tr>
<tr><td>I_2424</td><td>Soap, cleaning & cosmetic preparations</td><td>cosmetics-M-1_A_
cosmetic-M-1_A_products
cleaners-M-1_A_
cleaning products-S-1_A_
deodorant-S-1_A_
detergent-S-1_A_
perfume-S-1_A_
toiletr-S-1_A_
personal hygiene-S-1_A_
personal care-S-1_A_
personal beauty-S-1_A_
soap-S-1_A_</td></tr>
<tr><td>I_2429</td><td>Other chemical products n.e.c.</td><td>photograph-M-1_A_film|paper|material</td></tr>
<tr><td>I_2430</td><td>Man-made fibers</td><td>man made-M-1_A_fibre|fiber
man-made-M-1_A_fibre|fiber
polyester-M-1_A_fibre|fiber
nylon-M-1_A_fibre|fiber</td></tr>
<tr><td>I_2511</td><td>Rubber tires and tubes</td><td>^tire-M-1_A_
tyre-M-1_A_</td></tr>
<tr><td>I_2519</td><td>Other rubber products</td><td>rubber-M-1_A_product|good|article</td></tr>
<tr><td>I_2520</td><td>Plastic products</td><td>plastic-M-1_A_product|good|article</td></tr>
<tr><td>I_2610</td><td>Glass and glass products</td><td>glass$-M-1_A_
glass,-M-1_A_</td></tr>
<tr><td>I_2691</td><td>Pottery, china and earthenware</td><td>porcelain-M-1_A_
pottery-M-1_A_
earthenware-M-1_A_</td></tr>
<tr><td>I_2692</td><td>Refractory ceramic products</td><td>ceramic-L-2_A_</td></tr>
<tr><td>I_2693</td><td>Non-refractory clay; ceramic products</td><td>ceramic-L-2_A_
clay-M-1_A_product</td></tr>
<tr><td>I_2694</td><td>Cement, lime and plaster</td><td>^cement-M-1_A_</td></tr>
<tr><td>I_2695</td><td>Articles of concrete, cement and plaster</td><td>^tiles-M-1_A_
bricks-M-1_A_</td></tr>
<tr><td>I_2696</td><td>Cutting, shaping & finishing of stone</td><td>stones-M-1_N_precious|fruit
stone-M-1_A_cutting|shaping|mason</td></tr>
<tr><td>I_2699</td><td>Other non-metallic mineral products n.e.c.</td><td>mineral wool-M-1_A_</td></tr>
<tr><td>I_2710</td><td>Basic iron and steel</td><td>^iron-M-1_A_
steel-M-1_A_
ferrous-M-1_A_
alloy-M-1_A_</td></tr>
<tr><td>I_2720</td><td>Basic precious and non-ferrous metals</td><td>aluminum-M-1_A_
copper-M-1_A_
^tin$-S-1_A_
^tin,-S-1_A_
^nickel-S-1_A_
zinc-S-1_A_</td></tr>
<tr><td>I_2731</td><td>Casting of iron and steel</td><td>^iron-M-1_A_cast|finished
steel-M-1_A_cast|finished
ferrous-M-1_A_cast|finished
alloy-M-1_A_cast|finished</td></tr>
<tr><td>I_2732</td><td>Casting of non-ferrous metals</td><td>aluminum-M-1_A_cast
copper-M-1_A_cast
^tin-S-1_A_cast
zinc-S-1_A_cast</td></tr>
<tr><td>I_2811</td><td>Structural metal products</td><td>structural metal-M-1_A_contstruction</td></tr>
</table>

I_2812	Tanks, reservoirs and containers of metal	tanks-M-1_A_ reservoirs-M-1_A_ containers-M-1_A_metal
I_2813	Steam generators	nuclear reactors-M-1_A_ steam collector-M-1_A_ generator-M-1_A_steam
I_2891	Metal forging/pressing/stamping/roll-forming	metal-M-1_A_forg|roll|form
I_2892	Treatment & coating of metals	metal-M-1_A_coat|treat
I_2893	Cutlery, hand tools and general hardware	hand tools-M-1_A_ wrenches-S-1_A_ hardware-M-1_N_software cutlery-M-1_A_ cooking utensils-M-1_A_ saws-S-1_A_ knifes-S-1_A_ scissors-S-1_A_
I_2899	Other fabricated metal products n.e.c	screws-M-1_A_ nails-M-1_A_screws|nuts|bolts ^nuts$-M-1_A_^bolts ^bolts-M-1_A_^nuts$
I_2911	Engines & turbines(not for transport equip)	^engine$-M-1_N_auto|aircraft|aviation|plane|search|car|vehicle ^engines-M-1_N_auto|aircraft|aviation|plane|search|car|vehicle turbine-M-1_N_auto|aircraft|aviation|plane|wind
I_2912	Pumps, compressors, taps and valves	pumps-M-1_A_ compressor-M-1_A_ valves-M-1_A_ taps-M-1_A_
I_2913	Bearings, gears, gearing & driving elements	bearing-M-1_A_ gearing-M-1_A_
I_2914	Ovens, furnaces and furnace burners	ovens-M-1_A_ furnaces-M-1_A_ burners-M-1_A_
I_2915	Lifting and handling equipment	cranes-M-1_A_ forklift-M-1_A_ lifting-M-1_A_equipment|machinery
I_2919	Other general purpose machinery	air condition-M-1_A_ freezer-M-1_A_ aircondition-M-1_A_ coolers-M-1_A_ refrigerat-M-1_A_ cooling-M-1_A_
I_2921	Agricultural and forestry machinery	agricultural-M-1_A_machinery|equipment harvesters-M-1_A_ harvest-M-1_A_machine
I_2922	Machine tools	machine tool-M-1_A_ drill-M-1_A_
I_2923	Machinery for metallurgy	metalworking-M-1_A_machinery|equipment metallurg-M-1_A_ metal working-M-1_A_machinery
I_2924	Machinery for mining & construction	earth moving-M-1_A_ earthmoving-M-1_A_ earth-moving-M-1_A_

		bulldozer-M-1_A_ caterpillar-M-1_A_ construction-M-1_A_machinery|equipment oil-M-1_A_equipment gas-M-1_A_equipment extraction-M-1_A_equipment
I_2925	Food/beverage/tobacco processing machinery	food processing-M-1_A_machinery|equipment food production-M-1_A_machinery|equipment
I_2926	Machinery for textile, apparel and leather	textile-M-1_A_machinery
I_2927	Weapons and ammunition	ammunition-M-1_A_ armaments-M-1_A_ arms-M-1_A_ defense equipment-M-1_A_ defense goods-M-1_A_ defense procurement-M-1_A_ military procurement-M-1_A_ military goods-M-1_A_ weapons-M-1_A_ military equipment-M-1_A_
I_2929	Other special purpose machinery	paper production-M-1_A_machinery rubber production-M-1_A_machinery plastics production-M-1_A_machinery printing machinery-M-1_A_ type-setting machinery-M-1_A_
I_2930	Domestic appliances n.e.c.	appliance-M-1_A_domestic|household|electrical|electronic|home|products|accessor laundromat-S-1_A_ dryer-S-1_A_ heating-S-1_A_ ^heater-S-1_A_ washing machines-S-1_A_ washers-S-1_A_
I_3000	Office, accounting and computing machinery	computers-M-1_A_ computer$-S-1_A_part computer$-M-1_A_equipment|product|good data processing-M-1_A_machine PCs-M-1_A_ IT-related-M-1_A_goods|products|equipment informatics-M-1_A_goods|products|equipment information-M-1_A_technolog|telecommunication copiers-S-1_A_ printer-S-1_A_ office equipment-M-1_A_ office machine-M-1_A_
I_3110	Electric motors, generators and transformers	generators-M-1_A_ electric motor-M-1_A_ turbine-M-1_A_wind transformer-M-1_A_ heavy electrical-L-2_A_ ^HEE$-L-2_A_ energy generation-L-2_A_equipment|components|products energy sector-L-2_A_equipment|components|products power generation-L-2_A_equipment|components|products machinery-L-2_A_electrical

<table>
<tr><td>I_3120</td><td>Electricity distribution & control apparatus</td><td>control apparat-M-1_A_
switches-M-1_A_
voltage limiter-S-1_A_
surge suppressor-S-1_A_
plugs-S-1_A_
fuses-S-1_A_
heavy electrical-L-2_A_
^HEE$-L-2_A_
energy generation-L-2_A_equipment|components|products
energy sector-L-2_A_equipment|components|products
power generation-L-2_A_equipment|components|products
machinery-L-2_A_electrical</td></tr>
<tr><td>I_3130</td><td>Insulated wire and cable</td><td>wire$-M-1_A_cable
wire,-M-1_A_cable
wiring-M-1_A_
wires and cable-M-1_A_
electrical-L-3_A_materials</td></tr>
<tr><td>I_3140</td><td>Accumulators, primary cells and batteries</td><td>batteries-M-1_A_
accumulator-M-1_A_
electrical-L-3_A_materials</td></tr>
<tr><td>I_3150</td><td>Lighting equipment and electric lamps</td><td>bulb-M-1_A_
^lamps-M-1_A_
^lighting-M-1_A_
electrical-L-3_A_materials</td></tr>
<tr><td>I_3190</td><td>Other electrical equipment n.e.c.</td><td>ignition-M-1_A_
dynamo-M-1_A_</td></tr>
<tr><td>I_3210</td><td>Electronic valves, tubes, etc.</td><td>integrated circuit-M-1_A_
semi-conductor-M-1_A_
semiconductor-M-1_A_
drams-M-1_A_
d-rams-M-1_A_
circuit boards-M-1_A_
dynamic random access memor-M-1_A_
electronic-M-1_A_components|parts
Hynix-M-1_A_
photovoltaic-M-1_A_
solar panels-M-1_A_</td></tr>
<tr><td>I_3220</td><td>TV/radio transmitters; line comm. apparatus</td><td>telecommunication-M-1_A_equipment|apparatus|goods|products
mobile phone-M-1_A_
communications technology-M-1_A_
cell phones-M-1_A_
cellular phones-M-1_A_
cellular telephones-M-1_A_
smart phones-M-1_A_
audio-L-2_A_equipment
audio/visual-L-2_A_equipment
audio-visual-L-2_A_equipment
video-M-1_A_equipment
audio-L-2_A_equipment
music-L-2_A_equipment</td></tr>
<tr><td>I_3230</td><td>TV and radio receivers and associated goods</td><td>electronical-M-1_A_device|good|product|consumer|equipment|item
electronic$-M-1_A_device|good|product|consumer|equipment|item
electronics-M-1_A_</td></tr>
</table>

		television set-S-1_A_ receiver-S-1_A_ home entertainment-M-1_A_ video recorder-S-1_A_ players-M-1_A_ audio-L-2_A_equipment audio/visual-L-2_A_equipment audio-visual-L-2_A_equipment video-M-1_A_equipment audio-L-2_A_equipment music-L-2_A_equipment
I_3311	Medical, surgical and orthopedic equipment	medical-M-1_A_device|instrument|equipment|technolog|product surgical-M-1_A_instrument|equipment|technolog|product
I_3312	Measuring/testing/navigating appliances, etc.	scientific-M-1_A_equipment testing-M-1_A_equipment measuring-M-1_A_equipment gauges-S-1_A_ imaging-S-1_A_
I_3313	Industrial process control equipment	process control-M-1_A_ control-M-1_A_appartus
I_3320	Optical instruments & photographic equipment	optical-M-1_A_instrument photograph-M-1_A_equipment camera-M-1_A_ optical fibre-M-1_A_ microscopes-M-1_A_ projectors-M-1_A_ glasses-M-1_A_
I_3330	Watches and clocks	watches-M-1_A_ clocks-M-1_A_
I_3410	Motor vehicles	automotive-L-2_A_ auto$-L-2_A_industry\|sector\|pioneer\|regime ^car$-M-1_A_industry|sector vehicle-M-1_A_industry|sector autos-M-1_A_ ^cars-M-1_A_ auto-mobiles-M-1_A_ automobiles-M-1_A_ vehicles-M-1_A_ vehicle-S-1_A_purpose ^buses-S-1_A_ busses-S-1_A_ minibuses-S-1_A_ ^van$-S-1_A_ ^vans$-S-1_A_ sedan-S-1_A_ pickups-S-1_A_ pickup trucks-S-1_A_ knock-down-M-1_A_ ^kits-M-1_A_ transport-S-1_A_equipment
I_3420	Automobile bodies, trailers & semi-trailers	automotive-M-1_A_body|bodies auto$-M-1_A_body\|bodies car$-M-1_A_body|bodies vehicle-M-1_A_body|bodies coachwork-M-1_A_

		semi-trailer-M-1_A_
		trailer-M-1_A_auto∣truck∣car
I_3430	Parts/accessories for automobiles	automotive-L-2_A_
		auto$-L-2_A_industry∣sector∣pioneer∣regime
		auto$-M-1_A_parts∣components
		car$-M-1_A_parts∣components
		vehicle-M-1_A_parts∣components
		auto-M-1_A_part∣component
		^car$-M-1_A_part
I_3511	Building and repairing of ships	ship building-M-1_A_
		shipbuilding-M-1_A_
		ship-building-M-1_A_
		shipyards-M-1_A_
		ship repair-M-1_A_
I_3512	Building/repairing of pleasure/sport boats	pleasure boat-M-1_A_
		boat-M-1_A_
I_3520	Railway/tramway locomotives & rolling stock	locomotives-M-1_A_
I_3530	Aircraft and spacecraft	aircraft-M-1_A_
		airplane-M-1_A_
		plane-M-1_A_
		airbus-M-1_A_
		boeing-M-1_A_
		civil aviation-M-1_A_fleet
		satellites-M-1_A_
		aerospace-M-1_A_
		satellite exports-M-1_A_
		helicopter-S-1_A_
		space industr-M-1_A_
I_3591	Motorcycles	motorbike-M-1_A_
		motorcycle-M-1_A_
		harley-M-1_A_
I_3592	Bicycles and invalid carriages	bicycle-M-1_A_
I_3599	Other transport equipment n.e.c.	hand propelled-M-1_A_vehicles∣cart∣trolley
I_3610	Furniture	furniture-M-1_A_
I_3691	Jewelry and related articles	jewelry-M-1_A_
		jewellry-M-1_A_
		jewellery-M-1_A_
		jewelery-M-1_A_
		gem$-M-1_N_^mining
		gems-M-1_N_^mining
		precious stone-M-1_N_^mining
I_3692	Musical instruments	musical instrument-M-1_A_
I_3693	Sports goods	sporting-M-1_A_good
		sporting-M-1_A_equipment
I_3694	Games and toys	games-M-1_A_
		toy-M-1_A_
I_3699	Other manufacturing n.e.c.	^pens$-M-1_A_pencils
		cigarette lighters-M-1_A_
		umbrellas-M-1_A_
I_3710	Recycling of metal waste and scrap	scrap$-M-1_N_waste
		waste and scrap$-M-1_A_
I_3720	Recycling of non-metal waste and scrap	recycling-M-1_A_
I_4000	Electricity, gas, steam and hot water supply	public utilities-M-1_A_

<table>
<tr><td>I_4010</td><td>Production, collection and distribution</td><td>electric-M-1_A_power|utilit|compan|firm|provider
electricity-M-1_A_generation|sector
energy-M-1_A_production|sector
power-M-1_A_generation|sector|industr</td></tr>
<tr><td>I_4020</td><td>Manufacture of gas; distribution of</td><td>gas-M-1_A_supply</td></tr>
<tr><td>I_4100</td><td>Collection, purification and distribution of water</td><td>water-M-1_A_supply</td></tr>
<tr><td>I_4500</td><td>Construction</td><td>^construction-M-1_N_material|equipment
infrastructure project-M-1_A_
public works-M-1_A_
major project-M-1_A_</td></tr>
<tr><td>I_6000</td><td>Land transport</td><td>land transport-M-1_A_
transport-M-1_A_sector|industr|service</td></tr>
<tr><td>I_6010</td><td>Transport via railways</td><td>railway-M-1_A_transport</td></tr>
<tr><td>I_6020</td><td>Other land transport</td><td>trucking-M-1_A_
carrier-M-1_A_haul</td></tr>
<tr><td>I_6030</td><td>Transport via pipelines</td><td>pipeline-M-1_A_transport</td></tr>
<tr><td>I_6100</td><td>Water transport</td><td>water transport-M-1_A_</td></tr>
<tr><td>I_6110</td><td>Sea and coastal water transport</td><td>shipping-M-1_N_inland|river|lake|goods|exports|agricultur|manufactur|from
maritime-M-1_A_service
vessel-M-1_N_fish
operator-M-1_A_ship|maritime|vessel|flag|^port|harbor|sea|ocean
carrier-M-1_A_ship|maritime|vessel|flag|^port|harbor|sea|ocean</td></tr>
<tr><td>I_6120</td><td>Inland water transport</td><td>shipping-M-1_A_inland|river|lake</td></tr>
<tr><td>I_6200</td><td>Air transport</td><td>aviation-M-1_A_
civil aviation-M-1_N_fleet
airways-M-1_A_
airline-M-1_A_
space launch-M-1_A_
carrier-M-1_A_^air|aer</td></tr>
<tr><td>I_6300</td><td>Supporting and auxiliary transport activities</td><td>tourism-S-1_A_</td></tr>
<tr><td>I_6410</td><td>Post and courier activities</td><td>postal-M-1_N_rate
courier-M-1_A_
express delivery-M-1_A_
delivery services-M-1_A_</td></tr>
<tr><td>I_6420</td><td>Telecommunications</td><td>telecommunications-M-1_N_equipment|apparatus|goods|products
phone-M-1_A_service
cellular-M-1_A_service
telecom-M-1_A_service|basic|sector
telephony-M-1_A_</td></tr>
<tr><td>I_6500</td><td>Financial intermediation, except insurance and pension funding</td><td>banking-M-1_A_
banks-M-1_A_foreign
finance,-M-1_A_
finance-M-1_A_industr|intermediation|sector|service
financial-M-1_A_industr|intermediation|sector|service</td></tr>
<tr><td>I_6600</td><td>Insurance and pension funding, except compulsory social security</td><td>insurance-M-1_N_^CIF$
pension fund-M-1_A_</td></tr>
<tr><td>I_7100</td><td>Renting of machinery and equipment</td><td>renting-M-1_A_machinery|equipment
leasing-M-1_A_machinery|equipment</td></tr>
<tr><td>I_7200</td><td>Computer and related activities</td><td>software-M-1_A_</td></tr>
</table>

<table>
<tr><td></td><td></td><td>computer programs-M-1_A_
IT-related-M-1_A_service
information service-M-1_A_
informatics-M-1_A_ database-M-1_A_
data base-M-1_A_
data processing-M-1_N_machine</td></tr>
<tr><td>I_7300</td><td>Research and development</td><td>professional services-M-1_A_
professions-M-1_A_</td></tr>
<tr><td>I_7410</td><td>Legal, accounting, book-keeping and auditing activities, business and management consultancy</td><td>legal firms-M-1_A_
law firms-M-1_A_
foreign-M-1_A_lawyers
legal-M-1_A_services
accounting-M-1_N_GAO|standards
consultants-S-1_A_
consultancy-S-1_A_
business consulting-S-1_A_</td></tr>
<tr><td>I_7420</td><td>Architectural, engineering and other technical activities</td><td>testing service-M-1_A_</td></tr>
<tr><td>I_7421</td><td>Architectural and engineering activities</td><td>architect-M-1_A_
^engineering-M-1_N_genetic|bio
^engineers-M-1_A_</td></tr>
<tr><td>I_7430</td><td>Advertising</td><td>advertising-M-1_A_
advertisement-M-1_A_</td></tr>
<tr><td>I_7494</td><td>Photographic activities</td><td>photographic-M-1_A_service</td></tr>
<tr><td>I_8000</td><td>Education</td><td>education-M-1_A_services</td></tr>
<tr><td>I_8500</td><td>Health and social work</td><td>health-M-1_A_services</td></tr>
<tr><td>I_9200</td><td>Recreational, cultural and sporting activities</td><td>broadcast-M-1_A_
^cable-television-M-1_A_
^cable-M-1_A_TV|television|service
^stations-M-1_A_TV|television
audio/visual-L-2_A_service
audio-visual-L-2_A_service
video-M-1_A_service
audio-L-2_A_service</td></tr>
<tr><td>I_9211</td><td>Motion picture and video production</td><td>motion picture-M-1_A_
films-M-1_N_photograph
film export-M-1_N_photograph
cinematographic-M-1_A_
movie-M-1_A_
videocassettes-L-2_A_
video-cassettes-L-2_A_
video recording-L-2_A_ videotape-L-2_A_
video-tape-L-2_A_
audio/visual-L-2_A_
audio-visual-L-2_A_
video-L-2_A_</td></tr>
<tr><td>I_9214</td><td>Dramatic arts, music and other arts</td><td>artistic rights-M-1_A_
artistic work-M-1_A_
art objects-M-1_A_
artwork-M-1_A_</td></tr>
</table>

Notes: Product codes beginning with 'H' refer to the HS classification; codes beginning with 'I' refer to the ISIC rev. 3 classification.

Table A.I.3: NTE automated content analysis dictionary – U.S. actors

<table>
<tr><th>Code</th><th>Description</th><th>Search terms</th></tr>
<tr><td>UTC</td><td>United States International Trade Commission</td><td>International Trade_A_Commission</td></tr>
<tr><td>USG</td><td>U.S. Government</td><td>Trade_A_Representative</td></tr>
<tr><td></td><td></td><td>U\.S\._A_delegation,</td></tr>
<tr><td></td><td></td><td>U\.S\._A_Department</td></tr>
<tr><td></td><td></td><td>U\.S\._A_embassies</td></tr>
<tr><td></td><td></td><td>U\.S\._A_embassy</td></tr>
<tr><td></td><td></td><td>U\.S\._A_government</td></tr>
<tr><td></td><td></td><td>U\.S\._A_official</td></tr>
<tr><td></td><td></td><td>U\.S\._A_negotiator</td></tr>
<tr><td></td><td></td><td>U\.S\._A_agenc</td></tr>
<tr><td></td><td></td><td>U\.S\._A_Reagan|Bush|Clinton|Obama</td></tr>
<tr><td></td><td></td><td>president_A_Reagan|Bush|Clinton|Obama</td></tr>
<tr><td></td><td></td><td>administration_A_Reagan|Bush|Clinton|Obama</td></tr>
<tr><td></td><td></td><td>The Administration_A_</td></tr>
<tr><td></td><td></td><td>the Administration_A_</td></tr>
<tr><td></td><td></td><td>United States_A_</td></tr>
<tr><td></td><td></td><td>USDA_N_Agriculture</td></tr>
<tr><td></td><td></td><td>Federal Maritime Commission_A_</td></tr>
<tr><td></td><td></td><td>^FMC$_A_</td></tr>
<tr><td></td><td></td><td>^USG$_A_</td></tr>
<tr><td></td><td></td><td>USTR$_A_</td></tr>
<tr><td></td><td></td><td>USITC_A_</td></tr>
<tr><td></td><td></td><td>^we$_A_</td></tr>
<tr><td></td><td></td><td>^our$_A_</td></tr>
<tr><td></td><td></td><td>^us$_A_</td></tr>
<tr><td>USI</td><td>U.S. industry</td><td>U\.S\._A_accountant</td></tr>
<tr><td></td><td></td><td>U\.S\._A_airline</td></tr>
<tr><td></td><td></td><td>U\.S\._A_assembler</td></tr>
<tr><td></td><td></td><td>U\.S\._A_automaker</td></tr>
<tr><td></td><td></td><td>U\.S\._A_bidder</td></tr>
<tr><td></td><td></td><td>U\.S\._A_businesses</td></tr>
<tr><td></td><td></td><td>U\.S\._A_companies</td></tr>
<tr><td></td><td></td><td>U\.S\._A_company</td></tr>
<tr><td></td><td></td><td>U\.S\._A_corporation</td></tr>
<tr><td></td><td></td><td>U\.S\._A_dealer</td></tr>
<tr><td></td><td></td><td>U\.S\._A_distributor</td></tr>
<tr><td></td><td></td><td>U\.S\._A_exporters</td></tr>
<tr><td></td><td></td><td>U\.S\._A_export</td></tr>
<tr><td></td><td></td><td>U\.S\._A_^firm</td></tr>
<tr><td></td><td></td><td>U\.S\._A_grower</td></tr>
<tr><td></td><td></td><td>U\.S\._A_industries</td></tr>
<tr><td></td><td></td><td>U\.S\._A_industry$</td></tr>
<tr><td></td><td></td><td>U\.S\._A_insurer</td></tr>
<tr><td></td><td></td><td>U\.S\._A_investor</td></tr>
<tr><td></td><td></td><td>U\.S\._A_manufacturer</td></tr>
<tr><td></td><td></td><td>U\.S\._A_of interest to</td></tr>
<tr><td></td><td></td><td>U\.S\._A_operator</td></tr>
<tr><td></td><td></td><td>U\.S\._A_owner</td></tr>
<tr><td></td><td></td><td>U\.S\._A_producer</td></tr>
<tr><td></td><td></td><td>U\.S\._A_provider</td></tr>
<tr><td></td><td></td><td>U\.S\._A_professionals</td></tr>
<tr><td></td><td></td><td>U\.S\._A_publisher</td></tr>
<tr><td></td><td></td><td>U\.S\._A_reinsurer</td></tr>
</table>

		U\.S\._A_re-insurer
		U\.S\._A_services provider
		U\.S\._A_supplier
		U\.S\. copyright holder_A_
		U\.S\. patent holder_A_
		U\.S\. trademark holder_A_
		U\.S\._A_association
		IIPA_A_
		American_A_airline
		American_A_assembler
		American_A_automaker
		American_A_bidder
		American_A_businesses
		American_A_companies
		American_A_company
		American_A_corporation
		American_A_dealer
		American_A_distributor
		American_A_exporters
		American_A_exports
		American_A_firm
		American_A_grower
		American_A_industries
		American_A_industry$
		American_A_insurer
		American_A_investor
		American_A_manufacturer
		American_A_of interest to
		American_A_operator
		American_A_owner
		American_A_producer
		American_A_provider
		American_A_publisher
		American_A_reinsurer
		American_A_re-insurer
		American_A_services provider
		American_A_supplier
		American copyright holder_A_
		American patent holder_A_
		American trademark holder_A_
		American_A_association
USF	U.S. or foreign industry	accountant_A_foreign
		airline_A_foreign
		assembler_A_foreign
		automaker_A_foreign
		bidder_A_foreign
		businesses_A_foreign
		companies_A_foreign
		company_A_foreign
		corporation_A_foreign
		dealer_A_foreign
		distributor_A_foreign
		exporters_A_foreign|other
		exports_A_foreign|other
		products from the United States_A_
		^firm_A_foreign

		grower_A_foreign
		industries_A_foreign
		industry_A_foreign
		insurer_A_foreign
		investor_A_foreign
		manufacturer_A_foreign
		of interest to_A_foreign
		producer_A_foreign
		operator_A_foreign
		owners_A_foreign
		provider_A_foreign
		professionals_A_foreign
		publisher_A_foreign
		reinsurer_A_foreign
		re-insurer_A_foreign
		services provider_A_foreign
		supplier_A_foreign
		^holder_A_copyright|patent|trademark

Table A.I.4: NTE automated content analysis dictionary – U.S. actions

Code	Description	Search terms
G-Act-1	U.S. Gov. escalation level 1	^hope_A_\[\$USG
G-Act-1		^hoping_A_\[\$USG
G-Act-1		believe_A_\[\$USG
G-Act-1		believing_A_\[\$USG
G-Act-1		concern_A_\[\$USG
G-Act-1		reservations_A_\[\$USG
G-Act-1		worrie_A_\[\$USG
G-Act-1		worry_A_\[\$USG
G-Act-1		^is following_A_\[\$USG
G-Act-1		to watch_A_\[\$USG
G-Act-1		will watch_A_\[\$USG
G-Act-1		watching_A_\[\$USG
G-Act-1		watche_A_\[\$USG
G-Act-1		estimat_A_\[\$USG
G-Act-1		monitor_A_\[\$USG
G-Act-2	U.S. Gov. escalation level 2	U\.S\. effort_A_
G-Act-2		U\.S\. action_A_
G-Act-2		address_A_\[\$USG
G-Act-2		supports_A_\[\$USG
G-Act-2		recommended_A_\[\$USG
G-Act-2		recommending_A_\[\$USG
G-Act-2		emphasiz_A_\[\$USG
G-Act-2		highlight_A_\[\$USG
G-Act-2		stress_A_\[\$USG
G-Act-2		underscore_A_\[\$USG
G-Act-2		reiterate_A_\[\$USG
G-Act-2		reiterating_A_\[\$USG
G-Act-2		advocate_A_\[\$USG
G-Act-2		advocating_A_\[\$USG
G-Act-2		^raise_A_\[\$USG
G-Act-2		^raising_A_\[\$USG
G-Act-2		expect_A_\[\$USG

G-Act-2		express_A_\[\$USG
G-Act-2		expressing_A_\[\$USG
G-Act-2		its position_A_\[\$USG
G-Act-2		commented_A_\[\$USG
G-Act-2		provide countryName_A_\[\$USG
G-Act-2		indicat_A_\[\$USG
G-Act-2		noted_A_\[\$USG
G-Act-2		propos_A_\[\$USG
G-Act-2		provided comments_A_\[\$USG
G-Act-2		^view_A_\[\$USG
G-Act-2		^work_A_\[\$USG
G-Act-2		^action_A_\[\$USG
G-Act-2		^working group_A_\[\$USG
G-Act-2		technical meeting_A_\[\$USG
G-Act-2		technical consultation_A_\[\$USG
G-Act-2		technical level_A_\[\$USG
G-Act-2		negotiat_A_\[\$USG
G-Act-2		arrangement_A_reach|arrive|strik|struck|signed|conclu
G-Act-2		agreement_A_reach|arrive|strik|struck|signed|conclu
G-Act-2		negotiat_A_\[\$USG|experts|^held|^hold
G-Act-2		consultation_A_\[\$USG|experts|^held|^hold
G-Act-2		discuss_A_\[\$USG|U\.S\.|experts|^held|^hold
G-Act-2		dialog_A_\[\$USG|experts|^held|^hold
G-Act-2		meeting_A_\[\$USG|experts|^held|^hold
G-Act-2		talks_A_\[\$USG|experts|^held|^hold
G-Act-2		consult_A_\[\$USG
G-Act-2		pursue_A_\[\$USG
G-Act-2		pursuing_A_\[\$USG
G-Act-2		engage_A_\[\$USG
G-Act-2		ensuring_A_\[\$USG
G-Act-2		engaging_A_\[\$USG
G-Act-2		engagement_A_\[\$USG
G-Act-2		encourage_A_\[\$USG
G-Act-2		encouraging_A_\[\$USG
G-Act-2		^call_A_\[\$USG
G-Act-2		^outreach_A_\[\$USG
G-Act-2		seek_A_\[\$USG
G-Act-2		^effort_A_bilateral
G-Act-2		sought_A_\[\$USG
G-Act-3	U.S. Gov. escalation level 3	challenged_A_\[\$USG
G-Act-3		challenges_A_\[\$USG
G-Act-3		has asked_A_\[\$USG
G-Act-3		request_A_\[\$USG
G-Act-3		objected_A_\[\$USG
G-Act-3		disagree_A_\[\$USG
G-Act-3		objecting_A_\[\$USG
G-Act-3		oppose_A_\[\$USG
G-Act-3		its opposition_A_\[\$USG
G-Act-3		protest_A_\[\$USG
G-Act-3		^told_A_\[\$USG
G-Act-3		push_A_\[\$USG
G-Act-3		^urge_A_\[\$USG
G-Act-3		^urging_A_\[\$USG
G-Act-3		aggressive action_A_\[\$USG
G-Act-3		^push_A_\[\$USG
G-Act-3		to press_A_\[\$USG

<table>
<tr><td>G-Act-3</td><td></td><td>intervention_A_\[\$USG</td></tr>
<tr><td>G-Act-3</td><td></td><td>^presse_A_\[\$USG</td></tr>
<tr><td>G-Act-3</td><td></td><td>^pressing_A_\[\$USG</td></tr>
<tr><td>G-Act-3</td><td></td><td>^pressur_A_\[\$USG|U\.S\.</td></tr>
<tr><td>G-Act-3</td><td></td><td>reject_A_\[\$USG</td></tr>
<tr><td>G-Act-3</td><td></td><td>consultation_A_formal</td></tr>
<tr><td>G-Act-3</td><td></td><td>trade law_A_U\.S\.</td></tr>
<tr><td>G-OTL-3</td><td></td><td>watch list_N_priority</td></tr>
<tr><td>G-OTL-3</td><td></td><td>priority_A_watch</td></tr>
<tr><td>G-OTL-3</td><td></td><td>special 30_A_</td></tr>
<tr><td>G-OTL-3</td><td></td><td>super 30_A_</td></tr>
<tr><td>G-OTL-3</td><td></td><td>section_A_1377</td></tr>
<tr><td>G-OTL-4</td><td>U.S. Gov. escalation level 4</td><td>priority foreign country_A_</td></tr>
<tr><td>G-GSP-4</td><td></td><td>review_A_^GSP$</td></tr>
<tr><td>G-GSP-4</td><td></td><td>review_A_generalized system</td></tr>
<tr><td>G-NAF-4</td><td></td><td>NAFTA consultations_A_\[\$USG</td></tr>
<tr><td>G-NAF-4</td><td></td><td>Chapter 19_A_NAFTA</td></tr>
<tr><td>G-NAF-4</td><td></td><td>Chapter 20_A_NAFTA</td></tr>
<tr><td>G-NAF-4</td><td></td><td>dispute resolution_A_NAFTA</td></tr>
<tr><td>G-NAF-4</td><td></td><td>dispute settlement_A_NAFTA</td></tr>
<tr><td>G-WTO-4</td><td></td><td>dispute resolution_A_WTO|GATT</td></tr>
<tr><td>G-WTO-4</td><td></td><td>dispute settlement_A_WTO|GATT</td></tr>
<tr><td>G-WTO-4</td><td></td><td>Article XXII_A_WTO|GATT|^GA$</td></tr>
<tr><td>G-WTO-4</td><td></td><td>Article XXll_A_WTO|GATT|^GA$</td></tr>
<tr><td>G-WTO-4</td><td></td><td>Article 22_A_WTO|GATT</td></tr>
<tr><td>G-WTO-4</td><td></td><td>GATT consultations_A_\[\$USG</td></tr>
<tr><td>G-WTO-4</td><td></td><td>WTO consultations_A_\[\$USG</td></tr>
<tr><td>G-WTO-4</td><td></td><td>GATT case_A_\[\$USG</td></tr>
<tr><td>G-WTO-4</td><td></td><td>WTO case_A_\[\$USG</td></tr>
<tr><td>G-WTO-4</td><td></td><td>arbitration_A_WTO</td></tr>
<tr><td>G-WTO-4</td><td></td><td>arbitration_A_(WTO)</td></tr>
<tr><td>G-WTO-4</td><td></td><td>proceeding_A_WTO</td></tr>
<tr><td>G-WTO-4</td><td></td><td>proceeding_A_(WTO)</td></tr>
<tr><td>G-WTO-4</td><td></td><td>challenged_A_WTO</td></tr>
<tr><td>G-WTO-4</td><td></td><td>World Trade Organization_A_case</td></tr>
<tr><td>G-WTO-4</td><td></td><td>GATT case_A_</td></tr>
<tr><td>G-WTO-4</td><td></td><td>WTO case_A_</td></tr>
<tr><td>G-WTO-4</td><td></td><td>dispute_A_GATT</td></tr>
<tr><td>G-WTO-4</td><td></td><td>at the WTO_A_challenge</td></tr>
<tr><td>G-WTO-4</td><td></td><td>dispute_A_WTO</td></tr>
<tr><td>G-WTO-4</td><td></td><td>dispute_A_(WTO)</td></tr>
<tr><td>G-WTO-4</td><td></td><td>consultations_A_WTO|GATT</td></tr>
<tr><td>G-WTO-4</td><td></td><td>requested_A_WTO|GATT</td></tr>
<tr><td>G-301-4</td><td></td><td>section 30_A_filed|petition</td></tr>
<tr><td>G-NAF-5</td><td>U.S. Gov. escalation level 5</td><td>panel_A_NAFTA</td></tr>
<tr><td>G-Act-5</td><td></td><td>requested_A_establishment</td></tr>
<tr><td>G-WTO-5</td><td></td><td>panel_A_WTO|^USTR|request|findings|found|ruling|decision|proceeding|establish$|settlement</td></tr>
<tr><td>G-WTO-5</td><td></td><td>WTO ruling_A_</td></tr>
<tr><td>G-WTO-5</td><td></td><td>appellate_A_body|report|findings|found</td></tr>
<tr><td>G-WTO-5</td><td></td><td>compliance_A_panel</td></tr>
<tr><td>G-WTO-5</td><td></td><td>reasonable period of time_A_\[\$USG</td></tr>
<tr><td>G-301-5</td><td></td><td>section 30_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td>U.S. Gov. escalation level 6</td><td>withdrew benefits_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>withdrew concession_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>withdrew tariff reduction_A_\[\$USG</td></tr>
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<tr><td>G-Act-6</td><td></td><td>withholds concession_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>withholds tariff reduction_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>suspended benefits_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>suspended concession_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>suspended tariff reduction_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>withdrew countrName's benefits_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>withholds countrName's benefits_A_\[\$USG</td></tr>
<tr><td>G-Act-6</td><td></td><td>suspended countrName's benefits_A_\[\$USG</td></tr>
<tr><td>G-GSP-6</td><td></td><td>withdr_A_^GSP$|generalized system</td></tr>
<tr><td>G-GSP-6</td><td></td><td>suspen_A_^GSP$|generalized system</td></tr>
<tr><td>G-Act-6</td><td></td><td>retaliat_A_\[\$USG|WTO</td></tr>
<tr><td>G-Act-6</td><td></td><td>sanctions_A_\[\$USG|WTO</td></tr>
<tr><td>G-301-6</td><td></td><td>section 30_A_sanction</td></tr>
<tr><td>I-Act-1</td><td>U.S. industry action level 1</td><td>^note_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>^noting_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>believe_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>believing_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>concern$_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>concerns_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>concerned_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>worrie_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>worry_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>^fear_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>^claim_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>^point_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-1</td><td></td><td>according to_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td>U.S. industry action level 2</td><td>report_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>stress_A_\[\$USG|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>express_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>expressing_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>^cite$_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>^cites$_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>^cited$_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>^citing_A_\[\$USI|\[\$USF|industr|company|companies|e</td></tr>
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<tr><td></td><td></td><td>xporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>complain$ _A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>complains_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>complained_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>complaining_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-2</td><td></td><td>complaint_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-3</td><td>U.S. industry action level 3</td><td>^is working_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-3</td><td></td><td>^work with_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-3</td><td></td><td>^working with_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-3</td><td></td><td>estimat_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
<tr><td>I-Act-3</td><td></td><td>filed_A_petition|complaint|section 30</td></tr>
<tr><td>I-Act-3</td><td></td><td>filed_A_\[\$USI|\[\$USF|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer</td></tr>
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Table A.I.5: NTE automated content analysis dictionary – Negotiation Context

<table>
<tr><th>Code</th><th>Description</th><th>Search terms</th></tr>
<tr><td>cxt-A</td><td>Bilateral single-issue negotiations</td><td>bilaterally_A_\[\$USG</td></tr>
<tr><td></td><td></td><td>bilateral_A_negotiat|consultation|discuss|dialog|meeting|context|fora|effort|talks|agreement|issue</td></tr>
<tr><td></td><td></td><td>Memorand_A_Understanding</td></tr>
<tr><td></td><td></td><td>^MOU$_A_\[\$USG</td></tr>
<tr><td></td><td></td><td>exchange_A_letters</td></tr>
<tr><td></td><td></td><td>negotiat_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>consultations_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>discuss_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>meeting_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>dialog_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>talks_A_U\.S\.-|government-to-government|between|United States|technical</td></tr>
<tr><td></td><td></td><td>\[\$G\\Q-\\EAct\\Q-\\E4\$\]_A_</td></tr>
<tr><td></td><td></td><td>\[\$G\\Q-\\EAct\\Q-\\E5\$\]_A_</td></tr>
<tr><td>cxt-B</td><td>Bilateral multi-issue negotiations</td><td>free trade_A_negotiations|under</td></tr>
<tr><td></td><td></td><td>^FTA$_A_negotiations</td></tr>
<tr><td></td><td></td><td>free trade agreement_A_\[\$USG|launched|initiated|concluded|force</td></tr>
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<tr><td></td><td></td><td>under the_A_^FTA$</td></tr>
<tr><td>cxt-C</td><td>Multilateral single-issue negotiations</td><td>in the OECD_N_Agreement
at the OECD_A_
and other WTO_A_\[\$USG
and other countries_A_\[\$USG
and other governments_A_\[\$USG
with other WTO_A_\[\$USG
with other countries_A_\[\$USG
with other governments_A_\[\$USG
OECD_A_negotiat
OECD_A_discuss
OECD_A_meeting
OECD_A_talks
fora_A_in
working party_A_WTO
multilaterally_A_
multilateral_A_negotiat|consultation|discuss|dialog|meeting|context|fora|effort|talks|agreement</td></tr>
<tr><td>cxt-D</td><td>Multilateral multi-issue negotiations</td><td>in Geneva_A_\[\$USG
in the WTO_N_Agreement
at the WTO_N_case|proceeding|consultation|\[\$G\\Q-\\EAct\\Q-\\E4\$\]|\[\$G\\Q-\\EAct\\Q-\\E5\$\]
WTO_A_negotiat
WTO_A_discuss
WTO_A_meeting
WTO_A_talks
accession_A_WTO|World Trade Organization|^GA$|GATT
acceed_A_WTO|World Trade Organization|^GA$|GATT
Tokyo Round_N_commitments|obligations
Uruguay Round_N_commitments|obligations
Doha Round_N_commitments|obligations
Doha Development Agenda_A_
International Monetary Fund_A_assist|adjust|reform|support
World Bank_A_assist|adjust|reform|support</td></tr>
</table>

Table A.I.6: NTE automated content analysis dictionary – Trade partner (re-)actions

<table>
<tr><th>Code</th><th>Description</th><th>Search terms</th></tr>
<tr><td>neg1</td><td>somewhat negative</td><td>arbitrar_A_
^ambigu_A_
avoid_A_commit
backlog_A_
^burdening_A_
^burdensome_A_
bureaucratic_A_
complex_A_
complicated_A_
compulsory_A_
confus_A_
^control_A_import|price|variet
^controlled_A_poorly|tightly|closely|product|goods</td></tr>
</table>

chronic_A_
cumbersome_A_
delay_A_
discourag_A_
discretion_A_officals|cost$ums|authorit|bureaucra|ministr|
measure|practice|government
^doubt_A_
exacerbat_A_
elusive_A_
government-control_A_
high-cost_A_
impact_A_\[*|^ban$
impossib_A_\[\$U
ineffective_A_
inflexib_A_
in place_A_\[*
inefficient_A_
inflexib_A_
insufficiently_N_supply
intransparent_A_
irregular_A_
lengthy_A_
maintain_A_measure
^mandat_A_
need
to_A_\[\$USI|\[\$USF|\[*|import|\[\:|products|industr
|company|companies|exporter|firm|provider|insurer|grow
er|manufacturer
nontransparent_A_
non-automatic_A_
non-transparent_A_
onerous_A_
opaque_A_
outdated_A_
outstanding_A_
over-regulat_A_
parallel import_A_
^peaks_A_tariff
^piracy_A_
^pirated_A_
pretext_A_
redundant_A_
regulat_A_highly|strictly|closely|heavily|poorly
rigid_A_
^require$_A_\[\$USI|\[\$USF|\[\:|compan|firm|provider
|operator|product|good|service|\[*
^requires_A_\[\$USI|\[\$USF|\[\:|compan|firm|provider
|operator|product|good|service|\[*
^required_A_\[\$USI|\[\$USF|\[\:|compan|firm|provider
|operator|product|good|service|\[*
shorten_A_life
slow_N_declin
spotty_A_
stalled_A_reform|effort|privatiz|steps

		state-control_A_
		subject to_A_\[*
		time consuming_A_
		time-consuming_A_
		troubling_A_
		uncertain_A_
		unclear_N_is|remain
		unequal_A_
		uneven_A_
		unfounded_A_
		unlikely_A_
		unnecessar_A_
		unpredictabl_A_
		unreliabl_A_
		unwarranted_A_
		vague_A_
		^weak_A_
neg2	negative	^an issue_A_
		adverse_A_
		^away$_A_tak|took
		competitive advantage_A_domestic|local|national|over
		^affect_A_\[\$US|products|imports
		anticompetitive_A_
		anti-competitive_A_
		assist_A_domestic|local
		^barrier_N_*\}|reduc|revok|remov|lift|repeal
		below_A_international standards
		^bias_A_
		^burden$_A_
		^burdened_A_
		^burdens$_A_
		buy national_A_
		duty free_A_ceased
		duty-free_A_ceased
		concern_A_\[\$U|serious|major|significant|ongoing|continu|remain|raised|raises|raising
		cannot_A_\[\$US
		complaint_N_mechanism|prodedure
		contentious_A_
		constrain_A_
		contradict_A_
		contrary to_A_
		contraven_A_commitment|obligation|WTO|international|WIPO|TRIPS
		circumscrib_A_
		^cost$_N_saving|save|freight
		^costly_N_saving|save
		^costs_N_saving|save
		^costing_N_saving|save
		counterfeit_A_
		countervailab_A_
		curtail_A_import|participat|U\.S\.|\[\$\USI|\[\$\USF
		damag_A_\[\$U|U\.S\.|quality|trade|market|share|significant

decline_A_participat|export|proposal|market|share
deficien_A_
deteriorat_A_
detriment_A_
differential_A_
difficult_N_to estimate|assess|assign|identify|quatify
disadvantag_A_\[\$US|competitive
disappoint_A_
diminish_A_export|trade|import|incentive|access|opportunit|market
^discriminat_A_
disincentiv_A_
disrupt_A_
distort_A_trade|market
dominate_A_state|government|local|domestic
effect$_A_serious
^entry_A_prevent|deter
exclud_A_\[\:|market|foreign|\[\$USI|\[\$USF|compan|firm|provider|operator
expan_A_program|subsid|support|domestic|local
^expensive_N_products|goods
^expense_N_interest
^export_A_financ|facilitat|incentiv|scheme|program|promot|generate
fall_A_share|short|under
grow_A_tariff|duty|duties|tax|^VAT|burden|cost$
^fail_A_to
^favor_A_local|domestic|strategic|sensitive|import-sensitive|owned|state-owned
^forced_A_to
^frustat_A_
^had to_A_\[\$USI|\[\$USF|compan|firm|provider|operator
^halt_A_import|export|\[\$USI|\[\$USF
^hamper_A_
^harm$_A_
^harmed_A_
^harming_A_
^harms_A_
^hurt_A_
high$_A_tariff|duties|duty|charge|levy|levies|^fee|tax|^VAT|burden|cost$
higher_A_tariff|duties|duty|charge|levy|levies|^fee|tax|^VAT|burden|cost$
highest_A_tariff|duties|duty|charge|levy|levies|^fee|tax|^VAT|burden|cost$
^hinder_A_
hindrance_A_
hurdle_A_
impair_A_
imped_A_
impos_A_tariff|duty|duties|charge|^fee|tax|^VAT|burden|cost$|problem|hurdle|barrier|impedi
^inability_A_
inadequate_A_

inappropriate_A_
incentiv_A_export
inconsisten_A_
increas_A_tariff|duty|duties|charge|^fee|tax|^VAT|burden|cost$|problem|hurdle|barrier|impedi
infring_A_
insufficient$_N_supply
^interrupt_A_trade|export
irritant_A_
jeopard_A_
^lack of_N_*\}|reciprocity
^lack a_A_
^lacking_A_
^lacks_A_
^lax$_A_
^limit_N_circumstanc|condition|number
local_A_content
^lose_A_
^losing_A_
^loss_A_
^lost_A_
^low$_A_particip|share
must_A_\[\$USI|\[\$USF|import|\[\:|products|operator|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer
near-halt_A_import|export|\[\$USI|\[\$USF
negate_A_
negating_A_
negativ_N_test
negligible_A_
no change_A_
of concern_A_
oblig_A_\[\$USI|\[\$USF|compan|firm|provider|operator
obstacle_N_development
overcapacity_A_support|government|subsid|domestic
over-capacity_A_support|government|subsid|domestic
^peak_A_tariff
^pose_A_challenge|threat
^posing_A_challenge|threat
preclude_A_\[\$U|U\.S\.|compan|firm|provider|operator|access|market
prefer$_A_local|domestic|state-owned|countryName
preference_A_local|domestic|state-owned|countryName
prefers_A_local|domestic|state-owned|countryName
prefered_A_local|domestic|state-owned|countryName
prefering_A_local|domestic|state-owned|countryName
preferential_A_local|domestic|state-owned|polic|loan|financing|credit|treatment|arrangement
prevent_A_\[\$U|U\.S\.|particip|import|\[\:|products|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer|^competit
problem_N_avoid|solve|solution
protectionism_A_
questionable_A_

<table>
<tr><td></td><td></td><td>practices_A_unfair|engag|monopolistic</td></tr>
<tr><td></td><td></td><td>protect_A_local|domestic|strategic|sensitive|import-sensitive|owned|state-owned|tariff</td></tr>
<tr><td></td><td></td><td>raise_A_tariff|duties|duty|charge|^fee|tax|^VAT|burden|cost$|concern</td></tr>
<tr><td></td><td></td><td>reduc_A_value</td></tr>
<tr><td></td><td></td><td>refus_N_\[\$USI|\[\$USF</td></tr>
<tr><td></td><td></td><td>reject_A_</td></tr>
<tr><td></td><td></td><td>reluctant_A_</td></tr>
<tr><td></td><td></td><td>remain an issue_A_</td></tr>
<tr><td></td><td></td><td>remains an issue_A_</td></tr>
<tr><td></td><td></td><td>remain_A_challeng|effect</td></tr>
<tr><td></td><td></td><td>^requirement_A_</td></tr>
<tr><td></td><td></td><td>reserved to_A_</td></tr>
<tr><td></td><td></td><td>reserved for_A_</td></tr>
<tr><td></td><td></td><td>restrict_A_</td></tr>
<tr><td></td><td></td><td>shield_A_local|domestic|from</td></tr>
<tr><td></td><td></td><td>shrink_A_market</td></tr>
<tr><td></td><td></td><td>shrunk_A_market</td></tr>
<tr><td></td><td></td><td>steep_A_tariff|duties|duty|charge|^fee|tax|^VAT|burden|cost$</td></tr>
<tr><td></td><td></td><td>stingent_A_</td></tr>
<tr><td></td><td></td><td>^stop_A_import|export|\[\$USI|\[\$USF</td></tr>
<tr><td></td><td></td><td>subsidiz_A_</td></tr>
<tr><td></td><td></td><td>^strict_A_</td></tr>
<tr><td></td><td></td><td>suffer_A_</td></tr>
<tr><td></td><td></td><td>support_A_domestic|local|measure|payment|transfer</td></tr>
<tr><td></td><td></td><td>tariff protection_A_</td></tr>
<tr><td></td><td></td><td>unable_A_</td></tr>
<tr><td></td><td></td><td>unacceptabl_A_</td></tr>
<tr><td></td><td></td><td>undercut_A_</td></tr>
<tr><td></td><td></td><td>undermin_A_</td></tr>
<tr><td></td><td></td><td>unfair_A_advantage|practic|competit|measure</td></tr>
<tr><td></td><td></td><td>unfairly_A_</td></tr>
<tr><td></td><td></td><td>unfulfilled_A_</td></tr>
<tr><td></td><td></td><td>unjustif_A_</td></tr>
<tr><td></td><td></td><td>unpredictabl_A_</td></tr>
<tr><td></td><td></td><td>unproductive_A_</td></tr>
<tr><td></td><td></td><td>unreasonabl_A_</td></tr>
<tr><td></td><td></td><td>unreceptiv_A_</td></tr>
<tr><td></td><td></td><td>unresolved_A_</td></tr>
<tr><td></td><td></td><td>unsatisfactor_A_</td></tr>
<tr><td></td><td></td><td>unscientific_A_</td></tr>
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<tr><td></td><td></td><td>unviable_A_</td></tr>
<tr><td></td><td></td><td>^unwilling_A_</td></tr>
<tr><td></td><td></td><td>violat_A_</td></tr>
<tr><td></td><td></td><td>widespread_A_</td></tr>
<tr><td></td><td></td><td>worse_A_</td></tr>
<tr><td>neg3</td><td>strongly negative</td><td>^([0-9][0-9][0-9]) percent_A_tariff|duties|levy|levies|duty|^fee|tax|^VAT</td></tr>
<tr><td></td><td></td><td>^([0-9][0-9][0-9]) per cent_A_tariff|duties|levy|levies|duty|^fee|tax|^VAT</td></tr>
<tr><td></td><td></td><td>effectively eliminat_A_</td></tr>
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<table>
<tr><td></td><td></td><td>serious issue_A_</td></tr>
<tr><td></td><td></td><td>serious question_A_</td></tr>
<tr><td></td><td></td><td>serious challenge_A_</td></tr>
<tr><td></td><td></td><td>^ban$_N_law|constitution</td></tr>
<tr><td></td><td></td><td>^bann_N_law|constitution</td></tr>
<tr><td></td><td></td><td>^bans$_N_law|constitution</td></tr>
<tr><td></td><td></td><td>^bar$_A_</td></tr>
<tr><td></td><td></td><td>^barred_A_</td></tr>
<tr><td></td><td></td><td>^barring_A_</td></tr>
<tr><td></td><td></td><td>block_A_</td></tr>
<tr><td></td><td></td><td>^closed_N_illegal|factory|factories</td></tr>
<tr><td></td><td></td><td>^deni_A_access|entry|opportunity|licens|registration</td></tr>
<tr><td></td><td></td><td>^deny_A_access|entry|opportunity|licens|registration</td></tr>
<tr><td></td><td></td><td>^excessive_A_</td></tr>
<tr><td></td><td></td><td>inhibit_A_</td></tr>
<tr><td></td><td></td><td>no intention_A_</td></tr>
<tr><td></td><td></td><td>prohibit_N_under</td></tr>
<tr><td></td><td></td><td>shut_A_out</td></tr>
<tr><td></td><td></td><td>suspen_A_import|trade</td></tr>
<tr><td></td><td></td><td>zero-tolerance_A_</td></tr>
<tr><td></td><td></td><td>zero tolerance_A_</td></tr>
<tr><td>pos1</td><td>somewhat positive</td><td>abide_A_</td></tr>
<tr><td></td><td></td><td>accelerate_A_</td></tr>
<tr><td></td><td></td><td>^accept_A_will|would|fully</td></tr>
<tr><td></td><td></td><td>adhere_A_generally|agreement</td></tr>
<tr><td></td><td></td><td>^adequat_N_generally</td></tr>
<tr><td></td><td></td><td>^admit_A_imports|\[\:|foreign|\[\$USI|\[\$USF|U\.S\.|American|good|product|service</td></tr>
<tr><td></td><td></td><td>alleviat_A_</td></tr>
<tr><td></td><td></td><td>^appropriate_N_as</td></tr>
<tr><td></td><td></td><td>^approved_A_</td></tr>
<tr><td></td><td></td><td>^approval_A_grant|receiv|obtain|provid|expect</td></tr>
<tr><td></td><td></td><td>arrangement_A_reach|arrive|strik|struck|signed|conclu</td></tr>
<tr><td></td><td></td><td>assurance_A_given|gave|from|received</td></tr>
<tr><td></td><td></td><td>^automatic_A_licens|certification|approval</td></tr>
<tr><td></td><td></td><td>avoid_A_\[-</td></tr>
<tr><td></td><td></td><td>^bind_A_tariff</td></tr>
<tr><td></td><td></td><td>^bound_A_tariff</td></tr>
<tr><td></td><td></td><td>clarify_A_</td></tr>
<tr><td></td><td></td><td>^constructive_A_</td></tr>
<tr><td></td><td></td><td>conform_A_commitment|obligation|WTO|international|WIPO|TRIPS</td></tr>
<tr><td></td><td></td><td>convert_A_quota|^ban|non-tariff|measure|^tariff|valorem</td></tr>
<tr><td></td><td></td><td>^cooperate_N_OECD|agreement|gulf|\(|corrupt</td></tr>
<tr><td></td><td></td><td>^cooperating_N_OECD|agreement|gulf|\(|corrupt</td></tr>
<tr><td></td><td></td><td>^cooperation_N_OECD|agreement|gulf|\(|corrupt</td></tr>
<tr><td></td><td></td><td>corrective_A_</td></tr>
<tr><td></td><td></td><td>crackdown_A_</td></tr>
<tr><td></td><td></td><td>crack-down_A_</td></tr>
<tr><td></td><td></td><td>crack down_A_</td></tr>
<tr><td></td><td></td><td>deterrant_A_pirac|counterf|infring</td></tr>
<tr><td></td><td></td><td>^effective$_N_January|February|March|April|May|June|July|August|September|October|November|December|assess|19|20|pests|scientif</td></tr>
</table>

	^efficient_A_ ^effort_N_bilateral|industry expedite_A_ explan_A_ exptend_A_coverage ^evolv_A_ ^flexib_A_ foster_N_\[- headway_A_ harmoniz_N_system impartial_A_ inroads_A_ in line with_A_international|agreement|commitment|obligation|provision|FTA|WTO ^intension$_A_stated\|announced\|confirmed in accordance with_A_WTO\|GATT\|^FTA$ into compliance_A_designed|amend|began|intended|legislation|draft|effort|revise into conformity_A_designed|amend|began|intended|legislation|draft|effort|revise moderniz_A_ ^notif_A_WTO opportunit_A_\[\$U|new patentable_A_ phase_A_in_A_ phasein_A_ phase-in_A_ phase_A_out_A_ phaseout_A_ phase-out_A_ phase-down_A_ phase down_A_ pledge_A_its pledged_A_countryName ^predictab_A_ privatiz_A_ promis_A_ re-open_A_ ^reduc_A_stages replac_A_quota|^ban|non-tariff|measure|^tariff|valorem responsive_A_ revise_A_ ^reliab_N_information scientific_A_basis|bases|based|justif|follow|guidelines science-based_A_ science_A_based shorten_A_process|procedure|time simplif_A_ streamline_A_ ^timely_A_ ^transparen_A_

<table>
<tr><td></td><td></td><td>waiv_A_</td></tr>
<tr><td>pos2</td><td>positive</td><td>(^[0-1])(\.[0-9]?[0-9]?)? percent_A_tariff|duties|duty|levy|levies|fee|tax|VAT
(^[0-1])(\.[0-9]?[0-9]?)? per cent_A_tariff|duties|duty|levy|levies|fee|tax|VAT
^able_N_countryName|local|domestic|owned
abandon_A_
^accept_N_\[\$USG
access_A_immediate|increas|facilitat|accord|provide|full|enhanc|approv|obtain|grant|industr|company|companies|exporter|firm|provider|insurer|grower|manufacturer
address_A_problem|concern|weakness|deficiency|gaps|lack of
^adequate_A_generally
agreed$_A_
agreement_A_reach|arrive|strik|struck|signed|conclud
allow_N_official|ministr|agenc|developing|talk|negot|consultation|discuss|dialog|parallel|decompilation|preference|consider
attract_A_\[\$USI|\[\$USI
^cap$_A_\[*
committed_A_countryName|it
commitment_A_made|countryName|took
^competitive$_N_foreign|\[\$USI|\[\$USF|U\.S\.|American|good|product|service|\[\:|advantag|disadvantag|dis-advantag|price|countryName
complet_A_negotiat
complies_A_
comply_A_intent|indicated|WTO|commitment|obligation|international|agreement
conclud_A_negotiat
curtail_A_piracy|illegal|infring|$abus|monopol
^cut_A_tariff|duty|duties|tax|VAT
deregulat_N_fora
diminish_A_pirac|pirat|conterfeit
down_A_tariff|duty|duties|tax|VAT|pirac|infring|violat
duty free_N_ceased|suspend
duty-free_N_ceased|suspend
^ease$_A_
^eased_A_
^eases$_A_
^easing_A_
^easy$_A_
^easier$_A_
equitabl_A_
^enhance_N_export|genetic|bio|test|inspection|market
^entry_A_gain|immediate|increas|facilitat|accord|provide|full|enhanc|^ease|^easing|^easy
exchange_A_letter
expan_A_trade|invest|market|access|abilit|protection|quota|quantit|time|opportunit|coverage|competit|particip
^fall_A_tariff|duty|duties|tax|VAT
few_A_barrier|restriction
finaliz_A_negotiat
free_A_barrier|flow</td></tr>
</table>

^fulfil_A_obligation|commitment
^gain_A_access|approval
^good$_A_generally
grant_A_\[\$U
grow_A_export
^favorabl_A_effect|impact|result
implement_A_complete|timely|consistent|commitment|oblig|agreement|properly|TRIPS|WTO|^BAT$|^FTA$|reduc|concess
imprison_A_
improv_N_health
increas_A_competit|quota|sales|access|transparen|enforc|investment|coverage
international_A_standard
into compliance_A_brought
into conformity_A_brought
invester-friendly_A_
liberal_A_
^low$_A_tariff|duty|duties|fee|tax|VAT|burden
^lower$_A_\[*
market access_A_immediate|increase|facilitate|accord|provide|full|enhance|approv|obtain
meet_A_fully
memorandum_A_understanding
national treatment_A_grant|appli|apply|receiv|accord|provid
nondiscriminat_A_
non-discriminat_A_
^now$_A_able|available|receive|compet
obtained_A_commitment|protection|right
offered_A_countryName
participa_A_\[\$U|U\.S\.|foreign
permitted_N_than
^pleased_A_
positive_A_step|impact|result|move|outcome|change|development|side|vein
^pro-competitive_A_
^productive_A_
progress$_A_
progressed_A_
protect_A_afford|better|increas|extend|^adequate|^effective|guarantee|greater|provid|rais|raising|availabl|enact
ratif_A_
^raise_A_^limit|quota
^reduc_A_\[-|tariff|discret|licens|duty|duties|fee|tax$|VAT|burden|cost|number|bureauc|corrupt|barrier|gradual|percent
reform_A_undetake|comprehensive|effort|process|program|project|agenda|unilateral|tariff|obstacle|barrier|hurdle
reformed_A_
reforming_A_
relax_A_
recogniz_A_equival|test|fully
^rise_A_export

<table>
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^satisfactor_A_
^satisf_A_^not$
signatory_A_
^step$_A_
^steps$_A_
succeeded in_A_\[\$U
succeeding in_A_\[\$U
^success$_A_
^successes$_A_
tariff_A_concession
tariff free_A_
tariff-free_A_
tariff-reduction_A_
^tax break_N_subsid|support|assist
^terminat_A_\[*|\[\-|suspension|scheme|program|countryName
^welcom_A_
^willing_A_
^won_A_bid|contract
^zero$_A_tariff|duty|duties|fee|tax|VAT|burden|cost|percent|rate</td></tr>
<tr><td>pos3</td><td>strongly positive</td><td>^lift_A_
^open$_A_
^opens_A_
^opened_A_
^opening_A_
abolish_A_
abolit_A_
dismantl_A_
eliminat_N_effectively|substantially
remov_A_\[*|\[\-|suspension
repeal_A_suspension
rescind_A_\[*|\[\-|suspension
^resolve_A_
^resolution$_A_problem|\[\$U|\[\$G|reach|facilitat|fair|consult|negot|talks
revok_A_\[*|\[\-|suspension
unrestricted_A_
world class_A_
world-class_A_</td></tr>
</table>

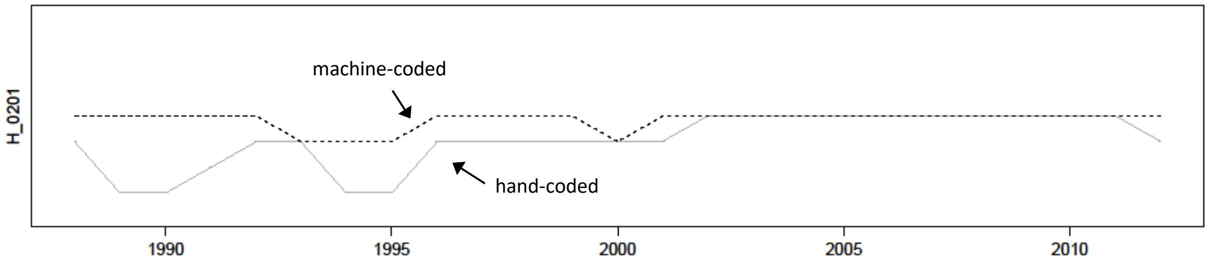
Table A.I.7: NTE automated content analysis dictionary – Negations and qualifiers

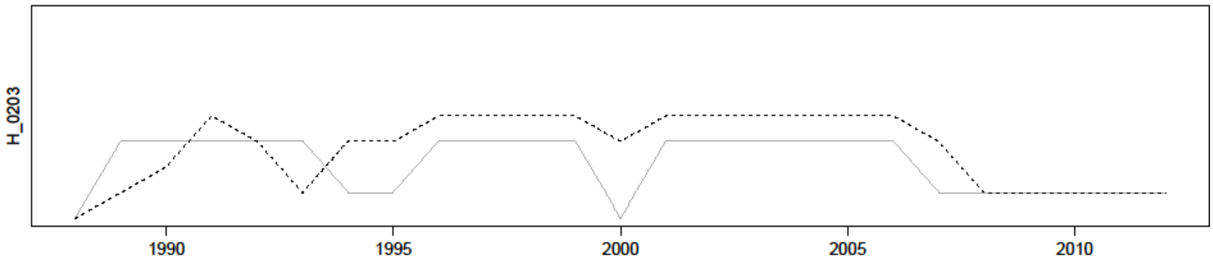
<table>
<tr><th>Code</th><th>Description</th><th>Search terms</th></tr>
<tr><td>-n</td><td>negations</td><td>cannot_N_\[\$US
^ever$_A_^no$
little_A_\[
neither_A_\[
^no$_N_intention|less|changes
^nor$_N_\{
^not$_N_covered</td></tr>
</table>

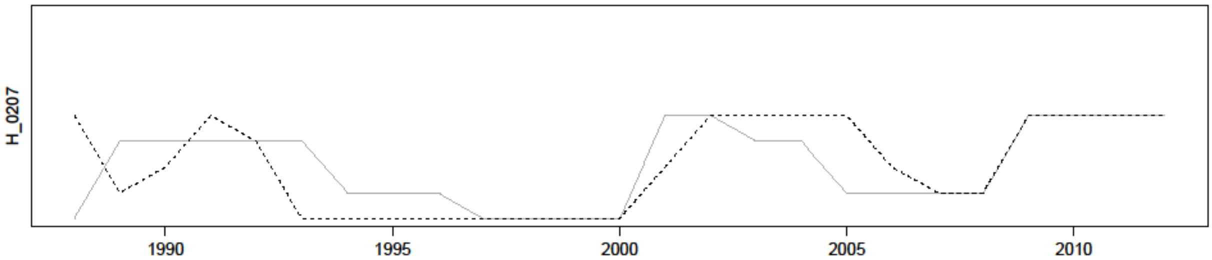
		^not$ yet_A_\[
		^not$ as yet_A_\[
		yet to_A_\[
		without_A_\[
-e	exceptions	except$_N_without
		excepted_N_without
		exception$_N_without
		exceptions_N_without
		not cover_N_cost
=0	conditionals	^if$_A_\[
		could_A_\[
		may_N_19|20
		might_A_\[
		whether_A_\[
+s	qualifiers	^few_A_\[
		gradual_A_\[
		a handful_A_\[
		^less_A_\[
		^limited_A_circumstanc|condition
		^partial_A_\[
		relatively_A_\[
		sometimes_A_\[
		slight_A_\[
		temporary_A_\[
		previously_A_\[-
+l	intensifiers	aggressive_A_\[
		acute_A_\[
		closely_A_\[
		complete$_A_\[
		considerable_A_\[
		deeply_A_\[
		effectively_A_\[
		enorm_A_\[
		especially \[\+pos1\+\]_A_
		especially \[-neg1-\]_A_
		especially \[\+pos2\+\]_A_
		especially \[-neg2-\]_A_
		especially \[\+pos3\+\]_A_
		especially \[-neg3-\]_A_
		exceedingly_A_\[
		exceptionally_A_\[
		extremely_A_\[
		extensive_A_\[
		^fully$_A_\[
		great_A_\[
		greatly_A_\[
		highly_A_\[
		important_A_\[
		^key$_N_^be$
		long standing_A_\[
		long-standing_A_\[
		longstanding_A_\[
		long running_A_\[
		long-running_A_\[

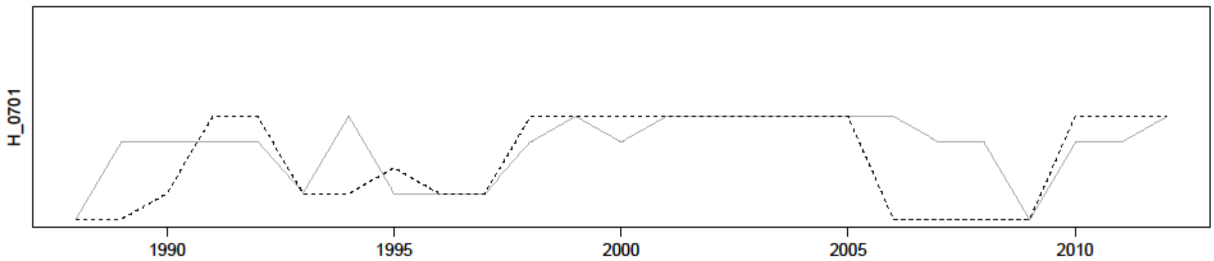
<table>
<tr><td></td><td></td><td>longrunning_A_\[
^more$_N_than
myriad_A_\[
numerous_A_\[
overly_A_\[
particularly \[\+pos1\+\]_A_
particularly \[-neg1-\]_A_
particularly \[\+pos2\+\]_A_
particularly \[-neg2-\]_A_
particularly \[\+pos3\+\]_A_
particularly \[-neg3-\]_A_
persistent_A_\[
pervasive_A_\[
repeated_A_\[
serious_N_issue|question|challenge
severe_A_\[
significant_A_\[
steep_A_\[
strongly_A_\[
substantial_A_\[
totally_A_\[
very_A_\[
vast_A_\[
virtually_A_\[
completely_N_knock|built</td></tr>
<tr><td>-C</td><td>calls for change (normative)</td><td>is needed_A_more|further|additional
are needed_A_more|further|additional
still needed_A_more|further|additional
is warranted_A_more|further|additional
are warranted_A_more|further|additional
still warranted_A_more|further|additional
necessary_A_more|further|additional
need for_A_more|further|additional
will need to_A_
will be necessary_A_
need to_A_\[\$USG|countryName
need to_A_\[\+|countryName
need for_A_\[\$USG|countryName
need for_A_\[\+|countryName
should be_A_\[\+
should_A_countryName
to be done_A_\[\+</td></tr>
<tr><td>+C</td><td>reactions to change</td><td>moved from_A_^USTR$|\[\$G
moving from_A_^USTR$|\[\$G
moved countryName from_A_^USTR$|\[\$G
moving countryName from_A_^USTR$|\[\$G
remov_A_^USTR$|\[\$G
terminat_A_^USTR$|\[\$G|investigation
^off$_A_^USTR$|\[\$G
withdr_A_case|proceeding|arbitration</td></tr>
</table>

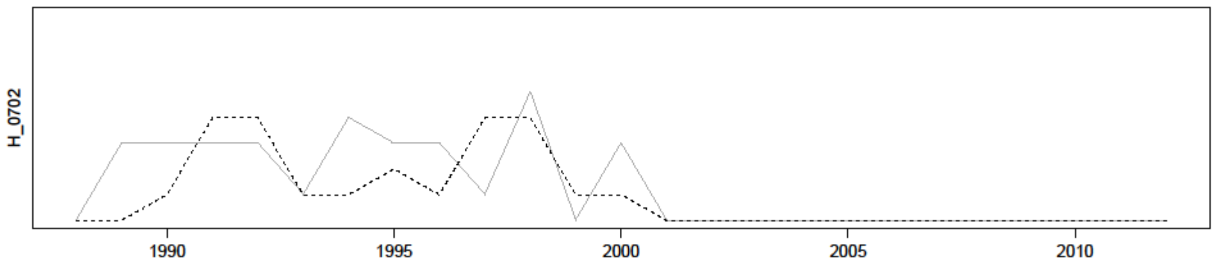
Appendix II – Automated Content Analysis: Full Set of Validation Plots

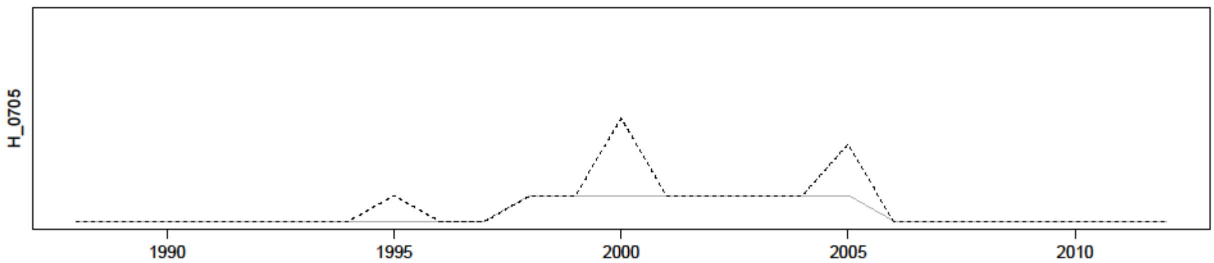


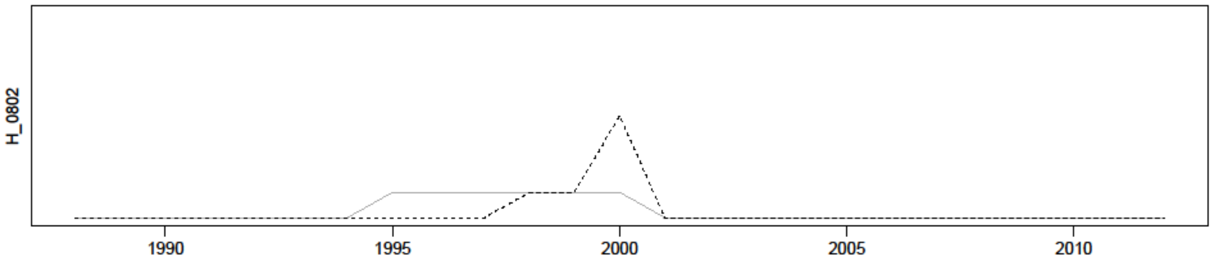








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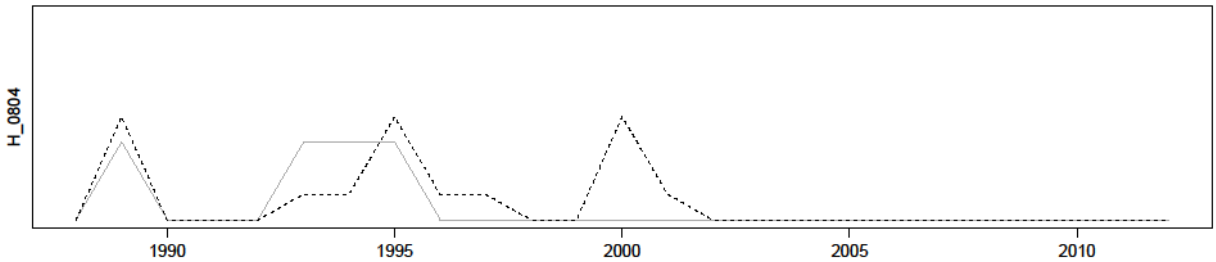
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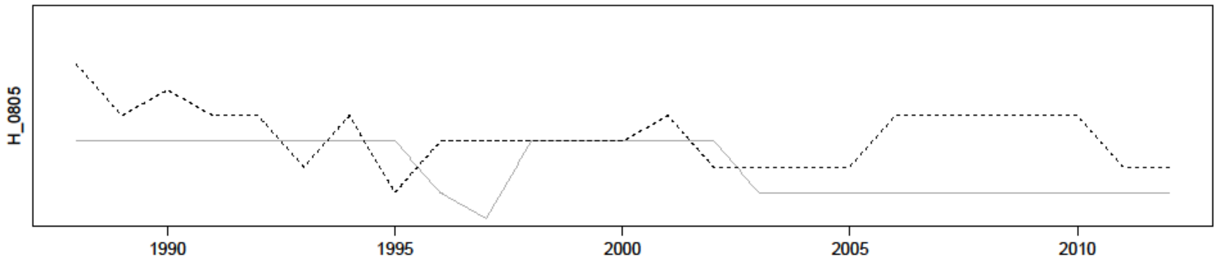
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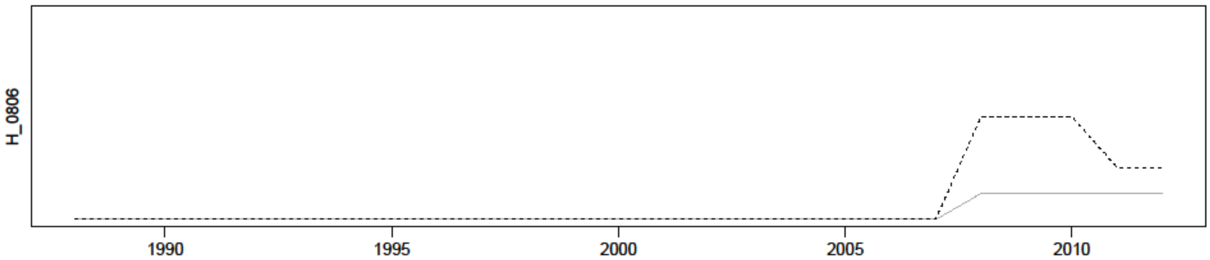
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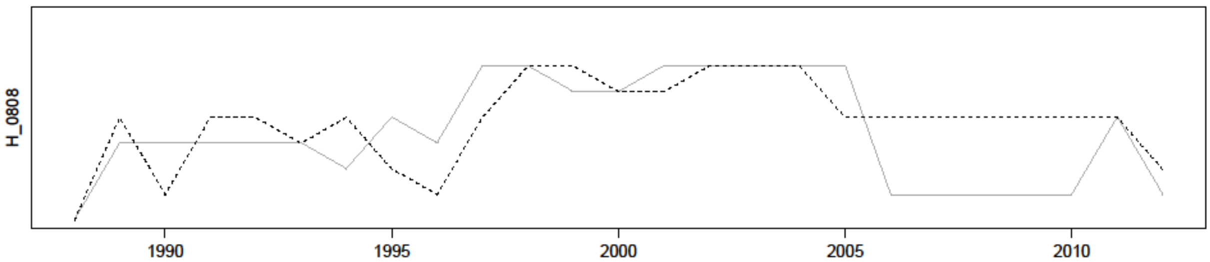
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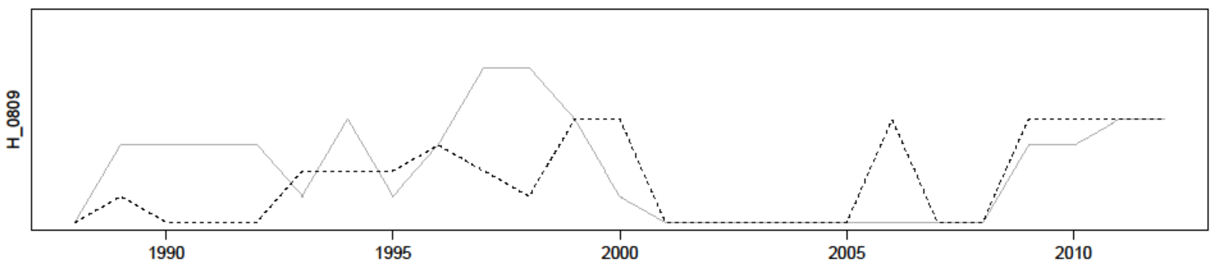
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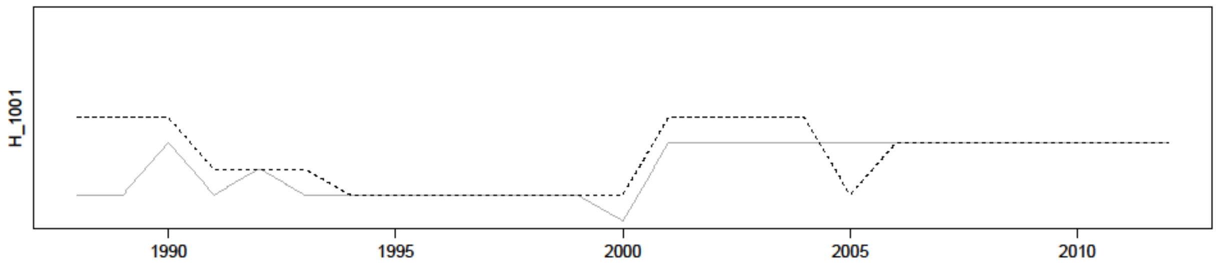
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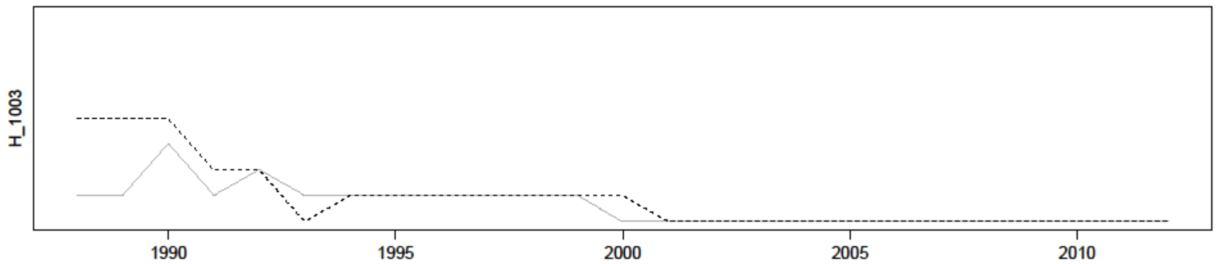
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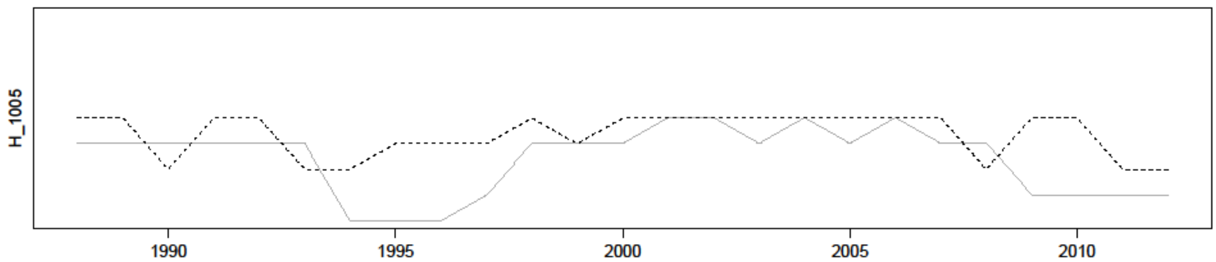
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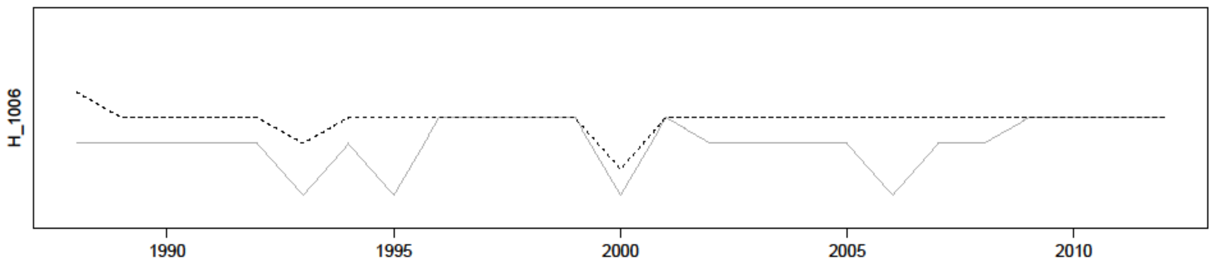
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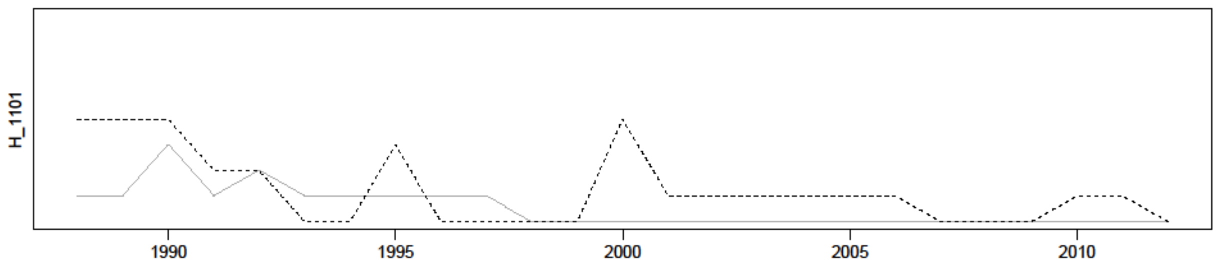
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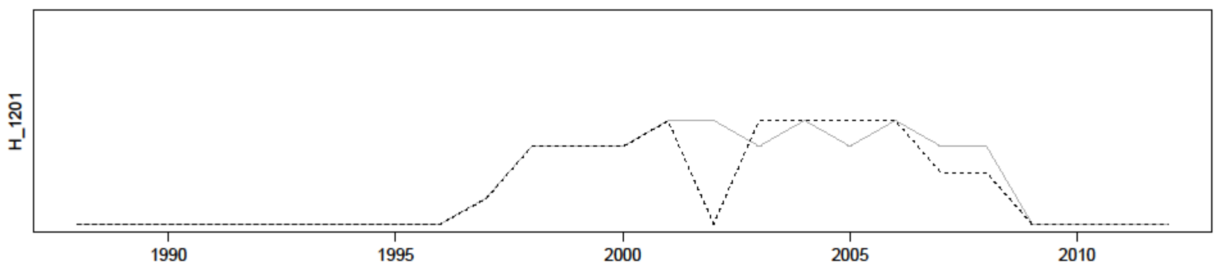
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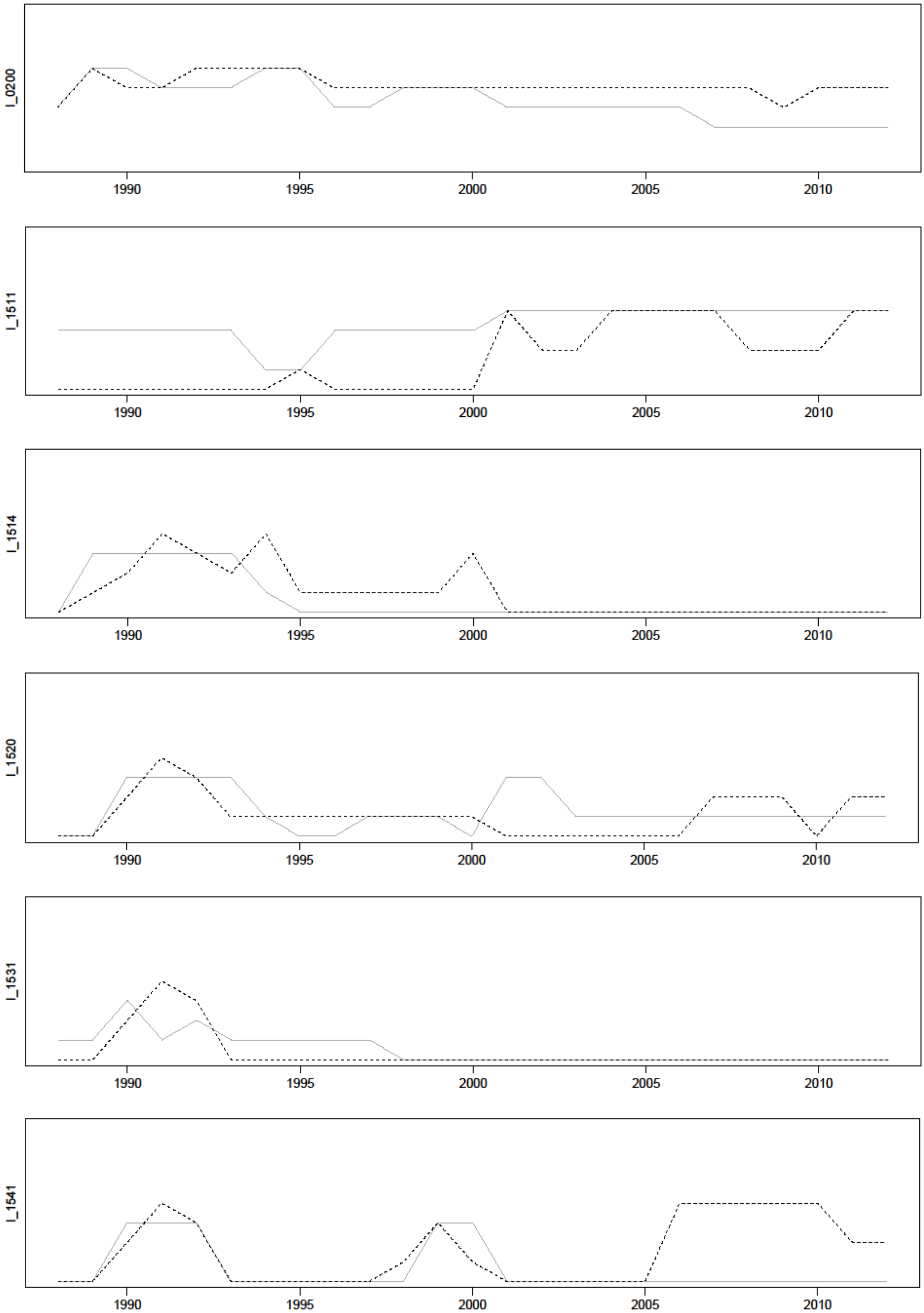
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2010
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I_1531
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I_1541
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1995
2000
2005
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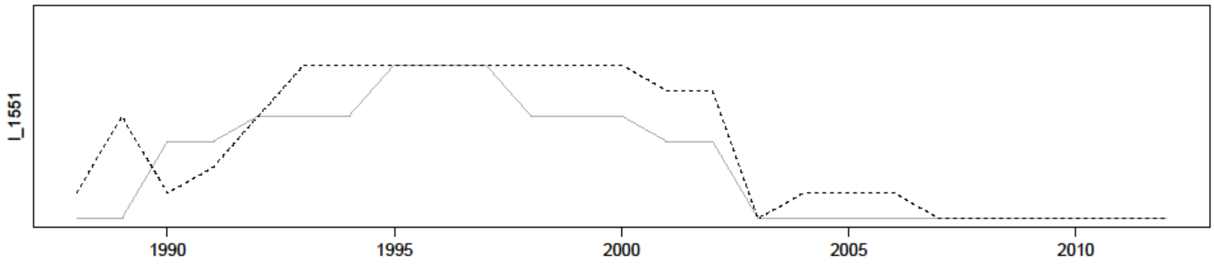
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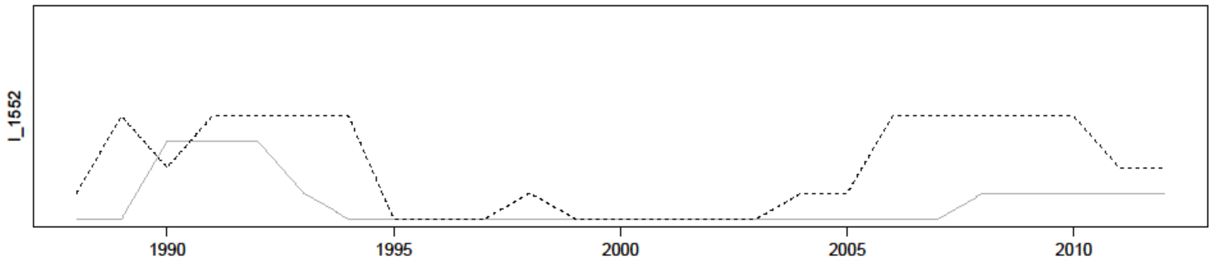
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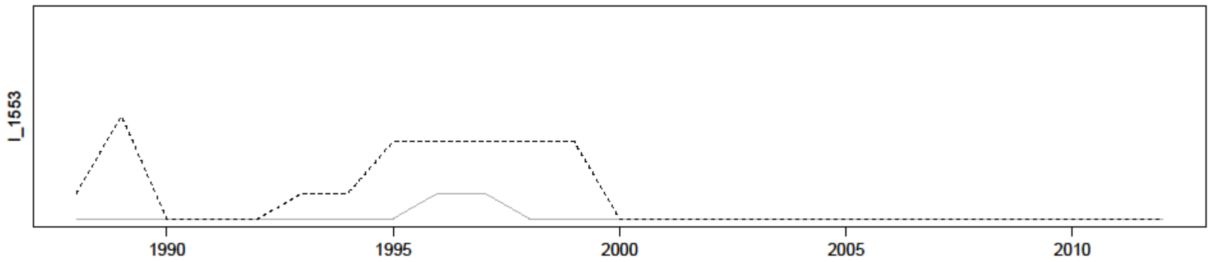
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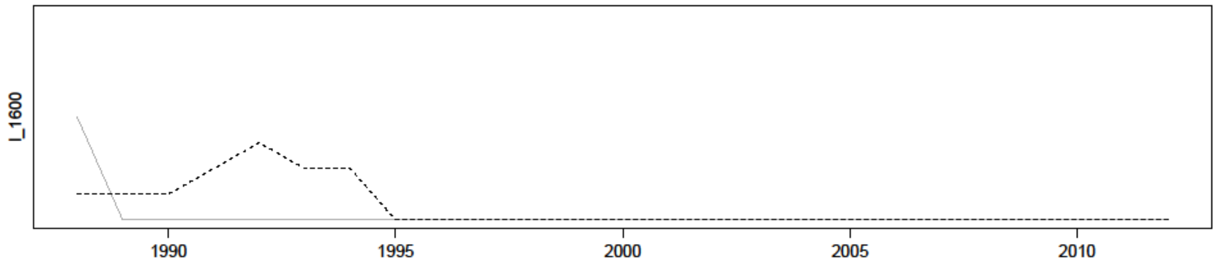
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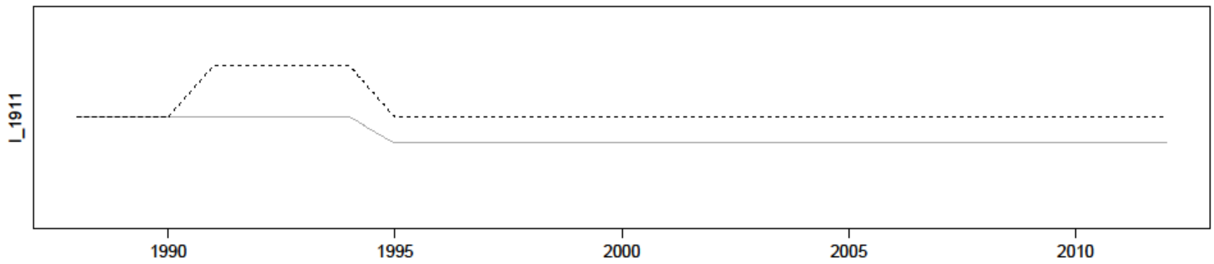
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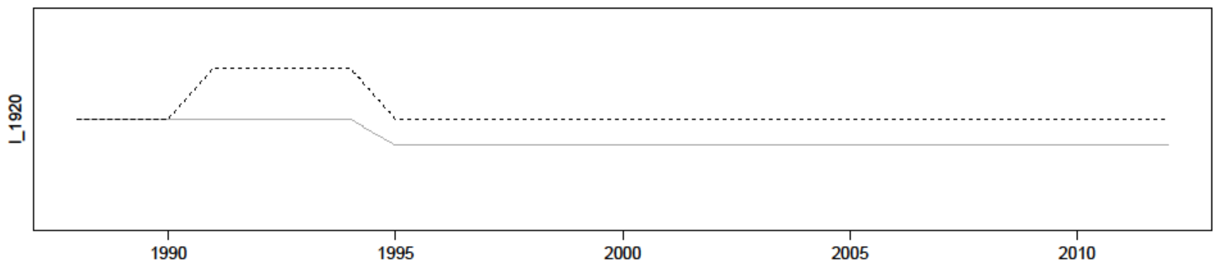
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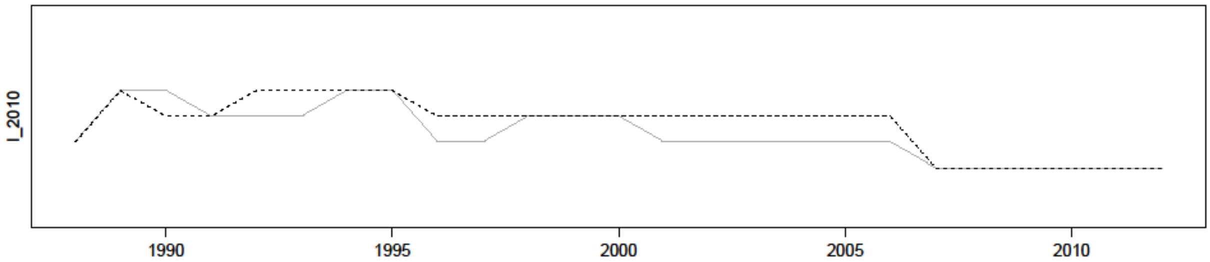
2005
2010


I_2010
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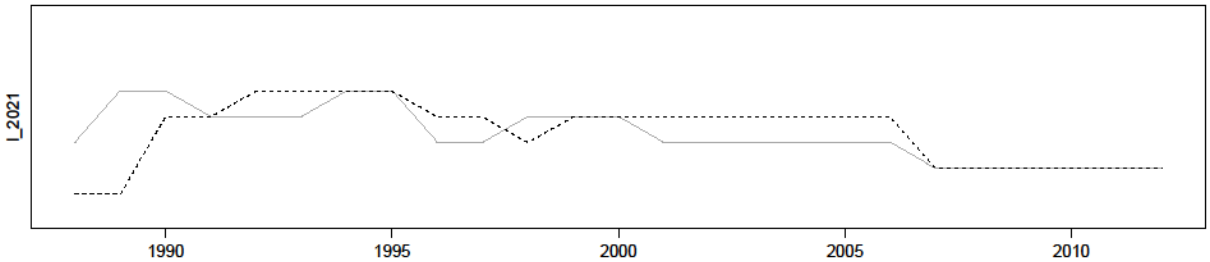
1995
2000
2005
2010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2005
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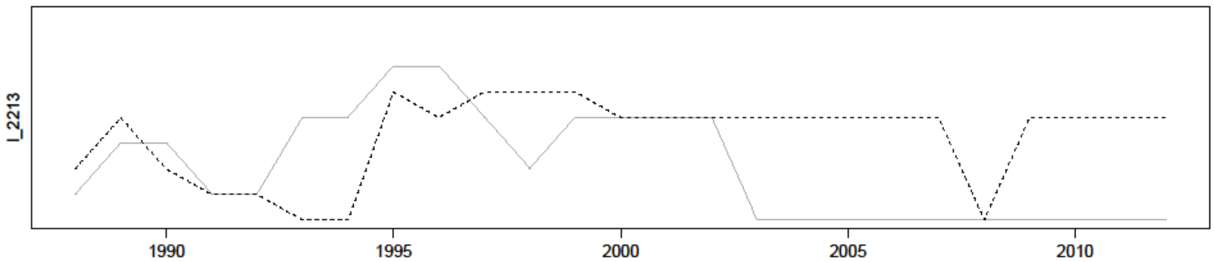
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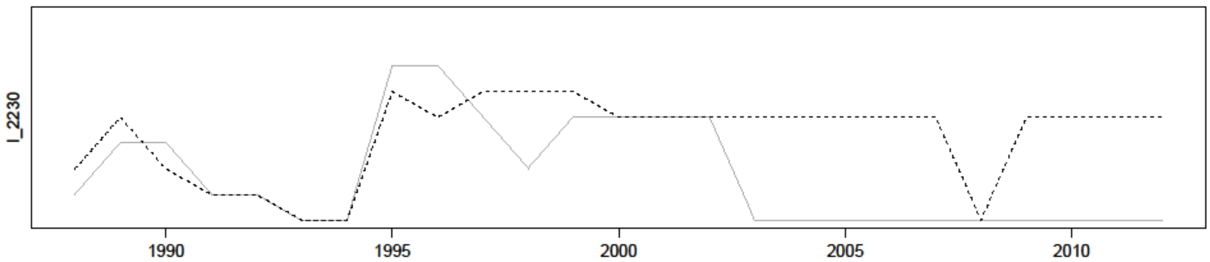
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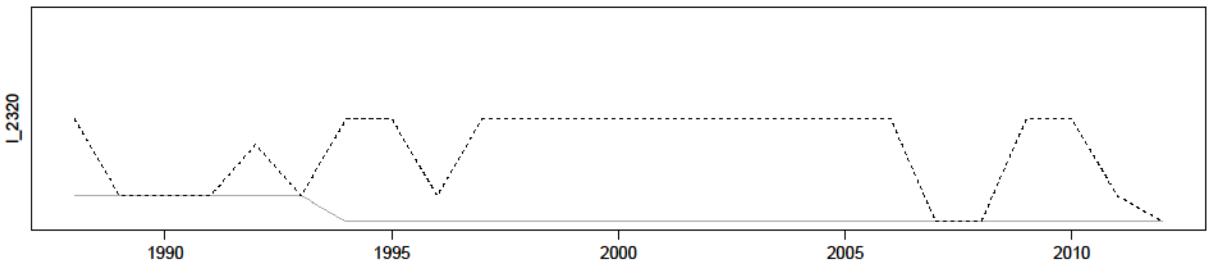
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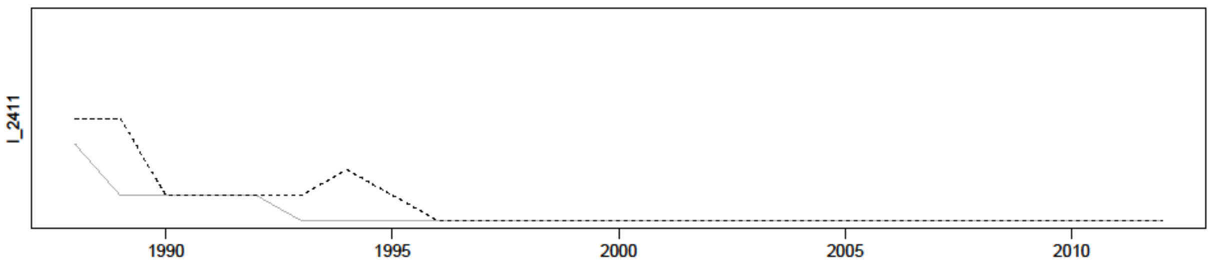
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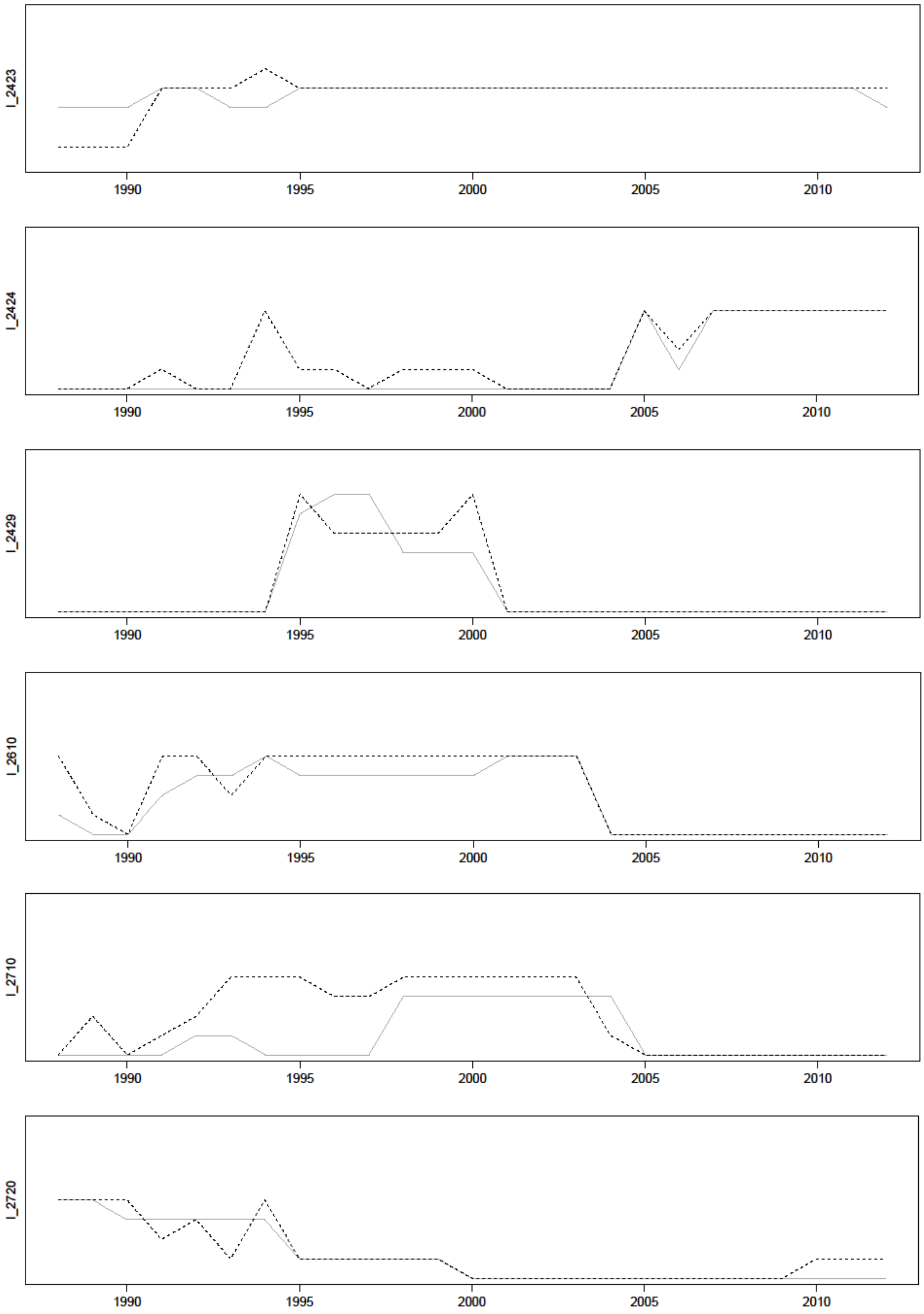
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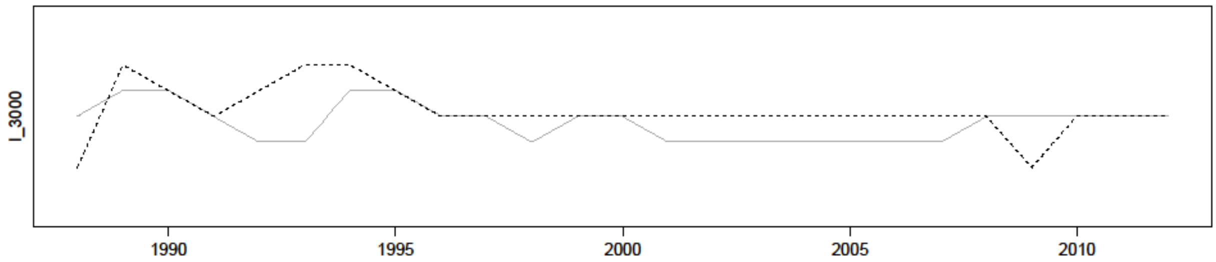
1995
2000
2005
2010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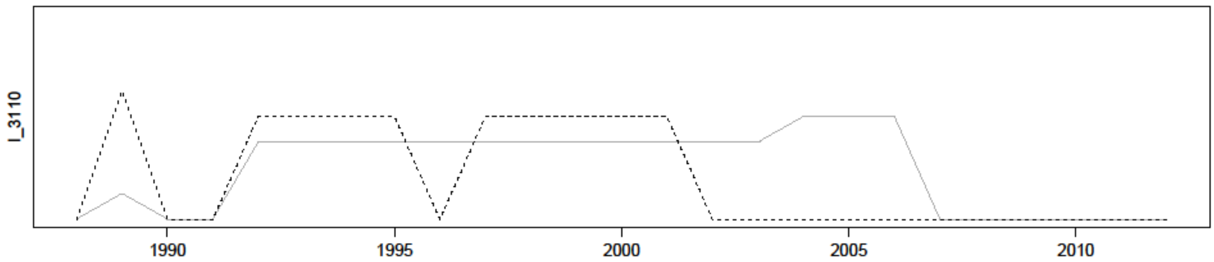
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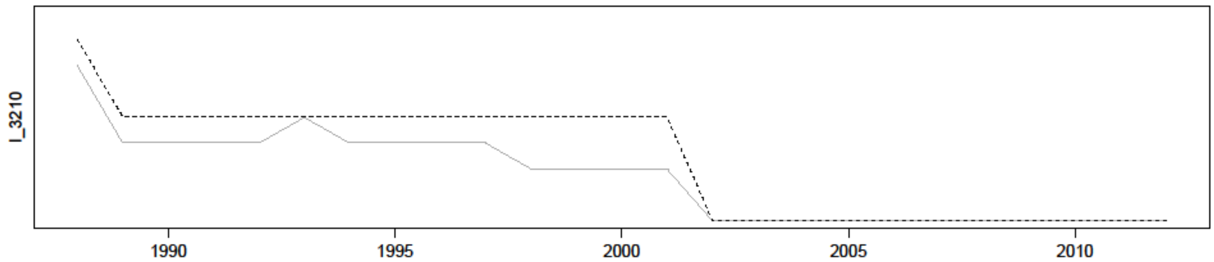
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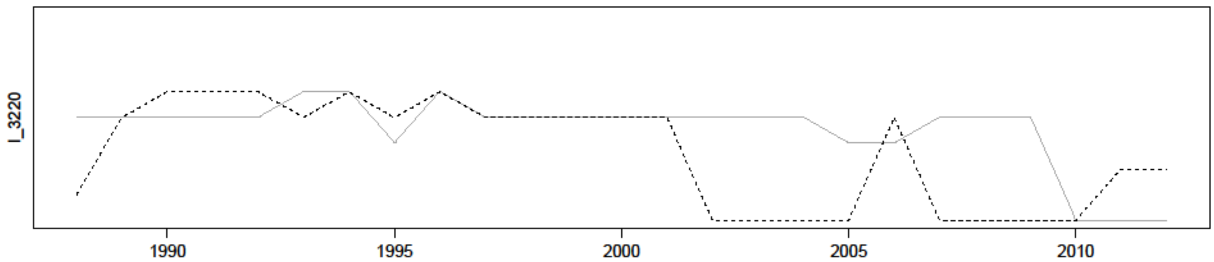
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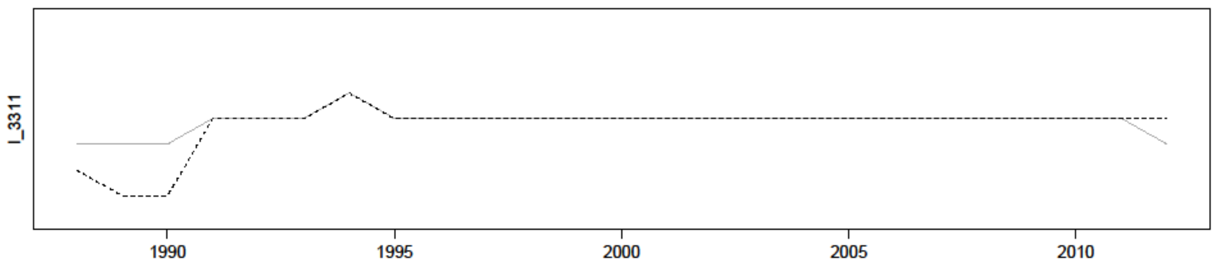
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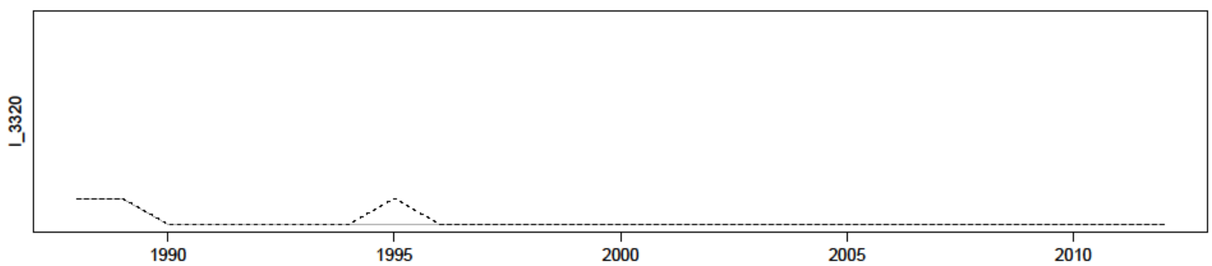
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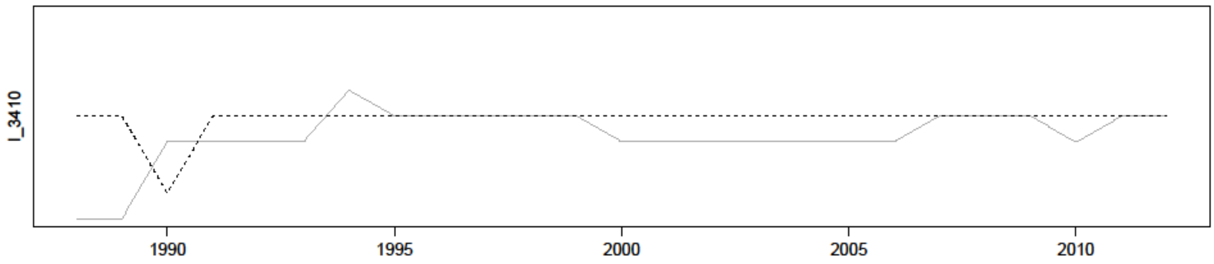
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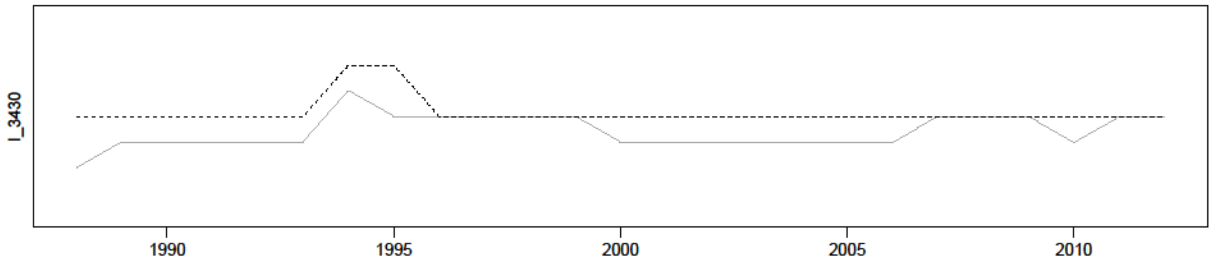
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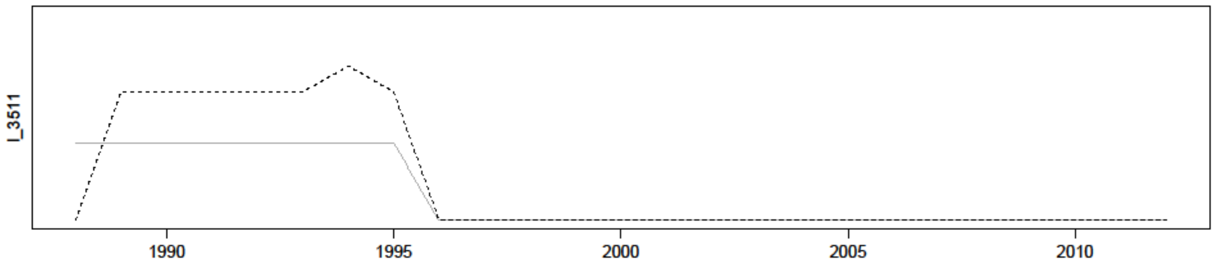
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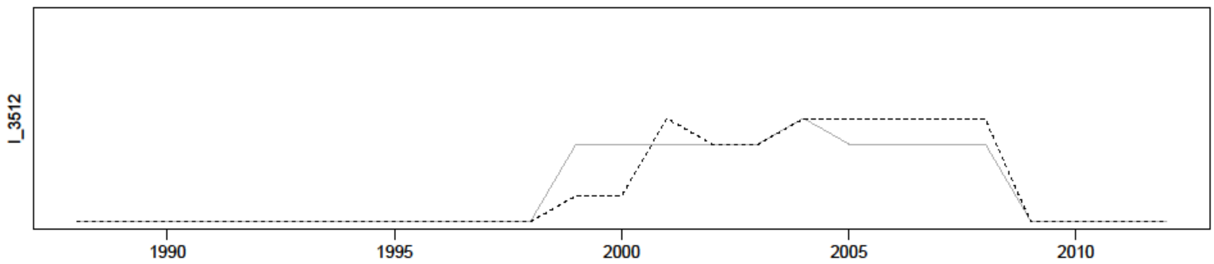
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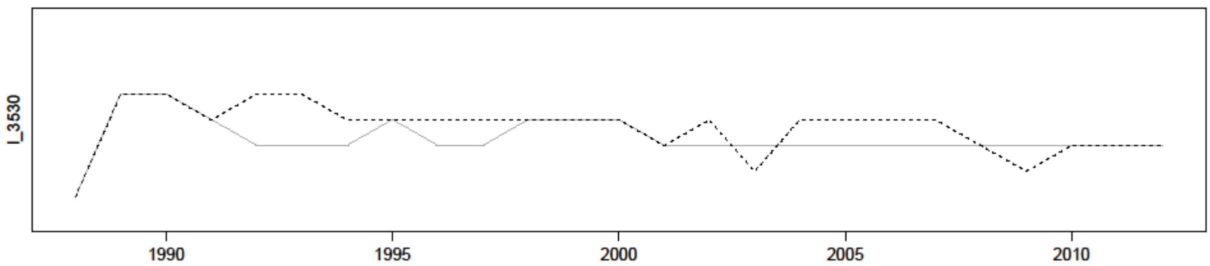
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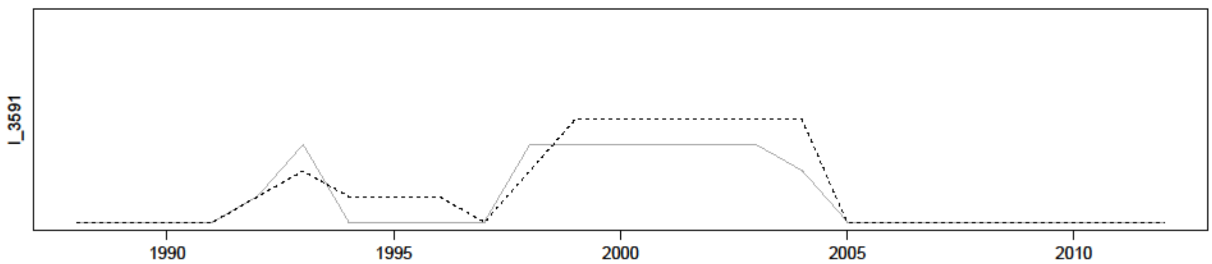
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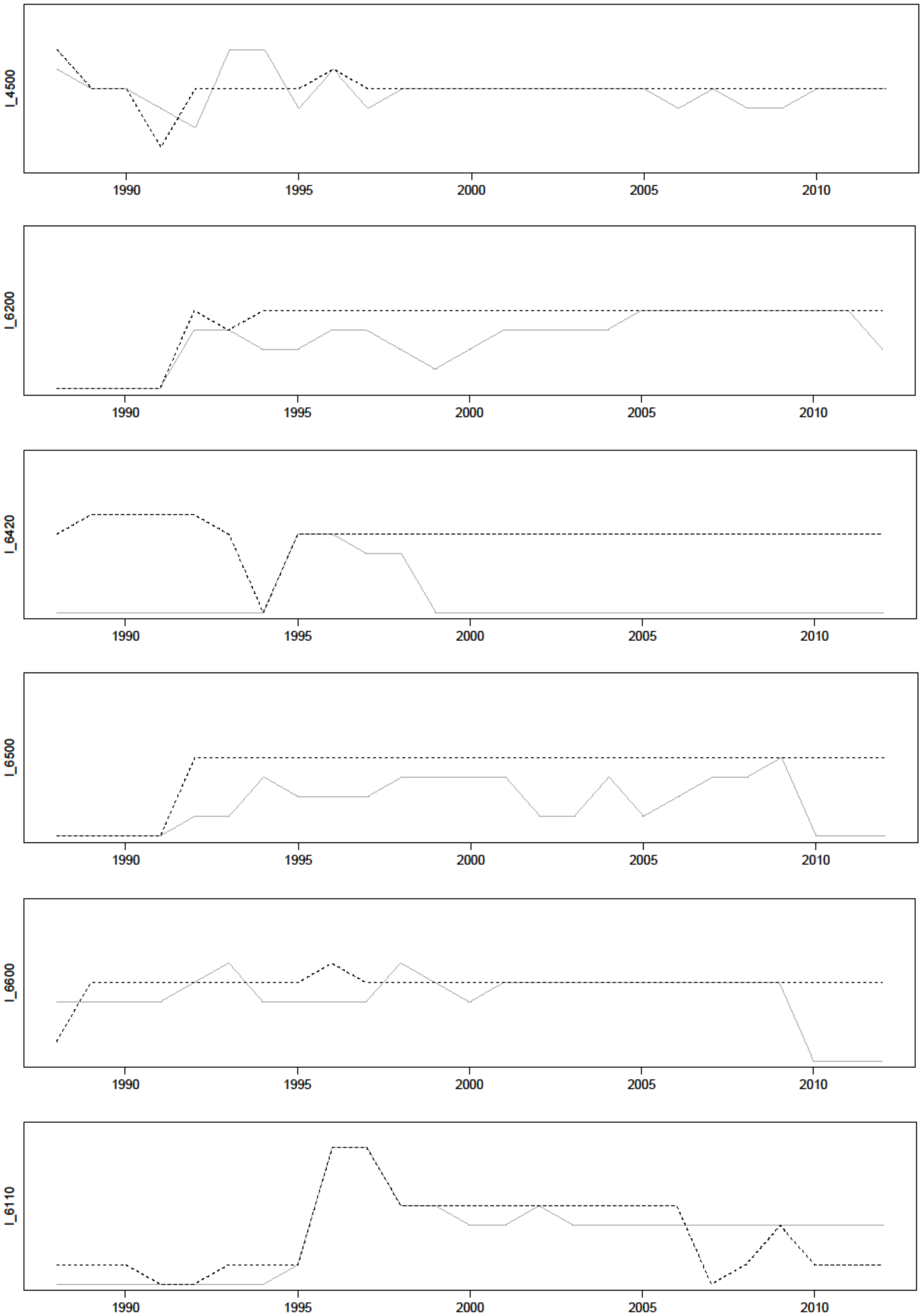
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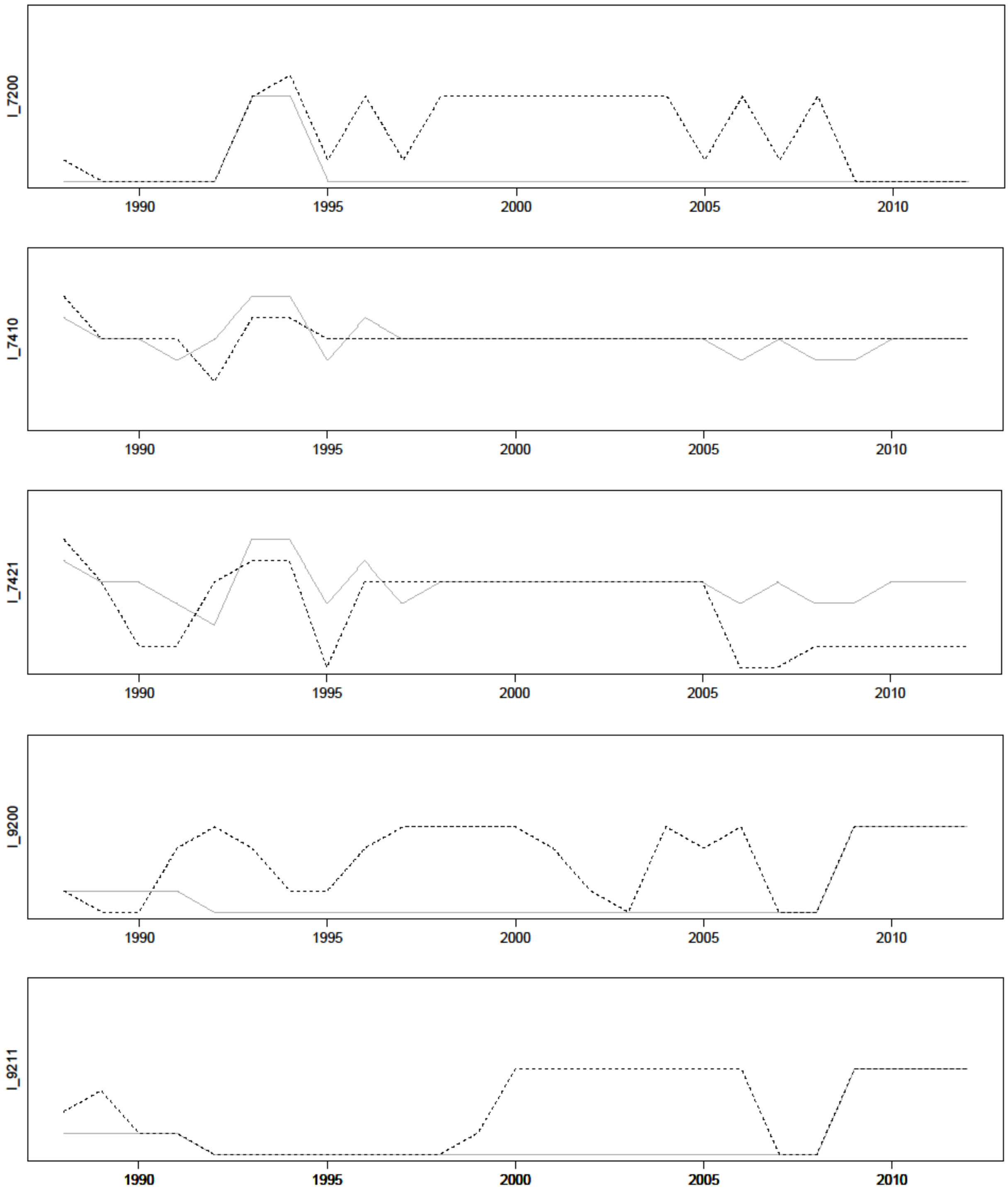

Note: The black dashed line shows the auto-coded data and the gray solid line shows the manually-coded data.

Appendix III – Non-Tariff-Barriers: Full List of Product-Level Estimates

Table A.III.1: Estimated NTB ad valorem equivalents – trade-weighted averages

Code	Description	AVE.1	AVEs.2
H_0101	Horses, asses, mules and hinnies, live	75.2	160.9
H_0102	Bovine animals, live	720.8	774.4
H_0103	Swine, live	803.5	786.0
H_0104	Sheep and goats, live	660.6	695.1
H_0105	Poultry, live,	1667.1	1671.7
H_0106	Animals, live, n.e.c. in chapter 01	2218.3	2152.6
H_0201	Meat of bovine animals, fresh or chilled	213.8	260.4
H_0203	Meat of swine, fresh, chilled or frozen	271.3	219.5
H_0204	Meat of sheep or goats, fresh, chilled or frozen	297.3	314.0
H_0205	Meat, of horses, asses, mules or hinnies, fresh, chilled or frozen	228.9	229.2
H_0207	Meat and edible offal of poultry	229.1	236.4
H_0208	Meat and edible meat offal, n.e.c. in chapter 2, fresh, chilled or frozen	138.0	150.2
H_0401	Milk and cream	416.5	480.9
H_0407	Birds' eggs, in shell, fresh, preserved or cooked	227.2	291.2
H_0409	Honey, natural	254.0	231.8
H_0701	Potatoes	392.7	442.4
H_0702	Tomatoes	42.6	94.7
H_0703	Onions, shallots, garlic, leeks	242.3	304.8
H_0704	Cabbages, cauliflowers, kohlrabi, kale	143.3	216.6
H_0705	Lettuce	78.3	167.2
H_0706	Carrots, turnips, salad beetroot, salsify, celeriac, radishes	229.8	313.3
H_0707	Cucumbers and gherkins	77.3	169.5
H_0708	Leguminous vegetables	393.6	459.5
H_0709	Vegetables, n.e.c.	63.3	134.6
H_0713	Vegetables, leguminous, shelled, whether or not skinned or split, dried	286.6	332.1
H_0714	Manioc	2213.8	2278.7
H_0801	Coconuts, Brazil nuts and cashew nuts	151.6	159.4
H_0802	Nuts other	91.5	145.9
H_0803	Bananas	22.4	100.4
H_0804	Dates, figs, pineapples, avocados, guavas, mangoes	151.2	210.9
H_0805	Citrus	91.1	124.1
H_0806	Grapes	224.5	306.7
H_0807	Melons (including watermelons) and papaws (papayas)	125.4	212.8
H_0808	Apples, pears and quinces	109.8	177.2
H_0809	Apricots, cherries, peaches (including nectarines), plums and sloes	65.5	113.6
H_0810	Fruit, fresh, n.e.c.	157.4	233.2
H_0901	Coffee	755.8	666.5
H_0902	Tea	163.5	239.1
H_0904	Pepper	240.7	252.1
H_0907	Cloves	450.8	437.9
H_0908	Nutmeg	0.0	15.2
H_0909	Seeds of anise, badian, fennel, coriander, cumin, caraway or juniper	268.9	348.4
H_0910	Ginger, saffron, turmeric (curcuma), thyme, bay leaves, curry	439.8	510.6
H_1001	Wheat and meslin	277.8	325.6
H_1002	Rye	802.4	898.5
H_1003	Barley	385.4	425.8

H_1004	Oats	251.4	285.2
H_1005	Maize (corn)	251.9	343.4
H_1006	Rice	343.1	392.5
H_1007	Grain sorghum	726.5	823.4
H_1008	Buckwheat	664.6	737.8
H_1201	Soya beans, whether or not broken	425.4	487.1
H_1202	Ground-nuts, not roasted or otherwise cooked	75.3	113.8
H_1204	Oil seeds, linseed, whether or not broken	56.5	81.6
H_1205	Rape or colza seeds	592.9	668.4
H_1206	Sunflower seeds, whether or not broken	378.8	427.3
H_1207	Oil seeds and oleaginous fruits, n.e.c.	869.7	938.9
H_1210	Hop cones	229.5	308.8
H_1212	Locust beans	823.2	849.1
H_1214	Swedes, mangolds, fodder roots, hay, lucerne (alfalfa), clover	1268.7	1259.4
H_1509	Olive oil and its fractions	530.2	578.5
H_1511	Palm oil and its fractions	11.9	65.3
H_1521	Vegetable waxes	1037.6	1017.9
H_1701	Cane or beet sugar	137.3	167.8
H_1801	Cocoa beans	72.7	100.2
H_2204	Wine of fresh grapes	517.9	181.8
H_2401	Tobacco	99.0	135.5
I_1511	Processing/preserving of meat	121.5	172.0
I_1512	Processing/preserving of fish	0.0	55.1
I_1513	Processing/preserving of fruit & vegetables	4.4	96.9
I_1514	Vegetable and animal oils and fats	52.7	148.5
I_1520	Dairy products	170.8	220.6
I_1531	Grain mill products	197.4	274.0
I_1532	Starches and starch products	45.3	118.2
I_1533	Prepared animal feeds	189.7	251.3
I_1541	Bakery products	58.7	144.0
I_1542	Sugar	185.4	270.3
I_1543	Cocoa, chocolate and sugar confectionery	0.0	81.2
I_1544	Macaroni, noodles & similar products	123.2	207.5
I_1549	Other food products n.e.c.	6.7	97.9
I_1551	Distilling, rectifying & blending of spirits	86.5	166.6
I_1552	Wines	108.2	182.3
I_1553	Malt liquors and malt	111.8	146.6
I_1554	Soft drinks, mineral waters	204.3	273.8
I_1600	Manufacture of tobacco products	369.8	442.6
I_1711	Textile fiber preparation, textile weaving	0.0	74.6
I_1721	Finishing of textiles	0.0	49.4
I_1722	Made-up textile articles, except apparel	0.0	76.9
I_1723	Carpets and rugs	31.1	127.0
I_1729	Cordage, rope, twine and netting	0.0	41.9
I_1730	Knitted and crocheted fabrics and articles	0.0	24.1
I_1810	Wearing apparel, except fur apparel	0.0	28.8
I_1820	Dressing & dyeing of fur, processing of fur	98.2	175.4
I_1911	Tanning and dressing of leather	0.0	41.8
I_1912	Luggage, handbags, etc.	0.0	36.0
I_1920	Footwear	0.0	41.5
I_2010	Sawmilling and planning of wood	62.9	149.4

I_2021	Veneer sheets, plywood, particle board, etc.	0.0	69.6
I_2022	Builders' carpentry and joinery	115.5	180.5
I_2023	Wooden containers	37.0	113.3
I_2029	Other wood products, articles of cork/straw	11.4	96.2
I_2101	Pulp, paper and paperboard	0.0	44.1
I_2102	Corrugated paper and paperboard	4.5	101.5
I_2109	Other articles of paper and paperboard	0.0	44.1
I_2211	Publishing of books and other publications	0.0	92.8
I_2212	Publishing of newspapers, journals, etc.	255.5	346.6
I_2213	Publishing of recorded media	0.0	26.3
I_2219	Other publishing	16.2	100.3
I_2221	Printing	155.1	237.5
I_2222	Service activities related to printing	1491.3	1559.3
I_2310	Coke oven products	1810.0	1793.6
I_2320	Refined petroleum products	0.0	69.8
I_2330	Processing of nuclear fuel	111.0	110.1
I_2411	Basic chemicals, except fertilizers	0.0	40.1
I_2412	Fertilizers and nitrogen compounds	99.5	187.3
I_2413	Plastics in primary forms, synthetic rubber	0.0	58.2
I_2421	Pesticides and other agro-chemical products	28.7	89.9
I_2422	Paints, varnishes, printing ink and mastics	2.0	99.2
I_2423	Pharmaceuticals, medicinal chemicals, etc.	0.0	78.4
I_2424	Soap, cleaning & cosmetic preparations	0.0	72.6
I_2429	Other chemical products n.e.c.	0.0	50.7
I_2430	Man-made fibers	0.0	65.0
I_2511	Rubber tires and tubes	0.0	67.6
I_2519	Other rubber products	0.0	57.5
I_2520	Plastic products	0.0	50.8
I_2610	Glass and glass products	0.0	61.2
I_2691	Pottery, china and earthenware	0.0	56.2
I_2692	Refractory ceramic products	47.2	132.8
I_2693	Non-refractory clay, ceramic products	72.7	166.1
I_2694	Cement, lime and plaster	238.8	327.6
I_2695	Articles of concrete, cement and plaster	226.1	322.5
I_2696	Cutting, shaping & finishing of stone	168.5	249.3
I_2699	Other non-metallic mineral products n.e.c.	0.0	90.7
I_2710	Basic iron and steel	0.0	51.4
I_2720	Basic precious and non-ferrous metals	0.0	56.8
I_2811	Structural metal products	17.4	111.0
I_2812	Tanks, reservoirs and containers of metal	31.7	123.2
I_2813	Steam generators	103.0	195.5
I_2893	Metal forging/pressing/stamping/roll-forming	0.0	80.1
I_2899	Treatment & coating of metals	0.0	36.8
I_2911	Engines & turbines (not for transport equipment)	66.3	147.2
I_2912	Pumps, compressors, taps and valves	0.0	28.8
I_2913	Bearings, gears, gearing & driving elements	0.0	48.6
I_2914	Ovens, furnaces and furnace burners	0.0	44.1
I_2915	Lifting and handling equipment	0.0	59.0
I_2919	Other general purpose machinery	0.0	47.6
I_2921	Agricultural and forestry machinery	0.0	79.6
I_2922	Machine tools	0.0	69.7

I_2923	Machinery for metallurgy	8.2	91.4
I_2924	Machinery for mining & construction	0.0	53.1
I_2925	Food/beverage/tobacco processing machinery	0.0	76.6
I_2926	Machinery for textile, apparel and leather	0.0	36.9
I_2927	Weapons and ammunition	187.4	265.3
I_2929	Other special purpose machinery	0.0	36.6
I_2930	Domestic appliances n.e.c.	0.0	51.7
I_3000	Manufacture of office, accounting and computing machinery	0.0	41.6
I_3110	Electric motors, generators and transformers	0.0	74.1
I_3120	Electricity distribution & control apparatus	0.0	52.3
I_3130	Insulated wire and cable	0.0	50.9
I_3140	Accumulators, primary cells and batteries	0.0	66.2
I_3150	Lighting equipment and electric lamps	0.0	41.5
I_3190	Other electrical equipment n.e.c.	0.0	34.2
I_3210	Electronic valves, tubes, etc.	0.0	41.4
I_3220	TV/radio transmitters, line comm. apparatus	0.0	46.6
I_3230	TV and radio receivers and associated goods	0.0	82.0
I_3311	Medical, surgical and orthopedic equipment	0.0	58.6
I_3312	Measuring/testing/navigating appliances, etc.	0.0	55.4
I_3313	Industrial process control equipment	0.0	71.8
I_3320	Optical instruments & photographic equipment	0.0	43.2
I_3330	Watches and clocks	0.0	36.9
I_3410	Motor vehicles	0.0	58.1
I_3420	Automobile bodies, trailers & semi-trailers	0.0	82.5
I_3430	Parts/accessories for automobiles	0.0	39.6
I_3511	Building and repairing of ships	94.5	173.2
I_3512	Building/repairing of pleasure/sport. boats	7.4	96.3
I_3520	Railway/tramway locomotives & rolling stock	59.6	141.1
I_3530	Aircraft and spacecraft	0.0	75.4
I_3591	Motorcycles	51.0	121.5
I_3592	Bicycles and invalid carriages	15.3	84.0
I_3599	Other transport equipment n.e.c.	19.8	87.4
I_3610	Furniture	0.0	72.7
I_3691	Jewelry and related articles	0.0	59.8
I_3692	Musical instruments	15.5	107.3
I_3693	Sports goods	0.0	41.5
I_3694	Games and toys	0.0	13.1
I_3699	Other manufacturing n.e.c.	0.0	56.1
I_4500	Construction	707.9	585.4
I_6200	Air transport	57.0	84.2
I_6300	Supporting and auxiliary transport activities, activities of travel agencies	494.0	490.7
I_6500	Financial intermediation, except insurance and pension funding	285.6	362.9
I_6600	Insurance and pension funding, except compulsory social security	251.2	229.2
I_7200	Computer and related activities	264.5	279.2
I_7300	Research and development	146.9	136.2
I_7500	Public administration and defense, compulsory social security	613.3	237.6
I_9200	Recreational, cultural and sporting activities	335.5	304.6

Note: Product codes beginning with 'H' refer to the HS classification; codes beginning with 'I' refer to the ISIC rev. 3 classification. The NTB *ad valorem* equivalents are reported in percent.

Appendix IV – Explaining Escalation: Additional Estimates

Table A.IV.1: Relating I. Maximum escalation levels counterfactual gain and loss shares (stakes)

	DV: I. Maximum Escalation			
	Linear Regression		Censored Regression (Tobit)	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–1.789***	–2.227***	–1.717	–3.262**
	(0.484)	(0.568)	(0.987)	(1.087)
L_{jk}	–0.745	–0.383	–1.980	–1.205
	(0.684)	(0.296)	(1.414)	(0.633)
$G_{USjk} \times L_{jk}$	8.823***	4.462***	9.995***	6.467***
	(1.580)	(0.732)	(2.688)	(1.337)
M_{jk}	0.044***	0.044***	0.025*	0.026*
	(0.008)	(0.008)	(0.012)	(0.012)
Log Sigma	–	–	0.773***	0.771***
			(0.017)	(0.017)
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	$k, j = ij$	$k, j = ij$
N	4,758	4,758	4,758	4,758
R^2	0.525	0.526	–	–
Log-likelihood	–	–	–5264.1	–5259.3
	Ordered Logit		Poisson	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–1.405	–2.494**	–0.636	–1.104**
	(0.821)	(0.902)	(0.348)	(0.386)
L_{jk}	–1.555	–0.923	–0.949	–0.548*
	(1.181)	(0.530)	(0.561)	(0.263)
$G_{USjk} \times L_{jk}$	8.156***	5.051***	3.011***	1.928***
	(2.228)	(1.109)	(0.887)	(0.442)
M_{jk}	0.029**	0.029**	0.002	0.001
	(0.010)	(0.010)	(0.002)	(0.002)
Log Sigma	–	–	–	–
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	$k, j = ij$	$k, j = ij$
N	4,758	4,758	4,758	4,758
R^2	–	–	–	–
Log-likelihood	–4507.8	–4504.0	–	–

Notes: The dependent variable is *I. Maximum escalation* as discussed in Section 7.1 and graphically shown in Figure 7.1. It ranges on a 9-point scale from 0 to 8. Higher numbers indicate higher maximum levels of escalation over the 1988-2012 time period. The calculations for parties' stakes, $G_{USjk}$and L_{jk}, are based on a hypothetical reduction of existing trade barriers by twenty-five percent by each importer j in each industry k. M_{jk}denotes total imports by importer j in each industry k measured in billion (10^9) US$ for meaningful coefficient interpretation. Importer/dyad (ij) and industry (k) fixed-effects are included as indicated; the intercept and fixed-effects coefficients are not reported. Huber-White robust standard errors for Linear and Poisson models and regular standard errors for Tobit and Ordered Logit models are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

Table A.IV.2: Relating II. Dispute intensity to counterfactual gain and loss shares (stakes)

	DV: II. Dispute Intensity			
	Linear Regression		Censored Regression (Tobit)	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–10.504	–12.456*	–22.623**	–36.331***
	(5.623)	(5.861)	(7.546)	(8.429)
L_{jk}	4.327	1.639	–33.323**	–18.428***
	5.415	(2.332)	(10.596)	(4.703)
$G_{USjk} \times L_{jk}$	74.007***	35.143***	128.933***	75.605***
	(17.145)	(7.927)	(22.417)	(11.141)
M_{jk}	0.657***	0.660***	1.117***	1.121***
	(0.130)	(0.130)	(0.010)	(0.096)
Log Sigma	–	–	2.975***	2.973***
			(0.017)	(0.017)
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	k, j_{WB}	k, j_{WB}
N	4,758	4,758	4,758	4,758
R^2	0.507	0.507	–	–
Log-likelihood	–	–	–9636.3	–9629.37
	Ordered Logit		Poisson	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–0.749	–1.925*	0.142	–0.260
	(0.804)	(0.884)	(0.448)	(0.497)
L_{jk}	–0.308	–0.374	0.449	0.089
	(1.166)	(0.524)	(0.681)	(0.318)
$G_{USjk} \times L_{jk}$	8.572***	5.352***	2.227*	1.483**
	(2.185)	(1.087)	(1.111)	(0.562)
M_{jk}	0.041***	0.041***	0.008**	0.008**
	(0.009)	(0.009)	(0.003)	(0.003)
Log Sigma	–	–	–	–
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	$k, j = ij$	$k, j = ij$
N	4,758	4,758	4,758	4,758
R^2	–	–	–	–
Log-likelihood	–8496.2	–8492.0	–	–

Notes: The dependent variable is *II. Dispute intensity* as discussed in Section 7.1 and graphically shown in Figure 7.1. It ranges from 0 to 132. Higher numbers indicate higher levels of dispute intensity over the 1988-2012 time period. The calculations for parties' stakes, $G_{USjk}$and L_{jk}, are based on a hypothetical reduction of existing trade barriers by twenty-five percent by importer j in each industry k. M_{jk}denotes total imports by importer j in each industry k measured in billion (10^9) US$ for meaningful coefficient interpretation. Importer/dyad (ij), importer income group (j_{WB}), and industry (k) fixed-effects are included as indicated; the intercept and fixed-effects coefficients are not reported. Huber-White robust standard errors for Linear and Poisson models and regular standard errors for Tobit and Ordered Logit models are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

Table A.IV.3: Relating III. Dispute duration to counterfactual gain and loss shares (stakes)

	DV: III. Dispute Duration			
	Linear Regression		Censored Regression (Tobit)	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–1.212	–1.316	–3.131	–5.559*
	(1.106)	(0.761)	(2.065)	(2.285)
L_{jk}	–0.329	–0.124	–10.047***	–5.203***
	(1.026)	(0.431)	(3.049)	(1.359)
$G_{USjk} \times L_{jk}$	9.735**	4.422***	25.027***	14.340***
	(3.204)	(0.949)	(6.020)	(2.973)
M_{jk}	0.093***	0.093***	0.208***	0.208***
	(0.019)	(0.010)	(0.024)	(0.024)
Log Sigma	–	–	1.558***	1.557***
			(0.023)	(0.023)
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	k, j_{WB}	k, j_{WB}
N	4,758	4,758	4,758	4,758
R^2	0.375	0.375	–	–
Log-likelihood	–	–	–4362.4	–4358.9
	Ordered Logit		Poisson	
	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$	$\omega_k = \widehat{\omega}_k$	$\omega_k = \infty$
G_{USjk}	–0.379	–1.248	0.777	0.426
	(0.933)	(1.019)	(0.525)	(0.583)
L_{jk}	–1.214	–0.771	–0.304	–0.253
	(1.434)	(0.649)	(0.986)	(0.464)
$G_{USjk} \times L_{jk}$	6.510**	4.013**	0.279	0.555
	(2.479)	(1.228)	(1.280)	(0.649)
M_{jk}	0.030**	0.030**	0.010**	0.010**
	(0.010)	(0.010)	(0.003)	(0.003)
Log Sigma	–	–	–	–
$Fixed\ effects$	$k, j = ij$	$k, j = ij$	$k, j = ij$	$k, j = ij$
N	4,758	4,758	4,758	4,758
R^2	–	–	–	–
Log-likelihood	–3597.4	–3595.6	–	–

Notes: The dependent variable is *III. Dispute duration* in years as discussed in Section 7.1 and graphically shown in Figure 7.1. It ranges from 0 to 25. Higher numbers indicate longer durations of disputes. The calculations for parties' stakes, G_{USjk} and L_{jk}, are based on a hypothetical reduction of existing trade barriers by twenty-five percent by importer j in each industry k. M_{jk} denotes total imports by importer j in each industry k measured in billion (10^9) US$ for meaningful coefficient interpretation. Importer/dyad (ij), importer income group (j_{WB}), and industry (k) fixed-effects are included as indicated; the intercept and fixed-effects coefficients are not reported. Huber-White robust standard errors for Linear and Poisson models and regular standard errors for Tobit and Ordered Logit models are in parentheses; ***, **, and * indicate significance at the .001, .01 and .05 levels, respectively.

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Research Interests

Bargaining, Conflict, Strategic Interaction, Trade Policy, Political Economy of Trade, Formal Modelling, Statistical Methodology and Applications

Education

05/2011–11/2017	**ETH Zurich, Ph.D.**, Political Science • Fields: International Political Economy & Political Methodology • Committee: Andreas Wenger, Frank Schimmelfennig, Dustin Tingley
04/2007–03/2011	**University of Heidelberg, M.A.**, Political Science, G*rade: A*
09/2008–02/2009	**American University Of Beirut (AUB)**, Semester Abroad
06/2006–12/2006	**Macquarie University Sydney**, Semester Abroad
10/2003–03/2007	**University of Giessen, M.A. intermediate exam/B.A. equivalent**, Political Science, G*rade: A*

Professional Positions

05/2011–11/2017	**Researcher (PhD Candidate)**, ETH Zurich
01/2010–03/2010	**Stagiaire**, Federal Foreign Office – German Embassy Kathmandu
07/2009–09/2009	**Intern**, Friedrich Ebert Foundation (FES) – Israel Office
03/2009–06/2009	**Free-lancer and Intern**, German Council On Foreign Relations
04/2008–09/2008	**Scientific Assistant**, South Asia Institute (SAI), University of Heidelberg
06/2007–09/2008	**Scientific Assistant**, Department of Political Science, University of Heidelberg

Publications and Manuscripts

–	The Logic of Escalation: Investigating Trade Disputes as a Lens to Conflict Processes (*dissertation manuscript*)
–	Backward-Engineering Trade Protection: How to Estimate Worldwide Industry-Level Trade Barriers (*working paper*)
–	A Text Mining Tool to Extract Trade Bargaining Histories from U.S. Trade Reports (*working paper*)
–	Measuring Preferences in International Trade Relations: Simulating Expected Gains and Losses from Trade Policy Reform (*manuscript in preparation*)
–	Dispute Escalation as a Bargaining Strategy: The Pattern and Effectiveness of U.S. Trade Enforcement in Disagreements over Industry-Level Import Barriers (*manuscript in preparation*)
2009	The G20 Economic Stimulus Packages – Background, Figures, Consequences, in: *IP*, 6/2009, S. 15-17 (*German*)
2009	Historical Travels in, to and from South Asia, in: KWI Essen (ed.), ‘Encyclopedia of the Modern Age,’ Vol. 10, Stuttgart, 2009 (German), with Gita Dharampal-Frick.

2008	The Fusion of Race and Caste in British India – Colonialism and its Implications, in: Dharampal-Frick, Gita / Berkemer, Georg (eds.): 'Electronic Publications on the History of South Asia,' Heidelberg 2008 (German).

Conference Presentations

2016	ISA Annual Convention, Atlanta, USA
2014	EPSA Annual Conference, Edinburgh, UK
2014	ISA Annual Convention, Toronto, Canada
2013	ISA Annual Convention, San Francisco, USA

Teaching Experience

2007/08	Various Teaching Support for Frank R. Pfetsch and Gita Dharampal-Frick
2007	Tutorial, Political Theory and Intellectual History, with Frank R. Pfetsch

Professional Service

11/2013–10/2017	**Secretary**, Association of Scientific Staff (ASST) of the Department of Humanities, Political and Social Sciences at ETH Zurich
11/2013–10/2017	**Scientific Staff Representative**, Science in Perspective (SiP) Teaching Committee of the Department of Humanities, Political and Social Sciences at ETH Zurich

Professional Memberships

American Political Science Association

European Political Science Association

International Studies Association

Swiss Political Science Association

Grants and Stipends

2015	National Science Foundation (NSF) scholarship *to participate in EITM Summer Institute 2015*
2014	Swiss Academy of Humanities and Social Sciences (SAGW) Travel Grant *to participate in the EPSA Annual Conference 2014 (USD 1000)*
2013	Swiss National Fund (SNF) Stipend/Scholarship *to participate in the ICPSR Summer Program 2013 (USD 4700)*
2013	Swiss Academy of Humanities and Social Sciences (SAGW) Travel Grant *to participate in the ISA Annual Convention 2013 (USD 1000)*
2012	Swiss National Fund (SNF) Stipend/Scholarship *to participate in the Essex Summer School 2012 (USD 5500)*
2009	German Academic Exchange Service (DAAD) Travel Grant *for the internship at the FES, Israel (USD 700)*

Methods Training

2015	**Empirical Implications of Theoretical Models (EITM)** Summer Institute, University of Michigan

2014	**Advanced Methods I: Models of Contextuality and Heterogeneity**, University of Zurich, Marco Steenbergen
2014	**Introduction to Nonparametric Modeling** (2 day course), University of Zurich, Luke Keele
2013	**Panel and Pooled Cross-Section Time-Series Analysis**, ETH Zurich, Vera Troeger
2013	**Mathematics for Economists**, University of Zurich, Bettina Klose, Xavier Del Pozo Somoza
2013	**Advanced Game Theory**, ICPSR Summer Program, University of Michigan, James Morrow
2013	**Advanced Topics in Maximum Likelihood Estimation**, ICPSR Summer Program, University of Michigan, Brad Jones/David Darmofal
2013	**Matrix Algebra**, ICPSR Summer Program, University of Michigan, Petro Sanchez
2013	**Missing Data**, ICPSR Summer Program, University of Michigan, Tenko Raykov
2013	**Introduction to Game Theory**, University of Zurich, Maria Saez Marti
2012	**Using R for Data Analysis and Graphics**, ETH Zurich, Martin Maechler, Andreas J. Papritz, Cornelia B. Schwierz
2012	**Selection and Strategic Models**, Essex Summer School, University of Essex, Curtis Signorino
2012	**Causal Models and Structural Equations**, Essex Summer School, University of Essex, Peter Schmidt
2012	**Discrete Choice Models in the Social Sciences**, Essex Summer School, University of Essex, Garrett Glasgow
2012	**Mathematics III**, Essex Summer School, University of Essex, Dan Brawn
2012	**Causal Inference** (1 week course), University of Zurich, Dominik Hangartner
2012	**Advanced Methods III: Bayesian Analysis**, University of Zurich, Marco Steenbergen
2011	**Advanced Methods I: Foundations of Quantitative Political Analysis**, University of Zurich, Marco Steenbergen

Technical Skills and Languages

Technical Skills:	R, Stata, Mathematica, Python, LaTex
Languages:	German – native, English – fluent, French – advanced

Main Areas of Skills and Expertise

Data Analysis:	Generalized Linear Models, Causal Inference, Structural Estimation
Text Mining:	Information Extraction, Sentiment Analysis, Dictionary Methods
Formal Theory:	Game Theory & Signalling, Trade Policy Simulations