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Exchange Rate Uncertainty and Firm Investment Plans
Evidence from Swiss Survey Data*

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Abstract

A sudden change in monetary policy happened in Switzerland on January 15th, 2015. The Swiss National Bank removed a lower exchange rate bound vis-à-vis the Euro. This unexpected change of regime induced a temporary uncertainty about future prices in foreign markets. We believe that this hampers firm investment in the short term. Using this change in monetary policy as a natural experiment and exploiting the continuous nature of a micro-level business tendency survey, we identify the source of uncertainty and disentangle first and second moment effects. We find that price uncertainty affects investment in equipment and machinery through real option effects and believe that growth option effects positively influences expenditures in research and development. We show that focusing on aggregate gross fixed capital formation masks important insights and suggest the use of disaggregated investment data to deepen our knowledge on the relationship between uncertainty and investment.

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1 Introduction

We focus on a monetary policy shock in Switzerland in 2015 and its effect on the revision of investment plans of Swiss firms. On January 15th, 2015 the Swiss National Bank (SNB) communicated that the justification for a lower exchange rate floor of the Swiss Franc vis-à-vis the Euro was no longer given. The central bank introduced a floating exchange rate regime immediately. This change of exchange rate regime came as a surprise. The CHF/EUR exchange rate dropped by around 20 percent within a couple of hours. We argue that this sudden appreciation did not only represent a first moment shift of the CHF/EUR exchange rate, but that it also increased uncertainty about the future exchange rate. Aggregate uncertainty indicators reacted strongly as a consequence of this policy change, which supports our claim. We assume that exchange rate uncertainty is the equivalent to foreign market price uncertainty and therefore affects firm investment planning via cost-benefit analysis.

We estimate the effect of uncertainty on investment plans of Swiss firms using this exogenous shock. We use firm-level data stemming from the biannual KOF investment survey. The biannual set-up provides firms' investment plans for 2015 twice, once in Autumn 2014 and once in Spring 2015. Therefore, we can measure the change in firms' investment plans for 2015 between the two survey waves, i.e. we can quantify by how much a firm adjusted their investment plans for 2015 between Autumn 2014 and Spring 2015, and link the difference to the exchange rate shock. The dataset allows the distinction between investments plans in equipment and machinery, in construction, and in research and development. Additionally, the dataset allows the identification of the subjective first and second moment impacts of the sudden appreciation of the Swiss Franc on firm level exchange rate expectations. Furthermore, the dataset contains information on firm characteristics, such as the sector in which a firm operates, a firm's number of employees, different degrees of irreversibility of investments, or a firm's export share. We will use this set of variables to explain firms' 2015 investment plan revisions for the different types of investment categories distinguished above.

According to theory, uncertainty can influence the real economy through different channels. We focus on real option and growth option effects. While real option theory suggests that uncertainty should lower irreversible investment temporarily if markets are not perfectly competitive, growth option effects lead to increased investment once uncertainty rises.

Our firm level proxy for uncertainty is able to explain firm investment plan revisions to a certain extent. We find a negative effect of uncertainty on investment plans in equipment and machinery and find that the effect of uncertainty is stronger for irreversible investment than reversible investment. This finding is in line with real option theory and means that uncertain firms reduced their investment plans for 2015 more or increased their investment plans less than firms not affected by uncertainty. Furthermore, we provide evidence that uncertainty affects expenditures in research and development through growth option effects, indicating that firms experiencing uncertainty actually planned increased research and development expenditures after the shock.

This work contributes to the existing literature in various ways. First, by exploiting an exogenous policy shock and using firm level data we can identify uncertainty, i.e. we know its source and can disentangle first and second moment effects. Second, we derive firm-level uncertainty from a survey question designed to measure perceived uncertainty. To our knowledge, this is a novel method of uncertainty measurement in the literature. Finally, we provide evidence that uncertainty affects different investment categories through different channels. We conclude that focusing on aggregated investment data such a gross fixed capital formation might mask the mechanisms at work, as the effects within the distinct investment categories are of opposite signs.

The rest of the paper is structured as follows. First, we reflect on the theoretical relationship of uncertainty and investment and elaborate on recent developments in measuring uncertainty. Then, we focus on the change in exchange rate regimes and the appreciation of the Swiss Franc before describing our hypotheses. Section 3 presents our dataset and explains the measurement of variables in detail. Finally, we present our identification strategy of uncertainty as well as our empirical model, Section 5 concludes.

2 Uncertainty and Investment

Recently, studies on uncertainty have received increased attention. Several factors have led to this surge in the literature. According to Bloom (2014), the sudden increase in economic uncertainty with the beginning of the Great Recession in 2008 and its role in the recession's trajectory led to heightened academic interest. Additionally, technical development such as increased computing power and the digitalization of news allowed for novel methods of measurement and estimation of uncertainty (Bloom, 2014). In this section, we will begin by summarizing developments in theoretical and empirical literature on irreversible investment under uncertainty. We will continue with a discussion on uncertainty measurement and finally provide arguments why the sudden exchange rate appreciation on January 15th, 2015 was accompanied by an increase in uncertainty about the future medium-term exchange rate. We conclude this section by defining our hypothesis.

2.1 Theoretical Aspects of Uncertainty

Uncertainty is an ambiguous concept. The term uncertainty is referred to in various applications of probability theory with perceptions differing fundamentally. An overview of different concepts and distinctions of uncertainty can be found in Hansen (2014). The relevant conception for uncertainty in investment decisions is uncertainty as described in Knight (1921).[1] We shall focus on this concept of uncertainty, defining it as the reducible part of ignorance about future events in line with Bernanke (1983).

Investment theory has long recognized that investment decisions are influenced by uncertainty. We shall focus on two theories, real-option and growth option theory. The real-option theory shows how uncertainty can reduce investment when irreversibility of investment is given (Bernanke (1983); Pindyck (1988); Caballero (1991)). Several studies have provided empirical evidence in favour of the real-option theory. Pattillo (1998) constructs an uncertainty measure using a firm's self-reported probability distribution about expected demand. He finds that uncertainty raises the firm-specific threshold of expected marginal revenue at which investments are triggered. Similar to Pattillo (1998), Guiso and Parigi (1999) proxy uncertainty using the variance of a firm's self-reported probability distribution about future demand. They find that uncertainty decreases firm investment among Italian firms. Additionally, they find that the negative effect of uncertainty on investment is stronger for firms with higher market power and more irreversible investment. More recent studies investigating the consequence of uncertainty on the real economy include Bloom et al. (2007), Bloom (2009), Fuss and Vermeulen (2008), Bontempi et al. (2010), Bachmann et al. (2013), Bachmann and Bayer (2013), Bianco et al. (2013) and Kang et al. (2014).

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[1]Knightian uncertainty represents a type of uncertainty which comprises a fundamental lack of knowledge about the future. It is the kind of uncertainty necessary to trigger a wait-and-see behaviour as in Bernanke (1983). The concept is probably best known from the "Ellsberg paradox" (Ellsberg, 1961). However, its first appearance in economic literature dates back to Knight (1921). More recently, Hansen (2014) offers a clear depiction of the concept's relevance in modern economic literature.

Even though a negative effect of uncertainty on investment is the most prominent finding in the literature, the relationship is not as clear-cut as often thought. Growth-option theory describes a mechanism by which uncertainty can actually increase investment. For example, when investment is reversible, firms operate in perfectly competitive markets, or when investment projects have a long time span, uncertainty may enhance investment activity. This result is based on the idea that eventual losses of an investment project are bounded at its initiation cost, while revenue is unbounded. A mean-preserving increase of uncertainty in the expected price development increases expected profit (Bar-Ilan and Strange (1996)). Empirical support for this theory has often be found in connection with research and development expenditure. Kraft et al. (2013) and Stein and Stone (2013) find positive effects of uncertainty on research and development intensive firms. However, Czarnitzki and Toole (2011) find that research and development investment falls in response to higher levels of uncertainty.

Another strand of literature focuses on temporal questions related to uncertainty effects. In this strand, the discussion is focused on the difference of effects on planned investment versus realized investment. Guiso and Parigi (1999) show that uncertainty affects the investment plans of Italian manufacturing firms, indicating an immediate effect of uncertainty on plans. Yet Fuss and Vermeulen (2008) show that investment plan revisions of Belgian firms are not affected by uncertainty, while realized investments are influenced by uncertainty. They conclude that uncertainty might affect investment decisions only after a certain delay.

2.2 Measuring Uncertainty

How to measure uncertainty remains an often discussed topic in the field. In recent years, a branch of this literature has started to focus more intensely on different sources of uncertainty and on new methods of measurement. The most prominent ways of measuring uncertainty include capturing sentiment in newspapers[2], the dispersion of point estimates of professional forecasters[3], the dispersion of firm assessments in survey data[4], and volatility measures in equity and bond markets[5].

Although certain indicators have become more prominent in this field (such as the uncertainty indicator by Baker et al. (2013) which incorporates and aggregates different types of information), it is still often unclear what kind of uncertainty is actually captured by various indicators. The variety of ways uncertainty is measured makes it difficult to derive clear policy decisions from existing literature. One way to tackle this deficit can be the use of natural experiments. Here, the exogenous source of uncertainty can be identified, while other indicators tend to have difficulties in identifying the origin of changes in their uncertainty measure. Recently, Julio and Yook (2012) used exogenous electoral cycles to identify uncertainty, while Baker and Bloom (2013) proposed the use of natural disasters, terrorist events, or policy shocks to identify uncertainty.

However, using exogenous policy events is not sufficient to fully identify uncertainty. A clean identification of uncertainty requires a differentiation between first and second moment effects.[6] In this paper we try to tackle both issues to obtain full identification of uncertainty. First, we

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[2]Baker et al. (2013), Iselin and Siliverstovs (2013), Abberger et al. (2014b), Abberger et al. (2015)

[3]Bomberger (1996), Boero et al. (2008), Baker et al. (2013)

[4]Pattillo (1998), Guiso and Parigi (1999), Temple et al. (2001), Driver et al. (2004), Bachmann et al. (2013), Bianco et al. (2013)

[5]Bekaert et al. (2010), Stein and Stone (2013)

[6]Investment is affected by first moment changes in prices. Changes in the first moment can be systematically related to changes in the second moment. If they are systematically related, not controlling for the first moment change would lead to a misspecified model and introduce an omitted variable bias.

exploit the unexpected switch in exchange rate regimes on January 15th, 2015 as an exogenous policy event. We argue that removing the lower bound led to a negative first moment shift in the CHF/EUR exchange rate and to an increase in uncertainty about the future exchange rate.[7] Second, we use survey data to obtain information on firm level investment and to determine the first and second moment effects on firms' subjective exchange rate expectations.

Finally, the abrupt appreciation of the Swiss Franc induced uncertainty of Knightian kind. In the immediate aftermath of the public announcement of the decision by the National Bank, uncertainty about the future exchange rate was high. But the prevailing uncertainty was of temporary nature. Firms knew that they would be more certain of the future exchange rate after a few months. In other words, in the immediate aftermath of the decision firms did not know whether the exchange rate would steer towards the 1.10 CHF/EUR as suggested by the member of the the national executive council Eveline Widmer-Schlumpf (Moser, 2015) or fall below parity, as feared by trade union economists after the announcement of the National Bank (Wegelin, 2015). The uncertainty at work is therefore of Knightian nature and capable of causing wait-and-see behaviour. We conclude that given the prevailing, yet temporary uncertainty, it is rational for firms to pause irreversible investment from a theoretical point of view as new information about the expected exchange rate should arise over time. This is in line with real-option theory.

2.3 Exchange Rate Uncertainty

An exchange rate floor of the Swiss Franc versus the Euro was introduced in September 2011. This step became necessary as the Franc had appreciated in value, representing a safe haven for investors in times of financial turmoil. The Swiss National Bank justified the implementation of such a regime with the explicit goal of limiting risks for the Swiss economy and of minimizing the possibility of deflation (Rathke and Sturm, 2015). Therefore, a minimal exchange rate of 1.20 CHF per Euro was defended with all means available to the central bank. In this chapter, we focus on explaining why the removal of the lower floor by the SNB caused uncertainty.

For more than three years, the National Bank defended this lower bound. Even in the days and weeks leading up to the announcement of a flexible exchange rate versus the Euro, executive members of the National Bank had continued to repeat the mantra of the necessity of this floored exchange rate. There were no indications for this regime changing any time soon (Rathke and Sturm, 2015; Fuster, 2014). As such, it came as an absolute surprise when the Swiss National Bank announced that this regime would come to an end on January 15th, 2015. Articles in the influential Swiss newspaper "Neue Zürcher Zeitung" support this point of view, stating that not even the national executive council (the "Bundesrat") had been informed before the announcement by the central bank (Flückiger, 2015). The arguments presented by the Swiss National Bank as to why they decided to leave this path were twofold. First, a divergence of currencies was observed. While the US Dollar was appreciating in value, the Euro (and along with it the CHF) was depreciating. As the European Central Bank had announced that they would loosen their monetary policy even further, this tendency was bound to continue in the coming months. Second, the president of the Swiss National Bank, Thomas Jordan, indicated that Swiss firms had been able to use the period of relative certainty to adapt to the new situation. After all, the introduction of a floored exchange rate had never been communicated as a permanent regime, its temporary nature was clear from

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[7]Note that the exchange rate determines the foreign market price, which is part of the cost-benefit analysis of investment projects. This means that uncertainty about the future exchange rate directly influences firms investment decisions. Also, note that Switzerland is a small open economy and that the European Market is the most important export market for Swiss firms (more than 50% of Swiss exports have a destination within the EU-28, Bundesamt für Statistik (2015)).

the beginning (Fuster, 2015). Even so, the actions of the National Bank leading up to January 15th, 2015 meant that no one saw this step coming. It had been expected that the Swiss National Bank would not exit this strategy abruptly, but that they would adapt step by step. Additionally, it had been assumed that this change would be announced (or at least suggested) publicly prior to any actual action (Fuster, 2015). Beside the modalities of communication and action of the Swiss National Bank, the time of action came as a surprise for all observers. It had been expected (despite all the arguments put forward by Thomas Jordan) that the exchange rate floor would be defended as long as inflation in Switzerland remained low and the economic crisis in Europe continued (Rathke and Sturm, 2015). The general economic situation in Switzerland and elsewhere had not changed, which made the abrupt change in policy all the more surprising. As such, we will consider the unexpected decision of the Swiss National Bank to allow the Swiss Franc to float versus the Euro as an exogenous shock, leading to exchange rate uncertainty for Swiss firms.

Admittedly, this assessment of the situation could be based on hearsay or anecdotal evidence. However, two quantitative indicators reproduce the shock at an aggregate level. First, Iselin (2015) develops an uncertainty measure similar to the media indicator documented in Baker et al. (2013). Here, a daily measure of the keywords "Switzerland+uncertainty" in Swiss newspapers is generated. The development of this indicator can then be understood as a reproduction of concern for uncertainty in the media. This is displayed in Figure 1 in the top panel. The daily data is aggregated to its monthly sum and subsequently standardized. Evidently, two periods of heightened newspaper coverage of uncertainty can be identified. The first period is after the acceptance of the initiative on immigration in February 9th, 2014 (MII), the second is between January and March 2015. This indicator points to the fact that the actions of the SNB were a shock inducing a higher media coverage of uncertainty, reflecting heightened concerns about uncertainty in the media (which is not necessarily economic uncertainty as such).

A second indicator to support the claim that floating the Franc came as a shock is shown in the bottom plot in Figure 1. This indicator is created by measuring the dispersion of short term demand expectations by industrial firms, identical to Theil's disconformity index for qualitative surveys (Theil, 1952). Firms are asked whether they expect demand to increase, stay unchanged, or decrease in the months to come in a KOF Business Tendency Survey (BTS). The measure is then obtained by the sum of the percentage of firms indicating an increase and that of those indicating a decrease, minus the squared difference of the two shares. The variance of expectations can be thus seen as a measure of aggregate demand uncertainty. The months after January 15th indicate the highest uncertainty by far. It is important to understand that the two indicators measure uncertainty differently, so that there are similarities, but also differences in the trend.

To summarize, the two quantitative indicators presented support our claim that the actions of the Swiss National Bank were a shock for both economic and political actors in Switzerland. This backs the anecdotal evidence based on the degree of surprise made public by relevant political actors after the press conference of the National Bank on January 15th, 2015.

2.4 Theoretical Hypotheses and Empirical Specification

Section 2.3 argued that the exchange rate shock came as a surprise. The sudden appreciation was not only a first moment drop in the exchange rate from 1.20 to below 1, but led to a substantial increase in uncertainty about the future exchange rate. Furthermore, as the exchange rate determines the foreign market prices, firms' investment decisions should be affected directly. Consequently, the sudden policy shock should provide perfect circumstances to investigate how uncertainty affects firm investment plans. As discussed in Section 2.1, uncertainty can affect firm investment through
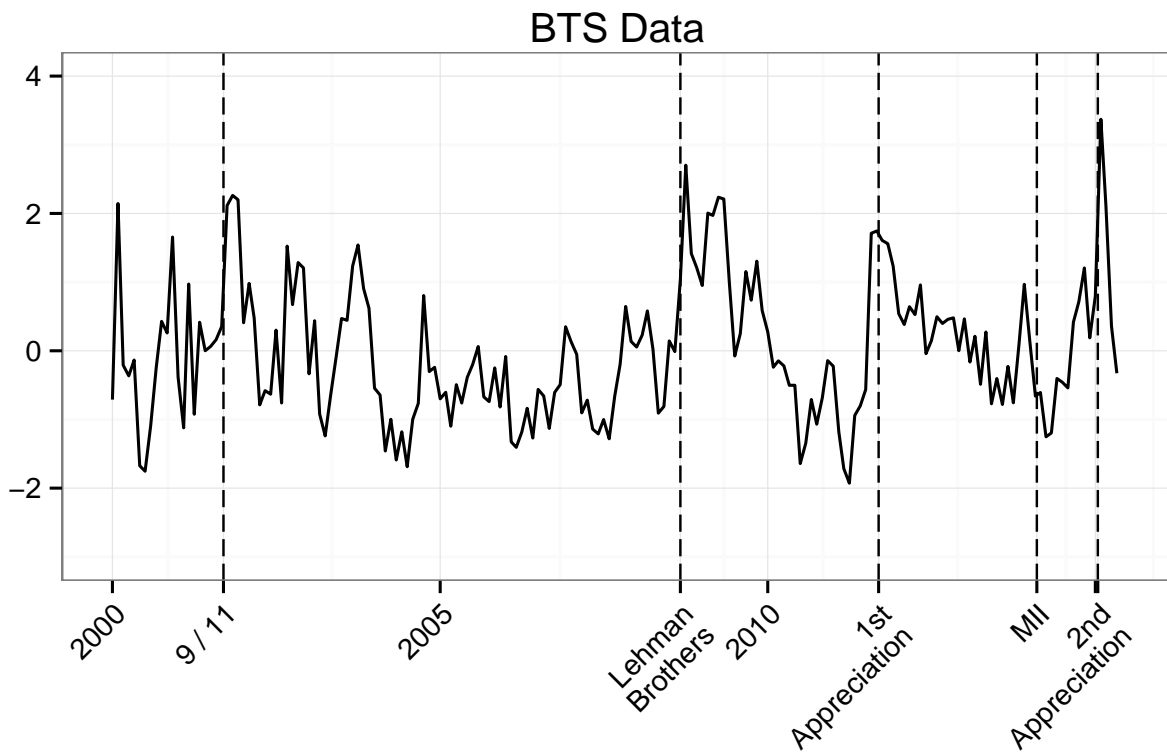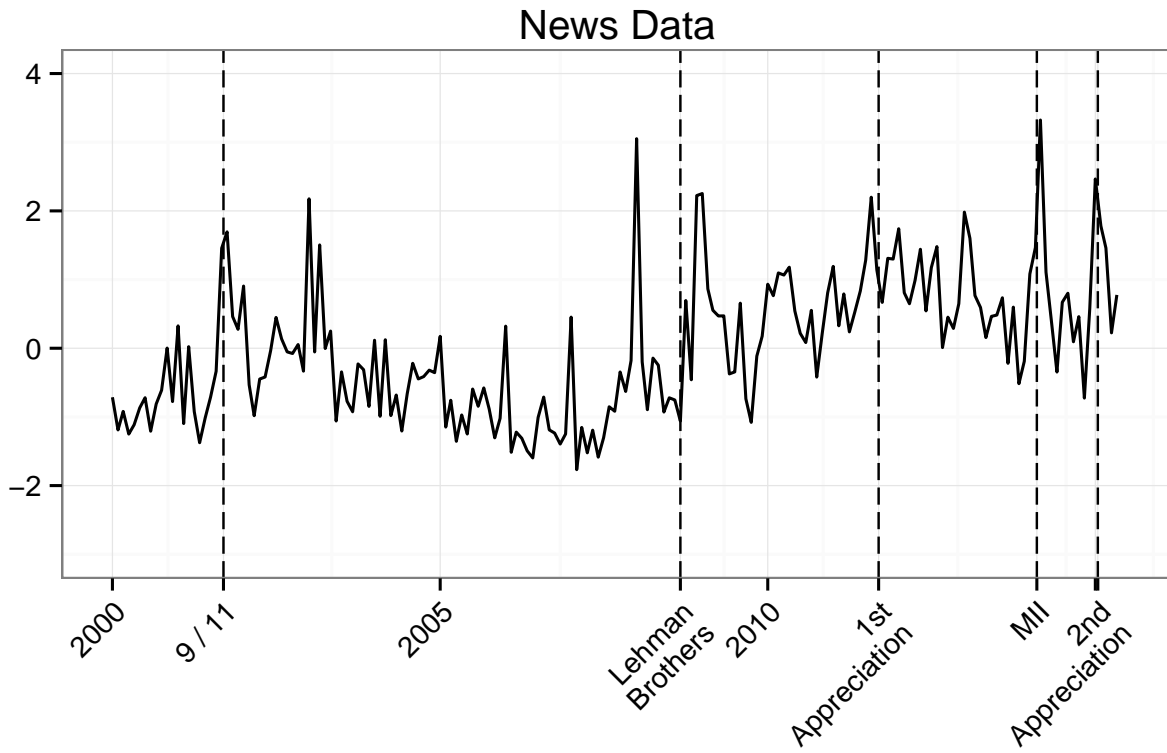
Figure 1: Uncertainty Indicators for Switzerland

different mechanisms. We focus on mechanisms described in growth-option and real-option theory. In order to test the influence of the uncertainty induced by the exchange rate shock, we would like to observe firm investment plans both before and after the shock. This would allow us to quantify revisions of investment plans and tie them to the exchange rate shock. Furthermore, we would like to observe how the shock changed the first and second moment of firms subjective exchange rate expectations. Finally, we would like to have information on the degree of irreversibility of planned investment. Ideally, we do not observe aggregate investment only, but have information separately for different subcategories of investment, such as investment in equipment and machinery, investment in construction, and investment in research and development. Observing all this would allow us to test the influence of the exchange rate shock on firm investment plan revisions via the following model:

$$\Delta I_{i,t=2015} = a_1 \Delta expected\ exchange\ rate_i + a_2 \Delta uncertainty_i + a_3 irreversibility_i +$$
$$a_4 \Delta uncertainty_i \times irreversibility_i + \mathbf{a}\mathbf{X}_i \quad (1)$$

where $\Delta I_{i,t=2015}$ represents the change of firm i's planned investment for the year 2015 due to the exchange rate shock (as explained in Chapter 3.2). $\Delta expected\ exchange\ rate_i$ represents the subjective first moment shift in the expected exchange rate of firm i. $\Delta uncertainty_i$ represents the change of the second moment of the expected exchange rate of firm i. The variable $irreversibility_i$ controls for the degree of irreversibility of firm i's investment plans. The interaction term $uncertainty_i \times irreversibility_i$ captures potential real option effects. And $\mathbf{X}_i$ controls for additional firm characteristics.[8]

As the sign of $\Delta expected\ exchange\ rate_i$ depends on the combination of a firms' export and import share, it is difficult to formalize expectations on the sign of the coefficient. It is much easier to formalize expectations on the signs of the remaining coefficients. In accordance with growth-option theory, we expect the coefficient of $\Delta uncertainty_i$ to be positive as an increase in uncertainty should lead to an increase in reversible investment. However, we expect that real-option effects prevail when controlling for $irreversibility_i$ and interacting it with $\Delta uncertainty_i$.

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[8]The vector X_i contains several other firm characteristics including $\Delta I_{i,t=2014}$ which represents the investment revision of firm i for year 2014 between the two surveys (see Chapter 3.2). "exchange rate", which covers the CHF/EUR exchange rate on the day the questionnaire in Spring 2015 was completed by the firm. "comp" takes value one if the firm operates in a highly competitive market and zero otherwise. "foreign owned" indicates if a firm is owned by a foreign company and zero otherwise. "export" is one if a firm's exports are higher than 5% and zero otherwise. "distance border" indicates a firm's distance to the closest national border. "share foreign employees" indicates the share of foreign employees. "days snb" counts the days passed between the decision of the SNB on January 15th, 2015 and the day a firm filled out the questionnaire. "certainty s2014" is one if a firm is very or fairly certain of their investment plans in Autumn 2014 and zero otherwise. Additionally, we control for number of employees, sector, and geographic region of a firm. Table A1 in the Appendix provides a detailed overview of these variables.

3 Data and the Problem of Measuring Relevant Variables

3.1 KOF Investment Survey

In order to empirically test the influence of uncertainty on investment plans, data from the biannual KOF investment survey is used.[9] The investment survey is conducted by the KOF Swiss Economic Institute amongst a large panel of private firms in Switzerland. The KOF investment survey is carried out twice a year. This paper uses data of the investment survey in Autumn 2014 and data collected in Spring 2015. Both survey waves asked for quantitative information on investment activity in 2013, 2014, and 2015. Because of the timing of the two waves, the information on investment activities refers to (practically) realized investment for the financial years 2013 and 2014 and to investment plans for 2015. The question distinguishes between investment in construction, in machinery and equipment, and in research and development. The questionnaires from both waves are included in the Appendix.

The investment survey in Autumn 2014 was sent to a sample of firms on October 8th, 2014. Answers were accepted until December 31st, 2014. From 8052 contacted firms, 3072 valid questionnaires were received, corresponding to a response rate of approximately 38%. The final dataset from Autumn 2014 contains approximately 40% of manufacturing firms, 7% of firms in construction and the 53% remaining firms are based in the services sector. In Spring 2015, questionnaires were sent to the same sample of firms on February 18th, 2015.[10] Answers were accepted until May 31th, 2015. From the 8072 firms that were contacted, 3395 valid questionnaires were received, corresponding to a response rate of approximately 42%. Firms in the manufacturing, construction, and services sectors cover 40%, 7%, and 52% of the final sample of this survey wave, respectively. The response rate was similar within sectors, with a slightly lower rate for construction firms. Table 1 summarizes the information regarding the sample of firms.

Table 1

| | Contacted Firms | | Response Rate | | Joint samples with complete answers | |
	Autumn 2014	Spring 2015	Autumn 2014	Spring 2015	Number of firms	Share
Manufacturing	3177	3133	40%	44%	495	49%
Construction	710	707	30%	36%	62	6%
Service	4160	4212	38%	43%	454	45%
Overall	8048	8072	38%	42%	1011	100%

Columns 1 and 2 present the absolute amount of firms contacted in each wave. Columns 3 and 4 show the response rate. Columns 5 and 6 contain firms which reported full investment figures in both waves.

Our final dataset contains 1011 observations. The reason for this relatively small overlap is that we only kept firms which reported investment figures for both 2014 and 2015 in both waves. Additionally, we need a full set of controls for each firm. From the 1011 firms in the merged and reduced dataset, 948 firms reported complete figures for investment in equipment twice and 414

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[9]Schenker (2007) examined the KOF investment survey regarding its quality, consistency and information content. Recent studies using KOF investment survey data include Abberger et al. (2014b), Bannert et al. (2015a) and Bannert et al. (2015b)

[10]There are small changes in the panel across different survey waves, as some firms drop out of the sample and others are added.

firms reported complete figures for investment in construction in both waves. 314 firms reported their investments in research and development in both Autumn and Spring.

The merged dataset displays a slight over-representation of firms in manufacturing (see Table 1 columns 5 and 6) with respect to the distribution among the firms originally contacted. While only approximately 39% of all contacted firms were in manufacturing, they account for approximately 49% of all firms in the final dataset. The over-representation of manufacturing firms is exclusively at the expense of service firms. While more than half of the firms contacted (approx. 53%) belong to the service sector, only 45% of the remaining observations stem from this sector.

3.2 Measuring firm-specific investment plan revisions

The biannual nature of the KOF investment survey allows us to observe firm investment plans for 2015 twice, once in Autumn 2014 and once in Spring 2015. Hence, we observe a firm's expected investment for 2015 before the exchange rate shock and after the shock ($I_{i,t=2015,s=\text{Spring 2015}}$ and $I_{i,t=2015,s=\text{Autumn 2014}}$). This allows us to quantify firms' investment plan revisions as shown in Equation 2.

$$\Delta I_{i,t} = log(I_{i,t,s=\text{Spring 2015}}) - log(I_{i,t,s=\text{Autumn 2014}}) \qquad (2)$$

The survey asks firms to state their investment separately for investment in equipment and machinery, investment in construction, and investment in research and development. Hence, we are able to compute revisions in overall investment plans (gross fixed capital formation - GFCF) as well as for the mentioned categories. The revisions of total investment plans and of different investment categories will serve as our dependent variables in the regressions.

Furthermore, the data contains information on firm investment for the year 2014. Although investment for 2014 was not affected by the exchange rate shock, we calculate firm investment revision regarding 2014 ($\Delta I_{i,t=2014}$). We use this information as an explanatory variable in the regressions. This variable allows us to control for inter-temporal shifts in investment and heterogeneous investment cycles.

3.3 Measuring firm-specific exchange rate expectations

In order to ensure a clean identification of the effect of uncertainty on investment plans, it is necessary to control for the first moment change in exchange rate expectations. After all, revisions in investment plans may well be due to expected shifts in the future exchange rate as elaborated in Section 2.3. In the survey wave in Spring 2015, the questionnaire asks for the expected exchange rate of the Swiss Franc vis-à-vis the Euro. Firms are asked to report the expected exchange rate in 6, 12, 18, and 24 months[11]. We include the firm-specific exchange rate expectation in 24 months as we consider it the most relevant time period of those available for the evaluation of investment projects. Summary statistics provided in Table 3 show that firms expect an exchange rate of 1.084 CHF/EUR on average, with a median of 1.10. However, variation in expectation is large, going from 0.83 to 1.40 CHF/EUR. This variable will enter our regression as an explanatory variable. Note that we do not observe the change in the expected exchange exchange rate. However, given the

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[11]The exact wording is presented in the questionnaire included in the Appendix.

stable exchange rate the previous three years, we assume that a priori firms expected the exchange rate to remain at 1.20.

3.4 Measuring firm-specific uncertainty

Ideally, we would use the change of the second moment of the expected exchange rate of firm i to measure shifts in uncertainty due to the policy shock (see Chapter 2.4). Unfortunately, this information is not provided in the data and we could not measure the change of the second moment as hoped for.

As an alternative, we derive firm specific uncertainty from another question asked in both waves of the KOF investment survey. The identification of uncertainty is based on a question concerning the overall realization certainty of firms' reported investment plans. Firms were asked how certain they are that their future investment plans would be realized.[12] Survey participants could classify their reported investment plans for 2015 as "very certain", "fairly certain", "fairly uncertain" or "very uncertain". Based on this question, firms can be identified which indicated a change in certainty between Autumn 2014 and Spring 2015. Table 2 provides an overview of how realization certainty changed between the two waves. For most firms, investment certainty did not change between the two survey waves. However, 188 firms indicated an increase in investment certainty (the sum of firms below the diagonal in Table 2). A slightly larger number of 191 firms indicated that they were less certain about the realization of their planned investment for 2015 in Spring than they were in Autumn (the sum of firms above the diagonal in the Table 2). The comparison of values given during both waves allows the identification of firms experiencing increased uncertainty.

		Spring 2015			
		Very Certain	Fairly Certain	Fairly Uncertain	Very Uncertain
Autumn 2014	Very Certain	92	70	12	0
	Fairly Certain	106	488	97	5
	Fairly Uncertain	13	60	50	7
	Very Uncertain	0	4	5	2

Table 2: Contingency table showing changes in firm specific investment uncertainty

We argue that not all firms where affected by the appreciation of the Swiss Franc to the same extent. For some, exchange rate uncertainty may be of no importance in planning investments. We identify firms reporting increased uncertainty and consider the change in realization certainty as driven by exchange rate uncertainty. We will come back to this claim in Section 4 and verify the validity of this assumption.

We construct a proxy for firm level uncertainty based on the responses to this survey question. A binary variable is created that takes value 1 if a firms' self-reported investment certainty decreased between the two survey waves in Autumn 2014 and Spring 2015. Technically, the variable *uncertainty* behaves the following way:

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[12]The exact wording is presented in the questionnaire included in the Appendix.

$$\Delta uncertainty_i = \begin{cases} 1 & \text{if } certainty_{i,s=\text{Spring 2015}} < certainty_{i,s=\text{Autumn 2014}} \\ 0 & otherwise \end{cases} \quad (3)$$

where $certainty_{i,s=\text{Spring 2015}}$ is the self-reported realization certainty of future investment plans of firm i reported in the investment survey in Spring 2015 and $certainty_{i,s=\text{Autumn 2014}}$ is the self-reported investment certainty of firm i stemming from the survey wave in Autumn 2014. The variable $\Delta uncertainty_i$ indicates if a firm experienced an increase in uncertainty.

3.5 Measuring firm-specific irreversibility

Real-option theory requires investment to be irreversible for uncertainty to affect investment (Bernanke, 1983; Pindyck, 1988; Caballero, 1991). If investment is perfectly reversible, changes in uncertainty should have little to no effect on investment. Fortunately, the investment survey of Spring 2015 contains a question on this topic, which we use to infer the degree of irreversibility of firm investment.[13] The source of the wording of this question is the Italian Survey of Investment in Manufacturing (SIM), which asked the same question in 1995. In line with Guiso and Parigi (1999), we use firms' answers to this question to proxy irreversibility. The question asks firms whether a second hand market exists for their current machinery and / or equipment.
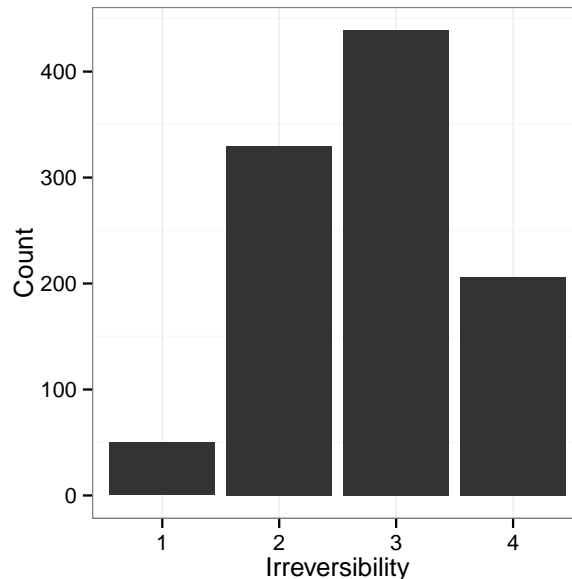

Figure 2: Histogram depicting irreversibility indicated (1 = full reversibility, 4 = full irreversibility)

The question provides four options, each indicating a separate level of reversibility of equipment and / or machinery within the company. The 4 item Likert scale goes from full reversibility to full irreversibility. The two categories in between the extremes are differentiated according to time required, difficulty, and expected prices when re-selling equipment and / or machinery. The overwhelming majority of firms indicate at least a certain degree of irreversibility. Similar to Guiso and Parigi (1999), the firms are designated as having high or low irreversibility if they indicated the upper two or lower two categories. As such, firms indicating that it is easy or only takes some time to sell their equipment and / or machinery are attributed low irreversibility, while those indicating

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[13]The exact wording is presented in the questionnaire included in the Appendix.

that it is very difficult or that there is no market for their equipment and / or machinery are attributed high irreversibility.

The distribution of responses given in the estimated data is displayed in Figure 2. The majority (436) of all firms indicated that re-selling equipment and / or machinery is very difficult but not impossible, while 324 firms indicated that re-selling is possible within a short period. 201 firms indicated that there is no market for their equipment and / or machinery, with only 50 out of 1011 firms indicating full reversibility.

3.6 Summary Statistics

Tables 3, 4, and 5 give an overview of the summary statistics for the firms in estimation. Table 3 contains all firms included in estimation, while Tables 4 and 5 split the sample into uncertain and not uncertain firms as described in Section 3.4.

Table 3: Summary statistics (Firms in estimation)

Statistic	N	Mean	St. Dev.	Min	Median	Max
$\Delta I_{i,t=2014}$ (GFCF)	1,025	-0.003	0.178	-1.398	0.000	1.631
$\Delta I_{i,t=2015}$ (GFCF)	1,025	0.013	0.236	-1.250	0.000	2.796
$\Delta I_{i,t=2014}$ (construction)	414	-0.002	0.274	-1.278	0.000	1.611
$\Delta I_{i,t=2015}$ (construction)	414	0.004	0.340	-1.395	0.000	2.197
$\Delta I_{i,t=2014}$ (equipment)	948	-0.007	0.194	-1.733	0.000	1.551
$\Delta I_{i,t=2015}$ (equipment)	948	0.024	0.250	-1.531	0.000	2.945
$\Delta I_{i,t=2014}$ (R&D)	314	0.026	0.578	-3.406	0.000	2.311
$\Delta I_{i,t=2015}$ (R&D)	314	-0.040	0.552	-2.486	0.000	3.508
uncertainty$_i$	1,025	0.189	0.392	0	0	1
irreversibility$_i$	1,025	0.629	0.483	0	1	1
expected exchange rate$_i$	1,025	1.084	0.059	0.830	1.100	1.400
employees$_i$ (fte)	1,025	273.600	1,250.000	1.000	91.000	37,139.000

Table 4: Summary statistics (Firms indicating no uncertainty)

Statistic	N	Mean	St. Dev.	Min	Median	Max
$\Delta I_{i,t=2014}$ (GFCF)	831	-0.007	0.166	-1.190	0.000	1.038
$\Delta I_{i,t=2015}$ (GFCF)	831	0.023	0.240	-1.250	0.000	2.796
$\Delta I_{i,t=2014}$ (construction)	336	-0.008	0.275	-1.278	0.000	1.236
$\Delta I_{i,t=2015}$ (construction)	336	0.007	0.327	-1.395	0.000	1.923
$\Delta I_{i,t=2014}$ (equipment)	767	-0.014	0.181	-1.731	0.000	1.122
$\Delta I_{i,t=2015}$ (equipment)	767	0.039	0.255	-0.688	0.000	2.945
$\Delta I_{i,t=2014}$ (R&D)	253	0.052	0.543	-2.854	0.000	2.311
$\Delta I_{i,t=2015}$ (R&D)	253	-0.071	0.571	-2.486	0.000	3.508
uncertainty$_i$	831	0.000	0.000	0	0	0
irreversibility$_i$	831	0.614	0.487	0	1	1
expected exchange rate$_i$	831	1.084	0.058	0.830	1.100	1.400
employees$_i$ (fte)	831	284.000	1,375.000	1.000	91.000	37,139.000

Table 5: Summary statistics (Firms indicating uncertainty)

Statistic	N	Mean	St. Dev.	Min	Median	Max
$\Delta I_{i,t=2014}$ (GFCF)	194	0.016	0.221	-1.398	0.000	1.631
$\Delta I_{i,t=2015}$ (GFCF)	194	-0.025	0.213	-1.167	-0.001	1.054
$\Delta I_{i,t=2014}$ (construction)	78	0.027	0.268	-1.074	0.000	1.611
$\Delta I_{i,t=2015}$ (construction)	78	-0.005	0.393	-1.248	-0.00000	2.197
$\Delta I_{i,t=2014}$ (equipment)	181	0.022	0.240	-1.733	0.000	1.551
$\Delta I_{i,t=2015}$ (equipment)	181	-0.037	0.218	-1.531	-0.001	0.620
$\Delta I_{i,t=2014}$ (R&D)	61	-0.084	0.698	-3.406	0.000	1.391
$\Delta I_{i,t=2015}$ (R&D)	61	0.089	0.449	-1.065	0.000	1.565
uncertainty$_i$	194	1.000	0.000	1	1	1
irreversibility$_i$	194	0.696	0.461	0	1	1
expected exchange rate$_i$	194	1.084	0.063	0.850	1.100	1.330
employees$_i$ (fte)	194	229.100	401.900	1.000	90.500	2,950.000

All in all, the final sample contains 1011 firms. Approximately 19% of all firms indicated an increase of uncertainty between the survey waves of Autumn 2014 and the wave of Spring 2015. The majority of firms questioned indicated either no change in investment plan certainty or higher certainty. As described in Section 3.5, it is possible to distinguish between firms indicating high irreversibility of investments and those indicating a low degree of irreversibility. The mean of the binary variable of irreversibility of 0.63 reflects the fact that the majority of firms indicated a high or very high degree of irreversibility. The mean expected exchange rate of the CHF versus the Euro in 24 months is 1.084 CHF/EUR. The variables $\Delta I_{i,t}$ represent the average investment plan revisions of firms, we separate this according to gross fixed capital formation, investment in equipment, construction, and research and development. On average, the revisions are not very large. The higher standard deviations for investment revisions of 2015 are intuitive and speak for the validity of the data.

For a better understanding of the structure of the data, we split the dataset into those firms indicating more uncertainty and those not indicating more uncertainty. Table 4 and Table 5 provide summary statistics for both sub-samples. The mean of the expected exchange rate in 24 month is virtually identical between the two groups. Overall, it seems that firms indicating higher uncertainty after the exchange rate shock have a higher degree of irreversibility than the other firms on average. Finally, more uncertain firms are marginally smaller than other firms when the median number of employees per sub-sample is considered.

4 Identification

The following section elucidates the identification of firms-specific uncertainty. There are two issues related to identifying uncertainty. One is over causality and one is over the exclusion. Even if the causal source of uncertainty can be identified via the exogenous shock, it is still necessary to disentangle first and second moment effects to address the issue of exclusion. In our case, identification is provided as we know what caused the uncertainty. Additionally, we are able to control for the first moment shift caused by the shock on a firm level, as we control for firms' exchange rate expectations. This allows us to disentangle the first moment effect from the second moment effect.

The way we identify more uncertain firms can be criticized. A reduction in self-reported realization certainty of planned investment between Autumn 2014 and Spring 2015 could be due to other developments than the exchange rate shock. For example, the firms reporting higher uncertainty may depend on a common economic trend which lead to an increase in uncertainty for other reasons than the decision of the Swiss National Bank. In this case, the increase in uncertainty may be due to a bad economic development and have nothing to do with changes in monetary policy. To address this potential criticism and support our claim that the increase in uncertainty was indeed caused by the exchange rate shock, we display the results of the Business Tendency Survey (BTS) of the KOF Swiss Economic Institute to track the economic performance of the firms in the final sample prior and post the SNB decision.
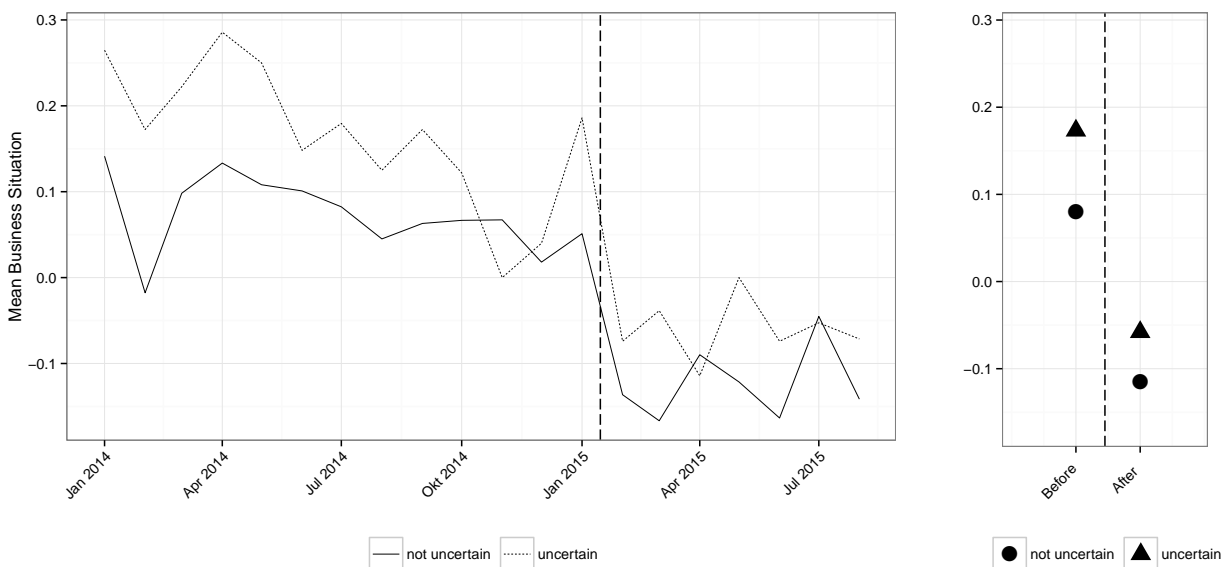

Figure 3: Business situation of treated versus untreated firms

BTS monitor important business variables over time. Although BTS cover all sectors represented in the investment survey, only about half of the surveys are conducted on a monthly basis (some sectors are contacted on a monthly, some only on a quarterly basis). To isolate the effect of the exchange rate shock as precisely as possible, we limit our analysis to monthly surveys.[14] In addition to this limitation, the BTS and the investment survey are not conducted with the same set of firms. The overlap of firms participating in both surveys is 169 firms. 32 firms of these 169 indicated higher uncertainty according to the definition provided above.[15]

All firms participating in the BTS are asked to report their current business situation.[16] The question is qualitative and firms judge their current business situation as "good", "satisfactory", or "poor". Figure 3 depicts the monthly mean[17] of the business situation over time for firms indicating

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[14]NACE 2 Digit covered by monthly BTS include 10-33, 41-43, 47, 64-66, 71

[15]As focusing on the overlap between the two surveys could induce a bias, we recalculated the summary statistics provided in Section 3.6 for firms in both surveys. The summary statistics are provided in the Appendix in Table A2 and A3. Comparing the properties of firms in the sample after the merger of the two datasets with the properties of those firms included in our underlying sample (see Tables 4 and 5), shows that they are similar to some extent, yet notable differences exist as well. However, we believe that BTS data are suitable to track the business situation of firms before and after the SNB decision in an informative way.

[16]Abberger et al. (2009, 2014a) show that business situation is a collective term which captures the most important business variables such as a firm's profit and cost situation, turnover, and liquidity.

[17]We coded "good" as 1, "satisfactory" as zero and "poor" as -1.

higher uncertainty (32 firms of Table A2) and not indicating higher uncertainty (137 firms of Table A3). The monthly means for both sub-samples are shown to the left in Figure 3, while the means for the entire periods before and after the SNB decision are shown to the right of the Figure. The dashed vertical line indicates January 15th, 2015. Figure 3 confirms two points. First, although the series of uncertain firms appears more volatile than the series of the other firms, both sets display a slightly downward-sloped movement throughout 2014. Second, the dismissal of the lower exchange rate floor has had a strong influence on firms' business situations. This holds true for both groups of firms. However, uncertain firms were hit harder. This is visible by the distance between the overall mean of the two sub-samples before and after the monetary policy shock.

We consider Figure 3 as supporting evidence that the identification of uncertainty via the self-reported investment certainty variable is not driven by a third factor in a systematic way and reflects the sudden exchange rate shock and subsequent uncertainty.

Finally, it is important to mention that the estimated effect of uncertainty on firm investment revision for 2015 is conditional to investment revisions of 2014. The variable should, besides inter-temporal shifts, control for heterogeneous investment cycles.

5   Results and Discussion

This section details the effect of uncertainty on firms' investment plan revisions. Observing the firm-specific investment plans for 2015 twice, once in the survey wave of Autumn 2014 and once in Spring 2015, allows the quantification of investment plan revisions due to the exchange rate shock. In addition, we are able to identify firms experiencing an increase in uncertainty because of the switch in exchange rate regimes. Uncertain firms are identified using a self-reported uncertainty measure as explained in Section 3.4. In line with the main part of the literature presented in Section 2.1, our results support the claim that foreign market price uncertainty induced by a monetary policy shock leads to downward revisions of investments plans in equipment.

On the other hand, increased uncertainty leads to higher planned expenditures in research and development. This too is in line with previous studies, Kraft et al. (2013) as well as Stein and Stone (2013) find similar results for research and development expenditure and attribute this effect to growth-option theory which is better suited in explaining the effect of uncertainty on expenditure on research and development. Both studies find that uncertainty enhances investment in research and development.

Table 6 presents average firms' investment plans for 2015 for total investment and investment in equipment, construction, and research and development. Ignoring any kind of firm-specific characteristics and irreversibility, we find that uncertainty reduces total investment plans by 6 percentage points (shown in GFCF). Uncertain firms reduced their investment in equipment and construction more compared to other firms. The opposite case must be made for investment in research and development. Uncertain firms planned to intensify their research activity in 2015 more relative to firms not experiencing uncertainty. We find that on average uncertain firms reduced their investment plans in equipment by approximately 6 percentage points vis-à-vis non-affected firms. The same holds true for investment in construction. Uncertain firms increased their research and development effort by about 4 percentage points relative to non-affected firms.

Table 6: Average Firm Investment 2015 (in log)

	GFCF			Construction		
	Autumn 2014	Spring 2015	Δ	Autumn 2014	Spring 2015	Δ
Certain	15.98 (0.62)	16.02 (0.69)	0.04 (0.93)	15.41 (0.77)	15.44 (0.82)	0.03 (1.12)
Uncertain	15.95 (0.57)	15.93 (0.56)	-0.02 (0.8)	15.3 (0.58)	15.26 (0.61)	-0.04 (0.84)
Δ	0.03 (0.84)	-0.09 (0.89)	0.06 (1.23)	0.11 (0.96)	-0.18 (1.02)	0.07 (1.4)

	Equipment			R&D		
	Autumn 2014	Spring 2015	Δ	Autumn 2014	Spring 2015	Δ
Certain	15.72 (0.46)	15.76 (0.55)	0.04 (0.72)	12.05 (2.55)	12.08 (2.57)	0.03 (3.62)
Uncertain	15.7 (0.44)	15.68 (0.42)	-0.02 (0.61)	11.74 (2.53)	11.82 (2.58)	0.08 (3.61)
Δ	0.02 (0.64)	-0.08 (0.69)	0.06 (0.94)	0.31 (3.59)	-0.26 (3.64)	-0.05 (5.11)

Table 7

	Dependent variable:							
	Diff GFCF		Diff Equipment Investment		Diff Construction Investment		Diff RnD Investment	
	OLS		OLS		OLS		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
uncertainty	−0.042*	−0.003	−0.070***	−0.004	0.0004	0.074	0.132*	0.211
	(0.022)	(0.036)	(0.024)	(0.040)	(0.053)	(0.087)	(0.080)	(0.147)
irreversibility		0.014		0.018		0.050		−0.093
		(0.018)		(0.019)		(0.042)		(0.071)
irreversibility × uncertainty		−0.056		−0.094**		−0.111		−0.099
		(0.042)		(0.046)		(0.101)		(0.175)
$\Delta I_{i,t=2014}$	−0.174***	−0.173***	−0.225***	−0.224***	−0.322***	−0.316***	−0.426***	−0.429***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.068)	(0.068)	(0.051)	(0.051)
expected exchange rate	0.175	0.172	0.147	0.140	−0.022	−0.010	−0.074	−0.059
	(0.131)	(0.132)	(0.146)	(0.146)	(0.304)	(0.304)	(0.507)	(0.506)
Constant	−1.849	−1.855	−3.776**	−3.822**	1.726	1.866	−0.965	−1.286
	(1.538)	(1.540)	(1.684)	(1.684)	(3.632)	(3.637)	(5.887)	(5.891)
Observations	1,025	1,025	948	948	414	414	314	314
R^2	0.076	0.078	0.105	0.109	0.179	0.184	0.370	0.378
Residual Std. Error	0.237 (df = 936)	0.237 (df = 934)	0.248 (df = 860)	0.248 (df = 858)	0.340 (df = 338)	0.340 (df = 336)	0.486 (df = 254)	0.485 (df = 252)

*p<0.1; **p<0.05; ***p<0.01

In order to assess the results shown in Table 6 and to verify whether the effect found also exists when controlling for firm-specific characteristics, the Equation 1 is estimated using OLS regression. Table 7 presents selected estimation results. These are separated according to investment category and the inclusion of the interaction term between irreversibility and uncertainty.[18] Uncertainty reduces total investment plans (GFCF) as shown in Model (1), but when controlling for irreversibility we find no significant effect of uncertainty (Model (2)). When we distinguish according to investment category, we find robust real-option effects for investment in equipment (Model (4)). The coefficient of the interaction term between $uncertainty_i$ and $irreversibility_i$ is negative and statistically significant for investment in equipment. In other words, firms indicating increased uncertainty decrease irreversible investment in equipment more or increase irreversible investment in equipment less than firms not indicating increased uncertainty. While the coefficient of the interaction term between $uncertainty_i$ and $irreversibility_i$ maintains its negative sign for investment in construction, no statistically significant relationship can be found in the data (Model (6)). Meanwhile, the effect of uncertainty on research and development is positive and significant at a p-value of 0.1 (Model (7)). However, controlling for $irreversibility_i$ renders the effect of uncertainty on research and development expenditure as insignificant (Model (8)). This means that firms indicating higher uncertainty increase their R&D activities when compared to other firms.

Further, we find the intuitive result that revisions of investment of 2014 are the best predictors for the revisions in investment plans for 2015. Finally, no significant influence of the expected exchange rate on investment revision is found. This finding might be surprising at first, but could suggest that exchange rate effects cancel out on an aggregate level. This indicates that firms losing from a negative first moment shift of the exchange rate (appreciation of the Swiss Franc) balance firms gaining from this shift. In other words, firms which primarily export their products but obtain their input factors from the domestic market cancel out firms which sell on the domestic market but obtain input factors from foreign markets.

6   Conclusion

In this paper we exploit an unexpected policy event to investigate the effect of price uncertainty on investment plans. On January 15th 2015, the Swiss National Bank decided that the lower floor of the Swiss Franc vis-à-vis the Euro was no longer justified and that they would stop defending it. Consequently, the CHF/EUR exchange rate dropped from 1.20 to below 1 within a couple of hours. We argue that this sudden drop in the exchange rate did not only represent a first moment shift in the CHF/EUR exchange rate, but also led to an increase in uncertainty concerning the future exchange rate.

Using survey data, we identify the changes in first and second moments of firm exchange rate expectations due to the monetary policy shock. As the source of uncertainty is known and first and second moment effects can be disentangled, we can fully identify uncertainty. The firm-level data provides information concerning realized and planned investments for 2014 and 2015, these values are observed twice. Once before the shock in Autumn 2014, once after the shock in Spring 2015. We quantify the revisions in investment plans at firm-level and connect them to the monetary policy shock. We can distinguish which part of investment plan revisions is due to the negative first moment shock and which part is due to the positive second moment shock. Furthermore, the dataset distinguishes between total investment and investment in equipment and machinery, construction, and research and development, and contains information on the degree of investment

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[18]We provide full estimation results in Table A4 in the Appendix.

irreversibility at firm-level. This enables us to test various channels through which exchange rate uncertainty could influence different investment categories.

This paper finds that exchange rate uncertainty caused by an abrupt change in monetary policy affects firms' investment plans. Uncertainty reduces total investment, but we find no evidence for a specific theoretical channel at the aggregate level. This result changes when we consider different investment categories. Uncertainty negatively affects irreversible investment in equipment and machinery, which is in line with real-option theory. However, we do not find statistically significant real-option effects for investment plans in construction. Furthermore, estimation results suggest that uncertain firms intensify their research and development efforts, which is in line with previous findings in the literature and might be attributed to growth-option effects. This article further sheds light on the question whether uncertainty has an immediate or delayed effect on investment plans. We find that uncertainty has an immediate effect and that it leads to a downward adjustment of firm investment plans in equipment and machinery. This finding does not hold true for investment in construction.

Finally, we provide evidence that the effect of uncertainty varies across different categories of investment. While real-option effects seems to be the dominant channel for investment in machinery and equipment, investment plans in research and development are affected via growth-option effects. We do not find any significant effect of uncertainty on investment in construction. A long planning phase and high adjustment costs once constructions are initiated could mask potential effects in our temporally limited set-up. Nevertheless, showing that uncertainty influences different type of investment through different mechanisms and potentially over different time horizons suggests that it is not sufficient to focus on aggregated investment such as fixed gross capital investment. Analysis should focus on disaggregated investment data to uncover more details about the relationship between uncertainty and investment.

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A   Appendix

Table A1: Variable abbreviations - full description

Abbreviation	Full description
$\Delta I_{i,t=2014}$ (GFCF)	Gross Fixed Capital Formation, Revision of logged Investment Plans (2014)
$\Delta I_{i,t=2015}$ (GFCF)	Gross Fixed Capital Formation, Revision of logged Investment Plans (2015)
$\Delta I_{i,t=2014}$ (construction)	Construction, Revision of logged Investment Plans (2014)
$\Delta I_{i,t=2015}$ (construction)	Construction, Revision of logged Investment Plans (2015)
$\Delta I_{i,t=2014}$ (equipment)	Equipment, Revision of logged Investment Plans (2014)
$\Delta I_{i,t=2015}$ (equipment)	Equipment, Revision of logged Investment Plans (2015)
$\Delta I_{i,t=2014}$ (R&D)	R&D, Revision of logged Investment Plans (2014)
$\Delta I_{i,t=2015}$ (R&D)	R&D, Revision of logged Investment Plans (2015)
expected exchange rate$_i$	Expected Exchange Rate (24 months)
uncertainty$_i$	takes value 1 if firm experience a decreased in certainty, 0 otherwise
irreversibility$_i$	firms' irreversibility
employees$_i$ (fte)	firms' FTE on December 31st, 2014
exchange rate$_i$	closing exchange rate on date of response
comp$_i$	takes value 1 if firms operates in a competitive market, 0 otherwise
foreign owned$_i$	takes value 1 if firm is owned by foreign entity, 0 otherwise
export$_i$	takes value 1 if firms' share of revenue abroad is above 5%, 0 otherwise
distance border$_i$	distance to border in km
share foreign employees$_i$	percentage of foreign employees
days snb$_i$	days since SNB announcement
certainty s2014$_i$	level of realisation certainty for investment plans 2015 in Autumn 2014

Table A2: Summary statistics (Firms indicating uncertainty)

Statistic	N	Mean	St. Dev.	Min	Median	Max
$\Delta I_{i,t=2014}$ (construction)	19	0.025	0.248	−0.719	0.001	0.586
$\Delta I_{i,t=2015}$ (construction)	19	−0.022	0.205	−0.490	−0.007	0.578
$\Delta I_{i,t=2014}$ (equipment)	31	−0.016	0.394	−1.733	0.010	0.556
$\Delta I_{i,t=2015}$ (equipment)	31	−0.053	0.275	−0.910	−0.016	0.492
$\Delta I_{i,t=2014}$ (R&D)	11	0.042	0.625	−1.072	0.000	1.391
$\Delta I_{i,t=2015}$ (R&D)	11	0.090	0.473	−0.471	0.000	1.322
uncertainty$_i$	33	1.000	0.000	1	1	1
irreversibility$_i$	33	0.697	0.467	0	1	1
expected exchange rate$_i$	33	1.081	0.066	0.950	1.080	1.230
employees$_i$ (fte)	33	367.600	553.000	29	140	2,950

Table A3: Summary statistics (Firms indicating no uncertainty)

Statistic	N	Mean	St. Dev.	Min	Median	Max
$\Delta I_{i,t=2014}$ (construction)	71	0.022	0.350	−1.236	0.000	1.236
$\Delta I_{i,t=2015}$ (construction)	71	0.011	0.431	−1.296	0.000	1.675
$\Delta I_{i,t=2014}$ (equipment)	127	−0.007	0.212	−1.306	0.000	0.677
$\Delta I_{i,t=2015}$ (equipment)	127	0.081	0.390	−0.651	0.000	2.945
$\Delta I_{i,t=2014}$ (R&D)	49	0.006	0.779	−2.854	0.000	2.311
$\Delta I_{i,t=2015}$ (R&D)	49	−0.011	0.665	−2.206	0.000	2.048
uncertainty$_i$	139	0.000	0.000	0	0	0
irreversibility$_i$	139	0.597	0.492	0	1	1
expected exchange rate$_i$	139	1.084	0.053	0.900	1.100	1.220
employees$_i$ (fte)	139	360.600	592.300	4	153	3,795

Table A4

	Dependent variable:							
	Diff GFCF		Diff Equipment Investment		Diff Construction Investment		Diff RnD Investment	
	OLS		OLS		OLS		OLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
uncertainty	−0.042* (0.022)	−0.003 (0.036)	−0.070*** (0.024)	−0.004 (0.040)	0.0004 (0.053)	0.074 (0.087)	0.132* (0.080)	0.211 (0.147)
irreversibility		0.014 (0.018)		0.018 (0.019)		0.050 (0.042)		−0.093 (0.071)
irreversibility × uncertainty		−0.056 (0.042)		−0.094** (0.046)		−0.111 (0.101)		−0.099 (0.175)
$\Delta I_{i,t=2014}$	−0.174*** (0.043)	−0.173*** (0.043)	−0.225*** (0.043)	−0.224*** (0.043)	−0.322*** (0.068)	−0.316*** (0.068)	−0.426*** (0.051)	−0.429*** (0.051)
expected exchange rate	0.175 (0.131)	0.172 (0.132)	0.147 (0.146)	0.140 (0.146)	−0.022 (0.304)	−0.010 (0.304)	−0.074 (0.507)	−0.059 (0.506)
employees (fte; logged)	0.006 (0.006)	0.006 (0.006)	0.014** (0.006)	0.014** (0.006)	−0.007 (0.014)	−0.006 (0.014)	0.020 (0.024)	0.023 (0.024)
exchange rate	1.285 (1.363)	1.270 (1.365)	3.215** (1.491)	3.227** (1.492)	−1.531 (3.247)	−1.693 (3.252)	0.256 (5.246)	0.609 (5.257)
comp	−0.015 (0.018)	−0.015 (0.018)	−0.008 (0.020)	−0.008 (0.020)	−0.070 (0.045)	−0.070 (0.046)	0.057 (0.078)	0.041 (0.078)
foreign owned	0.012 (0.021)	0.012 (0.021)	−0.014 (0.023)	−0.014 (0.023)	0.042 (0.051)	0.045 (0.052)	0.076 (0.081)	0.086 (0.081)
export	0.012 (0.021)	0.011 (0.021)	0.0002 (0.023)	−0.001 (0.023)	0.034 (0.055)	0.031 (0.055)	0.106 (0.081)	0.102 (0.081)
distance border	0.0003 (0.001)	0.0003 (0.001)	0.0002 (0.001)	0.0002 (0.001)	0.0003 (0.001)	0.0004 (0.001)	0.005* (0.002)	0.005** (0.002)
share foreign employees	0.0001 (0.0004)	0.0001 (0.0004)	−0.0002 (0.0004)	−0.0002 (0.0004)	0.001 (0.001)	0.001 (0.001)	−0.002 (0.002)	−0.002 (0.002)
days snb	0.002 (0.002)	0.002 (0.002)	0.003 (0.003)	0.003 (0.003)	−0.003 (0.005)	−0.003 (0.005)	0.008 (0.009)	0.008 (0.009)
(days snb)^2	−0.00001 (0.00001)	−0.00001 (0.00001)	−0.00001 (0.00001)	−0.00001 (0.00001)	0.00001 (0.00003)	0.00001 (0.00003)	−0.0001 (0.00005)	−0.0001 (0.00005)
certainty s2014	−0.008 (0.025)	−0.010 (0.025)	−0.001 (0.027)	−0.004 (0.027)	−0.041 (0.064)	−0.043 (0.064)	0.031 (0.091)	0.034 (0.091)
Constant	−1.849 (1.538)	−1.855 (1.540)	−3.776** (1.684)	−3.822** (1.684)	1.726 (3.632)	1.866 (3.637)	−0.965 (5.887)	−1.286 (5.891)
Observations	1,025	1,025	948	948	414	414	314	314
R^2	0.076	0.078	0.105	0.109	0.179	0.184	0.370	0.378
Residual Std. Error	0.237 (df = 936)	0.237 (df = 934)	0.248 (df = 860)	0.248 (df = 858)	0.340 (df = 338)	0.340 (df = 336)	0.486 (df = 254)	0.485 (df = 252)

*p<0.1; **p<0.05; ***p<0.01

Additionally controls for sector and geographic region are not shown

26

KOF **Business tendency survey**   KOF Swiss Economic Institute   Tel: 044 632 85 33   **0835186236**
ETH Zürich, LEE F 105, 8092 Zürich   Fax: 044 632 13 52
www.kof.ethz.ch   ivu@kof.ethz.ch

Branch name: _____   Survey

Classification: _____   Firm-ID

Contact-ID

Branch-ID

Questions autumn

Number of employees in Switzerland on 30 June 2014
(please convert part-time positions into full-time equivalent positions)

[ ][ ][ ] ' [ ][ ][ ]

In 2014 the following percentage of our production was exported

○ 0-5%   ○ 6-33%   ○ 34-66%   ○ 67-100%

1. Investment activity

a) Our investments in **Construction** in Switzerland amounted to / is likely to amount to

	mrd.	mio.	thd.	hnd.
2013				0 0 0 . -
2014				0 0 0 . -
2015				0 0 0 . -

b) Our investments in **fixed assets and software** in Switzerland amounted/ is likely to amount to

	mrd.	mio.	thd.	hnd.
2013				0 0 0 . -
2014				0 0 0 . -
2015				0 0 0 . -

c) Our investments in **research and development** in Switzerland totalled/ are expected to amount to

	mrd.	mio.	thd.	hnd.
2013				0 0 0 . -
2014				0 0 0 . -
2015				0 0 0 . -

d) Relative to 2014, in the year 2015 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and developpment
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

e) We consider the realisation of our investment plans for 2015 as

○ very sure   ○ fairly sure   ○ fairly uncertain   ○ very uncertain

2. Production capacity

In comparison to 2014 our technical production capacity in Switzerland in the year 2015 shall probably

○ expand   ○ leave unchanged   ○ reduce

3. Structure of the investment

Our investment in 2014/2015 serves (you may pick one or more categories)

		2014	2015
a)	replacement	☐	☐
b)	extension of the production capacity	☐	☐
c)	to streamline production	☐	☐
d)	environmental protection and regulations by trade law	☐	☐
e)	other objectives	☐	☐

4. Product programme

In terms of our product programme, in the year 2015 we are planning to

retain our product range   ☐

bring our products into line with the state of the art   ☐

add new products to the product range   ☐

5. Factors influencing the investment activity

Our investment activity will be positively/negatively influenced in 2014 and 2015 respectively by the following factors:

a) 2014	++	+	=	-	--	n.a.
Demand	○	○	○	○	○	○
Financial resources/ expected profits	○	○	○	○	○	○
Technical factors	○	○	○	○	○	○
Other factors	○	○	○	○	○	○
b) 2015	++	+	=	-	--	n.a.
Demand	○	○	○	○	○	○
Financial resources/ expected profits	○	○	○	○	○	○
Technical factors	○	○	○	○	○	○
Other factors	○	○	○	○	○	○

++ very stimulating   + stimulating   = no influence
- limiting   -- very limiting   n.a. no answer

6. Non-domestic investment

In the year 2015 we are planning to make direct investments abroad

○ yes   ○ no

If yes
The direct investment relates to the following activities:

Distribution   ☐

Production   ☐

Research and development   ☐

Figure A1: Questionnaire Investment Survey Autumn 2014

KOF **Investment survey**

KOF Swiss Economic Institute
ETH Zürich, LEE F 105, 8092 Zürich
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Tel: 044 632 85 33
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ivu@kof.ethz.ch

Branch name: _____

Classification: _____

Survey   IVU   2015   1   2

Firm-ID

Contact-ID

Branch-ID

Please note

- Your responses should refer only to the branch named above
- The questions refer to the activities of domestic branches
- Do not use a red pencil
- Tick the appropriate box ☒ ☒
- The notes are on the back of the sheet
- Please return the questionnaire by the

Your responses are treated strictly confidential.

Questions spring

1. Investment activity

a) Our investments in **construction** in Switzerland amounted to / is likely to amount to

	bn.	mio.	thd.	hnd.
2013				0 0 0 . –
2014				0 0 0 . –
2015				0 0 0 . –

b) Our investments in **fixed assets and software** in Switzerland amounted / is likely to amount to

	bn.	mio.	thd.	hnd.
2013				0 0 0 . –
2014				0 0 0 . –
2015				0 0 0 . –

c) Our investments in **research and development** in Switzerland totalled / are expected to amount to

	bn.	mio.	thd.	hnd.
2013				0 0 0 . –
2014				0 0 0 . –
2015				0 0 0 . –

d) Relative to 2014 , in the year 2015 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and development
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

e) Relative to 2015 , in the year 2016 our investment in Switzerland is likely to

	Machinery and equipment	Construction	Research and development
increase	○	○	○
remain unchanged (or remain at zero)	○	○	○
decrease	○	○	○

f) We consider the realisation of our investment plans for 2015 as

○ very certain   ○ fairly certain   ○ fairly uncertain   ○ very uncertain

2. Irreversibility

Bearing in mind the type of equipment / machinery used in making your main product / services, we would like to know whether a secondhand market exists where in case of need it **could be sold**.

Choose one of the following answers

○ Yes, and it is relatively easy to find a buyer in a short time willing to pay a reasonable price.

○ Yes, but it takes time to find a buyer and selling prices are not very rewarding.

○ Yes, but it is very difficult to find a buyer and selling prices can become very low.

○ No, there is no such market.

3. Number of employees

At the end of the year, the number of employees (in full time equivalent) in Switzerland will amount

	thd.	hnd.
2014		

4. Structure of the investment

Our investment in 2015 / 2016 serves
(you may pick one or more categories)

		2015	2016
a)	replacement	☐	☐
b)	extension of the production	☐	☐
c)	to streamline production	☐	☐
d)	environmental protection and regulations by trade law	☐	☐
e)	other objectives	☐	☐

5. Exchange rate CHF - EUR

a) On 15 January 2015, the SNB removed the exchange rate floor of 1.20 CHF for one euro. In order to enable investment plans for 2015 to be assessed more effectively, please can you indicate the level at which, in your view, the exchange rate is most likely to lie in future.

	6 months	12 months	18 months	24 months
maximum	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐
minimum	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐

b) If possible, please also state the most likely level of the exchange rate within the interval.

	6 months	12 months	18 months	24 months
Expected figure	☐.☐☐	☐.☐☐	☐.☐☐	☐.☐☐

Figure A2: Questionnaire Investment Survey Spring 2015