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The impact of policy awareness: Evidence from vehicle choices response to fiscal incentives

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ABSTRACT

Isolating the role of limited knowledge, psychological frictions and policy characteristics is key when evaluating a public program and designing future policies. We document limited awareness about the presence of fiscal incentives towards fuel efficient vehicles. Exploiting a direct measure of awareness at the individual level, we find vehicle choices response heterogeneity to these fiscal incentives between aware and unaware individuals. To estimate the effect of awareness, we leverage a field experiment randomizing information about the mere existence of the fiscal incentives. We show the simple intervention substantially increases policy awareness among vehicle buyers and affects consumers' vehicle choices. Further, we find increased awareness induces consumers to purchase vehicles that consume less fuel. Together, our findings highlight that limited awareness represents a critical barrier to the effectiveness of public programs.

1. Introduction

The proper design of policy measures crucially relies on the understanding of the reasons why some programs work while others do not. The effectiveness of a public program might be limited for several reasons, ranging from flaws in the incentive scheme to barriers related to the individuals' decision making process such as limited information, low program awareness, stigma, inattention, and other behavioral anomalies. The role of these factors has been discussed, for instance, in the context of the take-up of tax credits, subsidies for saving accounts, food stamps, Social Security, health insurance and environmental policies (Benartzi and Thaler, 2007; Congdon et al., 2009; DellaVigna, 2009; Gillingham et al., 2009; Chetty et al., 2014; Madrian, 2014; Bhargava and Manoli, 2015; Chetty, 2015; Allcott, 2016). One key challenge for academics and policy makers is to isolate the impact of a single potential factor on the (lack-of) individuals' response to economic incentives.

In this paper, we aim at identifying the impact of awareness about the presence of fiscal incentives in determining individuals choices response. Clearly, only those individuals in the target population that are aware of the existence of a specific public program may incorporate its incentives in their decision making process and possibly respond to its introduction. However, the mere knowledge of the existence of the fiscal measure is not sufficient to guarantee that the policy

reaches its desired goals in the presence of inadequate incentives, low salience, or behavioral or psychological biases in the individuals' decision making process. Nonetheless, failing to properly consider the role of low policy awareness might induce policy makers to conclude that the low effectiveness of a program is related to limitations in its design or other behavioral failures of its recipients, while it is adequate knowledge among the target population that is simply lacking. Moreover, corrective non-price interventions can have an equivalent effect than sizable price changes at a fraction of their cost (Allcott and Mullainathan, 2010; Bertrand et al., 2010).

To assess the consequences of limited policy awareness on individuals' responses to fiscal incentives, we consider the case of vehicle taxes on consumers' choices in Switzerland. As in most European countries, drivers in Switzerland have to pay each year a tax on car ownership — also known as registration tax. In addition, some of the regional administrative areas (cantons) introduced, in different years, a Bonus/Malus system based on vehicle energy efficiency or CO₂ emissions. For instance, a bonus applies to very energy efficient cars and provides a sizable percentage discount, ranging from 40 to 100 percent, to the baseline registration tax. The monetary savings from these fiscal incentives are substantial, corresponding to around 25 percent of the annual vehicle fuel cost on average. Because the

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incentives are applied automatically to the baseline vehicle tax, this policy is particularly well suited to study the role of policy awareness as we can rule out the role of transaction costs to access the fiscal benefits.

To obtain a measure of policy awareness at the individual level, we ask a representative sample of Swiss drivers whether they knew, at the time they bought their main car, if the registration tax in their canton of residence was based on fuel efficiency rating and/or CO₂ emission rate.¹ We document that only 42 percent of Swiss drivers are correctly informed about the presence of fiscal incentives for the purchase of efficient cars.

The Bonus/Malus system provides consumers with incentives for the purchase of efficient vehicles.² To explore the role of individuals awareness about the existence of these fiscal incentives on vehicle choices, we start providing descriptive evidence about the heterogeneous response to the Bonus/Malus system of aware and unaware consumers. To do this, we exploit the quasi-experimental variation in the introduction of the fiscal incentives across cantons and over time, as well as the availability of the direct measure of policy awareness at the individual level both in the presence and in the absence of the policy. We find suggestive evidence that the introduction of the policy affected individuals' vehicle choices differently depending on their policy awareness status.

To estimate the effect of individual awareness about the existence of the fiscal incentives for the adoption of fuel efficient vehicles on vehicle choices, we conduct a field experiment. A representative sample of the Swiss population was randomized between a treatment group, receiving information about the mere presence or absence of fiscal incentives for the adoption of energy efficient vehicles in the canton of residence, and a control group that did not receive any information. We show the treatment assignment is unconfounded.

We then exploit the random treatment assignment to estimate the intent-to-treat effects of the intervention on individual awareness and vehicle choices. First, we find the information treatment increases the probability vehicle buyers are policy aware by 13.5 percentage points on average. These findings show that a simple informational campaign can substantially increase individual policy awareness. Second, we show that providing information about the mere presence of the Bonus/Malus system induces those who can access these fiscal incentives to purchase vehicles that consume around 10 percent less fuel.

The randomized controlled trial allows us to obtain a clear exogenous variation in individuals' policy awareness. To provide an estimate for the causal effect of policy awareness on vehicle choices, we then use treatment assignment as an instrument for individual awareness. Under the assumption that our intervention affected vehicle choices only through its effect on awareness, we find that becoming aware of the presence of the fiscal incentives due to the informational intervention induces to purchase vehicles that consume around 32 percent less on average. Together, our results show that, while ignoring policy awareness would lead to conclude that the fiscal incentives introduced by the Bonus/Malus system are ineffective, awareness about the presence of the incentives has a relevant effect on individuals' vehicle choices.

Starting from [Simon \(1955\)](#), a large literature in economics has attempted to relax the traditional assumption of individuals taking decisions under full information. Less attention though has been devoted to considering the role of lack-of knowledge in the context of the evaluation of public programs. Our paper is related to a recent literature that considers the role of limited information on the individuals' responses to public policies ([Mastrobuoni, 2011](#); [Kling et al., 2012](#); [Chetty and](#)

[Saez, 2013](#); [Bhargava and Manoli, 2015](#); [Liebman and Luttmer, 2015](#)). This literature typically uses information treatments to study the impact of limited knowledge about the characteristics of a policy measure on individuals' choices. Our main contribution is to isolate the causal effect of awareness about the mere presence of a fiscal program on individuals' responses from that of other potential behavioral factors or policy characteristics influencing individual choices.³ Isolating the effect of individual awareness is also important as the effectiveness of an information treatment in influencing behavioral responses depends on whether the intervention affects the actual level of individuals' awareness or knowledge about the policy. Indeed, the process through which this knowledge is shaped is largely unknown ([Chetty and Saez, 2013](#)), and may be hindered by several factors, including the initial level of understanding of the policy, the program's complexity, the financial literacy of treatment recipients, and the type and framing of the information provided.

This work is also complementary to the paper by [Chetty et al. \(2013\)](#), who estimate the impacts of the Earned Income Tax Credit on labor supply in the US exploiting variation of knowledge at the local level even though they argue that, ideally, one would want to use a direct measure of knowledge at the individual level. To our knowledge, we are the first to use an explicit, direct measure of awareness at the individual level about a specific public program to study the implications for its effectiveness. We argue that the concept of awareness is distinct from other behavioral anomalies, like salience.⁴

Finally, we contribute to the growing literature on the effects of environmental taxation and information on vehicle choices ([D'Haultfœuille et al., 2014](#); [Klier and Linn, 2015](#); [Alberini and Bareit, 2017](#); [Huse and Koptuyug, 2017](#); [Grigolon et al., 2018](#); [Allcott and Knittel, 2019](#); [Cerruti et al., 2019](#); [van den Bijgaart and Cerruti, 2020](#)). Specifically, we are the first to study the role of awareness about the presence of an environmental policy measure in determining its effects. We document a large lack of consumers' awareness about the presence of tax incentives for the purchase of an energy efficient vehicle. We estimate a substantial consumers' valuation of yearly tax by policy aware consumers and provide an explanation for the limited average effects of vehicle taxes on vehicle choices estimated in the literature. Our findings highlight that low awareness represents a substantial barrier to the effectiveness of vehicle taxes in influencing vehicle purchases.

The rest of the paper is organized as follows. In [Section 2](#) we describe the Bonus/Malus system, our measure of policy awareness and the data. [Section 3](#) presents descriptive evidence on the role of policy awareness exploiting quasi-experimental policy variation. In [Section 4](#) we report on the experimental results. [Section 5](#) concludes.

³ Using a descriptive analysis of the survey data carried out following their main experiment, [Bhargava and Manoli \(2015\)](#) have already suggested that low program awareness may be one of the possible barriers to the take-up of fiscal benefits. Low policy awareness has also been suggested as one of the possible explanations for limited participation to financial aid programs for low income students ([Barr and Turner, 2018](#)) and low response to financial incentives for reusable bags ([Homonoff, 2018](#)).

⁴ The difference between awareness and salience is clear when considering contexts where low salience has been found to play a role as, for instance, automatic road tolls and sales taxes analyzed by [Finkelstein \(2009\)](#), and [Chetty et al. \(2009\)](#), respectively. While individuals might process partially the information about the existence of a toll or a sales tax when taking a decision due to their low visibility (low salience), they may still recognize their existence when explicitly asked about it. In our context, the concept of salience would apply only to the fraction of aware individuals that acknowledges the presence of the policy measure.

¹ We devised the awareness question to be included in the Swiss Household Energy Demand Survey (SHEDS), carried out yearly between 2018 and 2021 and collecting data on a representative sample of Swiss individuals.

² Throughout the paper we refer to both vehicles with high fuel efficiency rating and low CO₂ emissions as *energy efficient* cars.

2. Institutional context, methodology and data

2.1. Vehicle registration tax and the bonus/malus system

As in many other European countries, car owners in Switzerland have to pay a vehicle registration tax each year. The amount of these taxes is substantial, with the average annual registration tax on a vehicle purchased in 2015 that is around 435 CHF. The amount to pay typically depends on vehicle weight, engine size, and engine power, so that larger and more powerful cars pay more. Registration tax rates are not set by the central government: each of the 26 regional governments of Switzerland (known as cantons) are free to introduce their own scheme. Each canton – similarly to US states – enjoys vast freedom in setting up policies over a series of areas, including fiscal issues.⁵ Thus, there are considerable differences in the vehicle registration tax schemes between different cantons.

In addition to the regular vehicle tax, some cantons have introduced a Bonus/Malus incentive system, mostly between 2009 and 2014.⁶ Generally, while driving a fuel efficient or low CO₂ emission vehicle might guarantee a percentage discount to the baseline registration tax (bonus), driving a fuel inefficient or high emission car might increase the registration tax by a certain percentage (malus).⁷ Among the 26 cantons in Switzerland, seventeen introduced some vehicle registration tax incentives based on fuel efficiency, CO₂ emissions, or both, and it was often introduced at different times in different cantons. Appendix B provides details about the incentive scheme, its differences across cantons, and the years of implementation in each canton. In addition, in most cantons, the vehicle cannot be more than 3 or 4 years old to benefit from a registration tax discount. Therefore, older vehicles are typically not eligible for the tax incentives regardless their fuel efficiency or CO₂ emissions.

For the population of vehicles registered in Switzerland in 2015, the average incentive amount to around 209 CHF on average per year. This figure corresponds to around 25 percent of the annual vehicle fuel cost.⁸ Importantly, any discount or penalty to the registration tax is applied automatically by the canton and it is generally not advertised at the point of sale. This characteristic of the fiscal measure allows to rule out the role of transaction costs in the consumers' decision making process when studying the impact of policy awareness.

2.2. Methodology

The Bonus/Malus system introduced in some administrative areas in Switzerland decreases the vehicle registration tax on high efficiency cars that consumers need to pay each year, while increasing the amount to be paid for the least efficient vehicles. It thus provides incentives for the purchase of vehicles with higher fuel efficiency. In Appendix A, we sketch a simple theoretical framework for the role of limited awareness about the presence of tax incentives in determining consumers' vehicle choices. The model highlights that, while only consumers that

⁵ Switzerland is a federal state, with four different official languages and with three distinct levels of government: Federal, Cantonal (26 cantons), and Local (about 2500 municipalities). Each cantonal and local government is entitled with specific functions and large autonomy to impose taxes.

⁶ The only exception is canton Vaud, which introduced a Bonus/Malus scheme in 2005.

⁷ All cantons that applied a Malus system to the registration tax, also applied discount for efficient or low emission cars. Three cantons introduced a Bonus/Malus system based on fixed monetary amounts instead of percentage discounts/penalties. In one canton the tax is based on a function of the vehicle CO₂ emissions.

⁸ The annual vehicle fuel cost has been computed using the registration database of the whole vehicle fleet in Switzerland. We used as average annual mileage of km driven by Swiss drivers the value reported by the Swiss Federal Office of Statistics (11,828 km) (Swiss Federal Statistical Office, 2017).

are aware about the existence of the fiscal incentives might respond to them, separating the effect of limited policy awareness from that of other potential behavioral failures is crucial in the design and evaluation of the policy measure.

In this paper we aim to estimate the causal effect of individuals' awareness about the presence of the Bonus/Malus system for the vehicle registration tax on their vehicle choices. The ideal setting to address the question we are asking in this paper would be one where awareness about the presence of the incentive scheme had been randomly distributed to a group of individuals in cantons where the Bonus/Malus system is in place, with no possibility of information spillovers to other consumers in the same areas. That is, if individuals' awareness was determined exogenously, we could estimate the causal effect of being aware of the presence of the policy by simply comparing the fuel consumption of the vehicle purchased by aware consumers to that of unaware consumers only when the Bonus/Malus system is in place.

In our context, the identification of the causal effect of awareness about the presence of the Bonus/Malus system on vehicle choices is challenging because individuals' policy awareness is endogenous. For instance, prior to the vehicle choice, consumers might determine their level of awareness about the characteristics of the vehicles in their choice set as well as the associated taxation system, depending on the individual incentives that they face and that are unobservable to the researchers.

We first rely on the quasi-experimental variation in the presence of the Bonus/Malus system across cantons over time to provide descriptive evidence that the fiscal incentives only affect choices of vehicle buyers who are aware of the presence of such incentives at the time of vehicle purchase. To identify the effect of awareness about the presence of these incentives on vehicle choices, we then conduct a randomized controlled trial to exogenously alter the level of individuals' policy awareness among a representative sample of the Swiss population.

2.3. Measuring policy awareness

We elicit information on respondents' policy awareness about the presence of the registration tax incentives for efficient cars using a survey question that we have devised for the annual Swiss Household Energy Demand Survey (SHEDS), starting from 2018. We ask respondents whether they knew, at the time they bought their main car, if the registration tax in their canton of residence was based on fuel efficiency rating and/or CO₂ emission rate. The exact phrasing of the question is "At the time you bought your main car, did you know if in your canton the annual registration tax depended on the level of fuel efficiency and/or on CO₂ emissions of the cars?". The possible answers are "Yes, it depended on the fuel efficiency or on CO₂ emissions", "No, it did not depend on the fuel efficiency or on CO₂ emissions" and "I do not know".

The policy awareness question does not ask about specific characteristics of the Bonus/Malus, or even mentions the terms "bonus" or "malus".⁹ Our aim is to capture even vague awareness about the presence of the tax incentives, rather than the respondents' knowledge of the details of the registration tax scheme. Asking explicitly about the presence or the absence of the incentives allows us to distinguish between policy aware and not aware individuals also in cantons that never introduced a Bonus/Malus scheme on top of their registration tax.

Our measure of policy awareness combines information coming from the respondents' answer to the awareness question and the presence of the Bonus/Malus in their canton of residence at the time of purchase of the car. We classify as "policy aware" those respondents

⁹ Registration taxes can be based on engine size, vehicle power, or weight, but only the Bonus/Malus is an explicit and direct link between the tax amount and the efficiency rating or the CO₂ emission rate.

who answered “yes” and who bought a car in a canton that has introduced some registration tax incentives, when those incentives were in place. Respondents who bought a car when the incentives were not in place and who answered “no” have also been classified as “policy aware”. All other respondents were classified as not aware.

This survey question may potentially capture different mechanisms other than actual respondents’ awareness. First, some respondents may answer correctly by mistake or by guessing (false positive). Similarly, some respondents might have been informed about features of the registration tax at the time of purchase, but then answered wrongly or ‘don’t know’ to our question (false negative). Second, because the survey asks respondents about a purchase in the past and elicits knowledge *today* about the features of a tax *in the past*, respondents’ memory may intervene in a nonrandom way. Specifically, two issues may arise: (i) respondents not aware of the features of the tax at the time of purchase could be later negatively or positive surprised when receiving the yearly tax bill; (ii) the probability that respondents who were aware of the features of the tax at the time of purchase forget about it is lower if they did not enjoy the tax benefits. In both cases, the error in the measurement of awareness would be correlated with past vehicle choice. This raises an endogeneity bias when using this awareness measure to study the consequences of low program awareness on vehicle choices. In the next sections we discuss how we deal with these potential issues.

2.4. Data

Our main data source is the Swiss Household Energy Demand Survey (SHEDS), an annual survey collecting data on a sample of about 5000 households each wave, representative of the French and German speaking Swiss population of 25 cantons (excluding the Italian-speaking canton of Ticino).¹⁰ Most of the information we use comes from the waves of the SHEDS survey ranging from 2018 to 2021, while some additional data comes from waves 2016 and 2017.¹¹

The 2018 wave contains information on 5011 households. We complement those with 2051 households who were part of SHEDS in 2019 but not in 2018, for a total of 7062 households.¹² Among the whole sample, 5130 (72.64 percent) owned at least one car. Car ownership distribution in our data looks very similar to the official statistics from the Swiss government.¹³

The survey collects detailed information on respondents’ socio-economic characteristics and their main vehicle. Data on standard socio-economic characteristics, such as age, education, language and household income, are complemented by a rich set of information on environmental attitudes, values and social norms, life values, trust regarding advice on energy saving provided by various subjects (such as neighbors, government institutions, environmental organizations), voting preference for the green party, energy literacy and financial

¹⁰ The full text of the questionnaire, and information on how to get access to the data, can be found on <https://www.sccer-crest.ch/research/swiss-household-energy-demand-survey-sheds/>.

¹¹ Some questions are asked only the first time an individual participates to the survey, and are not asked again in the following waves. Regardless, the most relevant information for our analysis and baseline socioeconomic characteristics have been collected in the 2018 and 2019 waves. In particular, because the key question about policy awareness has been asked only from 2018, we restrict the sample to individuals that have been interviewed starting from 2018.

¹² We consider information given in the 2018 wave for respondents who participated in SHEDS both in 2018 and 2019.

¹³ In our sample, 27.36 percent of households do not have a car, 45.55 percent have one, 22.27 percent have two and 4.81 percent have three or more. A 2015 survey by the Swiss Federal Statistical Office found these shares to be 22 percent, 49 percent, 23 percent and 6 percent respectively (Swiss Federal Statistical Office, 2017, p. 11).

literacy (as in Blasch et al. 2021 and Lusardi and Mitchell 2014).¹⁴ Information on canton of residence and living area are also available.

Moreover, the survey asks respondents to report information on their vehicle fuel consumption per 100 km, its energy efficiency rating (from A to G), year of purchase and year of first registration. Most of respondents (92.33 percent) were able to provide information on fuel consumption per 100 km. On the other hand, only a small fraction of the respondents with at least one car (39.66 percent) provided information on the energy efficiency category of their main vehicle.

We use fuel consumption per 100 km as main outcome variable in the empirical analysis. Because of the low response rate on the energy efficiency category, substantial selection might arise from using this outcome variable and thus we prefer to use the self-reported fuel consumption as main outcome. In fact, fuel consumption rate is strongly correlated with the efficiency category and, within fuel type, exactly proportional to CO₂ emissions per km. In Appendix C, using data on the whole Swiss passenger vehicle fleet, we show that the distribution of actual fuel consumption is matched well by that of the self-reported fuel consumption, and we provide descriptive evidence about the association of fuel consumption with efficiency rating and CO₂ emissions.

Policy awareness in the data. A substantial share of respondents could not answer our policy awareness question correctly. We find that about 41.76 percent of the individuals in our sample are classified as “policy aware” according to our definition. About 39.54 percent of respondents answered “don’t know”, while 18.69 percent gave the wrong answer.

In Appendix E we present several tables reporting mean values of selected respondents’ characteristics, by groups of respondents characterized by different awareness and treatment statuses and by presence or absence of the Bonus/Malus. We do find that respondents in cantons that have introduced a Bonus/Malus scheme are more likely to live in urban areas, and are less likely to be German speakers. Furthermore, policy aware respondents are more likely to be male, with a university education, older and self-employed and French speakers. They are also more likely to provide the correct answer to our financial and energy literacy questions.

Finally, in Appendix F we show the evolution of the share of answers to the awareness questions and of aware individuals over the years of purchase of the vehicle. We present also graphs showing that aware individuals in cantons with Bonus/Malus tend to buy more efficient and newer vehicles than unaware individuals.

3. Descriptive evidence on the role of policy awareness

3.1. Exploiting quasi-experimental policy variation

Our first empirical strategy aims to provide suggestive evidence on the role of policy awareness on the fuel consumption of purchased vehicles exploiting the variation in the introduction of the Bonus/Malus system across cantons and over time. To do this, we leverage the availability of a direct measure of policy awareness both in the presence and in the absence of the policy. As described in Section 2.1, there is substantial variation in the timing of the introduction of the Bonus/Malus

¹⁴ Specifically, in the remaining of the paper we indicate with ‘financial literacy’ an indicator that is based on the understanding of the concepts of interest rates and inflation. We measure ‘energy literacy’ with a set of indicators based on whether the respondents understand the vehicle energy labels and know the energy costs of certain products. A detailed description of these variables is included in Appendix D. Some of the questions on environmental attitudes and literacy are asked only to new respondents. Thus, those questions might have been asked in the 2016 or 2017 wave for people who participated to the questionnaire more than once. Questions on baseline socio-economic characteristics, vehicle fuel economy, and policy awareness were all asked either in the 2018 or 2019 wave.

across cantons.¹⁵ Specifically, we adopt a triple differences approach in which we compare the behavior of aware versus unaware individuals, in cantons that do versus do not have the Bonus/Malus system, before versus after policy introduction. This strategy uses aware (and unaware) individuals in cantons *without* the Bonus/Malus system as a comparison group for the behavior of aware (and unaware) individuals in cantons *with* the Bonus/Malus system.¹⁶ This approach allows to deal with time (and policy)-invariant unobserved heterogeneity.

To obtain an estimate for the causal effect of policy awareness, this strategy requires assuming that the difference in purchasing behavior between aware and unaware individuals evolve in parallel in treatment and control cantons. There are several reasons why this is likely not the case. Most importantly, under this strategy, the ideal counterfactual for being aware in a canton with a Bonus/Malus policy is the group of people in cantons without a policy who would be aware if they were exposed to the same policy. However, the composition of the counterfactual that this strategy employs (i.e., aware individuals in cantons without the Bonus/Malus) may differ from the ideal. Therefore, the classification of aware individuals may be changing endogenously with the policy. Other potential issues which might undermine the validity of this approach to obtain an estimate for the causal effect of awareness are: (i) selective introduction of the Bonus/Malus system across administrative areas; (ii) lack of control for unobserved individual-specific characteristics that influence the process of information accumulation in the presence and in the absence of the policy; (iii) the presence of measurement error in awareness; (iv) the different definition of aware individuals in cantons with and without policy; (v) general equilibrium effects of the Bonus/Malus affecting choices of both aware and unaware individuals. To obtain an estimate for the causal effect of awareness, we rely on field experimental variation, as described in Section 4. Therefore, we would like to stress that this strategy only allows to obtain descriptive evidence of the effects of awareness on vehicle choices.

To provide this suggestive evidence on the heterogeneous policy effects by awareness status, we use SHEDS data from waves 2018 and 2019, with selected additional information from previous waves. Details about the information used in the main analysis, and the construction of the final sample are provided in Appendix D. The final sample used in the analysis includes 3433 observations.

3.2. Baseline DiD specification

To describe how the effect of the Bonus/Malus policy differs between individuals who are aware and unaware about the presence of the policy at the time of vehicle purchase, we estimate the following empirical specification:

$$y_{ict} = \beta \text{Aware}_i * \text{BMP}_{ct} + \theta \text{BMP}_{ct} + \psi \text{Aware}_i * \text{BM}_c + \gamma \text{Aware}_i + \delta X_i + \eta_c + \xi_t + \epsilon_{ict} \quad (1)$$

where y_{ict} is an outcome of the vehicle choice of individual i living in canton c in year t , Aware is a dummy for whether the respondent is policy aware, BM is a dummy for whether a canton has adopted some Bonus/Malus incentive at any point in time, BMP is a dummy that indicates if a Bonus/Malus system was in place in the canton and year in which the car was purchased, X is a set of respondents' characteristics, and η and ξ denote canton of residence dummies and

¹⁵ Table B1 in Appendix B provides detailed information on the different years of implementation.

¹⁶ In practice, with this strategy we exploit two double differences. The first is the difference in the before/after change in behavior of aware consumers between cantons with the Bonus/Malus system and those without the fiscal incentives. The second is the difference in the before/after change in behavior of unaware consumers between cantons with the Bonus/Malus system and those without the fiscal incentives.

year of purchase dummies, respectively. Depending on the presence of the Bonus/Malus in a given canton, the dummy variable Aware can indicate both respondents who know that a Bonus/Malus policy exists and respondents who know that a Bonus/Malus policy does not exist.

As discussed in Section 2.4 we use log fuel consumption per 100 km of the vehicle purchased as main indicator of vehicles' energy efficiency, and then perform robustness checks exploiting information on the vehicles' efficiency rating on the subsample for which this information is available. We then use the age of the vehicle at the time of purchase to study whether the incentives set by the Bonus/Malus system induced aware individuals to purchase newer cars. We cluster standard errors at the canton by year of purchase level.¹⁷ The coefficient of interest β indicates the reduced form effect of the fiscal incentives on vehicle choices for policy aware consumers, relative to that for unaware consumers. As discussed above, this is only merely suggestive of the effect of awareness, as the latter is endogenous. The coefficient θ gives the effect of the Bonus/Malus system for the unaware consumers. In the absence of supply side effects of the policy, we would expect the estimated θ to be equal to zero. Finally, ψ captures the time-invariant heterogeneity in vehicle choices within treatment group by awareness status. The term $\text{Aware}_i * \text{BM}_c$ controls then for the possibility aware individuals living in a canton that introduced a Bonus/Malus system are different (besides what we control for) to aware individuals living in cantons that never introduced such incentives. We include a large set of covariates to control for compositional differences among policy aware respondents in cantons with and without the policy. These include standard socio-demographics as well as investment literacy and environmental attitudes that can potentially influence both the decision of purchase of an efficient vehicle and the probability to be aware of the presence of the fiscal incentives. Moreover we include characteristics of the area of respondents' residence.¹⁸

Furthermore, to investigate the importance of considering policy awareness when studying the consequences of the Bonus/Malus system on vehicle choices, we also estimate Eq. (1) setting β , ψ and γ equal to zero. In this case, θ indicates the average effect of the Bonus/Malus system on the treated.

As discussed above, this specification assumes that the difference in vehicle purchasing choices between aware and unaware individuals would have evolved in parallel between cantons with and without Bonus/Malus. In Appendix G, we show that there are no statistically significant differences in the fuel consumption of vehicles purchased by aware and unaware consumers before the introduction of the Bonus/Malus system, in cantons that eventually introduced such incentives. While the latter evidence provides some support to the validity of the DiD assumption in this setting, we prefer to be cautious in interpreting the results of this analysis as causal effects of policy awareness as the latter is endogenous. We discuss the identification threats to this difference-in-difference strategy in Appendixes H and I.

In Appendix G, we show compelling descriptive graphical evidence about the heterogeneous response of aware and unaware individuals to the fiscal incentives provided by the Bonus/Malus system.

¹⁷ This is consistent with [Abadie et al. \(2017\)](#) who suggest that, in a model with fixed effects and in the presence of heterogeneous treatment effects, clustering should occur at the level of treatment assignment. We show that our findings are largely unaffected when applying the more conservative clustering at the cantonal level.

¹⁸ In particular, the set of controls includes: age, age squared, gender, education and employment status of the respondent, household size, monthly gross household income, respondent's main language, a set of indicators for energy and investment literacy, preferences towards the environment, life attitudes, type of living area (city, agglomeration, countryside) and a second-order polynomial in population size at the municipality of respondents' residence level in 2016. See Appendix D for a detailed description of the control variables used in the analysis.

Table 1
Effect of policy awareness on vehicle choices, OLS-DiD estimates.

	DiD		Only policy	
	No awareness		Awareness	
	(1)	(2)	(3)	(4)
BMP x Aware			-0.141*** (0.026)	-0.141*** (0.027)
BMP	0.013 (0.016)		0.059*** (0.018)	0.066*** (0.019)
BM x Aware			0.073** (0.033)	0.072** (0.033)
Aware		-0.083*** (0.016)	-0.004 (0.025)	-0.010 (0.025)
Controls	Yes	Yes	No	Yes
Purchase year FE	Yes	Yes	Yes	Yes
Canton FE	Yes	Yes	Yes	Yes
N	3433	1899	3433	3433

Notes: Dependent variable is the log of vehicle fuel consumption per 100 km. *BM* indicates respondents living in cantons who adopted a Bonus/Malus at some point; *BMP* indicates respondents buying a vehicle with a Bonus/Malus in place; *Aware* indicates policy aware respondents. Column (1): Effect of Bonus/Malus without considering awareness; Column (2): OLS estimate of awareness coefficient, only years and cantons with Bonus/Malus in place; Column (3): Main specification (Eq. (1)), without controls; Column (4): Baseline specification (Eq. (1)), that controls for individual and regional characteristics described in the text. Standard errors in parenthesis, clustered at the canton by time of purchase level. Three stars, two stars and one star indicate statistical significance at the 1 percent, 5 percent and at the 10 percent confidence level, respectively.

3.3. DiD estimation results

To highlight the importance of considering individuals' policy awareness to evaluate the consequences of the Bonus/Malus system, we first estimate the average effect of these fiscal incentives without taking into account whether consumers were policy aware or not (estimate Eq. (1) setting $\beta = \psi = \gamma = 0$). Column (1) of Table 1 reports the results of this analysis. When we do not consider the role of policy awareness, we do not find evidence of an average effect of the Bonus/Malus system on vehicle fuel consumption. This result is consistent with previous evidence (Klier and Linn, 2015; Alberini and Bareit, 2017) showing small or zero effects of vehicle registration taxes on fuel economy or emission rates.

To gain insights about the association between individuals' awareness and vehicle choices, we start considering only individuals that purchased a vehicle in a treated canton. We then simply regress the log of fuel consumption on awareness status and a large number of respondents' characteristics, canton and year of purchase dummies (this implies setting $\beta = \theta = \psi = 0$ in Eq. (1)). Results reported in Column (2) of Table 1 show that individuals living in treated cantons, that are aware of the presence of the Bonus/Malus system and purchased a vehicle after its introduction, own vehicles that consume on average around 8 percent less than unaware individuals.

We then estimate our baseline DiD specification (1) using OLS. The results are reported in Column (3) and (4) of Table 1. Estimation results in Column (3), obtained omitting individuals' characteristics, show that the introduction of the Bonus/Malus system reduces the fuel consumption of the vehicles purchased by individuals that are aware of the features of the registration tax scheme by around 14.0 percent, significant at the 1 percent confidence level.

Interestingly, we find that the introduction of the Bonus/Malus system increases the fuel consumption of the vehicle purchased by unaware consumers by around 6 percentage points. That might perhaps reflect short-term rigidities in the supply of energy efficient vehicles in a local market following the introduction of Bonus/Malus system, with aware consumers purchasing the more efficient vehicles to take advantage of the fiscal incentives, and unaware consumers that are

left with a reduced (less efficient) vehicles choice set. Another possible explanation would be a change in relative prices due to dealers increasing the retail prices of energy efficient vehicles in response to the introduction of the fiscal incentives. These possible general equilibrium effects imply that unaware consumers in the presence of the policy may purchase less efficient vehicles than they would have purchased were the policy never introduced. In this case, this strategy would be overstating the effect of policy awareness more, compared to a case in which these general equilibrium effects are not present, the greater the proportion of aware individuals in the population. Finally, we observe that aware individuals living in cantons that adopted a Bonus/Malus at any point in time tend to buy less efficient cars than aware individuals in cantons that never introduced such incentives. This raises concerns about whether aware individuals' choices across cantons with and without policy evolve in parallel over time, which is something the parallel trend tests cannot inform about.

In conclusion, results in Table 1 suggests the policy leads to a reallocation of efficient vehicles to aware consumers. These results are almost unaffected when we include a large set of respondents' characteristics (Column 4).¹⁹

In Appendix G we provide a series of robustness checks, various falsification tests, and an exploration of heterogeneous effects based on vehicle age and various socioeconomic characteristics of the car owners. In Appendix H we also run a propensity score matching analysis to address the potential compositional differences between aware and unaware individuals and individual in cantons with and without Bonus/Malus policies. Finally, in Appendix I we adopt an instrumental variable approach to make some progress in addressing the endogeneity of the awareness indicator, using as instrument: (i) the distance in years between Bonus/Malus implementation and vehicle purchase date; (ii) municipality-level voter participation rate to Swiss referenda; (iii) municipality-level variable measuring the diffusion of registration tax news through local newspapers. Despite these additional analyses, we recognize the limitations of the instrumental variable approaches (see the discussion in Appendix I) to provide an estimate for the impact of policy awareness in this context. For this reason, we consider the results presented so far as suggestive evidence of an effect of awareness. To obtain a clear exogenous variation in awareness, in Section 4 we conduct a randomized controlled trial.

4. Experimental evidence

4.1. Experimental design

We designed and implemented a randomized controlled trial that introduced information about the presence of fiscal incentives for the adoption of energy efficient vehicles. The experiment was conducted in collaboration with the marketing company (Intervista) that fields the SHEDS survey. We administered our experimental intervention to the sample of its panelists who had previously taken part to the survey at least once in the years 2016 to 2019 and who were still part of the panel on September 2019. This allows us to have an experimental sample that is representative of the French and German speaking Swiss population and detailed pre-treatment socio-economic characteristics on the participants. Our sample includes both individuals who previously owned a car and individuals who did not own a car. Further, we also include panelists living in a canton where a Bonus/Malus incentive system has not been introduced. The experimental sample consists of 9141 individuals who we randomized between the treatment group and the control group.

¹⁹ The complete list of the controls used is detailed in Appendix D.

The intervention. In October 2019, the 4600 members of the treatment group received an informational brochure enclosed in an email sent by Intervista. The email provided information about the existence, or not, of fiscal incentives for the adoption of energy efficient vehicles in the canton of residence. The information content was kept purposely extremely simple, aiming to merely raise awareness about the presence of the fiscal incentives while omitting any details about the eligibility rules, how much the incentives are worth or any message that may enact pro-environmental behavior. This is important because, consistently with the spirit of this work, we wish to leverage exogenous variation in policy awareness, and not detailed knowledge about how the fiscal incentives work or warm glow effects.

The object of the email reads “Do you know whether in your canton there are fiscal incentives for energy efficient vehicles?”. The main text of the email writes recipients that “we would like to inform you about the presence of fiscal incentives for energy efficient diesel and gasoline vehicles in your canton of residence in September 2019”. and suggests that such fiscal incentives “allow to save money on the annual vehicle registration tax”. Following this short text, a table is included indicating, for each canton, whether the annual vehicle registration tax is based on CO₂ emissions and/or fuel efficiency. A green “V” (a red “X”) was used to indicate that the registration tax depends (does not depend) on the vehicle’s energy efficiency. The full email is included in Appendix J.

The email informed recipients they received the email because they took part in a “scientific study conducted by Intervista” (i.e., the SHEDS survey study). We do not know the share of recipients who opened the email and read the attached brochure. However, the panelists are rewarded to be part of the panel and to participate in the activities proposed by Intervista, and are thus incentivized to check its mailings. The members of the control group in the panel did not receive any informational intervention.²⁰

Follow-up and attrition patterns. The last two waves of the SHEDS survey were carried out in May 2020 and May 2021. These served as experimental follow-up surveys and collected information on whether and when participants purchased a vehicle, its characteristics and the individual awareness about the presence of fiscal incentives for the adoption of energy efficient vehicles in the canton of residence.

Out of the experimental sample of 9141 individuals, 3769 and 3159 completed the 2020 and 2021 follow-up surveys, respectively, for a total of 4604 individuals who completed at least one survey. The substantial attrition rate (58.77 and 65.44 percent, respectively in 2020 and 2021) is not surprising since the experimental sample includes all panelists who had previously participated to at least one SHEDS survey.²¹ However, the attrition rate is extremely similar for the treated (59.07 and 65.00 percent, in 2020 and 2021 respectively) and the control group (58.47 and 65.89 percent, in 2020 and 2021 respectively). Formally, in Table K1 in the Online Appendix we show there is no evidence of differential attrition between treatment and control groups.

4.2. Sample characteristics

We link information from the experimental allocation to data from the SHEDS survey 2016–2021 to carry out the empirical analysis. 4604 individuals who were originally allocated to either control or treatment

²⁰ The panelists of Intervista receive several communications and requests to participate in different studies during the year. For this reason, we did not administer a placebo treatment to this group.

²¹ While administering the survey, Intervista contacts previous SHEDS participants starting from the most recent wave to reach the target of 5000 respondents. First-time respondents are enrolled only if the target of 5000 participants per wave is not reached. Despite members of the panel are compensated for answering the survey, they are not obliged to do so.

Table 2
Balance on observables.

	Control	Treatment	T-test
Age	48.313	48.665	(−0.77)
Female	0.485	0.486	(−0.10)
Educ.: high school or more	0.629	0.637	(−0.60)
Area: countryside	0.223	0.227	(−0.33)
HH size	2.319	2.341	(−0.61)
Bonus/Malus: Yes	0.726	0.736	(−0.76)
<i>N</i>	2289	2315	4604
<i>p</i> -value F-test		0.6930	

Notes: The Table reports summary statistics and tests of equality of means, between treatment and control groups, for selected controls. The first two columns show the sample averages for the control and the treatment groups, respectively. The third column shows the *t*-statistics for the t-test of equality of means. The last row reports the *p*-value for the F test of joint significance.

groups took at least one of the 2020 and 2021 SHEDS surveys. As already discussed above, the SHED survey is administered by Intervista such that respondents are broadly representative of the Swiss adult population. We find our sample is fairly representative of the national population with respect to gender, age, location, and household size, though we do observe a larger share of individuals with a university degree in our sample (see Table K2 in Appendix K).²²

Further, to test the assumption of unconfoundedness, we check that treatment and control groups are balanced with respect to observable characteristics. Table 2 shows a comparison of selected demographic characteristics between respondents who completed the follow-up survey in control and the treatment groups.²³ We find that the two groups are balanced with respect to age, gender, education, household size and living area. Importantly in this context, also the share of households living in a canton that introduced a Bonus/Malus system is balanced between the two groups. The standard F-test fails to reject these characteristics are jointly uncorrelated with the treatment status (*p*-value equal to 0.6930).²⁴

The 2020 (2021) follow-up survey asks our policy awareness question (as formulated in Section 2.3) to the respondents who purchased a new vehicle after the 2019 (2020) wave of the survey, and to those that did not participate to neither the 2018 nor the 2019 (nor 2020) surveys. In the analysis, we focus on the vehicle choice response in the year following our informational intervention. In the period November 2019–December 2020, 368 respondents purchased a vehicle among the 4604 who completed the follow-up surveys. We have information on post-intervention policy awareness for all the 368 respondents who purchased a vehicle.²⁵ The proportion of individuals purchasing a new vehicle by Bonus/Malus and information treatment statuses are reported in Table K4. Further, in Table K5, we show there is no differential selection into buying a car between treatment and control groups. Therefore, we study the effect of our treatment focusing on the subgroup of participants who purchased a new vehicle.

²² This might occur in part because individuals with a university degree are more likely to participate to the survey, and in part because our data refer to the reference person in the household, instead of the whole population. Table K2 in Appendix K reports selected statistics in the sample and in the national population.

²³ When available, we use socio-demographics information collected in wave 2020. We use information from wave 2021 only for those who did not participate to the 2020 wave.

²⁴ Full results of the linear probability model are reported in Table K3.

²⁵ We do not consider individuals who did not change the car after our intervention, as the awareness measure refer to car purchases before the treatment for these individuals. We therefore exclude about 254 individuals purchased a new car between the survey wave 2019 and the informational intervention, and also individuals who purchased their car before survey wave 2019.

As for the quasi-experimental evidence presented in Section 4, to analyze individual responses to our intervention, we use self-reported vehicle fuel consumption. In this experimental setting, potential issues of measurement error in vehicle fuel consumption would represent a threat to identification to the extent that misreporting is correlated with treatment status. We wish to stress that our informational intervention was purposely designed to only raise awareness about the presence of the Bonus/Malus system, whereas no information on eligibility rules or fuel economy was provided. For this reason, we believe that we can rule out selective misreporting between respondents in the treatment and control groups due to differential changes in fuel economy-related knowledge or wishful thinking reporting behavior. Among the 368 respondents who purchased a vehicle between November 2019 and December 2020, 303 reported its fuel consumption.²⁶ In Table K6 we show no statistically significant difference between respondents in treatment and control groups in terms of age, gender, household size, education, and presence of the Bonus/Malus policy. To corroborate the hypothesis that potential measurement error in self-reported vehicle fuel consumption is not correlated with treatment status, we show there is no difference in the probability to report missing vehicle fuel consumption between treatment and control groups (results in Table K7 in Appendix K).

4.3. Experiment results

The informational intervention we administered has the primary purpose of varying individual awareness about the presence of fiscal incentives for the adoption of fuel efficient vehicles. Our main goal is then to exploit the field experiment as a credible source of identification for the causal effect of policy awareness on vehicle choices. We first test to what extent our informational intervention actually affected the individual level of awareness about the presence of the Bonus/Malus system, i.e., the intention-to-treat (ITT) effect on policy awareness. We further explore whether our simple intervention affected vehicle choices.

4.3.1. Intent-to-treat effects

To estimate the effects of the informational brochure, we use variation from the treatment allocation at the individual level. We start by focusing on the response to our intervention among respondents who lived in cantons where some fiscal incentives for energy efficient and/or low carbon conventional fuel vehicles were present. Our baseline specification for the ITT effect is then simply:

$$y_{ic} = \alpha + \beta Treat_i + \delta X_i + \epsilon_{ic} \quad (2)$$

where y_{ic} is either our policy awareness indicator or the log of vehicle fuel consumption per 100 km, $Treat_i$ is an indicator for whether the respondent received the information treatment – the email – or not. A set of individual characteristics X_i is also included to increase the precision of the estimates. When we estimate Eq. (2) when the fiscal incentives are present, β indicates the ITT effect of the informational intervention.

Specification (2) assumes homogeneous treatment effects over time. However, the intervention may affect policy awareness status at the time of vehicle purchase and vehicle choices differently depending on the distance between treatment exposure and vehicle purchase. Therefore, we also estimate (2) allowing for the treatment effect to vary by year of car purchase (2019 vs. 2020). In this case, we include the interaction of indicator $Treat_i$ by year of car purchase and year of car purchase dummies.

²⁶ People who bought a battery electric vehicle (fully electric) and other alternative fuel vehicles are also treated as non-reporting. Without taking them into account, 338 individuals purchased a hybrid, gasoline or diesel vehicle between November 2019 and December 2020.

Further, we are interested in exploring how information about the lack of fiscal incentives affected policy awareness and vehicle choices. To do this, we also include individuals living in cantons without a Bonus/Malus system in the estimation sample, and exploit variation in the presence of the Bonus/Malus system at the cantonal level. Our specification for the ITT effect becomes:

$$y_{ic} = \alpha + \gamma Treat_i * BM_c + \beta Treat_i + \theta BM_c + \delta X_i + \epsilon_{ic} \quad (3)$$

where, as above, BM_c is an indicator for whether the canton has in place fiscal incentives for energy efficient and/or low carbon conventional fuel vehicles and all other variables are as in Eq. (2). When we let the ITT effect vary across individuals living in cantons with different Bonus/Malus policy status, β indicates the effect of the informational intervention on individuals living in cantons that did not introduce a Bonus/Malus system, while γ captures the information treatment effect on individuals actually facing a Bonus/Malus system, relative to that on those who do not face such incentives. The treatment effect on individuals who can access the fiscal incentives is then given by $\gamma + \beta$.

ITT on policy awareness. We start estimating Eq. (2) using our measure of individual awareness as dependent variable, and a linear probability model, for those individuals living in cantons where a Bonus/Malus system was in place.²⁷ Results are reported in Columns (1)-(4) of Table 3.

We find a large information treatment effect on individuals' policy awareness: the intervention increases the probability that respondents are policy aware by around 14 percentage points on average (based on column 1), corresponding to an increase of around 35 percent. Further, our results point towards the intervention being mostly effective in raising awareness about the presence of the fiscal incentives in the short-run. While the intervention increases policy awareness by around 39.4 percentage points among those who buy a vehicle in 2019 (see column 3), the effect becomes substantially smaller and not statistically significant among those who buy a vehicle in 2020.

When we estimate Eq. (3) on the full experimental sample, we find that the process of knowledge accumulation was affected by the intervention differently in the presence and in the absence of the fiscal incentives (results in Columns (5)-(8) of Table 3). Interestingly, the results show the information about the presence of the fiscal incentives was less effective in increasing individual policy awareness than that about their absence. However, we still find a positive treatment effect on policy awareness for individuals who can access the fiscal incentives (estimated $\gamma + \beta$, based on column 5) equal to 0.138, significant at the 5 percent confidence level. This evidence is confirmed when we allow for heterogeneous treatment effects by both Bonus/Malus policy status and year of car purchase: the intervention increases policy awareness more among those individuals who purchase a vehicle in 2019 in a canton without fiscal incentives for the adoption of energy efficient vehicles (as reported in Column 7). The results are little affected when we include a set of controls (see columns 2, 4, 6 and 8). As a falsification test, in Table K9 we show there is no effect of the treatment on awareness for the individuals who bought the car before our intervention.

ITT on vehicle choices. The ITT estimates on log fuel consumption are reported in Table 4. The results show that our simple informational intervention had a sizable impact on vehicle choices. Our intervention induced consumers to purchase vehicles consuming around 10 percent less fuel in the presence of a Bonus/Malus system (as reported in Column 1). When we allow the ITT to vary by the presence of a Bonus/Malus policy, we find substantially heterogeneous vehicle choices response to our intervention (columns 3 and 4). First, we find a positive but not significant treatment effect on vehicle fuel consumption among individuals living in cantons that did not introduced a

²⁷ Results in Table K8 show the results are largely unaffected using a Probit model.

Table 3
Experimental results: Treatment effect on policy awareness.

	Only with policy				Full sample			
	Whole effect		Effect by year		Whole effect		Effect by year	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BM x Treat					-0.163 (0.119)	-0.172 (0.119)		
Treat	0.138** (0.067)	0.135** (0.067)			0.301*** (0.098)	0.309*** (0.098)		
BM x Treat 2019							-0.027 (0.229)	-0.045 (0.227)
Treat 2019			0.394*** (0.140)	0.398*** (0.138)			0.445** (0.211)	0.458** (0.212)
BM x Treat 2020							-0.194 (0.126)	-0.201 (0.126)
Treat 2020			0.088 (0.075)	0.082 (0.076)			0.275*** (0.106)	0.279*** (0.105)
BM					0.214*** (0.076)	0.206*** (0.076)	0.221*** (0.076)	0.212*** (0.076)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
N	221	221	221	221	303	303	303	303
Mean dep. var. (control)			0.3894				0.3333	

Notes: Treatment effect on awareness, using only the sample of individuals living in cantons with Bonus/Malus (columns 1-4) or using the full sample (columns 5-8). Dependent variable is column (1) is a dummy taking value of one if the individual is policy aware. Treatment effect is split by year (2019 vs. 2020) in columns 3-4 and 7-8. Robust standard errors in parenthesis. Three stars, two stars and one star indicate statistical significance at the 1 percent, 5 percent and at the 10 percent confidence level, respectively. Linear hypothesis test: BM x Treat + Treat = 0.138 *p*-value 0.038 (column 5), 0.136 *p*-value 0.042 (column 6); BM x Treat 2019 + Treat 2019 = 0.418 *p*-value 0.002 (column 7), 0.413 *p*-value 0.002 (column 8); BM x Treat 2020 + Treat 2020 = 0.081 *p*-value 0.274 (column 7), 0.078 *p*-value 0.293 (column 8).

Table 4
Intention to treat effect on fuel consumption.

	Only with policy		Full sample	
	(1)	(2)	(3)	(4)
Treat	-0.099** (0.050)	-0.101* (0.051)	0.115 (0.099)	0.107 (0.103)
BM x Treat			-0.214* (0.111)	-0.206* (0.114)
BM			0.142 (0.089)	0.141 (0.092)
N	221	221	303	303
Controls	No	Yes	No	Yes

Notes: Intention to treat effect of the information letter on fuel consumption. The dependent variable is the log of vehicle fuel consumption. The sample includes respondents who bought a car between November 2019 and December 2020. Columns 1-2 use only respondents living in cantons with a Bonus/Malus policy; Columns 3-4 use the full sample. Robust standard errors in parenthesis.

Bonus/Malus system. Second, relative to the consumers living in cantons without fiscal incentives, we find that providing information about the mere presence of the Bonus/Malus system (to those who live in cantons with such policy) induces individuals to purchase vehicles that consume around 20 percent less fuel. Therefore, we find a treatment effect on individuals who can access the fiscal incentives equal to -9.95 percent, significant at the 5 percent level (estimated $\gamma + \beta$, based on column 3).

These results are consistent with the evidence obtained with the DiD analysis. They show that a simple informational intervention about the mere absence or presence of fiscal incentives for the adoption of energy efficient vehicles can induce substantial vehicle choices response. Importantly, they also highlight possibly unintended consequences of untargeted informational campaigns: informing individuals that no fiscal incentives for the adoption of energy efficient vehicles are available induces them to purchase vehicles with higher fuel intensity. Further, these ITT estimates would represent a lower bound for the effect of policy awareness on vehicle choices in case our intervention did not fully translate into knowledge about the presence of the fiscal program.

4.3.2. LATE of awareness

To address the issue of endogeneity of awareness discussed in Section 3.1 and obtain an estimate for the causal effect of policy awareness

on fuel economy, we use treatment assignment as an instrument for individual awareness. The results presented thus far have shown strength of our treatment assignment as an instrument for individual policy awareness. They also support the hypothesis that the treatment assignment is unconfounded. Therefore, we are confident that our instrument for individual awareness is exogenous with respect to unobservables influencing vehicle choices. To address potential concerns over our intervention affecting vehicle choices by enacting pro-environmental attitudes rather than through enhanced awareness, we explore the ITT effect of our intervention on a series of proxies for environmental values and behaviors.²⁸ As shown in Table K10, we find our intervention had no effect on any of these measures. These results provide additional support to the validity of our exclusion restriction. However, we cannot exclude our intervention also served as a nudge in favor of (against) energy efficient vehicles in cantons with (without) fiscal incentives for energy efficient vehicles. If the treatment resulted in people both becoming aware and being nudged, the nudge channel would contaminate the LATE estimates. Therefore, while the letter carefully omits any reference to other factors related to energy efficient cars rather than the Bonus/Malus system, we wish to point out this potential violation of the identifying exclusion restriction.

Under the assumption that the intervention affects vehicle choices only through increased awareness, our approach yields estimates for the causal effect of awareness on *compliers*, i.e. people who would have been unaware of the presence of the Bonus/Malus system without treatment, but who became aware upon receipt of the email.

LATE-IV on vehicle choices. We then estimate the following equation using two-stages least squares:

$$y_{ic} = \gamma \text{Aware}_i * \text{BM}_c + \beta \text{Aware}_i + \theta \text{BM}_c + \delta X_i + \epsilon_{ic} \tag{4}$$

where all variables are as in Eq. (1). We first estimate Eq. (4) for individuals who purchased a vehicle in the presence of a Bonus/Malus

²⁸ After the intervention, we ask respondents to assign a score from 1 to 5 to the importance or likelihood of the following environmental aspects and planned behavior: (1) Importance to have access to a clean environment; (2) Plans on reducing electricity consumption; (3) Plans on reducing heating consumption; (4) Plans on reducing carbon footprint; (5) Plans on reducing number of airplane flights.

Table 5
LATE of awareness on vehicle fuel consumption.

	Only with policy		Full sample	
	(1)	(2)	(3)	(4)
BM x Aware			-0.622*	-0.416
			(0.356)	(0.328)
Aware	-0.324*	-0.310*	0.218	0.087
	(0.195)	(0.182)	(0.279)	(0.260)
BM			0.290*	0.213
			(0.164)	(0.156)
Controls	No	Yes	No	Yes
N	221	221	303	303
Aware + BM x Aware			-0.404*	-0.329
			(0.238)	(0.226)
p-value F-test (Aware)	0.003	0.003	0.000	0.000
p-value F-test (BM x Aware)			0.000	0.000

Notes: The Table reports the IV-LATE of awareness on the log of vehicle fuel consumption per 100 km obtained using random treatment assignment as instrument for awareness. *BM* indicates respondents living in cantons who adopted a Bonus/Malus system; *Aware* indicates policy aware respondents. Results are obtained using only the sample of individuals in cantons with Bonus/Malus (columns 1-2) or using the full sample (columns 3-4). The linear test of the sum of the coefficients *Aware* and *BM* x *Aware*, and the *p*-value of the F-test/Sanderson-Windmeijer test for weak instrument, are also reported. Robust standard errors in parenthesis. Three stars, two stars and one star indicate statistical significance at the 1 percent, 5 percent and at the 10 percent confidence level, respectively.

system (setting $\gamma = \theta = 0$). To this end, we simply use Eq. (2) as first stage regression where either $Treat_i$ or $Treat_i$ by year of purchase are used as instruments for $Aware_i$.²⁹ In this case, β represents the LATE of awareness on vehicle fuel consumption.

Second, we estimate Eq. (4) on the entire experimental sample. β captures now the LATE of awareness on individuals living in cantons that did not introduce a Bonus/Malus system, while γ indicates the LATE of awareness on individuals actually exposed to the fiscal incentives for energy efficient vehicles, relative to the awareness effect when such incentives are not available. The LATE of awareness on individuals who can access the fiscal incentives is then given by $\gamma + \beta$.³⁰ Because of the large treatment effect heterogeneity on policy awareness by year of purchase documented in Section 4.3.1, our preferred specification for the first stage uses $Treat_i$ by year of purchase as instruments for $Aware_i$. In Table K11, we show our main results are confirmed (though more noisy) when we use only $Treat_i$ (or $Treat_i * BM_c$) as instrument for $Aware_i$.

Our LATE estimates of awareness on log fuel consumption are reported in Table 5 (results of the first stage are reported in Tables K12 and K13). Columns (1) and (2) present the results obtained for individuals purchasing a vehicle in the presence of the Bonus/Malus system (without and with controls, respectively), while columns (3) and (4) report the results obtained using the entire experimental sample. These results show that, in the presence of the fiscal incentives, policy awareness induces a substantial vehicle choices response (column 1 and 2). Specifically, we find that policy awareness induces compliers to purchase vehicles that consume around 32 percent less on average. The estimates for the effect of awareness on fuel economy are similar in magnitude (-40 percent) and statistically equivalent, when we estimate Eq. (4) on the full sample (result based on column 3, computing $\gamma + \beta$).

²⁹ As described above for our DID-IV approach, we deal with the presence of a binary endogenous variable by applying the three steps approach suggested by Angrist and Pischke (2008).

³⁰ When we estimate Eq. (4) on the entire experimental sample, we use both $Treat_i$ (or $Treat_i$ by year of purchase) and $Treat_i * BM_c$ as instruments for $Aware_i$ and $Aware_i * BM_c$.

5. Discussion and conclusion

When evaluating the impact of a public program, separating the role of policy awareness from that of other behavioral anomalies or possible limitations of the policy design is important because each of these factors have different implications for the understanding of individual behavior and the design of future policies.

In this paper we have explored the role of policy awareness on consumers' vehicle choices exploiting a direct measure of individual awareness about the presence of fiscal incentives for the adoption of fuel efficient vehicles and a field experiment in which we randomly vary individual awareness.

We show that ignoring policy awareness might lead to conclude the fiscal incentives are little effective in influencing vehicle fuel consumption and CO_2 emissions, consistently with previous estimates in the literature (Klier and Linn, 2015). Using a quasi-experimental design, we first provide suggestive evidence of heterogeneous policy responses between aware and unaware consumers. Exploiting the field experiment, we then show that policy awareness plays a crucial role to understand consumers' response to the fiscal incentives set by the Bonus/Malus system. Our results show that, while ignoring policy awareness might lead to conclude the fiscal incentives are little effective (consistently with previous estimates in the literature), policy awareness induces individuals to purchase more efficient vehicles. Hence, we find a substantial valuation of the yearly vehicle taxes by aware consumers. Our findings about the impact of policy awareness complement previous descriptive evidence suggesting low program awareness to be an important barrier to the take-up of fiscal benefits (Bhargava and Manoli, 2015).

In the context of fiscal incentives to promote the adoption of efficient vehicles, our results show that a simple and relatively inexpensive information treatment (sending a brochure within an email with disclosure of the presence of tax incentives), makes consumers aware of the existence of the fiscal incentives at the time of purchase and induces a significant vehicle choice response. This policy implication is not only relevant for Switzerland, as vehicle registration taxes based on vehicle fuel efficiency are widespread across European countries. More generally, the evidence we present prompts policy makers to complement the design and introduction of public policies with simple informational campaigns about their existence. We show that failing to do so might lead to a low average impact of the policy measure, which could be wrongly blamed on flaws of the policy design or other behavioral factors that would need different interventions to be corrected.

Another implication of our results is that the tax burden of fiscal measures disproportionately affects unaware individuals. While aware individuals could modify their behavior to access the monetary incentives, unaware consumers cannot benefit, even though they would potentially be better off when doing so. Moreover, our finding about the larger effect of policy awareness on vehicle choices among financially sophisticated individuals suggest policy makers should complement information campaigns with literacy programs that allow policy aware consumers to better understand the role of the fiscal incentives when taking investment decisions.

Our findings have implications for a wide range of existing public programs. The impact of increasing awareness on individual behavior might be especially prominent in contexts where the application of the benefits is automatic and requires little or no additional effort from the recipients (e.g., Medicare, marriage taxes and benefits, student quotas, discounts for public transport subscriptions). Clearly, the presence of other barriers to the access of fiscal benefits, such as transaction costs or stigma, might hinder the response of aware individuals to a public program. Moreover, in contexts with higher policy complexity, possible behavioral failures might play a more prominent role. Our study has also important implications for the design of environmental policies: if one wishes to create an environmental incentive, this should not be placed in a setting that allows for low awareness. Fiscal incentives for

energy efficient cars linked to a post-sale vehicle yearly registration tax are arguably less salient to perspective buyers than similar incentives at the point of sale, such as purchase rebates or discounts on the sales tax. Therefore, consumers are likely to become more aware of the existence of the former and respond to them. Hence, our findings have also implications for the collocation of environmental incentives within the optimal mix of high- and low-salience taxes discussed in Goldin (2015).

We have provided evidence about the impact of individuals' awareness about the presence of fiscal incentives on their vehicle choices. This is a reduced form estimate which might depend on the specific vehicle market conditions. Future research should investigate to what extent supply responses play a role, potentially influencing the effect of information treatments that aim to increase awareness among the population. Future work should also explore whether alternative types of intervention are better suited to foster the relevant individuals' awareness in different contexts.

Declaration of competing interest

We have no relevant or material financial interests that relate to the research described in the paper.

Data availability

Data will be made available on request.

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Supplementary material

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