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# Green taxes in a post-Paris world: are millions of nays inevitable?

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## Abstract

Turning greenhouse gas emissions pledges into domestic policies is the next challenge for governments. We address the question of the acceptability of cost-effective climate policy in a real-voting setting. First, we analyze voting behavior in a large ballot on energy taxes, rejected in Switzerland in 2015 by more than 2 million people. Energy taxes were aimed at completely replacing the current value-added tax. We examine the determinants of voting and find that distributional and competitiveness concerns reduced the acceptability of energy taxes, along with the perception of ineffectiveness. Most people would have preferred tax revenues to be allocated for environmental purposes. Second, at the same time of the ballot, we tested the acceptability of alternative designs of a carbon tax with a choice experiment survey on a representative sample of the Swiss population. Survey respondents are informed about environmental, distributional and competitiveness effects of each carbon tax design. These impacts are estimated with a computable general equilibrium model. This original setting generates a series of novel results. Providing information on the expected environmental effectiveness of carbon taxes reduces the demand for environmental earmarking. Making distributional effects salient generates an important demand for progressive designs, e.g. social cushioning or recycling via lump-sum transfers. The case of lump-sum recycling is particularly striking: it is sufficient to show its desirable distributional properties to make it one of the most preferred designs, which corresponds to a completely novel result in the literature. We show that providing proper information on the functioning of environmental taxes can close both the gap between acceptability *ex ante* and *ex post* and the gap between economists' prescriptions and the preferences of the general public.

**Keywords:** Carbon taxes; Acceptability; Political economy; Ballot data; Choice experiment

**JEL Codes:** D72; D78; H23; Q54

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# 1 Introduction

During the last decades, countries and international organizations have struggled to define a system of global governance able to tackle climate change. The Kyoto Protocol spurred the adoption of a first generation of climate policies (Fankhauser et al. 2015), but much more effort is required to meet the challenge of climate change mitigation (IPCC 2014). Unilateral policies have emerged to partly compensate for the continued failure of international negotiations (Ostrom 2009; Jordan et al. 2015), but only a fraction of countries opted for energy and carbon taxes (Baranzini and Carattini 2014; World Bank 2014). Most countries went for “soft policies” such as subsidies for renewable energies, which in some cases turned up to be not only strongly regressive but also extremely expensive (Marcantonini and Ellerman 2014). Vested interests and the general unpopularity of taxes are the main reasons behind this political choice.

The developments related with the 2015 Conference of Parties to the United Nations Framework Convention on Climate Change and the Paris Agreement have created a major breakthrough in the international negotiations for climate change mitigation. However, countries’ emissions pledges are not credible policy commitments. The world is at a turning point: strong domestic policies are now necessary to meet the Paris pledges at a reasonable cost. Any other outcome is likely to put the pledge-and-review system under pressure and to jeopardize the future tightening of current pledges (Baranzini et al. 2015).

How to overcome resistance to energy and carbon taxes is thus of primary interest. A recent literature has attempted to provide a first set of explanations to the lack of public support for environmental taxes. Since real ballots on environmental taxes take place sporadically and so real voting behavior is hard to observe, most of the literature relies on survey techniques to approximate the determinants of voting behavior. These surveys are usually realized in neutral times, i.e. absent any political campaigning. However, vested interests and media coverage are very powerful drivers of public opinion on environmental matters (Sampei and Aoyagi-Usui 2009; Jacobsen 2011; Spash and Lo 2012).

On March 8, 2015 the Swiss population was called to vote on a popular initiative aiming at replacing the current value-added tax (VAT) with an energy tax. About 2.2 million voters expressed their opinion. The proposal was rejected by a large majority, 92% of voters. Right after the ballot, we collected data on a representative sample of the Swiss population, to explain the observed voting behavior. This strategy is used to decrease the likelihood of socially-approved answers and also allows us to compare our sample with the observed outcome.

At the same time, we administered a choice experiment to another representative sample of the Swiss population, taking advantage from the very specific timing to assess the acceptability of alternative tax designs in presence of high political salience. In the choice-experiment setting we consider a carbon tax with four different tax rates and five revenue recycling options: income tax rebates, reduction of the value-added tax, lump-sum transfers, social cushioning and earmarking for additional emission abatements through the purchase of foreign offsets. We exploit the results of a general equilibrium modeling exercise to inform respondents on the expected outcomes of each tax design in terms of energy price increases, emission abatements, overall economic effects and distributional impacts. In this way, we address some of the most recurrent obstacles to the popularity of carbon taxes, all of which are arguably driven by imperfect information: excessive fear of adverse competitiveness and distributional effects, perceived ineffectiveness and misunderstanding of revenue neutrality. To the best of our knowledge, this is the first time such methodological approach is used. In the choice experiment, respondents face three alternatives: two different carbon tax designs, and the status quo. Hence, we reproduce the situation of real ballots, in which voters are asked to express their opinion on different proposals, with of course the possibility to reject all of them (see Kriesi 2005).

Our study is of interest for all democratic settings, with or without a system of direct democracy. We use Switzerland as a laboratory of study, but the divergence between economists and the general public on the benefits of revenue-neutral environmental taxes is a recurring problem to environmental tax reforms all around Europe (Dresner et al. 2006). The unpopularity of carbon taxes has hampered their implementation in France (Deroubaix and Lévèque 2006), while fear of competitiveness effects led to massive exemptions in Scandinavian countries, decreasing the potential for any sizeable environmental effect (Baranzini and Carattini 2014). Similar obstacles reduce the popularity of carbon taxes in emerging economies, too (Gevrek and Uyduranoglu 2015).

We find that the design of green taxes is the main driver of acceptability, and that information provision can lead to very different results from those in the literature. Data on voting behavior shows that the chances of the 2015 popular initiative would have been much higher if tax revenues had been earmarked for environmental purposes rather than for replacing the VAT, everything else equal. Concerns about the effect of higher energy prices on the distribution of income as well as on the competitiveness of firms are among the main determinants of rejection. People are also generally skeptics about the potential change in behavior that energy taxes could generate.

The design of our choice experiment addresses all these concerns and provides a series of original findings. Estimations from our modeling scenarios suggest that all carbon tax designs under investigation imply limited competitiveness effects and all provide significant reduction in emissions. Using the full tax revenue to purchase foreign offsets allow for massive emission abatements, in the domain of negative emissions. Most recycling options imply slightly regressive effects, except for lump-sum transfers and social cushioning, which (the latter by design) lead to a net progressive effect.

A common finding in the literature is that people are most willing to accept a carbon tax if its revenues are used to strengthen its environmental effectiveness, which people believe to be small. This stylized fact is confirmed by our analysis of voting behavior. However, our choice-experimental setting, by informing on the emissions reduction associated with the different carbon taxes, allows closing the gap between (possibly low) perceived effectiveness and (higher) predicted effectiveness. As a result, we find that earmarking for additional abatements is no longer particularly attractive. Information on the scenarios' predictions renders instead lump-sum transfers and social cushioning particularly popular, by making salient their progressive properties. The finding for lump-sum transfers is particularly striking. Despite their minimal administrative burden and the ability to address distributional concerns (Baranzini et al. 2000; Metcalf 2009), lump-sum transfers are especially neglected by the literature on the acceptability of carbon taxes. The reason for this is that these properties may not to be perceived by the population, along with revenue neutrality. Our setting shows however that it is sufficient to provide people with some supplementary information to reduce the gap between their preferences and economists' prescriptions.

We find that recycling through income tax rebates is relatively unpopular, as often found in the literature. People do not seem to understand the concept of environmental tax reform, or at least they do not see its advantages as some economists do. We stress that our modeling scenarios do not suggest the existence of a particular double dividend, i.e. positive economic effects through the reduction of distortionary taxes. Reductions in the value-added tax perform similarly poorly, in terms of acceptability. We also find that the support for green taxes decreases linearly with the rise in the tax rate. If we simulate based on our choice experiment the level of acceptability of the popular initiative voted on March 8 2015, we obtain a figure that is very consistent with the observed real outcome, indicating a high external validity of the results based on our choice experiment.

We contribute to the literature on the acceptability of carbon taxes by shed-

ding new light on the obstacles to the acceptability of carbon taxes. We make the voting decision in the choice-experimental setting as realistic as possible and provide people with sufficient details to take an informed decision on carbon taxes. Our results show that making the effect of environmental taxes salient can contribute to render relatively unpopular designs much more popular. So far, the literature has showed that only experiencing the functioning of a given policy allows citizens to revise their beliefs on the effectiveness and fairness of environmental taxes, which by default tend to be overly pessimistic (cf. e.g. Carattini et al. 2016). Our approach thus provides an alternative to the use of trials that has been increasingly called for to remedy environmental taxes' lack of popularity (Sælen and Kallbekken 2011; Cherry et al. 2014; Carattini et al. 2016). With the proper design and information, acceptable carbon taxes can exist at a moderately high tax rate, and sustain credible climate policies.

## **2 Context**

### **2.1 Literature review**

The theoretical literature on the political economy of environmental policy mostly focuses on lobbying by energy-intensive industries (see Oates and Portney 2003 for a review). Yet, Kirchgassner and Schneider (2003) stress the importance of considering voters' preferences, and how their pure economic objectives may compete with other interests, including environmental preferences. The opinion of the general public may however be biased by media and captured by vested interests, possibly leading to inaccurate opinion formation and policy-making (Millner and Ollivier 2015). But citizens can also organize in environmental advocacy groups and play an active role in the political arena. The model of Dietz et al. (2012) shows that the presence of green lobbies influencing policymakers may contribute to increase the stringency of environmental policy, as well as the likelihood of a stable coalition in environmental agreements.

The theoretical literature usually takes a narrow perspective and presumes that people rarely vote on policies, but rather for candidates and parties. The empirical literature has instead taken a broader perspective, assessing for instance the private willingness to pay for climate change mitigation (see Nemet and Johnson 2010 for a review), as well as the acceptability of specific policies. The case of environmental taxes has received particular attention. So popular among economists for reasons of efficiency and environmental effectiveness (Baranzini et al. 2015) and so unpopular among the general public,

they represent a unique opportunity to study the consequences of informational asymmetries between citizens, policy-makers and experts.

Empirical economists have used a wide range of tools to understand the determinants of energy taxes' acceptability. Qualitative assessments using focus groups have helped understanding the obstacles to the European Environmental Tax Reform (Dresner et al. 2006) and to environmental taxes more in general (Kallbekken and Aasen 2010). Qualitative surveys have also been used to orient quantitative surveys, as in Baranzini and Carattini (2016).

The focus groups of Dresner et al. (2006) revealed the high level of distrust in environmental tax reforms among the general public. The general public seems to underestimate the effectiveness of environmental taxes and to perceive them mainly as a pretext for raising additional public revenues. People may only be willing to support their introduction if revenues are clearly earmarked for environmental purposes. They also wonder how environmental taxes could green the economy if revenues were to be redistributed. Moreover, they raise fears of adverse competitiveness and distributional effects.

These findings from small samples have been then confirmed by larger surveys. Steg et al. (2006) interview about one hundred respondents in the Netherlands about the perceived effectiveness and acceptability of energy subsidies and taxes. They find subsidies to be much more effective, at least in people's eyes. "Pull measures" (i.e. subsidies) are seen as incentives driving a voluntary change in behavior, whereas taxes are felt as coercive measures imposing a change in behavior and facing people's resistance. Taxes can however be perceived as effective if revenues are earmarked for environmental purposes. In terms of acceptability, instruments and designs that are perceived as effective (i.e. subsidies) overperform those that are not (i.e. taxes). Similar results are provided in Kallbekken and Sælen (2011) based on a Norwegian sample. In their sample, perceived ineffectiveness of fuel taxes represents a major obstacle to acceptability, as in the study on the popularity of carbon taxes of Baranzini and Carattini (2016). In this respect, the latter find that acceptability depends on the expectation of both primary and ancillary benefits. Earmarking revenues for environmental purposes contributes to reduce the hostility to carbon tax, as well as renaming it "climate contribution".

The potential of standard surveys is however limited, in particular when respondents are required to deal with complex issues such as the design of carbon taxes. A few authors have thus opted for choice experiments, which also allow focusing on the internal validity and thus reduce the room for bias related to hypothetical answers. Bristow et al. (2010) analyze the acceptability of personal



carbon trading schemes and carbon taxes with a sample of about 300 individuals. They compare different tax rates and modes of recycling and find for instance that tax thresholds perform particularly well in terms of acceptability. Thresholds can indeed reduce the regressive effects of carbon taxes, similarly to lump-sum recycling. While the authors call for the use of larger samples to support their findings, they suggest that acceptable carbon tax designs are not a chimera. Sælen and Kallbekken (2011) show, with a choice experiment, that the chances for carbon taxes to be acceptable are higher with earmarking for environmental revenues. With this type of recycling, the Norwegian population would agree to an increase of the current fuel tax rate by about 15%. Brannlund and Persson (2012) also test different designs for a carbon tax with a choice experiment. The labeling of the tax changes randomly with the other attributes and the authors find that even labeling it “other” is better than using its real name, “tax”. Progressive designs are also preferred to regressive ones. Gevrek and Uyduranoglu (2015) extend the analysis of the acceptability of carbon taxes to emerging economies with a choice experiment for Turkey. While their setting does not allow measuring the overall level of acceptability of Turkish carbon taxes, their empirical exercise provides very similar findings to the literature in developed countries, including the preference for progressive schemes, for earmarking of revenues and for low tax rates.

Choice experiments contribute to tackle the issue of hypothetical bias. However, inference is still based on stated preferences. Revealed preferences are elicited in lab experiments, but issues of external validity may arise if the general public behaves differently than the sample participating in the experiment (Harrison and List 2004). Some examples of lab experiments are available in this literature. For instance, Kallbekken et al. (2011) provide experimental evidence in favor of tax aversion and of the demand for earmarking of Pigouvian tax revenues. They show that efficiency and acceptability may conflict even when real stakes are involved, i.e. participants do not necessarily prefer the policy that is pay-off maximizing. Labeling carbon taxes as “fee” helps however to reduce tax aversion. The experiment of Cherry et al. (2012) supports these findings, as well as the analysis of Steg et al. (2006), showing that “non-coercive” instruments such as subsidies (and even quotas) are much preferred to carbon taxes, so that policymakers betting on carbon taxes may end up with the status quo. In the authors’ words, inefficient “half measures” are more likely to be politically feasible than efficient “full measures”.

These methods are used as imperfect substitutes for the observation of real ballots on environmental taxes, which are unthinkable in some countries and very

rare in others. A few opportunities to study voting behavior on environmental matters already occurred in the United States or Switzerland (see Deacon and Shapiro 1975; Fischel 1979; Kahn and Matsusaka 1997; Fort and Bunn 1998; Salka 2001; Kahn 2002; Stadelmann-Steffen 2011), even though not exclusively on environmental taxes. An exception is Thalmann (2004), who analyzes three energy tax proposals voted and rejected by the Swiss population in 2000. While all proposals failed, two were really close to the majority threshold. Differences in the use of revenues (earmarking for subsidizing renewable energy versus redistribution) and in the tax rates are shown to potentially contribute to the small differences in the rate of approval between the revenue-neutral “Green tax reform” (44.6% of yes-votes) and the “Energy conservation package” (46.6%). The third alternative, the “Solar initiative” (31.9%), proposed to earmark half of the revenues for solar energy, and the other half for energy conservation. Differences in the socio-economic and geographic characteristics of voters explain instead within-proposal variation (see also Halbheer et al. 2006 and Bornstein and Lanz 2008).

## 2.2 Local context

On March 8, 2015, the Swiss population voted on a popular initiative launched by the Green Liberal Party aiming at replacing the current value-added tax with an energy tax<sup>1</sup>. The Swiss government and all other parties but the Green Party were against the initiative. In spite of the low probability of success of the initiative, the business organizations invested important efforts in a campaign emphasizing the potential drawbacks of such proposal.

The Green Liberals pointed to the following main arguments in favor of the initiative:

- Tax dirty energy sources, making renewable energy sources competitive without subsidization and allowing for a transition towards a more sustainable economy
- Ensure fiscal neutrality, by keeping both the revenues for the government and the overall tax burden unchanged
- Reward environmentally-friendly consumers, by allowing them to save money on the VAT while rewarding environmentally-friendly behavior

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<sup>1</sup>The maximum rate of the VAT is 8%. On the same day, the population also voted on a popular initiative of the Christian Democratic People’s Party of Switzerland aiming at increasing fiscal exemptions for families with children. This initiative was rejected at 75.4%.

- Reinforce the local economy, increasing independence from oil producer states and incentivizing green innovation in Switzerland
- Avoid costs to firms, by eliminating an administratively burdensome tax such as VAT

The government shared in principle all these objectives, but not the mean to achieve them as proposed by the initiative. In February 2015 Switzerland was the first country to submit a pledge to the United Nations Framework Convention on Climate Change's pledge-and-review system. It pledged to reduce greenhouse gas emissions by 50% by 2030 with respect to the levels of 1990. However, the Swiss government opposed the intention to completely erase the VAT and replace it with an environmental tax, which is supposed to over time reduce energy consumption, i.e. its own tax base. The government stressed that the VAT revenues represent the main source of funding for the federal government, and during the debate a price of 5 francs per liter of gasoline was mentioned to compensate the fall in VAT revenues<sup>2</sup>. This would have implied a three-time increase in the price of gasoline. The government also mentioned a series of concerns related with the competitiveness and distributional effects of the proposed reform.

This scenario was rapidly appropriated by the political parties and organizations opposing the initiative, who claimed that the initiative would have:

- Led to unaffordable energy due to exploding energy prices, e.g. 5 francs per liter of gasoline
- Jeopardized the funding of crucial government's tasks, since contrary to the VAT, which represents a stable source of revenues, the energy tax rate would have had to be regularly increased (and so the price of energy) to maintain revenues
- Generated adverse competitiveness effects, putting the country's prosperity at risk due to a loss in competitiveness

We consider that the last argument resonated particularly strongly in that specific period, which followed by a few weeks only the decision of the Swiss National Bank to drop its euro peg. The ensuing appreciation of the Swiss franc was at the time expected to put under extreme pressure the many export-oriented sectors of the Swiss economy.

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<sup>2</sup>Swiss franc close to parity with the US dollar at the time of the ballot.

The popular initiative was rejected at 92%. The Swiss government renounced to formulate a counter-proposal, but a few weeks after the ballot announced its strategy to meet the abovementioned pledges as well as to facilitate the planned phase out of nuclear energy (the so-called Energy Strategy 2050). This strategy consists in higher taxes on electricity and heating fuels, while the precise tax rates are left to further discussion and dependent on the final objectives in terms of greenhouse gas emissions abatement. Gasoline is also expected to be taxed, but only after a period of adaptation. We note that Switzerland introduced a carbon tax in 2008, but only on heating and process fuels. The current tax rate is 84 CHF per ton of CO<sub>2</sub>.

### **3 Methodology**

#### **3.1 Analysis of voting behavior**

Since 1977, the Swiss Centre of Expertise in the Social Sciences conducts the VOX survey after each federal ballot. 1500 observations are collected for each survey. We use these data to assess the determinants of voting behavior on the March 8 vote on energy taxes. VOX data are widely used to analyze voting behavior on different matters, as they perform well in terms of representativity and do not present the weaknesses of pure stated-preference studies. We took advantage of the strong presence of energy issues in the media at the time of this ballot and the debates following the presentation of the Swiss government's new energy strategy to administer a second survey. It uses a choice experiment format to elicit the acceptability of alternative energy tax designs (see below). Both surveys were carried out between March and May 2015.

In Switzerland, the rejection of a popular initiative is rather the rule, and not the exception. From 1891 to date, 9 out of 10 popular initiatives were rejected at the ballot box (sometimes after having influenced the legislative process). However, the rejection rate for this initiative is the second highest since 1891, the highest since 1929. This high rejection rate implies that voters from all government parties have contributed to reject the initiative, including the political left. The participation rate (42%) was slightly below the average participation rate for all popular votes during the period 1991-2014 (43.7%), the importance of the issue at stake being relatively low compared to the average ballot, and to hotter energy issues such as nuclear phasing-out.

## 3.2 Choice-experiment on alternative designs

### 3.2.1 Survey setting

Not all designs can be subject to vote. Previous research has shown the importance of the policy design for acceptability and it is thus crucial to have information on different policy attributes and the combination thereof. The only way to obtain such information from a relatively large sample – that is, larger than what is usually available in the laboratory – is to rely on stated preferences. It is however possible to set up a survey in a way that it makes choices and trade-offs the most realistic possible, such as with a choice experiment.

A choice experiment design allows putting the consumers, or voters, in a real-life situation and, thus, reduces the hypothetical bias. Furthermore, most of the focus is on the internal validity driven by the comparison of different designs. In our choice experiment, we present all respondents with three potential choices: two carbon taxes with two different designs and the status quo. By giving to respondents the possibility to reject all proposals, we are able to measure not only the relative preferences for a given policy attribute, but also the overall likelihood that a carbon tax can be accepted. The design of the proposed carbon taxes is the result of the combination of two attributes: the tax rate, measured in terms of Swiss francs per ton of CO<sub>2</sub> emitted, and the use of the tax revenues (see Table 1). Each respondent is requested to select one of the three options (two carbon tax designs and the status quo) in 8 different hypothetical ballots, with the attributes being randomly combined at each time. To increase precision in the identification of the attributes' effects, respondents are given one of the 15 randomly-generated versions of the questionnaire.

As all combinations included in the choice experiment were previously part of a modeling exercise, we are able to provide respondents with information on the order of magnitude for the expected impacts on the following items of each carbon tax design:

- Price of gasoline, diesel and heating fuel
- Greenhouse gas emissions abatements. When revenues are used to strengthen the environmental impact of the policy, we assume that foreign offsets are purchased and we thus also estimate the effect on greenhouse gas emissions abroad. We express this reduction in relative terms with respect to the emissions of Switzerland
- Purchasing power of average Swiss households, based on a proxy for overall consumption

TABLE 1: Choice experiment - attributes and levels

Attributes	Levels
Tax rate (CHF/tCO <sub>2</sub> )	60
	90
	120
	150
Revenue recycling	Income tax rebates
	VAT rebates
	Lump-sum transfers
	Social redistribution
	Environmental earmarking

- Purchasing power of average low-income households

We provide realistic numbers based on scenarios for 2020 from a dynamic multi-sectorial multi-household general equilibrium model of the Swiss economy, called GENESwIS (see Vöhringer 2012)<sup>3</sup>. For a range of uniform carbon taxes of 60 to 150 CHF/tCO<sub>2</sub>, the model achieves domestic emission reductions of 5-15%. Impacts on total consumption are generally negative, up to -0.5% for a tax rate of 150 CHF/tCO<sub>2</sub> combined with environmental recycling. As a notable exception, a small double dividend can be found for recycling through reductions of marginal income tax rates. Pure tax reforms with proportional rate reductions are regressive, and income tax recycling is the most regressive of the simulated variants. In contrast to this, lump-sum recycling renders the reform clearly progressive. International carbon offsets are cheap at the moment, and even very conservative assumptions allow for very sizable additional abatement abroad when carbon tax revenues are used for purchasing foreign offsets.

The aim of this simulation is to provide sufficient information for the most relevant variables that are supposed to guide voting behavior, replicating the effort that a government could do to introduce environmental taxes to the population. Since we carefully explain to respondents the functioning and effects

<sup>3</sup>In GENESwIS, households are disaggregated according to living standards and composition. Households and firms act rationally under perfect foresight and competition, and the government collects taxes and uses the revenue for public goods provision and social benefits (equal yield is assumed). Further standard features include international trade with an Armington assumption, labor-leisure choice, and a putty-clay representation for capital. GENESwIS is based on the 2008 energy related disaggregation of the Swiss Input-Output Table (Nathani et al. 2011), combined with the population census of the Swiss Federal Statistical Office (cf. Ecoplan 2012). Core elasticities of substitution that are relevant for carbon abatement have been taken from Mohler and Müller (2012).

of carbon taxes, we expect this specific setting to lead to different results with respect to what is most often found in the literature.

The recruitment of participants went as follows. A set of about 4'000 potential respondents was randomly selected and received by post mail the following material:

- A letter presenting the study, making participants familiar with the issue and encouraging them to participate in the survey if called by phone, following the guidelines of Harrison and List (2004)
- A detailed one-page fact sheet explaining how carbon taxes work and the main implications of each recycling option
- The full set of choice cards for all 8 votes displaying the attributes and related impacts as estimated by the computable general equilibrium model (see Figure A.1 for an example)

A randomly drawn sub-set of the about 4000 potential respondents was then contacted by phone and driven through the questionnaire. In total 1200 individuals were interviewed. When it came to taking a decision on the hypothetical ballots, all respondents were read a short and unique text describing the effects of each carbon tax type. This ensured that all respondents were provided with the same information, even those who had not spent time reading the material that they had received at home. As many already “voted” at home, respondents were given the possibility to skip the oral explanations<sup>4</sup>.

### 3.2.2 Preferences for attributes and carbon taxes

Before identifying the determinants of individual support for a carbon tax, we hypothesize what they could be, based on our literature review:

**Hypothesis 1: Tax rate** We expect higher tax rates to lead to lower acceptability for carbon taxes, everything else equal

**Hypothesis 2: Revenue recycling** We expect acceptability to vary substantially depending on the use of revenues. We expect use of revenues for environmental purposes to increase acceptability the most, followed by social

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<sup>4</sup>In Switzerland, people may be asked to vote several times a year. A few weeks before the day of voting, all potential voters receive by post mail written information about the ballot, so that they have the time to form their opinion and also vote by correspondence if wishing so. Our choice experiment is thus organized in a way that matches standard ballot procedures. We emphasize that information on proposed policies circulates widely also in democratic countries that do not use the instruments of direct democracy, even though in different forms.

cushioning addressing potential distributional effects. We expect lower acceptability with revenue-neutral recycling. Revenue neutrality (taxing here and reducing taxes elsewhere) is usually a criterion that the taxpayers do not request, or understand. This is particularly true in the absence of a double dividend. We do not have specific priors on the relative ranking within revenue-neutral recycling methods, i.e. income tax rebates, VAT reduction and lump-sum transfers

## 4 Empirical results

### 4.1 Analysis of voting behavior

The VOX survey mainly consists in a standard list of questions, unchanged from ballot to ballot, to which are added additional questions specific to each ballot (some of them on our request). Table 2 presents the main outcomes for our analysis along with other main variables of interest (see Table A.1 for descriptive statistics on the characteristics of our VOX respondents, Table A.2 for those of the choice-experiment sample and Table A.3 for the underlying population)<sup>5</sup>. As usual, the VOX ballot performs relatively well in predicting the ballot outcome. The frequency of no-votes in the survey, 90%, is indeed very close to the real outcome (92%). The survey overestimates instead to some extent participation, which was in reality 42%. We model participation below, along with the voting decision. Table 2 displays additional interesting statistics. For instance, we observe that most people take their decision on the vote on average 16 days, or about 2 weeks, before the ballot day. Only about 20% declare to have a set opinion from the start. This shows the importance of studying political acceptability in the presence of media coverage and political debates to capture the effect of (partisan) information on voters. Knowledge of the initiative is tested directly by the interviewers, based on an open question introducing the questionnaire.

The survey covers three arguments in favor, and three arguments against the initiative. These questions are asked only to respondents having participated in the ballot. Respondents can state their agreement or disagreement with such statements on a 1 to 4 Likert scale. The higher the score, the higher the agreement. In general, and not surprisingly comparing with the ballot outcome,

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<sup>5</sup>Predictably, the surveys may slightly under-represent young individuals, and slightly over-estimate educated, national and (by construction) Italian-speaking people. When appropriate, we control for these variables with our econometric models. Our main findings are unchanged if using sampling weights.



TABLE 2: VOX data: main outcomes and determinants of voting

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>	<b>N</b>
Voting decision					
No-vote	0.898	0.302	0	1	914
Participation	0.679	0.467	0	1	1509
Opinion formation					
Time of resolution before ballot day	-16.314	10.625	-1	-42	714
Immediate resolution	0.186	0.389	0	1	1514
Information					
Knowledge of the Energy Strategy 2050	2.767	0.861	1	4	1220
Knowledge of the initiative	0.661	0.473	0	1	1514
Agreement with arguments in favor					
Revenue neutrality	2.012	1.006	1	4	856
Environmental effectiveness	2.652	1.079	1	4	922
Energy security	2.652	1.079	1	4	922
Agreement with arguments against					
Competitiveness effects	3.026	1.004	1	4	908
Distributional effects	2.922	1.056	1	4	906
Decreasing tax base	3.002	1.012	1	4	852

arguments against the initiative score substantially higher than those in favor. In line with the literature, high concern is expressed for the competitiveness and distributional effects potentially generated by the implementation of the proposal. Another argument widely used by the opponents was that over time a decreasing tax base would have systematically implied higher tax rates, and so larger effects on the price of energy, on competitiveness and on the distribution of income. This argument also seems to have been well understood by the public. Consistently, the pro argument emphasizing revenue neutrality as a desirable property of the initiative did not receive much support, which corroborates the related stylized fact highlighted in the literature. The fact that higher fossil fuel prices would have resulted in a higher degree of independence from oil and gas exporters, and thus increased energy security, was moderately seen as a positive property of the energy tax. Among the pro arguments, the one that scores the highest relates with the effectiveness of energy taxes. The relative question asks respondents whether they believe that an energy tax creates incentives to save energy, and to switch to renewable energy. Yet, this straightforward question about the incentive effect of energy taxes does not receive massive support, and actually performs poorly in relative terms with respect to e.g. competitiveness concerns. Once again, we observe how the effectiveness of energy taxes is not an established fact for the general public, and its ability to change behavior is not shared by all the population.

We now analyze the determinants of voting behavior, and participation in the ballot. Since these two outcomes are jointly determined, we would face a selection problem if assessing voting behavior without taking into account the decision to participate or not in the ballot. We stress that participation is not compulsory in all cantons but one, the latter representing about 1% of the total population. We hence apply a standard Heckman selection strategy, and estimate jointly the probability to participate in the ballot, and to express either a “yes-” or a “no-vote”. Since both outcomes are binary, we use a Heckman-selection probit model. The selection of variables follows Thalmann (2004), who had used comparable VOX data. We start with a reduced model including only “objective” socio-economic characteristics potentially affecting the decision to participate in the ballot, or to accept the initiative. We include gender, dummies for age categories, education, the number of cars in household (as a proxy for carbon footprint), and the location of the voter, in terms of linguistic region and with respect to the urban-rural cleavage. The procedure suggested in Thalmann (2004) implies running a second model, in which additional “subjective” variables are added to the “objective” model. From the standard questions of

the VOX survey, we indeed know some general preferences, political priorities and concerns of the voters in our sample, as reported by respondents. In line with Thalmann (2004), we consider as potentially relevant for this ballot the following variables: concern with unemployment, with income inequality, and with public intervention in the economy. We also include a variable capturing the political affinity as declared by the respondents, based on the stated political positioning at the last national elections. Given that only two parties supported the popular initiative, the Green Liberals, its promoters, and the Green Party, while all others strongly opposed it, including all leftist parties, we capture support for either one of the two parties as a measure of affinity with green parties (called “green affinity” hereafter).

The top panel of Table 3 presents the estimates for the “objective” model. All coefficients are statistically significant in the participation model. Most estimates carry the expected sign: both higher education and age are correlated to a higher likelihood to participate in a ballot. Participation rates are higher for male individuals and in German speaking areas compared to French (the dummy of reference) and Italian speaking areas. Rural areas also experience higher turnout. These differences are very similar to those found by Thalmann (2004), and mirror general voting behavior in Switzerland. Interestingly, car ownership is also associated with a higher ballot participation.

Taking into account self-selection into voting, the vote model assesses the effect of the previous variables on the likelihood to express a yes-vote in the ballot. Higher education is found to be positively correlated with pro-environmental behavior, a common finding in the literature already at the time of the theoretical and empirical analysis of Californian referenda by Deacon and Shapiro (1975). Females are less likely to support the initiative, while young generations and older individuals are less likely to support energy taxes, exactly as in Thalmann (2004). The intuition is the following. Elderly are expected to benefit less from climate change mitigation. For young voters, two opposing effects may be at play: they have a higher probability to experience climate change, but are possibly also more exposed to labor market shocks.

Interestingly, we find that, in statistical terms, car ownership explains participation only, and not voting behavior. Yet, we note the expected negative sign, as car ownership represents our proxy for exposure to higher energy prices.

The bottom panel of Table 3 introduces the subjective variables. Most of the previous results concerning participation are robust to the addition of general political concerns and affinity. Among the subjective variables, only concern with unemployment is significantly linked to participation, with a positive sign

TABLE 3: Heckman-selection probit model

	Vote model		Participation model			
	Coefficients	(S.E.)	Marginal effects	(S.E.)	Coefficients	(S.E.)
<b>Objective model</b>						
Gender (1 = F)	-0.250**	(0.107)	-0.029**	(0.012)	-0.138*	(0.074)
Young (1 = 18-29 years)	-0.642***	(0.224)	-0.074***	(0.025)	-0.940***	(0.118)
Elderly (1 = 60+ years)	-0.180*	(0.119)	-0.021*	(0.013)	0.678***	(0.086)
German speaking	0.204	(0.126)	0.023	(0.014)	0.280**	(0.086)
Italian speaking	-0.145	(0.190)	-0.017	(0.022)	-0.540***	(0.107)
Education (1 = high school+)	0.274**	(0.116)	0.032**	(0.013)	0.277***	(0.077)
Number of cars in household	-0.084	(0.097)	-0.010	(0.011)	0.140**	(0.041)
Municipality is rural	-0.098	(0.129)	-0.011	(0.015)	0.271**	(0.089)
Intercept	-1.418**	(0.193)			-0.010	(0.120)
<i>N</i>	1403					
Censored observations	489					
Uncensored observations	914					
<b>Full model</b>						
Gender (1 = F)	-0.240**	(0.119)	-0.024**	(0.012)	-0.123	(0.078)
Young (1 = 18-29 years)	-0.561*	(0.277)	-0.056**	(0.026)	-0.936***	(0.120)
Elderly (1 = 60+ years)	-0.044	(0.129)	-0.004	(0.013)	0.671**	(0.089)
German speaking	0.140	(0.137)	0.004	(0.014)	0.265***	(0.090)
Italian speaking	0.092	(0.204)	-0.009	(0.020)	-0.605***	(0.090)
Education (1 = high school+)	0.145	(0.127)	0.015	(0.013)	0.268***	(0.079)
Number of cars in household	-0.003	(0.083)	-0.0003	(0.008)	0.113***	(0.042)
Municipality is rural	0.018	(0.138)	0.002	(0.014)	0.291***	(0.091)
Concern with unemployment	-0.063	(0.046)	-0.006	(0.005)	0.060**	(0.027)
Concern with income inequality	-0.103***	(0.038)	-0.010***	(0.004)	0.022	(0.024)
Concern with public intervention	-0.068*	(0.037)	-0.007*	(0.004)	-0.015	(0.023)
Green affinity	1.168***	(0.177)	0.117***	(0.022)	0.068	(0.159)
Intercept	-0.557	(0.338)			-0.378*	(0.221)
<i>N</i>	1318					
Censored observations	455					
Uncensored observations	863					

Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

as expected. The positive but non-significant effect for green affinity suggests that the sponsors and supporters of the initiative were not really able to mobilize their voters to participate in the ballot. The picture is slightly different for voting choice. Only gender and the age dummy for the youngest voters significantly affect the decision to cast a yes-vote in the ballot. The subjective variables seem to substantially contribute to explain variation in the model. In particular, we note how green affinity is linked to a higher propensity to support the initiative of the Green Liberals<sup>6</sup>. While the marginal effect is relatively small in absolute value, with only a 10% higher probability to vote yes for respondents declaring themselves as greens, the magnitude of this effect is very large in relative terms. Green voters may have intrinsically supported the initiative, or voted strategically in favor to avoid a major defeat. Polls were indeed forecasting a rejection as the most probable outcome, even though such debacle came clearly unexpected. In line with predictions, concern with income inequality, with public intervention, and with unemployment are associated with a negative coefficient, while the latter not in a statistically significant way. That is, the subjective variables seem to capture the main complaints with the proposal. To better understand the major impediments to a yes-vote, we exploit the pros and cons as introduced by Table 2. We recall that these variables are observed only for the respondents declaring to have participated in the ballot. Hence, we run a simple probit model, skipping the participation stage. Outcomes of interest are compared with the estimates of Table 3.

Table 4 shows the estimates for this additional model. Among the objective variables, only one significantly explains voting behavior once taking into account subjective variables and opinions on the popular initiative. This variable is the number of cars in the households, which now reaches statistical significance. That is, as in Thalmann (2004), the number of cars could be a measure of people’s economic sensitivity to higher energy prices, as families with more cars are less likely to approve the initiative. Concerning subjective variables, the concern for public intervention remains significant, and its magnitude virtually unchanged with respect to Table 3. Green affinity keeps its significance, although the marginal effect is reduced. People’s opinions on the pro and con arguments mentioned by the survey are the main drivers of voting behavior. All variables have the expected sign, and comparable magnitudes. Only the coeffi-

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<sup>6</sup>Given the small proportion of green voters, we estimate the joint effect of supporting either one of the two green parties. Both variables would positively affect the probability of casting a yes-vote if used separately. If additional variables for other parties would be included in the model, a negative and significant marginal effect could be found for supporting a centre-right party called FDP, or “The Liberals”. Besides these facts, no clear right-left pattern could be discerned in the voting model. All additional estimations are available by the authors upon request.

TABLE 4: Probit model including pros and cons

	Coefficient	(S.E.)	Marginal effects	(S.E.)
Gender (1 = F)	-0.311	(0.203)	-0.011	(0.008)
Young (1 = 18-29 years)	-0.478	(0.427)	-0.017	(0.016)
Elderly (1 = 60+ years)	-0.301	(0.207)	-0.011	(0.009)
German speaking	0.256	(0.278)	0.009	(0.010)
Italian speaking	0.080	(0.360)	0.003	(0.013)
Education (1 = high school+)	-0.130	(0.217)	-0.005	(0.008)
Number of cars in household	-0.457**	(0.132)	-0.016**	(0.007)
Rural municipality	-0.051	(0.228)	-0.002	(0.008)
Concern with unemployment	-0.042	(0.079)	-0.002	(0.003)
Concern with income inequality	0.019	(0.065)	0.0006	(0.002)
Concern with public intervention	-0.085*	(0.059)	-0.003*	(0.002)
Green affinity	0.628**	(0.260)	0.022**	(0.011)
Revenue neutrality	0.617***	(0.103)	0.022**	(0.007)
Environmental effectiveness	0.378***	(0.110)	0.013**	(0.005)
Energy security	0.181*	(0.108)	0.007*	(0.004)
Competitiveness effects	-0.394**	(0.094)	-0.014**	(0.005)
Regressive effects	-0.165*	(0.089)	-0.006*	(0.003)
Decreasing tax base	-0.057	(0.099)	-0.002	(0.003)
Intercept	-1.567*	(0.848)		
<i>N</i>			607	
Pseudo $R^2$			0.503	

Robust standard errors in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

cient for the argument that a decreasing tax base could be problematic is too small to be statistically significant. The adverse consequences of a decreasing tax base may already be accounted for by the other variables.

When looking at the marginal effects for these arguments, we observe that the Green Liberals' popular initiative was rejected based on the very same contrary arguments that are most often mentioned in the literature. Similarly, the pro arguments contributed to higher acceptability, but their lower uptake among the general public, again in line with the literature, did not help to substantially move the balance in favor of the reform.

For instance, the higher the agreement with revenue neutrality being considered a positive aspect of the proposed reform, the higher the likelihood to have voted yes. Yet, on average people were not particularly enthusiastic about revenue neutrality. The same applies to the energy security argument, whose agreement is also linked to a higher probability of approving the proposal. A recurrent finding concerning the perception of environmental effectiveness, largely discussed in the introductory parts, is corroborated by our ballot data. Being relatively confident that energy taxes provide an incentive to decrease energy consumption and to switch to cleaner sources is linked with a higher probability of a yes-vote. The magnitude of this effect may look relatively small if we compare with other survey studies testing the effect of perceived effectiveness on acceptability in a similar fashion, such as Baranzini and Carattini (2016). However, assessing the relevance of this and the other effects should take into account the overall outcome of the ballot, very well replicated by the VOX survey. In this light, the effects that we measure are considerable.

Similar considerations apply to the contrary arguments. The only difference is that these were on average considered as much more relevant than the arguments concerning pros. Competitiveness effects were already determinant in the ballot analyzed by Thalmann (2004), in spite of an unemployment level below 2% at that time in Switzerland. At the time of the ballot that we analyze, the unemployment rate was comfortably below 4%. Similarly to other contexts, competitiveness concerns often take the center stage when it comes to take important political decisions on climate policy. This can happen in spite of the overall minimal adverse effects on competitiveness observed so far (cf. e.g. Mathys and de Melo 2011). For instance, when designing their carbon taxes, Scandinavian countries opted for very generous exemptions to energy-intensive industries on competitiveness grounds, avoiding important profit losses to the firms concerned, but also watering down the environmental effects of the policy (Baranzini and Carattini 2014). The industry-flight argument and related

TABLE 5: Preferred modes of recycling

<b>Variable</b>	<b>Mean</b>	<b>Std. Dev.</b>	<b>Min.</b>	<b>Max.</b>
Subsidies for efficiency and renewables	0.568	0.496	0	1
Social cushioning	0.115	0.320	0	1
Reduction in existing taxes	0.13	0.337	0	1
Redistribution to households and firms	0.186	0.389	0	1

fears of substantial competitiveness effects largely contributed to the policy reversal observed in the case of the Australian carbon tax (cf. Spash and Lo 2012). Hence, the general public may tend to overestimate competitiveness effects, and this may be the result of very effective political campaigning from energy-intensive industries and fossil energy providers (cf. Ingold and Varone 2012).

Following the previous argument, we complete the analysis by testing the potential popularity of alternative recycling schemes. Two specific questions were introduced to respondents, asking them to mention their preferred recycling option, freely, first, and then among a list of four options. These options are: subsidies for efficiency improvements and renewable energy (environmental earmarking), social cushioning, reduction in existing taxes, and redistribution to households and firms. Most answers given in the open question correspond to one of these four categories. The results of the open question, in which respondents are not influenced by the options given by the questionnaire, are thus very similar to those of the closed question, displayed in Table 5.

Unsurprisingly, about 60% of respondents would like revenues from energy taxes to be used in the environmental domain. This result confirms previous findings in the literature, and suggests that Swiss voters are not different from the other samples analyzed so far. Only a small fraction of the population would use tax revenues to provide social cushioning, or to reduce existing taxes, and that in spite of the concerns expressed for distributional and competitiveness effects. Similar findings on this apparent inconsistency were already provided by Baranzini and Carattini (2016), based on a specific Swiss canton. Apparently, such concerns affect the decision to accept or not an energy tax at a given tax rate, but do not call for a diversion of revenues from environmental earmarking. Redistribution to households and firms, the current way of redistributing revenues from the existing Swiss carbon tax on heating fuels, is supported by



about one fifth of the sample only<sup>7</sup>. That is, if voters were asked to vote on the use of revenues of the current scheme, and absent any additional information, they would probably reject lump-sum transfers, and favor a switch towards full earmarking of revenues.

## 4.2 Choice experiment on alternative carbon tax designs

In this section we analyze decision making in our full-information choice-experiment setting and compare it with the observed real voting behavior, and with the previous literature, with the aim of testing our two main hypotheses concerning tax rates and recycling modes. Table 6 presents our main estimates. All columns display marginal effects from conditional logit. Column (1) shows estimates for the full sample, i.e. 1189 individuals. Since we survey a representative sample of the population living in Switzerland, not all respondents are Swiss nationals and so entitled to vote. Hence, column (2) restricts the sample to nationals only. Among nationals, we know self-declared participation to the usual four ballots per year. Column (3) excludes non-voters while column (4) retains only people declaring 100% ballot participation. Since all results remain the same in qualitative terms and most of the time also in quantitative terms, we discuss results based on column (1). The fact that we find similar results for different sub-samples is however an interesting finding in itself. That is, foreign respondents would not vote differently than Swiss citizens, according to this sample and for this matter. If we exclude those individuals that are most likely to abstain to better predict the outcome of a potential ballot, the results are also virtually unchanged. The propensity to vote seems thus to have no influence on how people perceive the tax designs proposed in our study, in spite of the non-negligible changes in observations across columns.

As expected, a higher tax rate is linked to a lower acceptability, everything else equal. This follows from economic theory and is in line with Sælen and Kallbekken (2011), Brannlund and Persson (2012) and Gevrek and Uyduranoglu (2015). However, the difference between 0 and 60 francs is relatively small in comparison with the other tax rates. Hence, in some situations, people might have preferred a carbon tax, with a moderate tax rate, than no carbon tax at all. Given that the tax rate of the current Swiss carbon tax on heating fuels was already fixed at 60 francs at the time of the survey, we did not include in the survey a lower tax rate, e.g. of 30 francs. Furthermore, we note that except for the first step from 0 to 60 francs, the progression is almost linear, suggesting

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<sup>7</sup>Note that up one third of revenues are earmarked for subsidies for energy efficiency in buildings.

that a well-shaped linear demand would be a good approximation for the case of carbon taxes.

This linearity allows speculating on the negative impact on acceptability of an extremely high rate, as the one suggested by the popular initiative promoted by the Green Liberals and rejected by the Swiss population. While promoters of and opponents to the popular initiative were disagreeing on the proposal's expected impact on energy prices, depending on the time horizon that they used in their campaigning, our most conservative computations suggest that in the short term the tax rate would have had to be of at least 300 CHF per ton of CO<sub>2</sub> to replace the revenues of the VAT. Figure 1 extrapolates linearly from the probabilities of success that we observe based on the tax rates proposed by the survey and predicts the outcome of an initiative proposing a tax rate of 300 CHF per ton of CO<sub>2</sub> (see Table A.4 for descriptive statistics). For a like-to-like comparison, Figure 1 shows only the predicted likelihood of success if revenues were to be used as proposed by the Green Liberals. While interpreting any out-of-sample prediction always requires a lot of precaution, our extrapolation provides support for the external validity of our choice experiment. At a rate of 300 CHF per ton of CO<sub>2</sub> the predicted support is virtually zero, which is very close to the share of yes-votes in the public ballot. That is, if anything, our choice experiment predicts lower support than the ballot.

The Green Liberals' popular initiative could probably have had a better outcome with a different use of tax revenues. As the estimates show, reducing the current value added tax is not linked to any higher acceptability with respect to income tax rebates (the reference case, omitted due to multicollinearity). Together, these two revenue-recycling options are the most unpopular. This result comes as expected and confirms our hypothesis on the low support for revenue neutrality. In this respect, it is important to recall that based on the modeling exercise we find none or little double dividend with these two ways to recycle revenues, the net effect on the domestic purchasing power being broadly as negative as with the other types of recycling. This confirms a general result in the double-dividend literature (Goulder 1995). Hence, respondents informed about the potential beneficial effects of reducing distortionary taxes knew that they should not be expecting a double dividend from lower income taxes or a reduction in the value-added tax.

We are however surprised by the estimates concerning lump-sum transfers, environmental recycling and to some extent social cushioning. The results that we provide for these variables are novel in the literature and deserve to be analyzed carefully. The signs for these variables are positive, negative and positive,

TABLE 6: Choice experiment - Estimates from conditional logit

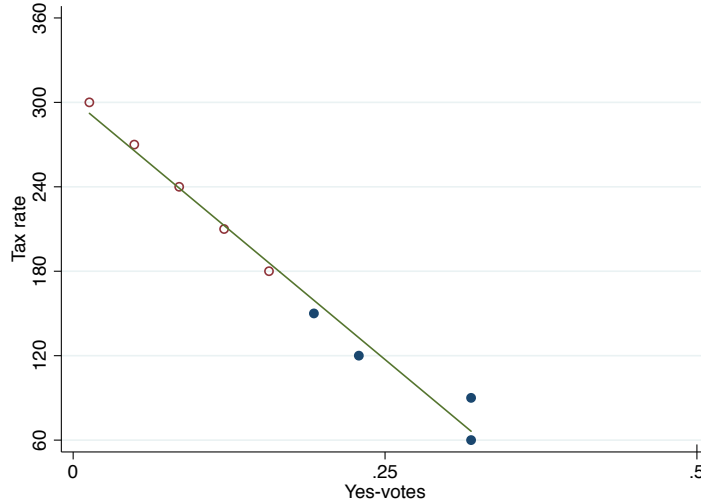
	Full sample (1)	Nationals (2)	Without no-voters (3)	Always voters (4)
<hr/>				
Tax rate				
<hr/>				
0 CHF (reference)				
60 CHF	-0.018 (0.015)	-0.030 (0.016)	-0.037** (0.067)	-0.043* (0.020)
90 CHF	-0.052*** (0.015)	-0.059*** (0.016)	-0.065*** (0.017)	-0.070*** (0.021)
120 CHF	-0.107*** (0.015)	-0.122*** (0.016)	-0.123*** (0.017)	-0.122*** (0.020)
150 CHF	-0.177*** (0.018)	-0.186*** (0.016)	-0.193*** (0.017)	-0.200*** (0.02)
<hr/>				
Revenue recycling				
<hr/>				
Income tax rebate (reference)				
VAT reduction	-0.013 (0.011)	-0.010 (0.012)	-0.012 (0.013)	-0.016 (0.016)
Lump-sum redistribution	0.137*** (0.012)	0.136*** (0.012)	0.135*** (0.013)	0.127*** (0.016)
Social cushioning	0.144*** (0.011)	0.145*** (0.012)	0.144*** (0.012)	0.135*** (0.016)
Environmental recycling	-0.021 (0.013)	-0.029* (0.014)	-0.035** (0.014)	-0.056** (0.018)
<hr/>				
Number of individuals	1189	1066	980	650
Number of hypothetical votes	28536	25584	23520	15600
Pseudo- $R^2$	0.0342	0.0360	0.0351	0.0404

*Note:* Estimates report marginal effects from conditional logit.

The dependent variable measures the acceptability of the proposed carbon tax designs.

Robust standard error in parentheses. \*  $p < 0.1$  , \*\*  $p < 0.05$  , \*\*\* $p < 0.01$ .

FIGURE 1: Prediction with VAT recycling as in the Green Liberals' initiative



*Note:* Filled circles indicate observations in the sample, empty circles indicate observations obtained through extrapolation.

respectively. That is, we find that lump-sum transfers and social cushioning are the most preferred options for recycling, while environmental recycling does not seem to obtain the support that it usually does in the literature. We have an explanation for all the three facts, as well as important policy implications.

Let us start with the relatively high acceptability of the lump-sum redistribution. The modeling exercise suggests moderate net gains for low-income households with lump-sum transfers. Only social cushioning does better, while the remaining types of recycling involve regressive effects. Respondents are informed about this fact and can internalize the beneficial distributional properties of lump-sum redistribution. Furthermore, respondents are informed by the introductory material that the current carbon tax on heating fuels is mostly redistributed through lump-sum transfers and it may be that this information could have increased the legitimacy of this type of recycling. This information is public, but according to Baranzini and Carattini (2016) only a limited number of individuals are aware of the current carbon tax on heating fuel, and an even smaller proportion knows how its revenues are redistributed (one fourth of the 1012 respondents interviewed in INFRAS 2015).

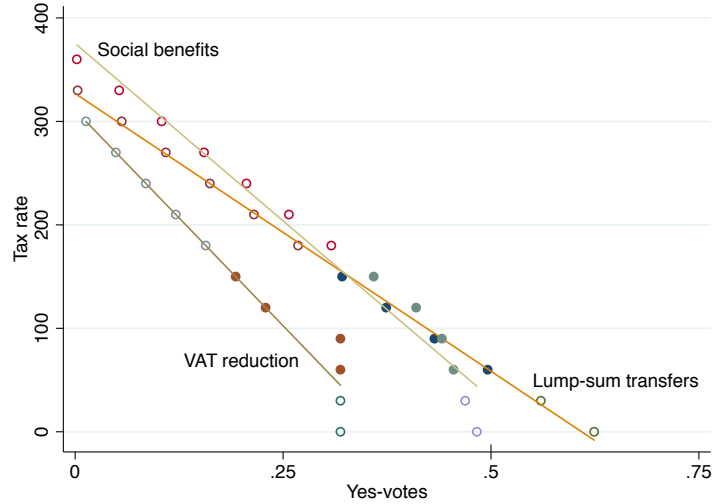
However, the most important finding concerns the low demand for recycling

for environmental purposes. This result is at odds with most of the literature on the acceptability of environmental taxes previously discussed. This is the first study providing survey respondents with an estimate of the emission abatements linked with the carbon taxes about which respondents are requested to express their opinion. Interviewers were instructed on how to provide simple explanations on the price sensitivity of consumers and they reportedly had to use such information to answer the general public's curiosity on the economic bases for the figures for emissions abatements included in the choice cards. That is, our survey addressed by construction one of the main obstacle to carbon taxes: perceived ineffectiveness, which often goes hand in hand with earmarking for environmental purposes. Since all carbon taxes in the survey are shown to be effective, and to the extent that the scientific credibility of our study was not challenged by respondents, the main driver for the demand for environmental recycling is wiped out. We also note that the demand for environmental recycling expressed so often in the literature may not necessarily correspond to the most effective way of obtaining additional emission abatements as economists would interpret it. Even with a conservative estimate for the price of emissions on foreign carbon markets, the revenues of a carbon tax between 60 and 150 francs per ton of CO<sub>2</sub> can lead to very large emission abatements abroad. All scenarios imply substantial negative emissions: even the lowest tax rate is shown to lead to abatements equivalent to five times Swiss emissions. Therefore, at the current carbon price levels, it would be very tempting for policymakers to purchase many years of carbon neutrality and so achieve long-term pledges, such as "the balance" between emissions and removals by sinks, at an extremely low cost. However, we understand that the respondents in our survey may wonder why compensating so much. The general public may also do not like the purchase of foreign carbon credits more in general. People may have a preference for local investments, which provide a number of local co-benefits, and may also have ethical or practical reservations with respect to the use of offsets in general (see Conte and Kotchen 2010; Anderson 2012; Carattini and Tavoni 2016).

Finally, the relative popularity of social cushioning does not completely surprise, given that distributional effects were made completely salient to respondents. Social cushioning is shown to provide the most progressive effects over all types of recycling, although lump-sum transfers perform similarly with moderate tax rates.

Figure 2 extends the simulation of Figure 1 with the most popular recycling options, lump-sum recycling and social cushioning. As Figure 1 already showed, our exercise suggests that even with an extremely low tax rate recycling through

FIGURE 2: Prediction with alternative recycling compared to VAT recycling



*Note:* Filled circles indicate observations in the sample, empty circles indicate observations obtained through extrapolation.

VAT rebates could hardly provide a majority in favor of a carbon tax. With social cushioning, and especially lump-sum transfers, the picture is different. While none of the two recycling options lead us to a majority with the tax rates considered by our survey, the prediction for recycling through lump-sum transfers suggests that anything below 60 CHF per ton of CO<sub>2</sub> would be in principle acceptable. This was the rate of the carbon tax at the time of the vote (since 2016 it is at 84 CHF), but it applies only to heating and process fuels, not vehicle fuels. While we recall the necessary precautions in taking at face values such predictions, we stress how recycling modes can completely shift the demand for carbon taxes, possibly also beyond the required threshold to make them acceptable. Based on these findings, we reformulate hypothesis 2 as follows:

**Hypothesis 2: Revenue recycling** We expect acceptability to vary substantially depending on the use of revenues. In relative terms, we expect lower acceptability with revenue-neutral recycling, as revenue neutrality (taxing here and reducing taxes elsewhere) is shown to be a criterion that the taxpayers probably generally do not request, or understand. This is particularly true in the absence of a double dividend. Lump-sum redis-

tribution can however be associated to higher acceptability provided that its progressive properties are made explicit. If distributional effects are salient, social cushioning and lump-sum redistribution can lead to higher acceptability. Providing information on the effectiveness of the carbon tax reduces the usual demand for revenue recycling for environmental reinforcement. Some types of environmental recycling may even cause lower support, such as recycling through the purchase of foreign carbon credits.

Finally, we consider how exploiting heterogeneity across individuals may provide further information on people’s preferences for carbon taxes. Similarly to e.g. Gevrek and Uyduranoglu (2015), we apply a latent-class model to explain heterogeneous preferences. According to our data, 5 latent classes can be identified<sup>8</sup>. Table A.5 in the Appendix displays how preferences change across classes, based again on a conditional logit model. Table A.6 introduces information on the characteristics of respondents, aiming at describing the composition of classes using a multinomial logit model<sup>9</sup>.

We briefly summarize the insights from this additional analysis. Classes are divided based on the importance given to each attribute (price or revenue recycling), on the preference for revenue recycling, the elasticity to variation in the tax rate, and overall acceptability. Low-income households tend to be associated with classes showing a marked preference for progressive designs, i.e. through lump-sum redistribution of revenues or social cushioning. The overall degree of acceptability, and the related sensitivity to tax rates, seems to be linked to different degrees of climate concern. Classes with lower degrees of climate concern tend to be linked to rather elastic behavior, and low to moderate overall acceptability. While a positive correlation between concern for climate mitigation and preferences for tighter climate policy is common in the literature (see Drews and van den Bergh 2015), we are, to the best of our knowledge, the first to empirically document different preferences for the distributional effects of carbon taxes across the income distribution.

### 4.3 Discussion

**Tax rate** We find that higher tax rates clearly imply lower acceptability. This fact recalls once again the general public’s sensibility with respect to the cost of climate policy, above all when the latter is as transparent as with carbon taxes.

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<sup>8</sup>AIC (BIC) values are given as follows: for two classes, 15495 (15616); for three classes, 14835 (15021); for four classes, 14620 (14870); for five classes, 14427 (14741).

<sup>9</sup>The number of observations is limited for a series of variables, such as income or commuting preferences for workers.

As pointed out in the literature, this reminds policymakers of the importance of proceedings in small steps (Baranzini and Carattini 2014). Starting at a moderate price level may also reduce the opposition from energy-intensive lobbies, even though some evidence suggests that vested interests may be mobilized against any departure from the status quo (see e.g. Rocchi et al. 2014)<sup>10</sup>. In this respect, it is important that policymakers have at their disposal estimates of the potential competitiveness effects of carbon taxes. These are indeed likely to be small overall and should not be overemphasized. Our results suggest that the general public is likely to be ready to give up some fraction of national income, if they have no doubts on the environmental effectiveness of the measures that they are supporting. Hence, resistance to carbon taxes seems not to be due to complete free riding in the provision of the global public good which is climate change mitigation, thus supporting the idea of some degree of cooperation in the climate commons (cf. Ostrom 2009; Carattini et al. 2015; Carattini 2015).

**Gradual introduction and information** The acceptability for a given instrument may increase once the instrument is in place, supporting the use of moderate tax rates to start. This for three reasons. First, the role of relative consumption: once the tax is in place, people realize that their purchasing power compared to the others around them may be actually unchanged (Howarth 2006; Gowdy 2008). Second, the role of revenue recycling: revenue neutrality can increase acceptability *ex post*, once people see that they are given some of the money back. Of course, this requires the redistribution of revenues to be sufficiently salient. With full redistribution, some households may be net winners, as with feebates. Third, the role of observing the functioning of the policy: as discussed, the general public tends to underestimate the effectiveness of environmental taxes, especially absent any recycling for environmental purposes. However, if the effect of the policy is sufficiently salient, people may review their beliefs *ex post*, causing an important gap between perceived effectiveness (and thus acceptability) *ex ante* and *ex post*. Evidence in this sense is provided for instance by Carattini et al. (2016), who exploit the forced implementation of pricing garbage by the bag on a relatively large population to assess its overall effectiveness, and its acceptability both before and after the implementation. People are very concerned with pricing *ex ante*, but implementing the policy substantially reduces concerns with effectiveness and fairness. Similarly, Kallbekken and Sælen (2011) have argued in favor of the use of trial periods, based

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<sup>10</sup>The descriptive statistics in Table A.2 report that a substantial majority of the choice-experiment sample would have a preference for a carbon tax that starts low and increases over time.



on the successful example of the Stockholm congestion charge (see also Cherry et al. 2014). In the specific case of carbon taxes, Murray and Rivers (2015) show based on poll data how resistance against British Columbia’s carbon tax substantially decreased after its introduction, with positive spillovers to the rest of Canada. In the case under consideration, we note that although Switzerland has already a carbon tax on heating and process fuels, an important fraction of the population is not aware of its existence.

Our choice experiment was designed to inform voters on the effectiveness of the incentive tax, something that is generally missing in similar studies in the literature as well as in the political arena.

**Revenue recycling** Selling an environmental tax reform may be hard, but not impossible. Our findings from the choice experiment support the decision of the Swiss government to go for full lump-sum recycling in the planned extension of the current carbon tax on heating fuels to all fuels, as announced in March 2015. However, our specific framework provides more detailed information than usually done in the public arena. As emphasized based on the VOX data, absent any additional information the general public would probably reject lump-sum transfers in favor of environmental earmarking. That is, policymakers should be willing to undertake the effort that is needed to reduce the informational gap between them and the general public. In our case, we provided respondents with clear and concise information on how carbon taxes work, on the mechanisms through which higher energy prices lead to lower energy consumption – including scenarios for emission abatements – and on the competitiveness and distributional effects of each type of revenue recycling for any given tax rate. Explaining how lump-sum redistribution works and how it can be progressive will be a first step in favor of higher acceptability of revenue-neutral designs.

We also believe that providing figures for the expected emission abatements will also improve acceptability and decrease the demand for environmental recycling. In this case we stress how it is crucial to explain to the population how the incentive effect works. These figures could also emphasize the existence of co-benefits for the local population. Expecting positive co-benefits is indeed associated with higher willingness to pay for climate change mitigation (Longo et al. 2012) as well as higher acceptability of carbon taxes (Baranzini and Carattini 2016).

## 5 Conclusions

Pledges are not *per se* credible policy commitments. The ability of countries to turn pledges into cost-effective policies such as carbon taxes will determine the possibility to ramp up future ambitions and to push for further policy tightening. The implementation of carbon taxes has experienced a hard time in many countries, so far. Learning from these experiences is crucial to increase their popularity and broaden their implementation in a post-Paris world.

This paper analyzes voting behavior in a real ballot on energy taxes in Switzerland. Revenues from these energy taxes were to replace completely the current value-added tax. The proposal was massively rejected. We collect data on a large representative sample of voters. We find that several obstacles limited its acceptability, such as distributional and competitiveness concerns and perceived environmental ineffectiveness. Given the perception of little environmental effects, revenue neutrality is not a priori a solution for the general public. These energy taxes would have instead been more popular if revenues were to be earmarked for environmental purposes.

At the same time of the ballot, we administer a choice-experiment survey, exploiting the salience of the topic. The choice experiment addresses all the obstacles emphasized by the analysis of real voting behavior. Based on a computable general equilibrium model, it provides information to all respondents on the social, economic and environmental impacts for different tax rates and use of revenues. We analyze the demand for carbon taxes for each design and show that this information leads to a very different outcome compared to the ballot and the literature. First of all, revenue-neutral policies can become popular, provided that their progressive properties are emphasized as in the case of lump-sum transfers. Second, environmental earmarking may no longer be absolutely necessary to receive a substantial support for carbon taxes, if information is provided on their environmental effectiveness.

Based on our findings we argue that policy designs usually preferred by economists, but in most cases opposed by the general public, are not necessarily unpopular, provided that the general public shares at least some of the information that economists have. Our findings can help devise effective carbon taxes that are accepted by citizens, because they are convincingly shown to be environmentally effective and because their revenues are refunded in a form that mitigates their burden on low-income households. Addressing the concerns and limited information of the general public is probably the only way to avoid important resistances to cost-effective instruments of climate change mitigation,

which could put at risk the realization of the current pledges and potentially jeopardize their necessary tightening. The consequences are known. The inability to turn Paris pledges into policy would this time hardly leave any room to avoid running into dangerous climate changes.

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# Appendix

## A.1 Figures

FIGURE A.1: Example of a choice card

<b>Tax rate:</b> CHF 150 / ton of CO <sub>2</sub>	
<b>Use of revenues:</b> income tax rebates	
<b>Order of magnitude of impacts:</b>	
• Increase in energy prices (gasoline, diesel, heating fuel)	14-16 cents per liter
• CO <sub>2</sub> emissions abatements in Switzerland	15%
• Purchasing power of all households	-0.2%
• Purchasing power of low-income households	

VOTE

## A.2 Tables

TABLE A.1: VOX data - Sample composition

Variable	Mean	Std. Dev.	Min.	Max.	N
Gender (female)	0.526	0.5	0	1	1514
Age 18-29 (young)	0.117	0.321	0	1	1514
Age 30-59	0.532	0.499	0	1	1514
Age 60+ (elderly)	0.351	0.477	0	1	1514
German speaking	0.534	0.499	0	1	1514
French speaking	0.267	0.442	0	1	1514
Italian speaking	0.199	0.399	0	1	1514
Education (high school+)	0.616	0.486	0	1	1514
Number of cars in household	1.381	1.031	0	9	1514
Rural municipality	0.258	0.437	0	1	1514
Concern with unemployment	4.846	1.487	1	6	1488
Concern with income inequality	3.952	1.649	1	8	1489
Concern with public intervention	4.249	1.668	1	6	1444
Green affinity	0.063	0.243	0	1	1514

TABLE A.2: Choice experiment - Sample composition

Variable	Mean	Std. Dev.	Min.	Max.	N
Socio-economic characteristics:					
Gender (male)	0.487	0.5	0	1	1200
Age	51.711	15.263	18	94	1200
National	0.897	0.305	0	1	1200
Education (years of)	15.341	2.072	11	18	1196
Household size	2.884	1.333	1	8	1200
Household annual income:					
<35'000 CHF	0.06	0.237	0	1	957
35'000-50'000 CHF	0.144	0.351	0	1	957
50'000-80'000 CHF	0.242	0.429	0	1	957
80'000-120'000 CHF	0.304	0.46	0	1	957
120'000-160'000 CHF	0.154	0.361	0	1	957
160'000-200'000 CHF	0.047	0.212	0	1	957
>200'000 CHF	0.049	0.216	0	1	957
Geographical location:					
German speaking	0.542	0.498	0	1	1200
French speaking	0.292	0.455	0	1	1200
Italian speaking	0.167	0.373	0	1	1200
Urban agglomeration	0.264	0.441	0	1	1200
Environmental attitudes:					
Main transport for commuting:					
Car	0.578	0.494	0	1	969
Bicycle	0.195	0.396	0	1	969
Bus	0.227	0.419	0	1	969
Concern for climate change:					
Very threatening	0.405	0.491	0	1	1189
Somewhat threatening	0.476	0.500	0	1	1189
Not threatening	0.119	0.324	0	1	1189
Preference for gradual carbon tax	0.635	0.482	0	1	1200

TABLE A.3: Swiss population - Socio-economic characteristics for comparison

Variable	Mean
Socio-economic characteristics:	
Gender (female)	0.505
Age 18-29 (young)	0.149
Age 30-59	0.448
Age 60+ (elderly)	0.234
National	0.757
Education (high school+)	0.521
Household size	2.25
Geographical location:	
German speaking	0.633
French speaking	0.227
Italian speaking	0.081
Rural municipality	0.17
Environmental attitudes:	
Votes to the Green Party	0.063
Votes to the Green Liberal Party	0.072

*Source:* All variables come from Swiss Statistics and concern the end of 2014.  
Election data concern the federal elections of 2015.

TABLE A.4: Choice experiments - Descriptive statistics

		Tax rate			
		60 CHF	90 CHF	120 CHF	150 CHF
Recycling	Income tax rebate	0.352	0.317	0.273	0.175
	VAT reduction	0.319	0.319	0.229	0.193
	Lump-sum redistribution	0.496	0.432	0.374	0.321
	Social cushioning	0.455	0.441	0.410	0.359
	Environmental recycling	0.350	0.295	0.215	0.148

TABLE A.5: Latent classes - Estimates from conditional logit

	Latent classes				
	(1)	(2)	(3)	(4)	(5)
<hr/>					
Tax rate					
0 CHF (reference)					
60 CHF	-0.130*** (0.032)	0.326*** (0.013)	-0.314*** (0.028)	0.582*** (0.0110)	0.0161 (0.026)
90 CHF	-0.099** (0.032)	0.377*** (0.010)	-0.425*** (0.036)	0.432*** (0.017)	-0.167*** (0.025)
120 CHF	-0.069* (0.023)	0.379*** (0.011)	-0.387*** (0.033)	0.266*** (0.019)	-0.308*** (0.028)
150 CHF	-0.119*** (0.028)	0.373*** (0.011)	-0.372*** (0.035)	0.126*** (0.025)	-0.463*** (0.031)
<hr/>					
Revenue recycling					
Income tax rebate (reference)					
VAT reduction	-0.0004 (0.030)	-0.009 (0.008)	-0.094* (0.044)	0.038 (0.021)	0.002 (0.029)
Lump-sum redistribution	0.552*** (0.031)	0.034*** (0.008)	-0.027 (0.039)	0.059** (0.022)	0.125*** (0.026)
Social cushioning	0.589*** (0.0302)	0.051*** (0.008)	0.0095 (0.034)	0.054* (0.023)	0.104*** (0.031)
Environmental recycling	-0.051 (0.038)	-0.018* (0.009)	-0.067 (0.042)	0.019 (0.020)	0.063 (0.033)
<hr/>					
$N$	3861	8190	6564	4191	5334
Pseudo- $R^2$	0.3752	0.3523	0.8726	0.5399	0.1635

*Note:* Estimates report marginal effects from conditional logit. The dependent variable measures the acceptability of the proposed carbon tax designs. Robust standard error in parentheses.

\*  $p < 0.1$  , \*\*  $p < 0.05$  , \*\*\* $p < 0.01$ .

TABLE A.6: Latent classes - Membership estimates from multinomial logit

	(1)	(2)	(3)	(4)	(5)
	Latent class 1	Latent class 2	Latent class 3	Latent class 4	Latent class 5
Socio-economic characteristics:					
Gender (male)	-0.025 (0.025)	0.058* (0.035)	0.021 (0.031)	-0.034 (0.028)	-0.020 (0.028)
Age	0.0006 (0.001)	0.0004 (0.001)	-0.0008 (0.001)	-0.0001 (0.001)	-0.0001 (0.002)
National	0.017 (0.041)	-0.011 (0.053)	0.008 (0.049)	0.0154 (0.045)	-0.030 (0.040)
Education (years of)	-0.009 (0.007)	0.007 (0.009)	-0.002 (0.009)	0.0001 (0.007)	0.004 (0.008)
Household size	-0.004 (0.009)	0.012 (0.014)	-0.002 (0.012)	-0.004 (0.011)	-0.002 (0.011)
Household annual income:					
<35'000 CHF	-0.286** (0.125)	0.297*** (0.112)	-0.069 (0.103)	-0.014 (0.097)	0.072 (0.099)
35'000-50'000 CHF	-0.142** (0.068)	0.184* (0.096)	-0.066 (0.077)	0.014 (0.073)	0.010 (0.085)
50'000-80'000 CHF	-0.061 (0.057)	0.135 (0.087)	-0.070 (0.068)	-0.022 (0.065)	0.018 (0.075)
80'000-120'000 CHF	-0.061 (0.051)	0.108 (0.083)	-0.119* (0.064)	-0.005 (0.061)	0.077 (0.070)
120'000-160'000 CHF	-0.031 (0.055)	0.099 (0.087)	-0.090 (0.068)	0.034 (0.064)	-0.013 (0.076)
160'000-200'000 CHF	-0.055 (0.073)	0.117 (0.103)	-0.105 (0.088)	-0.041 (0.088)	0.084 (0.087)
>200'000 CHF					
Geographical location:					
French speaking	0.0332 (0.027)	-0.040 (0.036)	0.005 (0.034)	0.0005 (0.030)	0.001 (0.032)
Italian speaking	0.062* (0.036)	-0.056 (0.050)	-0.056 (0.051)	-0.007 (0.041)	0.057 (0.042)
German speaking (reference)					
Urban agglomeration	0.002 (0.027)	0.032 (0.038)	-0.012 (0.036)	-0.021 (0.0314)	-0.002 (0.031)
Environmental attitudes:					
Main transport for commuting:					
Car	-0.027 (0.030)	-0.089** (0.040)	-0.006 (0.038)	0.077** (0.039)	0.045 (0.037)
Bicycle	0.009 (0.036)	-0.103** (0.049)	-0.039 (0.049)	0.101** (0.043)	0.032 (0.044)
Bus (reference)					
Concern for climate change:					
Very threatening	0.023 (0.050)	0.095* (0.057)	-0.095* (0.050)	0.041 (0.051)	-0.063 (0.044)
Somewhat threatening	0.083* (0.048)	-0.0003 (0.057)	-0.037 (0.048)	0.052 (0.050)	-0.098** (0.043)
Not threatening (reference)					
$N$			767		
Pseudo- $R^2$			0.0309		
Average class probabilities	0.7844	0.8588	0.9732	0.8110	0.9047
Share of respondents	13.3%	29.2%	23.1%	15.3%	19.2%

Note: Estimates report marginal effects. Robust standard error in parentheses. \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ . Average class probabilities and share of respondents obtained when identifying latent classes (AIC = 14427, BIC = 14741).