Nudging the Poor and the Rich – A Field Study on the Distributional Effects of Green Electricity Defaults

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Abstract

Choice defaults are an increasingly popular public policy tool. Yet there is little knowledge of the distributional consequences of such nudges for different groups in society. We report results from an elicitation study in the residential electricity market in Switzerland in which we contrast consumers' actual contract choices under an existing default regime with the same consumers' active choices in a survey presenting the same choice-set without any default. We find that the default is successful at curbing greenhouse gas emissions, but it leads poorer households to pay more for their electricity consumption than they would want to, while leaving a significant willingness to pay for green electricity by richer households untapped.

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1 Introduction

Public policy makes increasing use of behaviorally-guided interventions (Chetty, 2015; Madrian, 2014). Choice defaults are particularly attractive as they have strong effects on behavior and because they are straightforward to implement, cheap to administer, and do not nominally infringe upon people's freedom of choice. Choice defaults have, for instance, been shown to increase organ donation rates (Johnson and Goldstein, 2003), to foster retirement savings (Choi et al., 2003; Cronqvist and Thaler, 2004), or to fund public goods in the social or environmental domains (Carlsson et al., 2015). In particular, they have been shown to be a highly effective tool in changing environmental behavior in general (Schubert, 2017b) and specifically to increase end consumer demand for green energy (Ebeling and Lotz, 2015).

The effects of choice defaults on behavior are well documented,[1] but much less is known about the potential distributional consequences of such interventions. Usually, one and the same choice default is equally applied to all members of society, which could theoretically benefit some groups, but may harm others. Hence, the implications of choice defaults on the welfare of different groups in society are much less clear, and much less researched, than their unambiguous behavioral effects.

Recent contributions in the behavioral economics literature stress the importance of evaluating policy intervention nudges such as choice defaults not only on the basis of their effects on behavior or choices, but to apply rigorous cost-benefit analysis in order to analyze potential welfare implications (Allcott and Kessler, 2015; Bernheim et al., 2015). We contribute to this emerging work by analyzing how a choice default for the uptake of green electricity contracts affects the decisions of different groups of consumers and by documenting the distributional effects of such a behavioral intervention. Our analysis sheds light on the question of who carries the cost of the green default as a policy instrument targeted at fostering renewable energy demand. This is important as compared to other—more traditional—policy instruments such as subsidies, taxes or command-and-control regulation that could be used to achieve similar goals, the costs of behavioral policy interventions such as defaults are less well understood.

Specifically, we test the hypothesis that households with a low socio-demographic status are most strongly affected and experience negative effects in terms of individual welfare because of the nudge. This hypothesis follows from recent findings documenting that low-income individuals are more likely to stick to choice defaults. In particular, investigating electricity contract choices—like we do in our paper—Hortacsu et al. (2017) find that households with lower income and lower education are less likely to switch their electricity contract.[2] They also point out that this inertia on part of poorer households could

[1] Dhami (2016, see Chapter 22) summarizes several instances where choice defaults impact behavior.

[2] Beshears et al. (2016) find a similar effect for defaults in 401(k) pension plans.

have "important distributional implications" (p. 196). Our paper analyzes such distributional consequences and finds that indeed, poorer households lose money because of the default. The default option does often not correspond to poorer households' preferences, but they still fail to opt out of the default and choose a different contract.[3]

For our research we collaborated with an electricity utility that implemented a green choice default for its residential customers and that is a local monopolist in a medium-sized Swiss city. The default thus affected the city's entire population, which provides an ideal field setting for studying the effects of the default on different groups in society. The utility's residential customers can choose between five different electricity contracts, ranging from very grey (less environmentally-friendly, cheaper) to very green (more environmentally-friendly, more expensive) contracts. The choice default lies on an intermediately green and intermediately expensive option and is the same for all customers. Customers have the default contract whenever they do not actively opt out and choose another contract. They can opt out of the default by simply contacting the utility via phone, e-mail, letter, or online. Four years after the implementation of the green choice default in 2013, we administered a survey asking a representative set of households on their actually preferred electricity contracts in a well-tested active choice elicitation format. Moreover, we collected data on socio-demographic variables, measured a range of personality characteristics, and examined consumers' reasons for their current contract choice.

Three research questions guide our empirical analysis. First, we ask who is more likely to opt out of an existing default electricity contract and why. To answer this question, we combine elicitation and survey data from the field and identify general drivers of choice behavior in the presence of a choice default. Second, our most important research question asks whether and how the default affects choices relative to people's preferences and for which groups in society these effects are most relevant. To identify choice effects caused by the default, we contrast the active choice of an electricity contract (without a default) with the contract held in the current default setting. By analyzing the frequency and the nature of choice effects for different groups in society, we can assess the distributional consequences of the choice default. This analysis provides insights on the costs and benefits that different groups in society incur because of the default intervention. Third, we conduct a simple "back-of-the-envelope" cost-benefit analysis to evaluate whether the green electricity default is cost-effective in curbing harmful greenhouse gas emissions. Contrasting potential losses in consumer welfare due to the choice default with the amount of harmful emissions avoided allows assessing how efficiently a choice default helps curbing externalities.

[3]Similarly, Letzler et al. (2017) find that poorer households are less likely than richer ones to take active steps to cancel a fraudulent subscription that costs them money without providing actual benefits.

Our analysis of 1,362 survey responses yields multiple novel and policy-relevant findings. First, we find that people who are uninformed about the choice, who deem the choice as complex, who perceive the default as a recommendation, or who report to have procrastinated the decision are less likely to opt out of the default. These variables that are predictive of opting-out behavior turn out to be correlated with respondents' socio-economic status. Poorer households and households with less formal education tend to be less informed, perceive the choice as more complex, more often see the default as a recommendation and have a higher inclination to procrastinate on the choice. Thus, households with a lower socio-economic status are also more susceptible to the power of the choice default.

Second, speaking to our main research question on the effects and the distributional costs of the green default, we find that the default affects decisions in two directions. It both hinders choices to less expensive, greyer contracts and prevents greener, more environmentally-friendly choices. The first direction of the effect concerns poorer households with a lower socio-demographic status, especially in terms of formal education. The latter direction of the effect concerns households who have pro-environmental preferences, but who forgo a choice away from the default due to informational problems. Both effects have negative consequences on individual consumer welfare.

Third, a straightforward cost-benefit evaluation of the effectiveness of the green choice default—using annual electricity consumption data from our sample, as well as the carbon-intensity and the prices of the different electricity contracts in the choice set—shows that, indeed, the green electricity default reduces externalities by leading to electricity contract choices that result in lower CO_{2eq}-emissions. However, this emission abatement comes at a considerable cost to consumers, which seems to be higher than some recent estimates of the social cost of carbon.

Our results illustrate the impact of green electricity defaults on the welfare of different groups in society. As defaults are imposed in many residential electricity markets,[4] policy makers should be aware of these effects when designing consumer decision environments in energy markets. The green default implemented in our setting achieves the intended effect of curbing emissions from electricity consumption, but it does so at the cost of poorer households who would actively choose cheaper electricity contracts. Thus, effectively, the choice default acts like a hidden tax on the poor.

The remainder of this paper is organized as follows. Section 2 discusses related literature and section 3 describes the empirical context of retail electricity markets. In section 4 we outline our empirical strategy and in section 5 we present results. Section 6 concludes.

[4]Legislation in many countries stipulates binding rules for utilities that even if no choice is made, households must receive a basic supply of electricity, which is tantamount to inevitably setting a default.

2 Related Literature

The policy concept of 'libertarian paternalism' (Thaler and Sunstein, 2003)—i.e., the idea of addressing societal problems with behavioral nudges that do not nominally[5] infringe upon people's freedom to choose—has become increasingly influential in public policy making (see, e.g., Lunn, 2014 or Sousa Lorenco et al., 2016 for policy examples and Chetty, 2015 or Madrian, 2014 for an overview of the academic literature on nudges and their influence on public policy). While the general attitudes of the public seem to be rather positive towards these new tools of state intervention (Arad and Rubinstein, 2016; Sunstein et al., 2017), the academic debate has evolved, with some abstraction, around different sub-topics to which the results of our study can contribute.

First, our study contributes to a new strand of literature that stresses the importance of evaluating the wider distributional and welfare consequences of behaviorally-guided interventions rather than just their mere effects on behavior change. Different approaches and strategies exist on how to identify a baseline of people's preferences that serves as an input to welfare analyses of interventions guided by behavioral economics. Bernheim and Rangel (2005) were among the first to discuss conceptually how such interventions can be evaluated in terms of economic welfare analysis when considering potentially inconsistent and unstable preferences. Chetty (2015) provides an overview of currently applied methods, such as (i) using *subjective well-being* (i.e., happiness) as a direct measure of reported utility experienced by people when facing nudges, (ii) using *sufficient statistics*, i.e., revealed preferences from people's choices that reflect their true utility, or (iii) *structural modeling* that aims at identifying how behavior changes as a function of a bias and then extrapolates this to a situation without a bias. Nevertheless, despite these advances, measuring welfare when preferences are inconsistent remains difficult and this certainly also applies to the study presented in this paper. Theoretically, the work by von Weizsäcker (2014) shows some progress on how adaptive preferences can be reformulated into so-called improvement paths, which allow for welfare analysis. In the same vein of discussing theoretical underpinnings, Sugden (2013) argues that the political perspective of conventional welfare economics may require a change from the one of a maximizing benevolent planner to reaching mutually beneficial agreements across individuals.

Still, only few concrete empirical investigations of the welfare effects of nudging interventions applied in real field settings exist. So far empirical studies have investigated the welfare consequences of feedback on electricity consumption using social norms (Allcott and Kessler, 2015), of energy efficiency advisory programs for homeowners (Allcott and Greenstone, 2017), of energy efficiency standards and subsidies in the light-bulb market

[5]We explicitly state that behavioral nudges can only *nominallly* grant freedom of choice, because as Hausman and Welch (2010) discuss, providing freedom to make choices does not necessarily imply that people are capable of using this possibility to *effectively* make choices that correspond to their true preferences.

(Allcott and Taubinsky, 2015), and of reminders in fund-raising campaigns (Damgaard and Gravert, 2018). In addition, other authors were more concerned whether nudging interventions help consumers in general to attain a fit with their preferences (Camerer et al., 2003; Carroll et al., 2009; Choi et al., 2003; Keller et al., 2011). Relying on a stated preference approach, our paper contributes to this literature by adding substantive evidence that a prime criterion of libertarian paternalistic choice defaults, i.e., the inhibition of inconsistent choices, does not necessarily hold. In this way, we confirm and extend the laboratory findings of Ghesla (2017). In addition, we also add evidence from the field that nudges may affect people differently dependent on their characteristics as shown by My and Ouvrard (2019) in a public goods game with a student subject pool.

For the specific case of choice defaults, Bernheim et al. (2015) studied the welfare effects of default options in 401(k) pension saving plans in the United States. They show that finding the optimal default design for such plans, in the sense that the nudge should enhance overall welfare, is challenging and depends on the welfare perspective of the choice architect, as well as on the reasons why people stick to the default. In connection to this work, Brown and Weisbenner (2014) examine who chooses which pension contribution plan and why. They find that readily observable demographic variables, such as income or education, are only somewhat predictive of pension plan choice, thus making it difficult for a choice architect to decide about the optimal design of the default option. Most directly relevant to our study, and similar to our results, Brown et al. (2016) document that default options for pension plan choice can have negative consequences for individual welfare, as many individuals who have been defaulted into a plan later regret their 'choice'. Our study reveals comparable problems of a green electricity default: under the default regime, we observe a large share of people holding contracts that do not match their preferences. Moreover, such mismatches are particularly frequent for poorer households who end up paying more for their electricity consumption than they would want to. Second, our paper contributes to the discussion of the political economy of nudging, which refers to questions such as how well nudges may correspond to the goals of potentially self-interested choice architects or why behavioral interventions may be preferred in some contexts over other political instruments, such as taxes or standards (Schnellenbach, 2012; Schubert, 2017a).

Third, our results may be of interest for the active and rich debate on the broader ethical and philosophical implications as well as on the societal consequences of nudging approaches in public policy (see, e.g., Bovens, 2009; Desai, 2011; Gigerenzer, 2015; Hausman and Welch, 2010; Oliver, 2015; Rebonato, 2014; Sunstein, 2015). Specifically, our results provide an empirical illustration of who may benefit and who may lose when policy makers apply behavioral interventions.

3 Consumer Choice and Green Defaults in Electricity Markets

The deregulation and liberalization of state-owned electricity monopolies (Jamasb and Pollitt, 2005; Joskow, 2006; Schneider and Jäger, 2003) has led to consumers in many countries being able to chose from a menu of different electricity contracts. Approximately half of the federal states in the U.S. have liberalized their power markets offering substantial consumer choice of electricity contracts and power suppliers (American Coalition of Competitive Energy Suppliers (ACCES), 2017). Electricity markets in the EU (European Commission, 2017a), the United Kingdom and Australia have undergone similar developments (see International Energy Agency (IEA), 2005, for an overview). Differentiation in consumer choice for electricity contracts usually occurs along two, often interlinked, dimensions. First, retailers offer electricity at different prices per unit. Second, retailers tender electricity contracts with different underlying electricity production sources. Via this second line of differentiation, consumers' choices of electricity contracts can have an upstream effect on the composition of power sources used to produce electricity, as the choice of consumers of differentially sourced electricity contracts provides investment signals for producers of renewable electricity.

Mobilizing consumer interest for the environmental and societal implications of different electricity sources is a prime interest of many governments. Green electricity production from sources such as wind, solar, or biomass is assumed to produce fewer negative externalities, such as greenhouse gas emissions or nuclear waste, than conventional sources of electricity production. Thus, as a consensus has developed that anthropogenic emissions, including emissions from electricity production, cause climate change (Intergovernmental Panel on Climate Change (IPCC), 2014), getting consumers to opt for and demand more green electricity may help governments attain important policy targets, such as for instance, renewable portfolio standards in the United States (National Conference of State Legislatures (NCSL), 2016) or the goal of a 33% share of renewable electricity production by 2020 in the European Union (European Commission, 2017b).

Electric utilities have been adapting their contract portfolios accordingly. In the United States, the US Department of Energy (2016) reports that there are roughly 850 utilities offering green electricity from different sources and for varying prices. Additionally, there are other systems, such as 'Community Choice Aggregation (CCA)' schemes, which have been adopted in several federal states, bundling consumer choice on a community-wide level and offering green electricity.[6] Likewise, the Agency for the Cooperation of Energy Regulators (ACER) (2014) estimates that in the European Union there are at least 280 electricity suppliers that offer more than 690 different tariffs that

[6] As of today, more than 5% of the U.S. population are offered an electricity choice under CCA-schemes (Local Power Inc., 2017).

include shares of green electricity production. However, the share of new renewable electricity production, i.e., production from wind, solar, biomass, and geothermal sources, amounted to only about 9% of total production of the United States net power generation (Energy Information Administration, 2017, 2016 data) and to only 12% in the EU (Eurostat, 2017, 2014 data).

This lack in demand seems to speak against the generally assumed positive willingness-to-pay for green electricity (see, e.g., Soon and Ahmad, 2015). Upon closer examination, however, it becomes clear that although liberalization opens up electricity retail markets for choice, most consumers remain inactive when it comes to actually choosing an electricity contract. There are several potential reasons for this disengagement on behalf of consumers, such as inertia, lack of trust, or perceived complexity of the choice (Agency for the Cooperation of Energy Regulators (ACER), 2014; Hortacsu et al., 2017). According to the European Consumer Organization (2016) less than 10% of consumers in the EU have switched contracts or supplier in 2013. Thus, it seems that liberalization alone may not deliver the push in demand for green electricity that was initially hoped for.[7]

In this situation, policy makers and retailers in electricity markets have started to make increasing use of behaviorally-guided policy instruments to nudge people in socially desirable ways (see, e.g., Allcott, 2011; Costa and Kahn, 2013; Momsen and Stoerk, 2014; Newell and Siikamäki, 2014; Sunstein and Reisch, 2013). One of the most promising nudges is the use of green electricity defaults, which set the standard contract to a 'green' option. Thus, if households want to choose any other contract, they need to actively opt out of the default. As the active engagement of consumers within the electricity retail market is rather low, defaults have a strong effect on green electricity uptake (see, e.g., Ebeling and Lotz, 2015). While consumer choice in retail electricity markets almost always involves that a default option is present, the deliberate shifting of these defaults towards more expensive green options could involve diverging distributional consequences for different groups in society. The assessment of such distributional consequences constitutes the prime subject matter of this paper.

4 Study Design and Sample Composition

Our study makes use of a field setting, in which a Swiss utility—that acts as a local monopolist in a medium-sized Swiss city—introduced a new choice set of electricity contracts for its household customers.[8] Importantly, when implementing this change, the utility im-

[7]Note that here we focus on the demand side; governments also make use of a range of supply side measures to incentivize sustainable electricity production, such as feed-in-tariffs or renewable funds (for an overview see, e.g., Gan et al., 2007).

[8]Note that electricity markets in Switzerland have not yet been liberalized for households, thus in essence airtight monopolies exist in this market. Households have no choice but to obtain electricity from the local monopolist.

posed a green default contract for all household customers. The change occurred in 2013. Before that, there was only one contract available to all consumers. Hence, with the change of options all household were automatically defaulted into the newly established green electricity default contract and they had to actively opt out if they wished to select one of the other four contracts. When introducing the new regime, the utility informed households about this change in contractual options and the default via mailed letters. Issuing a mail and web-based survey four years after the new default has been set, we analyze whether the actual preferences for an electricity contract, elicited in an active-choice format, correspond to the contracts that the households currently hold under the default regime. With the help of this straightforward elicitation strategy we examine the mismatches between currently held and actively preferred contracts.

4.1 Survey method and procedure

We surveyed a sample of the partnering utility's residential electricity consumers in March and April 2017. We randomly selected 12,000 households (24% of the population of households) who had a valid billing address to receive a questionnaire. The sample was stratified by zip code in order to ensure reaching—as far as possible—a demographically representative segment of customers.[9] Furthermore, we ascertained that the proportions of consumers holding the different electricity contracts in the targeted sample were equal to those in the total population. After eliminating duplicate addresses, we sent out survey packages to 11,989 households. A survey package included a cover letter, a printed and folded questionnaire, and a pre-stamped reply envelope.

Households who chose to participate could either do so by filling out the paper questionnaire or by using an online link, which was provided in the cover letter.[10] As a thank-you participating households entered a lottery from which three winners were chosen randomly to receive prices worth ca. USD 1,000 in total. We received 1,906 questionnaires (a response rate of 16%). 380 respondents chose the on-line route and 1,526 sent their questionnaire via ordinary mail. We make use only of fully completed questionnaires, which leads to a final sample size of 1,362 respondents.[11]

The utility's customers can choose from five different contracts, which vary in their prices per unit of electricity and in the underlying electricity sources. Figure 1 illustrates

[9] We stratified the targeted sample by zip code because key demographic variables, such as income, may differ by zip code. The utility did not have any further socio-demographic or other data on their customers that would have allowed for a more precise stratification. Note that having a valid billing address implies that the household is entitled to choose an electricity contract.

[10] Translated copies of all materials are displayed in Appendix C.

[11] We thus keep the sample size constant across all analyses to ensure comparability. This list-wise deletion approach is more conservative than other methods (such as mean substitution or regression imputation). As we retain a large enough number of responses, statistical power is preserved (Allison, 2001). Moreover, for our key dependent variable (difference between currently held contract and contract chosen in the survey), there is no significant difference between respondents who fully completed the questionnaire and respondents who completed it only partially.

the five contracts available to customers. In the most expensive contract (GREEN++), a kilowatt hour of electricity costs roughly 15 Swiss cents more than in the cheapest contract (GREY−−, price: 8.10 cents/kWh). Note additionally, that the price difference between the default contract and the cheapest contract is 1 cent per kWh. In order not to reveal the identity of the partnering utility, we used self-invented labels for each contract. However, the choice set in our survey—in terms of pricing and composition of electricity production—corresponds to the choice set introduced by the utility together with the green default in 2013 and that was still in place at the time of our survey in 2017.[12]

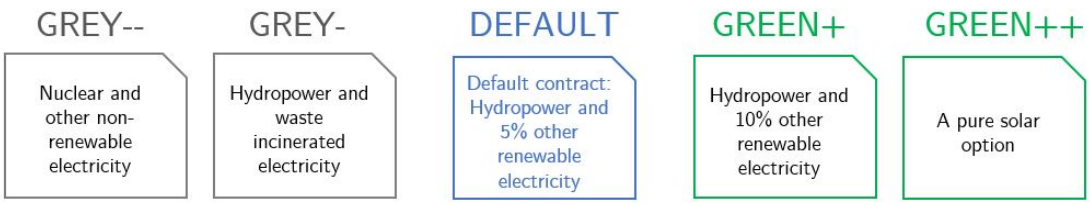


Figure 1: Selection of contracts

Note.—Prices per unit of electricity and environmental friendliness increase from GREY−− to GREEN++.

Table 1 provides an overview of the distribution of the different electricity contracts in the randomly selected sample, the sample data received (including also only partially completed questionnaires), and the final sample of fully completed questionnaires retained for analysis.[13] The distribution of contracts in the randomly selected sample is representative of the distribution of contracts in the total population. In the sample of received questionnaires, households who have opted out and have chosen a current contract other than the default are over-represented (see Table 1). This seems intuitive, as such households may have a higher interest for the topic in general and thus are more likely to respond to the survey. Households who remain in the default are thus slightly underrepresented. These observations also hold for the final sample, i.e., all fully completed questionnaires, used for analysis. This means that our results underestimate any consequences of choice effects of the green electricity default, as we oversample households with a higher involvement in the topic who are more likely to have made a conscious decision when choosing their current electricity contract rather than to stick with the default.

The questionnaire set off with an active-choice question that was embedded into a

[12] 100 Swiss cents = CHF 1 ≈ USD 1. Pricing of the contracts in our questionnaire is based on the mean price within the period of 2013-2017. Appendix C shows how the choice was presented to respondents in the questionnaire.

[13] Note that in accordance with Internal Review Board regulations and our legal agreement with the partnering electric utility all contractual data was anonymized such that it was impossible for the researchers to identify individual households. We used a generic identifier number to match the data on currently held contracts that we received directly from the utility with the data elicited from the consumers in the survey. Further, because of a confidentiality agreement with the partnering utility, we do not show the exact distribution of contracts in the total population.

Table 1: Distribution of contracts across random, received, and final sample

Electricity Contracts	Random Sample	Received Sample	Final Sample
GREEN++	0.29%	1.11%	1.40%
GREEN+	3.03%	8.71%	9.25%
DEFAULT	76.89%	64.85%	65.55%
GREY−	7.78%	12.33%	11.75%
GREY−−	12.01%	13.01%	12.11%
Total	100.00%	100.00%	100.00%

cheap-talk design (Cummings and Taylor, 1999). In the active choice, respondents indicated which electricity contract they would choose if they had to decide right now, thus revealing their preferences for an electricity contract.[14] The menu of contracts represented the actual options available to the utility's customers. The description of electricity sources provided the exact same information as the utility provides to customers in its marketing materials. We use the respondent's active choice in the survey to identify preference mismatches by comparing the active choice with the contract currently held under the default regime.

After the active choice, we elicited a number of additional variables in the questionnaire to analyze their relation to the observed mismatches. Table 2 in Section 4.2 contains a list of all variables together with summary statistics; Appendix C contains the full questionnaire. Our ex-ante hypothesis was that mismatches would be related to demographic characteristics, and in particular that poorer households would often actively prefer cheaper contracts in the survey than their currently held contract. To test this hypothesis, we measured a number of demographic variables that allow capturing respondents' socioeconomic status (income, education, occupation, property ownership) alongside further demographic control variables such as age, gender, and family status. In addition, the questionnaire measured three further sets of variables that we hoped could help shed light on some of the mechanisms behind the hypothesized correlation between demographics and mismatches. First, we assessed respondents' energy literacy by asking them to guess the average annual electricity consumption of a four-person family household, as well as the shares of hydro power and of new renewable energy sources in the Swiss electricity market. The intention was to capture respondents' knowledge about and interest in the electricity market. Second, we measured some potentially important personal attitudes and characteristics. Specifically, we elicited political preferences (on a spectrum from left

[14]This approach is in line with a key assumption in the framework of Chetty et al. (2009, p. 1170) that given full salience of taxes, "the agent chooses the same allocation as a fully-optimizing agent." This implies that an active choice without a default reveals fully-optimizing choices on behalf of respondents. We will use this assumption in section 5.4 to guide our cost-benefit evaluation of the green electricity default.

to right), pro-environmental attitude, self-reported ease of decision making, time preferences, trust and altruism (using the items proposed by Falk et al., 2016). Here, the idea was that these variables could both capture reasons for sticking to the default as well as be related with preferences for greener contracts. Third, we asked individuals to think of their current electricity contract and presented them with a number of statements capturing reasons why they did or did not make a choice when deciding about their current contract. These statements followed the main categories used in Brown et al. (2011) and Brown et al. (2016). Specifically, we asked how well-informed consumers were when making their contract choice at the time, how complex they perceived the choice to be, how much effort they put into making the choice, how important they deemed the choice, whether they procrastinated or forgot to make a choice, and whether they had perceived the default as a recommendation. By collecting data on these variables, we hoped to identify more proximate mechanisms that could help explain the reasons for mismatches between currently held and actually preferred contract.

4.2 Merits and limitations of survey data

As Dhami (2016) argues, structured and carefully collected survey data benefits the analysis of behavioral phenomena and can complement results from more tightly controlled experiments. Especially when it comes to the evaluation of potential public policy tools, more information on key characteristics and demographics of respondents allows for a more nuanced analysis of the effects of such tools, which can provide relevant insights for policy makers. Nevertheless, there are, at least, two important limitations of a survey approach, which we would like to address before subsequently presenting the descriptives of our sample and the corresponding results with regards to our research questions.

A first limitation concerns the hypothetical nature of our elicitation strategy of the actually preferred electricity contracts. The methodological gold standard is to elicit choices in an incentive-compatible fashion. Ideally, we would thus have preferred to incentivize choices by directly implementing the actively preferred contracts on behalf of the households. However, this would have implied that our questionnaire was designed in a legally binding way—a design choice that was unfortunately undesired by the partnering utility and thus not possible. Therefore, we opted to elicit hypothetical active choices of consumers' preferred electricity contracts.

Earlier studies concerned with the estimation of the willingness-to-pay for environmental goods, such as green electricity, have found that hypothetical and actual valuation might differ if choices are inconsequential to respondents (e.g., Horowitz and McConnell, 2002). For our study this means that even though households might indicate to have preferences for green electricity, if they had to incur the actual cost, they might refrain from switching to a greener, but also more expensive contract. In order to limit such potential

hypothetical bias, which may in part stem from respondents wanting to provide socially desirable answers, we made use of a cheap-talk script, a well-founded design method (see Cummings and Taylor, 1999). Cheap-talk scripts have been numerously and successfully applied in contingent valuation studies in environmental economics (e.g., Brown et al., 2003; Murphy et al., 2005). Cummings and Taylor (1999) demonstrated in several experiments that informing respondents about the existence of hypothetical bias, rather than just reminding them of budget constraints (such as Loomis et al., 1994), effectively mitigates hypothetical bias. We thus follow the approach by Cummings and Taylor (1999) and implement a brief cheap-talk script. Specifically, we explain in a simple example the difference between hypothetical and actual decision-making, thus explaining hypothetical bias to respondents before asking them to cast their active choices as if they were real. In support of this approach, results from other recent studies in the environmental domain point towards the effectiveness of cheap-talk designs to mitigate hypothetical bias in stated willingness-to-pay estimates (Howard et al., 2017; Tonsor and Shupp, 2011). Thus, even though we cannot completely rule out that respondents' contract choices in the questionnaire may still show some hypothetical answer biases, we minimize this problem by applying previously well-tested methods.

Another potential consequence of our unincentivized choice elicitation could be that respondents may just randomly select one of the five offered contracts, as the choice is inconsequential to them. To evaluate the extent of this potential problem, we can check in our data whether customers who have opted out of and hold a current contract other than the default make active choices in our study that are consistent with their currently held contract. If random choice poses a problem to our data collection, we should observe only 20% of consistent matches for this group of households. Yet, 60% of respondents who hold a current contract other than the default make a consistent choice in the hypothetical active choice in our questionnaire. This speaks against the view that respondents did not take the hypothetical choice seriously.[15]

A second limitation concerns the self-selection of certain households into our study. Even though we made sure that our randomly selected sample does not differ from the population of the utility's customers in terms of currently held electricity contracts and zip code (see Table 1 for details), we cannot prevent that households who are potentially

[15]We can only speculate on the reasons why nevertheless some of the households who have already opted out of the default contract show inconsistencies in the hypothetical choice. It could be that those respondents cast socially-desired answers, which we could not prevent with our cheap-talk design. Approximately 74% of respondents who are inconsistent between current contract choice and actual preferences elicited in the questionnaire have cheap, and less environmentally-friendly current contracts, but indicate to prefer more expensive, and more environmentally-friendly electricity contracts in the survey. Another reason for why these inconsistencies occur could be that some households do not possess stable preferences for an electricity contract, but that preferences are constructed as the choice itself emerges (see, e.g., Ariely et al., 2003), and can thus be affected by random influences that happen to be salient at the time of choice. See Table A1 in the Appendix for the specific numbers of consistent and inconsistent choices for each contract type.

Table 2: Characteristics of the final sample

	Final Sample	Population
Demographics		
Age, mean	48.01 (16.90)	39.60
Gender: Male	62.63%	49.05%
Nationality: Swiss	86.42%	75.88%
Native Speaker	91.12%	83.04%
Single household	28.27%	37.50%
Single parent	2.35%	18.60%
Household with children	25.18%	22.58%
Property owner	35.54%	27.70%
Occupation		
Full-time	41.48%	49.90%(†)
Part-time	23.42%	37.80%(†)
Self-employed	6.98%	12.30%(†)
In training/ in school	2.86%	–
Seeking work	1.10%	2.10%
House wife/ house husband	2.42%	–
Retired	21.73%	11.40%
Education		
Compulsory schooling	2.13%	19.88%
Vocational Training / A-Levels	37.74%	42.46%
Higher education (university or other)	60.13%	37.66%
Income per month		
below CHF4,000	11.16%	13.10%(†)
CHF4,001-6,000	18.36%	16.30%(†)
CHF6,001-8,000	24.08%	17.20% (†)
CHF8,001-10,000	16.59%	15.70%(†)
CHF10,001-12,000	12.33%	12.10%(†)
CHF12,001-14,000	7.56%	8.80%(†)
CHF14,001-16,000	4.99%	5.80%(†)
above CHF16,000	4.92%	11.10%(†)
Energy literacy		
Knowledge on annual consumption	30.69%	–
Knowledge on new renewable mix	43.76%	–
Knowledge on hydro power mix	25.26%	–
Attitudes		
Political attitude	4.38 (2.34)	5.00(†)
on scale from 0 (left) to 10 (right)		
Personal attitudes		
on a scale from 0 (less) to 10 (more)		
Nature and the environment matter	8.15 (1.63)	–
Happy to make decisions	7.19 (2.22)	–
Patience	6.47 (2.70)	–
Trust	5.10 (2.62)	–
Altruism	7.44 (2.63)	–

Table 2 continued

	Final Sample	Population
Reasons for choice		
on a scale from 1 (does not apply) to 4 (fully applies)		
Information before choice	2.66 (0.99)	–
Choice was complex	2.10 (0.91)	–
Unaware of choice	1.52 (1.00)	–
Choice was unimportant	1.65 (0.88)	–
Forgot to make choice	1.36 (0.82)	–
Default perceived as recommendation	2.52 (1.04)	–
Kept effort for decision as low as possible	2.74 (0.98)	–
Never got around to make a decision	1.61 (0.99)	–
Did not have enough information	1.65 (0.91)	–
Decision was made		
Alone	41.78%	–
Together with partner	53.23%	–
Not at all	4.99%	–
Sample Size	1,362	

Note.— Table 2 shows summary statistics for the variables elicited in the questionnaire. Standard deviations are in parentheses where applicable. Population estimates are provided to indicate the degree of representativeness of our sample. Population estimates are from official population statistics of the Swiss city we have sampled in, or if unavailable for the specific city, we have used data at the national level (indicated by a †). Please note that the sources of the official population statistics can be obtained on request from the authors, as publication would lead to the identification of the partnering utility and would thus violate confidentiality agreements. The altruism score has been reverse-coded such that higher values mean that the respondent attaches a higher importance to altruism.

more interested in the topic of energy in general or who are more keen to enter prize draws, are overrepresented in our final sample. However, when comparing collected demographic characteristics to the total sampled population (see Table 2), the data from our final sample look very similar. Moreover, even if, for instance, households who are better informed about electricity contract choices or more interested in the topic answer our questionnaire more frequently than those who are less interested, our results represent a lower bound of the choice effects of the green electricity default.

5 Results

Below, in section 5.1, we first discuss our econometric approach and how we constructed our dependent variables. In section 5.2 we present our results with regard to predictors of opting out of the default, section 5.3 presents the results on preference mismatches, and section 5.4 provides a back-of-the-envelope cost-benefit analysis of the default intervention.

5.1 Dependent variables and econometric approach

To answer the first two research questions—who is more likely to opt out of the default and how does the default affect choices relative to active preferences—we proceed in

three steps. First, to analyze who is particularly likely to opt out and who is more prone to stick to the default, we construct a dependent variable that takes the value 1 if a respondent has opted out of the default and that is 0 otherwise. We use an OLS-estimated linear probability model (LPM)[16] to analyze the influence of the variables elicited in the questionnaire on this dependent variable. Column (1) of Table 3 displays the regression results.

In the second step, we examine the determinants of the active choice preference for an electricity contract. As described in section 4.1, respondents could choose from a menu of five electricity contracts. Hence, the dependent variable has five different outcome categories (GREY−−, GREY−, DEFAULT, GREEN+, GREEN++) and is ordinal as the level of environmental friendliness and per unit prices increase with each category from GREY−− to GREEN++. We apply an ordered Logistic model (OL) to estimate the probability of choosing one specific contract against all others. As base category we use the contract GREY−−, thus the odds ratios reported in column (2) of Table 3 provide an indication whether changes in certain predictors are associated with an active preference for greener contracts. Odds ratios above 1.00 indicate that a change in the predictor increases the probability of choosing a greener contract than GREY−−.[17]

In the third step, we examine the mismatches between currently held and actively preferred contract. To do so, we compare the respondents' active choice for an electricity contract in the questionnaire with the contract that they currently have. There are two types of potential mismatches. On the one hand, we have households currently holding the DEFAULT contract who would actually prefer greyer and cheaper contracts. We call this kind of mismatch a *grey mismatch*. On the other hand, we have households currently holding the DEFAULT contract who would actually prefer greener and more expensive contracts. We call this second type of mismatch a *green mismatch*.

We create two separate dependent variables to capture these two types of mismatches. The dependent variable *grey mismatch* takes on value one if a household who currently holds the DEFAULT contract actively prefers GREY−, and it is two if such a household chooses GREY−− in the survey. Correspondingly, the dependent variable *green mismatch* takes on value one if a household who is currently in the DEFAULT actively prefers

[16]Note that LPM estimates can be directly interpreted as the change in the probability of opting out of the default associated with a one unit increase of the predictor variable. To check the robustness of our LPM results, we also estimated a Logistic model on the same data. The results are qualitatively (in terms of statistical significance) the same.

[17]The ordered Logistic model assumes that the order of outcomes is proportional, i.e., implying that the perceived 'distance' between each of the contracts is equal. This assumption may not fully hold in our case, as differences in price and environmental friendliness are not uniform across the contracts. Therefore, we also estimated a generalized ordered Logistic model (GOL), which allows to relax the assumption that the effects of independent variables on outcome levels are uniform across each level. As the results of both models (OL and GOL) are practically the same, we refrain from reporting the GOL model. We also estimated a multinomial logit model (MNL), which assumes that there is no intrinsic order in the menu of the electricity contracts at all. However, the estimation is less parsimonious and does not add any additional insights to our results. Therefore, again, we do not report the MNL model.

GREEN+ in the survey, and it is two if such a household actively chooses GREEN++. In all other cases the two dependent variables are zero. Specifically, the dependent variables capturing a grey or a green mismatch are thus zero (i) if a household does not have a mismatch, (ii) if the household does not currently hold the default contract,[18] or (iii) if the mismatch goes in the other direction than the dependent variable intends to capture. We again use ordered Logistic regressions to assess the influence of factors associated with grey and green mismatches (see columns (3) and (4) of Table 3).[19]

Table 3 shows our regression results at a glance. Column (1) analyzes the opt-out behavior in a linear probability model (LPM), column (2) examines the active preferences for an electricity contract, column (3) assesses the determinants of grey mismatches, and column (4) assesses the determinants of green mismatches. Models (2)-(4) are ordered Logistic regressions.

In the regressions, controlling for other variables that are potentially correlated with demographics may mask the relations between demographics and our dependent variables of interest. However, these correlations are interesting from a policy point of view when the aim is to assess the distributional effects of the implemented green default for different demographic groups in society. This is one of the key goals of our study, and we thus complement our regression models by also considering uncontrolled, bivariate correlations mainly with respect to the demographic variables we collected. Table A3 in the Appendix displays the full correlation matrix for all variables included in our study. Finally, we amend our econometric approach by also including the least absolute shrinkage and selection operator (LASSO), which is a machine learning algorithm to automatically perform variable selection (Tibshirani, 1996). We report the results from these analyses verbally for each of the regressions as outlined above.

[18] We construct the dependent variables in that way as our main goal is to identify preference mismatches caused by the default and not preference mismatches that may occur for another reason. The data indicate that the default seems to be the most important reason for preference mismatches. 45% ($n = 617$) of all our respondents hold the DEFAULT contract and have a mismatch. In addition, 14% ($n = 186$) of respondents do *not* hold the DEFAULT contract and nevertheless make an inconsistent active choice that does not match their currently held contract. As discussed in Section 4.2, the latter mismatches may be seen as random noise in our data as they are likely due to instable preferences or respondents making random hypothetical choices in the survey. We use these observations to evaluate the robustness of our results by running the analyses also on dependent variables that capture a mismatch in general and not only for respondents currently holding the DEFAULT contract. These analyses are reported in the Appendix. Our main results prove to be robust to redefining the dependent variables for mismatches in that way.

[19] We run separate analyses for grey and green mismatches as the effects of the independent variables may differ for the two different directions of mismatch. Note that regressions (3) and (4) in Table 3 are both based on the full sample, thus we do not split the sample in any way and it is only the dependent variables that differ between the two analyses. Alternatively, we could have obtained the same results with a dependent variable simply capturing the presence of a mismatch and then interacting all independent variables with a dummy variable capturing the direction of the mismatch.

Table 3: Regression analyses of opt-out behavior, active choice, and mismatches

	Opt-out behavior (1) | LPM	Active choice (2) | OL	Grey mismatch (3) | OL	Green mismatch (4) | OL
Demographics				
Language: Native	0.026	1.444*	0.699	1.300
	(0.046)	[0.981, 2.128]	[0.440, 1.123]	[0.719, 2.474]
Single	0.009	1.241	0.712*	1.795**
	(0.040)	[0.901, 1.712]	[0.476, 1.063]	[1.101, 2.947]
Household with children	0.054	0.685***	1.238	0.436***
	(0.034)	[0.521, 0.900]	[0.874, 1.749]	[0.278, 0.672]
Property owner	−0.011	1.178	0.644***	1.088
	(0.033)	[0.912, 1.521]	[0.456, 0.907]	[0.735, 1.611]
Occupation				
Base: Full-time				
Part-time	0.023	1.346**	0.953	1.084
	(0.035)	[1.019, 1.780]	[0.657, 1.377]	[0.720, 1.627]
Self-employed	0.057	1.499*	0.847	1.143
	(0.053)	[0.970, 2.318]	[0.471, 1.480]	[0.615, 2.067]
In training/ in school	−0.035	0.957	1.985*	1.215
	(0.071)	[0.486, 1.881]	[0.906, 4.262]	[0.469, 2.932]
Seeking work	−0.016	0.849	1.025	0.364
	(0.129)	[0.323, 2.265]	[0.279, 3.213]	[0.018, 2.281]
House wife/ house husband	−0.040	0.746	1.011	1.633
	(0.077)	[0.376, 1.470]	[0.430, 2.270]	[0.575, 4.191]
Retired	0.026	0.956	0.822	0.862
	(0.053)	[0.627, 1.455]	[0.474, 1.425]	[0.459, 1.619]
Education				
Base: Compulsory schooling				
Vocational training	−0.066	1.967*	0.679	1.270
	(0.099)	[0.892, 4.339]	[0.299, 1.595]	[0.384, 5.833]
A-Levels	0.026	1.801	0.343**	1.516
	(0.106)	[0.770, 4.219]	[0.135, 0.888]	[0.424, 7.281]
Higher education not university	−0.036	2.669**	0.412*	1.928
	(0.102)	[1.177, 6.065]	[0.171, 1.020]	[0.564, 9.039]
University	−0.035	2.353**	0.494	1.472
	(0.101)	[1.049, 5.284]	[0.210, 1.201]	[0.436, 6.828]
Income per month				
Base: below CHF4,000				
CHF4,001-6,000	−0.060	1.077	1.500	1.202
	(0.048)	[0.724, 1.603]	[0.921, 2.466]	[0.677, 2.164]
CHF6,001-8,000	0.009	1.246	0.913	1.138
	(0.050)	[0.834, 1.862]	[0.550, 1.529]	[0.633, 2.078]
CHF8,001-10,000	−0.027	1.117	1.152	1.466
	(0.053)	[0.716, 1.741]	[0.653, 2.043]	[0.765, 2.840]
CHF10,001-12,000	−0.049	1.405	1.006	1.590
	(0.060)	[0.866, 2.280]	[0.528, 1.916]	[0.773, 3.295]
CHF12,001-14,000	−0.064	1.748**	0.824	2.459**
	(0.067)	[1.026, 2.979]	[0.391, 1.706]	[1.143, 5.310]
CHF14,001-16,000	0.009	1.754*	0.808	2.701**
	(0.076)	[0.947, 3.247]	[0.345, 1.822]	[1.128, 6.404]
above CHF16,000	−0.051	1.687	1.291	1.932
	(0.079)	[0.899, 3.169]	[0.572, 2.862]	[0.756, 4.807]
Additional demographic controls	Yes	Yes	Yes	Yes

Table 3 continued

	Opt-out behavior (1) | LPM	Active choice (2) | OL	Grey mismatch (3) | OL	Green mismatch (4) | OL
Energy literacy				
Knowledge on annual consumption	0.027	0.982	0.948	0.879
	(0.027)	[0.791, 1.220]	[0.714, 1.253]	[0.633, 1.213]
Knowledge on new renewable mix	0.058**	1.126	0.759**	0.862
	(0.026)	[0.916, 1.385]	[0.576, 0.998]	[0.632, 1.174]
Knowledge on hydro mix	−0.018	0.961	0.984	0.922
	(0.029)	[0.764, 1.209]	[0.723, 1.331]	[0.653, 1.290]
Explains concept of green electricity easily	0.028	0.945	0.945	1.025
	(0.020)	[0.808, 1.106]	[0.773, 1.157]	[0.803, 1.311]
Attitudes				
Political attitude	0.011*	0.762***	1.137***	0.815***
	(0.006)	[0.724, 0.802]	[1.068, 1.212]	[0.753, 0.881]
Personal attitudes				
Nature and the environment matter	−0.002	1.353***	0.929*	1.251***
	(0.009)	[1.261, 1.453]	[0.852, 1.012]	[1.113, 1.412]
Happy to make decisions	0.009	0.941**	1.009	0.994
	(0.006)	[0.897, 0.987]	[0.951, 1.072]	[0.927, 1.068]
Patience	−0.009*	1.019	1.015	1.074**
	(0.005)	[0.980, 1.059]	[0.966, 1.068]	[1.013, 1.140]
Trust	−0.002	0.999	1.008	0.939**
	(0.005)	[0.960, 1.040]	[0.957, 1.062]	[0.885, 0.997]
Altruism	−0.014***	1.006	1.028	0.955
	(0.006)	[0.962, 1.052]	[0.973, 1.087]	[0.894, 1.022]
Reasons for choice				
Information before choice	0.089***		0.743***	0.749***
	(0.018)		[0.623, 0.886]	[0.607, 0.925]
Choice was complex	−0.038**		0.998	1.272**
	(0.015)		[0.850, 1.170]	[1.052, 1.539]
Unaware of choice	−0.006		0.944	1.175*
	(0.014)		[0.812, 1.094]	[0.989, 1.392]
Choice was unimportant	−0.001		1.242***	0.770**
	(0.016)		[1.060, 1.453]	[0.613, 0.956]
Forgot to make choice	−0.032*		1.041	1.216*
	(0.016)		[0.869, 1.243]	[0.974, 1.512]
Default perceived as recommendation	−0.026**		1.178**	0.974
	(0.013)		[1.031, 1.349]	[0.838, 1.133]
Kept effort for decision as low as possible	0.005		0.971	0.918
	(0.014)		[0.839, 1.125]	[0.776, 1.086]
Never got around to make a decision	−0.036*		0.999	0.944
	(0.017)		[0.832, 1.197]	[0.758, 1.173]
Did not have enough information	0.031*		0.986	0.954
	(0.015)		[0.833, 1.164]	[0.780, 1.161]
Decision was made				
Base: Alone				
Together	−0.039	1.776***	0.712***	2.140***
	(0.033)	[1.363, 2.318]	[0.511, 0.993]	[1.386, 3.356]
Not at all	−0.069	0.960	1.484	1.061
	(0.052)	[0.581, 1.583]	[0.836, 2.622]	[0.465, 2.273]

Table 3 continued

	Opt-out behavior (1) | LPM	Active choice (2) | OL	Grey mismatch (3) | OL	Green mismatch (4) | OL
R^2 | Pseudo R^2	0.139	0.102	0.103	0.105
AIC		3627.13	1773.26	1460.20
Observations	1,362	1,362	1,362	1,362

Note.— *p<0.1; **p<0.05; ***p<0.01

Refer to section 5.1 for a detailed explanation of the dependent variables. Column (1) presents an OLS-estimated linear probability model (LPM) and standard errors are shown in parentheses. Columns (2)-(4) are estimated with ordered Logistic regressions (OL). Coefficients in columns (2)-(4) are reported as odds ratios. Note that when reporting odds ratios standard errors are not helpful in determining statistical significance, therefore we report 95% confidence intervals for columns (2)-(4) in brackets. Constants of models are omitted for improved readability. Additional demographic controls include age, gender, nationality, parental status and city circle. Only fully completed questionnaires are considered for analysis.

5.2 Who opts out and who stays in the default?

At the time of our survey in 2017, four years after the first implementation of the green default, still over 75% of the households held the DEFAULT contract.[20] This suggests a large default effect that is comparable to previous studies on default effects in residential electricity markets. For instance, in a recent field experiment, Ebeling and Lotz (2015) find a share of 69.1% of green contracts purchased in an opt-out treatment.

The results reported in column (1) of Table 3, complemented by the correlational analysis reported in Table A3, provide interesting insights about why the green choice default in our setting works. In particular, the variables capturing reasons for the current contract choice, such as being well informed before the choice, perceiving the choice as complex, and procrastinating the choice, are predictive of opt-out behavior. Importantly, these variables turn out to be correlated with demographics (see Table A3 in the Appendix). Households with a low socio-demographic status (i.e., households who do not own property, have low formal education and low monthly income) are more likely to be less informed, to perceive the choice as more complex, to see the default as a recommendation and have a higher inclination to procrastinate the choice. Accordingly, such households are also more susceptible to stick to the default. These results are in line with previous studies (Beshears et al., 2016; Hortacsu et al., 2017) and with our ex-ante hypothesis that poor households are more strongly affected by green electricity defaults.

[20]The utility did not provide figures on the distribution of household customers' elecrity mix before the new default was introduced. Hence we are unable to estimate the exact size of the default effect at the introduction in 2013. However, we can assess the change in electricity mix before and after the introduction of the green default. Prior to the introduction of the green default in 2013, the utility offered only one contract for household customers with a pre-defined electricity mix that was substantially greyer than the current green default (i.e., approximately 1% were from new renewable sources, 17% thermal waste, 33% from hydro-power, 49% nuclear). The only choice households could make was to add some solar power to their mix, however, only very few households made use of this option. After the introduction of the green default, the shares in renewable electricity supplied to households almost doubled to 62%, thus indicating a strong effect of the default on renewable electricity demand.

In the following, we discuss the effects of the different explanatory variables for opt-out behavior in some more detail.

Demographics When controlling for all other covariates (as in the regression reported in column (1) of Table 3), the demographic variables are not significant predictors of opt-out behavior, as their explanatory power is taken up by the reasons for choice variables, to which they are correlated (see Table A3 in the Appendix).

Energy literacy Respondents who know the share of new renewables in the electricity market have a higher probability of opting out. Knowing the electricity mix is an indicator of interest in the electricity market in general, and it is not surprising that such households are more likely to make a conscious contract choice and are thus also more likely to opt out of the default.

Attitudes Political attitude is a significant predictor of opting out. The more respondents are on the right of the political spectrum, the higher the probability that they opt out of the default. Furthermore, more patient and more altruistic people are less likely to opt out.

Reasons for choice The more respondents inform themselves before choosing, the more they opt out of the default. Likewise, the more complex customers perceive the decision to be, the less likely they are to opt out. Perceiving the default as a recommendation provided by the utility, also decreases the propensity to opt out. Finally, the more people indicate to have procrastinated on the decision or to have forgotten to decide, the less likely they are to have opted out.[21]

Predictors selected by Lasso Regression When applying Lasso regression and specifying the opt out behavior in terms of the least absolute shrinkage and specification operator algorithm, we find that especially two reasons for choice play a decisive role for opt out decisions. Specifically, the Lasso retains that the more respondents inform themselves before choosing, the more they opt put of the default. Likewise, the model predicts that the tendency to procrastinate on the decision is an important factor for staying with the default.

[21]The marginally significant positive regression coefficient for "did not have enough information" is surprising, as it suggests that the more people indicate that they lack information on the available products, the more likely they are to opt out of the default. Note however, that the uncontrolled correlation of this variable with opt-out behavior has a negative sign (see Table A3 in the Appendix).

5.3 Preference mismatches

Preference mismatches in our setting occur because people who stick to the default (for various reasons) actually have preferences for another contract than the default when they make an active choice. Thus, in addition to the determinants of opt-out behavior, the determinants of the active choice preference for an electricity contract are important for understanding preference mismatches. Column (2) in Table 3 provides the corresponding regression analysis.[22] The results highlight the importance of higher socio-economic status (in terms of education, income, and other associated variables) as a relevant predictor for greener electricity contract choices (see, e.g., Sommer, 2018, for a similar result). As the determinants of active choice preferences are not by themselves a key focus of our paper, we refrain from discussing each result individually, and directly turn to the analysis of mismatches.

Table 4 shows the cross-tabulation of currently held contracts and the contracts actively preferred in the survey. There are pronounced deviations both towards greyer and cheaper contracts, as well as towards greener and more expensive contracts. Most importantly, households currently in DEFAULT have substantive preferences for other contracts (see the highlighted cells in Table 4). For instance, more than 40% of the respondents who currently hold the DEFAULT contract would actually prefer a cheaper contract (i.e., a grey mismatch), while on the other hand, more than a quarter would actually prefer a greener contract than DEFAULT (i.e., a green mismatch).[23] Figure 2 investigates this further by providing a graphical illustration of mismatches separately for three household income categories (with income increasing from the top to the bottom panel). The size of the arrows corresponds to the relative frequency of actively chosen contracts for DEFAULT customers in the respective income category. The figure allows for a first visual test of our hypothesis that households with a lower socio-demographic status are more negatively affected by the green default in the sense that they experience more mismatches. The results indicate that this is indeed the case, as the lowest income category experiences more mismatches, especially in the direction of the greyer contracts that are cheaper than the currently held default contract. As income increases, the frequency of such grey mismatches decreases, whereas the frequency of green mismatches increases.

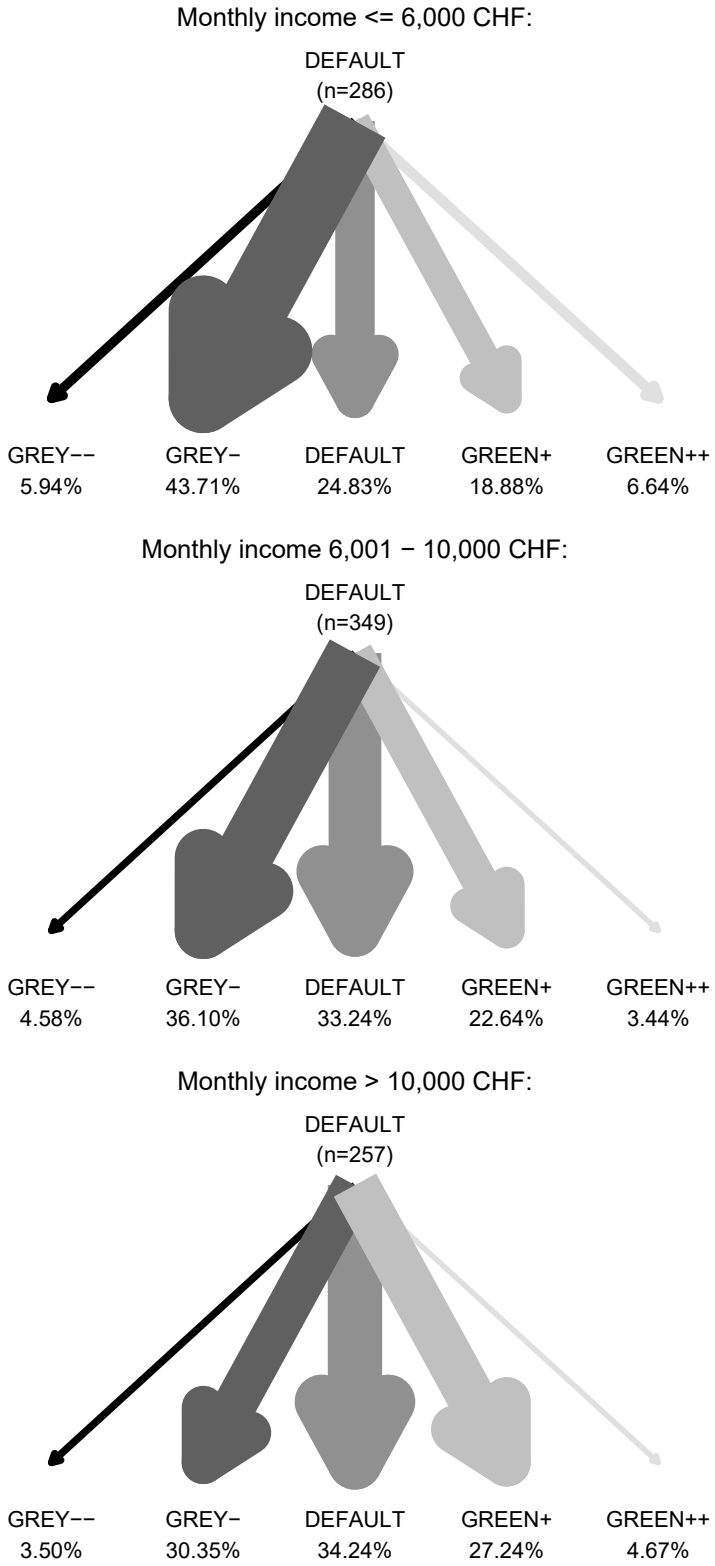
5.3.1 Who has a grey mismatch?

The regression analysis reported in column (3) of Table 3 shows that grey mismatches, i.e., holding the DEFAULT contract but actively preferring a cheaper and greyer contract, are

[22] Note that predictors on reasons for choice are not suitable for an analysis of the active choice, as the questionnaire specifically asked respondents to think back to their *current* electricity contract choice when answering the items about their reasons for choice.

[23] The distribution of mismatches does not statistically differ for respondents who did not fully complete the questionnaire.

Figure 2: Mismatches of current DEFAULT customers by income category



Note: The figure shows the distribution of actively chosen contracts for households who currently hold the DEFAULT contract by household income category. All households currently holding the DEFAULT contract ($n = 892$) were split into the three income categories indicated in the figure. The size of the arrows corresponds to the relative frequency of actively chosen contracts within the respective income category.

Table 4: Matches and mismatches between current and actively preferred contract

Current / Active	GREEN++	GREEN+	DEFAULT	GREY−	GREY−−	Current Total
GREEN++	16	1	2	0	0	19
GREEN+	18	78	20	9	1	126
DEFAULT	43	203	275	329	42	892
GREY−	1	9	34	107	9	160
GREY−−	2	7	18	55	83	165
Active Total	80	298	349	500	135	1,362

Note.— Table 4 shows the distribution of currently held and actively preferred electricity contracts in relation. Highlighted cells show mismatches from currently holding the default contract but actually preferring GREY−−, GREY−, GREEN+, or GREEN++. Total observations include 1,362 fully-completed questionnaires.

more common for people with lower formal education and no property ownership, and that they are more likely for people with right-wing political attitudes and low environmental preferences. Moreover, the variables capturing reasons for the current contract choice are important predictors of a grey mismatch.

Considering the correlation matrix reported in Table A3 in the Appendix provides further insights and allows for a better understanding of how grey mismatches come about. First, formal education, income and property ownership are all highly negatively correlated with having a grey mismatch, and they are also highly positively correlated with each other. Thus, respondents with a lower socio-economic status (lower education, lower income, no property ownership) are prone to suffer grey mismatches because of the current default regime. Second, as already pointed out when analyzing the drivers of default behavior, the households with lower socio-economic status tend to be worse-informed, perceive the electricity contract choice as more complex, are more often unaware that they could actually make a choice, procrastinate the choice more often, and are more likely to perceive the default contract as a recommendation. In turn, these variables are all significantly associated with grey mismatches (and with staying in the default contract). Thus, these variables can at least partly explain why poorer respondents who actively prefer contracts that are greyer and cheaper than the default contract, fail to act according to their preferences and end up with the default contract that is greener and more expensive than what they would like. In the following, we discuss the results for grey mismatches in some more detail.

Demographics The regression results (column (3) of Table 3) show that two variables associated with lower socio-economic status, lower formal education and no poperty ownership, increase the probability of having a grey mismatch.

Energy literacy Respondents who know the share of new renewable electricity have a reduced probability of having a grey mismatch.

Attitudes A more right-leaning political opinion and a lower pro-environmental attitude are associated with a higher likelihood of a grey mismatch.

Reasons for choice As discussed above, several of the variables capturing reasons for the current contract choice are particularly important for explaining grey mismatches. Specifically, being better informed about the choice is associated with a lower likelihood of a grey mismatch, whereas deeming the choice as unimportant and perceiving the default as a recommendation are associated with a higher likelihood. Also, if several people in a household decided together about the current electricity contract, there is a lower probability of having a grey mismatch.

Predictors selected by Lasso Regression The Lasso regression selects political and environmental attitudes as relevant predictor variables of a grey mismatch (with a more right-leaning political opinion and a lower pro-environmental attitude being associated with a higher likelihood of a grey mismatch). Furthermore, deeming the choice as unimportant and indicating to not have made a choice at all are variables retained by the Lasso that are positively associated with the likelihood of a grey mismatch, whereas being better informed about the choice is retained and is negatively associated with grey mismatches.

5.3.2 Who has a green mismatch?

Green mismatches, i.e., holding the DEFAULT contract but actively preferring a greener and more expensive contract, are more likely for high-income households with strong pro-environmental preferences and political opinions to the left. Like for grey mismatches we find that better informing oneself decreases the likelihood of a green mismatch. Perceiving the choice as complex, forgetting to make a choice, or being unaware of having a choice, in contrast, increases the likelihood of a green mismatch. Thus, there seems to be a significant share of the population with distinct environmental preferences and sufficient disposable income who may need more information or encouragement to make an active contract choice in order to attain a higher demand for greener electricity contracts and to lower the extent of green mismatches. An intermediate green electricity default as implemented in our setting actually impedes greener choices on behalf of these households. In the following, we discuss the results for green mismatches in some more detail.

Demographics The higher the household income the more likely is a green mismatch. Additionally, having children reduces the probability of a green mismatch, whereas being in a single-person household increases it.

Energy literacy We find no significant impact of energy literacy on green mismatches.

Attitudes Respondents with more left-leaning political attitudes have a higher probability of a green mismatch, as do respondents who attach a higher importance to the environment. Additionally, the more people rate themselves as trusting, the less likely, and the more they rate themselves as patient, the more likely they are to experience a green mismatch.

Reasons for choice The better informed households are, the lower the probability of a green mismatch. In contrast, perceiving the decision as complex, not knowing that there is the possibility to choose or having forgotten to decide adds to the probability of having a green mismatch, as does making the decision together with a partner. Conversely, the more respondents deem the electricity contract choice an unimportant decision, the lower the probability of such a mismatch. This last finding seems counterintuitive, as it suggests that people who attach a higher importance to the contract choice, have an increased probability of a green mismatch. However, this may also just be a sign of an intention-action gap. Even though a respondent may deem the decision important (e.g., because of its environmental implications), he or she may still fail to actually opt-out of the default and choose a greener contract. Taken together, a key message from these findings seems to be that better information and making people aware of the potential importance of the decision could significantly reduce green mismatches.

Predictors selected by Lasso Regression When applying a Lasso regression, we find that only one predictor is retained: political attitude. Respondents with more left-leaning political attitudes have a higher probability of a green mismatch.

5.4 Simple Cost-Benefit Assessment of the Green Electricity Default

Our analyses have shown that the green electricity default in our setting has utility-decreasing effects in two directions. First, households with low socio-economic status tend to stick to the default and fail to choose the less expensive electricity contracts they prefer. Second, households with a higher socio-economic status who are pro-environmentally minded, but not very well informed about the contract choice do not choose the greener contracts which they prefer. In the following, we conduct a simple back-of-the-envelope calculation that attempts to very roughly quantify the costs and benefits of these two types of mismatches for individuals and for society by putting the monetary cost of the default's choice effects for consumers in relation to the greenhouse gas emissions avoided by the default.

5.4.1 Costs and benefits at the individual level

Our simple cost-benefit calculation rests on the assumption that in a situation without a choice default, consumers make choices consistent with their preferences. We therefore assume that comparing active choices with the contracts currently held under the default regime provides an appropriate basis for assessing welfare effects of a choice default. Similar approaches have been used previously to derive 'sufficient statistics' for the welfare evaluations of nudges (see, e.g., Chetty, 2009; Allcott and Kessler, 2015).[24] The method relies on two central premises of a choice-oriented welfare framework described by Bernheim (2016, p. 33): "Premise A: (...) each of us is the best arbiter of our own well-being; Premise B: (...) we seek to benefit ourselves by selecting the alternative that (...) is most conducive to our well-being."

Contracts that are greyer than the default are cheaper in our example and contracts that are greener than the default are more expensive than the default. Based on the respective price differences and the annual electricity consumption data for each household in our final sample—data we received from our partnering utility—we can calculate the annual monetary gains or losses for individual households resulting from a mismatch. We extrapolate our estimation of costs and benefits to the total population of the utility's residential consumers to get an approximate idea of the aggregate effect.

Column (1) in Table 5 refers to the different types of mismatches that can occur. The two top rows indicate mismatches for individuals with greener preferences than the default, the two bottom rows indicate mismatches for individuals with greyer preferences than the default.

Column (2) in Table 5 shows the total individual level effects, i.e., the monetary benefits and costs for households who currently hold the DEFAULT contract, but whose active choice indicates that they would prefer a greener or a greyer contract. Individuals who actively prefer a greener contract than the default (i.e., GREEN++ or GREEN+) but stay with DEFAULT save money. The per unit prices of electricity for the default are cheaper than for greener contracts, thus by not opting-out of the DEFAULT and choosing a greener contract, households pay less for their electricity consumption (see rows 1 and 2 in Table 5). The economic interpretation is that an intermediate green electricity default prohibits skimming positive willingness-to-pay for green electricity, thus yielding negative utility for these individuals (as they would prefer paying more for a greener contract and receiving greener electricity in return). In fact, in the total population of households we sampled from, the default leaves at least USD 1.4m of additional willingness-to-pay for green electricity untapped.[25]

[24] Chetty (2009) describes 'sufficient statistics' as a methodological approach in-between the estimation of structural models for the analysis of welfare effects of policies and a simple program evaluation based on treatment effects. This approach aims at identifying a credible baseline for welfare evaluations, i.e., in our case the active choice, which allows to make predictions on the welfare effects of the policy.

[25] To calculate the individual disutility of a green/grey mismatch, we simply multiply the per unit

Table 5: Cost-benefit evaluation of the green electricity default (extrapolated to total population of utility's residential consumers)

Mismatch to default contract (1)	Total individual level effects [USD] monetary benefits (+) | costs (−) (2)	Total GHG-emissions [t/CO_{2eq}] caused (+) | avoided (−) (3)
GREEN++	502,442.00	3.26
GREEN+	942,876.00	6.40
GREY−	−336,665.00	−155.08
GREY−−	−60,882.00	−3,891.88

Note.— Table 5 shows a simple cost-benefit evaluation of the green electricity default used in this study. Estimates are linearly extrapolated to the total population of the study, i.e., approximately 50,000 households. We use the 2016 annual electricity consumption data for each household from our partnering utility to calculate individual level benefits and costs. Direct GHG-emissions are calculated with official statistics on the greenhouse gas potential of different production sources in the Swiss market (Messmer and Frischknecht, 2016). At the time of the study CHF 1 ≈ USD 1, therefore we directly report USD.

Households who actively prefer a greyer contract than the default (i.e., GREY−− or GREY−) but stay with the DEFAULT spend more money on electricity than what they would want to (see rows 3 and 4 in Table 5), as the per unit prices of electricity for the DEFAULT are more expensive than for greyer contracts. In total, households annually loose roughly USD 400,000 from not optimizing away from the default to cheaper contracts. This implies a negative effect with respect to consumers' utility.[26]

Note that this quantification of the total individual level welfare losses does not take into account potentially countervailing individual benefits of not needing to decide for a contract, i.e., avoiding the decision costs of choosing. If individuals act fully rationally, the costs incurred by not optimizing their choices and sticking to the default should completely reflect the benefits of not having to choose (see, e.g., Chesterley, 2017). Given that we do not measure the individual cognitive costs of making a decision and switching the electricity contract (a measurement problem that is not straightforward to solve), we must remain conservative in our interpretation of the welfare effects of the default at the individual level.

price difference between DEFAULT and a greener/greyer contract with the annual consumption figures of each household having a green/grey mismatch. The estimated monetary cost of the disutility due to mismatches thus represents an upper bound, as consumers might put some value on green energy but (in the active choice) might not be willing to pay as much as the price difference requires to switch to the next greener contract. Note that for this reason we also use upper-bound estimates for the CO_{2eq} emissions avoided thanks to the mismatches (see footnote 27).

[26]Note that the analysis of the individual level effects of mismatches does not differ with the level of electricity consumption. The shares of mismatches below and above median electricity consumption are equally dispersed.

5.4.2 Costs and benefits at the societal level

At the societal level, costs and benefits of mismatches are based on the mismatch-related differences in greenhouse gas emissions.[27] Using the annual electricity consumption data for each household in our sample, we can quantify the level of greenhouse gas emissions caused or avoided when consumers stay with the choice default instead of switching to their preferred greener or greyer contracts.

Column (3) in Table 5 shows the greenhouse gas emissions caused or avoided by mismatches, i.e., consumers currently holding DEFAULT but preferring a greener or greyer contract. Consumers who prefer a greener contract than the default (i.e., GREEN++ or GREEN+) but stay with DEFAULT cause slightly more greenhouse gas emissions compared to their active choice preference. The carbon intensity of the default is, however, only marginally higher than those of the two greener contracts, i.e., the default electricity contract in this setting is already quite environmentally-friendly in terms of greenhouse gas emissions. Thus, at the societal level only roughly 10 additional tons of CO_{2eq} are caused by people with green mismatches (see rows 1 and 2 in Table 5).[28] Consumers who prefer a greyer contract than the default (i.e., GREY−− or GREY−) but stay with DEFAULT avoid a substantial amount of greenhouse gas emissions. The default contract is much less carbon intensive than the two greyer contracts. In total, approximately 4,000 tons of CO_{2eq} per year are not emitted by people not holding a contract according to their preferences (see rows 3 and 4 in Table 5). This compares to taking around 4,000 cars off the streets in the sampled area, a city of roughly 100,000 inhabitants, per year.

5.4.3 Cost-effectiveness of the default for curbing emissions

Based on the costs and benefits of the green electricity default, we can evaluate the overall cost effectiveness of the green default for avoiding CO_{2eq} emissions (columns (2) and (3) in Table 5). With the default in place, roughly 4,000 tons of emissions (the sum of estimates in column (3)) are avoided annually. If we refer to the pure monetary costs to individuals (i.e., the cost to those individuals who prefer a cheaper contract but stay with the default), households pay in total roughly USD 400,000 for the avoidance of these 4,000 tons of emissions, i.e., USD 100 per ton of CO_{2eq}. If we also include the negative

[27] We use official statistics on the greenhouse gas potential of different electricity production sources in the Swiss market in order to quantify the per unit emissions of the electricity contracts in our setting (Messmer and Frischknecht, 2016). Each contract has a different emission potential based on its composition of electricity sources used for production. For GREY−− we could not obtain the exact composition of electricity sources as there is only a legal obligation to label renewable sources of an electricity mix. Therefore, we used conservative estimates of direct GHG-emissions attaching equal weights to electricity produced from lignite and hard coal, although the share of nuclear power in the Swiss electricity mix is much higher. Thus, the quantified emissions of GREY−− should be seen as an estimate at the higher end. In general, it should be noted that the Swiss electricity mix is already quite environmentally-friendly.

[28] To calculate the societal level effects, we simply multiply the difference in CO_{2eq}-emissions between DEFAULT and a desired greener/greyer contract by the annual consumption of each household having a green/grey mismatch.

effects of the default on the utility of those individuals who prefer a greener contract than the default, which we approximate in monetary terms by the untapped willingness to pay for greener contracts, emission avoidance is more costly, i.e., USD 460 per ton of CO_{2eq}. Comparing these estimates with recent estimates of the social cost of carbon in the range of USD 30 to USD 200 to USD 417 (e.g., Howard and Sterner, 2017; Nordhaus, 2017; Ricke et al., 2018), emission avoidance via the green default seems to be rather at the higher end in our setting.[29]

6 Conclusions

Our empirical results provide a number of important insights for policy makers who consider using choice defaults as a means of achieving their policy goals. Most importantly, our findings show that using defaults to trigger more environmentally-friendly choices can effectively act as a hidden tax on the poor. Poorer households are more prone to stick to the default option, and they are also more likely to prefer cheaper and greyer products. In consequence, a green default may make them end up with greener products than they prefer, which means paying more than they want. Our study in the residential electricity market documents that such undesired effects occur. In fact, if anything our survey-based approach could understate this problem as the households who decided to respond to our survey probably tended to be more interested in the topic of electricity contracts. This makes them more likely to have made a conscious decision for their current electricity contract and thus less likely to suffer a mismatch than those who did not respond.

Having a default in the choice set is often unavoidable and may indeed be welfare-enhancing in many contexts. Especially for consumers who face high decision costs when making an active choice, relying on a default option can be beneficial (see, e.g., Chesterley, 2017; Sallee, 2014). Our results illustrate, however, that using choice defaults as an instrument for green policy making, for instance by setting the default on a particularly green and expensive option, is likely to entail negative distributional consequences. Thus, it is important that policy makers in energy markets, and other choice architects who decide about the concrete design of a choice default, are aware of these effects and keep them under close scrutiny.

[29] Social cost of carbon (SCC) refers to the societal costs of emitting an additional ton of CO_{2eq}. Note that the literature on different estimates of SCC is diverse. There are different methodologies on how to assess the societal damage from climate change, which are controversially discussed. Nordhaus (2017) recently provided a SCC of as low as USD 31.20 per ton of CO_{2eq}. Howard and Sterner (2017) use different damage functions, which produce estimates three to four times above this value. Ricke et al. (2018) suggest that the social cost of carbon differs at the country level, specifying a range of USD 177 to USD 805 for different countries. Stoerk et al. (2018) provide further reasons, such as inadequate damage functions in models especially at high levels of warming, for why there may exist even larger inconsistencies when assessing economic values of the cost of carbon. On a side note, Switzerland currently (in 2019) imposes a CO_2 levy on fossil fuels of USD 96 per ton of emissions.

Our back-of-the-envelope cost-benefit analysis illustrates the challenges of using choice defaults as a policy tool for fostering green choices. The green default in our study is successful in reducing harmful greenhouse gas emissions from electricity consumption. However, the cost for this emission abatement seems to be at the higher end regarding recent estimates of the social cost of carbon. Therefore, the default seems to be only a second-best instrument for curbing emissions. Taxing the marginal social damage of electricity consumption is likely to be more efficient. Taxes, however, are often politically more difficult to implement—in part because their costs and distributional consequences are quite salient—than behavioral interventions such as green choice defaults—for which distributional consequences are ex-ante much more unclear. Hence, a silver bullet for achieving social equity and environmental targets may not exist.

Future research should address the implications of different designs of a choice default. In our study we observe the effects of one particular default and it is likely that the extent of mismatches and the individual and societal costs and benefits change with the exact design of the default (e.g., the position of the default within the choice set). Chesterley (2017) calls this the 'composition effect' of a choice default: Losses for consumers who are not opting out of the default and emissions avoided or caused by staying in the default may vary considerably according to which option is set as the standard. Systematically investigating these composition effects in the field is difficult. Yet, more tightly controlled experimental research in the laboratory would be valuable and add sensitivity to the results of our elicitation study. Such sensitivity analyses could generate important insights for choice architects in residential electricity markets and beyond.

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Online Appendix

A Inconsistent Choices

In order to check whether the individually stated preferences for an electricity contract are subject to random-answer bias, we can assess whether customers who have opted out of and hold a current contract other than the default also make active choices in our questionnaire that are consistent with their current contract. If random choice posed a problem, we would observe consistent choices only for 20% of these cases (there a five contracts on offer in the active choice.) Table A1 shows that random choice does not seem to pose a problem for our study. On average, 60% of the respondents who currently hold an electricity contract other than DEFAULT make consistent choices in the active choice elicitation part of our survey. The level of consistent choices differs somewhat between the contracts. It seems that customers who currently hold a greyer contract more often deviate in their hypothetical active choice towards greener contracts, which may be a sign of a social-desirability bias.

Table A1: Consistent and inconsistent choices between current and actively preferred contract

CurrentActive	GREEN++	GREEN+	DEFAULT	GREY−	GREY−−	Share of consistent choices
GREEN++	16	1	2	0	0	84%
GREEN+	18	78	20	9	1	62%
GREY−	1	9	34	107	9	67%
GREY−−	2	7	18	55	83	50%

Note.— Table A1 shows the consistent and inconsistent choices between current and actively preferred contract for consumers who have opted out of the default. Highlighted cells indicate consistent choices. The last column to the right provides the percentage share of consistent choices for each contract.

B Additional Models

In addition to the main analyses reported in the text, further regression models are presented in this Appendix.

We complement our analyses in Section 5.3 by reporting two additional models for the determinants of mismatches for consumers with greener or greyer preferences than the default. These models additionally capture the mismatches of respondents who currently have a contract different than DEFAULT, but who also prefer a different contract (than the currently held) in the active choice. We use these 'noisy' observations to evaluate the robustness of our results on the determinants of mismatches by running the analyses also on dependent variables that capture a mismatch in general and not only for DEFAULT contracts. In Table A2 we report in column (1) an ordered Logistic model that assesses the determinants for grey mismatches of consumers with greyer preferences than their currently held contract. In column (2) we report an ordered Logistic model that assesses

the determinants for green mismatches of consumers with greener preferences than their currently held contract.

Table A2: Ordered Logistic Models | Mismatches, with inconsistent choices

	Grey mismatch (1) | OL	Green mismatch (2) | OL
Demographics		
Language: Native	0.717	1.300
	[0.453, 1.147]	[0.719, 2.474]
Single	0.801	1.795**
	[0.540, 1.186]	[1.101, 2.947]
Household with children	1.234	0.436***
	[0.876, 1.734]	[0.278, 0.672]
Property owner	0.675**	1.088
	[0.480, 0.945]	[0.735, 1.611]
Occupation		
Base: Full-time		
Part-time	0.914	1.084
	[0.634, 1.311]	[0.720, 1.627]
Self-employed	0.829	1.143
	[0.467, 1.434]	[0.615, 2.067]
In training/ in school	2.059*	1.215
	[0.953, 4.367]	[0.469, 2.932]
Seeking work	0.974	0.364
	[0.266, 3.038]	[0.018, 2.281]
House wife/ house husband	1.514	1.633
	[0.675, 3.305]	[0.575, 4.191]
Retired	0.799	0.862
	[0.466, 1.368]	[0.459, 1.619]
Education		
Base: Compulsory schooling		
Vocational training	0.580	1.270
	[0.256, 1.347]	[0.384, 5.833]
A-Levels	0.320**	1.516
	[0.127, 0.816]	[0.424, 7.281]
Higher education not university	0.350**	1.928
	[0.146, 0.856]	[0.564, 9.039]
University	0.471*	1.472
	[0.201, 1.130]	[0.436, 6.828]
Income per month		
Base: below CHF4,000		
CHF4,001-6,000	1.531*	1.202
	[0.943, 2.508]	[0.677, 2.164]
CHF6,001-8,000	1.014	1.138
	[0.615, 1.686]	[0.633, 2.078]
CHF8,001-10,000	1.087	1.466
	[0.620, 1.917]	[0.765, 2.840]
CHF10,001-12,000	1.016	1.590
	[0.539, 1.919]	[0.773, 3.295]
CHF12,001-14,000	0.775	2.459**
	[0.370, 1.597]	[1.143, 5.310]
CHF14,001-16,000	0.938	2.701**
	[0.414, 2.067]	[1.128, 6.404]
above CHF16,000	1.659	1.932
	[0.760, 3.588]	[0.756, 4.807]
Additional demographic controls	Yes	Yes
Energy literacy		
Knowledge on annual consumption	1.034	0.879
	[0.785, 1.357]	[0.633, 1.213]
Knowledge on new renewable mix	0.768*	0.862
	[0.587, 1.004]	[0.632, 1.174]
Knowledge on hydro mix	1.023	0.922
	[0.757, 1.374]	[0.653, 1.290]
Explains concept of green electricity easily	0.935	1.025
	[0.768, 1.140]	[0.803, 1.311]

Table A2 continued

	Grey mismatch (1) | OL	Green mismatch (2) | OL
Attitudes		
Political attitude	1.133***	0.815***
	[1.065, 1.206]	[0.753, 0.881]
Personal attitudes		
Nature and the environment matter	0.902**	1.251***
	[0.829, 0.982]	[1.113, 1.412]
Happy to make decisions	1.011	0.994
	[0.954, 1.073]	[0.927, 1.068]
Patience	1.000	1.074**
	[0.952, 1.051]	[1.013, 1.140]
Trust	1.016	0.939**
	[0.966, 1.068]	[0.885, 0.997]
Altruism	1.009	0.955
	[0.956, 1.066]	[0.894, 1.022]
Reasons for choice		
Information before choice	0.744***	0.749***
	[0.626, 0.884]	[0.607, 0.925]
Choice was complex	1.000	1.272**
	[0.855, 1.170]	[1.052, 1.539]
Unaware of choice	0.917	1.175*
	[0.790, 1.061]	[0.989, 1.392]
Choice was unimportant	1.225**	0.770**
	[1.048, 1.430]	[0.613, 0.956]
Forgot to make choice	1.017	1.216*
	[0.851, 1.213]	[0.974, 1.512]
Default perceived as recommendation	1.165**	0.974
	[1.022, 1.329]	[0.838, 1.133]
Kept effort for decision as low as possible	0.961	0.918
	[0.832, 1.110]	[0.776, 1.086]
Never got around to make a decision	0.963	0.944
	[0.804, 1.151]	[0.758, 1.173]
Did not have enough information	1.043	0.954
	[0.885, 1.228]	[0.780, 1.161]
Decision was made		
Base: Alone		
Together	0.747*	2.140***
	[0.540, 1.036]	[1.386, 3.356]
Not at all	1.435	1.061
	[0.813, 2.519]	[0.465, 2.273]
Pseudo R^2	0.099	0.105
AIC	1853.66	1463.52
Observations	1,362	1,362

Note.— p<0.1; p<0.05; p<0.01

Ordered Logistic Models; the dependent variable for column (1) captures whether consumers with greyer preferences have a mismatch with their currently held contract (i.e., including all respondents with mismatches to a greyer contract, not only those in DEFAULT). The dependent variable for column (2) captures whether consumers with greener preferences have a mismatch with their currently held contract (i.e., including all respondents with mismatches to a greener contract, not only those in DEFAULT). These analyses complement and test for the robustness of the results presented in the columns (3) and (4) in Table 3. Coefficients in columns (1) and (2) are reported as odds ratios. We report 95% confidence intervals in brackets. Constants of models are omitted for improved readability. Additional demographic controls include age, gender, nationality, parental status and city circle. Only fully completed questionnaires are considered.

In Table A3 we report the full correlation analysis of our main dependent variables and covariates to support our findings in Section 5.3.

Table A3: Main dependent variables and covariates: full correlation matrix, n=1,362

	1	2	3	4	5	6	7
1 Opt-out behavior							
2 Active choice	−0.13***						
3 Grey mismatch	−0.44***	−0.54***					
4 Green mismatch	−0.34***	0.60***	−0.29***				
5 Language: Native	−0.04	−0.07*	0.06*	−0.04			
6 Single	−0.01	−0.04	0.02	0.01	−0.06*		
7 Household with children	0.02	0.03	0.03	−0.08**	0.05	−0.24***	
8 Property owner	0.10***	−0.03	−0.13***	−0.02	−0.10***	−0.24***	0.12***
9 Education	0.04	0.17***	−0.13***	0.05	−0.02	−0.13***	0.10***
10 Income per month	0.05*	0.09***	−0.10***	0.03	−0.10***	−0.43***	0.15***
11 Energy literacy	0.06*	0.06*	−0.08**	0.00	−0.04	−0.06*	0.03
12 Explains concept of green electricity easily	0.17***	0.07*	−0.14***	0.01	−0.06*	−0.13***	0.03
13 Political attitude	0.07*	−0.39***	0.14***	−0.19***	−0.01	−0.05	−0.05*
14 Nature and the environment matter	0.05	0.27***	−0.12***	0.13***	0.00	−0.01	−0.02
15 Happy to make decisions	0.11***	−0.08*	−0.02	−0.02	−0.08**	0.00	−0.06*
16 Patience	−0.04	0.01	0.03	0.04	0.06*	0.02	0.04
17 Trust	−0.05	0.04	0.01	0.00	0.03	−0.04	0.01
18 Altruism	−0.04	0.20***	−0.08**	0.08**	−0.10***	0.00	0.02
19 Information before choice	0.29***	0.06*	−0.22***	−0.05	−0.04	−0.07*	−0.02
20 Choice was complex	−0.11***	−0.02	0.08**	0.03	0.06*	0.05*	−0.01
21 Unaware of choice	−0.15***	−0.02	0.11***	0.05	0.14***	0.08***	−0.06*
22 Choice was unimportant	−0.11***	−0.22***	0.19***	−0.10***	0.06*	0.02	0.00
23 Forgot to make choice	−0.18***	−0.04	0.14***	0.03	0.13***	0.04	0.00
24 Default perceived as recommendation	−0.12***	−0.05	0.11***	0.00	0.06*	0.04	−0.04
25 Kept effort for decision as low as possible	−0.08**	−0.13***	0.10***	−0.04	0.00	0.04	0.01
26 Never got around to make a decision	−0.24***	−0.04	0.17***	0.03	0.15***	0.04	0.00
27 Did not have enough information	−0.12***	−0.03	0.10***	0.00	0.13***	0.02	0.01
28 Decision was made together	−0.01	0.17***	−0.11***	0.10***	−0.02	−0.57***	0.14***
M	0.35	2.77	0.18	0.27	0.09	0.28	0.25
SD	0.48	1.08	0.38	0.45	0.29	0.45	0.43
Range	0-1	1-5	0-1	0-1	0-1	0-1	0-1

Note.— *p<0.1; **p<0.05; ***p<0.01

Spearman rank correlation; 1 Opt-out behavior: 0=stay, 1=opt out, 2 Active choice: 1=GREY−−, 2=GREY−, 3=DEFAULT, 4=GREEN+, 5=GREEN++, 3 Grey mismatch: 0=no mismatch, 1=mismatch, 4 Green mismatch: 0=no mismatch, 1=mismatch, 5 Language: Native: 0=native, 1=non-native, 6 Single: 0=no, 1=yes, 7 Household with children: 0=no, 1=yes.

Table A3 continued

	8	9	10	11	12	13	14
8 Property owner							
9 Education	0.09**						
10 Income per month	0.28***	0.41***					
11 Energy literacy	0.04	0.10***	0.09**				
12 Explains concept of green electricity easily	0.16***	0.29***	0.22***	0.14***			
13 Political attitude	0.08**	−0.17***	0.07*	−0.05	−0.04		
14 Nature and the environment matter	0.06*	0.06*	−0.03	0.10***	0.19***	−0.26***	
15 Happy to make decisions	0.13***	−0.01	0.08**	0.02	0.17***	0.09**	0.12***
16 Patience	−0.03	0.01	0.01	0.01	0.00	0.05	0.09**
17 Trust	0.02	0.04	0.03	−0.02	−0.06*	−0.06*	0.09**
18 Altruism	−0.03	0.23***	0.10***	0.08**	0.17***	−0.32***	0.26***
19 Information before choice	0.24***	0.09***	0.14***	0.07***	0.38***	0.01	0.22***
20 Choice was complex	−0.02	−0.19***	−0.15***	−0.10***	−0.28***	0.07**	−0.04
21 Unaware of choice	−0.16***	−0.16***	−0.19***	−0.09***	−0.20***	0.04	−0.08**
22 Choice was unimportant	−0.07*	−0.06*	−0.03	−0.06*	−0.18***	0.18***	−0.26***
23 Forgot to make choice	−0.15***	−0.06*	−0.18***	−0.05	−0.15***	0.02	−0.09**
24 Default perceived as recommendation	−0.08**	−0.08**	−0.10***	−0.03	−0.13***	0.04	0.03
25 Kept effort for decision as low as possible	−0.05*	−0.02	−0.01	−0.03	−0.15***	0.08**	−0.21***
26 Never got around to make a decision	−0.20***	−0.07**	−0.12***	−0.09**	−0.25***	−0.01	−0.13***
27 Did not have enough information	−0.12***	−0.08**	−0.11***	−0.07**	−0.23***	0.03	−0.13***
28 Decision was made together	0.14***	0.16***	0.31***	0.04	0.13***	−0.06*	0.07*
M	0.36	3.70	3.68	0.33	2.91	4.38	8.15
SD	0.48	1.32	1.88	0.27	0.75	2.34	1.63
Range	0-1	1-5	1-8	0-1	1-4	0-10	0-10

Note.— *p<0.1; **p<0.05; ***p<0.01

Spearman rank correlation; 8 Property owner: 0=no, 1=yes, 9 Education: continuously increasing in formal value, 10 Income per month: continuously increasing in monthly household income, 11 Energy literacy: score that combines correct answers to the three energy literacy questions, continuously increasing, 12 Explains concept of green electricity easily: 4-point Likert scale, increasing from poor to very good, 13 Political attitude: 11-point scale, increasing right wing attitude, 14 Nature and the environment matter: 11-point scale, importance continuously increasing. Occupation is not displayed in this table, as selectable items do not follow a meaningful ordinal scale.

Table A3 continued

	15	16	17	18	19	20	21
15 Happy to make decisions							
16 Patience	0.14***						
17 Trust	0.03	0.14***					
18 Altruism	−0.01	−0.01	−0.08**				
19 Information before choice	0.18***	0.00	−0.04	0.07**			
20 Choice was complex	−0.10***	0.01	0.10***	−0.14***	−0.07***		
21 Unaware of choice	−0.08**	0.01	0.06*	−0.17***	−0.40***	0.09**	
22 Choice was unimportant	−0.06*	0.00	0.07**	−0.21***	−0.34***	0.14***	0.24***
23 Forgot to make choice	−0.09***	−0.01	0.11***	−0.14***	−0.39***	0.15***	0.40***
24 Default perceived as recommendation	−0.05	0.07*	0.09**	−0.06*	−0.17***	0.17***	0.14***
25 Kept effort for decision as low as possible	−0.05*	0.04	0.06*	−0.08**	−0.28***	0.14***	0.04
26 Never got around to make a decision	−0.16***	−0.01	0.08**	−0.12***	−0.54***	0.15***	0.47***
27 Did not have enough information	−0.15***	0.00	0.06*	−0.14***	−0.39***	0.19***	0.35***
28 Decision was made together	−0.04	0.00	0.06*	0.07**	0.11***	−0.06*	−0.05
M	7.19	6.47	5.10	7.44	2.66	2.10	1.52
SD	2.22	2.70	2.62	2.63	0.99	0.89	0.99
Range	0-10	0-10	0-10	0-10	1-4	1-4	1-4

Note.— *p<0.1; **p<0.05; ***p<0.01

Spearman rank correlation; 15 Happy to make decisions: 11-point scale, ease continuously increasing, 16 Patience: 11-point scale, patience continuously increasing, 17 Trust: 11-point scale, trust continuously increasing, 18 Altruism, 11-point scale, trust continuously increasing (reverse-coded), 19 Information before choice: 4-point Likert scale, information level increasing, 20 Choice was complex: 4-point Likert scale, complexity level increasing, 21 Unaware of choice: 4-point Likert scale, unawareness level increasing.

Table A3 continued

	22	23	24	25	26	27	28
22 Choice was unimportant							
23 Forgot to make choice	0.35***						
24 Default perceived as recommendation	0.13***	0.19***					
25 Kept effort for decision as low as possible	0.32***	0.19***	0.22***				
26 Never got around to make a decision	0.32***	0.56***	0.25***	0.22***			
27 Did not have enough information	0.25***	0.35***	0.14***	0.13***	0.52***		
28 Decision was made together	−0.06*	−0.07**	−0.03	−0.06*	−0.04	−0.03	
M	1.65	1.36	2.52	2.74	1.61	1.65	0.53
SD	0.88	0.82	1.04	0.98	0.99	0.91	0.50
Range	1-4	1-4	1-4	1-4	1-4	1-4	0-1

Note.— *p<0.1; **p<0.05; ***p<0.01

Spearman rank correlation; 22 Choice was unimportant: 4-point Likert scale, unimportance level increasing, 23 Forgot to make choice: 4-point Likert scale, forgetfulness level increasing, 24 Default perceived as recommendation: 4-point Likert scale, level of recommendation perception increasing, 25 Kept effort for decision as low as possible: 4-point Likert scale, level of agreement increasing, 26 Never got around to make a decision: 4-point Likert scale, level of agreement increasing, 27 Did not have enough information: 4-point Likert scale, level of agreement increasing, 28 Decision was made together: 0=alone or not at all, 1=together.

C Cover letter and questionnaire

The following pages include a copy of the cover letter and questionnaire that were sent out to the households. Note that the original versions were in German language and have been translated by the authors. The originals can be obtained from the authors on request.

Utility XY
1111 City XY

Telephone +41 (0) 123456
customer.service@utilityxy.ch
www.utilityxy.ch

Address

Date

Study on electricity contract choice

Dear Madam, dear Sir

The Federal Institute of Technology Zurich studies the electricity contract choice of households. Utility XY supports this project and asks for your assistance by providing answers to the attached questionnaire. It will take less than 10 minutes to complete it. You have two possibilities to participate:

- Fill in the printed questionnaire enclosed with this letter and send it back via ordinary mail (free reply coupon is enclosed)

- Fill in the questionnaire online:
  http://www.econ.ethz.ch/study.html
  Your participation number: 1000123

Among all fully completed questionnaires, we will **draw three winners**, which will receive three star prizes of a total worth of **1000 Swiss Francs**. Winners will be drawn randomly and contacted in written form.

Within the context of the study, Utility XY will forward data about your current electricity product and consumption to the Federal Institute of Technology Zurich. These data are handled and treated confidentially and anonymously.

Do you have questions concerning the study? Please write or call us.
study@econ.gess.ethz.ch or 000 123 456, Mo–Fr, 10–12 a.m.

Thank you for your participation in this study.

Best regards

Utility XY and Federal Institute of Technology Zurich

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Data privacy is important to us!

Members of the ethical committee of the ETH Zurich may review your originally provided data under strict confidentiality; however, use for commercial reasons is prohibited. The ethical committee of the ETH Zurich has approved this study (EK 2017-N-01).

☑ **Yes, I agree with the terms and conditions of this study and I allow sharing my electricity contract and consumption data with the researchers.**

QUESTIONNAIRE

In the following you see five different electricity products, which differentiate themselves between their relative prices and their sources of production.

If you need to decide right now for one of these five electricity products, which one would you choose?

Please note:

Earlier studies have shown that many people choose differently in choice situations, which have no direct implications for themselves as opposed to choice situations that have immediate consequences.

For instance, if people are requested in a survey to imagine that they receive 1000 Swiss Francs and are then asked how much of this money they would be willing to give to another person, people often respond that they are willing to give 500 of the 1,000 Swiss Francs. However, if the same people actually receive the 1,000 Francs and have to decide how much they would actually give to another person, the amount they give is generally much less. This difference in behavior between hypothetical and actual decision behavior may be explained by people not sufficiently thinking about the consequences of their own decision-making.

Therefore, we ask you to select one of the five electricity products, as if you actually need to select an option.

☒ ***Please select only one option***

☐ **Solar electricity**
Peak: 23,20 cents / kWh | Off-peak: 23,20 cents / kWh

☐ **Hydropower and a minimum of 10% other renewable energy (e.g., wind, solar, biomass)**
Peak: 12,60 cents / kWh | Off-peak: 10,30 cents / kWh

☐ **Hydropower and a minimum of 5% other renewable energy (e.g., wind, solar, biomass)**
Peak: 9,10 cents / kWh | Off-peak: 6,80 cents / kWh

☐ **80% Hydropower, 20% electricity from thermal waste utilization**
Peak: 8,30 cents / kWh | Off-peak: 6,00 cents / kWh

☐ **Nuclear power and other non-renewable energy**
Peak: 8,10 cents / kWh | Off-peak: 5,80 cents / kWh

*Peak: Monday-Friday 7am-8pm, Saturday 7am-1pm; Off-peak: all other times

Turn page please!

Please estimate: How much electricity (in kilowatt-hours) does a family with two adults and two children consume annually on average? *Hint: A washing machine uses on average one kilowatt-hour per stage of the washing program (60 degrees Celsius).*

☐ up to 1'000	☐ 1'001-2'000	☐ 2'001-3'000	☐ 3'001-4'000	☐ 4'001-5'000	☐ 5'001-6'000	☐ 6'001-7'000

Switzerland produces electricity from different energy sources. What do you suspect to be the share of electricity production...

...of new renewable electricity, like solar, wind, or biomass?	☐ 1-5%	☐ 6-10%	☐ 11-15%	☐ 16-20%	☐ 21-25%
...of hydropower?	☐ 26-35%	☐ 36-45%	☐ 46-55%	☐ 56-65%	☐ 66-75%

Imagine that you are asked to explain to another person the difference between green and conventional electricity. How well could you possibly describe this difference?

☐ Poor	☐ Rather poor	☐ Rather good	☐ Very good

How do you decide which electricity contract to select in your household?

☐ I take these decisions on my own.
☐ I take these decisions with somebody else in my household, e.g., with my partner, shared flat...
☐ I do not take these decisions in my household.

Please think about your <u>current product from your utility</u>. How applicable are the following statements to you?

	Does not apply	*Does rather not apply*	*Does rather apply*	*Does apply*
I have well informed myself before I have taken a decision on an electricity contract.	☐	☐	☐	☐
I deemed the selection of products as very complex.	☐	☐	☐	☐
I did not know that I could choose between different contracts.	☐	☐	☐	☐
I deemed the choice as unimportant.	☐	☐	☐	☐
I forgot to take a decision.	☐	☐	☐	☐
I have chosen an ecological electricity product.	☐	☐	☐	☐
I have chosen an inexpensive product.	☐	☐	☐	☐
The automatically offered electricity product of the utility seemed to me to be a recommendation.	☐	☐	☐	☐
I have invested little time and effort into this decision.	☐	☐	☐	☐
I never got around taking an active decision.	☐	☐	☐	☐
I did not have enough information about the products in order to take an active decision.	☐	☐	☐	☐

Turn page please!

How applicable are the following statements to you?

0 = does not describe me at all *describes me perfectly = 10*

Taking care of nature and the environment is important to me.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10
Generally, I find it easy to decide between two opportunities.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10
I abstain from things today so that I will be able to afford more tomorrow.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10
As long as I am not convinced otherwise I always assume that people have only the best intentions.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10
I do not understand why people spend their lifetime fighting for a cause that is not directly beneficial for them.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10

Natural gas products are often sold in combination with electricity products. How related are these two products for you?

☐ Completely different	☐ Rather different	☐ Rather similar	☐ Very similar

How applicable are the following statements to you, if you need to decide for a natural gas product?

	Does not apply	*Does rather not apply*	*Does rather apply*	*Does apply*
I would buy an environmentally friendly natural gas product.	☐	☐	☐	☐
I would buy an inexpensive natural gas product.	☐	☐	☐	☐

Please answer some last questions concerning your person.
These questions are important to contextualize the results of this study. Please note that we treat this data confidentially and report possible results only in aggregate form. The authors of this study may not relate any data to your personal identity.

How old are you?

_____ years

What is your gender?

☐ Female ☐ Male

What is your... *Multiple answers and abbreviations allowed*

Nationality	First language	Birth country

How many people live in your household? *Please fill in the corresponding numbers.*

_____ Adults	_____ Children (below the age of 18)

What is your current housing situation? *Please also fill in the number of rooms available.*

☐ Rent _____ number of rooms	☐ Own property _____ number of rooms

Turn page please!

What is your current employment status?

☐ Employed (full-time)	☐ Seeking work
☐ Employed (part-time)	☐ House wife / House husband
☐ Self-employed	☐ Retired
☐ In training / In school	☐ Other

What is your highest level of education?

☐ Compulsory school	☐ Higher education not university
☐ Vocational training	☐ University
☐ A-Levels	☐ Other

What is the monthly income (before taxes) for your complete household (in Swiss Francs)?

☐ up to 4'000	☐ 4'001-6'000	☐ 6'001-8'000	☐ 8'001-10'000	☐ 10'001-12'000	☐ 12'001-14'000	☐ 14'001-16'000	☐ above 16'000	☐ No answer

In politics, we often talk in terms of 'left' or 'right'. Where would you rank yourself in that spectrum?

0 = left *right = 10*

☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7	☐ 8	☐ 9	☐ 10

In which zip code area do you live?

☐ Zip code A	☐ Zip code B	☐ Zip code C	☐ Zip code D	☐ Zip code E

You have the opportunity to leave comments or feedback.
Please use the corresponding field.

Please put the filled-out questionnaire into the enclosed envelope and drop it into a postbox. You do not need to put a stamp on it.

Thank you for your help and good luck in the prize draw!