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Heterogeneous preferences and the individual change to alternative electricity tariffs

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**Heterogeneous preferences and the individual change
to alternative electricity tariffs**

February 2018

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Preliminary version

Abstract

Based on data from a large-scale computer-based survey among more than 3700 German citizens, this paper empirically examines the determinants of the general change of electricity tariffs and the specific change to green tariffs. Our econometric analysis with binary probit and multinomial logit models reveals a strong relevance of behavioral factors and individual values. For example, patience (which is measured by an incentivized experiment that was included in the survey) is significantly positively correlated with general changes to alternative electricity tariffs. Furthermore, social preferences (also measured by an incentivized experiment) and trust have an even stronger significantly positive effect on the specific change to green electricity tariffs. Our estimation results also imply an important role of political identification, i.e. citizens with a left-wing orientation significantly more often switch an electricity tariff and an ecological political orientation has a strong significantly positive effect on the change to a green electricity tariff. Furthermore, several socio-demographic and socio-economic variables like age, gender, or household income are also relevant. The empirical analysis thus provides new explanation patterns for the phenomenon that only a small number of households regularly change their electricity tariff and specifically to green tariffs, although they have high stated preferences for such changes. Our insights suggest several directions for policy, but also for electricity providers, to increase these switching rates. For example, the high importance of trust attitudes for the change to green electricity tariffs suggests a transparency initiative of electricity providers to decrease reservations against green power.

JEL classification: C93, D12, Q41, Q42, Q50

Keywords: Switching electricity tariffs, green electricity, heterogeneous preferences, behavioral factors, artefactual field experiment, individual values, econometric analysis

1. Introduction

After several energy market liberalizations, households are able to freely choose their electricity tariff in many countries (e.g. Sirin and Gonul, 2016). While the reduction of energy costs is one of the main reasons for the change of electricity tariffs, other reasons like the demand for renewable power can also be relevant. In spite of high stated preferences for electricity tariff changes, however, only a small number of households regularly use this possibility (e.g. He and Reiner, 2017). A good example is the switch to green electricity tariffs. While a large majority of households in the USA and European countries state to favor renewable energy and are even willing to pay a premium for it (e.g. Pichert and Katsikopoulos, 2008), the choice of corresponding electricity tariffs is indeed increasing, but still very limited, even in countries like Germany with a high proportion of electricity from renewable energy sources (e.g. Bundesnetzagentur and Bundeskartellamt, 2016). This can obviously lead to inefficiencies if households do not fully consider possible cost savings that are associated with an electricity tariff change or do not comply with their own tariff preferences. An insufficient change to green electricity tariffs can additionally lead to externalities if households do not internalize benefits from green electricity generation for other individuals.

According to Fehr-Duda and Fehr (2016), a main barrier for the individual change to alternative electricity tariffs is the unwillingness or inability to find and evaluate the large number of different tariffs and providers. Switching an electricity tariff is clearly associated with transaction costs including search and information costs. While a necessary economic condition for a change for most individuals is that all benefits of switching exceed the costs, errors in the perception of benefits and costs, i.e. an underestimation of the benefits and an overestimation of the costs, can obviously discourage the change of electricity tariffs (e.g. He and Reiner, 2017). In this respect, it is plausible to assume that households are heterogeneous with respect to the aforementioned perceived benefits and costs. On this basis, Sirin and Gonul (2016) consider behavioral factors for the choice of an electricity tariff. Similarly, by analyzing the change to a time-of-use electricity pricing program as an example for a specific electricity tariff, Qiu et al. (2017) argue that behavioral factors like risk and time preferences can cause the underparticipation in such cost-reducing tariffs.

Against this background, this paper empirically examines how heterogeneity in individual preferences and values affects differences in switching to alternative electricity tariffs.

The contribution of the study is threefold: First, it contributes to the literature on the general choice of electricity tariffs by considering a large number of possible determinants. Most previous studies in this field only consider a limited number of factors (e.g. Wilson and Waddams Price, 2010, Sirin and Gonul, 2016, He and Reiner, 2017) or refer only to the change to one specific electricity tariff (e.g. Qiu et al., 2017). In contrast, we examine a wide range of common socio-economic and socio-demographic variables as well as household specific factors such as relocation decisions or housing ownership for our econometric analysis to explain general electricity tariff changes. In particular, we additionally include several individual values (i.e. environmental values, political orientation, religious identification) as well as factors from behavioral economics and thus analyze time, social, and risk preferences as well as trust attitudes.

Second, since our identification of time and social preferences is based on artefactual field experiments (e.g. Levitt and List, 2009, List, 2011), our empirical analysis contributes to previous studies (e.g. Dohmen et al., 2011, Fischbacher et al., 2015) that mimic laboratory experiments in the field by considering incentivized measures in a large-scale survey among more than 3700 German citizens. We therefore also contribute to the more general large literature that examines economic effects of time, social, and risk preferences as well as trust attitudes. For example, previous studies identify the relevance of aggregate measures of trust for several macroeconomic variables like GDP growth, inflation, or the volume of trade between countries (see e.g. the overview in Fehr, 2009). At the individual level, it is, for example, shown that trust plays an important role for buying stocks (e.g. Guiso et al., 2008). Similarly, previous studies reveal the importance of risk preferences on behaviors and outcomes such as buying stocks, housing ownership, or patterns of occupational choice (see e.g. the overview in Dohmen et al., 2012) as well as the relevance of time preferences for lifetime outcomes such as income or unemployment (e.g. Golsteyn et al., 2014) or even for cognitive ability (e.g. Dohmen et al., 2010). However, to the best of our knowledge, these behavioral factors have not been jointly related to electricity tariff changes so far.

Third, by additionally analyzing green electricity tariffs, we also contribute to the large literature on preferences for renewable energy. We especially interpret the demand for renewable power as an explicit decision to switch from previous electricity tariffs to a new green tariff. Most previous studies in this field have instead examined the willingness to pay for green electricity on the basis of stated preferences data (see e.g. the meta-

analysis of Sundt and Rehdanz, 2015) and especially on the basis of stated choice experiments (e.g. Amador et al., 2013, Murakami et al., 2015). Only a few studies (e.g. Tabi et al., 2014) analyze the relevance of several factors including some behavioral variables for the choice among green electricity tariffs so far. However, common behavioral factors like time preferences have, to the best of our knowledge, not been considered so far. In contrast to most previous studies (an important exception is Kotchen and Moore, 2007, who also examine the effect of social preferences), our empirical analysis is furthermore based on the actual choice instead of stated choices of (green) electricity tariffs. In order to maximize the reliability of the corresponding answers, we did not ask the participants of the survey for the (green) properties of their electricity tariffs, but asked them to indicate the electricity provider and tariff directly from the last electricity bill. On this basis, we thoroughly examined whether the electricity tariff is completely green or not.

Our econometric analysis with binary probit and multinomial logit models reveals the strong relevance of heterogeneous preferences. For example, lower discount rates and thus a higher patience have a significantly positive effect on general changes to alternative electricity tariffs. This suggests that rather impatient citizens perceive the costs for evaluating different tariffs and providers as too high so that their willingness to change the electricity tariffs is restricted. For the specific change to green electricity tariffs, two further behavioral factors, i.e. trust and especially social preferences, are also relevant. This suggests that trust in the provider and the quality of the product are important in the case of green electricity and that citizens with higher social preferences draw a higher utility from their contribution to this specific public good. Our estimation results also imply an important role of political identification, i.e. an ecological political orientation has a significantly positive effect and a liberal political orientation has a significantly negative effect on the change to a green electricity tariff. Furthermore, several socio-demographic and socio-economic variables like age, gender, or household income also significantly affect the general change of electricity tariffs.

The remainder of the paper is organized as follows: Section 2 discusses the conceptual background of our study and develops several hypotheses that are empirically examined. Section 3 presents the data and the variables in our econometric analysis as well as some descriptive statistics. Section 4 discusses the estimation results and Section 5 draws some conclusions.

2. Conceptual background and hypotheses

The change to new electricity tariffs or even electricity providers is clearly associated with costs, such as search costs, learning and transaction costs, or cognitive decision-making costs (e.g. Wilson and Waddams Price, 2010, He and Reiner, 2017). If the main reason to switch the electricity tariff is the reduction of costs, a change can be considered as an investment since the costs arise immediately in the present, whereas the benefits (i.e. cost reductions) occur in the future. Therefore, it can be expected that time preferences play a role for the change of an electricity tariff. This argument can also be transferred to changes to those electricity tariffs like green electricity tariffs that are not necessarily associated with cost reductions in the future, but with search and transaction costs immediately in the present. The relevance of time preferences for energy-related behavior and preferences has already been shown in previous empirical analyses (e.g. Epper et al., 2011, Fischbacher et al., 2015, Newell and Siikamäki, 2015). In addition, Qiu et al. (2017) show in their analysis of switching to a time-of-use electricity pricing program that time preferences also matter for the adoption of programmable thermostats, which allow a better response to this specific tariff, but are associated with initial costs. This leads to the following hypothesis that is examined in our econometric analysis:

Hypothesis 1: More patient individuals are more likely to change the electricity tariff including a change to a green tariff.

In the study of Qiu et al. (2017), however, time preferences have no significant effect on the change to the time-of-use electricity pricing program. Instead, they reveal a strong effect of risk preferences. Other studies also show a high relevance of risk preferences for energy-related behavior if investments generate uncertain benefits in the future such as in the case of energy saving measures (e.g. Epper et al., 2011, Qiu et al., 2014, Fischbacher et al., 2015). While uncertain benefits in the future are obvious for changes to electricity tariffs with time-variant pricing as in the case of the aforementioned time-of-use electricity pricing program, even a change to (cheaper) tariffs with time-invariant pricing can have risks. In Germany, for example, several new electricity providers (which also offered green electricity tariffs) went into insolvency (e.g. TelDaFax, FlexStrom), which led to high uncalculated costs for the customers. Therefore, it is plausible to think that risk preferences can play a role for an electricity tariff change. This example additionally suggests that trust attitudes (e.g. specific trust in the financial solidity of an electricity provider) can be relevant for the switch to new electricity tariffs.

Trust in the provider and the quality of the product seems to be especially important in the case of green electricity tariffs if citizens have high preferences for this tariff, but want to be certain that the electricity is really completely generated from renewable energy sources. This leads to the following two hypotheses that are examined in our econometric analysis:

Hypothesis 2: More risk-taking individuals are more likely to change the electricity tariff including a change to a green tariff.

Hypothesis 3: More trusting individuals are more likely to change the electricity tariff including a change to a green tariff.

While the three discussed behavioral factors might be relevant for both general electricity tariff changes and specific changes to green electricity tariffs, the latter can be influenced by further factors. In line with the study of Kotchen and Moore (2007) who examine the participation in two green electricity programs including the change to a green electricity tariff, we consider the change to green tariffs as a voluntary contribution to a public good, i.e. to a climate or more general environmental public good. It can be expected that individuals with higher social or fairness preferences draw a higher utility from their contribution to public goods, i.e. that they have a higher propensity to internalize externalities. Previous studies have confirmed this expectation for general public good contributions like donations (e.g. De Oliveira et al., 2012) and for specific energy efficiency measures (e.g. Fischbacher et al., 2015). In particular, Kotchen and Moore (2007) reveal a high relevance of social preferences (measured by an altruism scale) for the participation in the two green electricity programs. This leads to the following hypothesis that is examined in our econometric analysis:

Hypothesis 4: Individuals with higher social preferences are more likely to change to a green electricity tariff.

While social preferences seem to be relevant for general public good contributions, it can be expected that environmental values additionally increase the individual utility from specific contributions to environmental and thus also climate public goods. Several previous studies have confirmed this expectation, for example, with respect to the reduction of electricity use (e.g. Kotchen and Moore, 2008, Delmas and Lessem, 2014), the probability to live in solar homes (e.g. Dastrup et al., 2012), carbon offsetting (e.g. Schwirplies and Ziegler, 2016), the willingness to pay higher prices for climate-friendly products

(e.g. Ziegler, 2017), and especially the purchase of green electricity (e.g. Attari et al., 2009, who additionally consider the purchase of low emission vehicles) and the participation in two green electricity programs (e.g. Kotchen and Moore, 2007). This leads to the following hypothesis that is examined in our econometric analysis:

Hypothesis 5: Individuals with stronger environmental values are more likely to change to a green electricity tariff.

Another important individual value for the contribution to climate or general environmental public goods is political identification. It can be expected that individuals adjust their behavior to their political orientation in order to comply with the rules of a certain social category which is, for example, connected with a program of a political party. Several previous studies have revealed the high relevance of a left-wing and especially ecological political orientation, which is in line with the programs of corresponding parties. For example, Kahn (2007) shows a positive relationship between the Green Party membership and a low self-reported consumption of gasoline, the waiver of the possession of a SUV, and the use of public transit. Furthermore, Dastrup et al. (2012) show a positive relationship between voting for the Democratic, Peace and Freedom, and Green Parties and living in a solar home, Costa and Kahn (2013) show a negative relationship between registering for the Democratic and Green Parties and the consumption of electricity, and Schwirplies and Ziegler (2016) and Ziegler (2017) show a positive relationship between a green political orientation and the willingness to pay higher prices for climate-friendly products. This leads to the following hypothesis that is examined in our econometric analysis:

Hypothesis 6: Individuals with a left-wing and especially ecological political orientation are more likely to change to a green electricity tariff.

A final important individual value for the contribution to climate or general environmental public goods is religious identity or religious affiliation. With respect to Christian religiosity, Cui et al. (2015) discuss two contradicting hypotheses about its relationship with pro-environmental behavior, namely the stewardship hypothesis that implies a positive correlation on the basis of the teachings of the Christian religions and the dominion hypothesis that implies a negative correlation on the basis of the early work of White (1967) who suggests an anthropocentric worldview (e.g. Martin and Bateman, 2014) of Christianity. The empirical analysis of Cui et al. (2015) rather confirms the dominion hypothesis since firms with high regional shares of Christians and especially Protestants show less environmental practices. In contrast, Martin and Bateman (2014) find that

Judeo-Christian religious values have no significant effects on individual pro-environmental behavior, at least if several control variables are included in the econometric analysis. In total, this leads to the following two contradicting hypothesis that are examined in our econometric analysis:

Hypothesis 7a: Individuals with (Christian) religious affiliation are more likely to change to a green electricity tariff.

Hypothesis 7b: Individuals with (Christian) religious affiliation are less likely to change to a green electricity tariff.

3. Data and variables

The data for our empirical analysis were collected from a large-scale computer-based survey among 3705 German citizens, which was carried out in June and July 2016 by the German market research company Psyma. In order to avoid biased answers with respect to electricity tariffs and costs, we only included citizens in our survey who are alone or together with a partner responsible for the electricity bills and the choice of electricity providers and tariffs in the household. To consider relevant population groups after this filtering, the sample (which was drawn from a Psyma Panel) was stratified in terms of age, gender, place of residence, and religious affiliation so that it is representative for these criteria.¹ The first part of the questionnaire referred to some screening questions including the identification of our target population of decision makers in the field of electricity. The second part of the questionnaire referred to personal values and attitudes including our main interesting behavioral factors and especially the two artefactual field experiments to identify time and social preferences. The next two parts referred to details in the electricity consumption and costs as well as to personal attitudes toward electricity and especially electricity generation. The fifth part of the questionnaire referred to a choice experiment with respect to different electricity tariffs, which is, however, not considered in this paper. The final part referred to further socio-economic and socio-demographic variables. The median for the completion time of the survey was about 28 minutes.

¹ However, this sampling strategy can lead to deviations for other criteria, for example, due to an overrepresentation of high education.

3.1. Dependent variables

In order to examine the determinants of individual electricity tariff changes, the participants were asked how often they have actively switched their tariff within the last ten years. Based on categorical answer classes (i.e. including the categories “not at all”, “once”, “twice”, and “more than twice”), we construct a dummy variable that takes the value one if a respondent has changed the electricity tariff at least once. With respect to the identification of the current electricity tariff and thus the change to a green electricity tariff, we asked the participants to pick up the last annual electricity bill and to indicate the electricity provider and the electricity tariff directly from it. On the basis of this information, we thoroughly examined whether the electricity tariff is completely green. This procedure certainly leads to a much higher reliability for the identification of green electricity tariffs than directly asking the participants for it since it is likely that many individuals are not able to recognize whether their electricity tariff is completely green or not. For the econometric analysis, we construct a dummy variable that takes the value one if a respondent has switched to a current green electricity tariff.

While for 1975 out of the 3705 respondents the electricity tariff can be directly derived from their answers, it can be additionally reliably identified from the corresponding indications of further 208 participants. In the case of 218 respondents, who only indicated the electricity provider, but not the specific tariff, it is also possible to identify green electricity tariffs if the household has a completely green provider or a provider that exclusively offers green electricity tariffs for private customers. In contrast, for the remaining 1304 respondents a fully reliable specification of the tariff is not possible due to completely missing information (84 respondents) or due to incomplete indications. However, for the latter case of 1220 participants we try to indicate whether the electricity tariff is green or not on the basis of specific assumptions. For example, if the respondent indicated the electricity provider, but not clearly or not at all the tariff, we imply the basic tariff for this provider. If the provider was indicated by “municipal utility”, “basic utility”, or something similar, we assume the basic tariff of the local electricity provider. However, due to the uncertainties in these assumptions, our empirical analysis of the current electricity tariff focuses on the 2183 respondents for whom we have reliable information about the tariffs. Nevertheless, in order to test the robustness of our estimation results, we also separately consider the group of 2401 respondents including green elec-

tricity consumers due to a green electricity provider² and especially the group of 3621 respondents including assumptions about the electricity tariff.

The first two lines in Table 1 report the means and the standard deviations for these two dependent variables in the econometric analysis. While the left part of the table refers to maximum number of observations (i.e. all 3705 participants in the case of general electricity tariff changes and 3621 participants in the case of the current electricity tariff), the right part refers to the restricted sample for which the information about the tariffs is reliable. The left part of the table shows that more than 62% of the respondents have switched their electricity tariffs within the last ten years and almost 30% have currently a green electricity tariff. Furthermore, the right part of the table report slightly higher average values for both variables. While these numbers seem to be rather high, it is very difficult to compare them with other (especially official) statistics since reliable information is not available. Perhaps the most credible current data can be found in the last monitoring report of Bundesnetzagentur and Bundeskartellamt (2016).³ It reveals that in 2015 8.7% of the German households have changed their electricity tariff by simultaneously changing the electricity provider and additionally 3.7% of the households have changed it without changing the provider. However, it should be noted that these numbers only refer to one year, whereas we analyze switches within the last ten years. The report also reveals that 19.1% of the German households had a green electricity tariff in 2015, which is lower than the proportion in our sample for 2016. With respect to the comparison of these numbers, however, it should be noted that our data are not completely representative for households due to our sampling strategy that only includes individual decision makers in the field of electricity, which could lead to slightly higher values for the proportion of electricity tariff changers and switchers to green tariffs.

² While the information about the green electricity consumers due to a green electricity provider is reliable, we do not focus on the sample including these respondents since the consideration of this group artificially increases the ratio of green electricity tariffs by definition.

³ The Bundesnetzagentur (Federal Network Agency) and the Bundeskartellamt (Federal Cartel Office) are required under the Energy Act (EnWG) and the Competition Act (GWB) to conduct joint monitoring activities in the electricity and gas sectors. A summary of the monitoring report in English can be found at https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Energie/Unternehmen_Institutionen/DatenaustauschUndMonitoring/Monitoring/Monitoring2016/MonitoringSummary2016.pdf?__blob=publicationFile&v=2

3.2. Behavioral factors

Our main explanatory variables refer to several behavioral factors. Time and social preferences were identified by two incentivized artefactual field experiments. For both experiments we informed the respondents that about 1% of them were randomly selected to be paid, respectively. Furthermore, we informed them that the winners are immediately notified after the survey and that the Euro amount is credited in bonus points on their account as member of the Psyma panel. In line with, for example, Dohmen et al. (2010) and especially Fischbacher et al. (2015), in our experiment for time preferences each participant was presented a choice table with 12 decision situations and asked to make a decision in every row. In each row the respondents had to decide to receive 80 Euros in one month or a higher amount in seven months (beginning with the same amount of 80 Euros in the first choice). The choice table in the survey can be found in Table 2. The higher the amount at which a respondent switches to the payment in seven months, the higher her discount rate and thus the higher her impatience. As in Fischbacher et al. (2015), we construct the variable “patience” for our econometric analysis, which is the minimum discount factor calculated as the ratio between 80 Euro and the value at which the respondent chooses the amount in seven months for the first time. Table 3 reports the distribution of the discount factors (varying between 0.741 and 1) across all 3705 participants and reveals similar results as in Fischbacher et al. (2015), even when the frequency of very impatient respondents who always prefer the amount of 80 Euros in one month is higher in our sample.

Also in line with Fischbacher et al. (2015), our experiment for social preferences is based on a standard dictator game, where generosity is costly. We informed the participants that they can divide the amount of 100 Euro with another randomly selected respondent in the case that they belong to the winner in the lottery. Each participant was presented a table and asked to make a decision for the distribution of the 100 Euro between him and another selected person. The corresponding choice table in the survey can be found in Table 4. We assume higher social or fairness preferences (i.e. a higher generosity) for higher shares of amounts that are allocated to another participant. Table 5 reports the distribution of the Euro amounts which are allocated to other respondents across all 3705 participants. The table shows that only very few participants allocate higher amounts to other persons, whereas more than a half allocates lower amounts and about one sixth of the participants even allocate zero Euros to other persons indicating very low social or

fairness preferences. In line with Fischbacher et al. (2015), however, the majority choose an equal distribution of the 100 Euro, even when the frequency for this group is lower in our sample. In the econometric analysis we consider the variable “social preferences” which is the amount that is allocated to another person divided by 100 and which thus varies between 0 and 1. Table 1 additionally reports the means and standard deviations of “patience” and “social preferences”.

Our variable for risk preferences is based on a survey question from the German Socio-Economic Panel (SOEP) that has been experimentally validated and shown to be a reliable indicator for the willingness to take risks in Dohmen et al. (2011) (see also the discussion in Charness et al., 2013) and already applied in several previous studies (e.g. Jaeger et al., 2010, Dohmen et al., 2012, Fischbacher et al., 2015). The participants were therefore asked how willing they are generally to take risks on a five-stage scale (instead of an eleven-stage scale in the SOEP) with the response categories “not at all willing to take risks”, “rather not willing to take risks”, “undecided”, “rather willing to take risks”, and “very willing to take risks”. On the basis of this ordinal variable, we construct the dummy variable “risk taking preferences” that takes the value one if the respondent indicated one of the latter two categories. Table 1 reveals that 28.5% of the participants self-assess as rather or very willing to take risks.

Our final behavioral factor refers to trust attitudes. The variable is also based on experimentally validated survey questions from the SOEP which are similar to common measures of trust in other surveys such as the General Social Survey (GSS) or the World Value Surveys (WVS) (e.g. Fehr, 2009) and that are used in Dohmen et al. (2012). We therefore consider the three following statements: “In general, one can trust people”, “nowadays one cannot rely on anyone”, and “when dealing with strangers, it is better to be careful before you trust them”. The respondents were asked how strongly they agree with these statements on a symmetric scale with five ordered response categories, i.e. “totally disagree”, “rather disagree”, “undecided”, “rather agree”, and “totally agree”, for which we assign integers from one to five for the first item and decreasing integers from five to one for the two latter items. On this basis, we construct the variable “trust” for our econometric analysis, which is an index that adds the values across the three single indicators. As a consequence, the trust index varies between three and 15. Table 1 shows that the average value of “trust” is slightly higher than eight and reveals very similar values in the full and restricted samples

3.3. Individual values and control variables

Our indicator for environmental values is based on the New Ecological Paradigm (NEP) scale according to Dunlap et al. (2000). The NEP scale is a standard instrument in the social and behavioral sciences and is increasingly common in the economic literature (e.g. Kotchen and Reiling, 2000, Kotchen and Moore, 2007, Attari et al., 2009, Delmas and Lessem, 2014, Fischbacher et al., 2015, Schwirplies and Ziegler, 2016, Ziegler, 2017). In line with Whitmarsh (2011), our indicator is based on the following six statements: “Humans have the right to modify the natural environment to suit their needs”, “humans are severely abusing the planet”, “plants and animals have the same right to exist as humans”, “nature is strong enough to cope with the impacts of modern industrial nations”, “humans were meant to rule over the rest of nature”, and “the balance of nature is very delicate and easily upset”. The respondents were asked how strongly they agree with these statements including five ordered response categories, i.e. “totally disagree”, “rather disagree”, “undecided”, “rather agree”, and “totally agree”, for which we assign increasing integers from one to five for the three environmentally positively worded statements and decreasing integers from five to one for the three environmentally negatively worded statements. The variable “NEP” is designed by adding up the values of the six items and thus varies between six and 30.

In contrast to most previous studies, but in line with Ziegler (2017), we do not consider a simple one-dimensional indicator for a right-wing or a left-wing political identification since it is possible that political orientations are interrelated. In Germany, for example, a conservative identification is often combined with a liberal identification. The participants were therefore asked how strongly they agree with the statements “I identify myself with conservatively oriented politics”, “I identify myself with liberally oriented politics”, “I identify myself with socially oriented politics”, and “I identify myself with ecologically oriented politics” again on a symmetric scale with the five ordered response categories “totally disagree”, “rather disagree”, “undecided”, “rather agree”, and “totally agree”. On the basis of these ordinal variables, we construct the four dummy variables “conservative identification”, “liberal identification”, “social identification”, and “ecological identification” that take the value one if the respondent indicated one of the latter two categories, respectively. With respect to religious affiliation, the respondents were asked whether they belong to the Roman Catholic Church, to Protestant Churches, to Islam, to other religious communities, or whether they have no religious affiliation. In

order to avoid confounding effects by several religious affiliations, we construct the dummy variable “no religious affiliation” that takes the value one if a respondent does not belong to any religious group.

Our first group of control variables refers to housing and household specific factors. Since it can be expected that electricity tariff changes are often caused by relocations, we consider the dummy variable “relocation” that takes the value one if the respondent has changed her primary residence within the last ten years. The dummy variable “household housing ownership” takes the value one if the respondent lives in an own house or apartment and thus is not a tenant. Furthermore, we consider the dummy variable “higher household income” that takes the value one if the respondent indicated a household income class with incomes that are higher than 2500 Euros. In addition, the variable “household electricity costs” indicates the annual costs in Euro divided by 1000. With respect to common socio-demographic variables, the variable “age” is the age of the respondent in years, the dummy variable “female” takes the value one if the respondent is a woman, the dummy variable “high education” takes the value one if the highest level of education is at least secondary (i.e. “Hochschulreife”), and the dummy variable “Eastern Germany” takes the value one if the participant lives in one of the new Eastern federal states including Berlin.

The lower part of Table 1 reports some descriptive statistics for the individual values and control variables. It reveals quite strong environmental values on average. Furthermore, it shows high ecological and social political orientations, whereas the identification with conservative politics is rather low on average. The statistics for “no religious affiliation”, “age”, “female”, and “Eastern Germany” are completely in line with the population in Germany since our sample was stratified according to these four criteria.

4. Estimation results

4.1. Binary probit model analysis

Table 6 reports Maximum Likelihood (ML) estimations of three different binary probit model specifications for the determinants of general changes of the electricity tariff.⁴ In line with the results of He and Reiner (2017) who report a low relevance of socio-

⁴ All estimations (and also all descriptive statistics as discussed above) were conducted with the statistical software package Stata. We consider robust estimates of the standard deviations of the estimated parameters and thus robust z-statistics.

demographic factors, we first consider model specifications that only include our four behavioral factors or only the four behavioral factors plus our six variables for individual values. The corresponding estimation results can be found in the first two columns of Table 6. While the first column reveals significantly positive effects of patience, risk taking preferences, and trust, which apparently confirms our first three hypotheses, the significance of the effects of the latter two variables becomes weaker if the individual values are included as further explanatory variables. According to the second column, not only a left-wing orientation, but also a conservative political identification is significantly positively correlated with the change to an alternative electricity tariff. Furthermore, citizens with no religious affiliation significantly more often and citizens with strong environmental values significantly less often change the electricity tariff.

However, the third column of Table 6 reveals that many of these significant effects are only spurious and become insignificant when our control variables are included. In contrast to He and Reiner (2017), most of these control variables are significantly correlated with switching the electricity tariff. As expected, relocations in the past have significantly positive effects on electricity tariff changes. But also the housing ownership and a high household income have significantly positive effects, whereas household electricity costs have a weakly significantly negative effect. Furthermore, older citizens, males, and citizens from Eastern Germany significantly more often switch the electricity tariff. In contrast, many effects of behavioral factors and individual values become insignificant so that only more patient citizens and citizens with a social or ecological political identification significantly more often change the electricity tariff. The latter result is in line with He and Reiner (2017), who also report a positive effect of a left-wing orientation. According to the former result, Hypothesis 1 can be confirmed with respect to the general change of electricity tariffs.

The fourth column of Table 6 reports the estimated average marginal and discrete probability effects and reveals that the strength of the estimated effects of patience, but also of social and ecological political identification are moderate. For example, an increase of the discount factor by 0.1 (which e.g. corresponds to an increase from the lowest value to the fourth-lowest value) leads to an approximately estimated average increase of the probability for switching the electricity tariff by 2.6 percentage points. An increase of the discount factor from the lowest value (i.e. 0.741) to the highest value (i.e. 1) leads to an estimated average increase of the probability by 6.7 percentage points, which corre-

sponds to an increase of the probability by 11.3%. However, the estimated discrete effects of several control variables like the housing ownership or the place of residence are stronger. For example, for male housing owners from Eastern Germany who have a higher household income and who have changed the primary residence within the last ten years the estimated average probability for an electricity tariff change is almost 27.9 percentage points and thus 55.6% higher than for the comparison group.

Table 7 reports ML estimations of binary probit models for the determinants of the specific change to a green electricity tariff. We again compare the estimation results in two restricted model specifications (see the first and second columns) with the results in a full model specification that includes all control variables besides the four behavioral factors and the six variables for individual values (see the third column). Now, the additional inclusion of control variables does not qualitatively change the estimation results in the restricted model specifications. The main result is the significantly positive effect of social preferences, trust, and an ecological political identification, which confirms Hypothesis 3 for the case of switching to a green electricity tariff, Hypothesis 4, and Hypothesis 6 with respect to ecological political orientation. The latter result is strengthened by the significantly negative effect of a liberal political identification. Furthermore, citizens without religious affiliation show a weakly significantly higher probability for a change to a green electricity tariff, which weakly confirms the dominion hypothesis and thus Hypothesis 7b (rejecting Hypothesis 7a). With respect to the control variables, only a higher education has a significantly positive and a place of residence in Eastern Germany has a significantly negative effect on switching to a green electricity tariff.

The corresponding estimated average marginal and discrete probability effects are again reported in the fourth column. The estimated effects of the two main behavioral factors, i.e. social preferences and trust, are now very strong. The results indicate that an increase of the trust index by one point leads to an approximately estimated average increase of the probability for switching to a green electricity tariff by 1.1 percentage points. An increase of the trust index from the minimum value (i.e. 3) to the maximum value (i.e. 15) even leads to an estimated average increase of the probability by 13.0 percentage points or 48.4%. The strength of the estimated effect of social preferences is similar. The value in the fourth column implies that an increase of the indicator by 0.1 (which corresponds to an allocated amount of 10 Euros to other persons in the dictator game) leads to an approximately estimated average increase of the probability for switching to a green

electricity tariff by 1.3 percentage points. An increase of the indicator from the minimum value (i.e. 0) to the maximum value (i.e. 1) leads to an estimated average increase of the probability by 12.7 percentage points or 45.5%. Another highly relevant factor is ecological political identification. The fourth column in Table 7 implies that for citizens with a high ecological orientation the estimated average probability for a change to a green electricity tariff is 10.7 percentage points or 39.7% higher than for citizens with a low ecological orientation. This factor is especially more relevant than environmental values, which, in contrast to many previous studies of other climate and more general pro-environmental activities, have surprisingly no significant effects on the change to a green electricity tariff.⁵

In order to test the robustness of the estimation results in both binary probit models, we have applied alternative approaches in several directions. Besides some alternative model specifications, we have, for example, considered two further indicators for time preferences. One indicator refers to the number of choices for the amounts in seven months across the 12 decision situations (e.g. Fischbacher et al., 2015). Another alternative indicator excludes those 176 respondents with non-monotone decisions, i.e. who switched more than once between the payments in one and seven months (e.g. Dohmen et al., 2010). Due to the underlying ordinal variables for our single trust and environmental values items, we have also constructed corresponding dummy variables for high trust attitudes and strong environmental values and then added up the values of the dummy variables, respectively. As a consequence, the alternative trust index varies between zero and three and the alternative NEP indicator varies between zero and six. However, the alternative estimation results are qualitatively very similar as in Table 6 and Table 7.⁶

4.2. Multinomial logit model analysis

However, one problem of the previous binary probit model analysis is that the two categories are very heterogeneous, respectively. In the first model approach the dependent variable takes the value one if a respondent has changed the electricity tariff within the last ten years so that this category mixes respondents who have switched to a green electricity tariff and respondents who have switched to another electricity tariff. Similarly,

⁵ The effect of environmental values is significant if the variable for ecological political identification is excluded, which is obviously due to the high correlation between the two variables. The corresponding estimation results are not reported due to brevity, but are available upon request.

⁶ The estimation results are not reported due to brevity, but are available upon request.

the dependent variable in the second model approach takes the value zero for both respondents who have never changed the electricity tariff within the last ten years and respondents who have indeed changed, but not to a green electricity tariff. Therefore, the identification of possibly different determinants for the explanation of belonging to the three relevant groups, i.e. changers to green electricity tariffs, changers to other electricity tariffs (but not to a green electricity tariff), and non-changers is difficult with the previous analysis. Against this background, we now separately consider these three categories in a multinomial logit model. Table 8 shows that the frequencies for these three mutually exclusive categories are relatively similar and all higher than 30%. The table also reveals that the number of observations is again smaller than in the first binary probit model analysis since the electricity tariff could not be identified for some respondents as discussed above.

Table 9 reports the corresponding ML estimations of a multinomial logit model that is based on our preferred specification with all behavioral factors, individual values, and control variables. The base category refers to respondents that have not changed to a green electricity tariff and additionally have not switched the tariff at all within the last ten years. The estimation results for time preferences are in line with the results in Table 6 and Table 7 and thus strengthen the significantly positive effect of patience on general electricity tariff changes, but not changes to green tariffs. The estimation results for social preferences in the multinomial logit model in combination with the results in both binary probit models suggest that these preferences mainly play a role for the choice between switching to a green electricity tariff and switching to another tariff, but not compared to the alternative of no change.⁷ Furthermore, in line with the estimation results in the binary probit models, risk preferences have no significant effect and trust has a specific significantly positive effect on the probability for the change to green electricity tariffs.

According to Table 9, environmental values have a specific weakly negative effect on the probability for a general change of electricity tariffs, but not to green tariffs. The estimation results for the ecological political orientation suggests that this identification is strongly significantly correlated with changes to green electricity tariffs compared with

⁷ This interpretation is strongly confirmed in a multinomial logit model where the base category refers to respondents that have changed the electricity tariff, but not to a green tariff. In this case, the social preferences parameter for the change to a green electricity tariff is highly significantly different from zero. The estimation results are not reported due to brevity, but are available upon request.

both no changes of tariffs at all and general tariff changes.⁸ Interestingly, the estimation results for religious affiliation suggest that the positive correlation for respondents without religious affiliation and switches to green electricity tariffs is even more significant compared with respondents that have not switched at all. This strengthens the confirmation of Hypothesis 7b. The estimation results for the control variables in the multinomial logit models are widely in line with the results in the binary probit models. One exception is the significantly lower probability to change to green electricity tariffs for women, whereas Table 7 does not indicate significant effects. These estimation results suggest that women especially have a higher aversion to electricity changes, independent of general changes or specific changes to green tariffs.

5. Conclusions

Based on data from a large-scale survey among more than 3700 German citizens, this paper empirically examines how heterogeneity in individual preferences and values affects the general change of electricity tariffs and the specific change to green tariffs. Our econometric analysis with binary probit and multinomial logit models reveals the strong relevance of behavioral factors and individual values. For example, lower discount rates and thus a higher patience have a significantly positive effect on general changes to alternative electricity tariffs. For the specific change to green electricity tariffs, two further behavioral factors, i.e. social preferences and trust, are obviously even more relevant. Our estimation results also imply an important role of political identification, i.e. citizens with a left-wing orientation significantly more often switch an electricity tariff and an ecological political orientation has a strong significantly positive effect on the change to a green electricity tariff. Furthermore, several socio-demographic and socio-economic variables like age, gender, or household income also significantly affect the general change of electricity tariffs.

Our study therefore provides a better understanding of the decision to switch the electricity tariff in Germany. The empirical analysis especially provides new explanation patterns for the phenomenon that only a small number of households regularly change their electricity tariff and specifically to green tariffs, although they have high stated preferences for such changes. For example, the results for time preferences suggest that rather

⁸ The latter result is again confirmed in the multinomial logit model with alternative base category as aforementioned.

impatient citizens perceive the costs for finding and evaluating the large number of different tariffs and providers as too high so that their willingness to change the electricity tariffs is restricted. Our estimation results also suggest that trust in the provider and the quality of the product are important in the case of green electricity and that citizens with higher social or fairness preferences draw a higher utility from their contribution to this specific public good, i.e. that they have a higher propensity to internalize the corresponding externalities. Furthermore, our empirical analysis reveals that environmental values only play a minor role for the choice of green electricity tariffs compared to an ecological political identification, which is obviously a much more dominating factor.

Since a high individual willingness to change electricity tariffs is a main condition for well-functioning electricity markets and a high extent to switch to green electricity tariffs is an important contribution to a public good, competition and environmental policy is generally interested in high switching rates. Our empirical results therefore suggest several directions for policy, but also for electricity providers, to increase these switching rates. For example, the high importance of patience for changing tariffs suggests the further reduction of switching costs such as search and transaction costs. Furthermore, the high importance of trust attitudes for the change to green electricity tariffs suggests a transparency initiative of green power providers, but also conventional electricity suppliers, in order to decrease reservations against green power. In addition, our significant effects of several socio-demographic and socio-economic variables suggest targeted marketing efforts for specific population groups.

Methodologically, our empirical study is based on data from the combination of a common survey and two incentivized artefactual field experiments to identify time and social preferences. Therefore, our paper contributes to previous studies that transfer laboratory experiments to the field. One limitation of our study is the possibility of imprecise information about the electricity tariffs and the switching behavior by the respondents. Administrative data of the customers from the electricity providers would certainly be helpful in this respect, especially if the switching behavior over time would be available as a basis for corresponding panel data analyses, which are able to control for unobserved heterogeneity. However, such data are not available so far and thus a direction for future research. The cooperation with an electricity provider would also be an excellent basis for natural field experiments in order to analyze more specifically several instruments that increase electricity tariff changes and especially changes to green tariffs.

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Tables

Table 1: Descriptive statistics of dependent and explanatory variables in the econometric analysis

Variables	Full sample			Restricted sample		
	Number of observations	Mean	Standard deviation	Number of observations	Mean	Standard deviation
Change of electricity tariff	3705	0.625	0.48	2183	0.661	0.47
Change to green electricity tariff	3621	0.294	0.46	2183	0.340	0.47
Patience	3705	0.864	0.10	2183	0.867	0.09
Social preferences	3705	0.341	0.20	2183	0.338	0.20
Risk taking preferences	3705	0.285	0.45	2183	0.277	0.45
Trust	3705	8.159	2.23	2183	8.266	2,22
NEP	3705	24.182	3.77	2183	24.211	3,74
Conservative identification	3705	0.224	0.42	2183	0.237	0.43
Liberal identification	3705	0.338	0.47	2183	0.355	0.48
Social identification	3705	0.637	0.48	2183	0.666	0.47
Ecological identification	3705	0.489	0.50	2183	0.507	0.50
No religious affiliation	3705	0.349	0.48	2183	0.361	0.48
Relocation	3705	0.543	0.50	2183	0.547	0.50
Household housing ownership	3705	0.421	0.49	2183	0.418	0.49
Higher household income	3705	0.461	0.50	2183	0.467	0.50
Household electricity costs	3705	0.796	0.41	2183	0.770	0.40
Age	3705	48.720	15.10	2183	48.749	14.99
Female	3705	0.505	0.50	2183	0.487	0.50
Higher education	3655	0.531	0.50	2155	0.544	0.50
Eastern Germany	3705	0.209	0.41	2183	0.218	0.41

Table 2: Choice table in the time preferences experiment

Choice situation	Option A (payment amount in one month)	Option B (payment amount in seven months)
1	80 Euro <input type="checkbox"/>	80 Euro <input type="checkbox"/>
2	80 Euro <input type="checkbox"/>	80,50 Euro <input type="checkbox"/>
3	80 Euro <input type="checkbox"/>	81 Euro <input type="checkbox"/>
4	80 Euro <input type="checkbox"/>	82 Euro <input type="checkbox"/>
5	80 Euro <input type="checkbox"/>	83,50 Euro <input type="checkbox"/>
6	80 Euro <input type="checkbox"/>	85,50 Euro <input type="checkbox"/>
7	80 Euro <input type="checkbox"/>	88 Euro <input type="checkbox"/>
8	80 Euro <input type="checkbox"/>	91 Euro <input type="checkbox"/>
9	80 Euro <input type="checkbox"/>	94,50 Euro <input type="checkbox"/>
10	80 Euro <input type="checkbox"/>	98,50 Euro <input type="checkbox"/>
11	80 Euro <input type="checkbox"/>	103 Euro <input type="checkbox"/>
12	80 Euro <input type="checkbox"/>	108 Euro <input type="checkbox"/>

Table 3: Frequencies of minimum discount factors

Discount factors	0.741	0.777	0.812	0.847	0.879	0.909	
Frequencies	1046 (28.23%)	209 (5.64%)	177 (4.78%)	203 (5.48%)	412 (11.12%)	436 (11.77%)	
Discount factors	0.936	0.958	0.976	0.988	0.994	1	Total
Frequencies	296 (7.99%)	164 (4.43%)	102 (2.75%)	80 (2.16%)	275 (7.42%)	305 (8.23%)	3705 (100%)

Table 4: Choice table in the social preferences experiment (i.e. dictator game)

Amount for you	0 Euro	10 Euro	20 Euro	30 Euro	40 Euro	50 Euro	60 Euro	70 Euro	80 Euro	90 Euro	100 Euro
Amount for another randomly selected person	100 Euro	90 Euro	80 Euro	70 Euro	60 Euro	50 Euro	40 Euro	30 Euro	20 Euro	10 Euro	0 Euro
Decision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table 5: Frequencies of payment amounts (in Euro) for other participants in the social preferences experiment (i.e. dictator game)

Payments	0	10	20	30	40	50
Frequencies	626 (16.90%)	208 (5.61%)	336 (9.07%)	396 (10.69%)	378 (10.20%)	1670 (45.07%)
Payments	60	70	80	90	100	Total
Frequencies	24 (0.65%)	16 (0.43%)	21 (0.57%)	15 (0.40%)	15 (0.40%)	3705 (100%)

Table 6: Estimation results in binary probit models, dependent variable: change of electricity tariff

Explanatory variables	Maximum Likelihood estimates (robust z-statistics)			Estimates of average marginal and discrete effects
Patience	0.782*** (3.58)	0.786*** (3.59)	0.698*** (3.09)	0.258***
Social preferences	-0.096 (-0.93)	-0.087 (-0.83)	-0.119 (-1.11)	n.s.
Risk taking preferences	0.104** (2.22)	0.089* (1.88)	0.061 (1.27)	n.s.
Trust	0.025*** (2.67)	0.019* (1.87)	0.011 (1.03)	n.s.
NEP	--	-0.014** (-2.28)	-0.010 (-1.58)	n.s.
Conservative identification	--	0.104** (1.97)	0.050 (0.92)	n.s.
Liberal identification	--	-0.030 (-0.64)	-0.046 (-0.96)	n.s.
Social identification	--	0.116** (2.37)	0.099** (1.96)	0.037*
Ecological identification	--	0.120** (2.44)	0.118** (2.34)	0.044**
No religious affiliation	--	0.139*** (3.09)	0.068 (1.38)	n.s.
Relocation	--	--	0.170*** (3.49)	0.063***
Household housing ownership	--	--	0.180*** (3.61)	0.066***
Higher household income	--	--	0.150*** (3.15)	0.055***
Household electricity costs	--	--	-0.106* (-1.81)	-0.039*
Age	--	--	0.005*** (2.76)	0.002***
Female	--	--	-0.106** (-2.37)	-0.039**
Higher education	--	--	0.023 (0.50)	n.s.
Eastern Germany	--	--	0.171*** (2.94)	0.062***
Constant	-0.562*** (-2.76)	-0.371 (-1.45)	0.611** (-2.15)	--
Number of observations	3705		3655	

Notes: * (**, ***) means that the appropriate parameter or effect is different from zero at the 10% (5%, 1%) significance level, respectively; n.s. means that the appropriate effect is not significant

Table 7: Estimation results in binary probit models, dependent variable: change to green electricity tariff

Explanatory variables	Maximum Likelihood estimates (robust z-statistics)			Estimates of average marginal and discrete effects
Patience	0.213 (0.85)	0.198 (0.79)	0.164 (0.63)	n.s.
Social preferences	0.361*** (2.99)	0.323*** (2.65)	0.357*** (2.89)	0.125***
Risk taking preferences	0.076 (1.42)	0.061 (1.13)	0.048 (0.86)	n.s.
Trust	0.038*** (3.43)	0.033*** (2.92)	0.031*** (2.62)	0.011***
NEP	--	0.005 (0.71)	0.008 (1.03)	n.s.
Conservative identification	--	-0.026 (-0.43)	-0.043 (-0.70)	n.s.
Liberal identification	--	-0.125** (-2.31)	-0.144*** (-2.63)	-0.050***
Social identification	--	0.011 (0.19)	0.007 (0.12)	n.s.
Ecological identification	--	0.313*** (5.52)	0.303*** (5.24)	0.107***
No religious affiliation	--	0.047 (0.91)	0.106* (1.90)	0.037*
Relocation	--	--	-0.041 (-0.73)	n.s.
Household housing ownership	--	--	-0.027 (-0.47)	n.s.
Higher household income	--	--	0.042 (0.77)	n.s.
Household electricity costs	--	--	-0.016 (-0.24)	n.s.
Age	--	--	-0.000 (-0.18)	n.s.
Female	--	--	-0.010 (-0.20)	n.s.
Higher education	--	--	0.115** (2.15)	0.040**
Eastern Germany	--	--	-0.210*** (-3.14)	-0.071***
Constant	-1.106*** (-4.71)	-1.295*** (-4.32)	-1.288*** (-3.89)	--
Number of observations	2918		2878	

Note: * (**, ***) means that the appropriate parameter or effect is different from zero at the 10% (5%, 1%) significance level, respectively; n.s. means that the appropriate effect is not significant

Table 8: Frequencies for the three alternatives in the multinomial logit model

Alternatives	Frequencies
Change to green electricity tariff	939 (32.18%)
Change of electricity tariff, but not to green electricity tariff	1080 (37.01%)
No change of electricity tariff	899 (30.81%)
Total	2918 (100%)

Table 9: Maximum likelihood estimates (robust z-statistics) in a multinomial logit model, base category: no change of electricity tariff

Explanatory variables	Change to green electricity tariff	Change of electricity tariff, but not to green electricity tariff
Patience	0.834 (1.63)	1.019** (2.06)
Social preferences	0.004 (1.50)	-0.004 (-1.62)
Risk taking preferences	0.113 (1.03)	0.061 (0.58)
Trust	0.063*** (2.73)	0.024 (1.06)
NEP	0.000 (0.00)	-0.023* (-1.72)
Conservative identification	0.012 (0.10)	0.164 (1.43)
Liberal identification	-0.216** (-2.01)	0.035 (0.34)
Social identification	0.105 (0.93)	0.175 (1.62)
Ecological identification	0.513*** (4.61)	0.028 (0.25)
No religious affiliation	0.239** (2.20)	0.120 (1.14)
Relocation	0.050 (0.46)	0.214** (2.02)
Household housing ownership	0.112 (1.00)	0.294*** (2.70)
Higher household income	0.127 (1.19)	0.103 (1.00)
Household electricity costs	-0.156 (-1.17)	-0.245* (-1.91)
Age	0.002 (0.50)	0.004 (1.18)
Female	-0.202** (-1.99)	-0.340*** (-3.50)
Higher education	0.266** (2.56)	0.132 (1.31)
Eastern Germany	-0.235* (-1.79)	0.210* (1.72)
Constant	-1.775*** (-2.69)	-0.680 (-1.09)
Number of observations	2878	