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Heterogeneous Preferences and Investments in Energy Saving Measures[*]

Urs Fischbacher[†] Simeon Schudy[‡] Sabrina Teyssier[§]

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Abstract

We investigate whether risk, time, environmental, and social preferences affect single family homeowners' investments in the energy efficiency of their house using established experimental measures and questionnaires. We find that homeowners who report to be more risk taking are more likely to have renovated their house. Pro-environmental and future-oriented renovators, i.e. renovators with lower discount factors, live in homes with higher energy efficiency. Generosity as measured in a dictator game relates positively to the energy quality of renovated houses. Controlling for the energy efficiency of houses, we further find that energy consumption as measured by heating and electricity costs is lower for future-oriented and pro-environmental individuals.

Keywords: Risk Preferences, Time Preferences, Environmental Preferences, Social Preferences, Energy Efficiency, Artefactual Field Experiment

JEL-Classification: C93, D03, Q01, Q50.

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1 Introduction

The building stock of EU member states accounts for over 40% of EU's final energy consumption. EU's residential energy use represents 63% of total energy consumption see Balaras et al. (2007) and, similarly, the US residential sector[1] strongly impacts total energy use and greenhouse gas emissions (Eichholtz et al., 2010; Eichholtz and Quigley, 2012; Royal Institution of Chartered Surveyors, 2005). However, according to several studies, the building sector also offers large possibilities for greenhouse gas abatement (Bardhan et al., 2014; Enkvist et al., 2007; Evans et al., 2011; Intergovernmental Panel on Climate Change, 2007; Levine et al., 1995; Stern, 2008). If more investments in energy saving measures are realized, energy consumption can be considerably reduced (see e.g. Gillingham and Palmer, 2014; McKinsey & Co, 2009). Why then do we observe large heterogeneity in energy investments across homeowners? Why do many homeowners appear to be reluctant to invest in energy saving measures? The aim of this paper is to provide a better understanding of differences in homeowners' investment behavior (and energy consumption) by relating it to the heterogeneity in homeowners' individual preferences.

From an economic point of view, homeowners' potential underinvestment in energy efficiency measures (i.e. an "energy-efficiency gap" between actual and the individually optimal investment) results from investment inefficiencies and externalities (Allcott and Greenstone, 2012; Hausman, 1979; Jaffe and Stavins, 1994).[2] Investment inefficiencies arise if homeowners do not fully consider the earnings associated to investments in energy saving measures, for instance,

[1] The U.S. Energy Information Administration defines the "residential sector" as an energy-consuming sector that consists of living quarters for private households. Energy use in this sector includes space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a variety of other appliances. The residential sector excludes institutional living quarters (see http://www.eia.gov/dnav/pet/tbldefs/pet_pri_prop_tbldef2.asp).

[2] There is an ongoing debate between economists and engineers on the size of this gap. Jaffe and Stavins (1994) provide a deeper discussion on the issue and highlight different notions of optimality which may determine the exact size of the gap. Generally, many economists argue that costs of investment in energy saving measures are neglected or underestimated due to individuals' behavioral considerations. Hence, the cost-benefit analysis of these energy-efficient investments may lead to over-estimate the energy-efficiency gap (Allcott and Greenstone, 2012; Gillingham and Palmer, 2014; Hirst and Brown, 1990; Metcalf and Hassett, 1999; Smith and Moore, 2010).

because they are imperfectly informed or present biased.[3] Externalities refer to the fact that homeowners may not internalize benefits of their investments for others, i.e. for human health and the environment.[4] Homeowners are likely to be heterogeneous in the degree of their investment inefficiencies (Allcott and Greenstone, 2012) as well as in the internalization of externalities. In addition, homeowners are likely to differ with respect to other important aspects that may matter for investments in energy saving measures. First, energy investments generate uncertain benefits. Second, benefits from investments in energy efficiency occur in the future and costs frequently arise in the present. If homeowners differ in their risk and time preferences, the differences in individual investments in energy efficiency measures may result from the differences in homeowners' risk attitudes and time preferences.[5]

The aim of this study is to broaden the understanding of homeowners' investments in energy efficiency measures by studying how heterogeneity in individual preferences drives differences in homeowners' investment behavior. The contribution of this study is twofold. First, we provide insights on how individual measures of risk, time, social and environmental preferences relate to the renovation decision of homeowners in general. Second, we shed light on how these preference measures relate to homeowners' energy consumption behavior. Our approach elicits preferences of single family homeowners (who live in their house) by combining

[3] See also Epper et al. (2011).

[4] See for instance Achtnicht (2011), who identifies environmental benefits as potential drivers of homeowners' investment in energy saving measures and Gowdy (2008) who suggests that social impacts relate to energy investments.

[5] There is a strong indication that risks associated with energy saving investments are central in the renovation decisions (Farsi, 2010; Hassett and Metcalf, 1993; Metcalf and Hassett, 1999). Also Epper et al. (2011) report that households explicitly state that they are uncertain about future energy costs which is a driving factor in the investment decision. Andreoni and Sprenger (2012) show with experimental data that risk preferences and time preferences are different. Their study suggests that if future earnings (or costs) are uncertain (as compared to present earnings or costs that are certain) both risk and time preferences must be considered. Newell and Siikamäki (2015) find a positive relation between preferences for energy efficiency (measured by hypothetical water heater choice tasks and federal energy efficiency tax credit claims) and individual discount factors (measured in a non-incentivized choice task, in which study participants choose between a hypothetical tax-free cash credit check of 1000$ to be received in one month or a higher tax free credit to be received in 12 months). While Jaffe and Stavins (1994, p. 805) note that uncertainty and heterogeneity in time preferences are not a source of market failure in and of itself, it is nevertheless crucial to understand whether such preference heterogeneity has to be taken into account when designing policy interventions aiming at the reduction of externalities.

methods from experimental economics with survey questions. By relating these measures to homeowners' renovation and energy consumption behavior our work further contributes to studies that relate incentivized preference measures used in laboratory experiments to real world behavior outside of the lab (see e.g. Benz and Meier, 2008; Chabris et al., 2008; De Oliveira et al., 2012; Dohmen et al., 2011). Such studies are essential to judge the generalizability of preference measures used in laboratory experiments.

The novelty of our study design is that it relates a set of directly elicited individual preference measures to homeowners' renovation behavior, the energy efficiency of their house and their energy consumption. Our set of individual preference measures consists of a measure of risk preferences, which is obtained using the experimentally validated risk questionnaire proposed by Dohmen et al. (2011), homeowners' individual discount factor (elicited using an incentivized individual decision task, in which homeowners decide between a lower payment in the near future and higher payments in the far future), homeowners' social preferences (obtained using incentivized Dictator and Envy games), and homeowners' preferences for the environment, which we elicit using a set of items based on the New Environmental Paradigm Scale (Dunlap and Van Liere, 1978).

We find that risk preferences are particularly important for the decision to renovate. Homeowners likely perceive the renovation decision as risky as homeowners who are more likely to take risks in general (or in financial matters) are also more likely to have their house renovated. Time preferences, social and environmental preferences seem to play a minor role for the decision to renovate but relate to the energy efficiency of renovated buildings. Among renovators, we find that homeowners' discount factors and pro-environmental preferences relate positively to the energy efficiency of the house. That is, renovators who value the future particularly strongly or reveal pro-environmental preferences own houses with higher energy quality. The findings on social preferences for renovators are mixed. Renovators who are generous with their own money

(in an incentivized Dictator Game) have a higher estimated energy quality whereas renovators who are generous with others' money, i.e. when it is costless for them (in an incentivized Envy Game), have houses with lower estimated energy quality. Finally, we find that environmentally friendly and more future oriented homeowners consume less energy (controlling for the energy efficiency of their house).

Our study includes a variety of preference dimensions and thus substantially contributes to the understanding of energy efficient renovation behavior of homeowners. In contrast to our approach, previous research has mainly relied on average estimates of utility function and implicit discount rates (Alberini et al., 2013; Hausman, 1979; Train, 1985) or has studied preference measures in isolation. For instance, Qiu et al. (2014) study how heterogeneity in risk preferences relates to individuals' decisions to invest in energy efficiency measures. While the findings of Qiu et al. (2014) are generally in line with our results (more risk averse individuals are less likely to make investments), Qiu et al.'s study differs in two dimensions from our approach. First, the authors elicit risk preferences with framed hypothetical lottery choices (similar to the approach by Holt and Laury, 2002) where each lottery is described as a different investment opportunity whereas we measure risk attitudes using the experimentally validated risk questionnaire proposed by Dohmen et al. (2011). Second, apart from studying risk preferences, we additionally introduce incentivized measures for individual time and social preferences as well as an individual measure for homeowners' environmental preferences. Thereby, we complement and broaden the analysis by Qiu et al. (2014). In particular, our broader set of preferences measures enables us to study how heterogeneity in different preference dimensions helps to explain heterogeneity in homeowners' investment behavior.

Our results also provide insights for the design of policy interventions. Traditional policies fostering energy efficient renovations have focused on monetary incentives such as tax reductions and subsidies (see e.g. Alberini and Filippini, 2011). In addition to monetary incentives

researchers have recommended to promote the diffusion of information about technologies and economics of energy efficiency renovations as well as the assignment of energy efficiency renovation specialists (Banfi et al., 2010). As we find heterogeneity in individuals' risk, time, social and environmental preferences to be reflected in homeowners' investments and energy consumption, we provide evidence calling for more targeted policies (see also Allcott and Greenstone, 2012; Golove and Eto, 1996) which weakens the policy argument for simply subsidizing energy efficient goods (see Allcott et al., 2014).[6] Our results further demonstrate that renovation decisions are perceived as a risky decision, whereas the extent of the renovation depends on homeowners' time and environmental preferences. Policies should therefore aim at reducing the (perceived) risk of renovations in general and provide gains for renovators as early as possible. One way to reduce the (perceived) risk of renovations is to provide households with future earnings "guarantees". E.g. governments or energy providers could engage in supporting energy efficient renovations by sharing the costs and risk but also the benefits from future savings.

The remainder of this paper is organized as follows. In Section 2, we briefly present the theoretical framework introduced by Allcott and Greenstone (2012) and derive our main hypotheses concerning the relation between individual preferences and energy investment and consumption behavior. In Section 3, we explain the data collection procedure. In Section 4 we present the data set we use for the analysis in Section 5. Section 6 concludes.

2 Theoretical framework and hypotheses

To provide some structure, we briefly describe the theoretical framework we have in mind when deriving our hypotheses concerning investments in energy saving measures. The framework is

[6] See also Bento et al. (2012) who provide evidence from simulation analyses that empirical studies ignoring consumer heterogeneity may overstate the magnitude of under-valuation of energy efficient products.

based on the model of investment in energy efficiency measures developed by Allcott and Greenstone (2012). We assume that energy efficiency investments are associated with present costs and future benefits. To simplify, consider the case in which individuals exist only in two periods: in the first period the individual decides whether or not to renovate and, if so, chooses how much to invest in energy efficiency. In the second period, the individual incurs costs from energy consumption, which depend on the investments chosen in the first period. That is, in the second period, the individual minimizes costs for a given level of comfort (i.e. a given level of utility).[7] In the first period, each individual compares her expected utility of future savings in terms of costs (EU_α) to the immediate cost of investment in energy-saving measures $C(q)$. The individual chooses to invest only if the expected utility of the investment outweighs the direct cost of the investment:

$$EU_\alpha\big(\delta, \gamma, p, \Delta E(q)\big) > C(q) \tag{1}$$

The expected utility of the investment $EU_\alpha\big(\delta, \gamma, p, \Delta E(q)\big)$ depends on the individuals discount factor δ, her internalization of externalities (i.e. her preferences for the environment and social preferences) γ, energy prices p and the potential energy savings $\Delta E(q)$, which occur in the future and are uncertain. The parameter q indicates the energy efficiency of the house which increases the direct costs of the investment $C(q)$ as well as the energy savings $\Delta E(q)$. The energy savings $\Delta E(q)$ correspond to the difference between the energy intensity of the house, if it has not been renovated E_{NR}, and the uncertain energy intensity of the house if it has been renovated $E_R(q)$, which decreases in the quality of the renovation q.[8] The individual knows that $E_R(q) < E_{NR}$ for $q > 0$ but, nevertheless, the difference $\Delta E(q)$ is uncertain. The parameter α reflects the

[7] We assume here that the objective regarding the level of utility to attain in the second period does not change depending on the individual's decision in the first period. This assumption might be violated if people overconsume after they have invested in energy efficiency in the first period. This may be the case if green technologies (e.g. solar panels) are not only be seen as an investment but also provide an additional consumption values for "green" consumers (see Dastrup et al., 2012).

[8] We abstract here from the fact that future energy prices themselves are uncertain. If we would allow for future prices to be uncertain also E_{NR} is uncertain. Clearly, Hypothesis 1 stems on this assumption.

individual's risk aversion. The individual's discount factor δ also affects expected utility. The stronger an individual discounts the future (the smaller δ), the lower will be her expected utility from investments.[9] Further, as the individual puts more weight on the environment or the welfare of others (higher γ), her expected utility of the investment increases (if she considers her investment in energy savings an investment in a public good). For the rest of the paper we label this type of (pro-)social preferences *Fairness* and measure it in our empirical analysis using a Dictator Game. To capture an additional aspect of social preferences, we introduce an Envy game that measures to what extent people dislike being behind. *Envy* may play an important role for energy investments of homeowners. On the one hand envy could reduce investments in the public good (if people do not want to be behind in a monetary dimension). On the other hand, envy may increase investments, if people do not want to be behind in terms of having a house with lower efficiency than others.[10] Fairness and envy indicate how people are affected by inequalities. This basic framework yields the following hypotheses concerning the investment behavior of homeowners:

H1: *Less risk averse homeowners are more likely to invest in energy efficiency.*

H2: *More future-oriented homeowners are more likely to invest in energy efficiency.*

H3: *Pro-environmental homeowners are more likely to invest in energy efficiency.*

H4: *Homeowners with pro-social preferences are more likely to invest in energy efficiency.*

Energy consumption in the second period yields certain present costs and benefits. However, energy consumption affects others and the environment. We therefore expect that pro-environmental and pro-social homeowners consume less energy.

H5: *Pro-environmental and prosocial homeowners consume less energy.*

[9] The market interest rate is taken into account with δ representing the individual's discount factor net of the interest rate.

[10] As it is ex-ante unclear to what extent and in which direction envy will affect investments, we refrain from formulating any directional hypothesis. Instead, we let our data inform us on the role of envy for investments.

3 Data collection and methodological aspects

Our study focuses on Swiss homeowners. Although Switzerland is one of the most advanced countries with respect to energy efficiency among OECD countries (Evans et al., 2011) there is an important potential to reduce greenhouse emissions in the Swiss housing market. Jakob and Madlener (2004) report that energy use for space heating may be reduced by 33-50% in existing buildings and by 80% or more in new buildings. Jochem et al. (2003) indicate that only few Swiss homeowners invest in renovating building envelopes, which may contribute substantially to improvements of buildings' energy efficiency.[11] Although Banfi et al. (2008) provide evidence that the willingness to pay for building efficiency enhancements exceeds the cost of implementing these measures, homeowners in Switzerland are reluctant to invest in energy saving by retrofitting their building envelopes and do so mainly at the end of the building element's lifetime (see Jakob, 2007b).[12] In turn homeowners may forgo profitable investments.

We collected the data in German-speaking Swiss cantons. First, we contacted 2500 homeowners in the canton of Zurich with the help of the canton of Zurich buildings insurance (GVZ). Second, we directly contacted 2139 additional households outside the canton of Zurich but within the German-speaking cantons of Switzerland (to avoid approaching the same homeowners twice). We received a total of 550 completed questionnaires, 264 in the canton of Zürich and 286 in other cantons.[13] The response rate was about 12 percent.[14] To minimize barriers for energy investments such as incentive conflicts between tenants and homeowners (Clinch and Healy, 2000;

[11] For further information see also Jochem and Jakob (2004), who provides a detailed analysis of energy perspectives on CO_2 reduction potentials in Switzerland up to 2010.

[12] It has also to be noted that not all building efficiency enhancements exceed the cost of implementation. For instance, Scarpa and Willis (2010) provide results which suggest that households' value of renewable energy adoption is not sufficient to cover the higher capital costs of micro-generation energy technologies such as solar-panels in the UK.

[13] A translated version of the letter sent to homeowners including the questionnaire and the experimental decision tasks is available in the Online Appendix.

[14] The response rate may appear low but it is similar to the size observed in other experimental survey studies using specific participants (such as, e.g., financial investors in Riedl and Smeets, 2017).

Golove and Eto, 1996; Levinson and Niemann, 2004)[15] we focus our analysis on homeowners of single family houses who also live in their house, who are most likely to benefit themselves from investments in energy efficiency measures (489 homeowners in total).

Homeowners were asked to answer questions on the energy quality of their house depending on three factors: window quality, roof quality and façade quality. They also had to indicate whether they did renovate their house in the past and whether they plan future renovation. Further we asked for the age and size of their house. For a subsample of households, we additionally elicited information about energy consumption.

To control for the financial situation of homeowners, we included questions from the German SAVE study (see Boersch-Supan and Essig, 2005) in our questionnaire. The questions focus on how much money is available at the end of a month and thereby indirectly and non-intrusively elicit a proxy for homeowners' wealth.[16]

Homeowners' time preferences and social preferences (i.e. preferences for fairness and envy) were elicited using incentivized pen and paper experiments. Homeowners' preferences with respect to risk were elicited using experimentally validated risk questionnaire proposed by Dohmen et al. (2011).[17] Homeowners' preferences for the environment were elicited using a set of items based on the New Environmental Paradigm Scale (Dunlap and Van Liere, 1978).

All participants of the study had the possibility to earn money by participating. Payments depended on the decisions made in the different incentivized choice tasks (Dictator Game, Envy Game, Time Preferences elicitation task), of which one was randomly selected to be paid. To

[15] For a further discussion of barriers and drivers of energy efficient renovations that are different from individual preferences, for instance retrofit costs or future energy prices, see Cameron (1985), who provides an early study that analyzes house retrofit decisions with data from the U.S. More recent studies highlight and discuss such barriers for Switzerland (Banfi et al., 2008), Canada (Sadler, 2003) the Netherlands (Poortinga et al., 2003), South Korea (Kwak et al., 2010), Sweden (Nair et al., 2010) and Germany (Achtnicht and Madlener, 2014).

[16] It has been shown that answers to these questions correlate highly with personal wealth (see Boersch-Supan and Essig, 2005, p.33).

[17] Dohmen et al. (2011) find that answers to the general risk attitude question predict actual behavior in lottery tasks with safe options.

ensure trust in the random selection of the payoff-relevant decision, we assigned a two-digit number to each decision which was linked to last digits of the Swiss public lottery (*Joker*).[18] On average, payments amounted to 40 Swiss francs. Participants received their payment via bank transfer or mail about one month after we received the questionnaire (and were informed about this procedure).[19] In the two following sections, we present the obtained measures for energy efficiency investments, risk, time, environmental and social preferences in more detail.

4 Data description

4.1 Background information

The sample used in the analysis encompasses a total of 341 participants.[20] The age of houses ranges from 2 to 405 years with a median of 17 years (standard deviation = 43.10). In order to cope with the possibility of a non-linear relationship between house age and renovation behavior, we generated four house age classes, based on a quartile split (1st quartile =14 years, 2nd quartile =17 years, 3rd quartile = 32 years).[21] The size of houses ranges from 44 square meters to 2400 (median=170; std. deviation=160.95). Concerning households' financial situation, we asked individuals to answer the following question: "If you think back to how you (and your partner)

[18] As mentioned above, we conducted two waves. In the first wave, on average every fourth participant received a variable amount determined by her own or some other participant's decision in one of the decision tasks. In the second wave, every participant received a fixed payment of 10 Swiss francs for participating plus a variable amount that was determined by the participants' decision in the choice task. We did so, as some participants in the first wave complained about the fact that not everyone was paid. As intended, this slightly increased the response rate (from 11 percent to 13 percent).

[19] Payments were delayed for a month to ensure that participants made all decisions in the same "risk-in-time" environment as in the time preference task, they received their payment either 1 or 7 months after the reception of their questionnaire.

[20] The reduction of the sample size to 341 homeowners results for two reasons. First, we only use the data of homeowners living in their own house, who made all decisions in the preference elicitation tasks and answered all questions that are used in the analysis. Additionally, we restrict the analysis to those participants who made consistent choices in the time preference tasks (e.g. we excluded homeowners who preferred 80.50 in 7 months over 80 in 1 month but preferred 80 in 1 month over 81 in 7 months).

[21] Each class includes its upper bound.

managed on with your income in 2010: What describes the situation best?" Homeowners could tick one of the following options "At the end of the month there was lots of money left", "At the end of the month there was frequently some money left", "There was only money left, if a nonrecurring income occurred", "At the end of the month it was often not enough", or "At the end of the month it was never enough" (see also Boersch-Supan and Essig, 2005). Only 2% of participants have either often not enough or never enough money at the end of the month, 12% have money left only if a nonrecurring income occurred and 86% have either frequently some money left or lots of money left.

4.2 Measures of energy investments

Our main analysis focuses on investments in energy efficiency. As explained in the theoretical framework, we understand the investment decision as deciding whether or not to renovate and if so, to what extent to invest in energy efficiency. Thus, our main dependent variables will be homeowners' renovation behavior in general (i.e. whether houses were renovated and whether a future renovation is planned) and an index of the energy efficiency of the house.[22] With respect to renovations we find that in total, 29.3% of houses are renovated, 10.3% are planned to be renovated, 13.2% are both renovated and planned to be renovated while 47.2% are not renovated and not planned to be renovated. Concerning the energy efficiency of the house, we construct an index that allows us to use all available information on the energy efficiency of the house in a single dependent variable, weighting different components of the house objectively. To do so, we first ask participants to evaluate the quality of their windows, roof and façade on a four point scale by answering questions similar to those used in Banfi et al. (2008) and second, to judge the overall energy efficiency of their house. Table 1 shows the share of respondents for each category of the quality variables of the different components of the house. The majority of respondents have

[22] We further included questions on the heating system, the use of energy efficient light bulbs and questions concerning heating and electricity costs (see Online Appendix).

standard insulated windows as well as standard roof and façade quality. Around one quarter of homeowners attribute enhanced insulation with respect to window quality. One third reports enhanced roof and façade quality. Less than 10 percent report the lower two quality categories for each of the three measures.

Table 1: Window, roof and façade quality

	Percent of respondents (n = 341)
Window quality	
Enhanced window	23
Standard insulated[23]	73
Medium old window	4
Very old window	0
Roof quality	
Enhanced roof insulation	32
Standard roof insulation[24]	61
Medium old roof insulation	5
Very old roof insulation	2
Façade quality	
Enhanced façade insulation	32
Standard insulation[25]	58
Repainted façade	6
Old facade	4

To obtain a proxy for the global energy efficiency of the house, we create an index variable that aggregates window, roof and façade quality. As these three types of quality characteristics may not have the same weight for households' overall appreciation of house quality, we estimate the weight of each characteristic using a question on the general subjective energy efficiency of participants' homes measured on a 5-point Likert scale (very low, low, medium, high and very high). Using households subjective evaluations of efficiency (mean=3.35, std. deviation=0.65)[26] we estimate how homeowners weight the importance of window, roof and façade quality for the efficiency of their house. We regress the subjective efficiency measure on window, roof and facade quality. As Table 2 shows, homeowners attribute on average slightly stronger weights to

[23] Standard window refers to coated window glass with complete gasket.

[24] Participants could choose among very good, "normal" (standard), medium old and old insulation.

[25] Participants had no additional information on façade insulation other than reported in the table.

[26] About 51% of homeowners rate their house as medium- efficient and about 39.4% as highly so. 7.1% consider the efficiency of their house as low, 1.8% as very high and 0.3% as very low.

Table 2: OLS estimation of subjective energy efficiency of the house[27]

	Subjective energy efficiency
Roof quality	**0.276*** **
	(0.054)
Window quality	**0.215*** **
	(0.065)
Façade quality	**0.372*** **
	(0.052)
Constant	**0.593*** **
	(0.213)
Observations	335
R-squared	0.414

Note: robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

façade quality and roof quality than to window quality. Using the regression results, we calculate for each household the estimated overall quality of the house (estimated overall quality = 0.276 * roof quality + 0.215 * window quality + 0.372 * façade quality + 0.593). The estimated overall quality ranges from 1.67 and 4.05 (mean=3.35, std. deviation=0.42).

4.3 Measures of individual preferences

4.3.1 Risk preferences

We measure risk preferences using the experimentally validated questionnaire by Dohmen et al. (2011). The risk questionnaire allows participants to indicate their willingness to take risks in general and context specific risks.[28] Participants tick a box on a five point scale ranging from "not ready to take risks" (value 1) to "very risk-taking" (value 5). Figure 1 presents the distribution of participants' answers to the risk task.

[27] Six subjects did not indicate a subjective level of the efficiency of their house. We do not use these six homeowners to construct the overall efficiency measure of the house. However, as all six subjects have indicated the façade, window and roof quality of their house, we calculate the overall efficiency of their house using the weights from the estimation shown in Table 2 (as for all other participants).

[28] The context specific risk attitudes encompass risk-taking in financial matters, car driving, leisure and sports, and professional career. Our analysis focuses on the relation between risk-taking in general and renovation behavior, energy quality and energy consumption. We found similar results e.g. on the relation of having renovated the house and risk taking in financial matters and career choice, but we found no significant relation of being a renovator and risk-taking in car driving, leisure or sports. The latter indicates that contextual factors can matter when studying risky decisions (see also Qiu et al., 2017, p. 130).

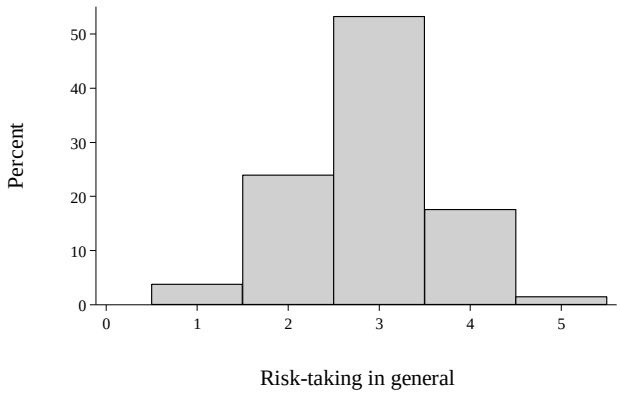

Figure 1: Risk-taking in general (n=341, not risk seeking=1, very risk seeking=5).

4.3.2 Time Preferences

Our measure of homeowners' time preferences is based on 11 decision situations in which homeowners had to decide whether they wanted to receive 80 Swiss francs in one month or a higher amount in seven months. The amounts available in the more distant future (i.e. in seven months) ranged from 80.50 Swiss francs to 108 Swiss francs. A person values future payments more strongly, the lower the monetary amount at which the person switches to the payment in the far future is.[29] For the analysis we focus on homeowners' minimum discount factor, i.e. $\frac{\text{amount in one month}}{\text{amount in seven month}}$, at which the respondent chooses the future amount for the first time.

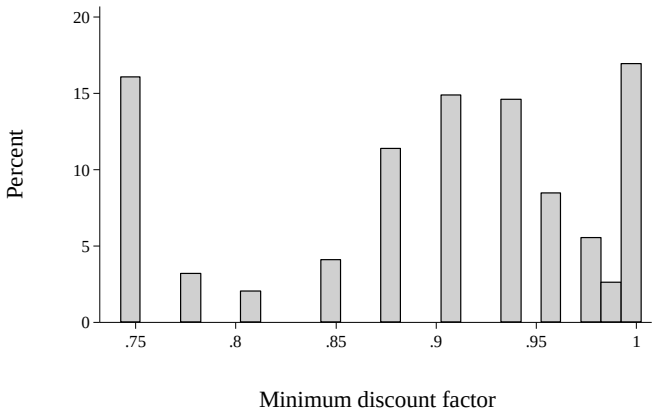

Figure 2: Minimum discount factors (n=341).

[29] For a critical review on discounting and time preferences see also Frederick et al. (2002).

The distribution of participants' discount factors is provided in Figure 2.[30] While some participants exhibit rather low discount factors, our results in general are in line with previous findings (see e.g. Frederick et al., 2002; Meier and Sprenger, 2010).

4.3.3 Environmental preferences

We measure environmental preferences with questions from a questionnaire on environmental preferences based on the New Environmental Paradigm Scale (Dunlap and Van Liere, 1978). Participants were asked to state their agreement with the following three statements (on a 5-point scale): "We are approaching the limit of the number of people the earth can support", "To survive, people have to live in harmony with nature", and "People do not have to adapt to nature, because they can restore it." We built an index on the following three statements by adding positively framed questions and subtracting negatively framed questions. The obtained environmental preference index then ranges from 0 to 9. Figure 3 presents the distribution of individuals' environmental preference index.

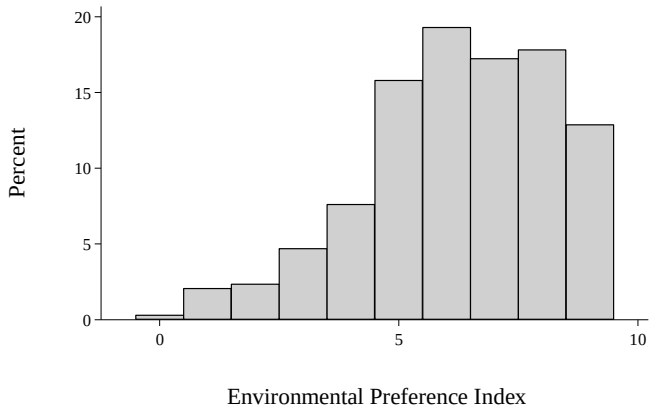

Figure 3: Environmental preference index (n=341)

4.3.4 Social preferences

We elicit social preferences using two incentivized experiments. In the first experiment (Envy Game) we measure envy, i.e. how much participants care about being behind when they can

[30] As a further proxy for time preferences we also calculated the number of choices in favor of receiving the payment within a month. The results are similar to those obtained using the minimum discount factor.

allocate money to others without incurring any cost (see also Fehr et al., 2008). In the second experiment (Dictator game), we focus on fairness, i.e. how participants care about the welfare of others when they have to pay for it (see e.g. Forsythe et al., 1994). The advantage of these monetarily incentivized experiments comes from the fact that they achieve construct validity by theory (see e.g. Fehr et al., 2008).

The Envy game

Homeowners play a two person Envy game in which a decision maker (Player 1) receives a fixed payoff of X and has to decide on the payoff Y for Player 2, with $Y \in [X - d, X + d]$ and $d \geq 0$. Player 2 is passive. The less money the decision maker allocates to Player 2, the more envious we consider the decision maker.[31] Figure 4 shows a histogram for the amount *not* allocated to Player 2 (envy) in terms of the fixed amount Player 1 receives (X). As can be seen in Figure 4 our envy measure splits the main part of our sample into two types of behavior: Envious participants do not allocate more than they receive themselves, i.e. the share given to the other player is $\leq$ X. Less envious participants chose to allocate a higher amount than X to the other player.

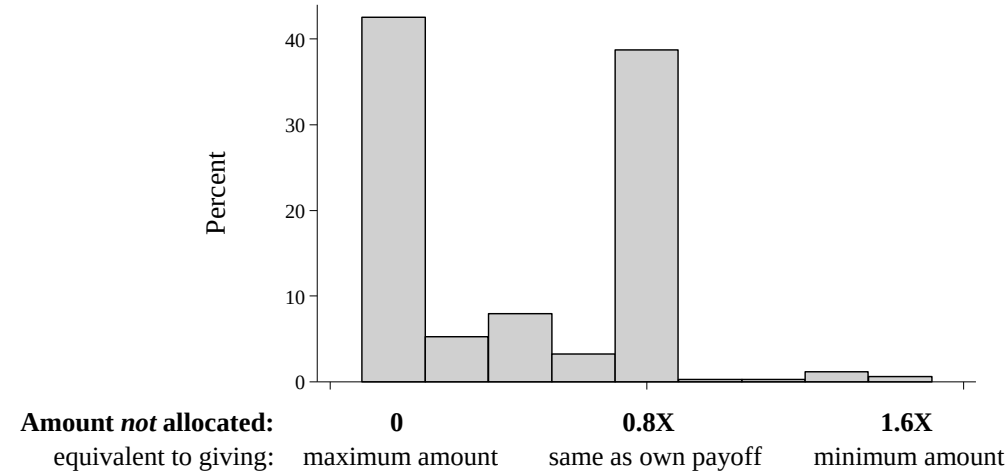

Figure 4: Amount not allocated to the other player (Envy)
(n=341, X=decision maker's payoff)

[31] In the experiment: d = 0.8X with X = 50 Swiss francs for the households in the first wave and X=25 for households in the second wave (as the latter households received a flat payment of 10 Swiss francs for participating).

The Dictator game

We used a dictator game in order to measure fairness regarding another participant, a motive of positive social preferences. In the dictator game, Player 1 receives an amount of money Z which she can distribute between herself and another Player. Thus, in this game being prosocial is costly. In our Dictator Game, the minimum share Player 1 can allocate to a player is restricted to 10 percent of Z.[32] Figure 5 shows a histogram for the share of Z allocated to the other player. More than 60 percent of participants establish perfect equality.[33] The second largest fraction of participants chooses the selfish option.

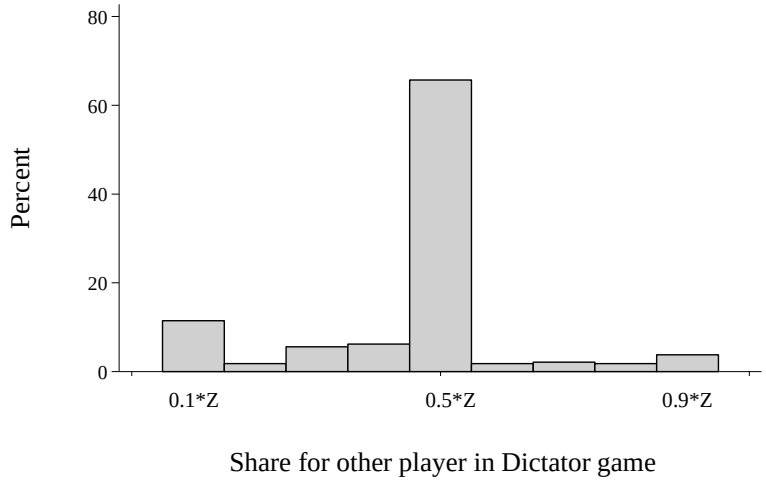

Figure 5: Share for other participant in the dictator game
(n=341, Z = pie to be divided among the two players)

5 Heterogeneous preferences, energy efficiency and consumption

Finally, we turn to the relation of our preference measures and energy efficiency and consumption. A natural way to think about investments in energy efficiency is to assume that households first decide on whether or not to renovate at all and second, they decide on the exact energy enhancements they want to achieve by retrofitting their home. Therefore, we first focus on the

[32] Z = 100 Swiss francs for the households in the first wave and 50 Swiss francs for households in the second wave (as the latter households received a flat payment of 10 Swiss francs for participating).
[33] As already documented by Engel (2011), also our non-student subjects give much more than usual student subjects.

decision to renovate the house in general and second analyze how the energy quality of the house relates to preferences contingent on renovation activity. As previous studies have shown that social norms impact households' decisions in energy conservation (Allcott, 2011; Baddeley, 2011) and therefore, house energy quality as well as renovation behavior of homeowners living in the same area may be correlated, we use cluster-robust standard errors with clustering on postal codes.[34]

In Section 5.1 we analyze how preferences relate to the renovation decision of homeowners. In Section 5.2 we study the impact of respondents' preferences on the energy efficiency of the house. Finally, in Section 5.3 we discuss the results and shed light on how preferences affect energy consumption behavior.

5.1 Renovation decision

Table 3 presents results from probit regressions explaining participants' decisions to renovate. In Model (1) we estimate the probability of having renovated in the past. In Model (2) we estimate the probability that participants have renovated in the past or plan to renovate in the future. Explanatory variables are the preference measures presented in the previous section: general risk preferences, time preferences, environmental preferences, as well as envy and fairness preferences.[35] Model (3) and Model (4) replicate models (1) and (2) controlling for the age class of the house and its size in square meters, which should take other (unobserved) factors about renovation costs and benefits into account.[36] Further, we control for homeowners' gender, age and financial position.

[34] We also ran the analysis with clustering on cantons and without clustering. The results are qualitatively similar. Also note that we do not find a statistically significant correlation between elicited risk attitudes and discount factors (ρ=0.070, p = 0.196) such that we are unlikely to encounter a problem of multi-collinearity due to including, both, risk attitudes and time preferences in our models at the same time.

[35] Note that we rescaled the share for the other participant in the Envy Game such that the decisions range, as in the Dictator Game, from 0.1 to 0.9. Envy is low and equals 0.1 when the participant chooses 1.8X for the other participant whereas it is high and equals 0.9 when the participant chooses 0.2X to the other participant. A participant who chooses X for the other participant looks for equality and the value of envy is 0.5.

Table 3: Decision to renovate

	(1)	(2)	(3)	(4)
	Past renovation	Past or future renovation	Past renovation	Past or future renovation
Risk-taking (from 1 to 5)	**0.060***	**0.056****	**0.058****	0.049
	(0.032)	(0.026)	(0.029)	(0.030)
Discount factor (from 0.747 to 1)	0.142	0.167	-0.043	-0.057
	(0.352)	(0.304)	(0.487)	(0.380)
Pro-environmental (from 0 to 9)	0.015	0.014	0.006	0.006
	(0.009)	(0.010)	(0.011)	(0.012)
Envy (from 0.1 to 0.9)	-0.069	**-0.208***	0.184	-0.023
	(0.099)	(0.112)	(0.127)	(0.131)
Fairness (from 0.1 to 0.9)	**-0.236****	**-0.213****	-0.015	0.005
	(0.100)	(0.106)	(0.124)	(0.131)
14-17 year old house			0.034	-0.005
			(0.076)	(0.066)
18-32 year old house			**0.400*****	**0.354*****
			(0.082)	(0.064)
House older than 32 years			**0.685*****	**0.586*****
			(0.034)	(0.034)
Log(House size)			0.005	0.093
			(0.082)	(0.070)
Female			-0.090	-0.027
			(0.077)	(0.072)
Age			-0.001	-0.002
			(0.003)	(0.004)
Good financial position (from 1 to 3)			-0.013	0.007
			(0.123)	(0.094)
Observations	341	341	341	341
# of clusters (postal code)	166	166	166	166
Pseudo R-squared	0.0160	0.0183	0.275	0.237

Note: robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regressions in Table 3 show that among our preference measures individuals' risk preferences are the main driver of past renovations. Participants who declare being more risk seeking in general have a higher probability of having had their house renovated in the past. Including future renovation plans in the dependent variable (see Model (2)) does not change this relation much. In line with Hypothesis 1, households seem to perceive renovations as risky investments.[37] Interestingly, time and pro-environmental preferences do not significantly relate to the renovation

[37] As mentioned earlier, we also elicited risk attitudes in specific domains. Conducting the same econometric analysis as in (3) using domain specific risk measures (available on request) shows that people who are more willing to take risks in financial matters or in their career are more likely to have renovated their homes whereas risk attitudes in car driving or sports do not relate significantly to the renovation decision. Further note that observed effect of risk attitudes is not necessarily limited to renovation behavior but may apply also to other consumer durables (see also Volland, 2017).

decision. Fairness and envy appear significant in model specifications (1) and (2) but turn out to be statistically insignificant when further controls are taken into account (see models (3) and (4)). As already observed e.g. by Alberini et al. (2011), older houses are more likely to have been renovated.

Result 1: *Homeowners who are more likely to take risks are more likely to renovate.*

5.2 Energy efficiency of the house

In the following we present results on how individual preferences relate to the energy quality of the house. We report results from OLS regressions explaining the estimated overall quality of the house in Table 4. In models (1) and (2), we regress the estimated overall quality of the house based on risk, time, environmental, and social preferences (envy and fairness preferences). In models (3) and (4), we add the age and size of the house and participants' gender, age and financial position as additional controls. In models (1) and (3), we consider all households. If we think about a renovation decision as a two-step procedure in which households first decide on whether or not to renovate and second, decide on the exact energy enhancements they want to achieve by retrofitting their home, it is worthwhile to investigate whether heterogeneity of preferences can explain the efficiency of houses among renovators separately. Therefore, in models (2) and (4), we restrict the analysis to households who already renovated their house. Additionally we run a Heckman selection analysis in Model (5), which takes the potential selection of homeowners who renovated into account and uses variables indicating the age of houses solely in the selection equation.[38]

[38] The qualitative results on the relation between our preference measures and outcome variables are robust to alternative specifications of the Heckman model. As one alternative selection criterion, we used whether a house was built before or after the announcement (1985) or official recommendation (1988) of new building standards (SIA 380/1), as these standards reduce the scope for energy efficient renovations (see also Jakob, 2007a). However, changes in building standards may correlate even stronger with energy efficiency than house age classes. A second alternative criterion was whether the house was built before 2000 (controlling for the age of the house) and thus whether

Table 4: Estimated overall energy quality of houses and Heckman selection

	(1)	(2)	(3)	(4)	(5)	
	Full sample	Renovated houses	Full sample	Renovated houses	Heckman selection model	
Dependent variable	Estimated energy quality				Selection: Renovated (Yes/No)	Estimated energy quality
Risk-taking (from 1 to 5)	**0.072*** **	0.009	**0.077*** **	0.017	**0.140** **	0.044
	(0.021)	(0.044)	(0.022)	(0.042)	(0.066)	(0.045)
Discount factor	0.208	**1.139*** **	0.362	**1.257*** **	0.063	**1.029*** **
(from 0.747 to 1)	(0.238)	(0.395)	(0.286)	(0.448)	(1.224)	(0.309)
Pro-environmental	0.003	0.001	**0.012***	**0.020** **	0.012	**0.021*** **
(from 0 to 9)	(0.006)	(0.006)	(0.006)	(0.009)	(0.028)	(0.008)
Envy	**0.190** **	**0.350*** **	0.021	0.136	0.401	**0.204***
(from 0.1 to 0.9)	(0.079)	(0.106)	(0.071)	(0.101)	(0.309)	(0.116)
Fairness	**0.240** **	**0.335*** **	0.080	**0.203*** **	-0.207	**0.186** **
(from 0.1 to 0.9)	(0.093)	(0.100)	(0.075)	(0.071)	(0.291)	(0.082)
14-17 year old house			-0.026	0.162	-0.016	
			(0.041)	(0.120)	(0.164)	
18-32 year old house			**-0.149*** **	0.048	**0.849*** **	
			(0.036)	(0.075)	(0.240)	
House older than 32 years			**-0.449*** **	**-0.280*** **	**2.070*** **	
			(0.034)	(0.076)	(0.145)	
Log(House size)			**0.102** **	**0.205*** **	0.030	**0.207*** **
			(0.044)	(0.028)	(0.225)	(0.036)
Female			0.038	-0.003	-0.219	-0.021
			(0.036)	(0.039)	(0.186)	(0.057)
Age			**0.007*** **	**0.007***	0.001	**0.007** **
			(0.003)	(0.004)	(0.009)	(0.003)
Good financial position			0.023	0.068	-0.017	0.068
(from 1 to 3)			(0.027)	(0.041)	(0.299)	(0.086)
Constant	2.767***	1.933***	1.818***	0.278	-1.513	0.090
	(0.311)	(0.466)	(0.631)	(0.687)	(1.150)	(0.715)
Observations	341	145	341	145	341	341
# of clusters	166	41	166	41	166	166
R-squared / λ	0.033	0.060	0.221	0.252	0.316	
Robust Std. Error of λ					(0.031)	

Note: Cluster-robust standard errors in parentheses. Model (5): $\lambda=\rho\sigma$, where ρ=correlation of the error terms of the two regressions, σ= the standard error of the residual in the efficiency equation; *** p<0.01, ** p<0.05, * p<0.1

Result 1 has shown that the more risk-taking homeowners are, the higher is the probability to renovate. In turn, models (1) and (3) in Table 4 indicate that participants who are more risk-taking have a higher estimated overall home quality with respect to energy efficiency. Models (2) and (4) shed more light on those households who decided to renovate their house. First note that risk

renovations were eligible for receiving subsidies for energy efficient renovations by the Swiss Gebaeudeprogramm (www.dasgebaeudeprogramm.ch). However, only 16 houses in our sample are not eligible for these subsidies.

attitudes do not predict higher energy efficiency among renovators. Instead, risk attitudes appear to matter for the decision to renovate in general.[39] Second, the estimated overall quality of renovated houses increases in households' discount factor. The Heckman selection Model (5) confirms these findings. It shows that risk taking is important for the decision to renovate (selection) but discount factors significantly relate to the estimated efficiency of the house (conditional on having been renovated). In line with Hypothesis 2, more future-oriented renovators have a significantly higher overall energy quality.

Result 2: *Future-oriented renovators have a significantly higher estimated energy quality.*

In regression models (3), (4) and (5), in which we add controls for the age and size of the house as well as the homeowner's gender, age and a proxy for her financial position, we find that also pro-environmental preferences also relate positively to the overall quality of their house.

Result 3: *Pro-environmental homeowners have a significantly higher estimated energy quality.*

We now turn to social preferences. Recall, we use two different measures for social preferences, fairness and envy. We find that the share offered to the other player in a Dictator Game tends to relate positively to the energy quality of the house. Interestingly, also Envy as measured in the Envy Game tends to relate positively to the energy quality. Those who dislike being behind in the experiment are also more likely to invest in energy efficiency. Focusing on Model (4), which includes our additional controls, only the fairness coefficient is significant. However, taking the

[39] These findings suggest that a negative relationship between risk aversion and energy efficient retrofits (as observed e.g. in Qiu et al., 2014) may stem rather from the perceived uncertainty of the act of renovating than from uncertainty about the benefits from energy efficient retrofits.

potential selection into account, both coefficients are insignificant for the renovation decision but significant for the estimated efficiency of renovated houses (see Model (5)). We summarize this finding in Result 4:

Result 4: *Renovators who care about inequality, i.e. those who are fair in the Dictator Game and envious in the Envy Game, have a higher estimated energy quality.*

5.3 Energy consumption and preferences

We now turn to the question of whether our preference measures significantly relate to energy consumption behavior. To be able to do so, we elicited for the subsample of homeowners in the second wave the annual heating and electricity costs. In Table 5, we regress the logarithm of total heating and energy costs on our preference measures. Model (1) includes only the preference measures as dependent variables. As hypothesized, pro-environmental preferences relate negatively to the annual heating and electricity cost but social preferences do not significantly relate to electricity and heating costs. In Model (2) we additionally add a set of control variables that are likely to influence heating and electricity cost (the age and size of the house, the number of persons in the household as well as gender, age and the financial position of the owner). To control for the energy efficiency of the house, we also include the estimated energy quality of the house as an explanatory variable in Model (2). Even if we do so, pro-environmental homeowners have lower heating and electricity costs. Although our theoretical framework does not predict differences in energy consumption for more future oriented homeowners, the regressions in Table 5 indicate that homeowners with high discount factors have lower heating and electricity costs; even when we control for the energy efficiency of the house. We conclude with Result 5:

> ***Result 5:*** *Pro-environmental and future oriented homeowners have lower heating and electricity cost (controlling for the estimated energy quality of the house).*

Table 5: Annual heating and electricity costs

	(1)	(2)
Dependent variable:	Log of Annual Heating and Electricity Costs	
Risk-taking (from 1 to 5)	0.034	0.045
	(0.039)	(0.041)
Discount factor (from 0.747 to 1)	**-0.547***	**-0.635****
	(0.312)	(0.281)
Pro-environmental (from 0 to 9)	**-0.047*****	**-0.041*****
	(0.015)	(0.015)
Envy (from 0.1 to 0.9)	-0.101	-0.058
	(0.152)	(0.147)
Fairness (from 0.1 to 0.9)	-0.057	0.019
	(0.227)	(0.199)
14-17 year old house		-0.010
		(0.061)
18-32 year old house		-0.124
		(0.096)
House older than 32 years		0.128
		(0.117)
Log(House size)		**0.180***
		(0.101)
Number of household members		**0.155*****
		(0.051)
Number of household members^2		**-0.014****
		(0.006)
Female		-0.028
		(0.078)
Age		**0.007****
		(0.003)
Good financial position (from 1 to 3)		-0.030
		(0.080)
Estimated energy quality (from 2.535 to 4.045)		-0.071
		(0.092)
Constant	**8.601*****	**7.232*****
	(0.341)	(0.711)
Observations	169	169
# of clusters	153	153
R-squared	0.085	0.214

Cluster-robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6 Conclusions and policy implications

The building sector is one of the most energy consuming sectors but also offers large possibilities for greenhouse gas abatement. A reduction in households' energy consumption can help to reduce greenhouse emissions and is crucial for sustainable development of the housing market. For a better understanding of households' behavior in terms of reduction of energy expenses in their homes, we analyze which preferences of households drive their investments in energy saving

measures for their houses. First, homeowners' willingness to take risks relates positively to the likelihood of having renovated the house. Second, renovators who are pro-environmental or value the far future more than the near future live in houses with higher energy efficiency. Third, pro-environmental and future oriented homeowners have lower heating and electricity cost (controlling for the quality of their home).

Our results provide a better understanding of households' investments into a public good (the environment) in a complex context with uncertain and future returns. We observe that private returns from the public good are the first dimension households take into account. The fact that returns are uncertain and occur in the future drives households' decisions whether to renovate and to what extent. Policies aimed at enhancing energy efficient building renovation (or construction) may therefore focus on providing financing schemes that reduce the risk of the renovation. However, such schemes may also be provided by the market. For instance, (risk neutral) energy companies may engage in supporting energy efficient renovations by sharing the costs, risks as well as the benefits of future savings. By this means, contracting on renovations may help to realize investments which are profitable but too risky to be undertaken by homeowners who are not willing to take risks themselves. Similar to zero-percent financing and leasing models that help customers to buy energy efficient refrigerators or washing machines, such a policy could make the housing sector more sustainable. Similarly, policies may aim at providing "early benefits" for homeowners who decide to renovate in order to make less future oriented homeowners more willing to renovate in a more energy efficient way.

Apart from potential policy implications our study also provides insights on the external validity of preference measures developed and commonly used in laboratory experiments. We find that several of our incentivized preference measures relate in the expected way to renovation and energy consumption behavior. Thus, reluctance in investments should not necessarily be understood as an individual energy efficiency gap but also as a reflection of homeowners' risk,

time environmental and social preferences which have to be taken into account when designing policies to reduce externalities for society and the environment.

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Online Appendix: Survey and experimental material

Below we provide the material used in the second wave (translated from German).

i. Letter (page 1)

John Doe
123 Main Street
87654 Swisstown,
Switzerland

October 25, 2011

Study on Swiss home owners' investment behavior

Dear Mr. Doe,

The Thurgau Institute of Economics (TWI) is an institute associated with the University of Constance and is financed by the Thurgau Foundation for Science and Research. Supported by the Swiss Federal Office of Energy (SFOE), we are currently carrying out a study on investment decisions of home owners. The objective of the study is to develop meaningful assistance measures for investments.

You have been randomly selected out of a group of Swiss building owners as a possible participant of the study. We would be very pleased if you supported our research project. The study uses new research methods from behavioral economics. That is, apart from answering a survey questions, you will also make decisions about monetary amounts. As usual in behavioral economics, you will receive real monetary amounts. For your participation, you will be receive between 15.- and 118.- Sfr. The completion of the necessary documents of the study takes about 10 to 20 minutes.

The supplementary sheet "information for participants" provides you with information on the most important questions. Further information is provided online at www.investitionsstudie.twi-kreuzlingen.ch. If you have any further questions, please do not hesitate to contact us either by email: investitionsstudie@twi-kreuzlingen.ch or telephone: 071 677 05 18. Your contact person for this study is Simeon Schudy.

We are looking forward to your response.

Kind regards,

Prof. Dr. Urs Fischbacher

Director of the Thurgau Institute of Economics (TWI)

Attachments: Information for participants, questionnaire, return envelope, supplementary sheet for payment.

ii. Letter (page 2)

Information for participants

Data Protection and Data Use

The Thurgau Institute of Economics (TWI) guarantees to analyze only anonymized data. The data will solely be used for scientific purposes. Commercial use of the data is prohibited. Individual data will not be provided to third parties.

Who should fill out the questionnaire?

The questionnaire shall be filled out by the person in the household, who is primarily involved in making the household's investment decisions.

Why should I participate?

If you participate, you contribute to fundamental research on investment decisions and help to develop new assistance measures for investments. Additionally, you receive a financial compensation for your participation.

How do I participate and how do I receive the financial compensation?

We ask you to put the completed material in the provided envelope and mail it to the Thurgau Institute of Economics. We will send you the Fr. 10.- for your participation as well as the additional payment, which results from your decisions, via mail. The budget of this study is large enough to monetarily compensate all participants. More information on the selection of the relevant payments for your decisions is provided at: www.investitionsstudie.twi-kreuzlingen.ch

Explanation of the approach of behavioral economics

Behavioral Economics is a sub-discipline in economics that studies human behavior in economically relevant decision situations. Behavioral economists use monetary payments to create decision environments that reproduce economically relevant decision environments. Study participants make decisions that affect their payments. Results from such studies provide insights for socially relevant problems. For example, behavioral economics studies questions such as:

Why do we observe speculative bubbles on stock markets?

Which incentives do bonus-contracts create?

How can we manage common property?

Although Behavioral Economics is a young research discipline, in 2002 Vernon Smith received the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel for the use of these research methods. In 2009, Elinor Ostrom, who also applied the methods from Behavioral Economics, received this Economics Nobel prize as the first woman. Similarly, we use methods from behavioral economics this study. You will make decisions about monetary payments and you will receive monetary amounts based on your (or others) decisions.

You have more questions? – Contact us!

Email: investitionsstudie@twi-kreuzlingen.ch
Phone: 071 677 05 18
Internet: www.investitionsstudie.twi-kreuzlingen.ch
You would like to know more about our research?
Visit our website at the University of Konstanz:
http://expecon.wiwi.uni-konstanz.de/

iii. Letter (page 3)

Supplementary sheet for payment (please enclose in return envelope)

Dear Mr Doe,

Please return this sheet together with the completed questionnaire. On receipt, we will separate the sheet from the questionnaire. It is only used for the payment of your decisions.

The amount of money, resulting from your decisions, is to be paid to:

John Doe

iv. Questionnaire and incentivized decision tasks

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an der Universität Konstanz

Investment decisions (building)

Please answer the following questions about your building.

What kind of building do you own?	□ single family house	□ apartment building
Do you live in the building?	□ yes	□ no
How large is the living space of the building (approx.)?		_ _ _ _
How many sources of light exist in the building (approx.)?		_ _ _ _
How many light sources use energy efficient bulbs?		_ _ _ _
How many people live in the building (approx.)?		_ _ _ _
How large are your annual heating costs (approx.)?		_ _ _ _ Fr.
How large are your annual electricity costs (approx.)?		_ _ _ _ Fr.
When was the building build (year)?		_ _ _ _
When was the building renovated for the last time (year)?		_ _ _ _
Is a renovation planned in the future?	□ yes, in (year)	_ _ _ _ □ no

What is the current state of the …

Windows:	□ very good insulation (triple insulated) □ normal insulation (coated glass, complete rubber coating) □ medium-old insulation (uncoated glass, no rubber insulation) □ old insulation (single glass pane, no coating)
Facade:	□ improved insulation □ standard insulation □ no insulation but recently painted □ Old, no insulation, not recently painted
Ventilation:	□ Controlled ventilation □ no controlled ventilation
Roof:	□ very good insulation □ normal insulation □ middle-old insulation □ old insulation

How do you heat the house mainly (check as many as apply)?

□ oil firing □ gas firing □ wood firing □ electric heating □ heat pump

□ other:_____

How do you rate the energy efficiency of your house?

□ Very low □low □medium □high □very high

How do you rate the energy efficiency of buildings in the direct neighborhood?

□ Very low □low □medium □high □very high

Does your building fulfill a MINERGIE® - Standard? □ yes □ no

Attitudes and Investment behavior

Are you a person willing to take risks or do you try to avoid risks?
Please rate your willingness to take risks in the following areas.

	not at all risk seeking				very risk seeking
in general	☐	☐	☐	☐	☐
in car-driving	☐	☐	☐	☐	☐
in financial decisions	☐	☐	☐	☐	☐
in leisure and sport	☐	☐	☐	☐	☐
in your professional career	☐	☐	☐	☐	☐

To what extent do you agree personally with the following statements?

	No approval				full approval
People in our society should be dutiful.	☐	☐	☐	☐	☐
We are approaching the limit of people, who can be fed by the earth.	☐	☐	☐	☐	☐
To survive, people have to live In harmony with nature	☐	☐	☐	☐	☐
People in our society should Accomplish something in their work.	☐	☐	☐	☐	☐
People do not have to adapt to nature, because they can re-establish nature to their own best.	☐	☐	☐	☐	☐
People in our society should help and support each other.	☐	☐	☐	☐	☐

If you reflect how you (and your partner) managed on with your income in 2010: What describes the situation best?

☐	At the end of the month there was a lot of money left.
☐	At the end of the month there was frequently some money left.
☐	There was only money left, if an additional non-recurring income occurred.
☐	At the end of the month it was often not enough.
☐	At the end of the month the money was never enough.

Which of the following statement fits best your (and your partner's) savings behavior?

☐	I/we save a fixed amount regularly, in a savings account, a savings contract, shares or life insurance.
☐	I/we save some money every month, but I/we adjust the amount to the current financial situation.
☐	I/we save something, if there is something to save left.
☐	I/we do not save, because there is little leeway for saving.
☐	I/we do not want to save but instead enjoy our life today.

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Decision making situations

We kindly ask you now to make several decisions about different monetary amounts.

- You will receive a monetary amount for your participation.
- The amount you receive depends on your and other participants' decisions.
- For each participant, exactly one decision will be paid.
- It will be randomly determined which decision will be paid
- The budget is large enough to pay all participants

You will receive a flat payment of Fr. 10.- for participating in this study. On receipt of your completed questionnaire, the payment will be sent to you by mail (within a month). Additionally, you will receive an amount of money from one of the decision making situations ranging from Fr. 5.- to Fr. 108.-.

You find detailed information about the payment procedure on:

www.investitionsstudie.twi-kreuzlingen.ch

Decision Situation 1

Your decision:

- You decide how much money another randomly chosen participant receives
- If your decision is chosen to be paid, you receive Fr. 25.- and another randomly chosen participant receives the amount you chose (Fr. 5.- to Fr. 45.-)

How do you distribute the money?

You Receive	Fr. 25.-								
Another participant receives	Fr. 45.-	Fr. 40.-	Fr. 35.-	Fr. 30.-	Fr. 25.-	Fr. 20.-	Fr. 15.-	Fr. 10.-	Fr. 5.-
Your decision	☐	☐	☐	☐	☐	☐	☐	☐	☐

Please select exactly one amount!

You may also be randomly selected to be paid an amount determined by a randomly chosen participant.

You have selected exactly one amount? Please continue with Decision Situation 2.

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Situation 2

Your decision

- You will decide on how Fr. 50.- are divided between you and another randomly chosen participant
- This is not the same participant as in Decision Situation 1.

How do you distribute the money?

You Receive	Fr. 5.-	Fr. 10.-	Fr. 15.-	Fr. 20.-	Fr. 25.-	Fr. 30.-	Fr. 35.-	Fr. 40.-	Fr. 45.-
Another participant receives	Fr. 45.-	Fr. 40.-	Fr. 35.-	Fr. 30.-	Fr. 25.-	Fr. 20.-	Fr. 15.-	Fr. 10.-	Fr. 5.-
Your decision	☐	☐	☐	☐	☐	☐	☐	☐	☐

Please select exactly one amount!

You may also be randomly selected to be paid an amount determined by a randomly chosen participant.

You have selected exactly one amount? Please continue with Decision Situation 3.

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Situation 3

Your decision:

- Do you want to receive Fr. 80.- in one month (after we receive your questionnaire) or a higher amount B in seven months?
- Please make this decision for the twelve amounts in the list below.
- If Decision Situation 3 is selected to be paid, you will receive the money in one month if you chose amount A and in seven months if you chose amount B.

Please make your choice – amount A (Fr . 80.-in one month) or amount B (higher amount in 7 months) - for each decision number in the respective column.

Decision number	Amount A (in one month)	Your choice	Amount B (in seven months)
1	Fr. 80.-	☐ A ☐B	Fr. 80.00
2		☐ A ☐B	Fr. 80.50
3		☐ A ☐B	Fr. 81.00
4		☐ A ☐B	Fr. 82.00
5		☐ A ☐B	Fr. 83.50
6		☐ A ☐B	Fr. 85.50
7		☐ A ☐B	Fr. 88.00
8		☐ A ☐B	Fr. 91.00
9		☐ A ☐B	Fr. 94.50
10		☐ A ☐B	Fr. 98.50
11		☐ A ☐B	Fr. 103.00
12		☐ A ☐B	Fr. 108.00

Please chose in each row either amount A or B

You have ticked an answer in each row? Then continue with the statistical information

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General Information

Are you?	☐female	☐male	
How old are you?	_ _		
Which is your highest degree of education?	☐ apprenticeship	☐Matura	☐University degree
	☐ other _____		
Do you vote?	☐ regularly	☐ sometimes	☐ never
Do you donate?	☐ regularly	☐ sometimes	☐ never

If you donate, to which kind of organizations do you give?

☐ environmental associations

☐ Social organizations

☐ cultural organizations

☐ Education and Science

☐ other: _____

How much do you donate per year (in Swiss Francs)? _____

Thank you for participating in our study!

You can donate a part of your payment for participation (at most 60%) to one of the environmental associations listed below.

- We will double your donation.
- If you give more than 40% of your payment you have the option to have your name published in a list of donors in the daily newspaper Tagesanzeiger.
- The amount donated will not be published.
- If you want us to publish your name, please fill in your name for publication here:
  _____

Which part of your payment do you want to donate?

☐0% ☐10% ☐20% ☐30% ☐40% ☐50% ☐60%

To which organization do you want to donate?

☐WWF ☐Greenpeace ☐Stiftung Bergwaldprojekt ☐equiterre (SGU)

Room for your comments

Thurgauer Wirtschaftsinstitut an der Universität Konstanz, Hauptstrasse 90, 8280 Kreuzlingen 2.
Phone 071 677 05 18, Email: investitionsstudie@twi-kreuzlingen.ch.
Contact person: Simeon Schudy.

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