Contractual Savings for Housing as a Commitment Device

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Abstract

Individuals struggling with self-control problems may benefit from precommitment. This study examines whether individuals with self-control problems use commitment devices in the form of contractual savings for housing (CSH), which is a well-established savings product that promotes household savings and homeownership. The empirical analysis is based on nationally representative German Socio-Economic Panel (SOEP) data. The education level is used as a proxy for sophistication to differentiate between sophisticated and naïve discounters, and the self-control problem is modeled by using self-assessed impulsivity and patience. The results suggest that the relationship between impulsivity and the take-up of CSH critically depends on sophistication and patience. Notably, there is a positive relationship between impulsivity and take-up among patient sophisticated individuals. This pattern demonstrates how future-oriented individuals aware of their self-control problems may use commitment devices in the form of CSH.

Keywords: *Commitment device, hyperbolic discounting, contractual savings for housing, impulsivity, patience, SOEP*
JEL classification: *D12, D14, D91*

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1. Introduction

Resisting temptation is challenging. For example, one can decide before going to a restaurant not to have dessert, but once the dessert menu is in one's hand, it is often tempting to have some. However, if one could completely remove the dessert menu beforehand, the person would not have to face this decision in the restaurant at all (Ariely & Wertenbroch, 2002). The ability to limit future choice set is likely to appeal to individuals struggling with self-control problems, as it enables precommitment (Angelini et al., 2020; Sourdin, 2008). Commitment devices are arrangements designed to limit individuals' future choice sets by making some choices more expensive or unreachable (Bryan et al., 2010). In the domain of financial behavior, the use of commitment devices helps individuals to withhold from current consumption and to save for the future. This article examines whether individuals aware of their self-control problems use such devices. The empirical analysis is based on the example of a well-established savings product that aims to encourage households to save for their own homes: contractual savings for housing (CSH).

Previous studies suggest that there is a demand for precommitment (Schilbach, 2019) and that commitment devices can enhance savings and, thus, provide a useful tool for controlling impulsive financial behavior (e.g., Ashraf et al., 2006; Cobb-Clark et al., 2021). However, existing research offers inconclusive evidence regarding the connection between self-control problems and the take-up of commitment devices. Moreover, most empirical evidence is based on randomized controlled trials (RCTs; e.g., Ashraf et al., 2006; Beshears et al., 2020; Burke, et al., 2018; John, 2020; Karlan & Linden, 2014). Even though RCTs provide valuable information on the commitment devices' potential, the saving products used in them can be unrealistic and unsustainable, with high rates of return and short saving periods. Thus, these settings do not provide direct evidence on the adequacy of existing savings products. Thus far, only limited attention has been paid to existing savings products and their ability to function as commitment devices. Earlier studies have mainly focused on retirement savings (e.g., Guo & Finke, 2018; Sourdin, 2008; Thaler & Benartzi, 2004) and rotating savings and credit associations (RoSCA; e.g., Dagnelie & Lemay-Boucher, 2012; Dupas & Robinson, 2013; Rabie, 2021). This article contributes to the literature by examining whether households use CSH as a commitment device.

CSH is a well-known financial product that is used in many European countries (e.g., Austria, France, Germany, and the Czech Republic) to help people accumulate savings to buy a home or to save in general (Kirsch & Burghof, 2018). Once a household's CSH savings reach a predetermined threshold, it becomes eligible for a mortgage. CSH includes elements that are common in commitment devices and strategies that aim to improve self-control: CSH is relatively illiquid, it has a clearly stated savings goal, and it gives the saver strict external rules or a schedule to follow. According to Angelini et al. (2020) homeownership itself can be used as a commitment device, and possession of illiquid assets such as retirement and life insurance savings often precedes the home purchase. In Germany, a large part of saving and financing for housing is conducted through a CSH called *"Bausparvertrag"*. Despite its popularity, significance in the housing market, and the state support it receives, empirical research on CSH is scarce (Kirsch & Burghof, 2018).

This study investigates whether individuals with self-control problems use CSH as a commitment device in Germany, making four key contributions to the literature. First, it examines an existing savings product rather than an artificial one, as is typically used in RCTs. Second, it investigates a rarely studied savings product that has not been previously studied as a commitment device. Third, it utilizes the German Socio-Economic Panel (SOEP), a nationally representative household panel survey that offers revealed preference data on savings along with relevant proxies for biases in decision-making, thereby enhancing the external validity of the findings. Fourth, while CSH may seem unnecessary in countries where households have access to well-functioning financial markets, previous research has offered rationale for its use (e.g., Burghof & Schairer, 2017; Kirsch & Burghof, 2018; Plaut & Plaut, 2004). This article contributes to the literature by demonstrating that some households utilize CSH as a commitment device. In doing so, this article deepens our understanding of how financial products can be used as commitment devices, ultimately contributing to increased individual welfare and the overall well-being of society.

2. Background literature

2.1 Self-control problems and intertemporal choice

Choosing to save is essentially an intertemporal choice between present and future consumption. Due to the problems with self-control, people may be unable to withhold their present consumption and, therefore, they may be unable to optimize their consumption over time. The types of self-control problems described in this study are assumed to arise from time-inconsistent preferences. In behavioral economics, the most common method used to model intertemporal choice is quasi-hyperbolic discounting[1] (Ericson & Laibson, 2018; Laibson, 1997; O'Donoghue & Rabin, 1999). This model (also called the βδ-model) is presented formally in Eq. (1), where utility (U) is a function of current consumption $u(c_t)$ and future consumption levels $u(c_{t+k})$. In this model, β refers to the degree of present bias (i.e., individuals' tendency to overvalue present payoffs compared to future payoffs), and δ is the exponential discount factor. When $\beta = 1$, the model is equivalent to the classical exponential discounting model and thus implies time-consistent discounting. However, $\beta < 1$ implies time-inconsistent discounting where additional value is placed on the present consumption (i.e., future consumption is discounted relatively more and thus valued less).

$$U(\{c_t, c_{t+1}, \dots c_T\}) = u(c_t) + \beta \sum_{k=1}^{T-t} \delta^k u(c_{t+k}) \quad (1)$$

From a psychological perspective, the present bias parameter β can be considered an indicator of impulsivity capturing self-control problems and the discount factor δ one of patience representing individual's future orientation (Sourdin, 2008). Both impulsivity and patience determine an individual's preferences regarding consumption over time. Previous studies have linked impulsivity to lower wealth accumulation (Biljanovska & Palligkinis, 2018), higher usage of consumer credit (Ottaviani & Vandone, 2011), and over-indebtedness (Gathergood, 2012), while patience has been connected to long-term savings (Falk et al., 2018; Finke & Huston, 2013).

Based on individual-level differences in impulsivity and people's awareness of their own impulsivity, individuals can be divided into three groups: naïve, sophisticated (partially and fully), and time-consistent. Naïve individuals are not aware of their self-control problems and are not consciously trying to precommit to goals to avoid the outcomes of impulsive behavior. Sophisticated individuals are aware of their self-control problems and might either use commitments or choose not to withhold consumption. Partially sophisticated individuals are not fully aware of their self-control problems and might estimate them poorly. This can lead to both under and over commitments, which may increase the probability to default (John, 2020). Time-consistent individuals do not have present bias and do not need commitment devices to help with their behavior.

Since naïve individuals are likely to underestimate their impulsivity (Cobb-Clark et al., 2021), the βδ-model predicts the demand for commitment devices only for sophisticated individuals. Even though previous research rarely identifies sophisticated individuals directly, it often infers sophistication from the take-up of commitment devices. Nonetheless, there are some notable exceptions. One approach has been to use the comparison between the ideal, predicted, and actual future behaviors (O'Donoghue & Rabin, 1999). For example, Cobb-Clark et al. (2021) identified naïfs, sophisticates, and time-consistent individuals using a combination of the individual's ideal, predicted, and actual body weight[2]. The study found that, compared to naïve individuals, sophisticates are more educated (as are their parents), have higher IQ, and are more likely to use commitment devices for exercising and saving. Importantly, sophistication seems to often compensate for the self-control problems, highlighting the importance of being aware of one's self-control (Cobb-Clack et al., 2021).

In theory, the take-up of savings products to precommit should be driven by sophisticated individuals, since they are the ones aware of their self-control problems. However, as savings products also typically have other lucrative features, such as a high rate of return, it is likely that people, regardless of their self-control problems, use these products. Beshears et

[1] *More on intertemporal choice and quasi-hyperbolic discounting see for example Ericson & Laibson (2018) or Wilkinson & Klaes (2012) pp. 260–332.*

[2] *Mandel et al. (2017) used dessert consumption and Wong (2008) used exam preparation.*

al. (2020) suggest that the higher rate of return on commitment devices increases their overall take-up, as these products attract not only sophisticated discounters but also time-consistent and naïve individuals due to these other appealing features. Also, the level of liquidity might play a role in the take-up of commitment devices. Naïve and time-consistent individuals may prefer more liquid savings products (Sourdin, 2008). Therefore, the greater deposits observed in such products (i.e., soft commitment devices)[3] by Burke et al. (2018) may reflect the behavior of individuals other than sophisticated discounters. Beshears et al. (2020) further suggest that the take-up of commitment devices by sophisticated individuals is higher when a device has a higher penalty (i.e., the harder the commitment, the higher the take-up). Besides the potential cost due to the penalty for failure, the cost of commitment (such as a participation fee) may influence the demand (Schilbach, 2019). Consequently, commitment devices can help both naïve and sophisticated individuals to alter their impulsive behaviors, even if this might take place unknowingly for naïve individuals (Beshears et al., 2020; Mandel et al., 2017).

2.2 Measurement of self-control problems

Previous research has typically assumed that the demand for savings commitment devices originates from sophisticated individuals despite these studies not having the ability to detect the level of sophistication or, sometimes, not even measuring self-control problems. This assumption is credible if the commitment device does not have other features, besides commitment, that makes it attractive to potential users. One plausible example could be an earlier deadline, which does not offer any other benefit besides commitment (see e.g., Ariely & Wertenbroch, 2002). Because this is rarely the case, it is likely that saving products are also used by individuals who have no intention or need to precommit. To examine whether saving products are used for precommitment, individual-level information on self-control problems is needed.

Previous research on savings commitment devices has attempted to capture self-control problems in different ways. Some studies use choices over time-dated monetary payments[4], asking participants to choose between two rewards twice; for instance, first, between a smaller reward today and a larger one in a month, and then between a smaller reward in 6 months and a larger one in 7 months (e.g., Ashraf et al., 2006; Brune et al., 2011; Dupas & Robinson, 2013). A time-preference reversal indicates a self-control problem. Others use the Brief Self-Control Scale (BSCS) by Tangney et al. (2004; e.g., Cobb-Clark et al., 2021; Rabie, 2021), where low trait self-control implies self-control problems. Another approach to measuring self-control problems involves using a proxy measure based on health-related behaviors (e.g., Guo & Finke, 2018; Sourdin, 2008). However, many of these behaviors—such as smoking, drinking, or gambling—can also be interpreted as risky behaviors. Consequently, while such proxies may capture aspects of impulsivity, they may also reflect underlying risk preferences, potentially confounding the measurement of self-control.

Heterogeneity across measurements of self-control problems may partly explain the inconclusive results regarding their relationship with the use of savings commitment devices. While some studies find self-control problems to be connected to the take-up of savings commitment devices (e.g., Ashraf et al., 2006; Sourdin, 2008), others do not observe such a relationship (e.g., Brune et al., 2011; Guo & Finke, 2018; Rabie, 2021). Another reason could be high take-up by the naïfs (and time-consistent individuals) when sophistication[5] cannot be identified. Moreover, savings products themselves vary between the studies and some of them may be less suitable or popular for precommitment purposes.

In this study, self-control problems are captured by self-assessed impulsivity and patience in the attempt to follow the quasi-hyperbolic discounting model. Patience represents an exponential discount factor δ from the Eq. (1), while impulsivity represents the degree of present bias β. These self-assessed measures used in SOEP have been applied to $\beta\delta$-model earlier by Friehe and Pannenberg (2020) and the intra-individual stability of the measures reduces endogeneity concerns

[3] *A commitment device can be called soft when the cost of failure is psychological rather than economical (Bryan et al., 2010).*

[4] *While this has been a common method to identify time preferences (see e.g., Andersen et al., 2008; Bauer et al., 2012; Sutter et al., 2013; Tanaka et al., 2010), according to Augenblick et al. (2015), its ability to identify time-inconsistent preferences regarding consumption have been questioned due to limited evidence after controlling for transaction costs and payment reliability (see e.g., Andreoni & Sprenger, 2012; Augenblick et al., 2015).*

[5] *The commitment device take-up can differ even between partially and fully sophisticated discounters (John, 2020).*

(Preuss, 2021). Education level is used as a proxy for sophistication[6] in this study, following prior research suggesting such a link (Sourdin, 2008). Empirical evidence from Cobb-Clark et al. (2021) further supports this approach, demonstrating a positive relationship between educational attainment and sophistication. While this proxy is less refined than comparing future behaviors (ideal, predicted, and actual), it avoids the need to infer sophistication solely from the take-up of the commitment devices.

2.3 The German CSH system – *Bauspar*

This study uses the German Bausparvertrag to examine CSH. CSH contracts are offered to households by CSH banks (*Bausparkassen*)[7] in Germany, and they consist of three time periods: saving, waiting, and borrowing (Dübel, 2009). The saving goal is decided together with the CSH banks and the applicants, and the goal takes each household's willingness and capability to save into consideration. Once a household meets the saving goal and other possible requirements, it becomes eligible for the loan (Braun et al., 2021). The saving goal is a share of the whole *Bauspar* sum (the purchase price or the part of it that the CSH is desired to cover), such as 40 percent (Börsch-Supan & Stahl, 1991), and this can vary between CSH banks and over time. Similarly, the monthly savings are also a share of the *Bauspar* sum, such as 0.4 percent. After the required savings amount target has been reached, the saver may need to wait for an undefined period of time before receiving the *Bauspar* loan (Dübel, 2009). This is because the *Bauspar* system is closed, and the loans can only be given when the system has collected enough funds from the other savers.

The German government supports low- and middle-income households' homeownership and offers subsidies to households who save through CSH (Lea & Renaud, 1995). Currently, there are three subsidy schemes: a housing subsidy, employee savings bonus, and homeowner's pension. To be eligible for the housing subsidy or the employee savings bonus, a household needs to have an income below a certain level. Additionally, these subsidies are capped at a certain amount of monthly savings, and any savings beyond this limit do not yield a higher rate of return.

The properties of CSH fit the description of a commitment device by Bryan et al. (2010). CSH makes some choices more expensive and others unreachable for its users since the savings cannot be withdrawn immediately. The fee to open CSH contract is paid upfront. Other than the commitment, the fee provides no benefit, such as a rate of return or a CSH loan, since these can only be received after successfully following the savings plan[8]. Due to real economic loss (the fee) from failing to complete the saving period, CSH qualifies as a hard commitment[9]. Moreover, CSH has a clear savings goal, and it establishes external rules for saving, both of which are positively related to the probability of saving (Kim & Hanna, 2017; Rha et al., 2006).

The benefits of closed building society-like systems are particularly evident when financial markets are dysfunctional, and housing finance is deficient. However, the benefits can be less apparent when the financial system functions well and housing loans are available. This has been one motivation for the previous research on CSH. These studies have shown that CSH increases household savings (Börsch-Supan & Stahl, 1991), improves loan performance (Burghof & Schairer, 2017), overcomes financing market failure that results from adverse selection (Kirsch & Burghof, 2018), and has a stabilizing effect on the housing market (Braun et al., 2022) and on the whole economy (Molterer et al., 2017). Moreover, previous studies suggest that CSH is used because of its hedging qualities (Plaut & Plaut, 2004). This implies that CSH has a valuable impact on society and on households, even in developed economies with functional financial markets.

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[6] *Zhang and Greiner (2021) use cognitive test to proxy for sophistication.*

[7] Bausparkassen *are similar to building societies, yet different. According to Braun et al. (2021), the main differences are the organizational structure and the savings goal.*

[8] *This can be seen like a long-term gym membership, where the gains come only from following the training program, not from the membership fee alone (see e.g., Dellavigna & Malmendier, 2006).*

[9] *A commitment device can be classified as hard when failure poses an economic cost for the saver (Bryan et al., 2010).*

3. Method

The aim of this study is to investigate whether CSH is used as a commitment device. To do this, the analysis focuses on the relationships between impulsivity, patience, sophistication, and the take-up of CSH. According to the quasi-hyperbolic discounting model, compared to impatient individuals, patient ones are more likely to prefer a larger reward later rather than a smaller one sooner. However, if they are impulsive, the patient individuals might have difficulty resisting the temptation of a smaller reward when it is not only sooner, but immediate. If individuals are sufficiently sophisticated to recognize this tendency, they should value commitment devices as tools to help alter their impulsive behavior.

The study's hypotheses are as follows:

H1: Among patient sophisticated discounters, impulsivity is positively associated with the take-up of CSH.

H2: Among patient sophisticated discounters, impulsivity has a stronger association with the take-up of CSH than with that of a savings account.

The rationale for H2 is that, since a savings account is more liquid and lacks many commitment features, patient sophisticates are not expected to use it as a commitment device to the same extent as CSH.

3.1 Data

This study uses data from the German Socio-Economic Panel (SOEP; see Goebel et al., 2019), which is a longitudinal survey representative of the German population conducted annually since 1984. The study sample is restricted to individuals from 20 to 80 years old and households with strictly positive incomes. The study sample consists of heads of households and their spouses[10]. The unit of analysis is an individual. The sample comprises 30,510 individuals from 20,046 different households in the years 2008, 2013, and 2018, resulting in a total of 49,753 individual-year observations. Of these, 5,891 individuals participated in the survey in all three years, 7,461 took part in two years, and 17,158 individuals participated only once. Even though many of the variables such as impulsivity and patience are measured at the individual level, some decisions are made on the household level such as the take-up of CSH. In this study, the sample consists of data measured at both the household and individual levels.

3.1.1 Dependent variables

The main dependent variable of interest is an indicator that equals one if the household has CSH and zero otherwise. The other two dependent variables of interest are an indicator for having a savings account (one if household has savings account, zero otherwise), and an indicator whether a household saved or not (one if household has money left at the end of a month, which can be saved or put aside, and zero if not).

3.1.2 Independent variables

The key independent variable in this study is impulsivity. Impulsivity is self-assessed using the following questions on an 11-point scale: *"Are you generally a person who thinks and thinks long before he acts, so isn't impulsive at all? Or are you a person who acts without much thought, so is very impulsive? How do you personally rate yourself?"* A value of 0 indicates "not at all impulsive" and a value of 10 means "very impulsive."

[10] *Here, spouse refers to the spouse, same-sex partner, or life partner of the head of the household.*

Good intra-individual stability reduces endogeneity concerns regarding the self-assessed single-item impulsivity measure used in this study (Preuss, 2021). However, the error-in-variable bias may still exist because people may either consciously or unconsciously misassess their traits. Since naïve individuals are likely to underestimate their impulsivity (Cobb-Clark et al., 2021), the focus of the analysis is on sophisticates. They are aware of their self-control problems and thus likely to give a more accurate estimate of their impulsivity.

3.1.3 Proxy for a patient sophisticate

Since CSH is likely to attract not only sophisticated discounters but also naïve and time-consistent individuals, education level is used to distinguish sophisticates from naïfs. Individuals with a university or college education[11] are classified as sophisticates, while others are assigned to the non-sophisticate group. Education is not only correlated with sophistication (Cobb-Clark et al., 2021), but previous studies have also found a link between self-control and educational attainment (see e.g., Cobb-Clark et al., 2022; Duckworth et al., 2014, 2019). This suggests it is more likely to achieve higher education if not struggling with self-control problems.

Self-assessed patience is used to narrow down the sophisticated discounters into patient sophisticates. Patience is self-assessed using the following question on a scale from 0 ("very impatient") to 10 ("very patient"): *"Would you describe yourself as an impatient or a patient person in general?"* This single-item measure for patience has been shown to have good intra-individual stability (Preuss, 2021) and is a valid measure of time preference and distinct from impulsivity (see Vischer et al., 2013). The mean level of patience in the sample is 6.09 (see Table 1). Therefore, individuals with a patience level above 6 are classified as patient, while those with a patience level of 6 or below are classified as impatient. In sum, individuals who have college education and a patience level over 6 are considered patient sophisticates.

3.1.4 Control variables

Since risk preferences are associated with choices regarding savings products (Dahlbäck, 1991), and impulsivity is linked with risk-prone behaviors, such as smoking (Mitchell, 1999), a variable indicating preference for risk is used as a control variable. This indicator is based on the following question and assessed on an 11-point scale: *"Are you generally a person who is willing to take risks or do you try to avoid taking risks?"* (0 = "not at all willing to take risks" [i.e., risk-averse]; 10 = "very willing to take risks" [i.e., risk-prone]). An experiment conducted by Dohmen et al. (2011) offers behavioral validity of this single-item measure, and a comparison to other measures of risk preference has shown that it is a good predictor of actual risk-taking behavior (Gürdal et al., 2017).

Following the literature, this study uses age, income, sex, marital status, and an indicator of whether the household has children as control variables (e.g., Browning & Lusardi, 1996; Harris et al., 2002; Rha et al., 2006; Strömbäck et al., 2017). However, income is controlled for only when using the model specification of Eq. (3). Since income is a possible mediator between education and saving behavior, it is excluded from the controls when using the model specification of Eq. (2). Age is measured with a categorical variable with 10-year age groups. The sex indicator equals one for females and zero for males. Household income is self-reported total monthly income and adjusted for household size dividing it by square root of household size. The marital status indicator equals one if the individual is married or in a registered same-sex partnership and lives together with their spouse, and zero otherwise. If the household has children under 16 years of age, the indicator for having children equals 1 and 0 otherwise. Furthermore, the models control for the region of residence (1 = East Germany, 0 otherwise) due to the possible regional differences between the former German Democratic Republic (GDR) and Federal Republic of Germany (FRG) or East and West Germany. Lastly, since the sample includes surveys from three years (2008, 2013, and 2018), these are also controlled for.

[11] *Higher education (see Table 1). Following the International Standard Classification of Education (ISCED 97) this includes levels 5A and 6.*

Table 1. *Descriptive statistics.*

	Mean	SD	Min	Max
Patient sophisticate	0.131	0.337	0	1
Others (naïfs and impatient sophisticates)	0.869	0.337	0	1
CSH	0.426	0.495	0	1
Savings account	0.699	0.459	0	1
Saved monthly[a]	0.674	0.477	0	1
Impulsivity	5.10	2.21	0	10
Patience	6.09	2.35	0	10
Risk preference	4.42	2.34	0	10
Age	52.1	14.8	20	80
Sex (female)	0.539	0.498	0	1
Household size	2.54	1.23	1	13
Household income (monthly; adj.)	1,987	1,336	100	70,710
Education				
In school	0.0002	0.013	0	1
Inadequately completed general education	0.011	0.104	0	1
General elementary	0.083	0.276	0	1
Middle vocational	0.502	0.500	0	1
Vocational + Abi	0.068	0.252	0	1
Higher vocational	0.075	0.264	0	1
Higher education	0.261	0.439	0	1
Married	0.654	0.476	0	1
Children	0.286	0.452	0	1
East Germany	0.244	0.429	0	1
Survey year 2008	0.317	0.465	0	1
Survey year 2013	0.315	0.464	0	1
Survey year 2018	0.368	0.482	0	1

Note: Household income is adjusted for household size but not for inflation; 30,510 individuals, 20,046 households, and 49,753 individual-year observations.
[a] Saving behavior is not available for 195 observations.

3.2 Data analysis

To investigate how impulsivity, sophistication and patience are related to CSH take-up, pooled ordinary least squares (POLS) were used in the linear probability model (LPM). First, models of the following form were estimated:

$$(2) \qquad Y_i = \alpha_0 + \alpha_1 \, impulsivity_i + \alpha_2 \, patient_sophisticate_i + X_i' \, \gamma + u_i$$

where Y is the outcome for individual *i, impulsivity* and *patient sophisticate* are the independent variables of interest, X is a vector of the control variables, and u is an idiosyncratic error term. Then, to examine whether impulsivity has a different association with CSH take-up among patient sophisticates and others, the following regressions models were estimated separately for these groups:

$$(3) \qquad Y_i = \alpha_0 + \alpha_1 \, impulsivity_i + X_i' \, \gamma + u_i$$

POLS considers each observation separately, even though some individuals enter the sample more than once. Since standard errors are likely to be correlated, individual-level clustered standard errors are used to account for possible heteroskedasticity and autocorrelation. When there is only one observation per individual, these reduce to robust standard errors.

4. Results

The analysis begins by looking at the direct effects between the variables of interest using model specification of Eq. (2). Table 2 indicates that impulsivity is not statistically significantly connected to the take-up of CSH (columns 1 and 2). However, impulsivity is negatively (p-value < 0.001) associated with the probability to save (columns 3 and 4). These findings are consistent with the previous research on impulsivity and imply that the measure captures the underlying concept it is supposed to.

The proxy for patient sophisticates has a positive (p-value < 0.001) relationship with the take-up of CSH with and without additional control variables (Table 2, columns 1 and 2). The positive relationship is in line with the theoretical prediction that sophisticates are likely to take up commitment devices (e.g., Laibson, 1997; O'Donoghue & Rabin, 1999). Also, the relationship between patient sophisticate and the probability to save is positive (p-value < 0.001) with and without additional controls (Table 2, columns 3 and 4).

Table 2. *Regressions on the relationship between impulsivity, patient sophisticates, the take-up of CSH, and saving behavior.*

	Linear Probability Model (POLS)			
Dependent variable:	**CSH**		**Saved monthly**	
	(1)	**(2)**	**(3)**	**(4)**
Impulsivity	-0.001 (0.001)	-0.0004 (0.001)	-0.004*** (0.001)	-0.003* (0.001)
Patient sophisticate	0.029*** (0.007)	0.029*** (0.007)	0.126*** (0.006)	0.125*** (0.006)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	49,753	49,753	49,558	49,558

Notes: The dependent variables equal one if the household has a CSH or if the household has saved monthly and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, marital status, children. Clustered (individual level) standard errors in parentheses. Estimated coefficients of control variables are reported in Table A1. Unbalanced panel.
****p<0.001; **p<0.01; *p<0.05*

The quasi-hyperbolic discounting model predicts the commitment device demand only among sophisticated individuals. Additionally, patient individuals are expected to be more future oriented than impatient ones. Therefore, the analysis focuses on patient sophisticates i.e., those who are motivated to save (patient) and likely aware of their impulsivity (sophisticated; n = 6,516). For comparison, the models are also estimated for others (naïfs and impatient sophisticates; n = 43,237), who, based on theoretical predictions, should not use commitment devices. Model specification Eq. (3) is used to analyze the subsamples. Regressing the separate models for these two subsamples is analogous to a fully interacted model (i.e., there would be an interaction term with *patient sophisticate* for each independent variable) allowing all the covariates to have different slopes.

Table 3 reports the main findings showing a positive (p-value < 0.05) relationship between impulsivity and the take-up of CSH among patient sophisticates (columns 1 and 2) while the relationship is negative for the others (columns 3 and 4). The results support hypothesis H1. Based on the results, a one-point higher impulsivity is related to a one percentage point higher probability to take up CSH (Table 3, column 2). This is visualized in Fig.1(a), where the slope of impulsivity is positive for patient sophisticates and negative for the others.

Table 3. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples.*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates		**Others**	
	(1)	**(2)**	**(3)**	**(4)**
Impulsivity	0.006*	0.010**	-0.002*	-0.003**
	(0.003)	(0.003)	(0.001)	(0.001)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	6,516	6,516	43,237	43,237

Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Estimated coefficients of control variables are reported in Table A2. Unbalanced panel.
****p<0.001; **p<0.01; *p<0.05*

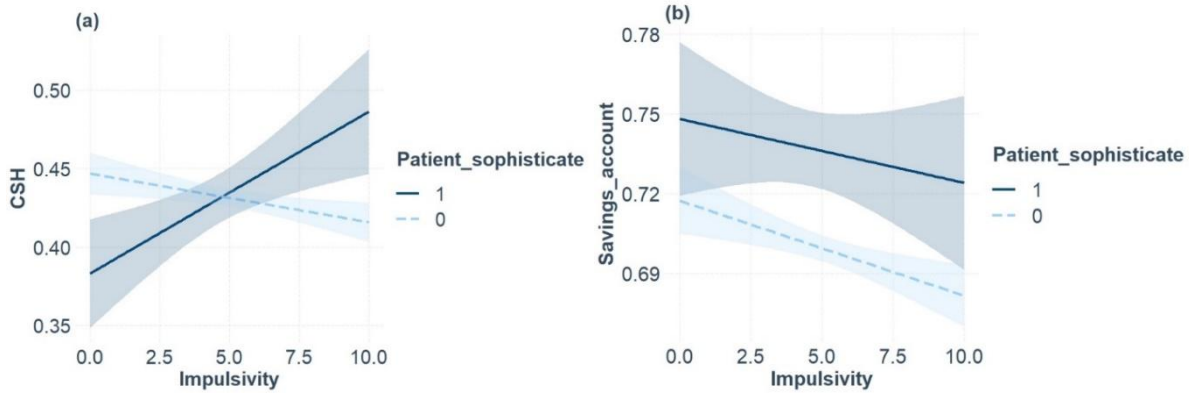
Lastly, if CSH is taken up by patient sophisticates due to its commitment properties, similar take-up should not show with other savings products with less of these properties. To test this, a more liquid savings account is compared to CSH. Table 4 indicates that the relationship between impulsivity and take-up of savings account is either negative or not statistically significant for both patient sophisticates and others. The results support the second hypothesis H2. Fig.1(b) shows that the relationship between impulsivity and the probability of having a savings account is negative or statistically insignificant among both patient sophisticates and others. These results are in line with previous research (see e.g., Sourdin, 2008).

Table 4. *Impulsivity and the take-up of savings account among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples.*

	Linear Probability Model: POLS			
	Dependent variable: Savings account			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	-0.007**	-0.002	-0.004***	-0.004***
	(0.003)	(0.003)	(0.001)	(0.001)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	6,516	6,516	43,237	43,237

Notes: The dependent variable equals one if the household has a savings account and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Estimated coefficients of control variables are reported in Table A3. Unbalanced panel.
****p<0.001; **p<0.01; *p<0.05*

Figure 1. *Relationship between impulsivity and the take-up of CSH (a), and the take-up of savings account (b) for patient sophisticates and others. The shaded areas indicate the 95% confidence intervals.*



Further analysis was conducted to test the robustness of the results. First, the results were estimated separately for female and male participants. The findings show that the relationship is driven by female participants (Table A4), which is consistent with previous research on savings commitment devices (e.g., Ashraf et al., 2006).

Second, to address the concern that some participants may not have made their own CSH contracts but instead had them arranged by their parents, participants aged 30 or younger were excluded from the sample. The assumption is that older participants are less likely to have a contract made by their parents. The results remained consistent with the main results (p-value < 0.05; Table A5).

Third, since the outcome is a binary variable, logit and probit models were used as a robustness check. The results remained consistent with the main results (p-value < 0.05; Tables A6 and A7).

Fourth, some of the individuals participated in the survey more than once and thus provided multiple responses. Since clustering standard errors may not fully address the potential problems caused by the correlated observations within an individual, an alternative approach was applied. In this approach, only one observation per individual was selected, specifically the first and the most recent. When including only the first observations, the results remained consistent with

the main results (p-value < 0.05; Table A8). However, when using only the most recent observations, the connection was statistically significant (p-value < 0.05) only after excluding male participants and those aged 30 or younger (Table A9).

Fifth, an alternative specification was used for patient sophisticates. First, instead of using the mean value of patience, the median value (7) and an alternative lower value (4) were used to categorize participants as patient or impatient, while sophistication was defined as earlier (i.e., higher education). In the total sample, with the inclusion of additional control variables, the results in Table A10 show a positive (p-value < 0.01) relationship between impulsivity and the take-up of CSH. For female participants, a positive relationship (p-value < 0.01) is shown both with and without additional controls (Table A11). Second, instead of specifying only the participants with "higher education" as sophisticated individuals, participants with "higher vocational education" were also categorized as sophisticated. Alternatively, also educational levels of "vocational + abi" and "middle vocational" were categorized as sophisticated. The cutoff value for patience was the same as in the original categorization. The results remained consistent with the main results, a positive relationship (p-value < 0.05) between impulsivity and the take-up of CSH, when additional control variables were included in the model for both the second and third specification (Table A12, columns 2 and 4). For female participants, a positive relationship (p-value < 0.05) is shown both with and without additional controls for the second specification (Table A 13, columns 1 and 2). The estimates became smaller and their statistical significance weaker when lower education levels were included in the specification.

Sixth, an alternative approach was used to examine whether sophistication (measured by educational level) is associated with the take-up of CSH among individuals who are likely to be motivated to save (high patience) but may also need commitment (high impulsivity). To assess this, two comparison groups were formed: Group 1 consists of individuals with high patience and low impulsivity, while Group 2 includes those with low patience and high impulsivity. If the hypothesis H1 holds, namely, that impulsivity is positively associated with CSH take-up among patient, sophisticated individuals, then it would be expected that sophistication has a stronger association with CSH take-up among those exhibiting both high patience and high impulsivity, compared to groups that either have less need for commitment (Group 1) or are less inclined to save (Group 2). The results in Table A14 indicate that the findings from this robustness analysis support the main conclusion of the study. The strongest relationship between sophistication and CSH take-up is observed among individuals who need commitment and want to save, in comparison to the two other groups.

In sum, the results supporting hypothesis H1 were robust for female participants, but the null hypothesis could not be rejected for male participants. The results supporting hypothesis H2, which propose that impulsivity is not positively linked to the take-up of a savings account, remain consistent across several additional tests.

5. Discussion

Commitment devices may be used as tools to enhance desired behavior over time. This may be especially true for individuals with self-control problems, who stand to benefit most from mechanisms that help regulate impulsive tendencies. This article investigated whether self-control problems are associated with CSH take-up. Using German panel data, the results show that the relationship between impulsivity and the take-up of CSH critically depends on the level of sophistication and patience. For patient sophisticates, impulsivity has a positive relationship with CSH, while this connection is negative for others (naïfs and impatient sophisticates). This pattern implies that future-oriented individuals who are aware of their self-control problems tend to use commitment devices in the form of CSH. These results are consistent with the quasi-hyperbolic discounting model, and they support the hypothesis that individuals with self-control problems use commitment devices to improve their saving behavior.

In previous research, the role of CSH as a savings product has been scarcely investigated, and, to the best of my knowledge, its potential as a commitment device for promoting financial behavior has not been studied before. This article adds to this scarce literature by showing that some households seem to use CSH as a commitment device. In addition to serving as a screening tool for banks and a signaling mechanism to demonstrate the households' ability to save, CSH can be used by some households to improve their long-term saving behavior. The use of CSH as a commitment device aligns partially with Kirsch and Burghof's (2018) suggestion that it could help teach financial discipline to households. Moreover, the

usage of CSH as an illiquid asset before purchasing a home is consistent with Angelini et al. (2020), who propose that individuals with self-control problems can use homeownership as a commitment device after retirement once pension savings become accessible and no longer work as a commitment device. This suggests that CSH may initially function as a commitment device, and homeownership will continue that function later.

Previous research has shown that good saving and financial behavior have a positive impact on subjective financial well-being, which refers to the individuals' perception of their own financial situation (Ranta & Salmela-Aro, 2018). Good financial behavior, however, is not only beneficial for the households themselves but also for the society as a whole. When households have robust savings rates, the society is more resistant to economic hardship. Besides increasing savings, earlier studies have suggested that CSH improves loan performance (Burghof & Schairer, 2017), overcomes financing market failure that results from adverse selection (Kirsch & Burghof, 2018), and has a stabilizing effect on the housing market (Braun et al., 2022) and on the aggregate economy (Molterer et al., 2017).

The robustness checks offer an additional insight, suggesting that the relationship between impulsivity and take-up of CSH is driven by female participants. Even though this is consistent with previous research on savings commitment devices (e.g., Ashraf et al., 2006), it leaves some unanswered questions regarding, for instance, the gender differences in precommitment and household decision-making dynamics that future research should try to tackle.

A key strength of this study is its use of the nationally representative SOEP, which provides revealed preference data and relevant proxies for decision-making biases, significantly strengthening the external validity of the findings. However, the study is not without limitations. First, even with additional control variables, the possibility of omitted variable bias cannot be excluded. Unobservable factors may be associated with impulsivity, patience, or sophistication (proxied by education) and the take-up of CSH. As a result, causal interpretation should be made with caution. Second, the level of education serves only as a proxy for sophistication and using it to distinguish between sophisticated naïve individuals has its limitations. For example, the ratio of time-consistent individuals within the sophisticated group remains unknown. Third, because the variables in this study are self-reported, there is a potential for error-in-variable bias arising from factors such as limited introspective ability and socially desirable responding. Fourth, it is still noteworthy that CSH contracts can sometimes be made by parents for their children, and, thus, the holder of the contract is not always the one who initially made it. However, the data do not allow the identification of the individual who entered into the contract. Lastly, the decision to take up CSH could be influenced by factors such as financial literacy, financial attitudes, or attitudes towards homeownership. For example, a higher homeownership rate or strong economic incentives might increase the take-up for reasons other than precommitment, potentially weakening the connection between impulsivity and take-up of CSH. To further explore these influences, future research could leverage the use of CSH in several countries, such as Germany, France, and the Czech Republic, where homeownership rates vary significantly. Moreover, since each country has adapted its own version of CSH, both the commitment features and the economic incentives they offer may vary.

In summary, the findings suggest that patient individuals who are aware of their self-control problems may use commitment devices in the form of CSH. This article contributes to and complements the literature on savings commitment devices—particularly on the scarcely researched CSH—by demonstrating its important commitment properties for certain households. Given that CSH systems are heavily subsidized by the government, these commitment features should be considered when updating the subsidy scheme or other aspects of the system.

References

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2008). Eliciting Risk and Time Preferences. *Econometrica, 76*(3), 583–618.

Andreoni, J., & Sprenger, C. (2012). Estimating time preferences from convex budgets. *American Economic Review, 102*(7), 3333–3356. https://doi.org/10.1257/aer.102.7.3333

Angelini, V., Bucciol, A., Wakefield, M., & Weber, G. (2020). Can temptation explain housing choices over the life cycle? *Manchester School, 88*(2), 229–261. https://doi.org/10.1111/manc.12304

Ariely, D., & Wertenbroch, K. (2002). Procrastination, deadlines, and performance: Self-Control by precommitment. *Psychological Science, 13*(3), 219–224. https://doi.org/10.1111/1467-9280.00441

Ashraf, N., Karlan, D., & Yin, W. (2006). Tying Odysseus to the Mast: Evidence from a Commitment Savings Product in the Philippines. *The Quarterly Journal of Economics, 121*(2), 635–672.

Augenblick, N., Niederle, M., & Sprenger, C. (2015). Working over time: Dynamic inconsistency in real effort tasks. *Quarterly Journal of Economics, 130*(3), 1067–1115. https://doi.org/10.1093/qje/qjv020

Bauer, M., Chytilová, J., & Morduch, J. (2012). Behavioral foundations of microcredit: Experimental and survey evidence from rural India. *American Economic Review, 102*(2), 1118–1139. https://doi.org/10.1257/aer.102.2.1118

Beshears, J., Choi, J. J., Harris, C., Laibson, D., Madrian, B. C., & Sakong, J. (2020). Which early withdrawal penalty attracts the most deposits to a commitment savings account? *Journal of Public Economics, 183*, 104144. https://doi.org/10.1016/j.jpubeco.2020.104144

Biljanovska, N., & Palligkinis, S. (2018). Control thyself: Self-control failure and household wealth. *Journal of Banking and Finance, 92*, 280–294. https://doi.org/10.1016/j.jbankfin.2016.10.010

Börsch-Supan, A., & Stahl, K. (1991). Do savings programs dedicated to home-ownership increase personal savings? An analysis of the West German Bausparkassen system. *Journal of Public Economics*, 44(3), 265–297. https://doi.org/10.1016/0047-2727(91)90016-U

Braun, J., Burghof, H. P., Langer, J., & Einar Sommervoll, D. (2022). The Volatility of Housing Prices: Do Different Types of Financial Intermediaries Affect Housing Market Cycles Differently? *Journal of Real Estate Finance and Economics*, 1–32. https://doi.org/10.1007/s11146-022-09907-y

Braun, J., Burghof, H.-P., Gehrung, M., & Schmidt, D. (2021). *Contractual Saving for Housing as Early Financial Development and Its Clients in Weimar Germany*. SSRN Working Paper. http://dx.doi.org/10.2139/ssrn.3742623

Browning, M., & Lusardi, A. (1996). Household Saving: Micro Theories and Micro Facts. *Journal of Economic Literature, 34*(4), 1797–1855.

Brune, L., Giné, X., Goldberg, J., & Dean, Y. (2011). *Commitments to Save A Field Experiment in Rural Malawi*. World Bank Policy Research Working Paper No. 5748. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1904244

Bryan, G., Karlan, D., & Nelson, S. (2010). Commitment Devices. *Annual Review of Economics, 2*, 671–698. https://doi.org/10.1146/annurev.economics.102308.124324

Burghof, H.-P., & Schairer, M. (2017). *Loan Performance of Contractual Savings for Housing*. SSRN Working Paper. https://doi.org/10.2139/ssrn.2925104

Burke, J., Luoto, J., & Perez-Arce, F. (2018). Soft versus Hard Commitments: A Test on Savings Behaviors. *Journal of Consumer Affairs, 52*(3), 733–745. https://doi.org/10.1111/joca.12170

Cobb-Clark, D. A., Dahmann, S. C., Kamhöfer, D. A., & Schildberg-Hörisch, H. (2022). The Predictive Power of Self-Control for Life Outcomes R. *Journal of Economic Behavior and Organization, 197*, 725–744. https://doi.org/10.5684/soep.is.2018

Cobb-Clark, D. A., Dahmann, S. C., Kamhöfer, D., & Schildberg-Hörisch, H. (2021). Sophistication about Self-Control. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3910869

Dagnelie, O., & Lemay-Boucher, P. (2012). Rosca Participation in Benin: A Commitment Issue. *Oxford Bulletin of Economics and Statistics, 74*(2), 235–252. https://doi.org/10.1111/j.1468-0084.2011.00641.x

Dahlbäck, O. (1991). Saving and risk taking. *Journal of Economic Psychology, 12*, 479–500. https://doi.org/10.1016/0167-4870(91)90028-R

Dellavigna, S., & Malmendier, U. (2006). Paying Not to Go to the Gym. *American Economic Review, 96*(3), 694–719.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association, 9*(3), 522–550. https://doi.org/10.1111/j.1542-4774.2011.01015.x

Dübel, H.-J. (2009). Contractual Savings for Housing. In M. J. Lea & B. Renaud (Eds.), *Housing Finance Policy in Emerging Markets*, 215–246. World Bank.

Duckworth, A. L., Gendler, T. S., & Gross, J. J. (2014). Self-Control in School-Age Children. *Educational Psychologist, 49*(3), 199–217. https://doi.org/10.1080/00461520.2014.926225

Duckworth, A. L., Taxer, J. L., Eskreis-Winkler, L., Galla, B. M., & Gross, J. J. (2019). Self-Control and Academic Achievement. *Annual Review of Psychology, 70*, 373–399. https://doi.org/10.1146/annurev-psych-010418

Dupas, P., & Robinson, J. (2013). Why don't the poor save more? Evidence from health savings experiments. *American Economic Review, 103*(4), 1138–1171. https://doi.org/10.1257/aer.103.4.1138

Ericson, K. M., & Laibson, D. (2018). *Intertemporal Choice*. NBER Working Paper No. 25358. http://www.nber.org/papers/w25358

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., & Sunde, U. (2018). Global evidence on economic preferences. *Quarterly Journal of Economics, 133*(4), 1645–1692. https://doi.org/10.1093/qje/qjy013

Finke, M. S., & Huston, S. J. (2013). Time preference and the importance of saving for retirement. *Journal of Economic Behavior and Organization, 89*, 23–34. https://doi.org/10.1016/j.jebo.2013.03.004

Friehe, T., & Pannenberg, M. (2020). Time preferences and political regimes: evidence from reunified Germany. *Journal of Population Economics, 33*(1), 349–387. https://doi.org/10.1007/s00148-019-00728-7

Gathergood, J. (2012). Self-control, financial literacy and consumer over-indebtedness. *Journal of Economic Psychology, 33*(3), 590–602. https://doi.org/10.1016/j.joep.2011.11.006

Goebel, J., Grabka, M. M., Liebig, S., Kroh, M., Richter, D., Schröder, C., & Schupp, J. (2019). The German Socio-Economic Panel (SOEP). *Jahrbucher Fur Nationalokonomie Und Statistik, 239*(2), 345–360. https://doi.org/10.1515/jbnst-2018-0022

Guo, T., & Finke, M. (2018). Are defined contribution plans a commitment device? *Journal of Financial Counseling and Planning, 29*(2), 234–244. https://doi.org/10.1891/1052-3073.29.2.234

Gürdal, M. Y., Kuzubaş, T. U., & Saltoğlu, B. (2017). Measures of individual risk attitudes and portfolio choice: Evidence from pension participants. *Journal of Economic Psychology, 62*, 186–203. https://doi.org/10.1016/j.joep.2017.06.010

Harris, M. N., Loundes, J., & Webster, E. (2002). Determinants of Household Saving in Australia. *Economic Record, 78*(241), 207–223.

John, A. (2020). When commitment fails: Evidence from a field experiment. *Management Science, 66*(2), 503–529. https://doi.org/10.1287/mnsc.2018.3236

Karlan, D., & Linden, L. L. (2014). *Loose Knots: Strong Versus Weak Commitments to Save for Education in Uganda*. NBER Working Paper No. 19863. http://www.nber.org/papers/w19863

Kim, G. J., & Hanna, S. D. (2017). Do Self-Control Measures Affect Saving Behavior? *Journal of Personal Finance*, 1–20.

Kirsch, S., & Burghof, H. P. (2018). The efficiency of savings-linked relationship lending for housing finance. *Journal of Housing Economics, 42*, 55–68. https://doi.org/10.1016/j.jhe.2018.05.003

Laibson, D. (1997). Golden Eggs and Hyperbolic Discounting. *The Quarterly Journal of Economics, 112*(2), 443–478. https://academic.oup.com/qje/article/112/2/443/1870925

Lea, M. J., & Renaud, B. (1995). *Contractual Savings for Housing: How Suitable Are They for Transitional Economies?* World Bank Policy Research Working Paper No. 1516.

Mandel, N., Scott, M. L., Kim, S., & Sinha, R. K. (2017). Strategies for improving self-control among naïve, sophisticated, and time-consistent consumers. *Journal of Economic Psychology, 60*, 109–125. https://doi.org/10.1016/j.joep.2016.12.003

Mitchell, S. H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology, 146*, 455–464.

Molterer, M., Amon, J., & Tyrell, M. (2017). *Specialized Financial Intermediaries and the Impact of Savings and Loan Contracts on Real Estate Finance*. SSRN Working Paper. http://dx.doi.org/10.2139/ssrn.2873919

O'Donoghue, T., & Rabin, M. (1999). Doing It Now or Later. *American Economic Review, 89*(1), 103–124.

Ottaviani, C., & Vandone, D. (2011). Impulsivity and household indebtedness: Evidence from real life. *Journal of Economic Psychology, 32*(5), 754–761. https://doi.org/10.1016/j.joep.2011.05.002

Plaut, P. O., & Plaut, S. E. (2004). The economics of Housing Savings Plans. *Journal of Real Estate Finance and Economics, 28*(4), 319–337. https://doi.org/10.1023/B:REAL.0000018785.07473.93

Preuss, M. (2021). Intra-individual stability of two survey measures on forward-looking attitude. *Journal of Economic Behavior and Organization, 190*, 201–227. https://doi.org/10.1016/j.jebo.2021.06.049

Rabie, D. (2021). *RoSCAs in Egypt: A Banking Institution or a Commitment Device?* ILE Working Paper Series No. 52. http://hdl.handle.net/10419/241869

Ranta, M., & Salmela-Aro, K. (2018). Subjective financial situation and financial capability of young adults in Finland. *International Journal of Behavioral Development, 42*(6), 525–534. https://doi.org/10.1177/0165025417745382

Rha, J.-Y., Montalto, C. P., & Hanna, S. D. (2006). The Effect of Self-Control Mechanisms on Household Saving Behavior. *Journal of Financial Counseling and Planning, 17*(2), 3–16.

Schilbach, F. (2019). Alcohol and self-control: A field experiment in India. *American Economic Review, 109*(4), 1290–1322. https://doi.org/10.1257/aer.20170458

Sourdin, P. (2008). Pension contributions as a commitment device: Evidence of sophistication among time-inconsistent households. *Journal of Economic Psychology, 29*(4), 577–596. https://doi.org/10.1016/j.joep.2007.12.005

Strömbäck, C., Lind, T., Skagerlund, K., Västfjäll, D., & Tinghög, G. (2017). Does self-control predict financial behavior and financial well-being? *Journal of Behavioral and Experimental Finance, 14*, 30–38. https://doi.org/10.1016/j.jbef.2017.04.002

Sutter, M., Kocher, M. G., Daniela, G. R., & Trautmann, S. T. (2013). Impatience and uncertainty: Experimental decisions predict adolescents' field behavior. *American Economic Review, 103*(1), 510–531. https://doi.org/10.1257/aer.103.1.510

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review, 100*(1), 557–571. https://doi.org/10.1257/aer.100.1.557

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High Self-Control Predicts Good Adjustment, Less Pathology, Better Grades, and Interpersonal Success. *Journal of Personality, 72*(2), 271–324. https://doi.org/10.1111/j.0022-3506.2004.00263.x

Thaler, R. H., & Benartzi, S. (2004). Save more tomorrow: Using behavioral economics to increase employee saving. *Journal of Political Economy, 112*(1). https://doi.org/10.1086/380085

Vischer, T., Dohmen, T., Falk, A., Huffman, D., Schupp, J., Sunde, U., & Wagner, G. G. (2013). Validating an ultra-short survey measure of patience. *Economics Letters, 120*(2), 142–145. https://doi.org/10.1016/j.econlet.2013.04.007

Wilkinson, N. & Klaes, M. (2012). An Introduction to Behavioral Economics [2nd ed.], Palgrave MacMillian, London.

Wong, W. K. (2008). How much time-inconsistency is there and does it matter? Evidence on self-awareness, size, and effects. *Journal of Economic Behavior and Organization, 68*(3–4), 645–656. https://doi.org/10.1016/j.jebo.2008.09.005

Zhang, Q., & Greiner, B. (2021). Time inconsistency, sophistication, and commitment: An experimental study. *Economics Letters, 206*. https://doi.org/10.1016/j.econlet.2021.109982

Appendix

Table A1. *Regressions on the relationship between impulsivity, patient sophisticates, the take-up of CSH, and saving behavior.*

	Linear Probability Model (POLS)			
Dependent variable:	**CSH**		**Saved monthly**	
	(1)	**(2)**	**(3)**	**(4)**
Impulsivity	-0.001	-0.0004	-0.004***	-0.003*
	(0.001)	(0.001)	(0.001)	(0.001)
Patient sophisticate	0.029***	0.029***	0.126***	0.125***
	(0.007)	(0.007)	(0.006)	(0.006)
Risk Preference		-0.003**		-0.002*
		(0.001)		(0.001)
Married		0.169***		0.134***
		(0.005)		(0.005)
Children		0.013*		-0.079***
		(0.006)		(0.006)
Age (ref. 20-29)				
Age 30-39	0.074***	-0.015	0.035***	0.018
	(0.010)	(0.010)	(0.010)	(0.010)
Age 40-49	0.067***	-0.009	0.031***	-0.004
	(0.010)	(0.009)	(0.009)	(0.010)
Age 50-59	0.039***	-0.047***	0.040***	-0.032***
	(0.009)	(0.010)	(0.009)	(0.009)
Age 60-69	-0.063***	-0.157***	0.038***	-0.051***
	(0.010)	(0.010)	(0.009)	(0.010)
Age 70-80	-0.165***	-0.249***	0.074***	-0.007
	(0.010)	(0.010)	(0.010)	(0.010)
Female	-0.024***	-0.017***	-0.016***	-0.009*
	(0.004)	(0.004)	(0.004)	(0.004)
Survey year (ref. 2008)				
2013	-0.014**	-0.008	0.026***	0.031***
	(0.006)	(0.005)	(0.005)	(0.005)
2018	-0.051***	-0.041***	0.052***	0.065***
	(0.005)	(0.005)	(0.005)	(0.005)
East Germany	-0.041***	0.031***	-0.022***	-0.017***
	(0.005)	(0.005)	(0.005)	(0.005)
Constant	0.478***	-0.443***	0.630***	0.614***
	(0.011)	(0.011)	(0.010)	(0.011)
Observations	49,753	49,753	49,558	49,558

*Notes: The dependent variable equals one if the household has a CSH or if the household has saved monthly and zero otherwise. The models were estimated using the linear probability model (LPM). Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A2. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples.*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.006*	0.010**	-0.002*	-0.003**
	(0.003)	(0.003)	(0.001)	(0.001)
Risk Preference		-0.011***		-0.004***
		(0.003)		(0.001)
Log of income		0.082***		0.196***
		(0.013)		(0.005)
Married		0.118***		0.128***
		(0.014)		(0.005)
Children		0.021		0.026***
		(0.018)		(0.007)
Age (ref. 20-29)				
Age 30-39	0.087**	0.020	0.072***	-0.025*
	(0.031)	(0.031)	(0.011)	(0.011)
Age 40-49	0.075*	-0.019	0.065***	-0.057***
	(0.030)	(0.031)	(0.010)	(0.010)
Age 50-59	0.032	-0.065*	0.039***	-0.089***
	(0.030)	(0.030)	(0.010)	(0.010)
Age 60-69	-0.077*	-0.168***	-0.063***	-0.174***
	(0.030)	(0.030)	(0.010)	(0.010)
Age 70-80	-0.176***	-0.254***	-0.165***	-0.255***
	(0.031)	(0.031)	(0.010)	(0.010)
Female	-0.032*	-0.029*	-0.024***	-0.012*
	(0.012)	(0.013)	(0.005)	(0.005)
Survey year (ref. 2008)				
2013	-0.017	-0.020	-0.014*	-0.026***
	(0.016)	(0.016)	(0.006)	(0.006)
2018	-0.056***	-0.067***	-0.049***	-0.082***
	(0.015)	(0.015)	(0.006)	(0.006)
East Germany	0.016	0.042**	-0.049***	0.001
	(0.014)	(0.014)	(0.005)	(0.005)
Constant	0.467***	-0.141	0.486***	-0.941***
	(0.032)	(0.097)	(0.011)	(0.036)
Observations	6,516	6,516	43,237	43,237

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A3. *Impulsivity and the take-up of savings account among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples.*

	Linear Probability Model: POLS			
	Dependent variable: Savings account			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	-0.007**	-0.002	-0.004***	-0.004***
	(0.003)	(0.003)	(0.001)	(0.001)
Risk Preference		-0.013***		-0.008***
		(0.003)		(0.001)
Log of income		0.111***		0.247***
		(0.012)		(0.005)
Married		0.051***		0.060***
		(0.013)		(0.005)
Children		0.009		0.036***
		(0.015)		(0.006)
Age (ref. 20-29)				
Age 30-39	0.025	-0.024	0.031**	-0.054***
	(0.025)	(0.026)	(0.010)	(0.010)
Age 40-49	-0.016	-0.080**	0.022*	-0.087***
	(0.025)	(0.027)	(0.010)	(0.010)
Age 50-59	-0.030	-0.107***	0.014	-0.099***
	(0.025)	(0.026)	(0.010)	(0.010)
Age 60-69	-0.034	-0.102***	0.056***	-0.033**
	(0.025)	(0.026)	(0.010)	(0.010)
Age 70-80	-0.012	-0.069*	0.110***	0.040***
	(0.026)	(0.027)	(0.010)	(0.010)
Female	-0.020	-0.024*	0.009	0.015***
	(0.011)	(0.011)	(0.004)	(0.004)
Survey year (ref. 2008)				
2013	0.066***	0.059***	0.005	-0.014*
	(0.013)	(0.013)	(0.005)	(0.005)
2018	-0.010	-0.027	-0.060***	-0.107***
	(0.013)	(0.014)	(0.005)	(0.005)
East Germany	-0.011	0.023	-0.025***	0.033***
	(0.012)	(0.013)	(0.005)	(0.005)
Constant	0.811***	0.015	0.692***	-1.062***
	(0.027)	(0.096)	(0.011)	(0.036)
Observations	6,516	6,516	43,237	43,237

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A4. *Impulsivity and the take-up of CSH among patient sophisticated female and male participants.*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates Female participants only		Patient sophisticates Male participants only	
	(1)	(2)	(3)	(4)
Impulsivity	0.013**	0.016***	-0.0003	0.005
	(0.004)	(0.005)	(0.004)	(0.004)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	3,044	3,044	3,472	3,472

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A5. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) including only participants over 30 years of age.*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.008*	0.012***	-0.002*	-0.003**
	(0.003)	(0.003)	(0.001)	(0.001)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	6,070	6,070	39,493	39,493

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A6. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples. Logistic regression.*

	Logistic regression			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.025*	0.045***	-0.010*	-0.014**
	(0.012)	(0.014)	(0.004)	(0.005)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	6,516	6,516	43,237	43,237

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using a logistic regression. Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A7. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) using the subsamples. Probit model.*

	Probit model			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.016*	0.028***	-0.006*	-0.008**
	(0.008)	(0.008)	(0.003)	(0.003)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	6,516	6,516	43,237	43,237

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using a probit model. Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A8. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) with only the first observations of the participants.*

	Linear Probability Model: POLS (the first responses)			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.008*	0.011*	-0.002	-0.002*
	(0.004)	(0.004)	(0.001)	(0.001)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	3,666	3,666	26,844	26,844

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Robust standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A9. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) with only the latest observations of the female participants over 30 years of age.*

	Linear Probability Model: POLS (the latest responses) Female participants over 30 only			
	Dependent variable: CSH			
	Patient sophisticates		Others	
	(1)	(2)	(3)	(4)
Impulsivity	0.014*	0.016**	-0.001	-0.003
	(0.006)	(0.006)	(0.002)	(0.002)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	1,641	1,641	13,250	13,250

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Robust standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A10. *Impulsivity and the take-up of CSH among patient sophisticates with alternative specification for patient (above 4; above 7 [median]) individuals.*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates (patience > 4)		Patient sophisticates (patience > 7)	
	(1)	(2)	(3)	(4)
Impulsivity	0.004	0.008**	0.006	0.011**
	(0.002)	(0.003)	(0.003)	(0.004)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	9,526	9,526	4,340	4,340

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A11. *Impulsivity and the take-up of CSH among patient sophisticates with alternative specification for patient (above value 4; above value 7 [median]) individuals. Female participants only.*

	Linear Probability Model: POLS (female participants only)			
	Dependent variable: CSH			
	Patient sophisticates (patience > 4)		Patient sophisticates (patience > 7)	
	(1)	(2)	(3)	(4)
Impulsivity	0.011**	0.013***	0.014**	0.017**
	(0.004)	(0.004)	(0.005)	(0.005)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	4,577	4,577	2,010	2,010

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A12. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) with alternative specification for sophisticates (includes additional level of education: higher vocational; includes additional levels of education: higher vocational, vocational + abi, and middle vocational).*

	Linear Probability Model: POLS			
	Dependent variable: CSH			
	Patient sophisticates (w/ higher vocational added)		Patient sophisticates (w/ higher vocational, vocational + abi, and middle vocational added)	
	(1)	(2)	(3)	(4)
Impulsivity	0.005	0.009**	0.001	0.003*
	(0.003)	(0.003)	(0.001)	(0.002)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	8,440	8,440	22,559	22,559

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A13. *Impulsivity and the take-up of CSH among patient sophisticates and others (naïfs and impatient sophisticates) with alternative specification for sophisticated (includes additional level of education: higher vocational; includes additional levels of education: higher vocational, vocational + abi, and middle vocational). Female participants only.*

	Linear Probability Model: POLS (female participants only)			
	Dependent variable: CSH			
	Patient sophisticates (w/ higher vocational added)		Patient sophisticates (w/ higher vocational, vocational + abi, and middle vocational added)	
	(1)	(2)	(3)	(4)
Impulsivity	0.007*	0.009**	0.004	0.005*
	(0.003)	(0.003)	(0.002)	(0.002)
Baseline controls	✔	✔	✔	✔
Additional controls		✔		✔
Observations	7,773	7,773	11,648	11,648

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, survey year, East Germany. Additional controls: risk preference, log of income, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*

Table A14. *Sophistication and the take-up of CSH among patient-impulsive, patient-non-impulsive (Group 1) and impatient-impulsive (Group 2) individuals using the subsamples.*

	Linear Probability Model: POLS					
	Dependent variable: CSH					
	High patience (> 7) and high impulsivity (> 5)		High patience (> 7) and low impulsivity (< 5)		Low patience (< 7) and high impulsivity (> 5)	
	(1)	(2)	(3)	(4)	(5)	(6)
Sophistication	0.076***	0.072***	0.037**	0.031*	0.031**	0.029**
	(0.015)	(0.015)	(0.013)	(0.012)	(0.010)	(0.010)
Observations	5,736	5,736	7,491	7,491	11,496	11,496
	Only female participants					
Sophistication	0.085***	0.082***	0.030	0.026	0.043**	0.041**
	(0.021)	(0.021)	(0.019)	(0.019)	(0.014)	(0.014)
Observations	3,221	3,221	3,739	3,739	6,588	6,588
Baseline controls	✔	✔	✔	✔	✔	✔
Additional controls		✔		✔		✔

*Notes: The dependent variable equals one if the household has a CSH and zero otherwise. The independent variable equals one if the individual has higher education and zero otherwise. The models were estimated using the linear probability model (LPM). Baseline controls: age, sex, survey year, East Germany. Additional controls: risk preference, marital status, children. Clustered (individual level) standard errors in parentheses. Unbalanced panel. ***p<0.001; **p<0.01; *p<0.05*