Financial Literacy, Cognitive Abilites, and Long-term Decision Making

Five Essays on Individual Behavior

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Tabea Bucher-Koenen

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Abteilungssprecher:	Professor Dr. Martin Peitz
Referent:	Professor Axel Börsch-Supan, Ph.D.
Korreferentin:	Professor Annamaria Lusardi, Ph.D.
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To Johannes

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1. General Introduction

What we measure determines the world we see in the moment [and] the limit of knowledge until an unobserved aspect of reality bites us.—Arthur Kennickel[1]

Demographic pressure and tight public budgets have led to extensive pension reforms in many developed economies within the last decades. Decreasing fertility, increasing life expectancy, and the baby boomers' transition to retirement pose challenges to public pension systems around the world. In the years to come a declining labor force will have to support an increasing number of retirees. Most developed economies have implemented fundamental pension reforms in order to stabilize their publicly funded systems. Barr and Diamond (2010) give an introduction to the economics of pension reform and provide an overview of different policy measures taken. Many of these reforms will result in declining public pension income in order to limit contribution rates. Thus, responsibility for old age income has shifted away from the state toward the individual in a lot of countries. The central question is: How well prepared are citizens to provide privately for their old age?

Saving for old age poses a challenge for individuals: It is a demanding and complex task which has to be taken under ambiguity and involves a long time horizon. Additionally, the application of heuristics, such as the observation of peers, is difficult because they have not dealt with these decisions themselves. This has led to extensive political and academic discussions about individuals' ability to provide for their retirement income privately. The cognitive capacity of individuals, their financial literacy and the awareness of potential pitfalls in long-term decision making are at the heart of the problem. Benartzi and Thaler (2007) provide a review of the heuristics individuals apply and biases they suffer from when deciding about retirement savings. In particular, individuals face difficulties when deciding whether to enroll in pension plans. They procrastinate, overwhelmed by the variety of choices offered. It is a challenge to figure out how much savings are necessary to provide for a certain standard of living in old age. A number of pitfalls loom when allocating savings to different asset categories: households apply naive diversification strategies, over-invest in the stocks of the company where they are employed, are subject to behavioral biases such as framing and mental accounting and may be influenced by peers and timing effects.

[1]Keynote Lecture at the BCL/ECB Conference on Household Finance and Consumption, Luxembourg, October 2010

The policy implications are widely debated. Recommendations from the field of behavioral economics range from paternalistic solutions such as automatic enrollment to financial education. There are potential advantages and disadvantages to both strategies: Automatic enrollment forces individuals to save. However, it is difficult for policy makers to design default options, because most likely one size does not fit all needs. Throughout their lives individuals are faced with a variety of financial decisions under potentially very different circumstances that defy standard solutions. The other suggestion, financial education, is presented as a tool to enhance consumers' capabilities in dealing with financial issues throughout their lives. The groups most at risk are arguably the hardest to reach and financial education has not been shown to overcome individuals' tendency to procrastinate. Governments have introduced other policies to increase private pension provision, most notably monetary incentives in the form of subsidies and tax breaks. In the transition to an increasingly market-based system, regulation of financial service providers is vital in order to ensure long-term stability and to preserve individual's trust in financial markets and those acting therein.

Generally, no single measure will be sufficient; rather, a combination of different approaches seems most promising to overcome the challenges outlined above. Measures like financial education have to be taken to build up individuals' capabilities to look ahead and stick to their plans. This has to be supplemented by financial market regulation to ensure transparency and the accrual of rents to those for whom subsidies are intended. Finally, the argument can be made for a limited amount of paternalistic approaches to raise people's awareness and force those individuals who prove to be completely unresponsive to the "softer" treatment.

In Germany, fundamental reforms of the public pension system were implemented between 1992 and 2007. The most important measures[2] taken are:

- The introduction of adjustment factors for early retirement.
- The increase of the legal retirement age.
- A reduction of pension entitlements to limit future contribution rates via a self-regulating pension adjustment formula.
- The introduction of state subsidized funded pensions to encourage private savings.

Thus, households in Germany are faced with the need to provide additional pension income from private savings. A variety of measures have been taken to provide incentives for private

[2]For an overview of the German pension system, its reform process and the consequences see, e.g., Börsch-Supan (2000), Börsch-Supan and Wilke (2004) and Wilke (2009).

provision in Germany. First, state subsidized private pensions, such as the Riester and Rürup schemes, were introduced to encourage private savings.[3] Second, non-profit and state-related consumer education and protection agencies took action in order to support individual decision making.[4] And third, there was a shift in communication strategies of policy makers. They stopped proposing that state provided pensions are secure and started admitting that there will be a decline in future pension income. The focus of my dissertation is the examination of German households' financial decision making abilities and the impact on private pension provision.

In addition to the challenges posed by an aging society, the world in 2007/2008 was hit by a dramatic financial and economic crisis. The crisis on the one hand had immediate effects on households' portfolios and their income from labor. On the other hand, the crisis will have far reaching consequences on household's income from public and and private pensions. Public pensions are affected by lower growth in wages and periods of unemployment which lower the claims individuals accumulate. Private pensions are affected by the drop in returns, portfolio restructuring, and skepticism towards financial markets and their actors.[5] Thus, it is important to analyze the effects of the financial and economic crisis on private households and their reaction to the shock.

This dissertation is concerned with individuals' ability to cope with the situation. The underlying connection between the five articles in this thesis is the relation between financial knowledge, cognitive abilities and long-term decision making. The first three sections deal directly with financial literacy and retirement planning (Chapter 2), private old age provision (Chapter 3) and financial advice in the context of private pensions (Chapter 4). In Chapter 5 I turn my attention to the effects of the recent financial and economic crisis on household's wealth and saving behavior. Chapter 6 takes a more general approach. It deals with the development of time preferences and time consistent decision making of children and teenagers.

All papers are to a large extent empirical analyses of households' or individuals' behavior. In the first four chapters I use SAVE data, a household panel examining households financial situation and decision making which is representative for Germany. The final paper is methodologically different. It is a field experiment conducted in four German schools. Thus, the subjects of my analysis are not households, but individuals between age 6 and 18.

In the course of my research I had the good fortune to cooperate with several other economists. The first paper is joint work with Annamaria Lusardi. The third paper was

[3]For more information, see for example Börsch-Supan et al. (2008), Coppola and Reil-Held (2009).

[4]Reifner (2003) provides an overview of financial education in Germany. Oehler and Werner (2008) examine the provision of consumer education in Germany.

[5]The effects of the financial and economic crisis on public and private pensions are examined in Börsch-Supan et al. (2010) and Börsch-Supan, Gasche and Wilke (2009).

developed together with Johannes Koenen. The fourth paper is co-authored with Michael Ziegelmeyer and in the fifth project I cooperated with Carsten Schmidt.

As an introduction, I will briefly outline the five respective articles which compose the remainder of this dissertation. The appendix includes additional material referred to in the text and is followed by the complete bibliography.

1.1. Financial Literacy and Retirement Planning in Germany

Objective. Financial knowledge is an important tool for making financial decisions. Our objective is threefold. First, we study literacy in Germany. We are able to compare financial literacy internationally because the questions measuring financial literacy in the American HRS (Health and Retirement Study) have been added to SAVE. Second, the unique setup of German re-unification allows us to compare financial literacy across two German regions with different economic structures and with households with differing experience. Third, we examine the relationship between financial literacy and retirement planning.

Methodology. In this section we use data from SAVE 2009 to examine financial literacy and retirement planning in Germany. In order to investigate the nexus of causality between financial literacy and financial decisions we develop an instrumental variable (IV) strategy by making use of regional variation in financial knowledge.

Main findings. Our findings indicate that knowledge of basic financial concepts (interest compounding, inflation, and risk diversification) is lacking among women, the less educated, and those living in eastern Germany. In particular, those with low education and low income in east Germany have even less financial literacy compared to their west German counterparts. Interestingly, there is a disparity in financial knowledge between women and men in the west but not in the east. Moreover, we find a positive impact of financial knowledge on retirement planning. Low levels of financial knowledge in east Germany point to potential problems. Decreasing pension income and interrupted employment histories due to the economic transition after German unification in combination with a lack of financial knowledge and retirement planning might give rise to old age poverty in the years to come.

1.2. Financial Literacy and Private Old Age Provision

Objective. The objective of the second paper is to go one step further and to determine the relationship between financial literacy and actual saving for retirement. State subsidized Riester pensions appear to be particularly beneficial for individuals with lower income and

for families with children. Lower income groups including single mothers are identified to be at risk of low financial literacy. Thus, the central question arising is: Is the Riester scheme successful at targeting individuals at risk of low financial literacy and low retirement savings to provide privately for their old age income?

Methodology. I develop hypotheses regarding the relationship between financial literacy and private old age provision on the basis of existing literature. In the empirical part of the paper, I analyze the relation between financial knowledge and the ownership of state subsidized Riester and other non subsidized private old age savings contracts. The analysis is based on SAVE 2009.

Main findings. Financial literacy is positively related to privately saving for retirement. This is true for standard private pensions as well as state subsidized Riester contracts. Levels of private pension coverage are particularly low among individuals in the lowest income quartile, who would profit most from the state subsidies. At the same time they show the lowest levels of financial literacy.

1.3. Do Smarter Consumers Get Better Advice?

Objective. This paper contributes to our understanding of the role of financial advisors. First we offer a different analytical explanation for the apparent puzzle that mostly better informed, wealthier individuals employ financial advisors although they may not need them. We argue in a simple analytical model, which includes the possibility to search for an option without seeking advice, that more informed customers—customers with higher financial literacy—may induce their advisor to exert more utility generating effort on their behalf. As a result, individuals with a higher level of expertise may still be more likely to solicit advice, despite the fact that they are able to find better solutions on their own. By integrating the consumer's choice whether or not to employ an advisor, this generates an *ex ante* complementarity between information and advice, as opposed to the purely substitutive relationship proposed by, e.g., Georgarakos and Inderst (2010). The central hypothesis derived from the model is the following: Consumers whose level of information, or signal thereof, to the advisor is better, should receive better advice. As a consequence, they should be more likely to follow the advice given to them, all else equal.

Methodology. We set up a simple theoretical model on search, financial literacy and financial advice. From this model we develop five testable hypotheses regarding the relationship between financial knowledge, search for information and the provision of financial advice and its quality. To verify our main hypotheses, we choose a two-pronged approach using data from the SAVE-panel. First we use a number of general questions and exploit the panel structure of the data to make first inferences about the relationship between financial

literacy and financial advice. Then, in order to corroborate these results, we turn to the topic of German private pension contracts in particular. We make use of a special module of questions regarding Riester pensions that we were able to add to the questionnaire in 2008.

Main findings. First we show that individuals with higher financial literacy are more likely to solicit financial advice, but less likely to follow it. Then, we turn to data on the market for subsidized private pension plans in Germany. The data is uniquely suited to our investigation, as we observe whether consumers buy a contract with the firm employing their financial advisor. We show that individuals are strongly influenced by their source of advice—with dependent financial advisors steering customers towards choice options yielding higher kickbacks. We finally demonstrate that individuals with higher financial literacy are less susceptible to this effect.

1.4. Who Lost the Most? Financial Literacy, Cognitive Abilities, and the Financial Crisis

Objective. The aim of the fourth paper is to study how and to what extent private households are affected by the recent financial crisis and how their financial decision making is influenced by this shock. We aim at answering the following questions: Are individuals with lower financial literacy and lower cognitive abilities more frequently affected by financial losses due to the crisis? Are individuals with lower financial literacy and cognitive abilities affected more severely if loss is measured as a percentage of wealth? And are individuals with lower financial literacy and cognitive abilities more likely to realize their loss?

Methodology. We develop three testable hypotheses on the effect of the financial crisis on households wealth and their reaction to the shock from existing literature. In our empirical analysis we use data from a special module of questions regarding the financial crisis which was added to SAVE 2009. Additionally, we use information on households before the crisis, i.e. in 2007 and 2008.

Main findings. Our analysis reveals that individuals with low levels of financial knowledge are less likely to have invested in the stock market and are therefore in general less likely to report losses in wealth due to the financial crisis. There is a higher likelihood that individuals with lower levels of financial literacy have sold their assets which have lost in value. This reaction of individuals with low financial literacy to short term losses might have substantial long-term consequences, especially in the light of increasing individual responsibility for old-age provision.

1.5. Instant Gratification and Self-Control in an Experiment with Children and Teenagers

Objective. In the final paper, we examine behavior of children and teenagers in order to evaluate how time related preferences evolve with increasing age and cognitive abilities. We contribute to the understanding of individuals' long-term decision making skills by observing how the pattern of preferences over time shifts with changes in individual's age and their cognitive capacity. Thus, this paper differs from the previous four chapters in many ways. The two most important differences are: First, we analyze behavior of individuals between age 6 and 18, and second, our data is experimental.

Methodology. We observe preferences over time of school children in a slightly modified food choice experiment of Read and van Leeuwen (1998). In contrast to existing literature dealing with changing discount rates over the life-cycle we do not ask for preferences between hypothetical payoffs but offer tangible choices in terms of Smarties (small sugar-coated chocolate sweets) and apples. The pupils choose between the healthy and the unhealthy food item on two consecutive days. On the first day they state their preference regarding tomorrow's consumption and on the second day they pick a food item for immediate consumption.

Main findings. We find that most of the 6 to 7 year olds consistently choose chocolate for future and immediate consumption. Pupils aged 8 to 12 showed an increase of time inconsistent behavior—pupils naïvely planning to consume an apple tomorrow and then choosing chocolate for immediate consumption. From age 14 on a larger share of pupils is sophisticated in the sense that they plan to and actually do consume an apple. In accordance with the literature, we observe that girls switch more often.

1.6. Unobserved Aspects of Reality

What we measure determines the world we see in the moment [and] the limit of knowledge until an unobserved aspect of reality bites us. This quote fits the objective of my dissertation on various levels. Overall, I aim at furthering the understanding of individuals' abilities to adjust to new situations and their capacity to make complex decisions in an ambiguous environment where "unobserved aspects of reality" keep biting them. I examine their capacity to realize and react to new situations, like the financial crisis or the pension reforms. For this purpose it is crucial to have good measures. I am very fortunate to be able to use SAVE data. This gives me the unique opportunity to use timely measures of households' situations, their attitudes, and their reactions to paint the current picture of our world and chew on the limits of our knowledge.

Even though individual households are at the center of my attention throughout most of this thesis, I also aim at policy makers. Demographic change and the financial and economic crisis were without question new aspects of reality biting them. They tried to face the new situation by adjusting the structure of pension systems and providing improved regulation of the financial system. The chapters in this dissertation are all to some extent evaluations of the measures taken with respect to the individuals affected by the changes in the system. Some point to areas where potential problems persist and further political action might be necessary.

- The first two papers point to the fact that not all households in Germany are equally well prepared to plan and save for retirement. Financial knowledge is lacking in particular among women, those with low education and those living in east Germany. Financial education programs could be tailored specifically to these groups to help them look ahead.

- The second paper points to the fact that at the bottom of the income distribution individuals with low levels of financial literacy have very low private pension coverage despite the generous subsidies of the Riester scheme. This is an indicator that more than the provision of financial incentives is required to motivate these households to provide for retirement. Tailored information about the generosity of subsidies could be one way to target these households.

- In the third paper we point to the fact that financial advisors play an important role in household's retirement planning. The market for Riester products is intransparent which increases individual's search cost and enhances the power of advisors. Reliable and easily accessible information about products from independent sources might improve the situation especially of those with high search cost and low financial literacy.

- In Germany participation in risky asset markets has been traditionally low but increased in recent years. The analysis in the fourth paper reveals that in particular individuals with low literacy left financial markets when returns declined. This reaction to short-term losses has potential long-term consequences for the distribution of wealth if households do not participate in markets' recovery and face lower returns in the long run.

- The final paper reveals that there is substantial variation in individuals' capability to plan and stick with their plan already at young ages. More research is necessary to determine the link between the development of capabilities at a young age and decision making later in live. In order to prepare individuals well for the new challenges they face.

Thus, by applying economic theory and making use of available data I hope to contribute to paint a picture of the world we currently see and extend the limits of our knowledge by including new aspects of reality.

2. Financial Literacy and Retirement Planning in Germany

Joint work with Annamaria Lusardi[1]

2.1. Introduction

Financial literacy has become an important topic in Germany. The reasons for this are manifold. One important aspect is the recent reform of the German public pension system (Gesetzliche Rentenversicherung) that transformed the monolithic system into a multi-pillar system and increased individuals' responsibility to provide privately for their retirement.[2] The German public pension system covers all private and public employees, i.e., about 85% of the workforce.[3] It is organized as a pay-as-you-go system and currently provides for about 90% of retirement income (see Börsch-Supan and Wilke (2006)). Until the recent reforms, the German pension system was famous for its generosity. However, in light of the demographic changes that will cause a steep increase in the old age dependency ratio in the coming years, fundamental changes are deemed necessary to ensure the sustainability of the system. After basic adjustments in 1992 and 1998, in 2001, to bridge the gap that arises in retirement income, the so called Riester scheme—a state-subsidized but voluntarily funded pillar—was introduced.

Every person that may be affected by the prospective decrease of the first-pillar pensions is eligible for Riester subsidies.[4] Currently about 38 million individuals have been estimated to be eligible (Fassauer and Toutaoui (2009)), and at the end of 2009 about 12.9 million Riester contracts were signed (BMAS (2009)). The fundamental concept is that savers contribute 4% (at least €60) of their income to a certified private savings contract and receive a lump-sum subsidy of (since 2008) €154. Additionally families with children receive €185 for each child (€300 if the child was born after 2007). Thus, the Riester scheme is particularly generous

[1] A revised version of this chapter is published under the following reference: Tabea Bucher-Koenen and Annamaria Lusardi, "Financial literacy and retirement planning in Germany", Journal of Pension Economics and Finance, Volume 10(4), pp. 565-584, (2011), Cambridge University Press.

[2] For an overview of the reforms of the German pension system, see Börsch-Supan and Wilke (2004).

[3] Civil servants have their own pension system and self-employed individuals can either self-insure or contribute to the public system.

[4] In 2008 the eligibility criteria were widened such that nowadays civil servants can also get subsidies.

for individuals with low income and families with children, who can obtain subsidies of well over 90% of their contribution (Sommer (2007), Gasche (2008)).[5] However, despite the high subsidies for the poorest, the coverage in the lowest income quintile is still low (see Chapter 3 for further details). More than 70% of the poorest households do not own any kind of supplementary private pensions. In the higher income quartiles this share is substantially lower: Just 20% of the households in the fourth income quartile do not own supplementary private pensions. Additionally, households in the lowest income quartile show the lowest level of financial literacy. Thus, the question has been raised about whether more than financial incentives are needed in order to get the poorest households with the least knowledge about financial issues to save.

A second reason for the public discussion about financial knowledge in Germany is the rapid development of financial markets with complex products that are available to everyone. Individuals are able to buy products they often do not understand, and most demonstrate an inability to judge the quality of financial advice they receive about these products. This topic seems particularly important in light of the 2007/2008 financial crisis and spectacular cases of individual households that lost major portions of their wealth. Even though the majority of households did not suffer from financial losses due to the crisis—only abut 20% of private households lost part of their financial wealth due to the crisis, and fewer than 4% of households lost more than 10% of their wealth—the public discussion about the financial crisis has caused major insecurity among private households with respect to their saving and investment strategies (see Börsch-Supan, Gasche and Wilke (2009)). Changes in consumer protection are currently under discussion in Germany.[6]

The objective of our study is threefold. First, we use SAVE, a survey of German households, to provide an overview of the level of financial literacy in Germany as measured by three questions on financial literacy that have been used in surveys around the world. By means of identical questions to measure financial literacy this analysis is part of a wider project comparing financial literacy and its effects on decision outcomes in various countries, like Germany, Italy, Japan, the Netherlands, New Zealand, Russia, Sweden, and the United States of America.[7] More specifically, we analyze answering behavior and identify groups at risk of low financial knowledge. We explain the country-specific context and thereby facilitate explanations for country-specific differences. Additionally, we link financial knowledge to retirement planning. Analyzing the relation between financial literacy, retirement

[5]For more information on the Riester pensions see Börsch-Supan et al. (2008), Coppola and Reil-Held (2009).

[6]See for example the initiative by the Bundesverbraucherzentrale (consumer protection agency) to integrate consumer protection as a major objective when reforming banking supervision (www.vzbv.de/go/dokumente/917/3/10/index.html).

[7]The international comparison is work in progress.

planning and country-specific differences in the institutional context will provide the opportunity to improve the understanding of how financial knowledge is acquired and its impact on decision making.

Second, we compare financial literacy in east and west Germany. The unique setup of German unification gives us the opportunity to investigate differences in financial literacy between two German regions with distinct economic structure and whose residents have different experience in financial decision making. Due to the communist centrally managed economy individuals in the east only gathered experience in financial decision making and accumulated financial knowledge within the last 20 years. We can examine whether east Germans were able to catch up with the west with respect to their financial knowledge. Moreover, we compare the level of financial knowledge of specific groups in east and west in order to understand who is better at closing the gap in knowledge and experience.

Third, we address the problem of causality between financial literacy and financial planning for retirement. We use an instrumental variables (IV) approach and exploit variation in financial knowledge at the regional level to estimate the effect of financial literacy on retirement planning.

The remainder of our paper is structured as follows. Section 2.2 describes the SAVE data. Section 2.3 provides the empirical evidence and tries to answer the following questions: How financially literate are German households (2.3.1)? Who knows the least (2.3.2)? What are the differences between east and west Germany (2.3.3)? And, does financial literacy matter (2.3.4)? We conclude in Section 2.4.

2.2. SAVE

SAVE is a representative German household panel designed to improve the understanding of savings behavior. It was first conducted in 2001 by the Mannheim Research Institute for the Economics of Aging (MEA). Consecutive waves of the survey were in the field in 2003/2004, and in every year since 2005. In 2009 there are 2,222 households in the panel. The data were collected during the early summer of 2009. The questionnaire is in paper and pencil format. A detailed description of the scientific background, design, and results of the survey can be found in Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009).

SAVE is a household survey.[8] One person who is randomly chosen from all household members who have information on household finances answers all questions in the survey. Thus, the individual completing the questionnaire is not necessarily the household head or the person who knows the most about the financial situation of the household. Individuals

[8]There are two different samples in SAVE. We restrict the analysis to households in the random route sample.

in the sample received €20 in cash with the cover letter independent of their participation in the survey. This procedure has been used in previous years of the survey, and due to the high stability of the panel, few households keep the money without participating.

The three questions on financial literacy were included in SAVE 2007, 2008 and 2009. We are using the cross-section from 2009 for the analysis in this paper. The financial literacy questions in the 2009 survey were changed slightly from earlier questions to allow for comparison across countries. The share of missing answers is between 2.5% and 3.3% of the total sample (N= 1,117) for each of the three questions. We will drop observations for which one or more of the answers to the financial literacy task are missing. Thus, we are left with 1,059 complete observations. Missing information on other variables is imputed using an iterative multiple imputation procedure based on a Markov-Chain Monte-Carlo method (Schunk (2008), Ziegelmeyer (2009)). Thereby the efficiency of estimates is increased due to a larger number of observations and the item non-response bias that occurs if observations with and without missing values differ systematically is reduced. Five multiply imputed data sets are used for the analysis and results are derived using Rubin's method (Rubin (1987, 1996)).

The average age of our respondents is 52. The youngest individual is 22; the oldest individual is 91 years old. Forty-seven percent of the respondents are male and 35% live in eastern Germany. Sixty-one percent of the sample have upper secondary education, 25% have higher degrees (tertiary or non-tertiary post-secondary education). Sixty-two percent of all respondents are either married or living with a partner. The average household has 2.4 members. The average number of children is 1.7, of which 35% live in the household. Thirty percent of the respondents are already retired. The average monthly income of all households in 2008 was €2,154. Table A.1, describing the socioeconomic details of the households in the sample, is contained in the appendix. Sample-specific weights with respect to age and income classes are constructed on the basis of the German Microzensus 2008 and are applied to our data.[9]

2.3. Empirical Evidence

2.3.1. How Much do Individuals Know?

Measuring Financial Literacy

The three questions on financial literacy used in this study were first developed by Lusardi and Mitchell (2011b) for the HRS in 2004. They are designed to assess the fundamental

[9]Details on the construction of the weights can be found in Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009).

skills that are at the core of individual saving and investment decisions. The same (or very similar) questions were included in several household surveys around the world, including the German SAVE survey.

Two of the questions measure basic financial concepts. The first question measures the understanding of interest and requires mainly the ability to calculate. The second question examines the understanding of the joint effects of interest and inflation. The third question measures advanced financial knowledge and deals with risk and diversification. The wording is as follows:

1. *Understanding of Interest Rate (Numeracy)*

   "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?" do not know / refuse to answer

2. *Understanding of Inflation*

   "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?" do not know / refuse to answer

3. *Understanding of Risk and Diversification*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know/ refuse to answer

Results

The answers to the first question (interest) are displayed in Table 2.1 (panel A) below. Eighty-two percent of all respondents correctly answered that they would have more than €102 in the account. Around 7% gave incorrect answers: 3% thought that the amount would be exactly €102 and 3.7% expected a smaller amount. About 11% said they did not know the answer or did not want to answer this question.[10] As the first question is very basic it is simple to answer for most of the German population. It only requires very rudimentary mathematical abilities. The calculation of compound interest is part of German school curricula and students should be familiar with it even if they have a low level of schooling.[11]

[10] "Do not know" and "refuse" was the same option. Thus, we are unable to distinguish the two. As mentioned in the data section we drop households with missing answers despite the "refuse" option.

[11] For an overview of financial education in German school curricula see Reifner (2003).

Table 2.1.: Answers to the Financial Literacy Questions

This table contains the frequency and the proportion of respondents who gave the respective answers to the interest, the inflation and the risk question.

Panel A—*Interest*

	households	in percent
more than 102 Euros	872	82.4
exactly 102 Euros	31	3.0
less than 102 Euros	39	3.7
do not know	116	11.0
total	1,059	100.0

Panel B—*Inflation*

	households	in percent
more	9	0.9
exactly the same	40	3.8
less	830	78.4
do not know	180	17.0
total	1,059	100.0

Panel C—*Risk*

	households	in percent
"false"	62	5.9
"right"	655	61.8
do not know	342	32.3
total	1,059	100.0

Source: own calculation on the basis of SAVE 2009, data is weighted.

The answers to the inflation question (question 2) are shown in Table 2.1 (panel B). More than 78% of the participants correctly responded that the purchasing power of their savings will decrease. Around 5% did not correctly answer this question; the majority of these individuals answered that the purchasing power of their money will stay the same (3.8%). The share of households who do not know the answer to this question is higher than the share that do not know the interest question (ca. 17%). To answer the second question correctly, individuals have to have a basic understanding of inflation and its impact on purchasing power of income or savings. The German Bundesbank has always followed a very conservative inflationary policy. Apart from a few inflationary periods in the 1970s and early 1980s, inflation has never exceeded 4% and since 1995 has stayed well below 2% in most years. Moreover, in the German Democratic Republic (GDR), i.e. the communist part of Germany before unification, inflation did not officially exist, as prices for almost all consumer goods were fixed by state plans. However, there was some hidden inflation due to the adjustment of packaging sizes, and there was inflation on the black market. Therefore, it is difficult to evaluate the experience of the eastern Germans with inflation before unification. All in all, the exposure to periods of high inflation is limited in the German population. However, the collective experience of "hyperinflation" in the early 1920s is still present and might influence the answers to this question.

Table 2.1 (panel C) contains the answers given to the third question on risk diversification. This question was correctly answered as "false" by 62% of the respondents; 6% incorrectly answered that the statement is correct. This question appears to have been difficult for many individuals: around one-third responded that they do not know the answer to this question. The knowledge of stock market risk and diversification is not part of most German high school curricula. Thus, to know about risk, one either has to have some economic or financial education or experience with stock investments. In the GDR no security markets existed (see, e.g. Sauter (2009)). Therefore, east Germans were not able to obtain stock market experience before 1990. However, even in west Germany, until recently, stock market capitalization was rather low compared to other European countries or the United States. Only the deregulation and centralization of the stock market during the 1990s contributed to its development. Stock market participation was much publicized in the German media in the mid 1990s when large state-owned German companies like Deutsche Post and Deutsche Telekom were privatized. In particular the privatization of Deutsche Telekom induced many medium-income German households to buy stocks for the first time—known as the beginning of the "Volksaktie."[12]

Table A.2 in the appendix shows aggregate financial accounts as reported by the Deutsche

[12]See Börsch-Supan and Essig (2003) for an overview of institutional details and trends in German stock market participation.

Bundesbank (2009). The share of directly held stocks in total financial wealth by private households and non-profit organizations increased from 6.6% in 1991 to around twice that in 2000. It moves around 8% in the 2000s and dropped to 3.8% by the end of 2008. All fluctuations are caused by the combined effect of increasing/declining stock value and portfolio restructuring. The share of investment funds (which can also include bond funds and real estate funds) increased from 4.3% to 11.3% between 1991 and 2008. Nevertheless, the share of directly and indirectly held stocks is still low in Germany compared to countries like the United States, the United Kingdom, and Sweden. Guiso et al. (2003) report that around 17% of German households directly participated in the stock market in 1998. If one includes indirect stockholding, this amount would increase slightly. Börsch-Supan and Essig (2003) argue that there is a large overlap between direct and indirect stockholders. Thus, most German households have no or very limited stock market experience. The majority of the households hold their assets in the form of saving deposits with banks or insurance contracts. This conservative investment behavior is reflected in the answers to the third question.

The overall performance of the respondents is summarized in Table 2.2. The inflation and interest questions were correctly answered by a majority of households (72%). However, only slightly more than half of the households (53%) were able to give correct answers to all of the questions. Moreover, it is important to examine how many respondents gave incorrect answers and how many replied that they do not know the answer. Table 2.2 reveals that about 10% of respondents do not know the answer to any of the questions (i.e., they respond incorrectly or respond "do not know"). Furthermore, 37% of households surveyed state that they do not know the answer to at least one of the questions and 8.4% respond "do not know" for all three questions.

Table 2.2.: Financial Literacy—Overall Performance

This table shows summary statistics for the performance of respondents on all three financial literacy questions. In particular, it displays the frequency and the proportion of households who were able to give correct answers to the inflation and the interest question and who were able to answer all three questions. Additionally, the fractions and frequencies of respondents who were unable to answer any of the questions, who gave at least one "do not know" response and who answered "do not know" in all three questions are reported.

	households	in percent
correct answers to *interest* and *inflation*	762	71.9
all answers correct	563	53.2
no correct answer	109	10.3
at least one "do not know/refuse"	392	37.0
all "do not know/refuse"	89	8.4

Source: own calculation on the basis of SAVE 2009, data is weighted.

Table 2.3 contains pairwise Spearman rank correlations between the correct answers to

the individual questions and the total number of correct answers. The pairwise correlations between all questions are positive and statistically significant. The correlation between the interest and the inflation question is slightly higher than the correlation between the risk and the interest question or the risk and the inflation question. The reason for this is that the risk question is more difficult to answer than are the inflation and the interest questions. While most individuals who correctly answered the interest question also correctly answered the inflation question, and vice versa, this is not the case for the relationship between inflation/interest and risk. Most of the individuals who correctly answered the risk question also correctly answered the inflation and/or the interest question, but not vice versa. This is also reflected in the correlation between the total number of correct answers and the correct answers to the individual questions: individuals who answered the risk question correctly were very likely to have correctly answered the other two questions.

Table 2.3.: Spearman Rank Correlations

In this table we report spearman rank correlations and p-values (in parenthesis) between giving a correct answer to the inflation, the interest and the risk question as well as the number of correct answers.

	interest	inflation	risk
interest	1		
inflation	0.4702	1	
	(0.000)		
risk	0.3445	0.3924	1
	(0.000)	*(0.000)*	
no. of correct answers	0.6538	0.7028	0.8499
	(0.000)	*(0.000)*	*(0.000)*

Source: own calculation on the basis of SAVE 2009, data is weighted.

In summary, around 70% of the individuals in the SAVE panel were able to answer the two simple interest and inflation questions correctly; respondents had more difficulty with the risk question. Only around 60% of respondents correctly answered this question. Overall, a little over half of the respondents correctly answered all of the questions.[13]

2.3.2. Who Knows the Least?

In the previous section we analyzed the overall performance on the financial literacy task. In the this section we concentrate on households that display lower levels of financial literacy. Other studies of financial literacy in various countries find low levels of literacy among respondents with low income and low education and in women and minorities; these groups accumulate too little retirement wealth (see, for example, Lusardi and Mitchell (2011b,

[13] In the course of the international project cross-references to the results from the other countries will follow. However, because the data on Germany was the first to be analyzed in this form there are no possibilities for comparison, yet.

2007b)) or are reluctant to invest in the stock market (see, for example, Van Rooij et al. (2011b)). Table 2.4 shows the answers to the financial literacy questions across different socio-economic characteristics.

Age. Overall, we find a hump-shaped pattern of financial literacy over age/cohort.[14] We perform simple two-sided t-tests to evaluate the differences in the means between all age-groups. The differences in levels of financial literacy between the youngest and the two middle age-groups are not significant. All other differences in the means to give three correct answers are significantly different from zero.[15] However, an analysis of responses to individual questions reveals a more diverse picture: correct answers to the interest question decline with age; correct answers to the inflation question increase with age; and correct answers to the risk question are hump-shaped. More specifically, individuals younger than 35 are most likely to answer the interest question correctly. However, they are least likely to correctly answer the inflation question. They perform second best on the risk question. Fifty-five percent of the respondents younger than 35 get all the answers right. Individuals between 36 and 50 perform best on almost all the questions (the young ones are marginally better at the inflation calculation). Overall those who are middle-aged know the most; older individuals know the least. Only 43% of the respondents over age 65 can answer all questions correctly. However, this is mostly because they cannot answer the risk question and they are a little less likely to calculate correctly on the interest question compared to younger individuals. People over 65 perform second best on the inflation task. In all questions apart from inflation, the oldest participants select "do not know" more frequently than younger ones.

Gender. We find that women perform significantly worse than men. Almost 60% of male respondents correctly answer all questions compared to 47.5% of female respondents (the difference is significant at 1%). However, it is notable that women do not give more incorrect answers than men, rather they state "do not know" much more often. Fewer than 30% of male and more than 43% of female respondents have at least one "do not know" response.[16] Additionally, we analyze the relationship between financial knowledge, gender and the role in financial decisions. We differentiate between four groups of decision makers: "Single decision makers with partner", i.e. decision makers who live with a partner but decide about financial

[14] We use a cross-section for our analysis. Thus, we are unable to differentiate between age and cohort effects. Financial literacy is most likely related to both.

[15] Below 36 vs. 65+: p-value 0.013; 36-50 vs. 51-65: p-value 0.078; 36-50 vs. 65+: p-value 0.000; 51-65 vs. 65+: p-value 0.011.

[16] One concern about the gender effect in financial literacy is the following: if in surveys the household head is requested to answer the questionnaire, the selection of women who are household heads is biased toward single mothers and widows due to traditional role allocations. However, as explained above, men and women are selected with equal probability for the SAVE survey. Thus, there should not be a gender selection bias.

issues by themselves, "single decision makers without partner", respondents that claim that their "partner makes most financial decisions" and "joint decision makers"[17]. Our results indicate that female single decision makers without partner have lower levels of financial literacy compared to male single decision makers without partner (significant at the 1% level). Female respondents indicating that they decide jointly with their partner also know significantly less than the respective male respondents (significant at the 5% level). There is neither a significant difference between women and men who are sole decision makers and live with a partner nor is there a difference between men and women claiming that their partner makes the decisions. Among women single decision makers without a partner have a significantly (at 5%) lower probability to answer three questions correctly compared to women who decide with a partner.

Education. Financial literacy is highly correlated with education and the gradient is rather steep. Table 2.4 shows answers across International Standard Classification of Education (ISCED) levels. Only 22% of the respondents with lower secondary education (the lowest level of education that a person in Germany can obtain due to compulsory schooling regulation) can correctly answer all questions. More than half of the respondents who completed upper secondary education can answer all of the questions. The difference between these two groups is significant at 1%. Respondents with higher educational degrees (tertiary and non-tertiary post secondary education) are significantly (at 1%) more likely to give three correct answers compared to respondents in the two groups with lower education: They answer all questions correctly with a probability of more than 70%.

Taking a closer look at German educational degrees reveals that respondents with a moderate level of general education (10 to 11 years of schooling) do not perform significantly worse than individuals with a higher degree (Abitur—12 to 13 years of schooling). However, respondents without an occupational degree are significantly less likely to answer the questions correctly compared to respondents with a vocational or higher degree. Moreover, respondents with university training are not more likely to correctly answer the questions than individuals with a vocational degree. Thus, the relationship between years of schooling and financial literacy is not linear.

Income. The number of correct answers increases over respondents' income quartiles.[18] In the quartile with the lowest average income only 38% give three correct answers, whereas among the top income quartile more than 70% get all the answers right.[19] The difference in correct responses between income quartiles is largest for the risk question: respondents in

[17] This can be jointly with a person outside the household. However, only 3 households decide jointly with a third party.

[18] We use quartiles of total household net income per month.

[19] The difference in the percentage of individuals with three correct between the first and the second income quartile are not significant. All other differences are highly significant at 1% significance level.

the bottom income quartile are almost 30 percentage points less likely to answer correctly than respondents in the top income quartile.

Region. There are some regional disparities in financial literacy in Germany. Respondents from urban areas are more likely to give correct answers. In areas with more than 5,000 inhabitants 54% of the individuals give three correct answers; in rural areas with fewer than 5,000 inhabitants only 43% achieve this. The difference is significant at 10%. Moreover, we compare financial knowledge in east and west Germany. We find that individuals in the west are significantly more likely to answer every single financial literacy question correctly (see table 2.4). Overall, 58% give three correct answers in west Germany. About 45% of the respondents in eastern Germany know the answers to all of the questions. This difference is significant at 1%.[20] Individuals in east Germany are substantially more likely to report "do not know" than those in west Germany. There is no difference in the incorrect answers between east and west. We will investigate the differences in financial literacy between east and west Germany in more detail in the next section.

In summary, bi-variate analysis reveals the same pattern of financial literacy or illiteracy over socioeconomic groups as previous studies: women are less likely to give correct answers than men; individuals with lower educational degrees, and less income also give fewer correct answers. The pattern over age is diverse; overall there is a hump-shaped pattern of financial literacy over age.[21] There are no large differences in the frequency of incorrect answers across groups, but there are substantial differences in the frequency of "do not know" responses. Thus, most of the individuals who do not know the answers actually appear to recognize their illiteracy and answer the questions accordingly.

2.3.3. Financial Literacy in East and West Germany

Even twenty years after unification there are still substantial differences between east and west Germany. Various studies examine for example differences in income and wealth (Fuchs-Schündeln et al. (2009)), precautionary savings (Fuchs-Schündeln and Schündeln (2005)), and stock market participation (Sauter (2009)). Especially differences in wealth and stock market participation can be related to the level of financial literacy. Jappelli (2009) finds in a cross-country study that financial literacy slowly improves with economic development. Thus, the questions asked in this section are: How large are the differences in financial literacy between east and west Germany? And, are the levels of financial knowledge over

[20] The effect remains significantly negative at 5% in a multivariate context even when controlling for differences in education and income etc.

[21] Most of the results found in the bivariate analysis remain significant in a multivariate context: women, older individuals, respondents living in east Germany, and individuals with lower education and lower income are less likely to give three correct responses. The difference between urban and rural regions is not significant in the multivariate case.

socioeconomic characteristics different in east and west?

In the previous section we already reported that levels of financial literacy are significantly lower in east Germany compared to west Germany. In this section we investigate the relationship between different socio-demographic variables and financial literacy within and across the two German regions. Thereby we can examine which respondents in east Germany have the lowest level of knowledge compared with their west German counterparts. Moreover, we can investigate if there are the same disparities between groups in both German regions. The frequency of correct responses to the three financial literacy questions over socioeconomic variables and regions are displayed in Table 2.5.

Age. Within both east an west, we find a hump-shaped pattern of financial literacy over age. In west Germany the 65+ age-group has a significantly lower probability of giving three correct answers compared to all other age-groups. Only 44% of the oldest age-group in the west are able to answer all questions compared to 63%, 65% and 58% in the youngest, and the two middle age-groups, respectively. The differences between the three younger age-groups in the west are not significant. In east Germany, even though we find a hump-shaped pattern of financial literacy over age, the differences between the age-groups are not significant. Comparing levels of financial literacy within the age-classes between east and west reveals that east Germans who are younger than 66 are significantly less likely to give three correct answers compared to their west German counterparts.[22] However, among old individuals (age 65+) there is no significant difference in the level of financial literacy in east and west; they know equally little.

Gender. The analysis of gender differences in east and west Germany reveals that women (men) in the west are significantly more likely to answer all financial literacy questions correctly compared to women (men) in the east (at 5% (1%) significance level). Moreover, it is interesting to note that among respondents in the west there is a strong gender difference: 65% of the men and only 52% of the women living in west Germany give three correct answers (significant at 1%). However, among respondents living in east Germany, there is no significant gender difference. On average 42% of the women and 48% of the men give three correct answers. Thus, in east Germany women and men know equally little.

Education. When comparing financial literacy across ISCED levels in east and west we find the same pattern as before: Individuals with higher education in east and west are more likely to give three correct answers. One rather striking result for east Germany is that among those with lower secondary education only 4% (1 out of 24) of the respondents are able to answer all financial literacy questions correctly. The comparison of financial literacy between east and west reveals that in particular the respondents with the lowest education

[22] Younger than 36, east vs. west: p-value 0.003; 36-50, east vs. west: p-value 0.015; 51-65, east vs. west: p-value 0.06.

in the east know less than their counterparts in the west. The probability to answer three financial literacy questions correctly for individuals with lower (upper) secondary education in east Germany is 23 (16) percentage points lower compared to west Germans with the same educational degrees (significant at 1%, respectively). The difference in the level of financial literacy of individuals with post-secondary non tertiary degrees in east and west is not significant. West Germans with tertiary education are more likely to give three correct answers (at 10% significance). However, for them the difference in knowledge is smaller than for individuals with a lower education.

In addition to where respondents are currently living, we have information on whether they obtained their educational degree in the GDR (see Table 2.4). One would expect to find that individuals who obtained large parts of their education during the GDR have lower financial literacy compared to individuals who were educated either in the east after 1990 or in the west. Our results show no significant differences between individuals with GDR education and non-GDR education. Given that there are substantial differences in the level of knowledge when differentiating according to current area of living it is rather surprising that there are no differences between individuals with a GDR education and individuals with other educational degrees.[23]

Income. Financial literacy in east and west Germany increases with income.[24] The differences in financial literacy between east and west are most pronounced at the bottom and at the top of the income distribution. Especially west German respondents in the lowest 25% of the income distribution and respondents among the 25% with the highest income know more than their counterparts in the east (significant at 1% and 10%, respectively). However, the difference in the probability of giving three correct answers between east and west Germans in the lowest income quartile is slightly larger (18 percentage points) than in the top income quartile (16 percentage points). Respondents among the median 50% of the income distribution are equally likely to give three correct answers in east and west Germany.

Migration between East and West. We can use the information on whether individuals obtained their educational degree during the GDR in east Germany in combination with the information on the current area of living to construct an indicator for migration between east and west. Comparing levels of financial knowledge between individuals who migrated from east to west reveals that in particular those who moved west (i.e. have a GDR

[23] In the multivariate regression the effect of GDR education is significantly and positively related on financial literacy.

[24] In the west the differences between the bottom two income quartiles are not significant. The differences between all other adjacent quartiles are significant at 5% and 1%, respectively. In the east the differences at the bottom of the income distribution are significant (at 1% and 5%, respectively). However, the difference in financial literacy between the third and the fourth income quartile are not significant.

education and live in the west) have higher knowledge compared to those living in the east, irrespective of GDR or non-GDR education. They have even slightly higher levels of financial literacy than their peers in the west (significant at 10%). This might on the one hand be due to a selection effect—the more capable individuals looked for job opportunities in west Germany after unification—and on the other hand due to learning from their new peers in the west.[25] However, among the population in the east—surprisingly—respondents who obtained their education during the GDR regime are significantly (at 1%) more likely to give 3 correct answers compared to individuals living in the east with a non-GDR education.[26]

In summary, we find that respondents in west Germany are more likely to respond to all three questions correctly than individuals in east Germany. The differences between east and west are particularly striking among the bottom of the income distribution and among those with lower education. There are only few differences in the level of financial knowledge among respondents in east and west with high education. However, when analyzing financial literacy in east and west in more detail, we find slightly differing patterns with regard to several dimensions: Most noticeable, there is no significant age pattern and there is no gender discrepancy in financial literacy in east Germany.[27]

Our results indicate that there are differences in the capability of learning about financial issues. The patterns of financial knowledge across socio-demographic groups in east Germany suggest that particularly individuals with low education and income have difficulties in accumulating financial knowledge. They were not able to close the gap in knowledge within the twenty years since unification. In contrast to this, there are no east-west discrepancies when analyzing individuals with higher education. Individuals who migrated west even have slightly higher levels of financial literacy than their west German peers.

2.3.4. Does Financial Literacy Matter?

Retirement Planning

In this section, we turn to the question of whether financial literacy matters for financial decision making, specifically for retirement planning. Previous research by Ameriks et al. (2003) and Lusardi (1999) as well as Lusardi and Mitchell (2007a) and Lusardi and Beeler (2007a) has shown that planning matters for the accumulation of wealth.

We measure retirement planning with a simple question. The wording of the question included in SAVE 2009 is similar to the questions used in the HRS (see for example Lusardi (2003) or Lusardi and Mitchell (2011b)). Respondents were asked the following:

[25] In the multivariate regression the difference is insignificant.
[26] This relationship remains significant in the multivariate analysis.
[27] We conducted multivariate analyses for east and west Germany. The result of the bivariate analysis persist.

"Have you and your partner ever tried to find out how much you would have to save today to reach a certain standard of living at old age?" [Yes/No]

This question is only asked of households in which at least one of the partners is not fully retired. Thus, the following analyses are based on a sample of 677 non-retired households.[28]

Overall, just one quarter of those surveyed (25.3%) responded that they have done some retirement planning. The majority of households (74.7%) have never tried to find out how much they should save to reach a certain standard of living in retirement. Thus, the share of planners in Germany seems rather low. Other surveys, mainly U.S. surveys on retirement planning such as Ameriks et al. (2003), find that 27% of a sample of relatively well educated, wealthy individuals below age 65 did not have a financial plan. And Lusardi (2003) reports that 32% of her sample of non-retired HRS respondents between age 50 and 62 have hardly thought about retirement at all. However, given that the German public pension system has been—and for many individuals still is—rather generous, the low level of retirement planning among German households is not so surprising. But given the pension reforms mentioned above, households are increasingly in charge of their financial well-being during retirement and some planning will be required. In particular younger individuals who will be fully affected by reductions in their pension income will need to plan for retirement.

In Table 2.6 we examine financial planning across levels of net wealth and other socioeconomic characteristics. We find that financial planning is highly correlated with wealth.[29] Individuals at the bottom of the wealth distribution are substantially less likely to plan for retirement. Only about 14% have tried to figure out how much they would need to save. Individuals in the middle and at the top of the wealth distribution are much more likely to have made a plan. Thirty-three percent of households in the middle of the wealth distribution and 41% of the richest households declare that they have planned for their old age.

When we compare planning behavior over socioeconomic characteristics the following relationships emerge:

- Older individuals are more likely to have engaged in planning than younger individuals.
- Men are more likely than women to state that they have planned.
- Individuals with higher educational degrees are more likely to plan than individuals with lower levels of education. Again, the relationship seems to be non-linear. Only

[28] In our regressions only 647 households remain, because of missing information on educational status.

[29] Our measure of wealth includes financial wealth (i.e. deposits in savings accounts, contractual saving for housing, fixed income securities, stock holdings and real estate funds, and other financial assets), private and employer provided pension wealth, housing and other real assets, and is reduced by households' debt. We do not consider business wealth.

8.5% of individuals with lower secondary degrees have planned for their old age whereas more than 23% of individuals with upper secondary education have done so. Individuals with post-secondary and non-tertiary education are most likely to plan: 44% of them report having thought about their retirement savings.

- Individuals in rural regions are almost as likely as individuals in urban regions to prepare for retirement.
- Individuals living in the east are less likely to make a plan than individuals in the west.
- Retirement planning increases with income. Thirteen percent of individuals in the lowest income quartile say that they planned for old age. In the top quartile more than 40% indicate that they have looked ahead.

Financial Literacy and Retirement Planning—A Causal Inference

Financial planning and financial literacy are positively correlated: Table 2.7 shows that households who have planned for retirement are more likely to give correct answers to all of the questions compared to households who have not planned. Overall, about 70% of the planners answered all three questions correctly versus only 54% of the non-planners. The non-planners are about twice as likely as the planners to have said "do not know" to at least one question.

In order to simultaneously examine the relation between financial planning, financial literacy, and socioeconomic characteristics we conduct multivariate analyzes. As a first step, we implement a simple linear regression. The dependent variable is a dummy that indicates whether households have planned for their retirement. Financial literacy is measured in two different ways. First, we us a dummy variable that equals one if the respondent was able to answer all three financial literacy questions correctly. Second, we use a variable counting the number of correct answers, i.e. the variable can take values between 0 and 3. [30] In addition, we control for differences between men and women, income, education, living in east Germany, and age. Moreover, we consider whether the respondent is living with a partner and the number of children in the household. As a second step, we conduct IV regressions using instruments for financial literacy in order to examine the causal effect of financial literacy on retirement planning.

[30] We also conduct robustness checks with more detailed measures of financial literacy. We include the correct answers to the interest, inflation and risk questions separately. We find that the single questions do not have a lot of explanatory power. Only the aggregation of answering behavior over all three questions reveals information on respondents' financial knowledge. Additionally we use dummies for answering zero, one, two or three questions. Here we find the largest effect of correctly answering three questions on financial planning. Therefore, we define our measure of being financially literate accordingly.

The results of the linear regression are displayed in Table 2.8.[31] Without considering income there is a significantly positive relation between financial literacy and financial planning (significant at 10% in specification 1). The ability to answer three questions correctly increases the probability of planning for old age by 7%. In the second specification income is added. The size of the effect of financial literacy on planning remains, however, it becomes insignificant (specification 2). When using a financial literacy score which takes values between 0 and 3 (specification 3 and 4) the effect of financial literacy on planning remains significant when adding income.

Gender does not seem to have any significant effect on financial planning, nor does living with a partner when controlling for income. We do not find significant differences in financial planning between age-groups. However, the age-dummies are jointly significant at 10% (specification 1,2,3). Individuals with lower educational degrees are less likely to plan than individuals with higher levels of education, but only the difference between lower and upper secondary education is significant. Retirement planning increases with income. In particular, individuals at the top of the income distribution have calculated saving and investment needs more frequently than individuals at the bottom.

The OLS estimates may be biased for various reasons. First, it may be that it is planning that affects financial literacy rather than the other way round: Those who have planned have acquired financial literacy, and our estimates are biased upward. Second, there might be an omitted variable bias due to missing information on ability or motivation to think about financial topics. This will bias our estimates upward. Third, there can be measurement error in the financial literacy variables that biases the estimate downward.[32] Using a framing experiment Alessie et al. (2011) show that the answers to the three questions might be subject to measurement error. Consequentially, the dummy variable measuring if the respondent is able to answer all three financial literacy questions correctly as well as the variable counting the number of correct answers are subject to measurement error. Overall the bias in the OLS estimation could be positive or negative.

In order to take account of these problems, we resort to instrumental variables (IV) estimation. We use exposure to financial knowledge of others in the same region as an instrument for financial literacy. The first assumption is that individuals who are exposed to people

[31] Given that retirement planning is a dichotomous variable we also conducted probit regressions, which give very similar results.

[32] In our case the financial literacy variable and its measurement error are non classical. However, Aigner (1973) discusses the measurement error of a dummy variable in the context of linear regressions. He is able to show, that if there is a positive probability of miss-classification (i.e. classifying a respondent as literate even though she is not) then the OLS estimate is downward biased (attenuation bias). Consistent estimates can be obtained using instrumental variable estimation. The situation for the count variable might be different, but we suspect that the argument regarding attenuation bias for discrete variables carries over to count variables.

who are financially knowledgeable become more financially knowledgeable themselves. Our second central assumption is that the financial knowledge of others is beyond the control of the respondent. Specifically, we proxy for financial knowledge of others by using political attitudes at the regional level. Kaustia and Torstila (2010) find that political attitude plays an important role in financial decision making. In particular, left-wing voters are found to have lower stock market participation compared to right-wing voters. According to the authors, this is due to a different "taste for assets," which is found to be independent of other preference parameters, like risk attitude. Van Rooij et al. (2011b) show that those who do not participate in the stock market are less financially literate than those who do participate. Thus, if left-wing voters have a lower likelihood of participating in asset markets, they are less likely to be financially knowledgeable compared to right-wing voters. Therefore, the exposure to financially knowledgeable individuals in regions with a high share of left-wing voters is lower than in regions with a high share of right-wing voters. We use the voting shares for the libertarian party and the voting shares for the leftist party in the 2005 national election at the administrative district level as instruments.[33]

The libertarian party "Freie Demokratische Partei" (FDP) in Germany strongly favors free markets and individual responsibility. On a left-right scale FDP would be positioned to the right of the median voter. In line with our previous argument, we expect individuals who support the FDP to be more financial knowledgeable. Nationwide the FDP achieved 9.8% of the votes in the national election in 2005. The share of votes in the administrative districts ranged from 5.2% to 17.9%. In contrast, the "Partei des Demokratischen Sozialismus" (PDS/dieLinke) is clearly a left-wing party. Therefore, we expect individuals supporting this party to display lower levels of financial knowledge, i.e., there should be a negative relation between the voting share for PDS/dieLinke and financial literacy in the region. PDS/die Linke obtained 8.7% of the votes in the 2005 national elections. The share of votes for PDS/dieLinke ranged from 2.1% to 32.7%. As PDS/dieLinke is the successor party of the "Sozialistische Einheitspartei Deutschlands" (SED), the communist party governing the GDR, voting shares for them are especially high in eastern Germany. We take care of this by controlling for living in East Germany in all regressions.

The results of our first stage regression are reported in Table 2.9 (see specification 1). There is a strong, positive, and highly significant relationship between the share of voters for FDP in the region and individuals' financial literacy. The share of voters for PDS/dieLinke

[33]The data is obtained from the Genesis data bank of the German national statistics office. There are currently 466 administrative districts in Germany. The 647 households which are part of our analysis come from 187 different administrative districts. Participation in national elections is not mandatory in Germany, however it is considered an important duty for citizens and participation rates are usually quite high. In the 2005 election almost 77% of the population voted. Among the regions included in our sample the minimum participation is 67%, the maximum is 83%.

is not negatively related to financial literacy. The F-value of the excluded instruments is 4.38 ($Prob > F = 0.0125$). Thus, the instruments are jointly significant at 5%. We are aware of the rather low F-values of our instruments. However, the small sample size (N=647) made it difficult to find a set of instruments with high predictive power.

The results of the IV regression are reported in Table 2.10. We cluster standard errors at regional level. Our results indicate that financial literacy has a positive and significant effect on financial planning for retirement. Thus, financial literacy makes individuals plan more for retirement. There are some smaller changes in coefficients and significance levels of the other variables. However, the overall picture remains the same as in the OLS models estimated before. Moreover, the exogeneity tests are rejected, indicating that our instruments are relevant. The results of the Hansen's J statistics show that over-identification restrictions are not rejected.[34] It is worth noting that the IV estimates of financial literacy on planning are larger than the OLS estimates in all specifications. We argued above, that the overall direction of the bias in the OLS regressions was not clear ex ante because the various potential biases point in different directions. However, the randomization exercise conducted by Alessie et al. (2011) shows that the measurement error might be large. Thus, it is not surprising that our IV estimates of financial literacy show a stronger effect on planning than the OLS estimates.

Alternative Explanations and Robustness of Our Results

One might argue that our instrument is not truly exogenous. We do not think that individuals select a certain region of living because they favor a certain political party. Nevertheless, other factors may exist which simultaneously influence the choice to live in a certain region, voting behavior, planning, and wealth accumulation. The preference for certain parties in the administrative districts is, for example, correlated with economic prosperity within these regions. FDP is known to be the party of the self-employed and wealthier sections of the population whereas PDS/dieLinke is more popular in regions where the level of unemployment is high. In order to take account of variations at the regional level, we include average income in the districts according to the national accounts of the German states (Länder). The F-value of the excluded instruments is slightly reduced to 4.37 ($Prob > F = 0.0127$). However, including the average income of the individuals living in the same region does not have any significant effect on financial literacy or planning behavior (see specification 2 in Tables 2.9 and 2.10).

Another argument against the validity of our instruments is that the probability to select a person with certain political preferences increases when the voting share of this party is

[34] We conducted the tests for all five imputed data sets separately. Exogeneity test are rejected at 5 percent significance in all five cases. Hansen's J are not rejected in any of the data sets.

higher within the region. We do not think that this is a problem in our case, because neither FDP nor PDS/dieLinke are catch-all parties for which the majority of individuals in the region votes. As previously explained votes for FDP range between 5.2% and 17.9% with a mean of 9.4% among the regions included in our sample. It is not the strongest party in any of the regions. The variance of voting shares for PDS/dieLinke is higher—voting shares range from 2.1% to 32.6% with a mean of 11.6% within the regions in our sample. However, there are only two among 187 regions where PDS/dieLinke is the party getting the majority of the votes. Thus, we do not think that this selection effect weakens our results.

One further concern is that political attitude is directly related to retirement planning. This might be true. However, we do not use personal political attitude as an instrument for financial literacy but the voting share within the region. There are two assumptions necessary to break the link between voting behavior in the region and retirement planning. Firstly and most critically, personal political attitude is independent of the political attitude of persons voting for FDP or PDS/dieLinke within the region. We think this is a plausible assumption because in Germany voting is a very private issue. One talks about political topics but not about which political party one votes for in the national elections. The second assumption concerns the impact of voting behavior within the region on individuals' expectations regarding pension policy. It could be that individuals plan (or do not plan) for retirement because they expect that FDP (PDS/dieLinke) will be in power in the future and thus individual responsibility (state responsibility) for old age income will be high. The counter argument is that neither FDP nor PDS/Linke are catch-all parties and are currently in positions to reform the pension system fundamentally. Thus, we think it is plausible to assume that there is no direct effect of voting shares for those two parties in the region on individuals' retirement planning.

In a sensitivity check we add two more instruments to proxy peer effects. Firstly, we use the number of high schools (Gymnasien) per population. Higher education is associated with higher financial literacy, i.e. a higher density of high schools per population in the region increases the probability to be surrounded by individuals with high education and therefore high financial literacy. Secondly, we use the population density (measured as population per square kilometer) in the administrative district as additional instrument. We assume that one is more likely "run into someone knowledgeable" in a more densely populated area and thus the level of financial literacy should be higher. None of the additional instruments have a significant impact on financial literacy (high school density: p-value 0.521, population density: p-value 0.120). The F-value of our excluded instruments is 2.82 ($Prob > F = 0.0235$). The results are presented in column 3 in tables 2.9 and 2.10. The inclusion of these additional instruments does not change our results fundamentally.

In addition to this, we conducted robustness checks using different measures of financial

literacy.[35] Overall, we find a positive and significant effect of financial literacy on retirement planning behavior.

2.4. Summary and Conclusions

Overall, the level of financial literacy is moderate in Germany. Seventy-two percent of the households in our sample were able to answer two simple questions on interest and inflation. However, only slightly more than half of the household respondents were able to answer all three questions. Thirty-seven percent were not able to answer at least one of the questions and accordingly reported "do not know".

Women are less likely to give correct answers than men. Individuals with lower educational degrees, less income also give fewer correct answers. Overall, there is a hump-shaped pattern of financial literacy over the life cycle. Respondents in east Germany have substantially lower levels of knowledge than respondents in the west—even when controlling for differences in socioeconomic background. Financial literacy in east Germany is particularly low among individuals with low educational attainment and low income. There are only small and insignificant differences in knowledge between respondents with high levels of education and high income in east and west Germany. This is an interesting result as it shows the most vulnerable groups in east and west Germany.

Financial literacy has an important effect on planning for retirement. In light of the recent pension reforms in Germany and increasing individual responsibility, this is an important finding. If individuals with lower financial knowledge are less likely to plan for retirement, they will be less likely to realize and fill the gap in retirement income that will result from the recent reforms. This may have dramatic effects, particularly on retirement security for individuals in east Germany because state pensions will be lower due to interrupted employment histories and high unemployment. Financial literacy is particularly low among east Germans with low education and low income. Thus, more targeted effort and programs may be needed if these groups are to improve their understanding of financial matters and take the appropriate steps to secure adequate retirement savings.

[35] We do not include them in the paper for the sake of brevity but are happy to provide them upon request.

Table 2.4.: Financial Literacy and Socioeconomic Variables

This table shows financial literacy across different socio-economic variables. In the first column . the relative frequencies of these groups within the sample are displayed. The following six columns show the percentage of **correct** answers and the percentage of "do not know" (**dk**) to each financial literacy question (interest, inflation, risk). The last two columns display summary performance on the financial literacy task, i.e. the percentage of respondents with three correct answers and the percentage of respondent with at least one "do not know". N=1,059.

	relative	**interest**		**inflation**		**risk**		**overall**	
	frequency	correct	dk	correct	dk	correct	dk	3 cor.	1 dk
Age									
35 and younger	19.3	84.6	11.0	69.5	22.0	65.6	30.9	55.3	36.8
35 to 50	30.8	84.1	10.6	81.4	14.4	69.4	25.4	60.7	29.8
51 to 65	23.5	83.1	7.7	79.4	16.2	64.1	30.8	53.3	36.1
older than 65	26.5	78.1	14.3	80.4	17.1	48.4	42.7	42.8	46.4
Gender									
men	46.8	83.2	9.4	83.2	12.4	67.6	25.8	59.6	29.9
women	53.2	81.1	12.4	74.1	21.0	56.8	38.0	47.5	43.3
Decision Making									
men:									
single without partner	36.1	78.5	13.5	75.8	16.8	61.2	32.0	54.5	35.3
single with partner	6.5	84.6	12.1	90.2	9.8	77.6	17.9	67.8	25.2
partner makes decisions	2.8	79.7	7.8	74.1	18.1	84.9	15.2	54.2	25.5
joint decision making	54.6	86.9	7.2	87.7	9.5	69.8	23.2	62.4	27.2
women:									
single without partner	39.1	78.0	13.4	70.9	23.6	49.7	44.4	40.4	50.4
single with partner	5.9	89.4	5.7	76.2	76.2	63.8	20.3	53.8	29.4
partner makes decisions	2.6	92.6	7.4	77.8	14.8	72.0	22.7	57.1	30.1
joint decision making	52.4	82.3	12.0	76.1	19.4	60.5	36.0	51.6	40.2
Education (ISCED 1997 classification)									
lower secondary	10.5	57.7	24.6	53.4	38.6	33.7	58.8	21.7	66.0
upper secondary	61.0	83.0	11.1	78.1	17.8	60.0	33.3	51.6	38.1
post-sec. non-tert.	9.9	89.4	6.0	89.2	6.9	78.7	15.9	70.1	21.6
tertiary	14.6	90.2	6.0	91.1	4.9	76.8	21.0	72.0	22.0
other	4.0	91.6	4.4	74.0	18.2	67.1	28.9	51.1	38.2
GDR	30.4	81.4	10.7	80.4	16.4	64.7	31.8	55.0	36.6
non GDR	69.6	82.8	11.1	77.5	17.2	60.6	32.5	52.4	37.2
Income									
1st quartile	24.5	73.4	16.7	68.3	25.9	48.8	44.9	38.1	52.7
2nd quartile	25.4	77.8	13.8	74.3	20.7	55.0	38.8	44.5	43.9
3rd quartile	25.1	86.4	8.7	82.8	14.1	65.9	27.9	59.0	31.5
4th quartile	25.1	91.7	4.9	87.9	7.4	77.5	17.8	70.8	20.3
Area of Living									
urban	92.1	83.4	10.5	79.2	6.4	62.3	31.8	54.1	36.3
rural	7.9	68.8	16.6	68.5	23.7	56.6	38.2	42.7	45.5
west	64.5	84.9	9.0	81.8	13.7	66.2	27.5	58.0	32.2
east	35.5	77.8	14.7	72.1	23.0	54.0	41.0	44.5	45.8

Source: SAVE 2009, own calculation, data is imputed (not financial literacy) and weighted.

Table 2.5.: Financial Literacy and Socioeconomic Variables in East and West Germany

This table displays the proportion of households who answer correctly to the interest, inflation and risk question, respectively in east and west Germany. The first two columns contain the relative frequency of the socioeconomic characteristics within east and west Germany. The last two columns display the percentage of respondents with three correct answers in east and west. N=1,059.

	relative frequency		**interest**		**inflation**		**risk**		**3 correct**	
	West	East	West	East	West	East	West	East	West	East
Age										
35 and younger	20.8	16.4	86.1	81.0	78.6	48.6	71.7	51.5	63.2	37.0
35 to 50	32.1	28.3	88.3	75.5	83.9	76.1	73.2	61.6	65.5	50.8
51 to 65	20.6	28.9	87.7	77.1	84.6	72.7	69.1	57.6	58.4	46.6
older than 65	26.5	26.4	77.6	79.1	79.8	81.6	51.1	43.4	44.4	40.0
Gender										
men	50.2	40.6	87.4	75.8	87.1	74.5	72.6	56.4	64.8	48.0
women	49.8	59.4	82.3	79.2	76.6	70.4	59.7	52.3	51.1	42.0
Education (ISCED 1997 classification)										
lower secondary	12.7	6.5	63.9	35.6	58.2	36.4	38.1	18.0	26.8	3.4
upper secondary	59.2	64.2	86.6	76.9	83.6	69.0	64.4	52.7	57.6	41.5
post-sec. non-tert.	11.9	6.4	90.1	87.0	89.9	87.0	84.0	61.0	72.8	61.0
teritary	11.7	20.0	89.7	90.6	92.6	89.5	84.0	69.2	78.5	65.3
other	4.6	2.8	94.6	82.7	76.6	34.0	75.2	43.2	58.5	20.6
GDR	10.1	67.2	86.3	80.1	89.0	78.1	74.9	61.9	67.2	51.7
non GDR	89.9	32.8	84.7	73.1	81.0	59.8	65.2	37.8	56.9	29.7
Income										
1st quartile	17.7	36.8	77.2	70.0	75.9	61.8	56.8	41.8	47.7	29.7
2nd quartile	23.6	28.7	77.9	77.8	75.7	72.2	55.5	54.3	43.6	45.8
3rd quartile	26.3	22.8	85.2	88.8	82.9	82.7	66.3	65.0	58.5	60.0
4th quartile	32.5	11.7	93.8	81.0	88.7	83.7	79.0	70.0	73.5	57.4

Source: SAVE 2009, own calculation, data is imputed (not financial literacy) and weighted.

Table 2.6.: Retirement Planning and Socioeconomic Variables
This table shows the proportion of households who planned and did not plan for retirement across different socioeconomic variables. N= 677.

	planning *in percent*	not planning *in percent*
	Wealth	
1st quintile	14.2	85.8
2nd quintile	13.9	86.1
3rd quintile	33.1	66.9
4th quintile	27.5	72.5
5th quintile	40.9	59.1
	Age	
35 and younger	16.9	83.1
36 to 50	26.0	74.0
51 to 65	31.8	68.2
older than 65	35.3	64.7
	Gender	
men	28.2	71.8
women	22.9	77.1
	Education	
lower secondary	8.5	91.5
upper secondary	23.2	76.8
post-sec. non-tert.	44.1	55.9
tertiary	35.1	64.9
other	25.7	74.3
	Income	
1st quartile	13.0	87.0
2nd quartile	24.5	75.5
3rd quartile	19.0	81.0
4th quartile	40.5	59.5
	Area of Living	
urban	25.5	74.5
rural	24.1	75.9
west	27.7	72.3
east	20.9	79.1

Source: own calculation on the basis of SAVE 2009, data is weighted and imputed.

Table 2.7.: Retirement Planning and Financial Literacy

This table shows the proportion of households who planned and did not plan for retirement across financial literacy.

	planning in percent	not planning in percent
	Interest	
correct	90.9	82.5
do not know	4.4	11.4
	Inflation	
correct	88.4	75.4
do not know	6.7	19.2
	Risk	
correct	77.4	64.0
do not know	16.4	32.0
	Overall	
inflation and interest correct	82.9	69.6
all correct	69.1	53.8
at least 1 dk	19.5	37.5

Source: own calculation on the basis of SAVE 2009, data is weighted and imputed (not financial literacy).

Table 2.8.: Multivariate Analysis of Retirement Planning: OLS Results

This table reports OLS estimates of the effect of financial literacy and several control variables on retirement planning. In specifications 1 and 2 financial literacy is measured by a dummy equal to one if all three financial literacy questions are correctly answered. In specification 3 and 4 financial literacy is measured by the number of correct answers to the three financial literacy questions; it can take values from 0 to 3. Coefficients and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). d indicates a dummy variable. ref. indicates the omitted category.

	1	2	3	4
financial literacy: 3 correct (d)	0.07	0.06		
	[0.04]*	[0.04]		
financial literacy: 0 to 3 correct			0.04	0.04
			[0.02]**	[0.02]**
living in east Germany (d)	-0.07	-0.02	-0.07	-0.02
	[0.04]**	[0.04]	[0.04]*	[0.04]
men(d)	0.01	0	0.01	0
	[0.04]	[0.04]	[0.04]	[0.04]
living with a partner	0.07	0.01	0.07	0.01
	[0.04]*	[0.05]	[0.04]*	[0.05]
number of children	-0.02	-0.02	-0.02	-0.02
	[0.01]	[0.01]*	[0.01]	[0.01]*
age: 35 and younger (d)	-0.07	-0.05	-0.07	-0.05
	[0.04]*	[0.04]	[0.04]*	[0.04]
age: 36-50 (d)	ref.	ref.	ref.	ref.
age: 51-65 (d)	0.06	0.06	0.06	0.06
	[0.04]	[0.04]	[0.04]	[0.04]
age: 66 and older (d)	0.06	0.1	0.05	0.1
	[0.10]	[0.09]	[0.09]	[0.09]
lower secondary education (d)	-0.12	-0.1	-0.11	-0.09
	[0.04]***	[0.04]**	[0.04]**	[0.04]**
upper secondary education(d)	ref.	ref.	ref.	ref.
post secondary, non tert. education (d)	0.12	0.09	0.12	0.09
	[0.07]	[0.07]	[0.07]*	[0.07]
first stage tertiary education (d)	0.07	0.01	0.07	0.01
	[0.05]	[0.05]	[0.05]	[0.05]
income: 1st quartile		ref.		ref.
income: 2nd quartile		0.08		0.08
		[0.05]		[0.05]
income: 3rd quartile		0.02		0.02
		[0.05]		[0.05]
income: 4th quartile		0.23		0.22
		[0.06]***		[0.06]***
constant	0.21	0.15	0.15	0.1
	[0.05]***	[0.05]***	[0.06]**	[0.06]
observations	647	647	647	647

Source: SAVE 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2.9.: First Stage Regressions

This table reports estimates of the first stage regressions of financial literacy on several control variables and the share of voters for FDP and PDS/dieLinke in the region. Specification 2 contains regional average income as an additional control. Specification 3 uses high school density and population density as further instruments. Coefficients and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Standard errors are clustered at the regional level. d indicates a dummy variable. ref. indicates the omitted category. Additional controls are gender, living in east Germany, living with a partner, number of children, dummies for income quartiles, dummies for age groups and education, i.e. all variables listed in the second stage regression are also controls in the first stage.

	1	2	3
share FDP voters	2.84	2.85	3.09
	[0.97]***	[0.97]***	[1.00]***
share PDS/Linke voters	0.06	0.04	0.25
	[0.55]	[0.58]	[0.68]
high school density			887.42
			[1,380.42]
population density			0
			[0.00]
average regional income		0	0
		[0.00]	[0.00]
constant	0.24	0.28	0.4
	[0.11]**	[0.24]	[0.26]
additional Controls	Yes	Yes	Yes
observations	647	647	647

Source: SAVE 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2.10.: Multivariate Analysis of Retirement Planning: IV Results

This table reports GMM estimates of the effect of financial literacy and several control variables on retirement planning. Financial literacy has been instrumented using voting shares for FDP and PDS/dieLinke. Specification 3 uses high school density and population density as additional instruments. Coefficients and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Standard errors are clustered at the regional level. d indicates a dummy variable. ref. indicates the omitted category.

	1	2	3
financial literacy: 3 correct (d)	0.88	0.86	0.73
	[0.35]**	[0.36]**	[0.31]**
men(d)	-0.08	-0.07	-0.06
	[0.06]	[0.06]	[0.06]
living in east Germany (d)	0.07	0.09	0.07
	[0.06]	[0.07]	[0.06]
living with a partner (d)	0.04	0.05	0.04
	[0.06]	[0.06]	[0.05]
number of children	-0.03	-0.03	-0.03
	[0.02]*	[0.02]	[0.02]*
income: 1st quartile (d)	ref.	ref.	ref.
income: 2nd quartile (d)	0.08	0.08	0.08
	[0.07]	[0.07]	[0.07]
income: 3rd quartile (d)	-0.06	-0.05	-0.04
	[0.08]	[0.08]	[0.07]
income: 4th quartile (d)	0.1	0.1	0.12
	[0.09]	[0.09]	[0.08]
age: 35 and younger (d)	-0.07	-0.07	-0.06
	[0.05]	[0.05]	[0.05]
age: 36-50 (d)	ref.	ref.	ref.
age: 51-65 (d)	0.11	0.11	0.1
	[0.06]*	[0.06]*	[0.06]*
age: 66 and older (d)	0.34	0.33	0.29
	[0.14]**	[0.14]**	[0.13]**
lower secondary education (d)	0.14	0.14	0.1
	[0.12]	[0.12]	[0.11]
upper secondary education(d)	ref.	ref.	ref.
post secondary, non tert. education (d)	-0.07	-0.07	-0.04
	[0.11]	[0.11]	[0.10]
first stage tertiary education (d)	-0.09	-0.09	-0.07
	[0.08]	[0.08]	[0.07]
average regional income		0	0
		[0.00]	[0.00]
constant	-0.28	-0.38	-0.31
	[0.19]	[0.27]	[0.24]
observations	647	647	647

Source: SAVE 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

3. Financial Literacy and Private Old Age Provision

3.1. Introduction

Private old age provision is growing increasingly important in times of demographic change and mounting strains on the public pension system. Major pension reforms were implemented in Germany since the mid-1990s. As a result responsibility for pension income has shifted from the state level towards the individual level. Currently about 85% of the German workforce is covered by the German public pension insurance. According to Börsch-Supan and Wilke (2006) about 88% of total disposable income during retirement in Germany is disbursed from the public pension system. After the recent reforms these payments will decrease and individuals are expected to accumulate substantial amounts of pension wealth in addition to their claims from the public pension system to bridge the gap that arises in old age income. In order to provide additional incentives for private old age savings the so called Riester pensions—state subsidized private pension or savings contracts—were introduced in 2001.[1]

Every person who may be affected by the prospective decrease of the first pillar pensions is eligible for Riester subsidies. In contrast to private (third pillar) retirement savings in the Netherlands and Sweden, Riester contracts are voluntary, supplementary pensions. Currently between 37 and 39 million individuals are estimated to be eligible,[2] and as of 2009, about 12.9 million Riester contracts have been signed (BMAS (2009)). The fundamental concept is that savers contribute 4% (at least €60) of their income to a certified private savings contract and receive a lump-sum subsidy of (currently) €154. Additionally, the contributions to Riester pensions are tax deductible. Moreover, families with children receive €185 for each child (€300 if the child was born after 2007). Thus, the Riester scheme is particularly generous for individuals with low income and families with children. They can obtain subsidies of well over 90% of their contribution.[3]

[1] See Börsch-Supan and Wilke (2004) and Wilke (2009) for details on the reform of the German retirement system.

[2] See, e.g., Fassauer and Toutaoui (2009), Sommer (2007).

[3] See Gasche (2008), Sommer (2007). For more information on the Riester pensions also see, e.g., Börsch-Supan et al. (2008) and Coppola and Reil-Held (2009).

For many individuals in Germany the need to save for old age in addition to the state pension is new. In order to evaluate the effectiveness of governmental programs, it is vital to examine who provides for their old age income and signs a Riester or other private old age savings contract and who does not. One important variable to be considered among individuals is their level of erudition as investors. In light of increasing individual responsibility and potential public measures such as targeted information and education programs it is therefore important to better understand the link between households' financial knowledge and financial decision making.

Studies of financial literacy in the US and the Netherlands found that in particular low income/low education households and women often lack financial literacy and thus accumulate low retirement wealth (see e.g. Lusardi and Mitchell (2011b), Van Rooij et al. (2011a)). In the previous chapter we found similar results for the German population. Riester pensions could address these issues, as they were designed to be especially beneficial to households with low income and households with children. Subsidies for children are assigned to the retirement savings contracts of women by default, so that women on average benefit more from the subsidies. However, the interaction with financial literacy has not been studied up until now. The following questions need to be answered: How financially literate are individuals with a Riester compared to individuals with other private old age savings and compared to households without any private provision? Are higher levels of financial literacy associated with greater private pension coverage? How are the incentives created by the subsidies related to the level of financial literacy, i.e., how does the association between financial literacy and private pension coverage change for households with lower income and/or with children?

This study contributes to the existing literature in several ways. First, I use a measure of financial literacy that has been used previously in studies in the US and the Netherlands and thus allows for a standardized way to evaluate the level of financial literacy in Germany. Second, I analyze the link between financial knowledge and owning private savings contracts for retirement. Several other studies found that the level of financial literacy among the German population is limited (e.g., Commerzbank AG (2003), Leinert (2004), Raffelhüschen and Victoria Lebensversicherung AG (2006), Bankenverband (2008)). However, these studies largely failed to link financial knowledge to financial decision making of individuals. The SAVE data gives me a unique opportunity to fill this gap. Compared to the previous chapter, in which we examined the relation between financial literacy and planning for retirement using the same data set, I will go one step ahead and look at the relation between financial literacy and actual retirement savings.[4] And finally, by analyzing the relation between

[4]I will focus on demand induced ownership of Riester contracts in my analysis. Besides this, one could argue how the objectives of the supply side influence ownership structure. This aspect is discussed in

financial literacy and Riester contracts as well as financial literacy and non-subsidized private pension contracts I hope to contribute to the ongoing debate about the success of financial incentives for private retirement provision.

The main findings are that there is a strong and positive association between financial literacy and any form of private retirement provisions even when controlling for differences in socio-demographic background. The coverage with old age savings products in the lowest income quartile is very low, despite the high subsidies for the poorest. More than 70% of the poorest households do not own any kind of supplementary private pensions. In the higher income quartiles this share is substantially lower: Only about 20% of the households in the top quartile do not own supplementary private pensions. Additionally, households in the lowest income quartile show the lowest level of financial literacy, even after adjusting for differences in socioeconomic status. Moreover, among low income households higher financial literacy is significantly and positively associated with ownership of a private savings contracts. In contrast to this, households with high income and higher financial literacy generally have a lower coverage with Riester pensions and a higher probability to own other forms of private coverage.

The remainder of this paper is structured as follows. In the following section I will briefly review the literature on financial literacy and saving behavior and give an introduction to the design of Riester pensions. I will then state my hypotheses. Section 3.3 describes the SAVE data. Section 3.4 provides the empirical evidence on financial literacy and retirement savings. Section 3.5 summarizes and discusses my conclusions.

3.2. Literature and Hypotheses

3.2.1. Life-cycle Savings and Financial Literacy

When analyzing old age provision one usually draws on the classical life-cycle savings theory by Modigliani and Brumberg (1954). The central outcome of their model is that as a result of optimization behavior individuals smooth their consumption path over the life-cycle (life-cycle savings hypothesis). To compensate for income-losses at old age forward-looking individuals should accumulate capital at younger ages. Thus, taking their current information into account individuals calculate an expected value of the future development of their income, their survival probability, the discount rates, the interest rate, their investments, the pension claims and inflation. They formulate their optimal consumption and savings plan based on these grounds (Lusardi (2008)).

more detail in Chapter 4.

However, empirical studies find that individuals' savings patterns are substantially different from the predictions of the classical life-cycle savings theory. Other saving motives like precautionary saving or bequest motives were subsequently included to improve the model's predictive power.[5] There are few studies that explicitly consider the role of financial literacy in a theoretical context. Maki (2004) argues relatively informally that financial education does not change preference parameters of individuals (risk and time preferences) but alters the choice set that individuals face when planning for the future. Thus, financial education increases individuals' awareness of possible ways to save for future consumption and thereby improves their decisions. Delavande et al. (2008) argue on similar grounds and assume that individuals are limited in their ability to optimize consumption and savings over the life-cycle due to restrictions in information access and information processing. However, individuals can improve their optimization abilities by acquiring financial knowledge, which is modeled as human capital production process. Peress (2004) explains the different pattern of stock holding and wealth by endogenous differences in information. He assumes that financial information about stocks is costly, and that its value for the individual increases with the amount to be invested in stocks. Thus, individuals with more money to invest, buy information and invest more in stocks because the investment is less risky for them. They thereby accumulate further wealth. The features common to all models of financial literacy acquisition are that information about financial investment opportunities is costly and individuals can acquire knowledge. In general, financial literacy and financial decision making are mutually enhancing: The more an individual knows about different options and consequences the better her financial decisions will be. At the same time the more decisions the individual makes, the more knowledge she can acquire.

There is empirical evidence, which links financial knowledge and saving behavior. In the United States of America (US) the first studies on financial knowledge were conducted by Bernheim (1998), Hogarth and Hilgert (2002), Hilgert et al. (2003) and Moore (2003).[6] Lusardi and Mitchell link financial literacy and the accumulation of retirement wealth in various studies.[7] Furthermore, Lusardi and Mitchell (2011b), Van Rooij et al. (2011b) as well as Christelis et al. (2010) discover that individuals with less financial knowledge and numeracy have fewer risky assets in their portfolio. Campbell (2006) argues that individuals with lower knowledge may face higher fixed cost of participation in the stock market or anticipate that their portfolio choice would be less efficient and thus stay out of risky assets.

In addition to these studies of the link between financial literacy, wealth accumulation and portfolio choice, there are a number of studies that examine the relationship between financial

[5]For a review see Browning and Lusardi (1996).
[6]Lusardi (2008) provides an overview of different studies.
[7]See, e.g., Lusardi and Mitchell (2011b, 2007a,b, 2008).

literacy and investment mistakes. According to Lusardi and Tufano (2009) individuals who know less about the effects of compound interest are more likely to report excessive debt. Campbell (2006) finds that financially sophisticated households are more likely to refinance mortgages when this is beneficial. Less educated households are much more likely to report implausibly low mortgage rates and may therefore fail to refinance. Müller and Weber (2010) discover that financially sophisticated investors are less biased towards past returns, pay lower front-end loads and less frequently miscalibrate forecasts for their own as well as the general stock market development. They detect a minor influence of financial literacy on buying passively vs. actively managed funds. A study by the OECD (2008) summarizes the effects of low financial literacy on the decision to annuitize, i.e. to insure against longevity risk and indicates that less literate individuals might be less likely to insure against longevity risk. According to Calvet et al. (2007) more educated, wealthier households with higher income tend to invest more aggressively and at the same time more efficiently. They face only moderate losses due to under-diversification of their portfolios. Calvet et al. (2009) discover that investment mistakes (under diversification, risky share inertia and the disposition effect) decrease with wealth as well as with education and financial experience. They also identify a strong positive correlation between the share of risky assets held in the portfolio and financial sophistication.

Overall, empirical research finds a positive relation between financial knowledge and the quality of financial decision making.

3.2.2. Riester Pensions

Due to the recent reforms in the German pension system and the resulting increase in individuals' responsibility for financial planning, it is particularly interesting to examine the link between financial literacy and old age savings. In the course of the German public pension reform the government decided to reduce the standard pension level in order to avoid dramatic increases in contribution rates. Börsch-Supan and Gasche (2010a) estimate public pension income in 2030 to be between 14% and 16% lower compared to a situation without the reform. The so called Riester pensions, state subsidized private pension plans, are tailored to encourage private savings in order to close the gap arising in public pension income. Riester pensions are private savings plans, investment funds or private pension plans that are subsidized depending on individuals' income and number of children.[8] The contracts are offered by private firms—mainly insurance companies or banks—and have to be certified.[9] According to the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) more

[8] In 2008 an additional scheme that subsidizes owner-occupied housing was introduced ("Wohn-Riester").

[9] Until June 2010 contracts were certified by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin), thereafter they are certified by the Bundeszentralamt für Steuern.

than 4,300 Riester products were certified between 2001 and 2009. The certification does not guarantee the economic stability of the provider or its cost effectiveness but is merely a check if certain criteria regarding the structure of the plan are fulfilled. For example, one of the central features of certification is that at least 70% of the accumulated sum have to be paid as annuity.

Every individual mandatorily insured in Germany's public pension system and public servants, as well as the eligible persons' spouses, are authorized to get Riester subsidies. The estimates of the number of eligible persons differ mainly due to the difficulties in estimating the number of indirectly eligible persons.[10] Most recent estimates by Fassauer and Toutaoui (2009) range between 38.2 and 39.0 million eligible individuals, i.e. more than 70% of all individuals aged between 15 and 64 can profit from the subsidy. Measuring this estimation against the 12.9 million signed Riester contracts at the end of 2009 gives a crude indication of the Riester coverage, i.e. around 34% of the individuals estimated to be eligible own Riester contracts. The analysis of micro-data in the following will give a more detailed picture of Riester coverage and its determinants.

Subsidies are either payed as lump-sum or tax deduction. The lump-sum subsidies are particularly generous for low income earners and families with children, whereas the tax reduction is more beneficial for households with higher incomes. The current regulation is summarized in Table 3.1. Depending on the number of children low income earners can obtain a *Zulagenquote*—ratio of subsidies to total contribution—between 70 and 90% in 2008. The ratio of subsidies is reduced to between 30 and 40% for individuals with high income in 2008.[11]

Table 3.1.: Riester Subsidies

This table summarizes the state subsidies for Riester products as applicable from 2008 onwards.

minimum percentage of income required to be saved to obtain full subsidies	4%
minimum own contribution in Euros per year	60
per capita subsidy in Euros per year	154
subsidies for children in Euros per year:	
- children born before 1.1.2008	185
- children born on 1.1.2008 and after	300
one-time bonus if the subsidized individual is younger than 25 in Euros	200
maximum tax deductible amount in Euros per year	2100

Source: based on Sommer (2007).

According to Stolz and Rieckhoff (2009) since the start of the program in 2002 a total sum of around 6 billion Euros of subsidies were granted until September 2009. This amount

[10] See, e.g., Sommer (2007), Fassauer and Toutaoui (2009).

[11] For further details on the structure of the subsidies, eligibility rules and the dynamics of the Riester plans see, e.g., Börsch-Supan et al. (2008), Coppola and Reil-Held (2009) and Sommer (2007).

is based on Riester contracts in 2006, because the application for subsidies allows a possible lag of two years. Moreover, it only covers the direct subsidies and not the amount of tax deduction. The authors evaluate data of the Zentrale Zulagenstelle für Altersvermögen (ZfA)—the government agency responsible for granting the subsidies. They find that in particular individuals with an income below the average apply for subsidies. Moreover, they find that almost half of the subsidy recipients have children and the percentage of subsidies for children is higher among women than among men. The average *Zulagenquote* is around 30% between 2006 and 2008. It is particularly high for women—mostly due to lower incomes and a higher share of subsidies for children. It is slightly higher for individuals in east Germany—probably also due to lower average income levels.

This analysis slightly misrepresents the true effect of the Riester campaign because the effect of tax deductions is not considered. Evaluations of micro-data confirm that Riester contracts are popular among women and individuals living in east Germany. In contrast to the result by Stolz and Rieckhoff (2009) the coverage among individuals at the bottom of the income distribution is still relatively low, but reveals a high dynamic (see Coppola and Reil-Held (2009) and Geyer and Steiner (2009)). Gasche and Ziegelmeyer (2010) find that there was no increase in new subsidized private savings contracts due to the financial crisis, however, they still detect a growing distribution of Riester contracts in the lowest income quintile 2009.

Generally, even nine years after the introduction, a vivid debate still rages about the effectiveness of Riester pensions, their distributional and macroeconomic effects.[12]

3.2.3. Hypotheses

Studies of financial literacy in the US and the Netherlands find that in particular households with lower income and lower education as well as women are at risk of lacking financial literacy and thus accumulate low retirement wealth (see e.g. Lusardi and Mitchell (2011b), Van Rooij et al. (2011a)). Our analyses in the previous chapter showed that financial literacy in Germany is particularly low among individuals with low income, low education, women, and those living in east Germany. However, whether these groups are also at risk of accumulating low retirement wealth remains an open question. Riester pensions are especially beneficial to households with low income and households with children. By default the subsidies for children are assigned to the contracts of women, so that on average women benefit more from the subsidies. This means that incentives to save for retirement are tailored to those groups that are identified to be at risk of having lower financial literacy

[12] See, e.g., Börsch-Supan et al. (2010), Börsch-Supan and Gasche (2010b), Coppola and Reil-Held (2009), Corneo et al. (2009), Börsch-Supan and Gasche (2010a), Gasche and Ziegelmeyer (2010), Pfarr and Schneider (2011), Sommer (2007).

in previous studies. Thus, it is interesting to study the effect of financial literacy on owning a Riester contract compared to other non-subsidized forms of private provision for old age. The question I would like to answer is: Are Riester pensions successful at encouraging individuals with lower financial literacy to save privately for their old age? The hypothesis to be tested is therefore:

Hypothesis 1: High state subsidies for Riester pensions create additional incentives for German households to provide privately for retirement. As incentives are particularly high for individuals with lower levels of financial literacy I expect the level of financial literacy of owners of Riester contracts on average to be lower compared to owners of other non-subsidized pensions.

Subsidies for Riester pensions differ considerably across income and for families with children. Previous evidence on the respondence of US households to incentives created by pension systems suggests that only those who are aware of the incentives also respond (see Chan and Stevens (2008)). Therefore my second central question is: How are financial literacy and the level of subsidies related? I would like to test the following hypothesis:

Hypothesis 2: I expect individuals with higher financial literacy to be better at realizing the size of the subsidy and therefore buy Riester contracts. Therefore, I propose that there exists a positive effect of financial literacy at the bottom of the income distribution and among households with children on owning a Riester contract.

There is a tension between the propositions in hypotheses one and two. In hypothesis one the expectation is that all households independent of their level of financial expertise will react to financial incentives and thus financial incentives can to some extent mitigate the lack of financial literacy on private retirement savings. Hypothesis two specifies that only those with higher levels of expertise will react to the incentives. For the evaluation of public policy I think it is particularly interesting to see which of the two behavioral assumptions describes actual behavior more accurately.

3.3. Data

3.3.1. SAVE

I use SAVE, a representative German household panel designed to improve the understanding of savings behavior, for the analysis. The survey was first conducted in 2001 by the Mannheim Research Institute for the Economics of Aging (MEA). Consecutive surveys were in the field in 2003/2004, and in every year since 2005. In 2009, there were 2,222 households in the panel. The data were collected during the early summer of 2009. The questionnaire

is in paper and pencil format.[13]

I use the random route sample for my analysis and restrict the sample to respondents without missing answers in the financial literacy task, i.e. 1,007 households remain in the sample. Missing information on other variables is imputed using an iterative multiple imputation procedure based on a Markov-Chain Monte-Carlo method (Schunk (2008), Ziegelmeyer (2009, 2011)). Thereby the efficiency of estimates is increased due to a larger number of observations and the item non-response bias that occurs if observations with and without missing values differ systematically is reduced. Five multiple imputed data sets are used for the analysis and results are derived using Rubin's method (Rubin (1987, 1996)). Table B.1 in the appendix describes the socioeconomic details of the households in the sample. Sample specific weights with respect to age and income classes are constructed on the basis of the German Mikrozensus 2008 and are applied to the all descriptive statistics.

In the first part of the empirical analysis I spent some time to describe the performance of German households on the financial literacy task. It is based on the sample of 1,007 respondents representative of the German population. In the second part of the paper I am interested in individuals' saving behavior prior to retirement. Thus, I restrict the analysis to households below the age of 60. Additionally, I proxy Riester eligibility and restrict the sample in the following way: I exclude single households who are retired and households where both partners are retired from the analysis.[14] In addition to the retired households I exclude self-employed and non-working households as long as they are not unemployed, raising children, or doing a civil or military service. Thus, in section 3.4.2 sample size is reduced to 509 households.

3.3.2. Measuring Financial Literacy

Much research has been conducted on ways to measure financial literacy, pioneered primarily by Annamaria Lusardi and Olivia Mitchell. Their stepping stone was the development of three quiz-like questions testing the understanding of inflation, interest and risk (Lusardi and Mitchell (2011b)). Their focus is on measuring actual knowledge rather than decision making skills or financial experience. These questions have been included in various surveys around the world and allow for some comparison of financial knowledge across countries. Based on these questions an extended set of questions was developed for the Dutch Household Panel (DNP) (Van Rooij et al. (2011b)) which was also used in the RAND American Life-Panel (ALP) (Lusardi and Mitchell (2007b)). Some of these questions were included in SAVE 2009

[13] A detailed description of the scientific background, design, and results of the survey can be found in Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009).

[14] Since 2008 disabled persons are also eligible for Riester subsidies. In SAVE I cannot distinguish between the forms of retirement. Therefore, I slightly underestimate the number of eligible households.

and form the basis for the analysis in this paper. Hung et al. (2009) aim at defining and validating various measures of financial literacy. They find that the extended measure of Lusardi and Mitchell (2007b) is internally consistent, shows good test-retest reliability and is stable over time.

In SAVE 2009 we included nine of the original questions measuring financial literacy. Four of the questions are classified as measuring basic financial concepts.[15] The first question concerns the understanding of interest and mainly requires the ability to calculate. The second question examines the understanding of the joint effects of interest and inflation. A third question deals with calculating compound interest and a fourth question is related to money illusion. Five additional questions are categorized as measuring advanced financial knowledge. They deal with risk and diversification, understanding asset fluctuations, the stock market, mutual funds, and bond pricing. The wording of the questions is contained in appendix B.2. These questions are used to measure financial literacy in a German household survey for the first time. Therefore, I will elaborate on the answering behavior in some detail in section 3.4.1.

3.3.3. Measure of Old Age Provision

Each year participants are requested to fill in a detailed household balance sheet. We obtain information on the kinds of saving products households own and how much of their wealth is invested in these. Regarding old age provision, households are requested to report if they owned private life insurances (*Private Lebensversicherung*),[16] state subsidized private pensions (*staatlich geförderte private Altersvorsorge*), or other non-subsidized private pensions (*private Rentenversicherungen*) at the end of the previous year, i.e. at the end of 2008. More specifically for each category we know the number of contracts the household owns, the amount of wealth invested, and the monthly contributions during 2008. For the analysis in this paper I am only using information on whether households own the respective contracts. I construct a dummy variable equal to one if households own state subsidized pension contracts ("Riester"). Additionally, I use a dummy if households have non-subsidized private pensions, i.e. private life-insurance or other non-subsidized private pensions ("non subsidized private old age provision"). There is some overlap between households with Riester and other non-subsidized forms of private provision. I construct an additional dummy equal to one, if households own both forms of private provision ("Riester and other").

[15] Van Rooij et al. (2011b) conduct factor analysis to categorize the questions and aggregate them into measures of basic and advanced financial literacy.

[16] In Germany private life-insurance contracts in the form of capital life-insurance contracts are a common way to accumulate retirement wealth.

3.4. Empirical Evidence

3.4.1. Basic and Advanced Financial Literacy

The responses given to all nine financial literacy questions are shown in Table 3.2. Overall, more respondents are able to give correct answers to the basic financial literacy questions (Panel A) compared to the advanced financial literacy questions (Panel B).

Basic Financial Literacy. Among the basic questions, most respondents answer the interest question correctly (83%). Surprisingly, almost 20 percentage points fewer respondents (83% compared to 63%) give a correct answer to the compound interest question despite the similarity in the style of the questions. Compound interest is calculated correctly by 63% of the respondents and incorrectly answered by around one fourth. For the money illusion question the frequency of incorrect answers is even higher (32%). Only around 56% correctly reply that the purchasing power of their money remains constant. The question regarding inflation has the fewest incorrect answers (5%) and the largest frequency of "do not know" (17%) among the basic questions. It is correctly answered by 79% of the individuals.

Table 3.2.: Responses to the Financial Literacy Task

Panel A–**Basic Financial Literacy**: This table contains the relative frequencies of respondents who gave correct or incorrect answers to the questions on the basic financial literacy task. DK/refuse refers to those respondents who were unwilling (refuse) or unable (do not know) to answer the respective question. N=1,007.

	Interest	**Inflation**	**Compound Interest**	**Money Illusion**
Incorrect	6.33	4.62	25.45	31.32
Correct	82.66	78.52	62.54	55.88
Dk/refuse	11.01	16.86	12.01	12.8
Total	100	100	100	100

Panel B–**Advanced Financial Literacy**: This table contains the relative frequencies of respondents who gave correct or incorrect answers to the questions on the advanced financial literacy task. DK/refuse refers to those respondents who were unwilling (refuse) or unable (do not know) to answer the respective question. N=1,007.

	Risk	**Return Volatility**	**Stock Market**	**Mutual Funds**	**Bond**
Incorrect	5.88	10.24	18.07	7.16	53.38
Correct	62.1	62.54	48.52	41.86	8.86
Dk/refuse	32.02	12.01	33.41	50.98	37.77
Total	100	100	100	100	100

Source: SAVE 2009, data is weighted.

Panel A in Table 3.3 displays the number of correct answers on the basic financial literacy task as summary measure for basic financial literacy. Around 10% of the respondents are unable or unwilling to answer any of the questions and 38% give four correct answers. In the multivariate regression I will use a dummy equal to one if a respondent is able to give

four correct answers as a measure for basic financial literacy.

Table 3.3.: Basic and Advanced Financial Literacy Index

Panel A–**Basic Financial Literacy**: This table contains the frequency and the proportion of respondents who were able to answer zero to four questions on the basic financial literacy task.

No. of correct answers	Freq.	Percent
0	98	9.74
1	72	7.13
2	153	15.15
3	299	29.71
4	385	38.27
Total	1007	100

Panel B–**Advanced Financial Literacy**: This table contains the frequency and the proportion of respondents who were able to answer zero to four questions on the advanced financial literacy task.

No. of correct answers	Freq.	Percent
0	208	20.61
1	138	13.66
2	167	16.58
3	220	21.82
4	275	27.33
Total	1007	100

Source: SAVE 2009, data is weighted.

Advanced Financial Literacy. Regarding advanced financial literacy I find that the bond question is the most difficult for individuals (see Table 3.2 Panel B). Only 9% are able to correctly answer this question. More than half of the respondents give an incorrect answer. Interestingly, the number of "do not know" is only second highest for this question. More respondents admit to be uninformed about the design of mutual funds compared to bond prices. The questions about stock market risk and returns of certain investment products are each answered correctly by around 62% of the respondents. I summarize the number of correctly answered questions on the advanced financial literacy task in Table 3.3 Panel B. The bond question is excluded from the advanced financial literacy measure, because there are so few correct answers.[17] Overall, more than 20% of the respondents are unable to give any correct answer. Just slightly more than 27% of the individuals answer all questions correctly. I will use a dummy variable equal to one if four questions are answered correctly to measure advanced financial literacy in the multivariate regressions.

Advanced and basic financial literacy are correlated. Table 3.4 shows the number of correct answers on each of the tasks. No respondent who is unable to correctly answer any of the questions on the basic task obtains four correct answers on the advanced task. However, respondents with four correct answers on the basic task are very likely to obtain four correct answers on the advanced task. In total almost 18% of the respondents are able to answer

[17]Principal components analysis revealed that this item does not correlate well with the other items.

all eight questions considered. The spearman rank correlation between the two measures is 0.54 (p-value 0.0000).

Table 3.4.: Basic and Advanced Financial Literacy

This table shows the joint distribution of basic and advanced financial literacy among the respondents. N=1,007.

		Advanced Financial Literacy Index					
No. of correct answers		0	1	2	3	4	Total
Basic Financial Literacy Index	0	8.08	1.16	0.35	0.14	0	9.74
	1	2.44	2.47	1.05	0.57	0.61	7.14
	2	3.79	2.85	3.53	3.1	1.88	15.15
	3	4.38	4.34	5.81	8.29	6.9	29.72
	4	1.97	2.78	5.89	9.67	17.94	38.25
	Total	20.66	13.6	16.63	21.77	27.33	100

Source: SAVE 2009, data is weighted.

International Comparison. Figures B.1 and B.2 in the appendix show the relative frequencies of correct responses to all nine questions in an international comparison. Currently results on the performance of individuals from the Netherlands (Van Rooij et al. (2011b)) and the US (Lusardi and Mitchell (2007b)) are available. The comparison reveals that German respondents are slightly less likely to give correct responses to all questions. The Dutch respondents outperform the US on the compound interest calculation and on the mutual funds question. However, the differences here are small. The US American respondents perform best on the rest of the questions. However, one should not over-interpret the differences detected between the countries. Besides being related to institutional differences deviations can be related to the design of the surveys (ALP respondents have higher education and income than the average American population[18]) or the design of the questionnaire (SAVE is a paper and pencil questionnaire, whereas DNP and ALP are internet panels).[19]

Financial Literacy and Socio-demographics. Financial literacy increases with education and income. Additionally, individuals older than 65 are less likely to know responses to the advanced questions. There are no differences between age-groups in the probability to answer the basic literacy questions. Levels of basic and advanced financial literacy are lower in east Germany. Women in west Germany are significantly less likely to be financially literate. The gender differences in the west are larger and more significant for advanced financial literacy compared to basic literacy. Interestingly, there are no differences across gender in advanced and basic financial literacy in east Germany: Men and women know equally little. Thus, the pattern detected for the three financial literacy questions in the previous chapter seems stable when using a more extensive measure of financial literacy.

[18] See, Lusardi and Mitchell (2007b), p.4.

[19] For further international comparisons based on three financial literacy questions see Lusardi and Mitchell (2011a).

3.4.2. Private Old Age Provision

Table 3.5 shows the prevalence of certain forms of old age provision for a sample of 509 non-retired households younger than 60 who are eligible for Riester subsidies. The analysis reveals that around 39% of the respondents eligible for Riester subsidies in 2009 actually own at least one Riester contract: 16% own Riester contracts only, while around 23% own Riester in addition to other non-subsidized private savings contracts. This is broadly in line with our crude previous estimation of a Rister coverage of 34% based on aggregate information. Moreover, all in all 43% of the households own non-subsidized private old age savings contracts and almost 41% of the households do not own any form of supplementary private old age provision.

Table 3.5.: Private Old Age Provision and Financial Literacy

This table contains the frequency and the proportion of households with different forms of private old-age provision. It also shows the average number of respondents' correct answers on the basic and advanced financial literacy task. Standard errors are in parentheses. N= 509.

			Financial Literacy	
	Freq.	**Percent**	**Basic**	**Advanced**
no private old age provision	207	40.6	2.55 (0.10)	2.02 (0.10)
Riester	82	16.2	2.86 (0.15)	2.41 (0.17)
other private old age provision	103	20.2	3.10 (0.12)	2.66 (0.14)
Riester and other	117	23.0	3.21 (0.09)	2.78 (0.12)
Total	509	100.0	2.86 (0.06)	2.39 (0.07)

Source: SAVE 2009, data is weighted and imputed (not financial literacy).

3.4.3. Financial Literacy and Private Old Age Provision

Hypothesis 1. I propose that high state subsidies for Riester pensions create additional incentives for German households to save privately for retirement. As incentives are particularly high for individuals identified with low levels of financial literacy, i.e. those with low income and women, I expect the level of financial literacy of owners of Riester contracts on average to be lower compared to owners of other non-subsidized pensions.

In addition to private pension ownership, Table 3.5 displays the average number of correctly answered basic and advanced financial literacy questions for households with different forms of private old age provision. The average number of correctly answered basic and advanced literacy questions increases with private pension ownership. Households without a private savings contract have the lowest levels of financial literacy: on average they are able to answer 2.6 of the basic questions and 2 of the advanced questions. Their level of basic and advanced financial literacy is significantly lower than that of households with private savings contracts—Riester or other.[20]

[20]Differences in the means between the four groups are tested using two-sided t-tests. Basic financial literacy:

Furthermore, households who only have a Riester contract and no non-subsidized private old age provision are slightly less literate than households who either only have non-subsidized forms of private old age provision or have a Riester contract in addition to non-subsidized private old age provision. They are able to answer on average 2.9 of the basic and 2.4 of the advanced literacy questions. There is a significant difference (at 5%) in basic financial literacy between those who only have a Riester contract and those who have a Riester in addition to a non-subsidized contract. The difference between Riester savers and non-Riester savers is not significant. The same pattern is detected using the advanced measure of financial literacy.

In summary, I find a significantly positive association between financial literacy and saving privately for retirement among SAVE respondents who are younger than 60. Also, the possession of Riester contracts is associated with a slightly lower level of financial literacy than the possession of other non-subsidized forms of private old age provision.

In order to separate the effects of the subsidies and financial literacy I conducted multivariate probit regressions (see Table 3.6). I control for the size of the subsidies by adding income and children. Other control variables are gender, living in east Germany, age, and education. In specification I in Table 3.6 I examine the association between financial literacy and owning a Riester contract, while controlling for other forms of private old age provision. In specification III I examine the relationship between other forms of old age provision and financial literacy while controlling for ownership of a Riester pension. In both regressions I find a positive association of advanced financial literacy with saving for old age: Answering all advanced questions correctly is associated with a 10% higher probability to own non-subsidized old age provision and an 8% higher probability to own a Riester contract. The effects are significant at the 5% level. Basic financial literacy does not show any significant effect in these regressions. In Hypothesis 1 I proposed that the association between financial literacy and private retirement savings should be stronger in case of non-subsidized contracts. In order to test the difference in the size of the effects across regressions a simultaneous equation model was estimated. The χ^2-test for the equality of coefficients is not rejected. Thus, in a multivariate context I find that advanced financial literacy is almost equally positively related to ownership of subsidized and non-subsidized private provision. Unfortunately, a causal interpretation of the coefficients is not possible, because of endogeneity issues, omitted variable bias and measurement error. Nevertheless, these issues should affect both regressions equally so that the interpretation of the difference between the two coefficients should be possible. I will further comment on this in the discussion.

no provision vs. Riester, significant at 10%; no provision vs. other private provision, significant at 1%; no provision vs. Riester+other private provision, significant at 1%. Advanced financial literacy: no provision vs. Riester, significant at 10%, no provision vs. other private coverage,significant at 1%, no provision vs. Riester+other private provision, significant at 1%.

Table 3.6.: Probit: Determinants of Private Old Age Provision

This table reports the effect of financial literacy and various covariates on owning private old-age provision. The dependent variable in specification I and II is a dummy that indicates if a household owns a Riester contract. In specification III the dependent variable is a dummy indicating if a household owns other non-subsidized private pension contracts. I report marginal effects (me) after estimating a probit evaluated at the mean of all variables and the respective standard errors (se). Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Marginal effects in the model with interaction terms are calculated according to Ai and Norton (2003). Basic and advanced financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	Riester				**Non-subsidized private old age provision**	
	I		II		III	
	me	se	me	se	me	se
Private old age provision (d)	0.15	0.04***	0.18	0.05***	-	-
Riester (d)	-	-	-	-	0.15	0.04***
Advanced financial literacy (d)	0.08	0.05**	0.11	0.06**	0.10	0.05**
Basic Financial Literacy (d)	-0.01	0.05	-0.01	0.05	0.00	0.05
Male (d)	-0.11	0.04***	-0.12	0.05***	-0.08	0.04**
Living in East Germany (d)	0.00	0.05	0.00	0.06	0.02	0.05
Age: 36 and younger (d)	0.07	0.05	0.07	0.06	-0.03	0.05
Age: 36-50	ref.	ref.	ref.	ref.	ref.	ref.
Age: 51-60 (d)	-0.11	0.05**	-0.12	0.06**	0.15	0.05**
Lower secondary education (d)	-0.04	0.07	-0.03	0.08	-0.13	0.08**
Upper secondary education (d)	ref.	ref.	ref.	ref.	ref.	ref.
Post sec. non tert. Education (d)	0.04	0.08	0.06	0.09	0.06	0.08
Tertiary education (d)	-0.03	0.06	-0.03	0.07	0.00	0.06
1st income quartile	ref.	ref.	ref.	ref.	ref.	ref.
2nd income quartile (d)	0.16	0.07***	0.18	0.08**	0.20	0.07***
3rd income quartile (d)	0.20	0.07***	0.21	0.08***	0.31	0.06***
4th income quartile (d)	0.20	0.07***	0.22	0.08***	0.41	0.06***
Children living in the hh (d)	0.10	0.05**	0.12	0.05**	0.00	0.05
2nd income * advanced financial literacy (d)			-0.24	0.17*		
3rd income * advanced financial literacy (d)			-0.32	0.18**		
4th income * advanced financial literacy (d)			-0.29	0.16**		
Children * advanced financial literacy (d)			0.13	0.11		
Observations	483		483		483	
Pseudo R2	0.11		0.12		0.18	

Source: SAVE 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

Hypothesis 2. Previous evidence suggests that only those who are aware of financial incentives within the US pension system also respond to these incentives (see Chan and Stevens (2008)). Börsch-Supan et al. (2008) and Coppola and Reil-Held (2009) find that among households with the lowest income Riester pension coverage is still quite low but experiences a high dynamic over time. Moreover, they identify a higher coverage of families with children. In a next step I will analyze how this is related to financial knowledge. I expect individuals with high financial literacy at the bottom of the income distribution and among families with children to be better at realizing the benefits from the high subsidies and buy Riester contracts.

Table 3.7 compares the relative frequencies of private old age provision and the average number of correctly answered financial literacy questions over income quartiles. First of all, it is notable that the share of households without private coverage decreases strongly with increasing income. In the first income quartile almost three quarters of the households are without any kind of private coverage. Around 18% own Riester pensions and around 13% own non-subsidized pensions.[21] In the upper parts of the income distribution the share of households without private pensions decreases from 45% in the second quartile to 27% in the third and 21% in the fourth quartile. Riester coverage as well as the percentage of households with non-subsidized pensions increases with income. An interesting aspect is that the increase in the prevalence of non-subsidized contracts is much steeper (from 13.5% to 67%) than the increase in the prevalence of Riester pensions (17.5% to 52%).

Moreover, the share of households with just a Riester contract is somewhat hump-shaped over income. It is highest for households in the middle of the income distribution. Households in the higher income quartiles are more likely to own non-subsidized forms of private old age provision either only or in addition to a Riester contract. The coverage in the lowest income quartile is still very low. Despite the high subsidies these households do not save for retirement.

Bernheim (1997, 1998) argues that it is important to distinguish between individuals who actively choose not to save due to budget restrictions or their preferences and individuals who save too little to meet their own objective or even fail to form an objective due to the inability to calculate correctly. The low old age saving in the lowest income quartile might on the one hand reflect reluctance to buy an old age savings contract due to skepticism and lack of knowledge. On the other hand households might not save due to budget limitations or save in more liquid forms due to being close to the budget restriction. However, Table 3.7 also indicates that overall the households in the lowest income quartile show a lower probability to be financially literate.

Comparing the average number of basic and advanced financial literacy questions correctly

[21] The shares do not add to 100% because households can own both, a Riester and a non-subsidized contract.

Table 3.7.: Private Old Age Provision and Financial Literacy over Household Income
This table contains the frequency and the proportion of households with different forms of private old-age provision in the four income quartiles. It also shows the average number of respondents' correct answers on the basic and advanced financial literacy task. Standard errors are in parentheses. N=509.

			Financial Literacy	
	Freq.	**Percent**	**Basic**	**Advanced**
		1st Quartile		
no private oldage provision	89	73.5	2.57 (0.15)	1.90 (0.16)
Riester	16	13.0	2.85 (0.27)	2.76 (0.34)
other private oldage provision	11	9.0	3.01 (0.30)	1.52 (0.47)
Riester and other	5	4.4	2.87 (0.51)	1.88 (0.93)
Total	121	100.0	2.66 (0.12)	1.97 (0.14)
		2nd Quartile		
no private oldage provision	49	45.4	2.30 (0.21)	2.17 (0.22)
Riester	20	18.7	2.50 (0.30)	1.87 (0.22)
other private oldage provision	19	17.7	3.10 (0.27)	2.84 (0.29)
Riester and other	20	18.2	2.94 (0.18)	2.45 (0.32)
Total	109	100.0	2.59 (0.12)	2.28 (0.14)
		3rd Quartile		
no private oldage provision	32	27.3	2.50 (0.27)	1.74 (0.27)
Riester	26	22.4	3.07 (0.26)	2.46 (0.27)
other private oldage provision	29	25.0	2.89 (0.23)	2.54 (0.25)
Riester and other	30	25.3	3.30 (0.18)	2.64 (0.22)
Total	118	100.0	2.93 (0.11)	2.33 (0.13)
		4th Quartile		
no private oldage provision	34	21.3	2.95 (0.21)	2.42 (0.29)
Riester	19	12.1	2.99 (0.32)	2.68 (0.38)
other private oldage provision	44	27.2	3.28 (0.18)	2.96 (0.22)
Riester and other	63	39.5	3.28 (0.12)	3.04 (0.17)
Total	161	100.0	3.18 (0.09)	2.84 (0.12)

Source: SAVE 2009, data is weighted and imputed (not financial literacy).

answered by respondents (Table 3.7) shows that basic and advanced financial literacy increase with income. In the bottom income quartile households on average answer 2.7 of the basic and less than 2 of the advanced questions correctly. In the top quartile households on average give more than 3 (almost 3) correct answers on the basic (advanced) task. Moreover, within all income quartiles the average number of correctly answered basic financial literacy questions is lowest for households without any private old age provision. The association between the level of advanced financial literacy and the probability to save privately for old age is strongest in the upper half of the income distribution. In the bottom half of the income distribution the pattern is less clear, however, the number of observations in some of the cells here is very low and standard errors are substantial.

To investigate this point a little further I conduct a probit regression including interaction terms between advanced financial literacy and income as well as having children (see specification II in Table 3.6). This gives me the opportunity to examine the relationship

between financial literacy and ownership of Riester for different levels of subsidies. In line with previous results, e.g., by Börsch-Supan et al. (2008) and Coppola and Reil-Held (2009), specification II reveals that households belonging to the lowest 25% of the income distribution show a significantly lower probability of owning subsidized private old age provision compared to individuals with higher incomes. Households with children are more likely to own Riester pensions compared to households without children.

Within the lowest income quartile advanced financial literacy shows a significantly positive (at 5%) association with ownership of a Riester contract. In the upper income quartiles financial literacy is negatively associated with ownership of a Riester contract. A possible explanation might be that financially literate individuals at the top of the income distribution already had private pensions before Riester subsidies were introduced. Alternatively, these households maybe look for more profitable ways of saving for old age especially in light of the debate about the high cost of Riester contracts. The interaction between having children and advanced financial literacy is positive but insignificant.

Thus, these results are at least partly in line with the second hypothesis. Financial sophistication appears to be positively associated with Riester ownership at the bottom of the income distribution where subsidies are particularly generous. However, I do not find this effect for families with children.

3.5. Discussion and Conclusions

In this paper I use a set of financial literacy questions to evaluate financial knowledge among German respondents which was previously used to evaluate financial sophistication in the US and the Netherlands. Overall, the level of financial sophistication among German respondents is similar to results found for US and Dutch respondents. Financial literacy is not wide spread: Less than 40% of the respondents were able to answer four basic financial literacy questions related to concepts like interest and inflation. The financial market specific knowledge is even lower: Only around 27% of all respondents were able to answer all four advanced question. Financial literacy is particularly low among women, those with low education and low income and among households living in east Germany. These groups have previously already been identified at risk of low literacy in Germany and other countries (see Lusardi and Mitchell (2011a)).

The objective was to examine whether financial literacy in Germany is related to private retirement provision. Overall, the analysis shows that financial literacy is positively associated with any form of private retirement provision even when controlling for differences in education and income. The relation between financial literacy and ownership of non-subsidized private old age provision is slightly stronger than the relation between financial

literacy and Riester ownership. However, the difference is not very big and not significant when comparing the size of the coefficients after multivariate regressions. Moreover, private provision in the lowest income quartile is still lower than in the rest of the population even though the subsidies for Riester are very high for those households. About three-quarters of those in the lowest income quartile do not save for retirement. At the same time financial literacy at the bottom of the income distribution is particularly low. The association between financial literacy and ownership of a Riester pension is strong and positive among these households.

Unfortunately, a causal interpretation of the effect of financial literacy on retirement savings is not feasible on the basis of my analysis. The main reasons are a possible endogeneity of financial literacy, omitted variable bias due to missing information on variables like, e.g., general ability, and measurement error. Overall the effect of financial literacy might be biased upwards or downwards. However, previous analysis using the same data set showed a strong positive effect of financial literacy on retirement planning using an instrumental variable (IV) approach (see Chapter 2). Additionally, many other studies, like e.g. Lusardi and Mitchell (2007b, 2011a), Van Rooij et al. (2011b), also use IV estimation and find strong positive effects of financial literacy on retirement planning and stock market participation. Interestingly, most of the studies using IV regressions find that the effect of financial literacy on financial decision making is stronger when using instruments. Thus, the effect of financial literacy on private pension ownership found in this paper most likely underscores the true effect.

Thus, despite these drawbacks, I would like to conclude that the analysis above indicates that the subsidies provided by Riester fail to encourage those with lower levels of financial literacy to save privately for old age. This result is in line with evidence provided by Coppola and Gasche (2011) that many of the households who do not own a Riester pension are unaware of the fact that they are eligible for subsidies. Only those with higher levels of financial literacy seem to respond to the financial incentives provided by the Riester scheme. Thus, more effort is needed here. One promising way can be to develop financial education programs targeted to specific groups at risk of low financial literacy and inform them about financial topics in general and the subsidies in particular.

4. Do Smarter Consumers Get Better Advice?

Joint work with Johannes Koenen

4.1. Introduction

4.1.1. Motivation

Whether their names are Iago, Alcibiades, Haman, Wormtongue or Madoff: There are copious examples in history and literature of advisors who had their own fortune in mind before that of their advisees or customers. The conflict of interest between the two roles is generic, though its extent may differ: In the best – or at least not so bad – case, the advisor has to work and think harder to find a better solution for the person who has placed trust in him; and is tempted to take the easy route instead. In the worst case, an advisor's incentives may be diametrically opposed to the customer's interests: Consider the case of salespeople whose bonuses depend on their volume of sales irrespective of the customer's utility.[1]

Nevertheless, people routinely rely on other individuals' paid or unpaid advice: on mechanics for car repairs, friends and salespeople when choosing a new outfit, relatives and spouses when evaluating a job offer, to name just a few. Arguably, it would be impossible (or at least uneconomical) to collect the required and relevant information for choices in every field oneself, which ensures that advisors will keep on playing a role in daily life. Their influence ranges from minor decisions (like the color of trousers to match a shirt) to very far-reaching ones, such as the choice of pension plans or major investments. This explains why economists from different areas of interest have recently started studying the role of financial advisors.

This paper contributes to our understanding of the role of financial advisors. First we offer a different analytical explanation for the apparent puzzle that mostly better informed, wealthier individuals employ financial advisors.[2] We argue in a simple analytical model,

[1] This case potentially arises in Inderst and Ottaviani (2009), which we discuss in the literature section below.

[2] See, e.g. Bi et al. (2002), Van Rooij et al. (2011b), Calcagno and Monticone (2011) or Hackethal et al. (2010) discussed below.

which includes the possibility to search for an option without seeking advice, that customers who appear to be better informed – customers with higher financial literacy – may induce their advisor to provide better advice on their behalf. As a result, individuals with a higher level of expertise may still be more likely to solicit advice, despite the fact that they are able to find better solutions on their own. By integrating the consumer's choice whether or not to employ an advisor, this generates an *ex ante* complementarity between information and advice, as opposed to the purely substitutive relationship proposed by, e.g., Georgarakos and Inderst (2010). The central hypothesis derived from the model is the following: Consumers whose level of information, or signal thereof, to the advisor is better, should receive better advice. As a consequence, they should be more likely to follow the advice given to them, all else equal.

We study two different settings to approach this subject empirically, both based on data from the representative SAVE survey: First we use a number of general questions and exploit the panel structure of the data to make first inferences about the relationship between financial literacy and financial advice. Then, in order to corroborate these results, we turn to the topic of German private pension contracts in particular. Some background is required to illuminate why this topic is of more than just regional interest: In 2001, Germany introduced state subsidies for private pension and old-age savings plans – the so called Riester-pension – part of a fundamental reform of the straining public pension system. Apart from its importance for the sustainability of the German social security system, this has also been a large scale choice experiment: Individuals were aware of the need to make decisions and choose private plans due to substantial cuts to the previously very generous public pensions; yet the typical heuristics of such an important choice – such as observing other people's outcomes within social networks – were impossible to adopt as nobody had as of yet entered the payment phase. Faced with a wide array of complex financial products, many individuals procrastinated, which led to a number of substantial legal reforms aimed at simplifying the products.[3] Within this changing legal framework, financial advisors played an extraordinarily important role in individuals' decision-making – a perfect setting to study financial advice.

This allows us to better understand how "first-generation" individuals made their private pension choices, and what role their financial knowledge and external financial advice played. We especially find that financial literacy significantly reduces the chance that an individual signs a contract with a bank or insurance company with which she interacts in another function – which would clearly be in the interest of her (dependent) financial advisor, whose kickbacks should be maximized in this case. We further show that people with higher

[3]See Börsch-Supan et al. (2008), Coppola and Reil-Held (2009) for an overview of the regulations and the distribution of Riester pensions among German households between 2001 and 2008.

expertise are significantly more likely to compare multiple offers before making a decision and are more likely to confer with independent consultants.

The remainder of this article proceeds as follows: First, we briefly present the related literature and define our contribution relative to existing articles. Then, we set up a simple model in which a single consumer chooses whether or not to interact with a single financial advisor. In the next section, we present the data and some descriptive statistics. Then, in section 4.4, we analyze the relationship between individuals' financial literacy and financial advice in general, before section 4.5 focuses on decisions related to private pensions. The final section concludes.

4.1.2. Related Literature and Contribution

Theory on Financial Advice and Choice of Financial Products

The article by Aghion and Tirole (1997) on authority within organizations can straightforwardly be interpreted as a model of advice. A principal and an agent both can exert effort to gather information on the set of project alternatives – if neither is successful, then it is optimal to choose inaction, while if only the agent is informed, it is optimal for the principal to rubber stamp his decision, as their incentives are aligned to a certain degree. In their language, an advisor-customer relationship can be regarded as a situation in which the customer retains formal control (makes the final decision on an investment), while the advisor provides her with suggestions. In this setup, they find that more information obtained by the principal crowds out the incentives to become informed for the agent. In this sense the two are substitutes.

More recent articles on advisors are based on the "cheap talk" game by Crawford and Sobel (1982). These include Krishna and Morgan (2001)[4], Ottaviani and Sørensen (2006), Esö and Szentes (2007) and Inderst and Ottaviani (2009). In Esö and Szentes (2007), a client faces an advisor who receives a (potentially imperfect) signal regarding the value of a project to the customer. Soliciting this contractible advice can lead to a more efficient project choice by the client. Ottaviani and Sørensen (2006) study a setup in which professional advisors develop a reputation when advice and realizations are compared ex-post. The most relevant purely theoretical article in this context for our study is Inderst and Ottaviani (2009), who focus on the agency problems associated with financial advisors working for a financial services firm. Agents, who are compensated through a fixed-wage plus bonus contract as an incentive to prospect for new clients, are tempted to lie to their clients regarding the utility the latter will receive from the product. With a certain probability, these lies are discovered ex-post,

[4]An extension of the original game to two advisors.

in which case the principal (firm) incurs liability. Stronger incentives (higher bonuses) lead to a more pronounced misselling problem.

As opposed to the articles above – with the exception of Aghion and Tirole (1997) – we allow consumers to search on their own in case they do not wish to consult an advisor or follow his advice. This introduces a simple outside option which depends on the level of investor sophistication. Further, we distinguish between "hard" and "soft" information – the costs of the options proposed by the advisor may be verifiable by the client, i.e. "hard" information, again depending on the client's financial acumen. In combination, this leads to a concave maximization problem on the part of the advisor. As a result, he can have an incentive to provide consumers with higher financial literacy with better advice.

Empirical Papers on Search and Financial Advice

Two recent papers show that search efforts and differing search costs have significant effects on outcomes in insurance and financial markets: Green et al. (2007) empirically analyze the market power that dealers can exert in municipal bond markets, in which transaction data is only released ex-post so that at the time of the deal the markets can be considered opaque. The higher the customers' incentives to gather information (larger deals) and the lower their complexity, the smaller the markups that dealers charge on average. Bolhaar et al. (2010) study the search behavior of Dutch consumers for health insurance contracts. In a simple theoretical model, they provide a further rationale for price dispersion in a market for a relatively homogeneous good, namely different search costs.[5] They further make use of a quirk in the system, according to which some consumers can (relatively randomly, at first glance) be offered so called group contracts—they show that more sophisticated consumers are significantly more likely to own (cheaper) group contracts.

The second related strand in the empirical literature focuses on the propensity and reasons of consumers to consult financial advisors: In a mainly descriptive paper, Bi et al. (2002) address the question which households in a 1998 Survey of Consumer Finances dataset use financial planners. They find that better informed households are more likely to employ financial planners, which points in the direction of complementarities and supports our approach. Moreover, Lusardi and Mitchell (2011b) and Van Rooij et al. (2011b) find that individuals with low financial literacy are more likely to rely on informal sources of advice, like family and friends, whereas financially literate individuals are more likely to consult formal sources of advice like newspapers, magazines, the internet, and professional advisors. Hackethal et al. (2010) seek to provide an alternative explanation for this finding—they argue that it is higher opportunity costs of time that lead wealthier and older clients to

[5]For a theoretical investigation into the incentives of firms to provide complicated price structures for homogenous goods, see Carlin (2009).

make use of financial planners, even though they would be better suited to perform the task themselves. Intriguingly, using two different data-sets with trade and banking data they find that investors whose accounts were supervised by agents had higher costs and lower returns on average than those who managed their own accounts.

There are a couple of article similar to ours. Georgarakos and Inderst (2010) is both a formal and empirical study of individual investment behavior in relation to financial advice. They construct a "cheap talk"-game, in which an advisor (agent) recommends one of two investment alternatives as more suitable for the investor (principal). While an uninformed investor must decide whether or not to trust the advice, an informed investor will (from a threshold level of information on) choose to completely disregard the advice and make her own decision—in this sense, information and advice are substitutes. They verify this result empirically using Eurobarometer data and show that "trust" only plays a role for less sophisticated investors, which supports their theory. Hackethal et al. (2011) consider, both in a simple theoretical model as well as empirically, how the reliance on an advisor affects the trading behavior of individuals. They show, similar to our results, that investors are less likely to follow advice given to them the more precise their own information and the larger the perceived conflict of interest of the advisor. More trades, which are beneficial to the advisor, should occur when individuals follow the recommendations. Both of these results are verified empirically using data from brokerage accounts. Calcagno and Monticone (2011) also model the interaction between an uniformed investor and a perfectly informed advisor. In their model the advisor has an incentive to reveal his information about asset returns to financially literate customers, while he does not have an incentive to reveal information to financially illiterate customers. Illiterate investors can either delegate their asset choice fully to the advisor or they can invest autonomously. This leads to the prediction that financially literate consumers are more likely to consult advisors, because they can improve their knowledge by asking for advice. The authors can confirm their predictions on the basis of data on the customers of a large Italian bank.

Contribution

Our paper contributes to the theoretical and empirical literature on advice in general and financial advice in particular. In our analytical model, we introduce a game of advice in which the customer's degree of sophistication (or access to information) and the advisor's quality of service are *ex ante* complementary, as opposed to the substitutive relationship proposed so far. From this model we derive a number of hypotheses regarding the likelihood of consulting an advisor and following his advice given a consumer's financial literacy. Our central hypothesis is that an advisor's (beneficial) effort should increase in the signal of the

consumer's financial knowledge that he observes.

We use a dual strategy to test our hypotheses: Using the SAVE-panel, we first study how consumers interact with financial advisors in general—as a crucial difference to Georgarakos and Inderst (2010), we include the decision whether or not to consult an advisor in the analysis. We find that the probability of consulting an advisor increases with the level of financial knowledge of a consumer, while the (self-assessed) likelihood of following his advice decreases in financial literacy.

We then turn to German private pension contracts in particular. We find that more knowledgeable consumers on average compare more offers, which indicates lower search costs. They are also more likely to consult with advisors, but less likely to follow their advice in the case of dependent advisors. We are able to study this last question, because we observe whether the chosen plan originated with a customer's bank or insurance – therefore we observe whether or not the individual has chosen the *advisor's* favored alternative. We show that individuals are less likely to adopt this "default" choice, the higher their level of financial literacy and the more search effort (measured by the number of products they report to have compared) they have exerted.

4.2. Analytical Framework and Hypotheses

We try to depict the following typical situation in our model: A customer at a bank sits down with an advisor – either for the first time or the advisor does not have a very close relationship to the client, which appears likely for most cases – in order to discuss the purchase of a financial product such as a private pension. Therefore the advisor tries to "get to know" his client with a few questions regarding her investment goals and major expenditures in the foreseeable future.[6] From this conversation and the bank database, he can derive her educational attainment as well as her monthly income. Based on this information, which we call *signal* in the model, he can judge her knowledge of financial matters to a certain degree and decides what kind of an investment alternative to suggest to her. In addition to the hard evidence in the data, we can draw on a number of experiences and ample anecdotal evidence to support this setting, e.g. an advisor getting a different binder with information materials after hearing that a customer has a PhD in economics or a different advisor offering to consult with the research department of the bank after a number of (semi-) informed questions and then coming up with a different offer. At the other end of the spectrum: a young woman without a high-school degree returning from a trip to the bank—originally to open an account—with a contract for a private pension

[6] According to the European Markets in Financial Instruments Directive (MiFID) advisors are required to collect information on clients' risk attitudes, current portfolios and previous investment experience.

insurance whose monthly required payments exceeded her disposable income.

For the following, it is necessary to define our understanding of the concept "financial literacy". Matching the way we measure it in the empirical part, we prefer a wide interpretation: Financial literacy is an individual's level of understanding regarding financial matters and financial products, in particular with respect to their risk, returns and cost structure as well as further benefits and relevant features.[7]

Based on this understanding, our model combines the following central building blocks:

1) Individuals with higher financial literacy should have lower search costs, i.e. a better outside option apart from financial advice.

2) Individuals with higher financial literacy should be able to better understand the advice given to them (in a way presented in detail below).

3) Advisers perceive a signal of the customer's financial literacy and are able to react to (1) and (2)—therefore they may have an incentive to give individuals with higher financial literacy (or signals thereof) better advice.

In the following sections, we present our brief model which organizes our empirical predictions. In order to further stress the inter-connectedness between the theory and the empirical part of the analysis, we phrase our results as testable "hypotheses" instead of "propositions".

4.2.1. Financial Literacy and Consumer Outside Option

Consider a model with two agents, a consumer/client (she) and a financial advisor (he). The consumer faces an investment choice from a distribution Q of potential investment alternatives. Each alternative a_i out of Q gives the consumer utility $u(a_i)$ respectively. Consumers differ in their levels of financial know-how or literacy θ, with consumer j's financial literacy normalized to the half-open interval $\theta_j \in [0, 1)$.

We assume that the consumer does not know the potential alternatives open to her ex ante. Instead, to uncover them on her own, she may engage in random search along the lines of Stigler (1961). Instead of spelling out the search model, we simply assume that this random search results in an alternative that yields expected utility $Eu(a_S|n^*(\theta_j))$. Here, $n^*(\theta)$ denotes the (ex ante) optimal number of search items that an individual with a given level of financial literacy chooses.[8] Rothschild (1974) demonstrates in a rather general setting

[7] Applied to the example of private pensions, this would include benefits to the surviving spouse and guaranteed annuities on the up-side, and administrative costs or limitations of withdrawals on the down-side.

[8] Equivalently, one could define a reservation value depending on the level of financial literacy. A higher reservation value is ex ante equivalent to an (in expectation) higher optimal number of search items.

that n^* and thereby Eu should be increasing as the search costs that an individual faces decrease.[9] In the following, we simplify notation for this term to $Eu(a_S|\theta_j)$.

For our theoretical framework, we posit that $Eu(a_S|\theta_j)$ is strictly increasing in θ which corresponds to strictly decreasing search costs in the level of financial literacy. We will try to establish this relationship empirically (see hypothesis 1 below). There are a number of arguments in favor: First, higher financial literacy may be associated with faster comprehension of technical terms and concepts, therefore less time and effort need to be spent for every search step. Second, better financial skills may be related to more efficient search techniques, such as requiring less time to recognize and dismiss unsuitable offers. Third, psychological costs such as anticipating discomfort due to lack of understanding should be lower the higher the level of expertise. It should be noted that Hackethal et al. (2010) argue for the opposite relationship due to higher opportunity costs of the time spent on research for people with better skills. We test the following prediction with regard to private pension contract offers empirically in section 4.5.

Hypothesis 1: *Due to lower search costs, the optimal number of alternatives that individuals compare when making investment decisions is increasing in their financial literacy.*

4.2.2. Structure of the Financial Advice Game

As opposed to searching for an alternative on their own, consumers may also turn to a financial advisor. The timing of our model of advice is the following: First the consumer makes the choice whether to consult a financial advisor or to search on her own (a consumer who decides to search on her own and picks $n = 0$ stays out of the market). If she approaches an advisor, he observes a noisy signal s of her financial literacy. Denoting the type distribution function of individuals who approach financial advisors as $F(\theta)$, we model the signal by $s' > s \Rightarrow F(\theta|s') < F(\theta|s) \forall \theta$. Therefore, the higher the signal, the higher the estimate of the customer's financial literacy by the advisor. We denote the associated density function as $f(\theta)$. This form of noisy signal appears justified, as in practice, the advisor may ask the customer about her income, educational attainment and previous investment experience, which are known to be related to financial literacy, but cannot force her to complete a sophisticated test on the premises. Then, the advisor suggests an alternative a_A to the consumer, who only understands this advice with probability θ_j in a sense described in detail below. Finally, the consumer decides whether to follow the advice given to her, to decline and search on her own, or not to invest.

[9] In particular, these results do not depend on the consumer knowing the distribution of prices.

If the consumer chooses to consult an advisor, she incurs the fixed costs κ, which can be interpreted as the time and hassle costs of making an appointment in addition to eventual fees charged by the institution. For our model, to get clearer effects we assume that these costs are identical for all customers.

The advisor's task is to choose and suggest an alternative a_A for the consumer. We assume that the alternatives in Q can be ordered according to the preferences of the advisor and the customer in the following way: for every a_i Q, there exists a choice variable of the advisor $e_i \in [0, E]$ which determines the utility $\nu(e)$ the advisor derives if the customer follows the advice and accepts the offer. As an interpretation, e may resemble the difference between the maximum possible kickback an advisor could receive and the kickback from the alternative chosen, or different levels of (effort) cost may be associated with preparing and customizing different offers. We further assume that, given that the offer is accepted by the customer, the utility to the advisor $\nu(e) > 0 \forall e$, while if the customer rejects the offer the advisor receives a strictly lower utility, normalized to 0. The assumption that even the alternative favored least by the advisor is still preferable to rejection by the consumer could be explained, for example, by the advisor's reputation suffering from his suggestion being shunned – in the extreme, an advisor is liable for demonstrably bad advice in many jurisdictions, so in particular, one could imagine advisors being punished for (detected) bad advice along the lines of Inderst and Ottaviani (2009). A minimum value of 0 for the rejection resembles limited liability of the advisor.[10] We refrain from subtracting eventual effort costs in order to ease the notational burden in the following – our results below would be qualitatively unchanged if we assumed that the advisor is left with a utility of $-c(e)$ if his advice is rejected, with $c(e)$ nondecreasing in e. To summarize: In our setting, the advisor either makes a successful sale and receives $\nu(e)$ or he is left with a payoff normalized to 0.

We assume that there is an inherent conflict of interest between the advisor and the advisee in that there is a subset of Q which we call the *relevant alternatives*, such that (I) $\frac{\partial u(a_A(e))}{\partial e} > 0$ and (II) $\frac{\partial \nu(e)}{\partial e} < 0$: A higher choice of e improves the result for the customer, while it reduces the advisor's utility. In particular, the advisor has a most favored (default) alternative that he can suggest with $e = 0$, which we call a_0. This implies, that switches away from the default alternative are beneficial to the customer. The relevant alternatives can be generated by eliminating all alternatives from Q which are dominated (an alternative a_i is dominated if a_j exists, such that both $u(a_j) > u(a_i)$ and $\nu(a_j) > \nu(a_i)$). This leaves at least one alternative, a_0, which will be the only alternative only if it is also the option that maximizes the customer's utility. Our assumption regarding the conflict of interest implies that this is not the case. It also implies that the advisor does not wish to unnecessarily harm

[10] For advisors dependently employed, this is part of their contract, independent financial advisors are required to own malpractice insurance.

the consumer while at the same time reducing his own utility. The additional assumption implied by (I) and (II) is that $\nu(e)$ is differentiable and for simplification we also assume that it is strictly concave: improving the customer's utility becomes increasingly expensive in foregone premiums for the advisor.

To summarize, there are two ways of interpreting this setup: It may either be costly for the advisor, in terms of mental effort and time, to research alternatives beyond the standard suggestion waiting in his drawer and to explain them to the satisfaction of the consumer; or the default investment is simply the alternative that yields the highest provision, and accordingly higher costs to the advisor resemble smaller provisions.[11] These two alternatives are not mutually exclusive, the utility $\nu(e)$ should be interpreted as an amalgam of monetary and non-monetary payoffs.

4.2.3. The Advisor's Problem

For a rational consumer to make a decision, she has to compare the utility she derives from the advisor's offer with the expected utility from searching in the market on her own. Some customers may not be able to perform the required computations. To take this into account, we assume – following, e.g., Inderst and Peitz (2008) – that expertise/financial literacy influences the informativeness of advice to the consumer: with probability θ_j, the customer "understands" advice given to her, i.e. she is able to judge the relationship between $Eu(a_S)$ and $u(a_A)$. In other words, with probability θ_j, the offer by the financial advisor is hard information for the customer, with probability $1-\theta_j$ it is soft information and all the customer learns is that the given investment alternative was suggested.

Let us first consider the decision of a consumer who has hard information: She should reject (not follow) advice whenever the following condition holds, i.e. she derives a higher expected utility from independent search than from the advised alternative:

$$u(a_A) < Eu(a_S|\theta_j) \tag{4.1}$$

As we assumed that $u(a_A)$ is a function of the choice e by the advisor and $Eu(a_S|\theta_j)$ is strictly increasing in θ_j, by (4.1) we can specify a critical value $\hat{\theta}(e)$ for each e, such that $u(a_A) = Eu(a_S|\hat{\theta})$. Then a consumer will only accept the offer if her financial literacy is below this cutoff-value, i.e. $\theta_j \leq \hat{\theta}(e)$. The advisor who has observed (noisy) signal s of the

[11] In the extreme for the second interpretation, there may only be two classes of alternatives from the point of view of the advisor: contracts yielding a provision, or contracts yielding no provision. This second interpretation on its own would be in conflict with the differentiability assumption above, while the mental-effort interpretation can easily be reconciled with this assumption.

customer's financial literacy, expects her to accept a given offer with probability $F(\hat{\theta}(e)|s)$. This probability is strictly decreasing in s and increasing in e. For simplicity, we make the strong assumption that uninformed consumers, for whom the advice is soft information, comply with the suggestion of the advisor.[12] As a justification for this assumption (outside the model), it may be easier for an advisor to dupe a consumer if she cannot understand the details of the given offer. Therefore, the expected gain $E[\Pi|s]$ that the advisor derives from choosing e given the observed signal s is:

$$E[\Pi|s] = \nu(e)(1 - E[\theta|s](1 - F(\hat{\theta}(e)|s))) \tag{4.2}$$

The advisor expects to gain utility $\nu(e)$ unless he is facing an informed consumer whose financial literacy is above $\hat{\theta}(e)$. The advisor's choice e given the signal s gives rise to the following first order condition:

$$\frac{\partial E[\Pi|s]}{\partial e} = \nu'(e)(1 - E[\theta|s]) + E[\theta|s][\nu'(e)F(\hat{\theta}(e)|s) + \nu(e)f(\hat{\theta}(e)|s)\frac{\partial \hat{\theta}}{\partial e}] \tag{FOC}$$

A change in e has the following effects: First, it reduces the advisor's utility in the case that the customer is uninformed (first term). Second, it reduces the advisor's utility in the case that the customer is informed but would have chosen the advised alternative nevertheless. Finally, it increases the probability that an informed consumer will choose to follow his advice at the margin of $F(\hat{\theta}|e)$. When is (FOC) also sufficient? It turns out that the expected profit function of the advisor is concave as long as the signal s is not too informative;[13] but one cannot rule out that the function is downward sloping over the entire domain – in which case the optimally suggested alternative by the advisor is clearly $e = 0$. If one defines incentive compatibility for the advisor as the condition for suggesting *any* but the default alternative, this boils down to the following:

$$|\nu'(0)(1 - E[\theta|s]) + E[\theta|s][\nu'(0)F(\hat{\theta}(0)|s)| < E[\theta|s]\nu(0)f(\hat{\theta}(0)|s)\frac{\partial \hat{\theta}}{\partial e} \tag{IC}$$

We are interested in when this condition is more likely to hold: Much depends on the value of $\nu'(e)$, which can be interpreted as the foregone bonus if an alternative other than

[12] The alternative would be to compare the expected utility from advice, given the signal of financial literacy the consumer expects the advisor to have received, with the expected utility from search. We show that the distortions introduced by our assumption are not too extensive, and that they are smaller for consumers with low financial literacy below, when discussing the consumer's participation constraint.

[13] See the mathematical appendix for a detailed discussion.

the one most favored by the advisor is selected. This is equivalent to the finding of Inderst and Ottaviani (2009) that higher bonuses for advisors increase the misselling problem in a purely binary setup. In our setting, the larger the step down from the optimum, the higher the incentive for the advisor to sell nothing but the default option. We find multiple effects of higher financial literacy: First, the share of informed consumers increases, which puts more weight on the second term on the left-hand side. Then, $F(\hat{\theta}(0)|s)$ decreases together with the cutoff-value above which consumers prefer acquiring information on their own. Finally, the right-hand side increases, again, as long as the signal to the advisor is not too informative, i.e. as long as $f(\hat{\theta}(0)|s)$ is non-degenerate. All of these effects work in the same direction: The higher the (perceived) financial literacy of the consumer, the more likely the advisor is to give better advice. From a policy perspective, this finding may be surprising: The more an individual is educated with regard to financial matters, the more likely she is to get useful financial advice from a bank or insurance agent.

The last component of the inequality is the initial level of $\nu(0)$. Interestingly, an increase of this value enhances the likelihood that a financial advisor picks a more useful alternative for the consumer ($e > 0$). In terms of incentives, this means that it is preferable to have a relatively high compensation for the advisor when he sells a contract to a customer (high $\nu(0)$), with as little as possible differentiation between the different alternatives that he can offer (small slope of ν). Clearly, if the financial advisor is employed by a firm selling financial products of its own, this will generally not be in the interest of the company. This may introduce systematically different effects between dependent advisors, i.e. advisors employed by a bank or insurance company, and independent financial advisors, if the former have "steeper" incentive functions.[14] We will use this distinction in our empirical approach in section 4.5.

Condition (IC) is more likely to be satisfied the higher the signal s and thereby the higher $E[\theta|s]$. This allows us to derive the central hypothesis of our model: As the signal s is informative with regard to the consumer's financial literacy θ_j, this implies that with increasing signals of financial literacy, the advisor is more likely to provide positive effort. Using (FOC), which solves the advisor's maximization problem whenever (IC) is satisfied, it is straightforward to see that a higher signal also induces a higher *level* of the advisor's effort in optimum. We combine these observations in the following hypothesis:

Hypothesis 2: *The higher the signal of financial literacy s that the advisor observes,* a) *the more likely he is to suggest an alternative that is better for the consumer than the default, and* b) *the better the advice he gives in this case.*

[14] From discussions with current and former employees of independent financial advisors, we learned that some firms enforce a cap to sales kickbacks for individual contracts which results in a comparatively "flat" structure of bonuses.

While this is the effect we were searching for, given the data available to us, we cannot observe the effort choice of advisors directly. What we do see is the choice behavior of consumers. Intuitively, we would expect consumers who receive better advice to be more willing to follow it. If we back out the advisor's optimal choice $e^*(s)$ and insert it into the consumer's constraint (4.1), we can show that this is true. This allows us to derive the following corollary, which we use in our identification strategy in the empirical part of the paper:

Corollary to Hypothesis 2: *For a given level of financial literacy of the consumer, the higher the signal that the advisor observes, (the better the suggested alternative and) the more likely the consumer is to follow the advice she receives.*

4.2.4. Financial Literacy and the Decisions to Solicit and Follow Advice

To close the model, we now have to consider on the one hand which consumers decide to consult a financial advisor and on the other hand how likely they are to follow the advice they receive given that they sought it. For a consumer to approach an advisor, the expected utility gain over searching autonomously must exceed her costs κ. The consumer's participation constraint is:

$$\text{(PC)} \qquad (1-\theta_j)E[u(a_A)|\theta_j] + \theta_j E\max\{u(a_A|\theta_j), E[u(a_S)|\theta_j]\} - \kappa > E[u(a_S)|\theta_j]$$

The left-hand side of the inequality resembles the *ex ante* expected utility from the decision to consult a financial advisor: If the consumer does not understand the advice, she accepts the offer as assumed above. The utility from the advised alternative is an expected value due to the fact that the consumer herself cannot perfectly observe the signal s as perceived by the advisor; she can only anticipate the level of effort he will exert based on the distribution of s given her financial literacy θ_j. The second term, implying that she understands the advice, resembles an option value: If she prefers the suggestion to searching on her own, she takes it, otherwise she declines. As $E\max\{u(a_A|\theta_j), E[u(a_S)|\theta_j]\}$ is strictly larger than $E[u(a_A)|\theta_j]$ and $E[u(a_S)|\theta_j]$, respectively, this option is valuable to the consumer.[15]

First note that individuals with very low financial literacy expect to have to take the advice they receive at face value. If the signal s is informative for low values of θ, the likelihood that the financial advisor will take advantage of them is high. If their outside

[15]Note that θ is defined on an open interval – therefore there is always a possibility that the consumer's financial literacy will be overestimated to her benefit.

option $E[u(a_S)|\theta_j]$ is negative *and* they expect to receive bad advice, they prefer to stay out of the market entirely. This reflects the stylized fact that individuals with very low financial knowledge are generally less likely to participate in stock markets (see, e.g., Van Rooij et al. (2011b)) or own private pension insurance (see, e.g., the results in the previous chapter). Further, this would be exacerbated if one allows κ to be decreasing in the financial literacy of consumers, say if it were to include psychological costs of soliciting advice.

Now consider the effects of an increase in the level of financial literacy of the consumer. If the (expected) signal s is positively correlated with the actual value, then the advice becomes more valuable in expectation. Further, the customer will be more likely to understand the advice given to her – this increases the probability of benefitting from the option value of being able to (informedly) choose between the advised option and own search. These two effects both make it more likely for more financially literate consumers to solicit advice.

There are two at least potentially countervailing effects: First, the value of the outside option – own search – straightforwardly increases. If this effect is dominant, this would lead consumers to prefer own search to advice. Finally, there is the effect of θ on what we coined the option value of advice $E\max\{u(a_A|\theta_j), E[u(a_S)|\theta_j]\}$. As θ is defined on a half-open interval, there is always the possibility that the consumer's financial literacy will be over-estimated from the signal and as a result, the option value is always positive, though it may be decreasing in θ – intuitively, the advisor, from a certain level on, cannot feasibly do better than the customer.

Given this brief discussion and the stylized fact that consumers with the lowest levels of financial literacy abstain from entering the market for risky asset and are significantly less likely to own private pension insurance – i.e. the least knowledgeable customers' outside option of own search must be negative – we propose that the probability of consulting a financial advisor must be at least locally increasing in their level of financial literacy. While this effect does not necessarily have to be monotone, we propose the following hypothesis:

Hypothesis 3: *Individuals with higher levels of financial literacy are more likely to solicit financial advice than those with the lowest level of financial literacy.*

Note that if consumers are aware of the signal-generating process, then for a given level of financial literacy a higher signal unequivocally would lead a consumer to be more likely to solicit advice: Intuitively, a graduate from a prestigious university *expects* to receive better advice than a high-school dropout, even if both persons are equally knowledgeable in financial matters.

This brief discussion allows us to revisit the behavioral assumption above that uninformed consumers follow the advisors' suggestions: First-off, it is completely rational for consumers to act in this manner as long as $E[u(a_A)|\theta_j] > E[u(a_S)|\theta_j]$. Given that advice was solicited,

(PC) a relatively financially illiterate consumer should follow this rule: then the participation constraint immediately implies the above. This can intuitively be interpreted in the following way: If someone did not expect to understand the advice she received, but still solicited it (incurring cost κ in the process), then she must expect to follow the advice even if turns out not to be intelligible ex post.[16] The higher the costs κ, the more slack there will be for this constraint. For higher levels of θ, i.e. consumers who solicit advice with the expectation that they will be able to make sense of it, this argument no longer holds. But as they are more likely to understand the advice given, the share of individuals, for which the behavioral assumption applies, decreases in θ.

Finally, we study the likelihood of a given consumer who *has* solicited advice following the suggestion she receives. According to our assumptions above, she understands the suggestion with probability θ_j and she follows it whenever she does not understand it. Ex ante, therefore a consumer who has approached an advisor will *disregard* advice with probability $\theta_j \mathbf{Pr}(u(a_A) > Eu(a_S)|\theta_j)$, where $\mathbf{Pr}$ denotes the probability with respect to the realization of s given θ_j. Again, we observe multiple effects of increasing levels of financial literacy θ: On the one hand, the probability of understanding the offer and therefore being able to decline it increases. It is further increased by the higher value of the outside option. The countervailing effect is that the increased efforts of the advisor may overcompensate the better outside option. If we are able to control for the signal that the advisor observes, we can eliminate the countervailing effect for our next hypothesis[17]:

Hypothesis 4: *Given a signal level s, the higher a consumer's financial literacy, the higher is the likelihood that she will reject the advisor's suggestion.*

The structure of the problem allows us to make a further prediction regarding individual choice behavior: By Hypothesis 2, the advisor exerts more effort if he observes a better signal, which in turn leads consumers to be more likely to follow advice. By Hypothesis 4, the magnitude of this second effect should differ over levels of financial literacy. In particular, it should be more visible for individuals with high financial literacy, in other words, the cross-partial derivative of the signal and financial literacy on the probability of following advice should be positive. We state this in our final hypothesis:

Hypothesis 5: *For individuals with higher levels of financial literacy, the increase in the likelihood of following financial advice with the level of the signal s should be stronger than for individuals with lower levels of financial literacy.*

[16] See Hackethal et al. (2011) for a similar argument.

[17] Note again that the strong behavioral assumption is not necessary for our result, as the increased expected value of own search efforts would be sufficient, given that one can control for the signal

4.3. Data

4.3.1. The SAVE Survey

In the empirical part of this article, we use SAVE, a panel of German households that contains detailed information on households' financial situation and socio-economic as well as psychological characteristics.[18] Our analysis is mainly based on data from SAVE 2008 and 2009. There are between 2,222 and 2,608 observations in the sample. We make extensive use of a special module of questions regarding Riester-pensions and the search process which we were able to add to the questionnaire in 2008. In addition to that we use information on financial literacy from the survey conducted in 2007.

Missing values in the data set are imputed using an iterative multiple imputation procedure based on a Markov-Chain Monte-Carlo approach (Schunk (2008)). The goal of this procedure is to increase the efficiency of our estimates due to a larger number of observations and to reduce the item non-response bias that occurs if observations with and without missing values differ systematically. For our analysis, five multiply imputed data sets are used and the results are derived using Rubin's method (Rubin (1987, 1996)). In the case of our explained variables (financial advice and following the advice) and key explanatory variables (financial literacy) robustness checks are conducted on the basis of unimputed data. The socio-demographic characteristics of the sample are provided in Table C.1 in the appendix.

All descriptive statistics are weighted and results are representative for the German population.[19] For the regression analyses no weights are used, following Deaton (1997).

4.3.2. Variables

Financial Advice—General Context

As discussed above, we use a dual strategy in trying to test our hypotheses, with measures of behavior regarding financial advice in general and behavior regarding the private pension choice in particular. For the general context, we use the following measures:

In the context of saving behavior, respondents are asked with whom they talk about financial issues. The exact wording of the question is *"Do you talk about financial topics with: relatives, who do not live in the same household / friends / colleagues / neighbors / financial advisors of banks, insurance companies or financial service providers. / I do*

[18] SAVE was first conducted in 2001 by the Mannheim Research Institute for the Economics of Aging (MEA). Consecutive waves were in the field in 2003/2004, and every year since 2005. A detailed description of the scientific background, design and results of the survey can be found in Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009).

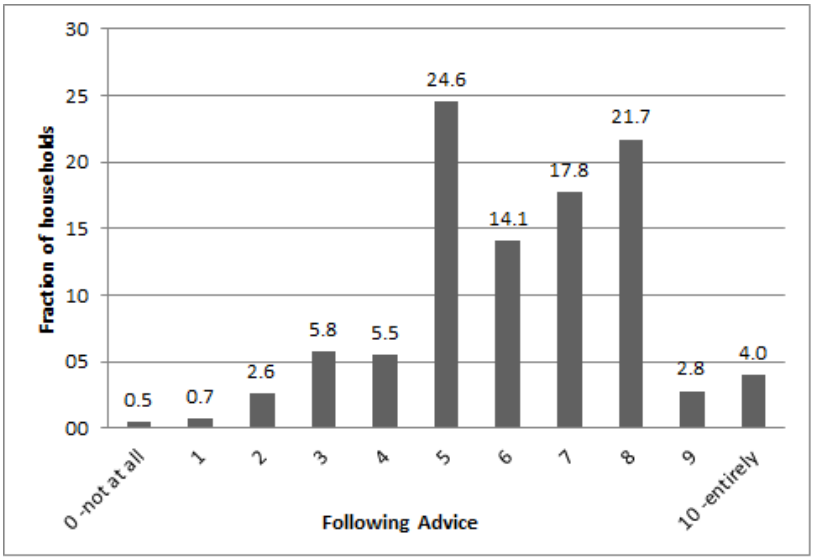
[19] The reference statistic to calibrate weights according to income and age classes is the German Mikrozensus. For a detailed description see Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009), p. 48-52.

not talk with any of these persons about financial topics." Respondents were able to give multiple responses. The focus of our study is professional financial advice. Thus we construct a dummy variable equal to one if individuals consulted a professional from a bank, insurance company or financial service provider. In 2009 about one third of the respondents in the sample talked to financial advisors (33.2%). Results are almost identical in 2007 (31.1%) and 2008 (33.2%).

As a follow-up question we asked those respondents who consult professional advisors how closely they followed the advice. The question included was *"How closely do you follow the advice obtained? Please evaluate your behavior on a scale from 0–"I /We do not follow the advice at all" to 10–"I/We follow the advice given entirely"* Answers to this question are depicted in the histogram in Figure 4.1.

Figure 4.1.: Following Financial Advice

This figure shows the relative frequency of respective responses regarding the following of financial advice by professional advisors in SAVE 2009.



Financial Advice—Riester-pensions

In SAVE 2008 we added four questions regarding the search process of consumers for subsidized private pension plans, so-called Riester-pensions. Two questions examined the number of alternative providers households approached and the number of written offers they obtained in total. In addition to this, we asked households how they obtained the information on the different offers, in particular whether they conducted own research, consulted peers or contacted dependent and independent financial advisors. The final question focused on the actual contract partner. We asked respondents whether they signed the contract with a familiar contract partner, i.e. a bank or insurance company with which they already have

other contracts, or an unfamiliar contract partner, i.e. a bank or insurance company or other provider of contracts with whom there were no prior relations. The wording of the questions is in appendix C.4.

Measuring Financial Literacy

We measure financial sophistication using two different "objective" —as opposed to a "subjective", i.e. self-assessed—measures of financial literacy.

A set of eleven financial literacy questions was developed and evaluated by Lusardi and Mitchell (2007b) and Van Rooij et al. (2011b). A subset of nine of these questions was introduced into SAVE in 2009. For the purpose of our study we construct a measure composed of four—judging by the answering behavior of respondents—relatively difficult questions. Our measure contains four of the five questions labeled "advanced financial literacy" by Lusardi and Mitchell (2007b) and Van Rooij et al. (2011b).[20] For this advanced measure, we create an index that reflects the number of correct answers by the individual and can therefore assume the values 0 through 4. Around 18% of the individuals in the 2009 survey were unable to give any correct answer and almost 14% gave only one correct answer. Sixteen percent were able to answer half of the questions correctly, 22% gave three correct answers and almost 30% were able to get all answers right.[21]

For different reasons, we also introduce a second measure based on a similar set of only three basic questions, originally developed by Lusardi and Mitchell (2011b) for the Health and Retirement Study in 2004 to assess the fundamental skills regarding individual saving and investment decisions, which was included in SAVE 2007. In the 2007 survey respondents encountered the financial literacy questions for the first time in SAVE, therefore arguably this year's answers have greater validity than in the following years. Moreover, there might be endogeneity problems related to financial literacy and financial advice, which we try to address by exploiting the panel structure of SAVE and using the lagged measure of financial literacy, defined as follows: a dummy variable, which takes the value 1 if all questions were answered correctly and 0 otherwise. In the year 2007 out of our sample 53.2% of the respondents were able to answer all financial literacy questions, whereas 46.8% had a least one incorrect answer or "do not know".[22] Previous studies of financial literacy among SAVE respondents analyzed the answers to the individual questions in more detail and show that

[20] We exclude the fifth question on the relationship between bond price and interest, because only few respondents knew the correct answer and a principal components analysis shows that this item does not correlate well with the other four items.

[21] For an analysis of the answering behavior across socio-demographic characteristics and a comparison with respondents in the US and the Netherlands see Bucher-Koenen (2010)

[22] In the questionnaire 2007 the interest and the inflation question did not have a "do not know" option. For this reason we treat missing answers as "do not know" and do not drop them from the sample.

this dummy is a good indicator of individuals' knowledge—they also revealed that financial literacy is particularly low among women, individuals with low education or income and individuals living in east Germany (see analyses in Chapter 2 and 3).

The questions for both measures of financial literacy can be found in the Appendix in section D.3.

4.4. Financial Literacy and Financial Advice

First, we briefly outline our empirical strategy to emphasize the relationship to our analytical framework. It relies on the fortunate fact that due to the structure of our questionnaire, we have access to the measure of the customer's financial literacy which the advisor does not observe directly. For the signal of the advisee's expertise, we need characteristics that are on average indicative of the individual's financial literacy as well as generally observable. We choose educational attainment, in particular whether or not the individual has completed tertiary education, because it fulfills both requirements: It is correlated with financial literacy (Advanced Financial Literacy 2009: Corr .178, $p < 0.01$, Financial Literacy 2007: Corr .193, $p < 0.01$) and it has even been used as a proxy for financial expertise in academic studies such as e.g. Georgarakos and Inderst (2010). Regarding observability, tertiary education confers a title to its holder, which is typically included in bank forms and protocols of advice sessions. The second signal that we contemplate is even more clearly observable to the advisor: the gender of the person seeking advice. Lusardi and Mitchell (2008), Van Rooij et al. (2011b) and our analyses in the previous two chapters each show that the financial literacy of women is on average significantly lower than that of men, even after controlling for factors such as education, age and income. The correlations coefficients are .194 ($p < 0.01$) for the advanced financial literacy measure 2009 and .144 ($p < 0.01$) for the basic measure 2007, for males respectively.

We would briefly like to address three empirical issues that arise in our approach in advance. The first issue is one of endogeneity: If one were to observe that higher levels of financial literacy are associated with a visit to a financial advisor, the causality is unclear. Perhaps an individual learned from the advisor, then the higher level of literacy may be a result of, not a reason for the visit. This effect would bias our estimates upwards. We solve this by using the panel structure of our data and employing the level of financial literacy that the customer exhibited *before* she solicited financial advice. The second issue is related to the question of who follows financial advice. Our model predicts that individuals with higher levels of financial literacy should be more likely to approach a financial advisor. This introduces a potential selection bias for the decision whether or not to follow the advice one receives, as both steps depend on the level of financial literacy. We account for this by

using a Heckman (1979) selection model in our estimation of the second stage. Finally, the correlation between financial literacy and educational attainment is both a blessing, due to the reasons discussed above, and a curse. This correlation introduces collinearity between the two measures; as a result, we will in some cases not be fully able to separate their effects.

4.4.1. Financial Literacy and the Demand for Financial Advice

In this section, we analyze which characteristics contribute to the decision whether or not to consult a financial advisor during a given year. We estimate different probit models of the following form:

$$y_{jt} = \beta_0 + \beta_1 x_{jt,(t-2)} + \beta_2 z_{jt} + \epsilon \tag{4.3}$$

Here, y is a dummy-variable that signifies whether someone has talked to a financial advisor in year t, i.e. 2009. x is one of two measures of financial literacy, depending on the specification: In models I and II, we use the score on the advanced financial literacy test, which may range from 0 to 4. To counter the issue of potential endogeneity—consulting with a financial advisor might improve a person's understanding of financial matters, as discussed above—we instead use the 2007 measure of basic financial literacy in model III.[23] The detailed results and specifications of the different models that we estimate for this section can be found in Table 4.1. Hypothesis 3 predicts a significantly positive sign of β_1: The higher the level of financial literacy, the more likely the individual should be to solicit advice.

In all three models, we find a significantly positive effect of financial literacy on the decision to consult a financial advisor. A higher score on the advanced literacy test increases the probability of consulting an advisor by between 2% and 3.1% per point. Being able to answer all three basic questions two years earlier makes it about 3.4% more likely that someone will consult a financial advisor in the given year.[24]

The difference between models I and II is the introduction of a dummy that measures whether an individual has previously contracted a financial advisor. While not included in our analytical approach, relational factors[25] are likely to play a role in the decision of indi-

[23] The 2007 version of SAVE did not yet include the advanced financial literacy questions.

[24] As a robustness check, we also introduced dummies for the respective number of correct answers for the simple measure. We find that giving one wrong answer and two wrong answers respectively lower the probability of soliciting financial advice significantly, but the difference between the two effects is not statistically significant. Therefore it appears to be justified to simply use a dummy for answering all questions correctly.

[25] See Ottaviani and Sørensen (2006) for a model of reputation acquisition of advisors.

viduals. To take this into account, we control for whether somebody has received financial advice in the previous year, to which the results are robust.

Individuals with higher monthly income are significantly more likely to seek out financial advice. The effect of our signals is neutral, in one of the specifications, the effect of university education is even negative. Our model has two potential explanations, why individuals with high financial literacy and a good signal would be more likely to approach an advisor: They are more likely to understand the advice offered to them and they anticipate that they will receive better advice than others whose signals are less promising. Our results suggest that the first channel plays a bigger result than the second, which has no significant effect on the choice to consult a financial advisor.

To relate our findings to our theoretical model: We find robust evidence that is consistent with hypothesis 3: Individuals with higher levels of financial expertise are more likely to solicit financial advice. The other major factor that encourages seeking advice is monthly income.[26]

[26] As opposed to Bi et al. (2002) and Hackethal et al. (2010), we do not find positive overall effects of education and age; unlike them, we are able to control for financial literacy directly.

Table 4.1.: Determinants of Consulting Financial Advisors

This table reports the effect of financial literacy and various covariates on consulting a financial advisor. The dependent variable in all specifications is a dummy that indicates if a household consulted with a financial advisor in 2009. We report marginal effects (Marg. Eff.) after estimating a probit evaluated at the mean of all variables and the respective standard errors (Std. Err.). Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by two differen measures: Financial Literacy 2009 measures the number of correct answers to the advanced financial literacy questions in 2009. It takes values between 0 and 4. Financial Literacy 2007 is a dummy variable which takes value 1 if all financial literacy questions in 2007 were answered correctly. (d) indicates the change of a dummy variable from 0 to 1. N= 2,141 for all specifications.

	I		II		III	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
Financial Literacy 2009	0.031***	0.008	0.020***	0.007		
Financial Literacy 2007 (d)					0.034*	0.020
Living in East Germany (d)	0.015	0.023	0.017	0.021	0.014	0.021
Male (d)	0.012	0.021	0.018	0.020	0.023	0.019
Age	-0.002	0.007	-0.007*	0.004	-0.007*	0.004
Age squ.	0.000	0.000	0.000*	0.000	0.000*	0.000
Income (log)	0.084***	0.024	0.052***	0.018	0.056***	0.018
University degree (d)	-0.008	0.031	-0.041*	0.025	-0.039	0.025
Positive Financial Wealth (d)	0.256***	0.035	0.178***	0.033	0.189***	0.033
German nationality (d)	0.146	0.089	0.181***	0.077	0.186***	0.076
Consulted an Advisor in 2008 (d)			0.332***	0.015	0.334***	0.014
N	2141		2141		2141	
Pseudo R2	0.068		0.185		0.183	

Source: Authors' calculation based on SAVE 2009 and 2007; * significant at 10%; ** significant at 5%; *** significant at 1%.

4.4.2. Customer Expertise and Following Advice

Next, we wish to study the determinants of a customer following the financial advice she has received. In the general context, we are able to use a self-reported direct measure observed within the SAVE survey: participants were asked to which degree they followed the financial advice they had received, given the decision to consult an advisor. The answers are on a 11-point scale (from 0 – "not at all" to 10 – "entirely") in the questionnaire. The measure is by necessity imperfect for two reasons: It is self-reported, which may introduce, for example, justification biases or similar issues. In addition, individuals may interpret the question and answer possibilities differently. We apply various strategies to address these issues, but clearly cannot solve them completely.

In this section, we employ different specifications of the following form:

$$y_{jt} = \beta_0 + \beta_1 x_{jt} + \beta_2 s_{jt} + \beta_4 z_{jt} + \epsilon \tag{4.4}$$

Here, y is the self-reported measure of how closely the advice was followed. x is the measure of financial literacy, s is the vector of two signals, gender and university degree, and z is a vector of controls. We present the detailed results of four different models in Table 4.2 below, each dealing with a different issue.[27] Model I is a simple OLS for the entire sample. The peak of answers at "5" can be an indication of default answering behavior and is likely to introduce unnecessary noise, therefore we exclude these answers in specification II, which is otherwise identical, and in the other specifications.

In specification III, we pay heed to the possibility that we observe the propensity to follow only for the (selection of) survey participants who actually solicited advice. Our previous results (and theoretical model) both indicate that this could introduce a selection bias, since individuals with low financial literacy (who would be more likely to follow advice later on) are less likely to solicit advice. Therefore we potentially underestimate, in absolute terms, the effect of financial literacy on following in the previous specifications. To counter this, we run a two-stage Heckman selection model. For the selection stage, we use the model from the previous subsection, so that dummies for German nationality and positive financial wealth are included in the first stage, only. On the one hand, nationality in our sample can be seen as a proxy for a person's propensity to remain in the country in the long-run and therefore the interest in making long-term investments. On the other hand, potential language issues may work as a psychological barrier to approach an advisor. The fact that an individual

[27] For brevity, we only report OLS coefficients and standard errors, which are readily interpretable. Ordered probit regressions deliver qualitatively identical results. We also ran probit regressions with a dummy taking the value 1 above the cutoff-value 8, indicated by the distribution of answers. Again, the results were qualitatively unchanged.

has positive assets clearly affect whether she will be interested in financial advice, but not necessarily whether she will follow it. The results bear this out: exclusion restrictions are jointly significant at the 1% level in the first stage, while they are jointly insignificant when inserted into the second stage in all cases.

Finally, we separate the samples for models IV and V into individuals with high financial literacy (four correct answers) in model IV and lower financial literacy (less than four correct answers) in model V, as we would expect different effects of the signals that we observe in each of the groups.

For each of the specifications, our hypotheses predict the following signs: β_1, the direct effect of financial literacy, should be negative by Hypothesis 4, as we control for the signals. β_2, the direct effect of the signals, should be positive, by Hypothesis 2. Finally, Hypothesis 5 implies that the effect of the signal should be strictly higher for individuals with high financial literacy than for individuals with low financial literacy, for which we use specifications IV, V.

Our results are the following. The Heckman Model does not deliver effects that are significantly different from the simple specifications, which is reflected by the non-significance of the rho-value. We find supporting evidence for Hypothesis 4: The higher the financial literacy of individuals, the less they report to follow the advice received. The coefficients in each of the specifications are negative and significant at the 10%-level, only, which reflects the lack of specificity of the underlying measure. Also, in every specifications, both gender and university education do not have a significant direct effect on the propensity to follow advice. There are two potential reasons for this, so this is not enough in itself to repudiate Hypothesis 2: On the one hand, it is difficult to completely disentangle the effects of education and financial literacy, on the other hand the measure for the dependent variable is not optimally suited, again. Finally, we study whether the signals have different effects for individuals with higher and lower financial literacy. Using a between-models chi^2 test, we find that the effects of university education are significantly different at the 5% level in each of the data-sets. This is the pattern predicted by Hypothesis 5. However, the effect of gender does not differ between the models. Among our controls, we find a significant positive effect of having previously consulted an advisor for the whole sample, which again points in the direction of relational effects. Further, individuals with higher age according to their own reporting are less likely to follow financial advice.

To summarize the results of the general questions regarding financial advice: We find robust support for Hypotheses 3 and 4, as well as some support for Hypothesis 5. "Smarter" individuals are more likely to consult an advisor, but, controlling for the signal, are significantly less likely to follow it. We do not find a significant direct effect of the signals of financial literacy, gender and education, on the propensity to follow advice. As predicted by

Hypothesis 5, the effect of the signals on the propensity to follow is significantly stronger for smarter individuals than for those less versed in financial questions.

Table 4.2.: Determinants of Following Financial Advice

This table reports the effect of financial literacy and various covariates on following the advice after consulting a financial advisor. We estimate ordinary least squares models. The dependent variable measures how strongly households follow the given advice on a scale from 0 to 10. Coefficient (Coef.) and standard errors (Std. Err.) are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by counting the number of correct answers to the financial literacy task in 2009 (it can take values 0 to 4). correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Specificaion I contains all households conditional on consulting a financial advisor. In Specification II to V those responding the middle of the scale (5) are excluded. Specification III corrects for selection into consulting an advisor. Specification IV and V the sample is split into those with 4 and those with less than 4 correct answers on the financial literacy task.

	I		II		III		IV		V	
	All observations		Excluding 5		Selection Model		Low financial literacy		High financial literacy	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Financial Literacy 2009	-0.119*	0.067	-0.146*	0.084	-0.116*	0.069				
Male (d)	-0.016	0.149	-0.087	0.186	-0.014	0.149	-0.265	0.238	0.176	0.308
University degree (d)	-0.105	0.186	-0.232	0.230	-0.108	0.188	-0.618**	0.307	0.305	0.360
Income (log)	-0.032	0.141	0.032	0.166	-0.026	0.151	0.067	0.198	-0.270	0.322
Living in East Germany (d)	-0.017	0.192	0.091	0.251	-0.016	0.192	-0.054	0.315	0.423	0.416
Consulted an Advisor in 2008 (d)	0.267*	0.160	0.256	0.207	0.308	0.348	0.101	0.266	0.418	0.325
Age	-0.059*	0.034	-0.060	0.041	-0.060*	0.034	-0.066	0.051	-0.029	0.069
Age squ.	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Constant	8.246***	1.287	8.246***	1.523	8.148***	1.542	7.800***	1.925	9.094***	2.719
Rho					0.026	0.218				
Sigma					1.948	0.058				
Lambda					0.053	0.425				
N	752		566		566		357		209	
R2	0.016		0.019				0.025		0.041	

Source: Authors' Calculation based on SAVE 2009 and 2007; * significant at 10%; ** significant at 5%; *** significant at 1%.

4.5. Financial Advice and Private Pension Choice

After studying the effects of customer expertise on the behavior of seeking and following financial advice in general, we now turn to a specific application for which we have unique data. We outlined in the introduction why the search for and choice of subsidized private pensions in Germany is a fascinating application of our analytical framework. To provide a brief outline of the institutional details: The fundamental idea of the so-called Riester Pensions—named after the former labor minister Walter Riester—is that eligible individuals contribute 4% of their monthly income to a private pension contract and receive a lump-sum subsidy of currently 154 Euros per year in addition to the gains of the underlying pension plan. Additionally, families with children obtain 300 Euros for each kid (185 Euros, if the child was born before 2008). Thus, Riester subsidies are particularly generous for individuals with lower income and families with children. Every person potentially affected by the future reductions in public pensions due to recent pension reforms is eligible for subsidies, which covers about 40 million individuals according to estimates.[28] Up to date, around 13 million contracts have been signed. Coppola and Reil-Held (2009) provide an overview of the dynamic of the adoption of Riester pensions by German households over time. In the 2008 wave of our sample, 37.0% of households own at least one so called Riester private pension insurance contract, a further 9.2% report that they are planning to sign such a contract.

There is a lively current discussion about the alleged lack of transparency in the market—both regarding the multitude of offers on the macro-level[29] and the complexity of the cost structure of individual contracts.[30] This complexity leads to interesting search patterns of individuals in the SAVE survey. Forty-four percent of consumers who own a Riester contract report that they acquired information regarding only one provider, 15.6% even state that they obtained no information concerning providers prior to signing their contract. In total, therefore almost 60% of consumers did not compare providers before signing a pension contract.[31]

Comparing individual offers in this market is more difficult than one would expect. Due to the pension character of products and different levels of subsidies, contracts are individualized to a certain degree and therefore depend on starting age, marital status, number

[28] Around 87% of individuals in our sample are eligible for the state subsidies that make Riester pensions attractive investments.

[29] In 2008 around 4,300 different Riester products were registered as certified products by the *Bundesanstalt für Finanzdienstleistungsaufsicht*— the Federal Financial Supervisory Authority— which is responsible for the regulation. Of those contracts around 4,000 were at the time available to customers. This number is inflated as identical offers may go by different names, which contributes to the opacity of the market.

[30] For a comprehensive overview, we refer to the book-length study by Feigl et al. (2010).

[31] The pattern does not change when including households who only plan to sign a Riester contract and have not done so yet.

Table 4.3.: Riester Pensions—Search for Information

This table displays the search for information of households who own Riester pensions at the end of 2007. Panel A contains the number of providers contacted by individuals who own a contract, Panel C shows the number of written offers obtained by those households, N=406.

Panel A: *Comparison of Providers*

	Freq.	Percent
No info	63	15.6
1 provider	179	44.1
2 or 3	128	31.6
More than 3	36	8.8
Total	406	100

Panel B: *Written Offers*

	Freq.	Percent
No written offer	182	44.9
1 offer	117	28.7
2 or 3	91	22.3
More than 3	16	4.1
Total	406	100

Source: SAVE 2008, data is weighted.

of children and current income, to name the most important factors. If a consumer wishes to compare contracts, she therefore has to provide these characteristics in order to obtain a spelled-out personalized offer. This is the background of the second question in our survey about how many written offers individuals compared before signing. Among owners of Riester pensions, 44.9% of individuals signed the contract without studying a written offer, a further 28.7% only obtained and studied a single offer in writing. Therefore the share of individuals who did not compare written offers is almost 74%. With about three-quarters of consumers choosing the first option they encounter, the origin of this offer, i.e. their source of information and financial advice, clearly plays a crucial role in this important long-term decision.

In the remainder of this section, we proceed as follows: First we determine how the number of providers an individual approached is related to her financial literacy. In the next subsection, we then look at the determinants for the choice of whether to approach (or be approached by) a dependent or an independent financial advisor in the context of private pensions. We also examine how many written offers individuals obtain, given that they approached a financial advisor—we interpret this as a measure of the quality of advice these households are offered. In the last subsection, we consider how the customer's expertise affects her decision to follow the advice using an objective measure, as opposed to the subjective measure in the general section above. We are able to analyze whether she has signed the contract with an unfamiliar or familiar contract partner given her source of advice. Note that the population in our analysis is composed of all individuals who have either purchased a private pension insurance or report planning to do so in the near future. Prior

to this, there is a selection step: some individuals consider Riester pensions while others do not. In Chapter 3 we analyzed this decision in detail. For the remainder of this article, we report regression results that disregard this selection step. For each of the calculations, we have also carried out a Heckman selection model and confirmed that the results are qualitatively unchanged. For the selection equation, following the results in Chapter 3 we utilize the fact whether individuals have children. The rationale is that Riester subsidies are particularly generous for families with children and thus predict ownership of Riester contracts but do not significantly influence the search/advice process.[32]

4.5.1. Financial Literacy and Search Efforts by Consumers

The most basic question we ask in this context is how individuals' financial expertise affects the number of providers that they approach. We already showed in the introduction to this section that around 60% of households who own a Riester pension approached at most one provider before signing their contract. Here we compare the number of providers approached by individuals' level of financial literacy.[33] Individuals with low levels of financial literacy are those unable to answer 3 basic financial literacy questions; individuals with high financial literacy were able to give three correct answers. Among those with low financial literacy more than 70% obtained information from one provider or less. Less than 30% approached 2 providers or more. In contrast to this, among those with higher levels of financial literacy around 46% compared several providers and only 54% approached one provider or less. This is a striking result in itself: Even among those considered financially literate more than half did not compare providers prior to signing a private pension contract to which they contribute 4% of their monthly earnings.

We conduct multivariate analyses to better understand the influence of financial literacy on comparing providers. As our measure of the number of providers that consumers compared is coded "none, one, two to three, more than three", we run an ordered probit model [34] of the following form:

$$y_{jt} = \beta_0 + \beta_1 x_{jt-1} + \beta_2 z_{jt} + \epsilon \tag{4.5}$$

[32] Results are provided by the authors upon request.

[33] For the analysis in this section we use the financial literacy measure from 2007. The reason is that we only have the advanced measure in the 2009 survey and we would loose observations when merging the 2009 data to the 2008 sample. This is critical as our working sample only consists of 406 households. Additionally, as discussed above by using the 2007 measure we address endogeneity concerns. Sensitivity checks show that our analyses are robust to using the advanced financial literacy measure from the 2009 survey, despite the smaller sample.

[34] We get identical results when using a probit model for the probability of approaching more than one provider.

Again, x is the measure of financial literacy and z resembles the controls. According to Hypothesis 1, we expect β_1 to be positive: Higher financial literacy should lead to more alternative providers being compared.

The results of the descriptive analysis above are supported by the regressions. Financial literacy has a significant positive impact on the number of offers that consumers compare (see Table 4.4). We also limit the sample to individuals who purchased their insurance contract post 2007 (specification II) to further rule out endogeneity, which in turn reduces sample size substantially, and the effect remains significant. In the context of a search model, it truly appears that higher expertise lowers search costs. Note that we are able to control for opportunity costs of time: In the limited sample, income has a negative effect on the number of providers approached by consumers. Finally we find that men report to approach significantly more different providers than women, even controlling for the level of financial literacy; the same holds for university education in the overall sample.[35]

Table 4.4.: Determinants of Search for Information

This table displays the results of an ordered probit regression of financial literacy and a variety of covariates on the number of providers households contacted before signing a contract. Specification I contains all households who owned a contract in 2008 (N=393). Specification II uses only a reduced sample of households who did not report ownership of a Riester contract before 2007 (N=105). Coefficients and robust standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by a dummy equal to one if all questions were correctly answered in 2007. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	I		II	
	Coeff.	Std. Err.	Coeff.	Std. Err.
Financial Literacy (d)	0.28**	0.127	0.476*	0.246
Living in East Germany (d)	-0.058	0.127	-0.065	0.249
Male (d)	0.429***	0.12	0.551**	0.231
Age	0.027	0.065	-0.12	0.117
Age squ.	-0.000	0.001	0.001	0.001
Income (log)	-0.115	0.123	-0.444*	0.24
University degree (d)	0.349**	0.157	0.353	0.338
Observations	393		105	
Pseudo R2	0.036		0.067	

Source: SAVE 2007 and 2008, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

[35] In these regressions we include only households which own Riester pensions. Our results persist when we model the selection step.

4.5.2. Sources of Financial Advice

Consulting Professional Financial Advisors

In this section we consider which customers owning or searching for[36] a Riester pension contract choose to solicit dependent and independent advice, respectively. In contrast to section 4.4.1, we are now able to more closely distinguish the different channels of advice. Table 4.5 displays which sources of information consumers utilize in our sample: About 28% of the households report that they conducted own research before signing a Riester contract. A subset of 16.6% talked to an advisor in addition to searching by themselves, which leaves 11.6% who only searched for information on their own. A substantially larger share of households has only consulted advisors (42.5%), while 29.4% report not to have obtained any information.

Table 4.5.: Riester Pensions—Source of Information

This table displays the sources of information households used when searching for a Riester contract. Information is for households who own a contract in 2008 or plan to buy one in the near future, N=500.

	Freq.	Percent
No own search and no advisor	147	29.37
Only own search	58	11.55
Only advice	212	42.47
Advice and own search	83	16.62
Total	500	100

Source: SAVE 2008, data is weighted.

Our third hypothesis states that individuals with higher financial literacy should be more likely to solicit financial advice compared to the group with low literacy: The descriptive statistics bear this out. Among those with high levels of financial literacy 64.4% consulted an advisor—for 43.1% the advisor was the only source of information, 21.3% consulted advisors in addition to on research—among those with lower levels of financial literacy 50.0% of the respondents approached financial advisors—only 8.7% of which consulted advisors in addition to conducting their own research.

To be able to control for the influence of other factors, we run the following familiar probit regressions:

$$y_{jt} = \beta_0 + \beta_1 x_{jt,(t-2)} + \beta_2 z_{jt} + \epsilon \tag{4.6}$$

[36] Note that in the previous section, by contrast we only studied individuals who actually have purchased a contract, to highlight the fact that even among those who are already locked in to a pension insurance plan, many did not compare offers prior to signing.

The complete regression results can be found in Table 4.6. Again, in specification II we reduced the sample to individuals who actually purchased insurance during the year in question. Straightforwardly, the effect of financial literacy on the propensity to consult an advisor is significant and positive. More financially literate individuals are between 10% and 17% more likely to consult an advisor concerning their private pension insurance. For the complete sample, we find a significant positive effect for men, in addition. This may simply reflect our previous finding that men exert more search effort in general, or men may additionally anticipate that they may receive better advice later on. Further, there is a positive, though decreasing, effect of age. Overall, we find further support for our third Hypothesis, parallel to Section 4 – smarter individuals are more likely to solicit financial advice.

Table 4.6.: Determinants of Consulting a Financial Advisor

This table displays the marginal effects and standard errors after estimating probit models. The dependent variable is a dummy if a an advisor was consulted. Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by a dummy equal to one if all questions were correctly answered in 2007. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	I.		II.	
	Marg.Eff.	Std. Err.	Marg.Eff.	Std. Err.
Financial Literacy (d)	0.099**	0.048	0.174**	0.076
Living in East Germany (d)	0.019	0.054	0.080	0.090
Male (d)	0.092**	0.047	0.000	0.080
Age	0.052**	0.022	0.045	0.034
Age squ.	-0.001**	0.000	-0.001	0.000
Income (log)	0.052	0.043	0.076	0.060
University degree (d)	-0.047	0.065	-0.081	0.115
N	478		183	
Pseudo R2	0.035		0.046	

Source: SAVE 2007 and 2008, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

Dependent vs. Independent Advice

In addition to this, our data allow us to differentiate between dependent—those working for a bank or insurance company—and independent advisors. Overall about 48% of respondents consulted with dependent advisors and about 20% approached independent advisors. There is some overlap: 8.7% report to have talked to both independent and dependent advisors when preparing to purchase a contract. Interestingly, there is hardly any difference in the probability to approach dependent advisors between those with high and low financial literacy: About 45.5% of the illiterate and 48.7% of literate respondents talk to financial advisors of banks or insurance companies. However, there is a large difference in the likelihood to

consult with an independent advisor: Only about 12.6% of illiterate households seek independent advice, whereas the fraction is almost twice as high for respondents with higher levels of financial literacy (24.7%).

Our model predicts that smarter consumers are more likely to approach an advisor for two reasons: They are more likely to understand the advice received and they anticipate to get better advice. We briefly discuss that for an advisor to really be willing to provide a better service, his incentive structure must be relatively "flat" – he must obtain a similar bonus for any product that he successfully sells. The incentive structures of dependent financial advisors, employees of banks or insurance companies, and independent advisors in reality differ substantially: While the former have "own" products to sell and associated with this relatively steep incentive functions (ν), the latter, as discussions with practitioners revealed, have relatively flat bonus-structures with strictly enforced upper limits.[37]

Our setup allows us to try to better understand the two reasons for why smarter consumers are more likely to seek advice: If consumers are more likely to consult an advisor only because they expect to understand him better, then we should observe similar results regarding dependent and independent advisors. If on the other hand the expectations regarding the quality play an additional role in the decision to consult an advisor, then the effect of financial literacy on obtaining independent advice should be relatively stronger.

To test this, we estimate a simultaneous equation probit model for the two decisions of the following form:

$$y_{jt} = \beta_0 + \beta_1 x_{jt-1} + \beta_2 z_{jt} + \epsilon \tag{4.7}$$

Here, y is a vector that captures whether individual j solicited dependent and independent advice, x is our measure of financial literacy and z is a set of controls. We provide the detailed regression results in table 4.7. Our results remain strongly in line with our predictions. Individuals with higher financial literacy are significantly more likely to consult an independent financial advisor, controlling for income, which also has a significant positive effect.[38] For the choice of dependent advisor, the effect is not only smaller, it is actually insignificant. Regarding the difference in the influence of financial literacy on dependent and independent advice, χ^2 tests show that the effects on the two choices are significantly larger for independent than for dependent advisors at the 1% level. We find that women

[37] In their model which includes prospecting for clients, Inderst and Ottaviani (2009) demonstrate that higher powered contracts may additionally induce agents to approach more clients and "oversell" their product, in which case an individual who intended only to open a bank account may find herself with a pension insurance in the evening.

[38] The financial literacy effect is also robust to limiting the sample to individuals who bought their insurance post 2007.

are significantly less likely to approach (or be approached) by a dependent financial advisor, while this is (barely) not significant for independent advisors at the 10% level.

Table 4.7.: Dependent and Independent Financial Advice

This table displays the marginal effects and standard errors after estimating a simultaneous probit equation model (biprobit). The two dependent variables are one dummy if a dependent advisor was consulted and a second dummy if an independent advisor was consulted. Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by a dummy equal to one if all questions were correctly answered in 2007. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	I: Dependent advisor		II: Independent advisor	
	Marg.Eff.	Std. Err.	Marg.Eff.	Std. Err.
Financial Literacy (d)	-0.009	0.053	0.106***	0.039
Living in East Germany (d)	0.010	0.056	-0.009	0.041
Male (d)	0.096*	0.049	0.059	0.037
Age	0.054**	0.024	-0.005	0.019
Age squ.	-0.001**	0.000	0.000	0.000
Income (log)	0.027	0.045	0.060*	0.037
University degree (d)	0.009	0.069	-0.044	0.045
N	478		478	

Source: SAVE 2007 and 2008, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

To summarize the findings of this section: Our results are in line with Hypothesis 3: individuals with higher financial literacy are more likely to solicit the services of financial advisors. The observation that this effect is significantly stronger for independent than for dependent advice indicates that smarter consumers may expect to obtain better advice — or alternatively, that they are better able to pick an advisor whose incentives are better aligned with theirs.

4.5.3. Financial Literacy and the Quality of Advice

While in Section 4, we attempted to indirectly disentangle the quality of advice from the data, we observe a direct, if imperfect, measure for the quality of advice in the pension context: the number of written offers that households report to have obtained. We are aware of the limitations of this measure, e.g., more choices are not necessarily experienced to be beneficial, or this may even signal attempts at selling sub-par products by employing framing such as compromise effects. We still feel that much can be learned from analyzing the decision making process of a representative sample of households in their choice of financial products in this fashion. We address the issues raised above, at least partially, by focussing only on the binary outcome of whether a customer was presented with more than one written offer by the advisor or whether he was not provided with any alternatives for comparison.

We argue that, while still noisy, the latter in most cases constitutes worse advice than the former.

Table 4.8 displays some descriptive results that shed first light on these relationships: Given on the sources of advice chosen by individuals and their financial literacy, which share of customers compared more than one written offer. We would like to draw attention especially to the second row: Given that someone *only* relied on an advisor, she was almost three times as likely to be offered more than one alternative if she was financially literate (22.7%) than if she was not (8.9%). Apart from the upper right field of the matrix, which covers only those 16 somewhat exceptional individuals who report to have only searched themselves and have low financial literacy, those most likely to have obtained multiple offers are those who searched on their own in addition to receiving advice.

Table 4.8.: Number of Written Offers and Financial Literacy

This table displays the probability to obtain more than one written offer when searching for information about Riester contracts. Information is for households who own a contract in 2008 or plan to buy one in the near future, N=500. In column II. and III. the sample is split into those who are (un)able to give three correct responses to the financial literacy task.

	I.All	II.High Lit	III.Low Lit
only own search	47.3	41.4	62.2
only advice	17.6	22.7	8.9
advice and own search	58.5	59.2	55.2
N	500	330	170

Source: SAVE 2008, data is weighted.

In our regression analysis, we are now able to directly address the question of the quality of advice given the qualification of consumers. We estimate probit models of the following form:

$$p_{jt}(\#o > 1|advice) = \beta_0 + \beta_1 x_{jt-1} + \beta_2 s_{jt} + \beta_3 z_{jt} + \epsilon \tag{4.8}$$

The approach is very simple: Given that someone has solicited advice, we analyze the probability that she has obtained more than one written offer and relate it to her level of financial literacy x, the signals for financial literacy s as well as a set of controls z. Our model predicts a positive sign for β_2 — higher signals of financial literacy should lead to better advice being proffered. A positive and significant sign for β_1, the effect of financial literacy itself, might imply that the signals do not capture all that the advisor observes or that the advisee takes an active role in the process, e.g. by asking more questions. In model I, we look at the sample of *all* individuals who approached an advisor, in model II, we look only at those who report not to have sought information on their own in addition to consulting an advisor. Column III represents a different, though related regression. Returning to the

question of how likely individuals are to follow advice, here we look at the probability of an individual seeking out information on her own, given that she has also solicited financial advice. The rational (parallel to our model) is that individuals who are unsatisfied with the advice received should be more likely to search for information on their own, in addition. The detailed results may be found in Table 4.9.

Table 4.9.: Number of Written Offers and Financial Literacy—Multivariate Regressions

This table displays the marginal effects and standard errors after estimating probit models. In specification I and II the dependent variable is a dummy taking value one if more than one written offer was obtained. Specification I contains all households who approached a professional advisor (N=287). Specification II limits the observations to those how consulted advisors but did not conduct own search (N=207). In specification III the dependent variable is a dummy which is equal to one when households conducted own search given that they also approached an advisor (N=287). Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by a dummy equal to one if all questions were correctly answered in 2007. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	I. Comparing offers		II. Comparing Offers		III. Own Search	
	Marg.Eff.	Std. Err.	Marg.Eff.	Std. Err.	Marg.Eff.	Std. Err.
Financial Literacy (d)	0.116*	0.061	0.117*	0.061	0.141**	0.065
Living in East Germany (d)	-0.039	0.066	-0.044	0.066	0.044	0.063
Male (d)	0.132**	0.056	0.045	0.057	0.116**	0.055
Age	-0.023	0.030	-0.006	0.029	-0.023	0.030
Age squ.	0.000	0.000	0.000	0.000	0.000	0.000
Income (log)	0.054	0.057	0.000	0.053	0.054	0.056
University degree (d)	0.084	0.072	-0.001	0.081	0.054	0.068
N	287		207		287	
Pseudo R2	0.060		0.033		0.055	

Source: SAVE 2007 and 2008, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

The first, and central finding is that individuals with a higher level of financial literacy are about 11% more likely to obtain multiple offers, both if one allows them to search on their own and if one looks at individuals who completely relied on financial advice for their decision. They are offered more alternatives by the advisor, potentially because they demand it, which in our eyes clearly resembles receiving better advice. For the sample including individuals who also search on their own, males obtain more written offers, though dropping those with own search in II turns this insignificant. The effect of university education is parallel, though it already starts out insignificant.

The results of the alternative model III show who is more likely to search on their own in addition to receiving financial advice. It can be interpreted as a further test of hypothesis 4. We find that smarter individuals are significantly and substantially, about 14%, more likely to obtain additional information on their own given that they consulted an advisor,

which strongly supports our hypothesis. It is also worthy to note that despite controlling for ability, income, age and education, men are significantly more likely to additionally search on their own than women. The pattern that emerges in this respect deserves more close scrutiny in future studies.

4.5.4. Expertise, Advice and the Choice of Contract Partners

The last step of our analysis is to show that the choice of advisor related to consumers' levels of financial literacy is associated with other economically relevant decisions that consumers make. In particular, we will show that it significantly affects the contracting partner that individuals contract with. Regarding this contract choice of consumers who own a Riester pension, we observe whether they contracted with a company that is also their provider of banking or insurance services. In this case, we refer to the firm as "familiar contracting partner". If the consumer has no such interactions with her pension provider, we refer to the situation as "unfamiliar contracting partner". As the final step of our analysis, we now turn to the question which customers sign a contract with a firm that is likely also to employ their (dependent) advisor as opposed to with an unfamiliar firm.

We first estimate a basic model of the following form:

$$y_{jt} = \beta_0 + \beta_1 x_{jt-1} + \beta_2 z_{jt} + \epsilon \tag{4.9}$$

y captures whether the consumer has purchased a contract from a familiar firm an x is our measure of financial literacy, while z are the familiar controls. We would expect the overall effect of financial literacy to be negative. Next, we add the channels of this effect that we have identified above. In our first alternative model II, we look at the effect of comparing more than one offer. In the second alternative, III, we control for the source of information with dummies for whether the individual has respectively consulted a dependent or independent advisor, or searched on her own. In the last specification, IV, we include both the sources of information and the fact whether or not somebody compares multiple offers. For the detailed specifications and results, we refer to Table 4.10.

For our basic model, as expected, we find a significantly negative effect of financial literacy on the probability that the consumer purchases her contract with a known firm. The only other controls we find that show a significant sign, which is robust over all specifications, is the measures for age (positive) and age squared (negative). This may be related to different levels of experience and more possibilities to interact with players apart from the relational savings and insurance company at different stages in life. While the overall effect of financial literacy is negative, we also care about the channel by which this comes to be. Controlling

for the sources of information, the coefficient for financial literacy is slightly smaller and still significant at the 5%-level. What we do find, though, is that individuals who consult an independent advisor are significantly less likely to sign a contract with a familiar firm. In itself, this is not surprising. It points in the direction that part of the overall sign of financial literacy is due to the fact that more literate consumers are more likely to consult an independent advisor as discovered above. When we control for the customer stating that she compared multiple offers, this has a significantly negative effect on the probability that the consumer stays with a familiar company. For this regression, the term for financial literacy also remains significant. Combining all controls in the final specification, we find significantly negative effects for consulting an independent and significantly positive effects for consulting a dependent advisor. The financial literacy remains significantly negative.

To summarize these results: The overall effect of higher financial literacy on the probability that an owner of a Riester pension contract signed with a familiar company is significantly negative. These consumers are more likely to collect more alternatives to compare than their peers, are more likely to solicit independent and as likely to solicit dependent advice, as shown above. Each of these factors contributes to their choosing a contract partner beyond their "default" alternatives, their relational bank or insurance company.

Table 4.10.: Determinants Contract Partner

This table reports the effect of financial literacy and various covariates on signing a Riester contract with a familiar provider. The dependent variable in all specifications is a dummy that indicates if a household owned a Riester contract provided by a bank or insurance company where the households also owned other products. We report marginal effects (Marg. Eff.) after estimating a probit evaluated at the mean of all variables and the respective standard errors (Std. Err.). Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Financial literacy is measured by a dummy equal to one if all questions of the task were correctly answered in 2007. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used, N= 478.

	I.		II.		III.		IV.	
	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.	Marg. Eff.	Std. Err.
Financial Literacy (d)	-0.116**	0.049	-0.105**	0.049	-0.092**	0.048	-0.089*	0.048
Approaching more than 1 provider (d)			-0.079*	0.044			-0.066	0.057
Dependent advice (d)					0.088**	0.043	0.100**	0.045
Independent advice (d)					-0.137***	0.049	-0.117**	0.052
Own search (d)					-0.045	0.045	-0.010	0.055
Living in East Germany (d)	0.050	0.053	0.055	0.053	0.048	0.052	0.051	0.052
Male (d)	0.010	0.043	0.021	0.044	0.011	0.043	0.015	0.043
Age	0.046**	0.020	0.047**	0.020	0.040**	0.019	0.041**	0.019
Age squ.	-0.001**	0.000	-0.001**	0.000	-0.001**	0.000	-0.001**	0.000
Income (log)	-0.002	0.046	0.003	0.046	0.007	0.045	0.007	0.045
University degree (d)	0.051	0.058	0.062	0.058	0.049	0.058	0.054	0.058
N	478		478		478		478	
Pseudo R2	0.026		0.032		0.053		0.056	

Source: SAVE 2007 and 2008, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

4.6. Conclusion

The question that motivated our study was why more informed individuals with higher levels of financial literacy are more likely to solicit advice in general and financial advice in particular. Existing explanations focus on higher opportunity costs of people with higher incomes, such as Hackethal et al. (2010). Controlling for income simultaneously should eradicate this effect, but it does not: The level of financial literacy still significantly contributes to explaining whether or not an individual solicits financial advice. We suggest an alternative channel in an analytical model. Individuals with higher levels of expertise may receive (and expect to receive) better advice, which would result in ex-ante complementarities between advice and consumer information. Similarly to Inderst and Ottaviani (2009) this will especially be the case if the advisor's incentives are not stacked too greatly on behalf of one favored option; as opposed to, for example, a bank employee charged with selling his banks products exclusively. As a result, our model predicts that individuals with higher levels of financial literacy should be more likely to solicit financial advice. On the other hand, they may be less prone to follow the advice given to them conditional on soliciting it, as they are more often aware of the fact that their outside option, own search, yields better expected outcomes.

In the empirical part of this work we are fortunate in that we are both able to observe individual's choice *whether* to consult a financial advisor, as opposed to the related work of Georgarakos and Inderst (2010), and also which kind of advisor they consult, the latter in the context of private pension contracts. We show that it is more sophisticated consumers who consult advisors more frequently in the general context, and that the more financial literate individuals report to be somewhat less likely to follow the advice they received. For the choice of private pension provider, more sophisticated consumers in their own search efforts compare more offers than the less financially literate—an indication that their search costs are truly *lower*. While they are neither more nor less likely to consult a dependent financial advisor at their bank or insurance company, they are substantially more likely to consult a third-party independent financial advisor. These observations have a clear consequence with respect to their investment choice: financially literate consumers are significantly less likely to sign the pension contract with a familiar company, their default option: Due to the non-homogeneous fee-structures of Riester pensions spelled out in detail in Feigl et al. (2010) comparing multiple offers can result in substantial savings in fees: One example where higher levels of financial literacy may result in considerable payoffs.

In answering the question posed in our title: We provide a theoretical foundation and find empirical evidence that smarter consumers do receive better advice. Beyond that, they are also more likely to ask for it and are better at picking advisors who are more likely to give them advice that is in their interest. From a welfare point of view, this is a serious

conundrum: those whose financial decision making capabilities are worst are actually less prone to ask for the help they need. As consultations with financial advisors can also be a source of financial knowledge and improve financial decision making, the more sophisticated consumers are caught in a virtuous circle, while those most in need watch inactively from the sidelines. Our analysis suggests two reasons for this fact: less financially literate consumers may expect not to understand the advice they are going to receive and they anticipate that the advisor will provide them with sub-par services. The latter may include being talked into purchasing products which are over-priced or not suited to the consumer's current situation. These problems have come to the attention of politicians, to some degree. Recent legal reforms require financial advisors to provide a written, checklist-like protocol of advisory sessions, which aims at increasing transparency of the process. But an example shows how the potential effectiveness of even such weak measures is further undermined: Interpreting the law literally, only the employee of the bank offering advice is required to sign the protocol.

5. Who Lost the Most? Financial Literacy, Cognitive Abilities, and the Financial Crisis

Joint work with Michael Ziegelmeyer

5.1. Introduction

The recent financial downturn and economic crisis provided a major challenge for financial institutions, politicians, companies and private households around the world. A concern is how and to what extent private households were affected by the financial and economic crisis and how their financial decision making is influenced by the shock. There was no housing or mortgage crisis in Germany in 2007/2008. Thus, the losses (or gains) in wealth of German households are purely related to the composition of financial portfolios and their adjustments in the course of the crisis. While households with a large share of equity in their portfolio are likely to have suffered from the economic downturn, households could gain higher returns on time deposits, saving accounts and government bonds at the same time.[1]

In this paper, we examine the portfolio composition of German households. Our first objective is to determine financial losses suffered by individual households at the end of 2008. Furthermore, we relate financial losses to socio-demographic characteristics and measures of financial literacy as well as cognitive abilities in order to determine who lost the most. The central questions to be answered are:

- Are individuals with lower financial literacy and cognitive abilities more frequently affected by financial losses due to the crisis?
- Are individuals with lower financial literacy and cognitive abilities affected more severely if loss is measured as a percentage of wealth?

[1]The German DAX, which measures the development of the 30 largest and best-performing companies on the German equity market and represents around 80% of the market capital authorized in Germany (http://deutsche-boerse.com) dropped by about 40% during 2008. In contrast to this the returns on private deposits with a duration of less than 2 years increased from an average of 3.6% in 2007 to an average 4.25% in 2008 (http://www.bundesbank.de/statistik).

- And are individuals with lower financial literacy and cognitive abilities more likely to realize their loss?

Despite the short-term perspective of our analysis, the financial crisis can have substantial effects on the long-term financial well-being of households depending on their reactions. If markets recover and households have long-term investment horizons we should not see lasting negative effects of the crisis. However, if individuals shy away from risky investments or feel confirmed in their scepticism towards financial markets, it will have substantial consequences, particularly in the light of the recent pension reforms and increasing individual responsibility for old age income.

Our analysis is based on SAVE, a representative panel of German households that contains very detailed information on their financial and socio-economic situation as well as financial literacy and cognitive abilities. We use information from the surveys conducted in the early summer of 2007, 2008, and 2009 and make extensive use of a special module of questions regarding the financial crisis that were added to the questionnaire in 2009.

Our analysis reveals that individuals with low levels of financial knowledge fared relatively well during the financial crisis. They are less likely to have invested in the stock market and are therefore in general less likely to report losses in wealth due to the financial crisis. Thus, we confirm the finding by Calvet et al. (2007) and Van Rooij et al. (2011b) that individuals with low levels of financial knowledge stay out of risky assets. Additionally, conditional on stock market participation we find that individuals with high financial literacy incur larger losses measured as a fraction of their wealth. This is in contrast to our hypothesis. However, individuals with lower levels of financial literacy sold the assets which have lost in value with a higher likelihood. General cognitive abilities do not seem to play any significant role.

The paper is organized as follows: In section 5.2 we give a brief overview of the literature on household investment behavior and develop our hypotheses. Section 5.3 describes the SAVE data and the variables used for our analysis. In section 5.4 we report answers to the questions raised above. We conclude in section 5.5 with a brief discussion.

5.2. Related Literature and Hypotheses

5.2.1. Stock Market Participation

One of the central findings of capital market theory is that every household should invest part of their wealth in risky assets in order to profit from the risk premium.[2] Over the

[2]This result is based on Markowitz (1952), Merton (1969, 1971), and Samuelson (1969). For a comprehensive overview of the literature on strategic asset allocation see Campbell and Viceira (2003) as well as Curcuru et al. (2004).

life-cycle the absolute amount of assets held in stocks should increase until retirement and decrease thereafter. Without fixed cost of stock market participation the relative amount of stocks in the portfolio should decrease with age; young investors should hold 100% of their assets in stocks.[3] These results persist even when controlling for a variety income risk and other background risks.[4] Empirical examinations of households' portfolio choice reveal that many households do not hold equity.[5] This phenomenon is known as the stock market participation puzzle. One of the arguments put forward to explain the reluctance of households to invest in risky assets is the existence of fixed participation cost (e.g., Mankiw and Zeldes (1991), Haliassos and Bertaut (1995), Vissing-Jorgensen (2002, 2003), and Calvet et al. (2007)). Mankiw and Zeldes (1991) find that stock market participation increases with income and education. They argue that this is in line with the existence of participation cost because, firstly, high income households have larger portfolios and can afford to pay the fixed participation cost, and secondly, the cost of information acquisition is lower for highly educated households. However, they also find that even among households with more than $100,000 of liquid assets participation in equity is below 50% and conclude that information cost must be substantial or non-economic reasons influence households' behavior. The introduction of a fixed cost of stock market participation in the model of Campbell and Viceira (2003) merely shifts stock market entry to later ages but does not fundamentally change the predictions of the model. Vissing-Jorgensen (2002) and (2003) estimates that a fixed participation cost of around 50 dollars in 2003 can explain non-participation of half the households in her sample. Andersen and Nielsen (2010) find that fixed entry and participation costs in monetary terms can account for roughly one third of non-participation in the stock market. They conclude that participation seems to be influenced by other factors like for example behavioral biases and cognitive abilities. The authors show that the probability of participation in the stock market after a windfall gain is significantly higher for educated and financially literate individuals. This is in line with other studies which find evidence that in particular individuals with lower financial knowledge and lower cognitive abilities are less likely to participate in the stock market.[6] In particular, Grinblatt et al.

[3] See Campbell and Viceira (2003).

[4] See e.g.Cocco et al. (2005), Curcuru et al. (2004).

[5] See e.g. Mankiw and Zeldes (1991), Haliassos and Bertaut (1995), and Guiso et al. (2003) for international evidence. Börsch-Supan and Essig (2003) find that only around 17% of German households directly participate in the stock market. The amount would increase when including indirect stock holdings, however, the authors argue that there is a large overlap between direct and indirect stock holders. Based on aggregate data, Ramb and Scharnagl (2010) report that the share of direct equity holdings in German households' portfolios moved around 5% since the burst of the "dot com bubble" in 2000. The fraction of mutual funds in portfolios was around 14% in recent years.

[6] See e.g. Guiso and Jappelli (2005), Calvet et al. (2007), Van Rooij et al. (2011b), Christiansen et al. (2008), Christelis et al. (2010), McArdle et al. (2009), Cole and Shastry (2009), and Grinblatt et al. (2010).

(2010) find evidence that even among the most affluent individuals higher IQ increases stock market participation. This implies that individuals with high financial literacy and high cognitive abilities face lower cost of acquiring information and thus lower participation cost than individuals who know little about financial markets and have low cognitive abilities. In addition to this, Calvet et al. (2007) suggest that individuals with low financial literacy might be aware of their weakness and stay out of risky markets to avoid investment mistakes like for example under-diversification. Furthermore, individuals who invest in the stock market have an incentive to acquire knowledge and thus participants have higher levels of financial literacy than non-participants. Moreover, McArdle et al. (2009) and Cole and Shastry (2009) propose several alternative mechanisms through which cognitive abilities and financial education could be related to financial market participation. For example, time preferences simultaneously influence the investment in education and saving behavior. Thus, it is hard to determine causality. However, for our analysis the mechanism that drives stock market participation of households is only of secondary importance. Assuming that the financial crisis was an unanticipated exogenous shock, financial losses of individuals should be closely related to stock market participation and thus, our first hypothesis on the effect of the crisis is:

Hypothesis 1: Households with higher financial literacy/cognitive abilities are more likely to hold risky assets in their portfolio (select portfolios with a higher expected return at higher risk). Thus, they are more likely to incur losses due to the financial crisis.

This point is even strengthened by the fact that individuals who invested in relatively safe assets could profit from higher returns during the crisis.

5.2.2. Under-Diversification and Other Investment Mistakes

There is a growing literature which investigates the relationship between financial investment mistakes, cognitive abilities and financial literacy. The central finding is that individuals with lower cognitive abilities and lower financial knowledge are more likely to suffer from biases and make investment mistakes.[7] Kimball and Shumway (2010) suggest that the most plausible reason is that more financially literate investors are better informed and therefore are better at managing their portfolios.

One of the most investigated deviations of investors from optimal behavior is lack of diversification.[8] In their comprehensive study of 60,000 US brokerage accounts Goetzmann

[7] See, e.g., Benjamin et al. (2006), Agarwal et al. (2009), Kimball and Shumway (2010).

[8] See, e.g., Blume and Friend (1975), Moskowitz and Vissing-Jorgensen (2002), Vissing-Jorgensen (2003), Campbell (2006), Calvet et al. (2007), Goetzmann and Kumar (2008).

and Kumar (2008) for example find that on average investors hold under-diversified portfolios. The degree of diversification increases with age, income, education, and sophistication.[9] Specifically, they find that under-diversified investors overestimate specific industries, and local stocks, and are sensitive to past returns. Thereby they earn 2.4% lower annual returns than diversified investors. Kimball and Shumway (2010) discover that financially literate investors are less likely to apply naive diversification heuristics, like the 1/n rule. Moreover, they invest fewer amounts of their assets in company stocks; and they are less frequently suffering from a home bias. Guiso and Jappelli (2008) also find that a lack of diversification is related to a lack of financial literacy. They argue that financially illiterate investors are likely to undervalue the benefits from diversification—or even ignore them altogether—and additionally have difficulties to assess the correlation between their assets' returns. Thus, individuals with high financial knowledge hold a larger number of different assets in their portfolio. Similarly Grinblatt et al. (2010) find that individuals with higher IQ invest in a larger number of different stocks and are more likely to hold mutual funds in their portfolio.

Additionally, Goetzmann and Kumar (2008) find that investors with better diversification are also better at selecting stocks with higher returns, probably also because they are better informed. The authors identify a small group of active investors who are under-diversified and perform very well—most likely a group of very well informed investors. Grinblatt et al. (2009) observe that high IQ investors on average earn 11% higher returns than low IQ investors.

If financially literate investors are better at managing their portfolios in "normal times" they most probably were also better prepared during the financial crisis. Thus, we hypothesize:

Hypothesis 2a: Conditional on stock market participation, households with higher financial literacy/cognitive abilities are better at managing their portfolios. Thus, they suffer smaller losses as a percentage of their wealth.

On the other hand, Odean (1998) argues that overconfidence leads investors to overestimate the precision of their own evaluation of signals which leads them to hold portfolios that are more risky than the portfolios of non-overconfident investors with the same degree of risk aversion. Moreover, Barber and Odean (2001) find that overconfident investors trade too much and thereby lower their returns. Furthermore, they find that men tend to be more overconfident than women with similar sophistication. If men on average hold riskier portfolios due to overconfidence compared to women, they should have incurred larger losses

[9] They define sophisticated investors as those who "trade options, engage in short-selling, and have greater investment experience"(p.435).

as a fraction of their wealth compared to their female counterparts. Therefore, we propose the following hypothesis:

Hypothesis 2b: Conditional on stock market participation, households with a male decision maker are more likely to suffer from overconfidence compared to households with female decision makers with a similar degree of financial literacy and cognitive ability. Thus, men compared to women hold riskier portfolios and incur larger losses as a percentage of their wealth.

5.2.3. Portfolio Adjustments

The German stock market lost about 40% of its value in the course of 2008. On the aggregate level a strong tendency to shift from risky to less risky assets has been observed. Many investors sold their equity in particular at the trough of the crisis in October 2008 (Bundesverband Investment und Asset Management e.V. (2009)) and thus did not only incur paper losses but realized their losses. The re-balancing behavior of households has been subject to many examinations. A variety of different rational as well as irrational reasons for active re-balancing have been examined for example by Odean (1998), Coval and Shumway (2005), Locke and Mann (2005), Massa and Simonov (2005), and Calvet et al. (2009).

In order to understand the mechanisms that were driving individuals' reactions to the financial crisis, we have to examine their motives. It is unclear if the realization of losses can be seen as a financial investment mistake from an ex ante perspective. Ex post it seems that it would have been better not to sell assets which have lost in value but rather buy assets when prices were low and profit from markets' recovery.

We differentiate between selling assets due to constraints and portfolio re-balancing caused by a change in expectations. If individuals need their funds to buffer unexpected shocks to income due to the crisis, they might have to sell assets that lost their value.

Besides smoothing consumption, households might have adjusted portfolios due to a change in expectations. Some households might have realized their losses in order to reduce their (future) tax burden. Moreover, if households had an ex ante rule to sell their stock as soon as the value dropped below a certain threshold in order to avoid suffering from a disposition effect (holding losers too long and selling winners too soon), the selling of loser stocks might have been plausible. We expect that individuals with higher financial literacy and cognitive abilities are more likely to apply these strategies.

On the other hand, if households sold their risky assets because they expected the future returns to be lower permanently, they were not well informed. Households with higher financial knowledge should have been better informed about the long-term development of

future returns and thus were more likely not to sell their risky assets. Moreover, investors might have suffered from "myopic loss aversion" (investors give high weight to losses compared to gains and evaluate their portfolios too often) as argued by Benartzi and Thaler (2007) or were influenced by an atmosphere of panic. Benartzi and Thaler (2007) as well as Duflo and Saez (2003) find that particularly unsophisticated investors are strongly influenced by peer effects. Calvet et al. (2009) examine re-balancing behavior of Swedish households and observe that in particular financially sophisticated households were less likely to exit financial markets between 1999 and 2002 when the stock market declined. Assuming that financial sophistication is related to financial literacy and cognitive abilities one would expect individuals with low financial literacy/cognitive abilities to sell loser stocks more frequently.

Thus, we end up with two competing hypotheses:

*Hypothesis 3a: Households with **higher** financial literacy/cognitive abilities are more likely to realize their losses.*

and

*Hypothesis 3b: Households with **lower** financial literacy/cognitive abilities are more likely to realize their losses.*

The empirical analysis can contribute to clarify which of the two effects prevails.

5.3. Data

5.3.1. SAVE

We use SAVE, a panel of German households that contains detailed information on households' financial situation and socio-economic as well as psychological characteristics.[10] The analysis is based on the surveys conducted in the early summer of 2007, 2008, and 2009, and we make extensive use of a special module of questions regarding the financial crisis which was added to the questionnaire in 2009. Currently there are 2,222 households in the panel.

Due to item non-response, the SAVE data set is imputed using an iterative multiple imputation procedure based on a Markov-Chain Monte-Carlo method (Schunk (2008)). The goal of this procedure is to increase the efficiency of our estimates due to a larger number of observations and to reduce the item non-response bias that occurs if observations with and without missing values differ systematically. For our analysis, all five multiple imputed data sets are used and the results are derived using Rubin's method (Rubin (1987, 1996)). In the

[10] SAVE was first conducted in 2001 by the Mannheim Research Institute for the Economics of Aging (MEA). Consecutive waves were in the field in 2003/2004, and every year since 2005. A detailed description of the scientific background, design and results of the survey can be found in Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009).

case of our explained variables (absolute and relative loss, assets sold) and key explanatory variables (financial literacy and cognitive abilities), we do not use imputed values. Thus, our sample consists of 2,012 households. The socio-demographic characteristics of the sample are provided in Table D.1 in the appendix.

All descriptive statistics are weighted and results are representative for the German population.[11] For the regression analyses no weights are used.[12]

5.3.2. Measuring Financial Losses

Reported Losses

Absolute Financial Losses. We measure losses due to the financial crisis by directly asking households. The question in SAVE 2009 was phrased in the following way: *Have you and /or your partner personally suffered losses in wealth due to the financial crisis? If yes, how high was your total loss in 2008 in Euros?*[13] At this point it is unclear if households reported paper or realized losses. However, we will elaborate on this in the course of our analysis.

About 79.5% of the households responded that they did not incur financial losses due to the crisis. 20.5% reported a loss. The average loss reported by households conditional on reporting a loss is 13,153 Euros. The median loss is 5,000 Euros. The distribution of losses is skewed to the right and is plotted in figure D.1 in the appendix. The unconditional average loss of all households in Germany is 2,562 Euros. In comparison, the average loss of German households calculated on the basis of aggregate financial account statistics of the Deutsche Bundesbank is 3,105 Euros.[14] The difference may at least partly be explained by the fact that some households have not reported paper losses.

In order to evaluate how well households estimate their losses we simulate financial losses on the basis of their portfolios at the end of 2007. We apply the approach taken by Börsch-Supan et al. (2010), i.e., we use households' portfolio composition at the end of 2007 and apply average returns of these assets during 2008. We deduct the simulated wealth level at the end of 2008 from the wealth level at the end of 2007 to obtain paper losses and gains during 2008. To construct our simulated loss variable we exclude gains as our direct question

[11] The reference statistic to calibrate weights according to income and age classes is the German Mikrozensus. For a detailed description see Börsch-Supan, Coppola, Essig, Eymann and Schunk (2009), p. 48-52.

[12] Deaton (1997) mentions that "when the sectors [sub populations] are homogeneous, OLS is more efficient, and when they are not, both estimators are inconsistent. In neither case is there an argument for weighting." (p. 70)

[13] We do not compare households' balance sheets at the end of 2007 and 2008 as the net wealth position of households can also be influenced by consumption-saving decisions and bequests, etc.

[14] Estimated on the basis of Deutsche Bundesbank (2009): Geldvermögen und Verbindlichkeiten der privaten Haushalte. Tabelle aus der Finanzierungsrechnung; http://www.bundesbank.de/statistik/statistik_wirtschaftsdaten_tabellen.php

only covered losses. According to the simulation about 29.6% of households in Germany were affected by losses in financial wealth. The difference compared to reported losses can be due to the fact that some of the households did not report their paper losses when asked directly. Furthermore, some households might be unaware of the fact that they were affected by the financial crisis. We will comment on this aspect after we introduce measures of financial literacy and cognitive abilities. The average simulated loss of households is 2,658 Euro. This is quite close to the reported average loss of 2,562 Euros.[15] Conditional on reporting a loss the average simulated loss is 10,692 Euros, i.e. the value is below the average reported loss of 13,153 Euros. We also analyze the difference between simulated and reported losses on the individual level and find that about 13% underestimate their losses and about 22% overestimate their losses. For 64% of the respondent reported and simulated losses both are zero. The deviations can be due to misreporting of the households as well as due to the imprecise estimation of simulated changes in wealth during 2008. We calculated the returns on asset classes using average returns of these assets as we do not have information of the precise composition of households' portfolios. Overall, we come to the conclusion that households on average seem to have a plausible notion of their losses during the financial crisis. We will comment on the deviation in more details below.

Relative Financial Losses. We divide financial losses by households' total financial wealth at the end of 2007. Total financial wealth is constructed using deposits held in savings accounts, building savings contracts, fixed income securities, stocks, stock mutual and real estate funds, life insurance contracts, private and employer-based pension wealth as well as other financial assets. On average households lost about 3.6% of their gross financial wealth. Conditional on suffering a loss, households lost about 18.6% of their gross financial wealth. The median loss is 9.5%. Overall, about 9.2% of the households lost more than 10% and about 1.8% lost more than half of their financial assets. The average simulated loss relative to financial wealth at the end of 2007 is 3.7% which is again quite close to the reported one.

Additionally we relate losses to total wealth. Thus, we add housing and business wealth as well as other real assets (e.g. jewelery, antiques etc.) to our financial wealth variable. Related to their total gross wealth at the end of 2007, households on average lost 1.7% of their wealth. Conditional on reporting a loss, the fraction of total wealth lost is 8.9% with a median of 2.5%. 3.8% lost a fraction of wealth higher than 10% of all assets. Less than 1% of all households lost more than half of their total wealth.

[15]The correlation of simulated and reported losses is 0.52 (p-value 0.000).

Realized Losses

As a follow up question we asked respondents: *What did you do with the assets that lost in value? We kept the assets. / We sold some of the assets. / We sold all of them.*

This question was only asked conditional on reporting a loss. Thus, 458 households gave an answer to this question. 75.2% responded that they kept the loser assets in their portfolio. Thus, these households reported paper losses. 13.2% report that they sold all of the assets that lost in value and 11.6% sold at least some of them (see Table 5.1). For the analysis conducted later on we construct a variable equal to 1 if households sold some or all of their assets.

Table 5.1.: Households' Reaction to Financial Losses

This table contains the frequency and the proportion of respondents who gave the respective answers to the question "What did you do with the assets that lost in value?" Additionally the average loss and the average fraction of wealth lost are reported.

	Freq.	Percent	Mean Loss	Fraction of Wealth Lost
I/we kept the assets	344	75.2	12196	17.4%
I/we sold some of the assets	53	11.6	23518	22.5%
I/we sold all of them	61	13.2	9187	22.5%
Total	458	100.0	13153	18.7%

Source: SAVE 2009, data is weighted.

Table 5.1 also relates the absolute and relative losses of households to their reaction. We find that the average loss of households who kept their assets is little over 12,000 Euros. The average loss of households who sold some of the assets is almost twice as large (about 23,500 Euros). However, the loss of households who sold all their assets is only around 9,000 Euros. Investors who kept their assets on average lost 17.4% of their wealth which is about 23% less than the average relative losses of investors who sold some or all of their assets and who suffered an average relative loss of 22.5%.

5.3.3. Measuring Financial Literacy

We measure financial sophistication using an "objective" —as opposed to a "subjective", i.e. self-assessed—measure of financial literacy. A set of three quiz-like questions was developed by Lusardi and Mitchell (2011b) for the Health and Retirement Study in 2004. The questions are designed to assess the fundamental skills that are at the core of individual saving and investment decisions. In the meantime, the same (or very similar) questions were included in several household surveys around the world, including the German SAVE survey. Two of the questions are classified as measuring basic financial concepts (Van Rooij et al. (2011b)). The first question concerns the understanding of interest and requires the ability to calculate.

The second question examines the understanding of the joint effects of interest and inflation. The third question is categorized as measuring advanced financial knowledge and deals with risk and diversification. The wording of the questions can be found in the appendix.

We use the answers to the financial quiz from the SAVE survey in 2007 because the financial crisis might have changed financial knowledge of households. The survey was conducted in the early summer of 2007 before the start of the financial crisis.

Finally, we define two measures of financial literacy. We construct an index taking values 0 to 3 according to the number of correct answers given by each respondent. The answers given by the respondents are displayed in Table 5.2. The second variable is a dummy, which takes the value 1 if all questions were answered correctly and 0 otherwise. In our sample 53.2% of the respondents were able to answer all three financial literacy questions correctly, whereas 46.8% had a least one incorrect answer or "do not know".[16] A comparison of these responses with results from earlier studies like Lusardi and Mitchell (2011b) and Van Rooij et al. (2011b) is difficult due to the missing "do not know" option in SAVE. We compare the answers across countries on the basis of SAVE 2009 in Chapter 2 and 3.

Table 5.2.: Financial Literacy 2007

This table contains the frequency and the proportion of respondents who were able to answer zero to three questions on the financial literacy task.

no. of correct answers	Freq.	Percent	Cum.
0	138	6.9	6.9
1	178	8.8	15.7
2	626	31.1	46.8
3	1070	53.2	100.0

Source: SAVE 2007, data is weighted according to sample weights 2009, N= 2012.

Previous analysis of financial literacy among SAVE respondents revealed that financial literacy is relatively low among women, individuals with low education, low income and individuals living in east Germany (see analyses in Chapter 2).

5.3.4. Measuring Cognitive Abilities

Cognitive abilities are measured using the cognitive reflection test (CRT) developed and tested by Frederick (2005). To our knowledge, SAVE is the first representative sample which contains this measure. The CRT consists of three quiz-like questions. All questions have an intuitive but incorrect answer and a correct answer that is a little more tricky to find. The CRT has been found to be a very efficient way to estimate cognitive abilities of

[16] In the questionnaire 2007 the interest and the inflation question did not have a "do not know" option. For this reason we treat missing answers as "do not know" and do not drop them from the sample.

individuals in questionnaires. It correlates well with more comprehensive intelligence tests. The wording of the questions can be found in the appendix.

The CRT was only introduced in the SAVE survey in 2009. However, there is no reason to assume that the crisis influenced cognitive abilities of our respondents. Thus we do not see any difficulty in using this data.

Similar to our measures of financial literacy we define a measure of cognitive abilities. We construct an index taking the values 0 to 3 corresponding to the number of correct answers given. The results can be found in Table 5.3. 43% of our respondents gave no correct answer. Around 20% gave one and 21% two correct answers. 15% of the respondents were able to answer all three questions correctly. Moreover, we construct a dummy variable which takes the value 1 if all questions were correctly answered. The percentage of individuals with three correct responses in the study by Frederick (2005) ranges between 48% (61 students at Massachusetts Institute of Technology) and 5% (138 students at the University of Toledo). On average around 17% of the participants—mostly young university students—in his samples give three correct answers.

Table 5.3.: Cognitive Reflection Test

This table contains the frequency and the proportion of respondents who were able to answer zero to three questions on the cognitive abilities task.

no. of correct answers	Freq.	Percent	Cum.
0	871	43.3	43.3
1	434	21.6	64.9
2	403	20.0	84.9
3	303	15.1	100.0

Source: SAVE 2009, data is weighted, N= 2012.

Our analysis of cognitive abilities and financial literacy reveals a significantly positive correlation (spearman rank correlation: 0.2899, p-value 0.000) between the two. In Table 5.4 we show that about 4.3% of the respondents answer none of the questions correctly and 11.2% give six correct answers. Financial literacy increases with cognitive capacity: Among those with low cognitive abilities (0 correct answers) 37% give three correct answers on the financial literacy task whereas among those with high cognitive abilities (3 correct answers) the probability of correctly answering all financial literacy questions is roughly 75%.

Table 5.4.: Financial Literacy 2007 and Cognitive Reflection Test
This table contains the relative frequency of respondents who were able to give the respective number of correct answers on the financial literacy and the cognitive abilities task.

	Financial Literacy 2007				
Cognitive Abilities	0	1	2	3	Total
0	4.5	5.6	17.0	16.2	43.3
1	1.1	1.7	6.9	11.9	21.6
2	0.9	1.1	4.2	13.8	20.0
3	0.4	0.5	3.0	11.2	15.1
Total	6.9	8.8	31.1	53.2	100.0

Source: SAVE 2007 and 2009, data is weighted, N= 2,012.

5.4. Empirical Strategies and Results

5.4.1. Who is Affected by Financial Losses Due to the Crisis?

Model to Test Hypothesis 1

In section 5.2.1 we argued that the probability of incurring a financial loss during the crisis depends on whether the household invested in risky assets, which in turn depends on factors like participation cost, income volatility, and risk preferences. In order to test *hypothesis 1* we substitute the determinants of stock market participation into the equation to estimate the loss probability. Thus, we estimate the following reduced form probit:

$$L = \beta_0 + \beta_1 z + \beta_2 w + \beta_3 k + \beta_4 c + \epsilon. \tag{5.1}$$

Where L is an indicator equal to one if a household incurred a loss, z is a vector of socio-demographic variables, w is wealth, k is financial literacy, and c is cognitive abilities. ϵ is a standard normal random error.

We proposed that households with high financial literacy/high cognitive abilities are more likely to hold risky assets in their portfolio and thus are more likely incur losses due to the financial crisis.Therefore, we expect β_3 and β_4 to be positive. The awareness of individuals of their exposure to risk during the crisis and the losses related to this might depend on the knowledge of individuals about their own financial situation which might again depend on their levels of financial literacy. However, it is unclear if individuals with lower levels of financial literacy are more likely to over- or underestimate their losses. An analysis of the deviations between reported and simulated financial losses with respect to financial literacy and cognitive abilities reveals that there are no systematic over- or under-estimations of the losses depending on abilities. Furthermore, there is no relation between financial literacy and the squared difference between simulated and reported losses, i.e. financially illiterate

households are not deviating more strongly. Thus, we do not think that our estimates are systematically biased.

Empirical Results: Model 1

In this analysis all 2,012 respondents are included. As proposed in hypothesis one, households with high financial literacy are more likely to incur losses due to the financial crisis. Bi-variate analysis reveals that 11% of the households with a respondent who was unable to answer all financial literacy questions report to be affected by a loss in wealth as a result of the financial crisis. In contrast, 29% of the respondents who answered all questions correctly report financial losses. Moreover, the fraction of households suffering from losses increases from 19% for low cognitive abilities (less than three correct answers) to almost 30% for high cognitive abilities (three correct answers).

To understand the effect of financial literacy and cognitive abilities on being affected by losses in wealth, we conduct a multivariate regression as specified in equation 5.1. The results are reported in Table 5.5.

We measure financial literacy by using a dummy variable for three correct answers to the financial literacy task and cognitive abilities by using a dummy variable for three correct answers in the cognitive abilities task. [17] Furthermore, we include financial wealth at the end of 2007, income and education as controls. These variables are used as proxies for the ability and willingness of households to incur fixed participation cost. Moreover, Campbell and Viceira (2003) argue that the participation in risky asset markets can be influenced by income risk of households. We include two variables to proxy income risk: one measure for subjective income volatility of households in the past 5 years[18] and one variable controlling for self-employment of the person answering the questionnaire. We also include a measure for risk aversion in the domain of financial matters.[19] Additionally, controls for age, living in east Germany[20] and gender are included. We find that all of our controls show the expected signs and thus, are in line with portfolio choice theory.

Our regression reveals that financially literate individuals have a more than 13% higher chance to incur a loss during the crisis compared to financially illiterate respondents (sig-

[17] All our results maintain for alternative definitions of cognitive abilities and financial literacy. More specifically, we ran regressions using variables taking values from 0 to 3 for cognitive abilities and financial literacy, respectively.

[18] The wording of the question is: "Over the past five years did your personal income fluctuate considerably, fluctuate somewhat, or not fluctuate at all?"

[19] The wording of the question is: "To what extent do the following statements apply to you? Please answer on a scale from 0 to 10, where 0 means "does not apply at all" and 10 means "applies very well". I do not mind taking risks with respect to financial matters." Dohmen et al. (2011) establish the predictive validity of this measure. We take the measure from SAVE 2008, i.e. it is measured in spring 2008.

[20] There are still substantial differences in the economic situation between the former communist and non-communist part of Germany, thus it seems appropriate to control for these structural differences.

Table 5.5.: Probit "Financial Loss"

This table reports the effect of cognitive abilities, financial literacy, and various covariates on reporting a loss due to the financial crisis. The dependent variable is a dummy that indicates if a household incurred a loss in wealth due to the financial crisis. We report marginal effects after estimating a probit evaluated at the median of all variables and the respective standard errors. Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	marginal effect	standard error
Cognitive Abilities 3 (d)	0.033	0.028
Financial Literacy 3 (d)	0.134***	0.028
Age: 35 and younger (d)	-0.019	0.036
Age: 36-50 (d)	Ref.	Ref.
Age: 51-65 (d)	0.065**	0.024
Age: 66 and older (d)	0.070**	0.026
Log financial wealth 2007	0.036***	0.007
Men (d)	-0.043**	0.023
Living in East Germany (d)	-0.001	0.024
Low level of schooling (d)	Ref.	Ref.
Intermediate schooling (d)	-0.010	0.027
High schooling (d)	0.027	0.027
Log monthly net income	0.067**	0.023
High Income Volatility (d)	0.010	0.026
Self-employed (d)	0.059	0.037
Risk Preference	0.027***	0.004
Observations	2012	
R2	0.177	

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

nificant at 1%). Therefore, hypothesis 1 is confirmed with respect to the effect of financial literacy. The effect of cognitive abilities is insignificant.

Our results are robust to a restriction on households with positive financial wealth at the end of 2007, the argument being that only households with positive wealth had something to lose. Again we find that individuals with higher financial literacy are more likely to be affected by losses in financial wealth.

5.4.2. Who Lost the Most?

Model to Test Hypothesis 2

In section 5.2.2 we proposed that households better at managing their portfolios should incur smaller losses relative to their financial wealth. The ability to manage ones portfolio in turn depends on financial knowledge and cognitive capacity. In order to test *hypothesis 2* we estimate a model of the form:

$$l = \beta_0 + \beta_1 z + \beta_2 r + \beta_3 k + \beta_4 c + \beta_5 m + \beta_6 fa + invmills + \epsilon. \tag{5.2}$$

Where $l = loss/w_{07}$ is the loss relative to wealth at the end of 2007, z is a vector of socio-demographic variables, r is a proxy for the share of risky assets in the portfolio and k and c are financial literacy and cognitive abilities, respectively. m is an indicator if the household has a male decision maker. If households know little about financial markets they might compensate for their lack or knowledge by consulting advisors. Therefore, we include an indicator fa if a household consulted a financial advisor before spring 2008.[21] ϵ is a standard normal random error.

We estimate model 2 using a Heckman two-step estimation and include the inverse mills ratio in the estimated equation. The first step is households' decision to invest in risky assets at the end of 2007. It is estimated using the model developed in the previous section (equation 5.1). We use the logarithm of financial wealth, income volatility and self-employment as exclusion restrictions. We estimate the model using three different specifications of risky financial assets as a dependent variable in the selection equation. First we use any kind of risky asset, i.e. the dependent variable of the selection equation equals one if households invested in any kind of financial wealth apart from savings accounts and contractual savings for housing. In the second specification we are more restrictive, we use a dummy equal to one if a households invested in stocks, bonds, mutual funds or other risky assets such as

[21] The measure is taken from SAVE 2008 and thus from the same questionnaire when households report their financial situation before the crisis in December 2007.

hedge funds and the like. In the third specification the dependent variable in the selection equation is a dummy indicating if households invested directly or indirectly in stocks.

We hypothesize that households with higher financial literacy/cognitive abilities are better diversified and therefore suffer smaller losses as a percentage of their wealth, i.e., we expect β_3 and β_4 to be negative. Moreover, we expect households with male decision makers to incur higher losses, i.e., β_5 should be positive.

Potential problem of truncation. Respondents in SAVE 2009 were only asked for their losses in financial wealth and not for their gains. Therefore, our dependent variable is potentially truncated. In SAVE 2010 we modified this question and instead asked respondents for their gains and losses over the last two years. A first glance at data from SAVE 2010 gives us the opportunity to estimate an upper limit of the fraction of respondents which might have reported gains when asked in 2009. The comparison of losses reported in 2009 compared to losses and gains reported in 2010 reveals a very high correlation of 0.6751 (p-value 0.000). About 1.4% of all respondents report no loss during 2008 and a gain over a two year period between 2008 and 2010. This is the maximum fraction of respondents that are subject to truncation because it also contains those households who incurred no loss during 2008 but a gain during 2009. Thus, we do not think that we have a substantial problem of truncation in our data.

Empirical Results: Model 2

The analysis of this model is restricted to households with positive financial wealth in 2007. The descriptive analysis reveals that the fraction of wealth lost is around 10.3% for individuals with little knowledge and decreases slightly for highly literate households (9.1%). The difference between the two groups is insignificant. The analysis of relative losses over levels of cognitive abilities shows that individuals with lower cognitive abilities on average lost a higher fraction of their wealth (9.8%) than individuals with higher cognitive abilities (8.1%). Again, the difference between the two groups is insignificant.

The results of a Heckman model as specified in equation 5.2 to test hypothesis 2a and 2b can be found in Table 5.6. Our dependent variable in this regression is the loss (measured in Euros) divided by financial wealth at the end of 2007.

Not surprisingly, we find that the fraction of wealth lost is higher, the higher the share of financial wealth invested in stocks, bonds or other risky assets.[22] The share invested in stocks has the largest impact on the fraction of wealth lost and is highly significant. Unfortunately we only have very broad definitions of asset classes so that not all information about individuals' portfolio composition is captured. Therefore, we add risk preferences and

[22]These variable are not included in the selection equation because for all individuals without risky assets the fractions are 0. There is no variation in these variables for the households not selected.

find a highly significant effect on the fraction of wealth lost despite our inclusion of the share of wealth invested in risky assets. Consulting financial advisors has a significantly positive effect on the fraction of wealth lost (specification II and III in Table 5.6).

Regarding the effect of financial literacy and cognitive abilities on the fraction of wealth lost, our results are not straight forward. In specification I we estimate a the fraction of wealth lost conditional on ownership of any kind of assets with a potential risk. It is the widest classification of risky assets possible. We find that financial literacy is positively associated with the fraction of wealth lost (significant at 10%). The effect of cognitive abilities on the fraction of wealth lost conditional on ownership of any kind of risky assets is negative and significant at 10%.

If we use stricter definitions of risky assets ownership for the selection equation the effect of financial literacy on the fraction of wealth lost becomes even larger and more significant. Conditional on owning bonds, stocks or other risky assets individuals with higher financial literacy incurred larger losses. Conditional on owning stocks or mutual funds we also find, that those with higher literacy incurred larger losses. The effect of cognitive abilities becomes negative and insignificant. I.e., our results do not confirm hypothesis 2a: We do not find any indication that individuals with higher cognitive abilities or financial literacy were better at managing their portfolios and lost less of their wealth during the crisis. On the contrary we find conditional on stock market participation those with higher financial literacy lose larger fractions of their wealth. The most plausible explanation is that we are not able to control for the portfolio structure sufficiently. Households with higher literacy select portfolios with higher returns at higher risk which is not completely captured by the fraction of wealth invested in stocks, bonds and other risky assets even if we control for risk preferences in addition to this.

To test hypothesis 2b we include two dummy variables to control for decision making within the household. The reference group are single female decision makers. We find no significant difference between single female or male decision makers on the size of the loss. Neither do we find a significant difference between single male or single female and joint decision makers, respectively, as proposed in hypothesis 2b.

To check if our results are influenced by the performance of households with very risky portfolios and accordingly very large losses, we conducted a sensitivity check and restricted our estimation to households with a fraction invested in stocks that is smaller than 80%, i.e. we exclude the top 5% of households with the highest share of risky investments in their portfolio. Financial literacy is still positively related to the fraction of wealth lost, but the effect is smaller and not significant. Thus, the effect of financial literacy on the fraction of wealth lost is mostly driven by few households with very risky portfolios and high literacy.

Table 5.6.: Heckman Two-Step "Loss/Wealth 2007"

This table reports coefficients and standard errors calculated after estimating a Heckman twostep model. The dependent variable of the second stage equations is defined as loss in Euro relative to financial wealth at the end of 2007 in Euro. The three specifications differ from each other by the dependent variable of the selection model: in the first specification we select households with any kind of assets which were subject to some risk during 2007, i.e. this is the widest definition of risky assets. In the second specification the selection equation is for households who own stocks, mutual funds, bonds and other kinds of risky assets such as hedge funds. The third specification uses the strictest measure of risky assets. It only selects households who report owning stocks and mutual funds at the end of 2007. Coefficients and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the omitted category if various dummies are used. We condition all models on positive financial wealth at the end of 2007; N=1650.

	I				II				III			
	Second step		first step		second step		first step		second step		first step	
	coef	se	coef	se	coef	se	coef	se	coef	se	coef	se
Cognitive Abilities (d)	-0.01*	0.01	-0.04	0.13	-0.01	0.02	-0.09	0.10	-0.01	0.02	0.09	0.10
Financial Literacy (d)	0.01*	0.01	0.16**	0.09	0.03**	0.02	0.38***	0.08	0.03**	0.02	0.33***	0.08
Age: 18-35 (d)	0.00	0.01	0.37**	0.17	-0.01	0.02	0.14	0.13	-0.01	0.02	0.15	0.13
Age: 36-50 (d)	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Age: 51-65 (d)	0.01**	0.01	-0.43***	0.12	0.04**	0.02	-0.10	0.10	0.04**	0.02	-0.13*	0.10
Age: older than 65 (d)	-0.02*	0.01	-1.27***	0.13	0.00	0.02	-0.06	0.10	-0.01	0.02	-0.20**	0.10
Share bonds	0.04*	0.03	-	-	0.05*	0.03	-	-	0.04	0.06	-	-
Share stocks and mutual funds	0.23***	0.02	-	-	0.23***	0.02	-	-	0.23***	0.03	-	-
Share other risky assets	0.16**	0.05	-	-	0.17***	0.06	-	-	0.08	0.08	-	-
Men (d)	0.00	0.01	0.12	0.11	0.00	0.01	-0.11	0.09	-0.01	0.02	-0.04	0.09
Living in east Germany (d)	-0.01	0.01	0.16*	0.11	-0.01	0.02	-0.07	0.09	0.00	0.02	-0.04	0.09
Low schooling (d)	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Intermediate schooling (d)	0.00	0.01	-0.02	0.11	0.00	0.02	0.14*	0.09	0.00	0.02	0.03	0.09
High schooling (d)	0.01	0.01	0.11	0.12	0.01	0.02	0.31***	0.10	0.01	0.02	0.20**	0.10
Log monthly net household income	-0.01	0.01	0.24***	0.09	0.00	0.01	0.03	0.08	-0.01	0.02	0.07	0.08
Risk preferences	0.00**	0.00	0.03**	0.02	0.01***	0.00	0.07***	0.01	0.01***	0.00	0.07***	0.01
Finacial Advisor (d)	0.01	0.01	0.21**	0.10	0.02**	0.01	0.41***	0.07	0.04**	0.02	0.36***	0.07
Female decision maker (d)	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.	ref.
Male decision maker (d)	-0.01	0.02	-0.24*	0.16	-0.01	0.02	0.13	0.14	-0.01	0.03	0.07	0.14
Joint decision making (d)	0.00	0.01	-0.15	0.12	-0.01	0.02	-0.02	0.11	-0.01	0.02	-0.03	0.11
Log Financial wealth 2007	-	-	0.38***	0.03	-	-	0.50***	0.04	-	-	0.39***	0.03
High income risk	-	-	0.01	0.10	-	-	-0.18**	0.09	-	-	-0.22**	0.09
Self-employment	-	-	-0.05	0.19	-	-	-0.06	0.14	-	-	-0.09	0.13
Constant	0.04	0.07	-4.32***	0.64	-0.09	0.11	-6.00***	0.60	-0.07	0.15	-5.37	0.59
Observations	1650		1650		1650		1650		1650		1650	

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

5.4.3. Who Realizes Their Loss?

Model to Test Hypothesis 3

In section 5.2.3 it was argued that different reasons might have existed to sell ones assets during the crisis and realize a loss. To investigate our competing *hypotheses 3a and 3b* we estimate a probit of the following form:

$$s = \beta_0 + \beta_1 z + \beta_2 k + \beta_3 c + \beta_4 y + \epsilon, \tag{5.3}$$

where s indicates whether the household has sold assets that lost in value, and y indicates a shock to income. All other variables are defined as before. As argued in section 5.2.3, individuals with higher financial literacy and cognitive abilities might be more or less likely to sell their assets, thus β_2 as well as β_3 can be positive or negative.

Empirical Results: Model 3

The question about the realization of losses was asked conditional on reporting a loss, i.e. only 458 households are included in the regression.[23] Descriptive analysis reveals that the fraction of households who sold their assets that lost value is 21% for highly financially literate respondents compared to 36% on average for respondents answering less than 3 questions correctly. Similarly, the percentage of households who sold at least some of their loser stocks deceases from 26% for low cognitive abilities to 21% for high cognitive abilities.

The results of probit regressions modeled as suggested in equation 5.3 are shown in Table 5.7.

Cognitive abilities as well as financial literacy have a negative effect on selling the loser stocks which is in line with the descriptive results. However, only the effect of financial literacy is significant at the 1% level. The ability to answer all financial literacy questions correctly decreases the probability to sell assets after a loss by 9.3%.

The second interesting point to notice is that individuals older than 66 are significantly more likely to sell their assets, compared to individuals between 36 and 50. The reason is probably that they were pessimistic about medium term future stock returns and have shorter future time horizons compared to younger investors. Apart from the variables we already introduced, a variable is included to take account of shocks to income and whether individuals had to sell the assets to smooth consumption. We have information if households were affected by the crisis via the labor market. Specifically we asked respondents if they

[23] In future versions of this paper a Heckman selection model should be estimated. We are currently working on improving this estimation.

Table 5.7.: Probit "Realized Loss"

This table reports the effect of cognitive abilities, financial literacy, and various covariates on selling assets during the financial crisis. The dependent variable is a dummy that indicates if households sold some or all of their assets which lost in value during the crisis. We report marginal effects after estimating a probit evaluated at the median of all variables and the respective standard errors. Marginal effects and standard errors are calculated using 5 imputed data sets and combined according to Rubin's Rule (Rubin (1987, 1996)). Cognitive abilities and financial literacy each are measured by a dummy equal to one if all questions of the respective tasks were correctly answered. (d) indicates the change of a dummy variable from 0 to 1. Ref. indicates the reference category if various dummies are used.

	marginal effects	standard errors
Cognitive Abilities 3 (d)	-0.029	0.043
Financial Literacy 3 (d)	-0.091**	0.038
Age: 35 and younger (d)	0.048	0.061
Age: 36-50 (d)	ref.	ref.
Age: 51-65 (d)	0.045	0.040
Age: 66 and older (d)	0.106***	0.040
Log financial wealth 2007	-0.007	0.007
Men (d)	0.043	0.039
East (d)	0.049	0.041
Low level of schooling (d)	ref.	ref.
Intermediate schooling (d)	0.038	0.039
High schooling (d)	-0.020	0.046
Log monthly net income	0.029	0.037
Risk preferences	-0.004	0.007
Budget limit	0.008	0.047
Unemployment due to crisis	0.060*	0.039
Observations	458	
Pseudo R2	0.048	

Source: SAVE 2007 to 2009, own calculation. * significant at 10%; ** significant at 5%; *** significant at 1%.

lost their job due to the crisis. We discover that job loss during the crisis had a positive effect on selling assets.

For households who sold at least some of the assets, there was a follow up question asking for the destination of the money:

What did you do with the money from selling the assets? We used most of it for consumption. / We transferred most of it to our checking account or other forms of assets.

The results from this analysis shows that most of the households who sold the assets did not aim at smoothing consumption. Only about 17% of the respondents consumed most of the money from the assets they sold. The majority (83%) transferred the money to other assets.

Summing up, we are able to reject hypothesis 3a according to which households with higher financial literacy are more likely to realize their losses. We find evidence that higher financial literacy is positively related to keeping the loser assets. Thus, individuals with lower financial literacy were more likely to realize their losses and leave the equity market during the crisis.

5.5. Conclusions

Our analysis of the effects of the financial crisis on households' portfolios and their reactions reveals the following results:

- On average, households in Germany do not seem to have suffered substantially from the financial crisis. Little more than 20% of households in Germany report financial losses. Mean losses are about 2,560 Euros or 3.6% of financial assets.

- Comparing reported and simulated losses reveals that households have a plausible notion of their losses during the financial crisis.

- Households with lower financial literacy and cognitive abilities are less likely to participate in risky asset markets and thus less frequently report financial losses due to the crisis. The effect of financial literacy is significant even if we control for socio-demographic differences, risk preferences and income risk. Thus, our results are consistent with the results of Calvet et al. (2007). The authors argue that financially unsophisticated households are skeptical about financial markets and thus stay out of risky assets to avoid investment mistakes.

- Contrary to the predictions derived from existing theory, households with lower financial literacy and cognitive abilities did not lose larger fractions of their wealth if they

participated in the stock market. Moreover, our indicator of overconfidence does not reveal any significant effects on the size of the loss.

- Financially illiterate households were more likely to sell the assets which lost in value during the crisis. Calvet et al. (2009) observe that financially unsophisticated households in Sweden are more likely to exit risky asset markets when incurring a loss. We confirm these findings using German household data.

However, one should not jump to conclusions too fast. Even though the effects of the financial crisis in Germany appear to be limited in the short run they can have substantial consequences in the long run. In Germany, participation in risky assets has been traditionally low but has increased slightly in recent years. Malmendier and Nagel (2011) find that past returns matter for households' participation in stock and bond markets. If the shock to financial market returns has a negative impact on financial market participation, the rising trend in stock market participation might slow down or even be reversed (we observe households leaving the stock market due to the crisis). Consequentially, there might be substantial losses in future welfare for households who leave or stay out. This might impact households' financial well-being particularly in the light of demographic transition and declining pension benefits. Mankiw and Zeldes (1991) estimate that consumption patterns of stockholders and nonstockholders differ substantially: stock holding households have overall larger volatility of consumption, but at the same time they have higher average levels of consumption. Cocco et al. (2005) estimate a welfare loss of 1.5 to 2% of annual consumption due to lack of stock market participation. We found stock market participation decisions to be related to financial literacy. Investors who avoided financial losses during the crisis by staying out might feel confirmed in their investment strategy due to the downturn. They might be even less likely to invest than before the crisis. Additionally, financially illiterate investors were more likely to leave the equity market. Thus, due to different investment strategies of financially literate and illiterate investors income inequality at old age might increase. Therefore an active policy is necessary to reestablish "trust" in financial markets and get illiterate households to participate and improve the management of their portfolios.

6. Instant Gratification and Self-Control in an Experiment with Children and Teenagers

Joint work with Carsten Schmidt

6.1. Introduction

There are many ways to make putting off unpleasant tasks—like signing an old age savings contract or starting a diet—appear to be quite rational: We hope to face less temptation after the holiday season or are waiting for free advice from a relative. However, in most cases when putting the task off one already knows that it will most likely not be more pleasant later. Nevertheless, many people postpone things up to the point where it becomes harmful, and many economists as well as psychologists have wondered how this can happen. One popular example is the study on 401(k) pension plans by Choi et al. (2002). The authors find that 68% of the individuals in their study realize that they save too little for their retirement. 24% plan to increase savings in the future but nevertheless fail to put the plan into action. Only 3% out of the 24% actually increased their savings rate four months later. Another example is the examination of gym payment plans by Della Vigna and Malmendier (2006). They discover that individuals with a monthly membership in a gym pay almost twice as much for their training compared to pay as you go rates (19$ instead of 10$). The explanation proposed for this "irrational" behavior is that individuals know that their plan to go to the gym tomorrow will fail and thus try to bind their future self by buying a monthly membership. However, they are unable to consider that the cost of the monthly membership will be irrelevant when deciding about going to the gym tomorrow. In another study on credit card borrowing Laibson et al. (2000) find that individuals pay high interest on credit card debt while at the same time holding large amounts of relatively illiquid assets.

With increasing evidence that economic behavior and decision making in general are not necessarily constant over the life-cycle[1], behavioral experiments in which children participate

[1]Neurological studies by Brown et al. (2005), Fair et al. (2007) and Fair et al. (2008) analyzing the development of brain activity of children of different ages find that neuronal control networks change substantially over age, which, in turn, may result in changes in behavior.

have become increasingly popular for studying the evolution of economic behavior. Webley and Lea (1993) and Harbaugh et al. (2001) argue that to understand adult decision making it is necessary to examine how economic socialization takes place and how choice behavior develops over age.[2] Thus, to shed light onto time consistent and inconsistent human behavior, it is crucial to know how children develop a time perspective and the ability to delay gratification. In particular, we are interested in the following questions: How does the ability to delay gratification vary over age and cognitive abilities? How does this affect time consistent and inconsistent decision making?

Time preferences have been linked to many important fields of human decision making, among them nutrition choices, health behavior (e.g. vaccination, smoking, exercising) and financial decisions. Chabris et al. (2008) provide an extensive overview of the relationship between time discounting in the laboratory and real-world behavior of individuals. Even though they find low correlations between measured discount rates and behavior in one particular situation like exercising or smoking, they provide evidence that discount rates predict aggregate behavior reasonably well. By examining the development of time preferences over age and cognitive abilities we hope to further the understanding of time consistent and inconsistent behavior and ultimately contribute to the design of policies and educational programs for children and adults. Moreover, economic models of household decision making increasingly take into account children's influence on household outcomes. Therefore, while thinking about bargaining power and preference formation within the household it is vital to improve the understanding of preferences of young household members and how their behavior might influence aggregate outcomes.

We contribute to the literature by examining children's decision making at two different points in time in a simple food choice experiment. In particular we apply a slightly modified version of the food choice experiment of Read and van Leeuwen (1998) to individuals aged between 6 and 18. We approach individuals on two consecutive days. On the first day we ask whether children prefer a healthy apple or unhealthy Smarties (small sugar-coated chocolate sweets) for consumption tomorrow. On the second day individuals have the opportunity to reconsider their choice for immediate consumption. Thereby, we can detect age effects in decision making as well as the effect of cognitive abilities within the age groups and how they

[2] Webley (2005) provides a review of the development of children's understanding of economic concepts and their economic behavior. Most of the experimental economic studies analyze the behavior of children in interactive contexts, popular examples are the studies on ultimatum bargaining by Murnighan and Saxon (1998) as well as Harbaugh et al. (2007), on trust and trustworthiness by Sutter and Kocher (2007), on fairness and pro-social behavior byHouser and Schunk (2009) and Sutter (2007). Few studies analyze individual decision making of children. Harbaugh et al. (2001) for example examine the rationality of individual choices of children between 7 and 11 and find that older children violate the generalized axiom of revealed preference less frequently than younger children. Bettinger and Slonim (2007) arrive at similar conclusions and additionally find that older children are more patient.

influence time consistent and inconsistent behavior. In contrast to existing literature dealing with changing discount rates over the life-cycle (e.g. Green et al. (1994, 1996, 1999), Read and Read (2004)) we do not ask for preferences between (hypothetical) monetary pay-offs but offer real pay-offs in terms of Smarties and apples. Our experiment is closely related to the study by Bettinger and Slonim (2007). Contrary to their design of offering Toys'R'Us gift certificates as payout, our design allows for the observation of choice in a situation that is very familiar to the children (food-choice) and there is only a marginal lag between the payout of the reward and its consumption in our experiment. Our study can on the one hand be seen as a robustness check of their result and on the other hand as an extension to a different area of decision making.

The remainder of this paper is organized as follows. In section 6.2 we develop our hypotheses based on the existing literature on self-control and discounting. Section 6.3 describes the participants and the experimental design. In section 6.4 we report our results before discussing them in section 6.5. We conclude in section 6.6.

6.2. Literature and Hypotheses

The most widely used economic model to describe decision making over time is the discounted utility (DU) model by Samuelson (1937). It assumes that a discount rate can be used to substitute between future utility and today's utility. Many of the axioms that form the basis of the DU model have been questioned with regard to their empirical validity, but still most attempts to describe human behavior over time are modifications of Samuelson's basic framework. Frederick et al. (2002) provide a comprehensive overview of the theoretical and empirical economic literature on time preferences. Some of the biggest empirical puzzles and challenges to the DU model of human behavior over time are raised by preference reversal or time inconsistency as in the examples mentioned above. A potential alternative to the DU framework which resolves many of these issues is hyperbolic discounting, first formulated in Strotz (1955-56). Unlike in Samuelson's model, individuals do not use the same discount rate for all future periods. Instead, more distant future periods are discounted at a lower rate (weaker discounting) than the more immediate future, which is discounted more strongly. Within this framework Strotz as well as Pollack (1968) distinguish between two kinds of individuals, the naïves and the sophisticated. Naïve individuals postpone unpleasant activities, while being convinced that they will carry them out later (i.e. they are ignorant about the changes in the discount rates over time). Sophisticated individuals anticipate the changes in discounting, thus they are aware of their weakness and tendency to postpone. They may therefore try to find mechanisms to bindingly commit their future self to carry out decisions perceived to be beneficial at the earlier point in time. Based on these contributions,

Laibson (1997, 1998) develops a simple model of present-biased preferences, also known as quasi-hyperbolic discounting or $\beta\delta$-framework, to explain inconsistencies arising in the context of inter-temporal choice. This specification of the utility function has provided good fit to experimental and empirical data[3] and has also been examined neuro-economically.[4]

Preference reversals occur when individuals plan to do one thing tomorrow but, when faced with the decision for immediate consumption, change their mind and choose the opposite. Such reversals are at odds with forward-looking agents in standard economic theory. Read and van Leeuwen (1998) find that these reversals occur on the one hand due to intrapersonal empathy gaps, i.e. the inability of individuals to make a decision considering future preferences without heavily weighting their current preferences (also referred to as state of arousal). On the other hand, they may be due to quasi-hyperbolic discounting. In this experiment we are particularly interested in preference reversal due to quasi-hyperbolic discounting while holding states of arousal constant. Therefore, we examine individuals at roughly the same point in time on each day (if possible after the first school break) and additionally control for food intake of that day and the self-reported intensity of hunger in order to be able to control for changes in individuals' states.

In order to analyze dynamic inconsistency, Read and van Leeuwen (1998) define goods relative to each other as "virtues" and "vices". Virtues compared to vices yield higher utility in the long run and lower utility in the short term. This means that the opportunity cost of choosing a virtue is relatively low and comes into effect immediately while the opportunity cost of a vice is relatively high and occurs late in time. Based on the model of quasi-hyperbolic discounting Read and van Leeuwen (1998) state that if individuals put higher weight on immediate than on future utility, the food choice of individuals should reflect this. Mirroring these considerations, in our choice experiment a healthy snack (apple) is a virtue relative to the unhealthy snack (smarties). Therefore, we expect a higher choice of healthy snacks for delayed than for immediate consumption:

$$\text{H1: } Prob_F(apple) > Prob_I(apple),$$

where $Prob_F(apple)$ is the probability to choose an apple for future consumption and $Prob_I(apple)$ is the probability to choose an apple for immediate consumption.

[3] See for example Angeletos et al. (2001), Laibson et al. (2000), O'Donoghue and Rabin (1999).

[4] For a review of neuroeconomical studies see Camerer et al. (2005), Loewenstein et al. (2008). McClure et al. (2004) and McClure et al. (2007) find that two separate neural systems may be involved when people make decisions regarding immediate versus future monetary payoffs (or real payoffs in terms of water or juice, as well as gift certificates). In contrast to this, Kable and Glimcher (2007) and Glimcher et al. (2007) find no neurological evidence for distinct β- and δ-discounting. Instead they argue for a single system in charge of these processes. Hare et al. (2009) find evidence that self-control is related to activities in two different brain regions.

Becker and Mulligan (1997) argue that individuals can exert effort to evaluate the payoffs in future time periods. As younger individuals have higher incentives to invest into improved imagination, a u-shaped pattern of time discounting over age emerges. The older people are, the more investments they have accumulated, but at some point the limited remaining life-span dominates this effect as it induces individuals to prefer instant gratification. Empirical economic studies examining the development of discount rates for individuals of different ages indicate that the valuation of payoffs in future time periods is indeed not constant but changes over the life cycle (for example Green et al. (1994, 1996, 1999), Read and Read (2004)). Most of the authors that estimate discount factors for individuals of different ages using data from experiments find that discounting does decrease with increasing age at least until adulthood.[5] Furthermore, Mischel and Metzner (1962) and Mischel et al. (1989) find that self-control and patience develop with age. The ability to resist temptation increases when children's cognitive abilities improve and a "time feeling" develops. Thus according to these studies, preference for delayed rewards is a function of age, intelligence and the length of the delay interval. They find a strong relationship between the preference for delayed reward (larger chocolate bar) and age as well as a less strong but significant relationship with intelligence. Furthermore, the authors find evidence that individuals who are better at delaying gratification tend to have more realistic estimates of future events. In a second experiment Mischel et al. (1989) examine the strategies applied by children to resist temptation and find that older children are better at finding successful delaying strategies. Additionally, they discover that better delayers have better scholastic aptitude test (SAT) scores ten years later and are evaluated as having higher social and cognitive abilities. Similar relations between patience and cognitive abilities were found by Mischel et al. (1988, 1990) and Kirby et al. (2005). Bettinger and Slonim (2007) identify that rationality (defined as time consistent behavior) as well as patience in an intertemporal choice experiment increases with age and achievement in a test of mathematical ability. Webley et al. (1991), Furnham (1999) and Otto et al. (2006) examine children's savings behavior (partly in play economies, i.e. games within an economic setting). The overall result is that older children apply successful saving/waiting strategies, avoid temptation and reach targets more frequently than younger children.

In line with the existing literature young children are expected to discount strongly and therefore have higher preferences for instant gratification. With increasing age and cognition the valuation of future time periods increases, i.e. individuals discount less. Therefore, we expect that with increasing age and cognitive abilities the proportion of individuals that choose chocolate when deciding for tomorrow should decrease, i.e. the probability to choose the apple for tomorrow should increase as individuals learn to take future time periods into

[5]Discount rates might increase again at old age due to declines in life-expectancy.

account.[6]

$$\text{H2: } Prob_F(apple|cohort1) < Prob_F(apple|cohort2) < \text{etc.},$$

where *cohort 1* is younger (H2a) or has lower cognitive abilities (H2b) than *cohort 2*.

Moreover, Becker and Mulligan (1997) point out that time discounting of children could change with parental wealth as richer households have more resources to invest into future-oriented capital, i.e. "wealth causes patience" and not vice versa. Thus, we propose H2c as above, where *cohort 2* has richer parents than *cohort 1*. As parents could spend their own time instead of wealth on the education of their offspring, children's patience can also increase with the parental level of education (H2d).

The argument above holds equally for immediate choice. Thus, with increasing age (H3a), cognitive abilities (H3b) and parental wealth and education (H3c and H3d) the proportion of individuals choosing instant gratification when deciding immediately should decrease and therefore the probability to choose the apple for current consumption should increase.

$$\text{H3: } Prob_I(apple|cohort1) < Prob_I(apple|cohort2) < \text{etc.},$$

In the (quasi-) hyperbolic discounting framework it is relatively easy to make good decisions for future selves (I can always plan to eat healthy food or go to the gym tomorrow). The hard part is to stick with the choice. If the first step of individuals is to realize that it would be better to eat healthy tomorrow and the harder second step is to actually do so, we expect differences in the choice structures over age and cognitive abilities. In other words, we expect that the speeds with which the ability to be far-sighted (choose the apple for tomorrow) and the ability to stick with the choice (choose the apple also for immediate consumption) develop are different. The pattern of choice that should emerge is that the majority of young children will be time consistent and myopic. These kids will always select highest instant gratification ("chocolate-choosers"). With increasing age and cognition the ability to delay rewards as well as the valuation of future time periods increases. Therefore, time inconsistent behavior emerges because it is more difficult to exert self-control in immediate than in future choices. Children will choose the apple for future consumption, however when it comes to picking for now they will prefer chocolate, i.e. there is a high amount of "switchers". Furthermore, the amount of time consistent "apple-choosers" rises with age and cognitive abilities. Expressed more formally this means that:

$$\text{H4: } Prob_I(switching|cohort1) > Prob_I(switching|cohort2) > \text{etc.},$$

[6] We are aware of the fact that the same pattern of preferences will be observed if the taste for sweets changes over age. We will discuss this point in the conclusion.

where *switching* is the decision to take chocolate for immediate consumption *given that* the individual has chosen the apple on the day before. Again *cohort 1* can be younger (H4a), have lower cognitive abilities (H4b) or have less wealthy and less educated parents (H4c and H4d) compared to *cohort 2*.

In addition to this Read and van Leeuwen (1998) find that women and men significantly differ in their choice pattern. Women choose fewer (or at least not more) unhealthy snacks for future consumption than men. However, they choose significantly more unhealthy snacks when deciding for current consumption. In contrast to this, Bettinger and Slonim (2007) find that boys are less patient than girls, but in their experiment there was a substantial time lag between receiving and consuming the pay-off. Accordingly, we expect our pattern of future choices for boys and girls to be similar to the results of Read and van Leeuwen (1998); i.e. choices for future consumption of boys and girls should be similar but we expect a higher preference for the unhealthy snack by girls when choosing for current consumption.

$$\text{H5: } Prob_F(apple|female) = Prob_F(apple|male) \text{ and}$$
$$Prob_I(switching|female) > Prob_I(switching|male)$$

6.3. Methodology

6.3.1. Participants

We conducted the experiment with pupils in four schools in Germany between May and July 2008. Two of the schools were located in the state Baden-Württemberg (one primary school and one high-school ("Gymnasium")) and two in Rhineland-Palatinate (one primary and upper secondary school and one high-school ("Gymnasium")). We obtained the permission to conduct the experiment from the headmasters of the schools as well as the parents of pupils in advance. Data of 244 pupils from age 6 to 18 was collected, 133 of them were female and 111 male. In total we visited 12 classes and collected data from two 1st (age 6-7), 3rd (age 8-9) and three 6th (age 11-12) and 9th (age 14-15) as well as two 12th (age 17-18) grade classes. Table 6.1 contains the population statistics.

6.3.2. Experimental Design

Procedure

The choice experiments are designed in a one-to-one, face-to-face procedure[7] on two consecutive days at approximately the same time of day. On day one we ask the pupils for their

[7]For exemplary designs of experiments in which children participate as subjects see Houser and Schunk (2009) and Häger et al. (2010). The exact wording of our experiment is contained in the appendix.

Table 6.1.: Sample Statistics

This table contains summary statistics—mean (m) and standard deviation (std)—for the respondents in our sample.

	all		**Age 6-7**		**Age 8-9**		**Age 11-12**		**Age 14-15**		**Age 17-18**	
	m	std	m	std	m	std	m	std	m	std	m	std
Female	0.55	0.50	0.49	0.51	0.53	0.50	0.57	0.50	0.52	0.50	0.65	0.49
Hungry (Day 1)	0.94	1.01	0.35	0.82	1.18	1.11	1.28	0.99	0.95	0.92	0.81	0.94
Hungry (Day 2)	1.11	0.95	0.63	0.80	1.17	1.12	1.26	0.85	1.11	0.93	1.50	0.91
Math	2.58	0.98	-	-	2.05	0.79	2.80	0.96	2.59	1.00	2.86	0.97
German	2.64	0.88	-	-	2.24	0.74	2.94	0.82	2.69	0.90	2.44	0.95
Parental Wealth	2.14	0.49	-	-	1.90	0.58	2.11	0.46	2.28	0.41	2.26	0.42
Parental Education	4.31	1.29	-	-	4.00	1.31	4.24	1.41	4.37	1.26	4.85	0.83
No. of classes	12		2		2		3		3		2	
N	244		47		43		65		63		26	

future choice, i.e. what they prefer for the following day. On day two when the payoff period for the future choice comes into effect we ask pupils for their immediate choice. Thus, they are given the opportunity to change their mind and decide on their immediate consumption without being reminded of and restricted by their previous choice. The experimental protocol can be found in appendix E.1.

On the first day the pupils are introduced to the experiment, they fill in a questionnaire concerning their age, sex, and the food intake of the day as well as several background variables like parental wealth and grades in the last report card and a personal code.[8] We will explain the variables in greater detail in section 6.3.3. The questionnaire is placed in an envelope and sealed. After that the teacher continues with the regular class and pupils leave the classroom one by one to meet the experimenter. The experimenter is seated behind a table where one of each of the food items is displayed. The experimenter asks the pupil individually whether she prefers an apple or Smarties on the following day.[9] The decision is written on the sealed envelope. After that, the pupil goes back into the classroom. Pupils are requested not to communicate with their classmates when they go back. A second experimenter staying in the classroom during the experiment enforces this when necessary.

On the second day, pupils fill in a questionnaire asking for the food intake of the second day and the same personal code. The questionnaire is placed in an envelope and sealed. Again the pupils meet the experimenter one by one, while class continues. The experimenter on day two is always a different person than the day before in order to credibly assure that the

[8] The personal code allows us to match the questionnaires and decisions on the two days without being able to connect them to an individual pupil. There is a slightly modified procedure for the first graders as they cannot answer the written questionnaire in any reasonable time. We ask them about their hunger and food items in their lunch bags etc. face to face. We do not obtain information on their parental background and grades because they are not graded yet.

[9] The order of the food items in the question asked by the experimenter is randomly switched and noted for each individual. We add this as a control in our regressions.

experimenter does not know the pupil's prior decision. Again, the groceries are displayed on a table and the experimenter asks the pupil whether she wants an apple or Smarties now. The experimenter points out that pupils are not bound to stick to the decision they took the previous day. In addition to that, a basket containing many apples and Smarties packages is displayed in the background on day two to show that there is no shortage of snacks if pupils change their mind. As soon as the individuals make their choice the snack is given to them. In order to not disturb teaching the pay-off is placed in a paper bag, such that other participants cannot observe it when the pupil goes back into the classroom.[10] Pupils are asked to wait with the consumption until all pupils finished the experiment. The consumption delay is no longer than 15 to 20 minutes at most.

Choice

Smarties count as vices compared to apples: they give high immediate pleasure due to high calories, high sugar, the chocolate taste and an appealing appearance. However, they are associated with long-term cost like weight problems, coronal heart disease, bad teeth, etc. Their image as being unhealthy is in line with our pretest results (see Table 6.2).[11] Compared to Smarties, apples are reckoned as virtues. They give less immediate pleasure due to their lower calorie level and are less sweet, but they are associated with low long-term cost. The healthiness of apples is a common perception as shown by our pretest results. Details on the "objective" and "subjective" characteristics of the alternatives are displayed in Table 6.2. Apples and smarties are selected as most healthy and most unhealthy, respectively, by our pretest group of 39 individuals (see Figure E.2 in the appendix).

6.3.3. Additional Variables

Before the contact with the experimenter on each day, individuals are asked to fill in a short paper and pencil questionnaire in class. It is handed to the experimenter when pupils meet him/her individually.[12] In this questionnaire we ask for variables like age and sex. In addition to that several questions related to hunger and the food intake of the day as well as the food in the lunch box are asked. A list of the questions and variables constructed is contained in the appendix. Hunger is measured on a scale form 'very hungry' to 'not hungry at all' on both days. To estimate the difference in hunger between the two days we construct

[10] In fact, many of the pupils held the bag behind their back when they entered the class in addition to this.

[11] See appendix E.2 for details on the pretest. Houser and Schunk (2009) as well as Murnighan and Saxon (1998) use yellow M&Ms as pay off in experiments with children. However, our pretest reveals that people perceive yellow M&Ms, which contain peanuts, not as unhealthy as Smarties (see Figure E.1). In order to avoid subject confusion about the type of M&Ms we use Smarties, which are similar to the brown M&Ms.

[12] The questions asked on both days are contained in appendix E.3.

Table 6.2.: Choice Alternatives

This table describes the alternatives participants could select on both days.

	Apple	Smarties
Weight	140 g	38 g
Price	0.30 Euro/apple	0.35 Euro/Smarties snack
Objective measure of healthiness	Low calorie: ca. 80 kcal	High calorie: ca. 174 kcal
	Low fat: ca. 0.6 g	High fat: 8 g
Subjective measure of healthiness*	Mean: 9.36	Mean: 2.49
	SD: 0.87	SD: 1.23
	Min: 7	Min: 1
	Max: 10	Max: 6

* Pretest score (on a scale of 1 to 10, where 10–very healthy, 1–very unhealthy) . Pretests are described in the appendix.

two dummy variables. The first one (less hungry) takes the value one if pupils indicate a lower value compared to the first day. Similarly the second dummy (more hungry) takes the value one if pupils indicate a higher value on the second day compared to the first.

Moreover, we collect data on pupils' skill levels by asking for their grades in math and German in the last report card. Grades have been used in previous experiments to measure differences in cognitive abilities among students. Houser and Schunk (2009) find a correlation between performance in math (math grade) and the amount of M&Ms sent in a dictator game. They relate this to the fact that cognitive abilities are relevant in many economic decision making contexts (e.g. Frederick (2005), Rydval and Ortmann (2004)). In Germany school grades are measured on a scale from 1–very good to 6–insufficient. From this information we constructed two dummies: 'math good' takes the value one if a pupil has a better grade than the average of the pupils of the same age and 'language good' indicates if the pupil was better than average in German.

To control for a variation in family background that might influence students' preferences and their cognitive development we include two items from the OECD's Program for International Student Assessment (PISA) 2000 questionnaire. The first item is related to the educational background and asks for an estimate of the number of books at home. Students were given some help in doing this estimation. After some calculation they had to indicate on a scale how many books their parents approximately have at home. We constructed a variable equal to 1 if parents own more than 250 books.[13] The second item focuses on parental wealth by asking for the number of mobile phones, televisions, calculators, computers, music instruments, cars and bathrooms of the students' families.[14] Pupils could answer on a scale from 0–none to 3–three or more. We calculated a mean level of wealth by averaging over all seven items. In addition, we collect data on school type, class subject, time and date of the

[13] We played around with different cutoff values and our results do not change.

[14] For a discussion of these items in the context of PISA see Kunter et al. (2002): Item 1 "Besitz an Büchern" (p.244), Item 2 "Vorhandene Menge bestimmter Wohlstands- und Kulturgüter" (p.243).

experiment as well as outside temperature.

6.4. Empirical Results

6.4.1. Revealed Preferences for Future and Immediate Consumption

The respective choices on the first and on the second day are displayed in Table 6.3. About 57% of the pupils prefer an apple and 43% prefer Smarties for tomorrow's consumption (rows). However, for immediate consumption pupils choose apples and Smarties with equal probability (columns). Thus, as proposed by *hypothesis 1* and in line with the results of Read and van Leeuwen (1998), we find that pupils are more likely to choose the healthy snack for future consumption compared to the unhealthy snack. Moreover, they are more likely to switch from healthy to unhealthy when selecting a snack for immediate consumption than vice versa. Symmetry of the choice reversal is rejected at the 5% significance level (p=0.022).

Table 6.3.: Revealed Preferences for Immediate and Future Consumption
This table contains the choices pupils made on both days. The cells contain the pattern of time consitent and inconsistent choices. The last column describes choices made on the first day for consumption tomorrow. The last row contains choices made for immediate consumption on the second day. The symmetry of the choice reversal is rejected at 5% significance (p=0.022) by a McNemar test.

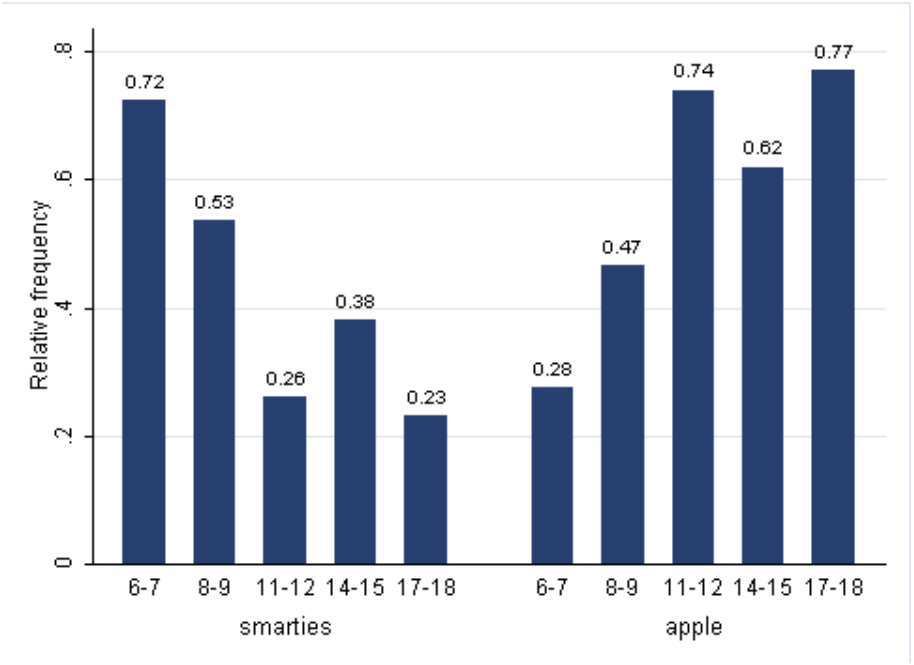
		Immediate consumption (day 2)		
		Unhealthy snack	Healthy snack	Total
Future consumption (day 1)	Unhealthy snack	85 (34.5%)	19 (7.8%)	104 (42.6%)
	Healthy snack	37 (15.2%)	103 (42.2%)	140 (57.4%)
	Total	122 (50%)	122 (50%)	244 (100%)

6.4.2. Who Chooses Healthy for the Future?

The analysis of choice for future consumption over age reveals that among the first graders about 28% choose the apple for tomorrow, whereas 77% of the 12th graders choose healthy for tomorrow (see Figure 6.1). This difference persists in the multivariate analysis of future choice. We conduct probit regressions, where the dependent variable equals one if the individuals select an apple for tomorrow (see Table 6.4).

In line with *hypothesis 2a* we find an overall positive and significant effect of belonging to an older age group on choosing an apple for tomorrow (model 0). Including individual dummies for all age groups reveals no significant differences in the choices between first and third graders (model 1). However, compared to the third graders, sixth, ninth and twelfth graders are all significantly more likely to choose the apple. We conducted one-sided χ^2–tests

Figure 6.1.: Choice for Future Consumption over Age



This figure displays the relative frequencies of choosing Smarties and apples for consumption tomorrow, i.e. choice on day 1, over age for all participants (n=244).

to compare the marginal effects of the other age-groups. We find that there are no significant differences in the probability to choose the apple between the sixth and the twelfth as well as the ninth and the twelfth graders, respectively. Surprisingly, compared to the ninth graders the sixth graders are more likely to choose the apple. In these regressions we also control for the self-reported state of arousal ("hungry"), gender, and whether the apple was mentioned first. Mentioning the apple first has a weakly significant negative effect (at 10% significance) on choosing the apple for tomorrow in the first specification (model 0), but the effect is not robust to including dummies for the age groups. Moreover, when choosing for tomorrow no significant difference between male and female individuals can be detected (*hypothesis 5*).[15]

In models 2 and 3 controls for cognitive abilities (math grade in the last report card) and parental background (education and wealth) are added. As we do not have information on cognitive abilities and parental background for first graders the number of observations is lower in these regressions. The first remarkable result is that including additional variables does not substantially change the age effect. Secondly, in contrast to our *hypothesis 2b* cognitive abilities turn out to have no overall significant effect on children's choices for the future (model 2). And finally, we can not detect any influence of parental wealth or education

[15] We also run separate regressions for girls and boys. The age effects we detect are very similar across gender. Additionally, we ran all regressions excluding the 12th graders, because there is some selection into 12th grade on the basis of cognitive abilities. Overall, our results persist when excluding this age-group.

(*hypothesis 2c* and *2d*) on children's food selection.

To investigate the effects of age and cognitive abilities in more detail we include interaction terms between math grade and the cohort dummies (model 3). The interaction effects should reveal whether cognitive abilities play a role for future choices within certain age groups. When interaction terms are included, the age-dummies hardly change. Moreover, we do not find any effect of cognitive abilities in the youngest and the oldest age group. Among the sixth graders pupils with above average math abilities are more likely to pick the apple, however among the ninth graders the opposite is the case. Thus, with respect to our *hypothesis 2b* we find that there is no clear positive effect of cognitive abilities for children of a particular age on the probability of choosing the apple for tomorrow.[16]

6.4.3. Who Chooses Healthy for Now?

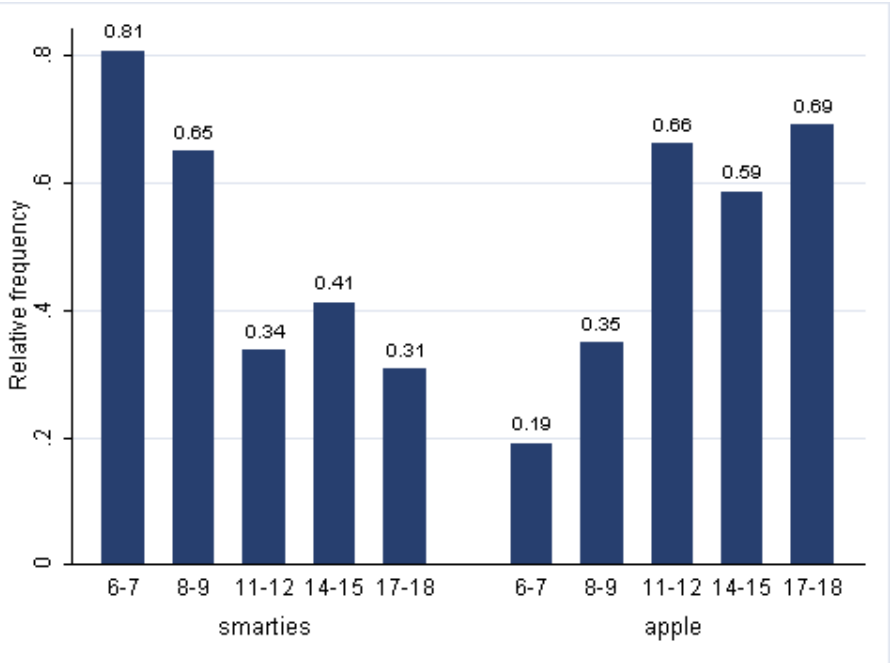
In *hypothesis 3* we propose that the effects of age and cognitive abilities on the choice of an apple largely apply in the same manner for immediate and future consumption. Figure 6.2 indicates that the propensity to choose the apple for immediate consumption increases with age. Regression results are displayed in Table E.4 in the appendix. We find that older individuals are significantly more likely to choose the apple for immediate consumption. Compared to our previous analysis cognitive abilities in terms of math or German grade grade show a positive effect on choosing the apple here (at 5% significance). Moreover, parental wealth increases the probability to pick an apple for immediate consumption (at 10% significance). Apart from that we find that girls are significantly less likely to choose the apple for immediate consumption which is in line with *hypothesis 5*. We omit a detailed discussion of these results as the more interesting question concerns the immediate choice conditional on the choice on the previous day.

Figure 6.3 displays the frequency of all choice combinations on day 1 and day 2. The top panels show that the frequency of consistently choosing chocolate decreases over age whereas the likelihood to select an apple on the first day and stick with it increases with age. The two bottom panels show the inconsistent choices. The frequencies of switching from apple to chocolate and vice versa are hump-shaped over the age groups. However, there are more individuals changing their choice from apple to chocolate than the other way round at all ages.

We are particularly interested in the determinants of selecting chocolate for immediate consumption when the apple was chosen on the day before. Therefore, we condition the following analysis on the individuals that choose an apple on the first day (see figure 6.4).

[16] We conduct the same regressions using the German grade instead of the math grade. Overall, the results remain similar. For girls we find that better language abilities have a positive and significant effect on selecting an apple for tomorrow's consumption.

Figure 6.2.: Choice for Immediate Consumption over Age



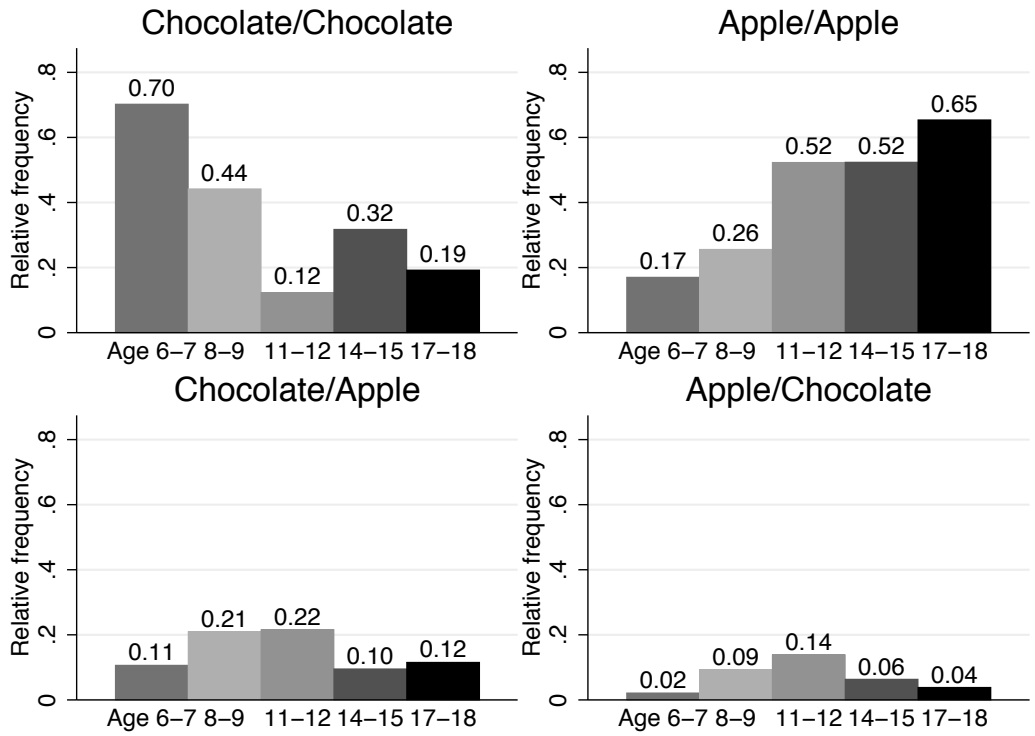
This figure displays the relative frequencies of choosing Smarties and apples for immediate consumption, i.e. choice on day 2, over age for all participants (n=244).

In the first and the third grade there is the largest share of pupils who change their mind. Specifically, among the 6 and 7 year old 38% of the kids that choose an apple for the future change their mind and prefer chocolate when selecting for immediate consumption. Among the 8 and 9 year old 45% change their mind. In contrast to this, only 15% of the older individuals (14/15 and 17/18 year old) switch from apple to chocolate on the second day.

We conduct probit regressions to single out the determinants of the second day choice in more detail. The dependent variable here is a dummy which is equal to one if individuals choose chocolate on the second day conditional on the choice of an apple on the previous day (Table 6.5). As proposed in *hypothesis 4a*, there is a significant negative effect of age on switching, i.e. younger individuals are less likely to stick with their choice of an apple on the second day, even when controlling for changes in the self-reported state of hunger between the first and the second day (model 0).[17] Using dummies for all age groups (model 1) shows that the probability of switching is highest among the third graders. The first graders as well as the older pupils are more likely to stick with their choice compared to individuals at age 8/9. The negative effect for the first graders compared to the third graders is a little surprising. However, this effect might be due to the fact that few pupils in the first grade choose an apple for tomorrow. And the ones that do so might have strong preferences

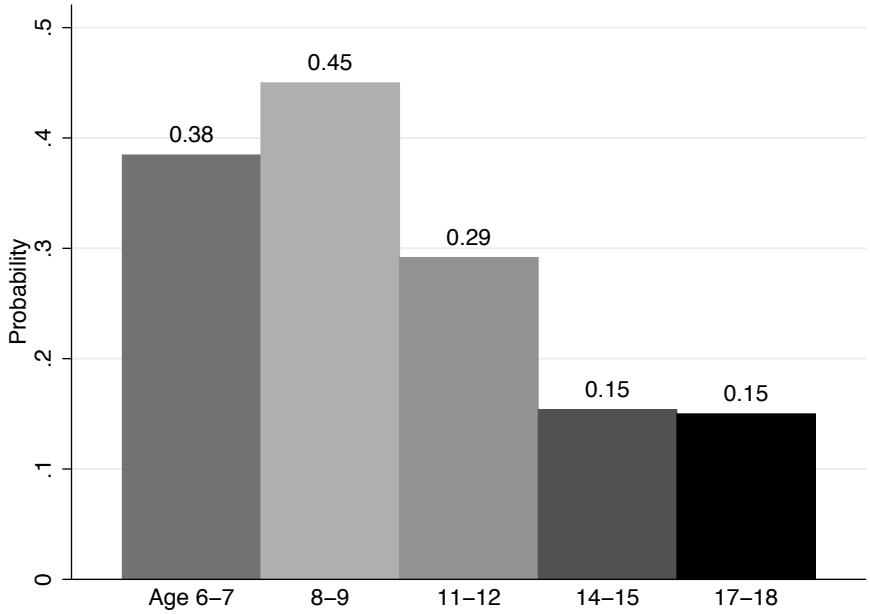
[17] For a more detailed discussion of preference reversals due to hot-cold-empathy gaps see Read and van Leeuwen (1998).

Figure 6.3.: Time Consistent and Inconsistent Choices



In this figure the relative frequencies of choice combinations over age are depicted for all participants (N=244). Top Panel Left: Immediate choice of Smarties conditional on choice of Smarties for future consumption; Top Panel Right: Immediate choice of apple conditional on choice of apple for future consumption; Bottom Panel Left: Immediate choice of Smarties conditional on choice of apple for future consumption; Bottom Panel Right: Immediate choice of an apple conditional on choice of Smarties for future consumption.

Figure 6.4.: Smarties for Immediate Consumption Conditional on Choice of an Apple for Future Consumption



This figure displays the relative frequencies of choosing Smarties for immediate consumption on the second day conditional on selection of an apple for future consumption on the first day over age (n=140).

for the apple and thus are less likely to switch compared to the third graders. Again we conducted one-sided χ^2-tests to determine if the differences between the older age-groups are significant. Pupils aged 14 to 15 and 17 to 18 are significantly less likely to switch from apple to chocolate compared to all younger age groups. Between the two oldest cohorts there is no significant difference in the probability of switching. In line with the findings of Read and van Leeuwen (1998) and our *hypothesis 5*, girls tend to change their mind more often (24 of the 37 individuals switching from apple to smarties are female, 13 are male). They have a higher probability of choosing chocolate on the second day conditional on selecting the apple before.

In models 2 and 3 we add controls for cognitive abilities and parental background. Again first graders are omitted. As proposed in *hypothesis 4b* the math grade turns out to have a weakly significant (at 10%) negative effect on switching (model 2).[18] The results regarding parental background are mixed. Consistent with *hypothesis 4c*, there is a negative effect of parental wealth on selecting chocolate on the second day when the first choice is an apple (significant at 5%). However, we find no significant effect of parental education on the likelihood to change one's mind (*hypothesis 4d*).

[18] German grade turns out to have no significant effect on the children's conditional food choice on the second day.

As in the previous analysis we add interaction effects between age and cognitive abilities (model 3). The analysis reveals a surprising effect of cognitive abilities on the probability of switching. Among the oldest participants all pupils with good math sticked with the apple (therefore this variable is dropped from the estimation because it predicts failure perfectly.) which is in line with *hypothesis 4b*. However, among the 11 to 12 and 14 to 15 year old being good in math increases the probability of switching. This result is in contrast to *hypothesis 4b*.[19]

What determines the switching from Smarties to apples? Similarly to our previous analysis we estimate probit models where the selection of an apple on the second day is the dependent variable. We condition on a choice of Smarties on the previous day. Our results reveal no overall age effect (model 0 in Table E.5 in the appendix). When adding cohort dummies (model 1) we find that individuals in the sixth grade are significantly more likely to switch from chocolate to apple than the third graders. First graders are significantly less likely to change their mind in this direction compared to third graders. However, there are no effects for the older individuals. Interestingly, parental education measured by the number of books at home is significantly negatively related to switching from Smarties to apple.

6.5. Discussion

Our experimental design allows for the simultaneous observation of long-term oriented behavior and instant gratification by giving the same individuals the opportunity to choose between healthy and unhealthy snacks on two consecutive days. Thus, we contribute to the economic as well as the psychological literature on instant gratification, and intertemporal decision making.

Overall, a large share of individuals in our experiment behaves in a manner that can be considered time consistent. The pattern of choices we observe is substantially more stable than the choice pattern detected by Read and van Leeuwen (1998). This is probably due to our slightly modified design: First of all we tried to keep states of arousal constant, i.e. we approached kids approximately at the same point in time on each day. Secondly, we restricted our choice to two food items only (one healthy and one unhealthy) in order to simplify the choice. Nevertheless, we confirm previous results of time inconsistent behavior. More individuals choose the healthy alternative for the future, however when it comes to selecting food for immediate consumption, individuals are prone to changing their mind and prefer the unhealthy alternative *(hypothesis 1)*.

With regard to age we find that older individuals are more likely to choose the healthy

[19] When using German grade effects are the same.

snack for the future and at the same time they are more likely to stick with their original decision *(hypothesis 2a and 4a)*. Thus, older individuals are both better at planning for the future and at resisting temptation. We find the largest differences in the probability to select the apple for the future between the third and the sixth graders, i.e. at the onset of puberty pupils seem to become better at planning for the future. However, when it comes to sticking with their choice, we find that the third and the sixth graders both are more likely to change their mind and select Smarties for immediate consumption compared to the older individuals.

Thus, the following stylized pattern of revealed preferences emerges: The choices of younger individuals are time consistent but myopic in the sense that long-term effects of the choice are disregarded. They discount strongly and choose chocolate for future and immediate consumption. With increasing age, individuals become more long-term oriented, which introduces time inconsistent behavior in some. They choose the apple for the future but fail to stick with it when selecting for immediate consumption. According to Strotz (1955-56) and Pollack (1968) they would be classified as naïve. They know that they should care about the future; however, they are not able to bind their future self successfully to reach the long-term rational goal. With further increasing age and cognition individuals are more likely to stick with their healthy choices. These individuals choose an apple for the future and for immediate consumption. They are long-term oriented and time consistent – if this results from successful strategies to deal with temptation, they would classify as sophisticated. Frederick et al. (2002) point out that the degree of naïvety and sophistication of individuals might have important policy implications: if individuals are sophisticated, the provision of commitment devices might be optimal, however, if individuals are naïve, more effort is needed in terms of education to increase awareness of time inconsistent behavior.

A potential point of criticism of our results is that not only time preference but also taste changes with age, i.e. we observe the declining preference for Smarties, because there is a shift in preferences away from sweets. Cooke and Wardle (2005), for example, find that the preference for sweet and fatty food items decreases between age 8 and 16. However, at the same time they find that the preference for fruits decreases with age as well. Overall they find that sweet and fatty food is preferred over fruit at all ages. Thus, according to their finding, we should not see a systematic shift from unhealthy to healthy food over age. Moreover, if our results are driven by changes in the taste for sweets and fruits, we should not observe the time inconsistencies. In the case of changing tastes one would expect that there is no difference between preferences for future and preferences for immediate consumption.

Cognitive abilities are not revealed to have an overall effect on choosing an apple for the future or resisting temptation *(hypothesis 2b and 4b)*. Moreover, the results regarding the role of cognition at certain ages are mixed. This is somewhat contradictory to results by

Mischel and Metzner (1962) and Mischel et al. (1989) who find that patience is associated with higher cognitive capacity. Our results might be influenced by the fact that we use self-reported grades and do not check with teachers if the information given by students is correct. Another explanation might be that we ask for the grade in the last report card which was given to pupils approximately four months before the experiment. Thus, some students might not remember their grade and thus the measurement error might be high.

We are not able to detect any systematic influence of parental background (wealth and education) on the choice of apples for the future *(hypothesis 2c and d)*. However, we find a significant and negative effect of parental wealth on switching behavior *(hypothesis 4c)*. There is no significant effect of parental education on switching from apple to Smarties *(hypothesis 4d)*. We might not find effects for parental education because of a high measurement error in the estimate of the number of books at home. On the one hand it might not be a perfect proxy for parental education and on the other hand students might have had difficulties in estimating the number of books despite the support we gave in doing the estimation.

A further issue is that there might be communication among students and among students with their parents between the first and the second day. Therefore, food choices as well as lunch boxes might be adjusted to the additional food item offered by the experimenter. Firstly, regarding the communication among students: The concern is that pupils want the same item as their peer. However, we do not think that this effect influences our result because students did not know anything about the choice before making their decision on the first day and until the last moment on the second day they did not know about the opportunity to change their mind. Secondly, with regard to the communication with parents the concern is raised that parents might adapt the lunch boxes of their children on the second day according to the choice of the child, i.e. those who picked chocolate do not get chocolate in their box and those who pick apples do not get additional fruit. We checked the dynamic adjustment of consumption and do not find any evidence that pupils eat differently on the first and on the second day.

6.6. Conclusions

We are the first study to clearly demonstrate changing patterns of time preferences over age in the context of a typical situation that children are faced with on a daily basis: choosing between two food items. We do not need to rely on children's ability to actually discount as in experiments using monetary incentives, or abstract from the given situation (e.g. experiments using delayed rewards such as gift certificates, Bettinger and Slonim (2007)). In this regard, our results can be seen to apply more directly and may be considered

as a robustness check to previous results.

Apart from that, we believe that the patterns in choice behavior that we detect point to certain policy recommendations. A lesson that parents have understood from the dawn of time is that it clearly makes sense to restrict the choices of children as long as they are not able to consider the future impact of their decisions. But, more importantly, children act in a way that is to some degree predictable and regular – therefore it may not only be promising to balance their disregard for long-term effects of their behavior by providing them with "high-powered" short-term incentives but also to teach them about long-term consequences of their behavior.

Children actually do learn to consider the long-term effects of their decisions. With our experimental setup, we were clearly not equipped to establish whether this is a conscious or a subconscious effort. More research is required to determine whether and how to teach young individuals about the long-term impact of their choices, perhaps by helping them to avoid forming self-damaging preferences and to increase their ability to appreciate future consequences of today's actions. It would be very interesting to conduct a long-term study of human behavior and relate time preferences at young ages not just to cognitive abilities but also to real-world decisions they make later in life. In this vein, additional design options for public policies aimed to improve long-term rational behavior of individuals may be found, which could influence such different but equally important realms as individual health, private retirement planning and addiction.

Moreover, we believe that this realm should not be limited to sociological research, but that neurological and neuro-economic studies may have an important role to play in this context: Perhaps as a first step, a neurological examination of children's decision making may solve the conflicting results of McClure et al. (2004, 2007), Glimcher et al. (2007) and Hare et al. (2009).

Table 6.4.: Selecting an Apple for the Future

This table shows marginal effects after a probit regression of age, cognitive abilities, and various other covariates on selecting an apple for future consumption. The dependent variable is a dummy equal to one if pupils choose an apple for tomorrow. Age cohort is a categorical variable taking values from 1 (age 6-7) to 5 (age 17-18). Hungry is a dummy equal to zero if respondents did not feel hungry at all and one in all other cases. Parental wealth is the average over all seven wealth categories. Parent's education is a dummy equal to one if there are more than 250 books at home and zero if there are less. (d) indicates a dummy variable. Ref. refers to the omitted category if various dummies are used. Marginal effects in the model with interaction terms are calculated according to Ai and Norton (2003). Standard errors are clustered at the class level. In the first two specifications all pupils are included (N=231). In specification 2 and 3 the first graders drop out due to missing information on cognitive abilities and parental background (N=183).

	Model 0	Model 1	Model 2	Model 3
Age cohort	0.11			
	[0.05]**			
Age 6-7 (d)		-0.16		
		[0.19]		
Age 8-9 (d)		Ref.	Ref.	Ref.
Age 11-12 (d)		0.28	0.3	0.30
		[0.06]***	[0.06]***	[0.04]***
Age 14-15 (d)		0.17	0.2	0.19
		[0.04]***	[0.06]***	[0.05]***
Age 17-18 (d)		0.3	0.31	0.30
		[0.04]***	[0.04]***	[0.04]***
Female (d)	-0.02	-0.03	-0.02	-0.03
	[0.03]	[0.03]	[0.04]	[0.04]
Hungry (d)	-0.09	-0.04	-0.07	-0.07
	[0.09]	[0.06]	[0.07]	[0.06]
Apple first (d)	-0.07	-0.07	-0.03	-0.03
	[0.04]*	[0.05]	[0.06]	[0.06]
Parent's education (d)			0	-0.02
			[0.10]	[0.11]
Parental Wealth			-0.08	-0.07
			[0.09]	[0.09]
Math good (d)			0.07	-0.02
			[0.06]	[0.11]
Math* Age 11-12				0.09
				[0.06]*
Math* Age 14-15				-0.22
				[0.09]**
Math* Age 17-18				-0.09
				[0.13]
Observations	231	231	183	183
Pseudo R2	0.08	0.11	0.06	0.07

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6.5.: Switching from Apple to Smarties

In this table the determinants of switching from apple to smarties on the second day are examined. The table shows marginal effects after a probit regression of age, cognitive abilities, and various other covariates on selecting smarties for immediate consumption conditional on having chosen an apple for future consumption. The dependent variable is a dummy equal to one if pupils choose smarties for now. Age-cohort is a categorical variable taking values from 1 (age 6-7) to 5 (age 17-18). Hungry is a dummy equal to zero if respondents did not feel hungry at all and one in all other cases. Parental wealth is the average over all seven wealth categories. Parent's education is a dummy equal to one if there are more than 250 books at home and zero if there are less. (d) indicates a dummy variable. Ref. refers to the omitted category if various dummies are used. Marginal effects in the model with interaction terms are calculated according to Ai and Norton (2003). Standard errors are clustered at the class level. In the first two specifications all pupils who selected an apple on the first day are included (N=131). In specification 2 and 3 the first graders drop out due to missing information on cognitive abilities and parental background (N=116).

	Model 0	Model 1	Model 2	Model 3
Age-cohort	-0.09			
	[0.02]***			
Age 6-7 (d)		-0.08		
		[0.04]**		
Age 8-9 (d)			Ref.	
Age 11-12 (d)		-0.2	-0.18	-0.25
		[0.05]***	[0.05]***	[0.09]***
Age 14-15 (d)		-0.28	-0.21	-0.29
		[0.03]***	[0.04]***	[0.08]***
Age 17-18 (d)		-0.25	-0.2	-0.26
		[0.03]***	[0.06]***	[0.06]***
Female (d)	0.14	0.14	0.19	0.21
	[0.06]**	[0.07]**	[0.06]***	[0.07]***
Apple first (d)	-0.05	-0.05	-0.12	-0.15
	[0.09]	[0.09]	[0.09]	[0.08]**
less hungry (d)	0	0.02	0.04	0.05
	[0.10]	[0.10]	[0.10]	[0.12]
more hungry (d)	-0.11	-0.09	-0.18	-0.18
	[0.07]	[0.08]	[0.07]**	[0.07]***
Parent's education (d)			0.07	0.06
			[0.13]	[0.06]
Parental wealth			-0.22	-0.07
			[0.08]**	[0.09]
Math good (d)			-0.15	0.06
			[0.08]*	[0.14]
Math* Age 11-12 (d)				0.53
				[0.08]***
Math* Age 14-15 (d)				0.95
				[0.10]***
Math*Age 17-18 (d)				dropped
Observations	131	131	116	108
Pseudo R2	0.08	0.09	0.18	0.21

* significant at 10%; ** significant at 5%; *** significant at 1%.

A. Appendix to Chapter 2

A.1. Summary Statistics

Table A.1.: Socioeconomic Characteristics

This table contains summary statistics (mean and standard deviation (std.)) for 1,059 respondents in the SAVE random route sample in 2009.

	mean	std.
age	52.11	16.78
male	0.47	0.50
east	0.35	0.48
rural (pop smaller than 5.000)	0.08	0.27
household size	2.38	1.26
no. of children	1.69	1.42
children in the household	0.35	0.48
martial status		
married	0.55	0.50
single	0.20	0.40
divorced	0.13	0.33
widowed	0.10	0.30
separated	0.02	0.15
education		
lower secondary	0.10	0.31
upper secondary	0.61	0.49
post secondary, non tertiary	0.10	0.30
tertiary	0.15	0.35
other	0.04	0.20
labor market status		
employed	0.52	0.50
retired	0.30	0.46
occupation		
blue collar	0.14	0.35
white collar	0.27	0.44
civil servant	0.04	0.19
self-employed	0.06	0.24
income and wealth in Euros		
income per month	2,154	1,485
wealth (end of 2008)	130,967	255,311

Source: own calculation on the basis of SAVE 2009, data is weighted and imputed.

A.2. Financial Accounts in Germany 1991-2008

Table A.2.: Share of Financial Assets in Germany 1991-2008

This table contains the share of certain asset classes among total financial assets of private households and non-profit organizations in percent in Germany between 1991 and 2008 calculated on the basis of aggregate statistics of the Deutsche Bundesbank.

	1991	1995	2000	2005	2006	2007	2008
checking deposits and savings accounts	48.1	44.0	35.1	35.7	35.1	35.7	39.5
insurance and pension wealth	27.7	28.6	30.1	31.9	32.1	32.5	34.5
stocks, bonds, mutual funds and other financial assets	24.3	27.4	34.8	32.5	32.8	31.8	26.0
of these:							
stocks	6.6	7.5	12.9	7.8	8.0	8.2	3.8
investment funds	4.3	7.4	11.6	12.3	11.7	12.0	11.3
Total	100	100	100	100	100	100	100

Source: own calculation on the basis of Deutsche Bundesbank (2009).

B. Appendix to Chapter 3

B.1. Summary Statistics

Table B.1.: Summary Statistics

This table contains summary statistics for 1,007 respondents in the SAVE random route sample in 2009.

Variable	Mean	Std. Dev.	Min	Max
Age	51.87	16.63	22	91
Men	0.47	0.50	0	1
Living in east Germany	0.36	0.48	0	1
Rural Region (below 5,000 inh.)	0.08	0.27	0	1
Married	0.55	0.50	0	1
Single	0.20	0.40	0	1
Divorced	0.13	0.33	0	1
Widowed	0.09	0.29	0	1
Separated	0.02	0.15	0	1
Partner	0.63	0.48	0	1
Household size	2.40	1.26	1	8
Number of Children	1.68	1.41	0	10
Children in the Household	0.35	0.48	0	1
Employed	0.53	0.50	0	1
Full-time	0.33	0.47	0	1
Part-time	0.20	0.40	0	1
Retired	0.30	0.46	0	1
Lower secondary schooling	0.10	0.31	0	1
Upper secondary schooling	0.61	0.49	0	1
Post sec., non-tert. schooling	0.10	0.30	0	1
Tertiary schooling	0.14	0.35	0	1
Other schooling	0.04	0.20	0	1
Income (per month in Euros)	2,158	1,505	0	15,000
Net wealth (end of 2008 in Euros)	129,404	251,906	-287,222	6,050,000

Source: own calculation on the basis of SAVE 2009, data is weighted and imputed.

B.2. Measures of Financial Literacy

Basic Literacy

1. *Understanding of Interest Rate (Interest)*

   "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the

money to grow: more than €102, exactly €102, less than €102?" do not know / refuse to answer

2. *Understanding of Inflation (Inflation)*

   "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?" do not know / refuse to answer

3. *Understanding of Compound Interest (Compound Interest)*

   "Suppose you had €100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total: more than €200, exactly €200, less than €200 ?" do not know / refuse to answer

4. *Understanding of Money Illusion (Money Illusion)*

   "Suppose that in the year 2012, your income has doubled and prices of all goods have doubled too. In 2012, how much will you be able to buy with your income: more than today, the same, less than today?" do not know / refuse to answer

Advanced Literacy

1. *Understanding of Risk and Diversification (Risk)*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know/ refuse to answer

2. *Understanding Average Asset Fluctuations (Return Volatility)*

   "Normally, which asset displays the highest fluctuations over time: Savings accounts, bonds, stocks?" Do not know / refuse to answer

3. *Understanding of the Main Function of the Stock Market (Stock Market)*

   "Which of the following statements describes the main function of the stock market?" The stock market helps to predict stock earnings. / The stock market results in an increase in the price of stocks. / The stock market brings people who want to buy stocks together with those who want to sell stocks. / None of the above. / Do not know / refuse to answer

4. *Understanding of Mutual Funds (Mutual Funds)*

"Which of the following statements is correct?" Once one invests in a mutual fund, one cannot withdraw the money in the first year. / Mutual funds can invest in several assets, for example invest in both stocks and bonds. / Mutual funds pay a guaranteed rate of return which depends on their past performance. / None of the above. / Do not know / refuse to answer

5. *Bond Prices and Interest (Bond)*

   "If the interest rate falls, what should happen to bond prices?" Rise / Fall / Stay the same / None of the above / Do not know/ refuse to answer

B.3. International Comparison of Financial Literacy

Figure B.1.: International Comparison of Basic Financial Literacy

This figure shows the relative frequency of correct responses to the basic financial literacy questions in SAVE 2009 (Germany) in comparison to responses in the American Life Panel (ALP, USA) as reported in Lusardi and Mitchell (2007b) and the Dutch National Household Panel (Netherlands) as reported in Van Rooij et al. (2011b).

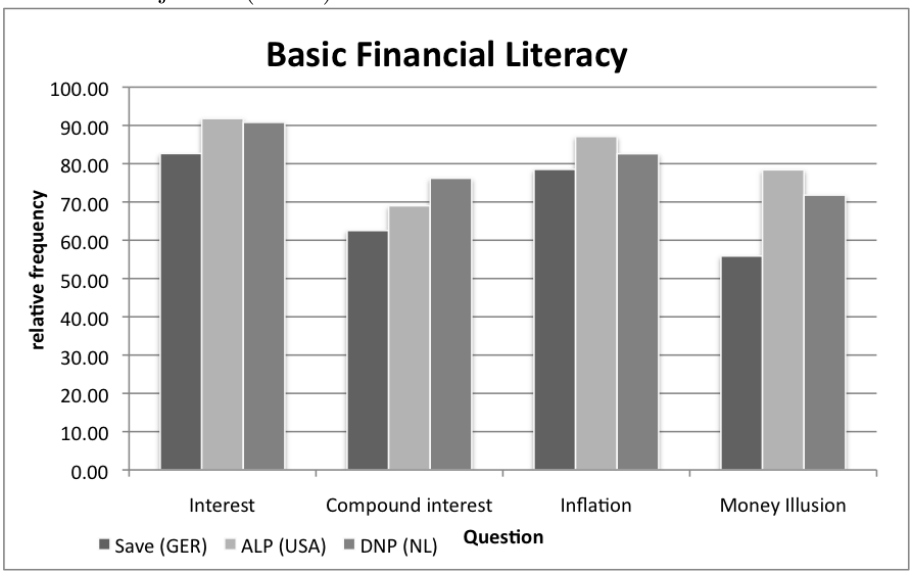
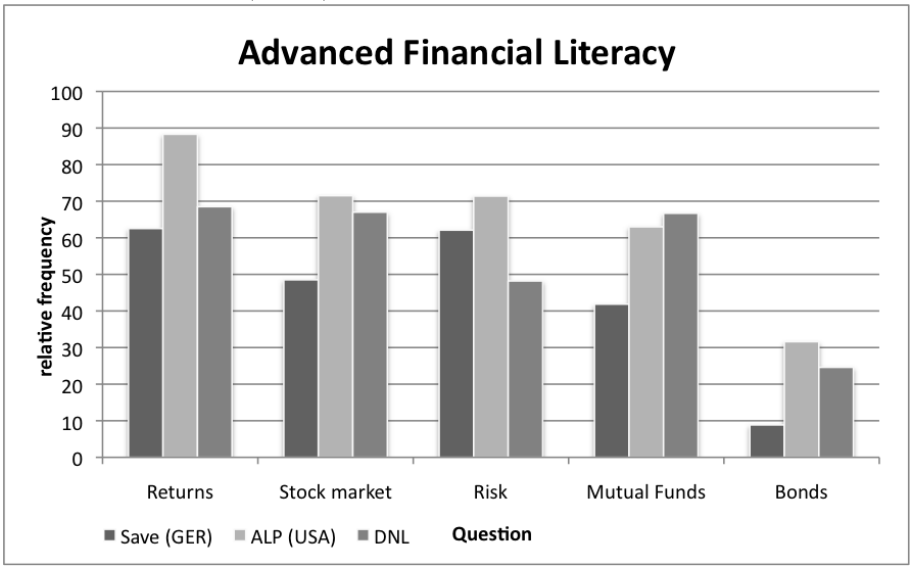


Figure B.2.: International Comparison of Advanced Financial Literacy

This figure shows the relative frequency of correct responses to the advanced financial literacy questions in SAVE 2009 (Germany) in comparison to responses in the American Life Panel (ALP, USA) as reported in Lusardi and Mitchell (2007b) and the Dutch National Household Panel (Netherlands) as reported in Van Rooij et al. (2011b).



C. Appendix to Chapter 4

C.1. Mathematical Appendix

The advisor's maximization problem - sufficiency

Concavity of the advisor's expected profit function requires the following second derivative to be negative:

$$\frac{\partial^2 E[\Pi|s]}{\partial e^2} = v''(e)(1 - E[\theta|s]) + E[\theta|s][v''(e)F(\hat{\theta}(e)|s)] +$$
$$2v'(e)f(\hat{\theta}(e)|s)\frac{\partial \hat{\theta}(e)}{\partial e} + v(e)\frac{\partial^2 \hat{\theta}(e)}{\partial e^2}[f(\hat{\theta}(e)|s) + \frac{\partial f(\hat{\theta}(e)|s)}{\partial \hat{\theta}}]] \tag{C.1}$$

Inspecting the individual terms, we find that $v''(e)$ is negative due to the concavity of $\nu(e)$, i.e. increasing costs of effort, therefore the first term and the first part of the second term are negative. The second part of the second term is negative as $v'(e)$ is negative. The sign of $\frac{\partial^2 \hat{\theta}(e)}{\partial e^2}$ depends on assumptions regarding the customer's utility and search costs in relationship to the distribution of offers. It appears sensible to impose that the increase in the critical type is non-increasing in the effort spent, therefore this term is non-positive. This leaves the last part of the second term. We know that the second derivative must be negative if $f(\hat{\theta}(e)|s) \geq |\frac{\partial f(\hat{\theta}(e)|s)}{\partial \hat{\theta}}|$.[1] This will be the case if the conditional distribution of types is relatively "smooth", or equivalently, if the signal obtained by the advisor is not too informative. To illustrate, take the case of a perfectly informative signal, such that $E[\theta|s] = \theta$. Then one of two choices must be optimal for the advisor: either $e = 0$ or making the informed consumer exactly indifferent between accepting and rejecting the offer, a generally convex problem.

[1] This condition is stronger than necessary, if it is not fulfilled, the shape of the function depends on the relative magnitude of the terms.

C.2. Summary Statistics

Table C.1.: Summary Statistics

This table contains summary statistics for 2,608 respondents in SAVE 2008.

Variable	Mean	Std. Dev.	Min	Max
Age	51.28	16.40	21	96
Female	0.55	0.50	0	1
Living in East Germany	0.28	0.45	0	1
Living with a partner	0.63	0.48	0	1
Householdsize	2.43	1.24	1	9
Retired	0.33	0.47	0	1
No vocational training	0.14	0.34	0	1
Vocational Training	0.70	0.46	0	1
University Degree	0.17	0.37	0	1
Lower sec. schooling	0.35	0.48	0	1
Intermediate sec. schooling	0.37	0.48	0	1
Upper sec. schooling	0.28	0.45	0	1
Income (per month in Eur.)	2,100	1,453	18	22,500
Net wealth at the end of 2007	179,503	340,635	0	7,720,000

Source: own calculation on the basis of SAVE 2008, data is weighted and imputed.

C.3. Measures of Financial Literacy

Financial Literacy 2007 and 2008

1. *Understanding of Interest Rate (Numeracy)*

   "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?"

2. *Understanding of Inflation*

   "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?"

3. *Understanding of Risk and Diversification*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know

Advanced Financial Literacy 2009

1. *Understanding Average Asset Fluctuations*

   "Normally, which asset displays the highest fluctuations over time: Savings accounts, bonds, stocks?" Do not know / refuse to answer

2. *Understanding of the Main Function of the Stock Market*

   "Which of the following statements describes the main function of the stock market?" The stock market helps to predict stock earnings. / The stock market results in an increase in the price of stocks. / The stock market brings people who want to buy stocks together with those who want to sell stocks. / None of the above. / Do not know / refuse to answer

3. *Understanding of Risk and Diversification*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know

4. *Understanding of Mutual Funds*

   "Which of the following statements is correct?" Once one invests in a mutual fund, one cannot withdraw the money in the first year. / Mutual funds can invest in several assets, for example invest in both stocks and bonds. / Mutual funds pay a guaranteed

rate of return which depends on their past performance. / None of the above. / Do not know / refuse to answer

C.4. Questions Relating to Private Pension Choice

1. *Comparison of Providers*

   "In case that you or your partner have signed or are planning to sign a Riester contract in the near future: How many providers did you consult?" None / One provider /Two to three providers / More than three / Question does not apply; I/ we have neither procured nor plan to procure a Riester contract in the near future"

2. *Comparison of Offers*

   "How many offers in written form did you or your partner obtain before signing a contract over the course of your planning process?" None / One offer in written form / Two to three offers in written form / More than three offers in written form

3. *Sources of Information*

   "How/ from whom did you obtain information on the different offers? Several answers are possible" Own research / Relatives / Friends / Colleagues / Consultants employed by a bank and/ or an insurance company / Independent financial or investment advisors

4. *Chosen Provider*

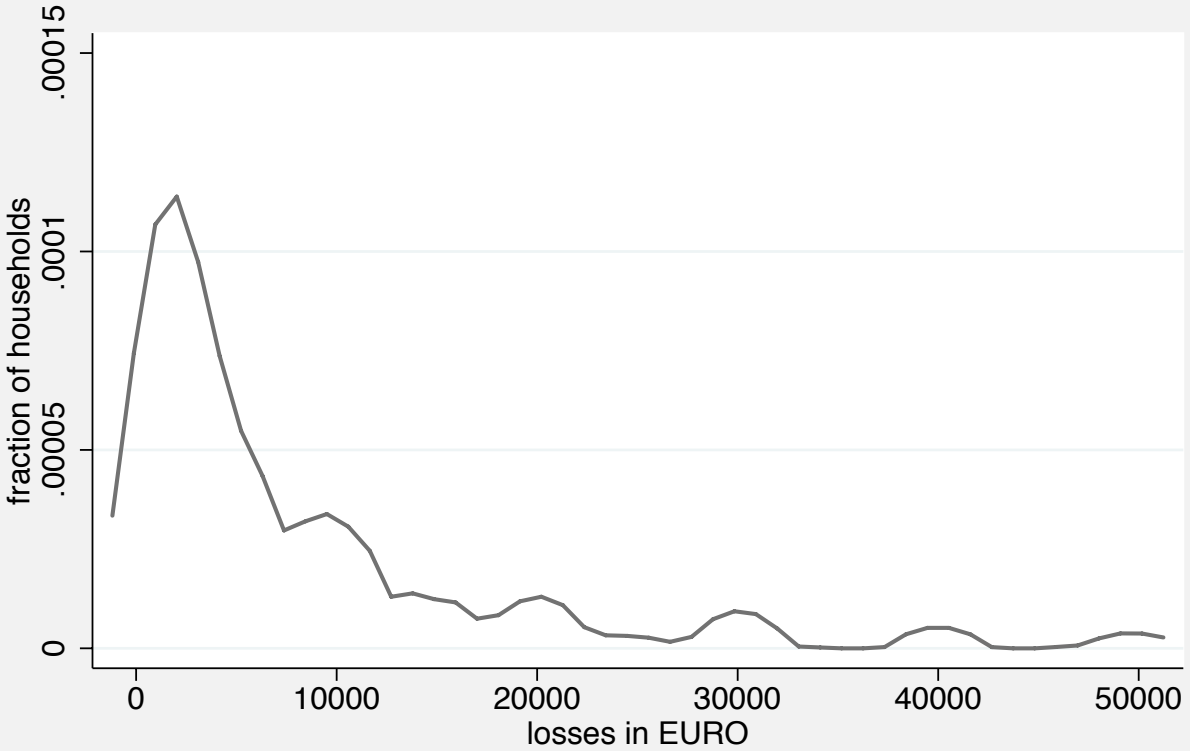
   "What provider did you or your partner procure/ are planning on procuring the Riester contract from? Several answers are possible" My/ our main bank / Another bank / An insurance company that I/ we have already concluded another insurance contract with (e.g. liability or household insurance) / An insurance company that I/ we do not have any other insurance contracts with / Another provider of Riester products, please specify:

D. Appendix to Chapter 5

D.1. Financial Losses

Figure D.1.: Density Function Financial Losses

This figure shows the distribution of losses conditional on reporting a loss. The function is smoothed using a univariate kernel density estimation (Epanechnikov kernel function).



Source: SAVE 2009, weighted data.
Observations up to the 95% percentile included (N=412).

D.2. Summary Statistics

Table D.1.: Summary Statistics

This table contains summary statistics for 2,012 respondents in SAVE 2009.

Variable	Mean	Std. Dev.	Min	Max
Age	50.8	15.9	21	90
Men	0.47	0.50	0	1
East	0.28	0.45	0	1
Rural	0.15	0.36	0	1
Married	0.57	0.50	0	1
Single	0.21	0.40	0	1
Divorced	0.13	0.33	0	1
Widowed	0.08	0.26	0	1
Separated	0.03	0.16	0	1
Partner	0.65	0.48	0	1
Employed	0.55	0.50	0	1
Fulltime	0.34	0.47	0	1
Parttime	0.20	0.40	0	1
Unemployed	0.08	0.28	0	1
Homemaker	0.19	0.40	0	1
Retired	0.28	0.45	0	1
Household size	2.43	1.22	1	9
Households with children	0.37	0.48	0	1
Number of children	1.67	1.38	0	8
Lower secondary education	0.08	0.27	0	1
Upper secondary education	0.60	0.49	0	1
Post secondary, non tert. education	0.12	0.33	0	1
First stage tertiary education	0.17	0.38	0	1
Other education	0.03	0.17	0	1
Household income (Euro/month)	2,127	1,389	22	22,500
Gross wealth - end of 2007 (Euro)	187,281	384,198	0	7,720,000
Gross financial wealth - end of 2007 (Euro)	38,855	114,128	0	2,870,000

Source: SAVE 2008 and 2009, data is weighted and imputed.

D.3. Measures of Financial Literacy and Cognitive Abilities

Financial Literacy

1. *Understanding of Interest Rate (Numeracy)*

   "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?"

2. *Understanding of Inflation*

   "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?"

3. *Understanding of Risk and Diversification*

   "Do you think that the following statement is true or false? Buying a single company stock usually provides a safer return than a stock mutual fund." do not know

Cognitive Reflection Test

1. "A bat and a ball cost 110 cents in total. The bat costs 100 cents more than the ball. How much does the ball cost?"

2. "If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?"

3. "In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?"

E. Appendix to Chapter 6

E.1. Experimental Protocol (in German)

Experimental Protocol for 3rd to 12th grade. Among the first graders we slightly modified experimental procedures as they cannot answer the written questionnaire in any reasonable time. We asked them about their hunger and food items etc. face to face. We did not ask for their parental background. Neither did we ask for grades because they are not graded yet.

Tag 1:

- Den Schülern wird kurz das Ziel des Experimentes erklärt. Sie werden gebeten, ihre Nachbarn und Freunde nicht beim Ausfüllen des Fragebogens zu stören und sie auch sonst nicht zu beeinflussen.
- Die Fragebögen und Umschläge werden an alle Schüler verteilt. Es wird erklärt, wie der individuelle Code gebildet wird. Ein Beispiel wird anhand einer Folie auf dem Overhead vorgeführt.
- Danach werden die Schüler gebeten, selbständig den Fragebogen auszufüllen und ihn im Umschlag zu platzieren.
- Die Schüler werden der Reihe nach einzeln zum Experimentator geschickt.
- Der Experimentator sitzt an einem Tisch. Vor ihm liegen ein schöner Apfel und eine Packung Smarties.
- Der Experimentator fragt, welches Lebensmittel sie am kommenden Tag lieber möchten.
- Der Schüler schreibt die Entscheidung auf den Umschlag.
- Der Experimentator bittet den Schüler, zurück in die Klasse zu gehen und nichts zu verraten.

Tag 2:

- Wie am Tag 1 werden die Schüler gebeten, einen Fragebogen auszufüllen und mit ihrem persönlichen Code zu versehen. Der Fragebogen wird in einem Umschlag platziert und verschlossen.

- Die Schüler werden wieder der Reihe nach und einzeln zum Experimentator geschickt.

- Der Experimentator (eine andere Person als am Vortag) sitzt an einem Tisch. Vor ihm liegen ein schöner Apfel und eine Packung Smarties. Im Hintergrund steht ein Korb mit Äpfeln und eine Korb mit Smarties, die zu jedem Zeitpunkt etwa gleich voll sind, so dass klar ist, dass von beiden Lebensmitteln genügend vorhanden ist.

- Der Experimentator bittet die Schüler um den Umschlag und fragt, welches Lebensmittel sie jetzt möchten.

- Der Experimentator händigt entsprechend der Entscheidung ein Lebensmittel aus (aus dem Korb, so dass die zur Schau gestellten Lebensmittel immer identisch sind). Er schreibt die Entscheidung auf den Umschlag.

- Die Auszahlung wird in eine Papiertüte gelegt, damit die anderen Schüler die Auszahlung nicht sehen.

- Der Experimentator bittet den Schüler zurück in die Klasse zu gehen und nichts zu verraten.

Wörtlicher Ablauf des Experiments am ersten Tag

1. In der Klasse mit allen Schülern:

Guten Morgen. Ich bin Tabea Bucher-Koenen. Und das ist mein Kollege Carsten Schmidt. Wir kommen von der Universität Mannheim. Wir machen eine Studie zu Entscheidungen von Schülern. Deshalb sind wir heute hier. Zuerst bekommt ihr einen kurzen Fragbogen zum Ausfüllen. Bitte füllt den Fragebogen alleine aus und steckt ihn danach in den Umschlag und klebt ihn zu. Danach kommt ihr einzeln nach draußen und wir stellen euch eine einfache Frage. Dann geht ihr zurück in die Klasse. Es ist sehr wichtig, dass ihr bis zum Ende der Stunde auf keinen Fall mit euren Mitschülern über das Experiment sprecht oder anders kommuniziert. Eure Entscheidung bleibt geheim. Morgen kommen wir noch einmal und ihr bekommt eure Belohnung.

Welche Fragen habt ihr dazu?

Wir teilen jetzt den Fragebogen und den Umschlag aus. Bitte füllt noch nichts aus. Bevor ihr den Fragebogen ausfüllt, möchte ich noch erklären, wie ihr euren persönlichen Code bildet.

[Verteilen der Fragebögen und Umschläge]

Auf der ersten Seite des Fragebogens findet ihr unten vier Felder, in die ihr euren persönlichen Code schreibt. Es ist wichtig, dass in jedem Feld nur ein Buchstaben oder eine Zahl steht. Ich erkläre euch jetzt wie ihr den Code bildet.

In das erste Feld tragt ihr den Anfangsbuchstaben vom Vornamen eurer Mutter ein. Wenn ihr Name Anne ist, z.B. ein A. In das zweite Feld tragt ihr den Anfangsbuchstaben vom Vornamen eures Vaters ein. Wenn sein Name Peter ist, z.B. ein P. In das dritte Feld tragt ihr den Tag Eures Geburtstags ein. Ich habe zum Beispiel am 30. August Geburtstag, deshalb trage ich eine 30 ein. In das vierte Feld tragt ihr den letzten Buchstaben eures Vornamens ein. Ich heiße Tabea, deshalb trage ich ein A ein.

Habt ihr dazu noch Fragen?

Dann füllt jetzt bitte den Fragebogen aus und wenn ihr fertig seid, steckt ihr ihn in den Umschlag. Wenn ihr fertig seid, kommt ihr in folgender Reihenfolge einzeln nach draußen. Es fängt die Person an, die am nächsten an der Tür sitzt und dann kommt der Nachbar. Danach fangt ihr wieder außen an bis alle dran waren.

2. Während des Experiments:

Experimentator (E) 1: Hallo. Setz dich! Möchtest du morgen einen Apfel oder Smarties haben *(Reihenfolge zufällig wechseln, wird notiert)*? Schau dir beides genau an.

Schüler (S): É

E 1: Bitte schreib deine Entscheidung auf den Umschlag.

E 1: Vielen Dank. Du kannst jetzt zurück in die Klasse gehen. Bitte verrate keinem, was wir dich gefragt haben und wie du dich entschieden hast. Tschüß.

Wörtlicher Ablauf des Experiments am zweiten Tag

1. In der Klasse mit allen Schülern:

Guten Morgen. Heute haben wir Euch eure Belohnung mitgebracht. Der Ablauf ist genau wie gestern. Zuerst bekommt ihr einen kurzen Fragbogen zum Ausfüllen. Bitte füllt den Fragebogen alleine aus und steckt ihn danach in den Umschlag und klebt ihn zu. Danach kommt ihr einzeln nach draußen und wir stellen euch eine einfache Frage. Dann geht ihr zurück in die Klasse. Es ist auch heute sehr wichtig, dass ihr bis zum Ende der Stunde auf keinen Fall mit euren Mitschülern über das Experiment sprecht oder anders kommuniziert.

Wir teilen jetzt den Fragebogen und den Umschlag aus. Bitte füllt zuerst die Felder mit eurem persönlichen Code aus. Es soll derselbe sein wie gestern.

[Verteilen der Fragebögen und Umschläge]

Dann füllt jetzt bitte den Fragebogen aus und wenn ihr fertig seid, steckt ihr ihn in den Umschlag. Wenn ihr fertig seid, kommt ihr wie gestern einzeln nach draußen, d.h. es fängt die Person an, die am nächsten an der Tür sitzt und dann kommt der Nachbar. Danach fangt ihr wieder außen an bis alle dran waren.

2. Während des Experiments:

Experimentator (E) 2: Hallo. Setz dich! Möchtest du jetzt Smarties oder einen Apfel *(Reihenfolge zufällig wechseln)*? Es ist nicht wichtig, wie du dich gestern entschieden hast. Bitte entscheide, was du jetzt lieber möchtest.

Schüler (S): É

E 2: Bitte schreib deine Entscheidung auf den Umschlag.

(Experimentator legt Auszahlung in Papiertüte, damit die anderen Schüler das Ergebnis nicht sehen)

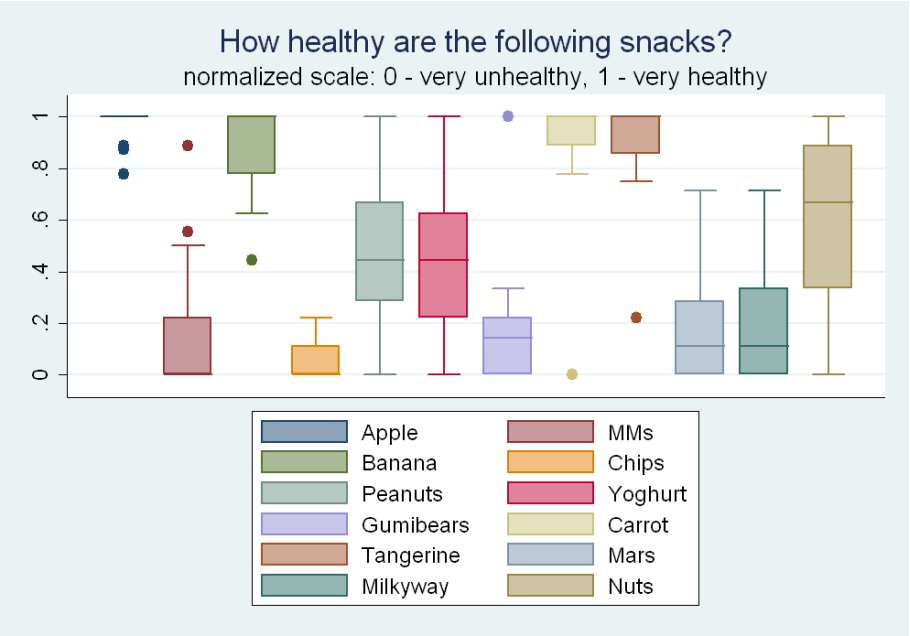
E 2: Vielen Dank. Du kannst jetzt zurück in die Klasse gehen. Bitte verrate keinem, was wir dich gefragt haben und wie du dich entschieden hast. Lass die Papiertüte zu, bis alle deine Mitschüler bei uns waren. Tschüß.

E.2. Pretest

We conduct two pretests to select the food items for our experiment. The objective is to find two groceries that are perceived as healthy and unhealthy by many participants and that are chosen for consumption. Our first pretest is conducted among participants in a lab experiment at the University of Mannheim. Participants are between 18 and 24 years old. They are asked to rate 12 food items (which are displayed in front of them) on a scale from 1–"very unhealthy" to 10–"very healthy" and then select one as their pay-off for immediate consumption. The items and their rating are displayed in a boxplot in figure E.1. The two most frequently selected items were apples and M&Ms. The boxplot indicates that the distribution of the ratings for the apple is very skewed towards one with few outsiders, i.e. apples are clearly rated as healthy. However, M&Ms were selected twice as frequently as apples and their rating as unhealthy is not so clear as we can see from the boxplot. Therefore, we conducted a second pretest.

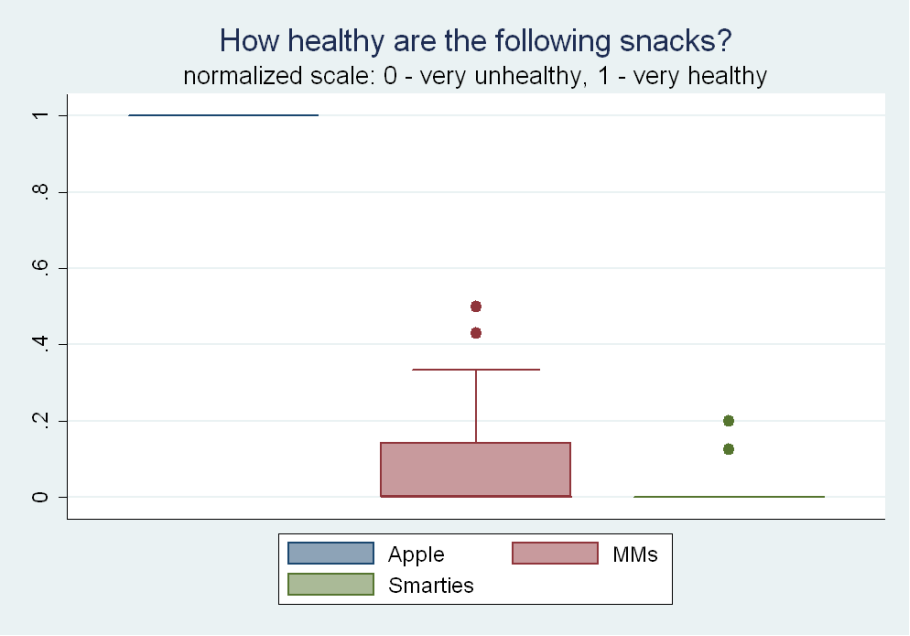
The second pretest was carried out among students and pupils aged between 12 and 29. We asked them to rate and select only among three items: apples, Smarties and M&Ms. The results are displayed in figure E.2. We find that the ratings for the apple again are very skewed towards one. Surprisingly, M&Ms are not rated as unhealthy as Smarties. The distribution of ratings for Smarties is skewed towards 0, i.e. respondents clearly rate them as unhealthy.

Figure E.1.: Pretest 1 (N=24)



The box indicates the area in which the median 50% of the distribution are situated, i.e. the upper and lower edge of the box are the 25% and 75% percentile. The line in the box displays the median rating. The end of the whiskers indicate the 5th and 95th percentile of the ratings. Dots represent outsiders.

Figure E.2.: Pretest 2 (N=39)



The box indicates the area in which the median 50% of the distribution are situated, i.e. the upper and lower edge of the box are the 25% and 75% percentile. The line in the box displays the median rating. The end of the whiskers indicate the 5th and 95th percentile of the ratings. Dots represent outsiders.

E.3. Questionnaires

Table E.1.: Questions Day 1

Nr	Question	Answer
1	Did you have breakfast today?	Yes
		No
2	What did you have for breakfast today?	
3	Did you have something to eat	Yes
	during your last break?	No
4	What did you eat during your last break?	
5	What else did you bring to eat today?	fruit (e.g. Apple, Banana)
		sandwich
		chocolate or other sweets
		nothing
		something else:
		I brought money with me and will buy some:
6	I am hungry	That's true
		That's mostly true
		That's mostly not true
		That's not true
		I don't know
7	How many books does your family have at home?	none
		1 to 10
		11 to 50
		51 to 100
		101 to 250
		251 to 500
		more than 500 Books
8	How many of the following objects does your family own?	
	Cell phone	none
		one
		two
		three or more
	TV	none
		one
		two
		three or more
	Calculator	none
		one
		two
		three or more
	Computers	none
		one
		two
		three or more
	Music instruments (e.g. piano, violine)	none
		one
		two
		three or more
	Cars	none
		one
		two
		three or more
	Bathrooms	none
		one
		two
		three or more
9	What was your grade on your last report	Mathematics
	in the following subjects?	German
10	Your age	
11	Gender	male
		female

Table E.2.: Questions Day 2

Nr	Question	Answer
1	Did you have breakfast today?	Yes
		No
2	What did you have for breakfast today?	
3	Did you have something to eat	Yes
	during your last break?	No
4	What did you eat during your last break?	
5	What else did you bring to eat today?	fruit (e.g. Apple, Banana)
		sandwich
		chocolate or other sweets
		nothing
		something else:
		I brought money with me and will buy me some:
6	I am hungry	That's true
		That's mostly true
		That's mostly not true
		That's not true
		I don't know
10	Your age	
11	Gender	male
		female

E.4. List of Variables

Table E.3.: List of Variables

variable	coding
applefirst	pupil was asked by the experimenter in the order apple, smarties: 1; smarties, apple: 0
cohort	age cohorts: 1 - 6/7 years, 2 - 8/9 years, 3 - 11/12 years, 4 - 14/15 years, 5 - 17/18 years
female	1 - female, 0 - male
hungry	hunger: 3 - very hungry, 2 - hungry, 1 - not so hungry, 0 - not hungry, null - I don't know
hungry less	1 - if less hungry on the second day, 0 - else
hungry more	1 - if more hungry on the second day, 0 - else
language	German language grade; 1 best, 6 worst
language good	1 - better than average German grade, 0 - else
math	math grade; 1 best, 6 worst
math good	1 - better than average math grade, 0 - else
parents' education	number of books at home: 0 - none, 1 - 1-10, 2 - 11-50, 3 - 51-100, 4 - 101-250, 5 - 251-500, 6 - 500+
high parental education	1 - more than 250 books, 0 - less than 250 books
wealth1	number of cell phones at home
wealth2	number of tvs at home
wealth3	number of calculators at home
wealth4	number of computer at home
wealth5	number of instruments at home
wealth6	number of cars at home
wealth7	number of bathrooms at home
wealth	Average of parents' wealth, i.e. average over wealth 1 to 7

E.5. Additional Regression Results

Table E.4.: Selecting an Apple for Now

This table shows marginal effects after a probit regression of age, cognitive abilities, and various other covariates on selecting an apple for immediate consumption. The dependent variable is a dummy equal to one if pupils chose an apple for now. Age cohort is a categorical variable taking values from 1 (age 6-7) to 5 (age 17-18). Less hungry is a dummy equal to one if pupils were less hungry on the second day compared to the first. More hungry is a dummy equal to one if they indicated to be more hungry on the second day. Parental wealth is the average over all seven wealth categories. Parent's education is a dummy equal to one if there are more than 250 books at home and zero if there are less. (d) indicates dummy variables. Ref. refers to the omitted category if various dummies are used. Standard errors are clustered at the class level. In the first two specifications all pupils are included (N=227). In specification 2 and 3 the first graders drop out due to missing information on cognitive abilities and parental background (N=179).

	Model 0	Model 1	Model 2	Model 3
Age cohort	0.15			
	[0.04]***			
Age 6-7 (d)		-0.14		
		[0.18]		
Age 8-9 (d)				
Age 11-12 (d)		0.38	0.38	0.39
		[0.05]***	[0.05]***	[0.04]***
Age 14-15 (d)		0.28	0.25	0.25
		[0.02]***	[0.06]***	[0.05]***
Age 17-18 (d)		0.39	0.37	0.36
		[0.05]***	[0.06]***	[0.06]***
Female (d)	-0.08	-0.1	-0.12	-0.14
	[0.06]	[0.05]*	[0.06]*	[0.08]*
Less hungry (d)	0.01	-0.01	-0.02	0.03
	[0.10]	[0.10]	[0.11]	[0.11]
More hungry (d)	-0.12	-0.09	-0.08	-0.08
	[0.08]	[0.09]	[0.12]	[0.11]
Apple first (d)	0.04	0.06	0.09	0.1
	[0.07]	[0.07]	[0.08]	[0.08]
Parent's education (d)			-0.11	-0.1
			[0.09]	[0.09]
Parental wealth			0.12	0.11
			[0.07]*	[0.06]*
Language good (d)				0.14
				[0.07]**
Math good (d)			0.17	
			[0.07]**	
Observations	227	227	179	178
Pseudo R2	0.10	0.13	0.09	0.09

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.5.: Switching from Smarties to Apple

In this table the determinants of switching from smarties to apple on the second day are examined. The table shows marginal effects after a probit regression of age, cognitive abilities, and various other covariates on selecting an apple for immediate consumption conditional on having chosen smarties for future consumption. The dependent variable is a dummy equal to one if pupils choose an apple for now. Age-cohort is a categorical variable taking values from 1 (age 6-7) to 5 (age 17-18). Hungry is a dummy equal to zero if respondents did not feel hungry at all and one in all other cases. Parental wealth is the average over all seven wealth categories. Parent's education is a dummy equal to one if there are more than 250 books at home and zero if there are less. (d) indicates a dummy variable. Ref. refers to the omitted category if various dummies are used. Standard errors are clustered at the class level. In the first two specifications all pupils who selected smarties on the first day are included (N=96). In specification 2 and 3 the first graders drop out due to missing information on cognitive abilities and parental background (N=63).

	Model 0	Model 1	Model 2	Model 3
Age-cohort	0.07			
	[0.04]			
Age 6-7 (d)		-0.16		
		[0.05]***		
Age 8-9 (d)				
Age 11-12 (d)		0.33	0.42	0.54
		[0.08]***	[0.13]***	[0.16]***
Age 14-15 (d)		-0.01	-0.03	0.03
		[0.08]	[0.15]	[0.15]
Age 17-18 (d)		0.11	0.18	0.39
		[0.22]	[0.26]	[0.26]
Female (d)	0.01	0.01	0.14	0.12
	[0.06]	[0.07]	[0.11]	[0.13]
Apple first (d)	0.08	0.07	0.17	0.18
	[0.07]	[0.06]	[0.09]*	[0.09]*
less hungry (d)	0.12	0.13	0.34	0.42
	[0.14]	[0.14]	[0.22]	[0.21]**
more hungry (d)	-0.21	-0.14	-0.16	-0.14
	[0.10]**	[0.11]	[0.18]	[0.18]
Parent's education (d)			-0.27	-0.33
			[0.12]**	[0.12]***
Parental wealth			0.14	0.11
			[0.17]	[0.16]
Language good (d)				0.28
				[0.14]*
Math good (d)			0.08	
			[0.12]	
Observations	96	96	63	63
Pseudo R2	0.17	0.29	0.29	0.34

* significant at 10%; ** significant at 5%; *** significant at 1%.

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Eidesstattliche Erklärung

Hiermit erkläre ich, die vorliegende Dissertation selbständig angefertigt und mich keiner anderen als der in ihr angegebenen Hilfsmittel bedient zu haben. Insbesondere sind sämtliche Zitate aus anderen Quellen als solche gekennzeichnet und mit Quellenangaben versehen.

Mannheim, 02.11.2010.

Tabea Bucher-Koenen

Curriculum Vitae

1999	Graduation from Secondary School, Paul-von-Denis Gymansium, Schifferstadt
2000–2001	Voluntary Ecological Service (FÖJ), KUKA Hannover, Germany
2001–2006	Undergraduate Studies in Business and Intercultural Management, University of Jena, Germany
2003–2004	Master in European Integration, University of Kent at Canterbury, Great Britain
2006–2010	Graduate Studies in Economics at the Center for Doctoral Studies in Economics (CDSE), University of Mannheim, Germany
2007–2010	Research Mannheim Reserach Institute for the Economics of Aging (MEA) Professor Axel Börsch-Supan, Ph.D., University of Mannheim, Germany
2009	Visiting Scholar at Dartmouth College, Hanover (NH), USA