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Verfasser: Aida Čumurović

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Prof. Dr. Steffen Müller, Prof. Reint E. Gropp, PhD

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To my mom,

Andrej,

and Bobso

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1 Introduction

In modern finance, financial decision making of households plays an important role. At least the recent global financial crisis recalled the role of the household sector in financial stability. Besides the debate how, for example, the introduction of financial sector regulations and reforms can enhance the stability of financial systems and prevent future crises, research focuses on how household behavior contributes to financial stability and the performance of the economy. By allocating their resources, e.g., making decisions about labor supply, consumption, savings, and debt, households directly affect market production and prices and, thus, make a relevant contribution to financial stability. The exposure to the financial sector enables households to influence the overall economy (Santoso and Sukada, 2009).

Household debt is just one important aspect in this context. Excessive indebtedness does not only result in depressed consumption and investment, loan defaults and private bankruptcy. Apart from the effects on the household itself, indebtedness directly affects the real economy and the financial market. Above a certain level, debt will hamper economic growth and, in the medium run, negatively affect employment (Cecchetti et al., 2011; Mian et al., 2017). Further, above trend household indebtedness increases the probability of recessions (Sutherland and Hoeller, 2012). Historically, a strong rise in household debt almost always preceded recessions (Mian and Sufi, 2015).

As household decisions contribute to market efficiency, it is of high importance to enhance financial decision making. First, a better understanding of how households save, invest, and consume or respond to changes in income and wealth can serve as a basis for policymakers, regulators, or industries to develop strategies that help consumers. Second, it is highly relevant to understand how to increase financial understanding and, thus, improve decision making. This dissertation is devoted to the issues how information access can shape financial literacy, and how, in turn, finan-

cial literacy, on the one hand, and changes in wealth, on the other hand, influence individual decision making.

In recent years, the financial market has been in a constant state of flux. Various developments on the financial markets have changed the opportunities and challenges of households, and risks have been increasingly shifted to the household sector (Santoso and Sukada, 2009). The digitalization has contributed to the evolution of the financial market. The financial technology can lower transaction costs, foster competition, and improve financial stability (Philippon, 2016). Furthermore, with crowdfunding and *fintechs*¹, for example, it facilitates access to financial services to those who would not have without these innovations (Philippon, 2016). Yet, a growing set of options is not only accompanied with new opportunities and higher efficiency, it also entails new challenges (Elsinger et al., 2018). For example, new financial products enable a direct matching between savers and investors resulting in the dis-intermediation of finance. For financial inclusion and participation, also the growing complexity of the financial market and the dramatically increasing set of opportunities require a minimum of understanding for economic interrelations and risk (Elsinger et al., 2018).

Informed financial decision making is facilitated by financial literacy. Lusardi and Mitchell (2014) define financial literacy as the “ability to process economic information and make informed decisions about financial planning, wealth accumulation, debt, and pensions” (Lusardi and Mitchell, 2014, p. 6). On the individual-level, financial literacy is a relevant part of poverty prevention having significant impact on saving and debt behavior, stock market participation and diversification, retirement preparation, and eventually how individuals come through financial crises (e.g., Lusardi and Mitchell, 2014).² Thereby, financial literacy directly affects financial sta-

¹ At this point, Fintech describes providers of technological financial innovations, while FinTech describes computer programs and other technology used to support or enable banking and financial services.

² See, for example, literature on financial literacy and saving (Jappelli and Padula, 2013), indebtedness (Disney and Gathergood, 2013), stock market participation (Van Rooij et al., 2011a), portfolio diversification (Gaudecker and Von, 2015), retirement prepara-

bility. Apart from departures from full rationality that explain late mortgage payments and defaults in the recent subprime mortgage crisis, also financial illiteracy contributed substantially to delinquencies and defaults (Akerlof and Shiller, 2010; Gerardi, 2010). As the quality of decision making contributes to market stability, it is of substantial interest of central banks, policy makers, and the public to enhance financial literacy.

In all of the countries studied, most people are relatively poorly financially literate (e.g., Jappelli, 2010; Lusardi and Mitchell, 2014). Despite the importance of financial literacy, little is known about how to enhance it. Socio-demographic differences in financial literacy are well-documented,³ but there is little evidence on the processes explaining the differences. Findings on the effectiveness of financial education, for example, are ambiguous (Amagir et al., 2018). Against the backdrop of the relevance of financial literacy for the financial stability, and given the low levels of financial literacy in a wide range of different countries and little evidence on how to enhance it, in this dissertation, I shed light on this issue. Getting back to the definition of financial literacy provided by, *inter alia*, Lusardi and Mitchell (2014), individuals need to be able to process economic information and use their knowledge to make informed decisions. However, this is based on the prerequisite that economic information is available and accessible. I aim to augment the literature by examining the question of whether and how financial literacy is influenced by the access to and use of information via new information and communication technologies, more precisely the Internet.

As mentioned above, so far, the focus of the financial literacy research is on the effect on pure financial decisions. It provides ample evidence on the beneficial impact of financial literacy on household wealth by affecting, for example, borrowing costs and debt levels, stock market participation, and private retirement preparation

tion (Van Rooij et al., 2012), and financial crises (Bucher-Koenen and Ziegelmeier, 2013; Gerardi et al., 2013).

³ See, for example, Agarwal et al. (2009) on financial literacy and age, Agnew (2010) and Lusardi and Mitchell (2008) on gender, and Van Rooij et al. (2011a,b) on education.

(e.g., Lusardi and Mitchell, 2014). In this dissertation, I further aim to augment the understanding of the influence of financial literacy on decision making beyond pure financial decisions. Financial innovations and financial inclusion can help strengthen opportunities not only for individuals but also for small and medium-sized enterprises, and promote economic growth and wealth (Beck and Demirguc-Kunt, 2006). In the debate on the role of small and medium-sized enterprises in economic development, one strand of literature sheds doubt on a causal link. However, entrepreneurial attitudes do not only stimulate GDP (e.g., Doran et al., 2018). One reason for the lack of contribution of small firms to economic growth is a lack of access to finance (Beck and Demirguc-Kunt, 2006). Access to formal sources of external finance is an important growth constraint for small and medium-sized enterprises, and innovative financing instruments can help facilitate the access to finance (Beck and Demirguc-Kunt, 2006). As stated above, the latest innovations in financial technology offer various new ways to access external finance easier. Thus, the financial technology can serve as new channel for accessing finance through innovative financing instruments. However, these may also require a certain level of knowledge and understanding for financial economic contexts and financial risks from individual investors. This dissertation sheds light on the relation of financial literacy and employment decisions, and provides new insights on the impact of financial literacy on self-employed.

As discussed before, household decision making directly and indirectly affects both labor and financial markets. Both demographic structure and individual labor supply are key factors of economic growth and the financial market (e.g., Bodie et al., 1992; Kelley and Schmidt, 1995; Poterba, 2001; Wei and Hao, 2010). Concurrently with the technological changes in the past decades, demographic structures and the factors of labor supply have evolved - all dimensions mutually reinforcing (e.g., Blau and Kahn, 2007; Ohanian et al., 2008). Particularly in the light of these changes, it is of high importance to understand what drives (changes in) labor supply. Individual decisions about labor supply are determined by socio-demographic characteristics, but also by financial incentives and constraints, such as heuristics, framing, and

market inefficiencies.⁴ Also differences in national institutions, policies, and markets have an influence on individual behavior (e.g., Christelis et al., 2013; Loayza et al., 2000). Moreover, long-term labor supply changes are found to be associated with institutional settings such as tax regulation and welfare policies (e.g., Blundell and MaCurdy, 1999; Mulligan, 2002; Ohanian et al., 2008). Whereas standard economic theory assumes labor supply to fall after positive wealth shocks, empirical studies do not provide unambiguous evidence (e.g., Joulfaian and Wilhelm, 1994; Sila and Sousa, 2014). It seems not sufficient to measure whether aggregated labor changes as consequence of wealth shocks. To understand the response and to develop policy initiatives and frameworks, it is essential to also understand who will change behavior and why. This dissertation aims to augment the understanding of the effects wealth shocks have on labor supply, and focuses on the differences in labor supply response by social factors.

This dissertation consists of three self-explaining essays. The first paper contributes to the literature on determinants and drivers of financial literacy by investigating the effect of Internet use on financial literacy. Studying the role of financial literacy for the likelihood of being self-employed, the second contribution adds to the literature on the effects of financial literacy, on the one hand, and entrepreneurship, on the other hand.⁵ The final chapter deals with the effects of wealth shocks on labor supply, and provides evidence of the impact of windfall gains on retirement.

In “Going Online, Being Financially Literate?”, I present first empirical evidence for the effects of individual Internet use on financial literacy. To address endogeneity in Internet use, I propose an instrumental variable approach that exploits the regional variation in high-speed Internet availability across German administrative districts. The availability of high-speed Internet today depends to a large extent on the telecommunication infrastructure installed in the 1960s. I merge individual-level

⁴ See for more information on behavioral economics, for example, Barberis and Thaler (2003) and Shleifer (2000).

⁵ Chapter 2 is based on a published paper in *Journal of Consumer Affairs* that is co-authored with Walter Hyll (Ćumurović and Hyll, forthcoming).

survey data with unique telecommunication data on high-speed Internet availability, and instrument individual Internet use using the regional coverage of high-speed Internet. I find significant effects of Internet use on financial literacy. Financial literacy increases significantly when individuals have access to web content. A differentiation according to basic and advanced financial literacy shows that Internet use shapes in particular the advanced knowledge about financial markets and less basic numerical issues. Several robustness tests support a causal interpretation of the results.

In “Financial Literacy and Self-Employment”, we study the relationship between financial literacy and self-employment.⁶ We use established financial knowledge-based questions to measure literacy levels. The analysis shows a highly significant and positive correlation between the two measures. We address the direction of causality by applying instrumental variable techniques based on information of maternal education. The results provide support that financial literacy positively affects the probability of being self-employed. Several robustness checks, which take potential endogeneity issues - such as financial socialization and intergenerational transfer of characteristics and wealth - into account, support our interpretation.

“Socio-Demographic Differences in Retirement after Wealth Shocks: Evidence from Germany” investigates the retirement effects of wealth shocks using German survey data. Applying propensity score matching and a discrete time proportional hazards model, I test whether the retirement hazard of recipients and non-recipients differ. I find strong negative employment effects for women after windfall gains. The odds of entering retirement for recipients are about 2 times the odds of entering retirement for non-recipients. Further, I find that anticipation of future shocks affects the retirement effect. The overall effect among women is driven by education, income, and socialization. The retirement effect is particularly high for low-educated women, women with low income, and women from West-Germany, and diminishes among highly educated women, high income women, and women from East-Germany. For

⁶ “Financial Literacy and Self-Employment” is co-authored with *Walter Hyll*. A version of the article has been published in *Journal of Consumer Affairs* (Ćumurović and Hyll, forthcoming).

none of the various specifications I find employment effects among men. Overall, the evidence supports the idea that gender, education, and socialization contribute to labor supply response to wealth shocks.

2 Going Online, Being Financially Literate?

2.1 Introduction

In recent years, financial markets have been in a constant state of flux. New financial services and products are growing rapidly, and small investors can easily access financial markets, for instance, via Internet websites. The Internet has lowered costs of producing financial services (Barber and Odean, 2001), and accessing the Internet changes the set of financial investment opportunities. However, new financial products are not only easily accessible but also very complex. Additional important challenges in Internet-enabled financial products are the dis-intermediation of finance and, thus, the lack of certifiers (Elsinger et al., 2018). Consequently, highly complex and non-transparent products expose especially financially less literate investors to the risk of (unexpected) losses (Lusardi and Mitchell, 2014). The expanded range of options and the complexity require a sufficient level of financial literacy. Thus, financial sophistication is even more important in particular in the context of recent developments in digitalization of financial services.

Since individual financial mistakes can put the financial system at risk, financial literacy can make a significant contribution to the stability of the financial market and the performance of the economy (Gerardi, 2010; Gerardi et al., 2013).¹ Hence, financial literacy and the understanding thereof are more important than ever to protect small investors against financial mistakes and, thus, the efficiency of the financial system. There is a burgeoning literature documenting the beneficial effects of financial literacy on household wealth accumulation by having impact on saving

¹ Investments in ways that are hard to reconcile with standard financial theory are defined as financial mistakes and include, for example, excess interest rate and fee payments, suboptimal use of credit card balance transfer offers, or mis-estimation of the value of one's house (Agarwal et al., 2009; Calvet et al., 2009). Portfolio under-diversification ranks among those mistakes that are potentially most costly (Gaudecker and Von, 2015).

behavior, stock market participation and portfolio diversification, consumer debt and mortgage defaults.² The beneficial effects of financial literacy are thus well documented, however, less evidence exists on how to improve financial literacy. Whereas an expanding strand of literature has considered the effects of financial education and socialization, and found ambiguous results, there is no study on the impact of new media or new information and communications technologies (ICT) on financial literacy.³ In this paper, I proceed into this direction by empirically investigating whether the use of Internet has an impact on financial literacy.

There is reason to assume that the Internet as information and communication technology can contribute to removing of information asymmetries and fostering learning processes and literacy. The Internet provides innumerable opportunities to gather information and knowledge about economics and monetary issues, to receive economic consulting, and it provides platforms for exchange on economic topics. In the course of this, it is the quickest and most up to date mass medium so that knowledge can be kept up to date. The emergence of high-speed Internet extremely lowered the costs of media use and information. Economic news are - mostly free-of-charge - reaching also those who are not actively searching for it. Having (free) access to finance and business newspapers, the financial section of a local or regional newspaper, to tutorials, or guides is cost-reduced in different ways: money, effort and time-saving. By reducing the costs of accessing economic and financial information, the Internet offers more convenient ways of engaging in financial activities. All this makes the Internet a valuable resource for finding out information about a wide range of topics. Information access can diminish differences in knowledge observed between women and men, individuals of different age groups or with difference socioeconomic statuses (e.g. Carpini and Keeter, 1996). Consequently, Internet availability can provide more equality of opportunities and reduce costs of compensating

² See, for instance, Agarwal et al. (2015); Behrman et al. (2012); Disney and Gathergood (2013); Gaudecker and Von (2015); Gerardi (2010); Jappelli and Padula (2013); Van Rooij et al. (2011a).

³ See, for example, Amagir et al. (2018); Gudmunson and Danes (2011).

for information asymmetries.⁴ Therefore, if Internet access not only enables but also leads to regular use of web content,⁵ if therefore, Internet users are more likely to be exposed to (financial) information, and if the Internet allows a better acquisition of information and learning, it can increase knowledge. By fostering the acquisition and processing of economic information and developing the ability to make informed decisions about financial planning and wealth accumulation, the use of web content might enhance financial sophistication. I thus expect Internet use to affect financial literacy positively.

This paper is the first, to my knowledge, to directly examine this hypothesis. For the empirical analysis, I use survey data that provide information on individual Internet access and Internet use, as well as a set of financial literacy questions, which enable generating an index for financial literacy. Furthermore, the data allow controlling for relevant control variables of financial literacy and Internet use. To address endogeneity concerns, I propose an instrumental variable (IV) approach. For this purpose, I merge the survey data with unique telecommunication data on high-speed Internet availability, and instrument the individual Internet use with the regional coverage of high-speed Internet.

The regional variation in broadband Internet availability is on account of the fact that for many years virtually all high-speed Internet connections in Germany have been based on the on a technology that relies on the telephone network architecture that was widely determined in the 1960s. The telephone network infrastructure was provided by a state monopoly with the declared goal to provide telephone service of equal quality to all households (Falck et al., 2014). The underlying idea of the approach is that the acquisition of information and learning is allowed by Internet use, which is facilitated when having access to the Internet. The strategy is based on the assumption that Internet access affects individual financial literacy only through

⁴ The transparency of price information, for example, enables removing of traditional information asymmetries, which exist between buyers and sellers (Grewal et al., 2003).

⁵ A broadband connection increases the probability of engaging in a variety of online activities (Best and Krueger, 2005; Grubestic and Murray, 2002).

the individual use of the Internet.

The empirical investigation reveals a positive and statistically significant effect of Internet use on financial literacy. Persons who have access to web content are found to have significantly higher levels of financial literacy even after controlling for individual characteristics, financial socialization, and resident change. Internet users achieve about 26 percentage point higher financial literacy scores than non-users. A detailed examination shows that it is especially the advanced knowledge on financial markets and types of investment that is shaped by the use of web content, whereas basic financial knowledge is less affected. Several robustness tests support a causal interpretation of the results. The remainder of the paper is organized as follows. In Section 2.2, I introduce the identification strategy. Section 2.3 describes the microeconomic data, and provides descriptive statistics. In Section 2.4, I present the regression results, discuss the robustness of the results, and provide extensions to the regression model. Section 2.5 concludes.

2.2 Identification Strategy

The main aim of this study is to provide an estimate of the relationship between Internet use and financial literacy. For this purpose, I start with the following linear specification:

$$FL_i = \beta_0 + \beta_1 Internet_i + \beta_2 X_i + \beta_3 reschange_i + \epsilon_i \quad (1)$$

where FL_i denotes the financial literacy index of individual i . $Internet_i$ is the covariate of interest that represents the measure for Internet use for each individual. The vector X_i contains a set of individual demographics, which are related to financial literacy, such as age, gender, and education (e.g., Gudmunson and Danes, 2011). The binary variable $reschange_i$ denotes a change of residence up to the year in which

Internet use and the control variables are measured.

Using the Internet may be endogenous to financial literacy. Hence, a causal interpretation of the simple linear regression models is hindered by different endogeneity concerns that need to be addressed in identifying the effect of Internet use on financial literacy. For example, reverse causality may arise if individuals who are more interested in financial issues are more likely to subscribe to Internet service particularly because they are more interested and would like to use the Internet to get better information on financial topics or financial advice.

Another source of endogeneity concerns are omitted variables. Individuals may have unobservable characteristics that influence both Internet use and financial literacy. Indeed, descriptive statistics of the data used in this empirical analysis (in Section 4.3) show, for instance, differences in education between Internet users and non-users and a positive association between education and financial literacy. Also I find a gender gap in both Internet use and financial literacy.

Yet, selection may also operate so that less literate, less informed individuals subscribe to Internet service because they have less opportunities to gather information on financial issues from other sources like financial advisors among family and friends. Since financially literate individuals are more likely to consult advisors (Calcagno and Monticone, 2015), they might be less likely to subscribe to Internet services to gather information and advice on financial topics.⁶

2.2.1 Empirical Identification

I address endogeneity in Internet use by proposing an instrumental variable approach. A valid instrument should exhibit meaningful correlation with individual Internet use, but no correlation with the error term, and affect financial literacy only through

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In particular, financial advice is found to rather serve as a complement to than a substitute for financial literacy. Persons with higher educational attainment, income, and levels of financial literacy are most likely to receive financial advice (Calcagno and Monticone, 2015; Collins, 2012).

this channel and not through other unobserved factors (Cameron and Trivedi, 2005).

For this purpose, I exploit a historical peculiarity in the regional variation in high-speed Internet availability in Germany. The foundation of the main infrastructure of high speed Internet was laid in the 1960s in West-Germany (at a time when this infrastructure was intended to serve as telephone service only) and in the 1990s in East Germany. A number of studies exploits the quasi-experimental setting in West- and East-Germany and the variation in access to broadband Internet (e.g., Bauernschuster et al., 2014; Bertschek et al., 2013; Czernich, 2012; Falck et al., 2014). I instrument the individual Internet use with the regional coverage of high-speed Internet within the administrative district the individual is living in, a strategy that is proposed in the literature (e.g., Bertschek et al., 2013).

2.2.2 Internet in Germany

Virtually all high-speed Internet connections in Germany have been based on the digital subscriber line (DSL) technology for many years (Falck et al., 2014). The first generation of DSL technology relies on the telephone network architecture, which was widely determined in the 1960s.

In the 1960s, the telephone network was a state monopoly, and the declared goal was to provide a universal telephone service to all households (Falck et al., 2014). The availability of telephone services depended on a (copper wires) connection between a main distribution frame (MDF) and the household. For the quality of telephone services, the distance between the MDF and the household (i.e., the length of the copper wires) was irrelevant. Hence, as soon as a household was connected to an MDF, there was no variation in the availability and quality of telephone service across regions. Only such constraints as the availability of a physical infrastructure (such as lots and buildings for the constructions of the MDFs) determined the choice of the MDF positions.

Contrary to the telephone services, the DSL network quality crucially depends on the length of the copper wires today: As soon as a threshold is exceeded (4,200m),

the DSL service is no longer accessible (Falck et al., 2014).

Since the basic structure of the West German public switched telephone network was widely determined in the 1960s, the availability of high-speed Internet today depends to a large extent on the telecommunication infrastructure installed in the 1960s.

Figure 2.1 presents the context graphically: Using data on the positions of more than 8,000 MDFs (provided by the Federal Ministry of Economics and Technology, BMWi, 2009) I first plot the exact locations of all MDFs in the districts (black dots) and then the 4,200m-radius (white area) of each of the MDFs. Thus, the white area corresponds to the area that is covered by the MDFs, while the green area is not covered.

In East-Germany, the variation in the Internet availability comes from another source: In the 1990s, after the German reunification, there was an enormous lack of telephone access lines. In consequence, the East German telephone network was updated (Bauernschuster et al., 2014; Czernich, 2012; Falck et al., 2014). Instead of copper wires, optical network elements (a special type of fiber wires) were applied in East Germany. The latter were supposed to be the forward-looking and the primary technology for the telecommunication services in the future. But it was not the optical network technology that became the leading standard of access technologies in the following years in Germany, it was the DSL technology. The optical network technology, however, is not suitable to be upgraded to DSL. The preferred DSL technology requires a continuous copper line and does not work on passive optical fibers.⁷ Now, providing DSL in areas with the optical network technology is much more costly than in areas in which the telephone network is completely based on copper wires, such that the roll-out of DSL is strongly hampered for the former.

⁷ In fact, there are already fibre-optic data transmission technologies but the technology is so expensive that it is even more profitable to tear open the streets again, lay a copper cable next to the fibre optic cable and purchase the technology for copper (Czernich, 2012).

2.3 Data and Descriptive Analysis

For the empirical analysis I employ survey panel data that allows measuring individual Internet use, quantifying financial literacy, and taking relevant individual characteristics into account. I merge the survey data with telecommunication data on high-speed Internet availability to instrument the individual Internet use with the regional coverage of Internet.

2.3.1 The SAVE study

The German individual-level panel data of the SAVE study are provided at the administrative district-level. The representative household panel covers the period 2001-2013 and focuses on saving behavior and asset accumulation of private households (Börsch-Supan et al., 2008). I draw the main data from the 2007-2009 surveys that include information on Internet access and Internet use such as a set of eleven financial literacy questions. The data set further provides information on socio-demographic characteristics.

Financial Literacy The outcome variable is a financial literacy index that is derived from financial literacy questions. The 2009 SAVE data contain a set of 11 questions related to basic and advanced financial subjects. Four questions are used to quantify a basic understanding of interest rates (simple compound interest calculations), inflation, and money illusion.⁸ Further five questions cover the knowledge of financial market issues, such as of portfolio diversification, volatility, the stock market, mutual funds, and bond prices. Two more questions refer to characteristics of the German statutory pension insurance (the amount of the contribution rate and the use of the contributions).

In line with existing studies, I define the first four questions as basic financial lit-

⁸ The precise wording of these questions is given in the Appendix A.

eracy questions and the latter as advanced questions (e.g., Van Rooij et al., 2011a,b, 2012). Following recent studies, the financial literacy index indicates the total number of correct answers in response to the eleven questions (e.g., Van Rooij et al., 2011a, 2012). I apply the percentage of correct answers in the regressions for reasons of comparability.

Internet Use The explanatory variable quantifies the individual Internet use. Up to and including 2008, individuals were asked whether they have access to the Internet (*Yes/No*), and how often they use the Internet (*Less than once a month, At least once monthly, Several times per week, Daily*). In line with observations in the existing literature (e.g., Best and Krueger, 2005), the descriptive statistics of the data show that once individuals have Internet access, they use it regularly (see Section 2.3.3). Hence, I define the explanatory variable *Internet use* as a binary variable being one if the individual has access to the Internet and use it regularly and zero if the individuals has no access to the Internet.

2.3.2 The Broadband Atlas

For the empirical investigation, I employ data on DSL high-speed Internet availability from the *broadband atlas* (“Breitbandatlas Deutschland”) published by the Federal Ministry of Economics and Technology (BMWi, 2009; Falck et al., 2014). Telecommunication providers report the number of households that are covered by their high-speed Internet networks within municipalities. The data are available for the years 2005-2008. Since the SAVE data is provided on the district level, information on the share of households that are covered by DSL technology is aggregated to the district level. The variable *DSL* indicates the percentage share of households that are covered by DSL technology within an administrative district, and serves as instrumental variable for the individual Internet use in the empirical analysis.

2.3.3 Descriptives Statistics

Demographics The literature shows that financial literacy particularly varies with age, gender, and educational level (Gudmunson and Danes, 2011). To estimate the effect of Internet use on financial literacy I include these demographics in the empirical analysis. Therefore, I provide descriptive statistics for these variables in the following.

Table 2.1 presents descriptive statistics for the variables of the regression sample by Internet access. The data show that in 2008, 71% of the individuals had access to the Internet and 91.3% of the respondents with Internet access used the Internet daily or several times per week, while only 2% of them use the Internet less than once a month. This confirms that once people have Internet access they use it regularly.⁹ The summary statistics further show that the share of women is higher among individuals without Internet access and that Internet users are considerably younger than non-users. The observations of the sample are in accordance with the Internet usage patterns of the German population (Forschungsgruppe Wahlen e.V., 2018).

To control for differences in education I determine the educational achievement using two measurements provided by the SAVE study. First, I define individuals' highest school leaving-qualifications (in three categories: *Basic school qualification*, *Secondary school certificate*, and the high school graduation *Abitur*). In addition, I take the vocational qualification into account. Thereby, I classify the qualification levels in compliance with existing research (e.g., Van Rooij et al., 2012) and according to the International Standard Classification of Education (ISCED) in four categories: *Vocational training*, *Master craftsman training*, *University education*, and a fourth group that captures the response categories *No vocational education* and *Other vocational education*.

The descriptive data show that Internet users are better educated than non-users

⁹ A broadband connection increases the probability of engaging in a variety of online activities (Best and Krueger, 2005; Grubestic and Murray, 2002).

(Table 2.1). Both measurements indicate higher educational levels among individuals with Internet access compared to individuals without access. These findings also reflect observations of the German population (Forschungsgruppe Wahlen e.V., 2018).

Financial Socialization A young strand of literature shows that state-dependent financial socialization is a determinant of future financial literacy. Bucher-Koenen and Lamla (2014) find a financial literacy gap between East and West German individuals, 20 years after reunification. In addition, state dependent socialization plays a crucial role in people’s trust, for example, in democratic institutions, banks, and media (e.g., Mishler and Rose, 1997; Stix, 2013; Tsfati and Ariely, 2014). Guillén and Suárez (2005) argue that cross-national differences in Internet use are the consequence of economic, regulatory, and socio-political characteristics of the countries. Therefore, it is conceivable that the state-dependent socialization of East and West-German individuals does not only affect financial literacy but also the use of the Internet as source of information. In the empirical investigation, I therefore will control for potential channels and apply a binary variable that is one if the respondent graduated from school in the GDR and zero otherwise.

Besides the educational achievement, the economics education at school can be an important factor of financial literacy (e.g., Van Rooij et al., 2012). In Germany, there is no comprehensive economics education during school. Only in exceptional cases, individual schools offer business-related or economic-related classes. SAVE provides self-assessed information on how intensively respondents dealt with economic topics during their school years. I quantify the economics education on a three point-scale (low, medium, and high) and include the self-assessed information as further measure for the financial socialization in the empirical analysis.

Cognitive ability and financial literacy are found to be correlated (Lusardi et al., 2010). Furthermore, cognitive processes may be influenced by the Internet (Johnson, 2006). Particularly among the elderly, cognitive ability may be related to motivation to become an Internet user (Freese et al., 2006). Against the backdrop of the

relevance of this characteristic, I add a proxy for the individual's cognitive ability in the model as proposed in the literature (Christelis et al., 2010). Three mental exercises are included in the SAVE survey and used to construct a cognitive ability measure. The cognitive ability index yields the number of correct answers to the three questions (0-3).¹⁰

The descriptive statistics in Table 2.1 show no difference in Internet use by East/West German origin and economics education during school.¹¹ When descriptively comparing the outcomes of the mental exercises of Internet users and non-users, I see a similar pattern as for the educational levels, which are also compliant with literature. Cognitive ability is higher among Internet users: they answer 1.4 out of 4 questions correctly, while non-users answer only 0.8 questions correctly.

Financial Literacy In Table 2.2, I provide summary statistics of financial literacy levels by demographics. In total, the average number of correct answers to the 11 financial literacy questions is 6.2. On average, 2.9 out of four basic questions and 3.3 out of seven advanced questions are answered correctly. The average number of correct answers on all questions is significantly higher among men (6.8) than women (5.7), supporting the observations of a gender gap in financial literacy (e.g., Lusardi and Mitchell, 2008). Furthermore, the descriptives show that financial literacy increases with both school leaving qualification and vocational qualification. This observation is also consistent with existing studies (e.g., Lusardi and Mitchell, 2008; Van Rooij et al., 2011a,b). In addition, financial literacy also increases with self-assessed economics education and cognitive ability. The difference in financial literacy scores of West Germans and East Germans is relatively small.

I further observe that the average number of correct answers to the financial literacy questions is remarkably higher among individuals who have Internet access (6.8) than among those without Internet access (4.9). This supports the notion that

¹⁰ The precise wording is given in the Appendix A.

¹¹ Additional two-sample t-tests with equal variances indicate no significant differences.

Internet use relates positively to financial literacy.

2.4 Empirical Results

In this section, the results of the linear estimations and instrumental variable estimations are presented and discussed. In all regression models, the outcome variable is the financial literacy index, and the explanatory is a binary variable capturing individual Internet use. The instrumental variable measures the Internet availability within the administrative district. In all specifications, I cluster standard errors at the district level in order to account for different covariance structures within the data that vary by districts.

2.4.1 Internet and Financial Literacy: Linear Regression

In testing the relationship of Internet use and financial literacy, I start the empirical investigation with a look at simple cross-section associations according to Equation (1). Table 2.3 presents the OLS regressions of financial literacy on Internet use and demographic covariates. The first specification of the linear regression (Column 1) includes the basic socio-demographic control variables age, gender, school leaving-qualification, and vocational training. To address the aspect of spatial sorting, all specifications further include a binary control variable indicating a resident change before 2008. The results indicate a positive and statistically significant association between Internet use and financial literacy conditional on the covariates. I further see that being male and highly educated is positively associated with financial literacy. Financial literacy further slightly increases with age. These results are in line with findings of the existing literature (e.g., Gudmunson and Danes, 2011).

In the second specification (Column 2, Table 2.3), I further include the controls for financial socialization to address a potential socialization channel. It includes a binary variable for education in the former GDR, a control for economics educa-

tion during school, and a proxy for cognitive ability, in addition to the basic socio-demographics. The results support the observation that Internet use and financial literacy are positively associated. The positive correlations between financial literacy and the covariates male, age, and education also remain. Financial literacy is further positively associated with a West-German origin, economics education during school, and cognitive ability.

The estimates are in line with the hypothesis that Internet use is positively related to financial literacy, even after taking demographic characteristics into account, and also confirm the relevance of the covariates in estimating financial literacy effects. However, a causal interpretation is hindered by different endogeneity concerns that are discussed in Section 2.2. In the following section, I present the results from an instrumental variable approach.

2.4.2 Internet Use and Financial Literacy: Instrumental variable regressions

Table 2.4 presents the regression results of the IV model. The first specification includes the basic control variables that are found to be related to financial literacy (age, gender, and education) and a control for changes in individuals' residence before 2008 to tackle the issue of spatial sorting (Columns 1 and 3 in Table 2.4). To address potential financial socialization channels, I include controls for financial socialization (GDR, economics education, and cognitive ability) in the second specification (Columns 2 and 4 in Table 2.4).

The first stage regression results in Table 2.4 (Column 1 and 2) show that Internet availability has a positive and statistically significant effect on individual Internet use. Not only is the instrumental variable statistically significant, but the F-statistics are relatively high to avoid the weak instruments problem. Further, the underidentification test indicates that the model is identified, i.e., that the excluded instruments are correlated with the endogenous regressors and, thus, are relevant. Therefore, the regional Internet availability instrument is a strong predictor for the actual individ-

ual Internet use. Living in an area with a high Internet availability is a relevant instrument for individual Internet use. The results remain robust once I add the controls for socialization.

Having a look at the effects of further control variables, the results are also essentially in line with previous findings. Men are more likely to use the Internet than women, and Internet use decreases with age. The effects of education, both school leaving qualification and vocational qualification, are positive and statistically significant pointing to a positive relation between educational achievement and Internet use. These findings are in accordance with the actual Internet usage patterns of the German population (Forschungsgruppe Wahlen e.V., 2018).

Turning to the second stage results in Table 2.4 (Column 3 and 4), I find a positive and statistically significant effect of instrumented Internet use on financial literacy. Persons who use the Internet regularly achieve substantially higher financial literacy levels. This is in accordance with the proposed information channel. The effect is not only statistically but also economically significant. The magnitude implies that using the Internet leads to 26% higher financial literacy scores once controlling for financial socialization. Relative to the general education measures, Internet use has a relevant effect on financial literacy. By comparison: Having the highest school leaving-qualification (*Abitur*, compared to the lowest level of school leaving-qualification) is associated with 7.5% higher financial literacy scores, and having a higher level qualification with 5.5% higher scores (compared to no vocational qualification).

Turning to the estimates of the control variables, the results are in essence in accordance with previous findings. I find significant lower financial literacy levels of women than men (e.g., Agnew et al., 2008) and a strong positive association with educational achievement (e.g., Lusardi and Mitchell, 2008). Additionally, my results confirm that financial literacy is positively related to cognitive ability (e.g., Lusardi et al., 2010) and that dealing with financial issues during the school years affects financial literacy in adulthood positively (e.g., Van Rooij et al., 2012). Furthermore,

compared to West German peers, individuals from the former socialist GDR perform weaker. However, the effect is not statistically significant.

In all IV specifications, the effect of Internet use on financial literacy is larger than the linear regression estimate, which implies a downward bias in the OLS estimation (see also Bauernschuster et al., 2014; Bertschek et al., 2013). One possible explanation for higher IV estimates is that an attenuation bias caused by measurement error of Internet use reduces the OLS estimates.¹² Using an independent source of information about the Internet availability as instrument can solve the attenuation bias.

Another potential explanation is the local average treatment effect (LATE) in an IV approach. Applying the linear regression model yields the average treatment effect over the entire population, while applying the IV model yields the local average treatment effect. The IV approach identifies the treatment effect for the subpopulation of compliers. They change their treatment status due to the variation induced by the instrument. In this case, these are individuals who do not have Internet access for the exogenous reason of living in an area without Internet availability, but would otherwise use the Internet.

A third possible explanation is that the upward bias is diminished by the downward bias. This is the case if the sample contains individuals who avoid being exposed to financial information disproportionately select into using the Internet because it provides (i) the opportunity to carry out other activities in a targeted manner, for example, to read other content in a targeted way, or because it provides (ii) alternatives to how one does not have to educate oneself financially in order to make decisions, for example, to make use of financial consultation.

Basic and Advanced Financial Literacy It is conceivable that using web content will not enhance financial knowledge in all fields. In order to understand

¹² In recent studies on the effect of education on income using IV techniques IV estimates are larger than OLS estimates. The reason for this is often given with measurement errors in the explanatory variable. See for an overview, for example, Card (2001).

whether using web content affects certain fields of financial knowledge, and because the effect might differ at different levels of financial literacy, I re-estimate the model with different financial literacy indices. I start with the basic financial literacy index that captures the four basic financial literacy questions, and continue with two advanced indices (see Section 2.3). The first advanced index contains advanced questions on the financial market only, the second contains two further questions on the German statutory pension insurance (see Section 2.3). The results of the model on basic and advanced financial literacy are presented in Table 2.5 and support the interpretation of the main model results. The effect of the instrumental variable is statistically significant, and the first stage F-statistic are of similar magnitude (Column (1), Table 2.5). This confirms that the instrumental variable is a relevant instrument for the individual Internet use.

The second stage results confirm positive effects of Internet use on financial literacy (Columns (2)-(4), Table 2.5). The financial literacy effect is positive and statistically significant for advanced financial literacy. The effect on basic financial literacy is considerably lower and not statistically significant. The difference in magnitudes and significance suggests that the use of web content is more relevant for more complex issues than for basic questions. Yet, the effect is reduced to some extent when including specific questions on the German statutory pension insurance.

Subsequently, I re-estimate the effects on single financial literacy questions. Turning to the results, I see a pattern in the effects that confirms the former observation (Table 2.6). Internet use mainly has an impact on the advanced knowledge of the financial market. While it hardly affects the compounding interest effect questions, for example, mainly the knowledge on characteristics of the stock market is affected by the use of web content. The estimates for the knowledge on (i) bond prices, (ii) stock market, (iii) money illusion, and (iv) mutual funds are substantially higher than for other questions and statistically significant. Also the knowledge on the pension insurance fund seems to be less affected by Internet use.

The results confirm the findings of the previous specification, and indicate that

Internet use will not necessarily improve the calculation of interest rates, but it does affect the knowledge on characteristics and elements of the stock market.

2.4.3 Extensions and Robustness Checks

Financial Socialization Financial socialization during childhood affects financial literacy, attitudes, and behavior. Two factors are in focus of research on the promotion of financial literacy: First, the economy and politics of a country (Bucher-Koenen and Lamla, 2014; Jappelli, 2010) and second, and apparently more important, the parental financial socialization as a trigger for the transmission of financial literacy (Hancock et al., 2013; Kim and Chatterjee, 2013). Shim et al. (2010) argue that the parents are the key socialization mediators so that their behavior is dominant in their children’s financial socialization. The parental behavior and orientations as well as perceived parental influence have a clear impact on the children’s economic behavior as well as financial attitudes and behavior in adulthood (Jorgensen and Savla, 2010; Webley and Nyhus, 2006). The interaction, especially through learning from and discussing with the parents, is a trigger for the transmission of financial literacy (Shim et al., 2010).

Thus, I now turn to see whether the estimates change after I control for this potential channel of acquiring financial literacy. In the main model, I already account for state-dependent socialization (GDR), economics education during school, and cognitive ability. The SAVE data provide further information on the perceived parental influence during childhood, which I use as proxies for socialization.

The data set contains information about pocket money habits during the respondent’s childhood. For instance, receiving pocket money in childhood has an impact on financial confidence in adulthood, and teaching budgeting and encouraging to save positively affect financial literacy of the adult children (Grohmann et al., 2015; Sansone et al., forthcoming). Following the existing literature, I include information on (i) whether respondents received pocket money regularly and (ii) whether they spent that pocket money immediately (both on a 11 point-scale) as proxies for

parental influence and, thus, for financial socialization by the parents.

Table 2.7 (Column 2) reports the IV estimates of the effect of Internet use on financial literacy to which, in addition to the control variables used in the main model, I add the information about pocket money during childhood. The IV estimates of Internet use are barely affected by the addition of these variables. The results of both first stage (Table A.2 in the Appendix) and second stage (Table 2.7) regressions hardly change, and the first stage F-statistic is of similar magnitude. I find that the proxies do not matter for financial literacy beyond the effects of the explanatory variables discussed previously. Thus, Internet use has a positive effect on financial literacy beyond the parental influence through pocket money habits when controlling for the education, economics education, and state-dependent socialization.

Next, I test on the indirect influence of parental financial factors and use information about the respondent's parents as perceived by the respondent. I include a variable that measures parents' understanding of financial matters on a three point-scale (low, medium, high) and information on whether the parents keep (or have kept) private accounting records, in the next specification (following, e.g., Alessie et al., 2011; Van Rooij et al., 2011a).

Column 3 in Table 2.7 presents the estimates to which I add the characteristics of parents in addition to the control variables used in the main model. The IV estimates of Internet use remain positive, statistically significant, and do not change substantially in magnitude. Whereas I find no effect of the added proxies on financial literacy beyond the effects of the explanatory variables discussed previously, the effects of the other covariates do not change. The results support the interpretation that Internet use has a positive effect on financial literacy above and beyond parental characteristics once I control for education and socialization.

In the last specification (Column 4 in Table 2.7), I add all discussed financial socialization proxies in addition to the controls used in the main model to the regression. The estimates of Internet use are barely affected by the addition.

The main results are robust to all specifications. The instrumental variable has

strong predictive power for individual use: The F-statistics of the excluded instruments range from 28.4 to 34.4, and confirm that living in an administrative district with a high coverage of high-speed Internet is a relevant instrument for individual Internet use. The estimates of instrumented Internet use on financial literacy remain positive, statistically significant, and of similar magnitude. The effect confirms that Internet use can increase financial literacy levels by approximately 26 percentage points. The significant coefficients of age, gender, and education hardly change once I add proxies for socialization, while the coefficients of most of the added variables are relatively small and statistically not significant. In sum, Internet use has an effect on financial literacy beyond the potential effects of financial socialization.

Finally, I carry out estimates of the effect of Internet use on advanced financial literacy (see Table A.1 in the Appendix). All specifications are applied on the advanced financial literacy index described in Section 2.3. The results confirm that the use of Internet content is in particular relevant for advanced financial knowledge. The marginal effects are substantially higher compared to the specification on the general financial literacy index.

Employment and Income Financial literacy is shown to be related to wealth and labor market characteristics (Ćumurović and Hyll, forthcoming; Monticone, 2010; Van Rooij et al., 2011b). For example, Monticone (2010) finds that wealth can have a positive but small effect on the degree of financial knowledge. Also having Internet access at home might be related the employment and income. Especially in the beginning of the establishment of home high speed Internet, the costs of subscription to the Internet were relatively high. It is therefore likely that low income households could not afford an Internet service subscription and therefore were less likely to use web content. Furthermore, labor market status and type of employment are also likely to be related to an Internet subscription. For example, employed persons might be more likely to subscribe to Internet services than unemployed due to their employment, or self-employed might rather subscribe to Internet services than wage workers by reason of their work in the own businesses.

In the main specification, income and wealth controls such as occupations are not included in the regressions as they could be outcome variables, too (Behrman et al., 2012; Ćumurović and Hyll, forthcoming), and may induce endogeneity issues. To test the robustness of the core results, wealth proxies and labor market controls are included in the next specifications. First, a control for the occupational status is added to the model. Binary variables indicate occupational statuses as blue-collar worker (base category), white-collar worker, civil servant, self-employed, and non-working.¹³ Secondly, an income control variable and a homeownership dummy variable as proxy for household wealth are included in the next specification. Finally, to test for the intergenerational wealth transmission information on windfall gains such as inheritances (financial assets and real estate) and gifts as well as regular financial support payments as proxies for wealth transmission are added to the model. In the last specification, I add all discussed wealth proxies in addition to the controls used in the main model to the regression.

Table 2.8 presents the IV results from the specifications including occupational status (Column 2), wealth controls (Column 3), and controls for wealth transmission (Column 4). The estimates hardly differ from the core results, and affirm a positive and statistically significant effect of Internet use on financial literacy. The identification statistics confirm the relevance of the instrument.

We also find that financial literacy does indeed have a relation to wealth. The homeownership is positive and statistically significant, and the windfall coefficients indicate a positive relation (though not statistically significant), too. Furthermore, the results from first stage regressions confirm that Internet use is positively associated with wealth (see the first stage results in Table A.3 in the Appendix).

Regional Centers It is likely that in densely populated areas the share of households with a broadband Internet connection is disproportionately higher than in sparsely populated areas. Therefore, I account for the size of the place of residence,

¹³ The term non-working here refers to all respondents who state not employed or not applicable when asked about their type of employment.

in the following specifications. The data provide information on the size of the municipality as categorical variable with ten categories. This control variable is included in the subsequent specifications. Furthermore, I re-estimate the model on different subgroups: I exclude observations living in (i) cities with more than 500,000 inhabitants, and (ii) cities with more than 100,000 inhabitants or the outskirts of cities with more than 500,000 inhabitants.

Table 2.9 presents the estimates of a specification relating to the main model, including a municipality size control variable and (1) excluding observations living in large municipalities (more than 500,000 inhabitants) or (2) excluding observations living in municipalities with more than 100,000 inhabitants or in the outskirts of large municipalities (with more than 500,000 inhabitants).

Taking the size of the place of residence into consideration does not change my baseline results. Although, I loose a third (2) and nearly a half (3) of my observations, respectively, the variables of interest remain statistically significant and similar in magnitude. In spite of the sharp decline in sample size, the first stage F-statistics of the excluded instruments remain relatively high. Thus, taking densely populated places of residence into account does not take away the importance of Internet use for financial literacy.

Resident Change All previous specifications include a binary control variable that indicates a resident change before 2008 to address the issue of spatial sorting. Nevertheless, it cannot be completely ruled out that financially educated people have sorted themselves in areas with high Internet availability.

To test the robustness of the results, I re-estimate the effects in a specification (i) without controlling for resident changes before 2008, (ii) controlling for residence change and differentiating between moves to municipalities with higher and lower Internet availability, (iii) excluding all individuals who have changed their residence before 2008. When taking resident changes into account, I find that the results are barely affected (Table 2.10). The IV estimates of the variables of interest do not change.

A closer look at the data shows that in the baseline analysis sample of 1,501 individuals only 18 have changed their state of residence in the previous years. On the one hand, I can assume that a potential bias due to always-takers is rather marginal since the number of those moving is relative small. On the other hand, I find no difference in financial literacy between individuals who moved and did not move. Comparing the financial literacy scores of persons moving and persons not moving suggests no disproportionately higher levels for moving than non-moving individuals. A two-sample t-test of financial literacy by resident change yields an insignificant difference in means of financial literacy.¹⁴

2.5 Summary

Financial literacy is shown to beneficially affect household financial decision making and wealth and, thus, to have an impact on financial stability. So far, the literature has been able to detect socio-demographic differences in financial literacy. Yet, there is little evidence on the processes explaining these differences, and studies on the effect of financial education find rather ambiguous conclusions. This study is, to the best of my knowledge, the first to investigate the financial literacy effects to Internet use.

Based on German individual level-data, I measure financial literacy using financial literacy questions that are widely applied in the literature. The data allow to control for the most important characteristics that are found to be associated with financial literacy and Internet use.

I merge the survey data with telecommunication data on high-speed Internet availability at the administrative district-level, and instrument individual Internet use with Internet availability. The underlying idea is that the acquisition of informa-

¹⁴ The two-sample t-test using groups (move before 2008) yields $t = -0.9065$; $\Pr(|T| > |t|) = 0.3648$ for c.

tion and learning is allowed by Internet use, which is facilitated when having access to the Internet. The strategy is based on the assumption that the Internet access at the district level affects individual financial literacy only through the individual use of the Internet.

First, I find that Internet use is systematically related to higher financial literacy levels. The results are robust to different specifications with respect to financial socialization and wealth. Secondly, a closer look at the financial literacy questions shows that Internet affects especially advanced financial literacy. Using web content thus shapes primarily advanced knowledge about, for example, the stock market and types of investment, and less basic knowledge concerning compound interest or inflation. Also specialized knowledge on the characteristics of the German statutory pension system is shown to be less affected. These findings support the proposed information channel stating that Internet users seem to be more likely to be exposed to financial information that improves financial literacy.

By providing first evidence of the effects of Internet use, this study contributes to the literature on financial literacy. Empirical insights on the formation of financial literacy are rare, and findings are mixed. I show that Internet access and the use of it can contribute to the promotion of financial knowledge, and add to the understanding of the formation of financial literacy.

The results further contribute to a young literature that focuses on the impact of new information and communication technologies. While Internet use is found to be positively related to income and social capital, the effect on educational achievement is not straightforward (e.g., Bauernschuster et al., 2014; Falck et al., 2016). My results suggest that Internet use can help to overcome information asymmetries, close literacy gaps, and improve informed financial decision quality.

2.6 Tables

Table 2.1: Descriptive Statistics by Internet Access

Variable	Full Sample		Internet		No Internet	
	Mean	S. D.	Mean	S. D.	Mean	S. D.
Male	0.48	0.50	0.52	0.50	0.41	0.49
Age	53.78	14.60	50.22	13.92	62.34	12.52
School leaving qualification						
Basic	0.30	0.46	0.22	0.41	0.51	0.50
Secondary	0.37	0.48	0.38	0.49	0.33	0.47
<i>Abitur</i>	0.33	0.47	0.40	0.49	0.16	0.36
Vocational qualification						
No/other	0.13	0.34	0.11	0.31	0.2	0.40
Vocational training	0.62	0.48	0.60	0.49	0.67	0.47
Master craftsman	0.08	0.26	0.08	0.27	0.06	0.24
University degree	0.17	0.37	0.21	0.41	0.07	0.26
GDR	0.27	0.44	0.27	0.44	0.28	0.45
Economics education						
Low	0.38	0.49	0.37	0.48	0.40	0.49
Medium	0.51	0.50	0.51	0.50	0.50	0.50
High	0.11	0.32	0.12	0.32	0.10	0.31
Mental exercises						
0	0.35	0.48	0.29	0.45	0.49	0.50
1	0.26	0.44	0.26	0.44	0.27	0.44
2	0.23	0.42	0.25	0.44	0.17	0.38
3	0.16	0.37	0.20	0.40	0.07	0.25
Average	1.21	1.09	1.37	1.10	0.82	0.95
Internet use	0.71	0.46				
Frequency:						
Less than once a month	0.02	0.12	0.02	0.14		
At least once monthly	0.05	0.22	0.07	0.26		
Several times per week	0.21	0.40	0.29	0.45		
Daily	0.44	0.50	0.62	0.49		
<i>N</i>	1,501		1,061		440	

Note: This table shows descriptive statistics for the main variables used in the analysis by Internet access. The definitions of variables are given in Section 2.3. Shares do not sum up to 1 because of rounding.

Table 2.2: Financial Literacy by Characteristics

	N	Mean	Std.Dev.	Min	Max
Financial literacy	1.501	6.20	2.71	0	11
Basic financial literacy	1.501	2.91	1.21	0	4
Advanced financial literacy	1.501	3.29	1.87	0	7
<hr/>					
Financial literacy					
Male	729	6.76	2.57	0	11
Female	772	5.68	2.73	0	11
School leaving qualification					
Basic	454	5.21	2.75	0	11
Secondary	554	6.02	2.69	0	11
<i>Abitur</i>	493	7.32	2.26	0	11
Vocational qualification					
Vocational training	934	5.96	2.67	0	11
Master craftsman	113	7.24	2.33	0	11
University degree	253	7.46	2.20	0	11
None/other	201	5.18	2.94	0	11
East Germany (GDR)	403	6.10	2.54	0	11
West Germany (FRG)	1098	6.24	2.77	0	11
Economics education					
Low	568	5.93	2.77	0	11
Medium	761	6.10	2.68	0	11
High	172	7.37	2.40	0	11
Mental exercises					
0 correct	521	4.91	2.60	0	11
1 correct	393	6.09	2.52	0	11
2 correct	344	7.18	2.38	0	11
3 correct	243	7.78	2.27	0	11
Internet	1.061	6.75	2.53	0	11
No Internet	440	4.89	2.67	0	10

Note: This table shows the means of financial literacy scores of the regression sample by characteristics. *Financial literacy* gives the number of correct answers on the total of eleven financial literacy questions, *basic financial literacy* the number of correct answers on four basic questions, and *advanced financial literacy* the number of correct answers on seven advanced questions (see Section 2.3).

Table 2.3: Financial Literacy and Internet Use: Linear Regressions

	Financial Literacy	
	(1)	(2)
Internet use	0.129*** (0.014)	0.102*** (0.013)
Male	0.066*** (0.011)	0.045*** (0.011)
ln(age)	0.039** (0.020)	0.033* (0.018)
School leaving qualification (base: basic):		
Secondary	0.047*** (0.015)	0.039*** (0.014)
<i>Abitur</i>	0.136*** (0.018)	0.104*** (0.017)
Vocational qualification (base: none/other):		
Vocational training	0.045*** (0.017)	0.036** (0.016)
Master craftsman	0.104*** (0.027)	0.086*** (0.026)
University degree	0.060*** (0.023)	0.043** (0.021)
GDR		-0.022 (0.014)
Economics education (base: low):		
Medium		0.002 (0.011)
High		0.083*** (0.016)
Mental exercises (base: 0 correct answers):		
1 correct		0.080*** (0.014)
2 correct		0.158*** (0.015)
3 correct		0.184*** (0.017)
Resident change	Yes	Yes
<i>N</i>	1501	1501

Note: This table reports OLS estimates of the effect of Internet use on financial literacy. *Financial literacy* is defined as the percentage of correct answers to 11 financial literacy questions. *Internet use* is a binary variable indicating whether the individual uses the Internet. Clustered standard errors on the district level are reported in brackets.

* $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.4: Financial Literacy and Internet Use: IV Results

	First stage		Second stage	
	Internet Use		Financial Literacy	
	(1)	(2)	(1)	(2)
DSL	0.878*** (0.150)	0.919*** (0.159)		
Internet use			0.347*** (0.116)	0.257** (0.119)
Male	0.055** (0.023)	0.047** (0.022)	0.052*** (0.014)	0.037*** (0.013)
ln(age)	-0.498*** (0.037)	-0.498*** (0.037)	0.147** (0.059)	0.109* (0.058)
School leaving qualification (base: basic)				
Secondary	0.156*** (0.029)	0.141*** (0.029)	0.017 (0.024)	0.018 (0.022)
<i>Abitur</i>	0.193*** (0.042)	0.171*** (0.041)	0.092*** (0.033)	0.075** (0.032)
Vocational qualification (base: no/other)				
Vocational training	0.155*** (0.031)	0.143*** (0.031)	0.014 (0.025)	0.015 (0.023)
Master craftsman	0.226*** (0.050)	0.208*** (0.050)	0.059 (0.037)	0.055 (0.035)
University degree	0.287*** (0.052)	0.263*** (0.051)	0.004 (0.036)	0.005 (0.033)
GDR		0.027 (0.024)		-0.016 (0.016)
Economics education (base: low)				
Medium		-0.047** (0.022)		0.009 (0.012)
High		-0.066* (0.034)		0.093*** (0.018)
Mental exercises (base: 0 correct answers)				
1 correct		0.081*** (0.026)		0.068*** (0.018)

	First stage		Second stage	
	Internet Use		Financial Literacy	
	(1)	(2)	(1)	(2)
Mental exercises (base: 0 correct answers)				
2 correct		0.128*** (0.030)		0.138*** (0.020)
3 correct		0.168*** (0.031)		0.157*** (0.028)
Resident change	Yes	Yes	Yes	Yes
<i>N</i>	1501	1501	1501	1501
Underidentification test	13.252	13.339		
Chi-sq(1) P-val	0.0003	0.0003		
Weak identification test (First stage F-statistic)	34.18	33.38		

Note: This table reports IV regression results of the effect of instrumented Internet use on financial literacy. First stage results are reported in Columns (1) and (2) and second stage results in Columns (3) and (4). *Financial literacy* measures the percentage of correct answers to 11 financial literacy questions. The instrumental variable *DSL* gives the share of households in a district that have access to the Internet. *Internet use* is a binary variable indicating whether the individual uses the Internet. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.5: Basic and Advanced Financial Literacy and Internet

	First stage	Second stage		
	Internet Use	Basic	Advanced I (5 Questions)	Advanced II (7 Questions)
DSL	0.919*** (0.159)			
Internet use		0.172 (0.114)	0.398** (0.173)	0.306** (0.142)
Male	0.047** (0.022)	0.021 (0.017)	0.048*** (0.017)	0.046*** (0.015)
ln(age)	-0.498*** (0.037)	0.095 (0.059)	0.151* (0.085)	0.116* (0.070)
School leaving qualification (base: basic)				
Secondary	0.141*** (0.029)	0.031 (0.024)	0.017 (0.033)	0.010 (0.027)
<i>Abitur</i>	0.171*** (0.041)	0.085*** (0.032)	0.097** (0.043)	0.070* (0.037)
Vocational qualification (base: none/other)				
Vocational training	0.143*** (0.031)	0.004 (0.024)	0.014 (0.033)	0.022 (0.028)
Master craftsman	0.208*** (0.050)	0.062* (0.035)	0.049 (0.049)	0.052 (0.042)
University degree	0.263*** (0.051)	0.010 (0.033)	-0.024 (0.051)	0.002 (0.042)
GDR	0.027 (0.024)	-0.026 (0.018)	-0.016 (0.020)	-0.009 (0.018)
Economics education (base: low)				
Medium	-0.047** (0.022)	0.001 (0.016)	0.023 (0.017)	0.013 (0.014)
High	-0.066* (0.034)	0.048** (0.022)	0.134*** (0.024)	0.118*** (0.021)

	First stage	Second stage		
	Internet Use	Basic	Advanced I (5 Questions)	Advanced II (7 Questions)
Mental exercises (base: 0 correct answers)				
1 correct	0.081*** (0.026)	0.087*** (0.021)	0.058** (0.025)	0.057*** (0.022)
2 correct	0.128*** (0.030)	0.152*** (0.022)	0.132*** (0.030)	0.130*** (0.025)
3 correct	0.168*** (0.031)	0.165*** (0.028)	0.151*** (0.039)	0.153*** (0.033)
Resident change	Yes	Yes	Yes	Yes
<i>N</i>	1501	1501	1501	1501
Underidentification test	13.339			
Chi-sq(1) P-val	0.0003			
First stage F-statistic	33.38			

Note: This table reports IV regression results of the effect of instrumented Internet use on basic and advanced financial literacy. First stage results are reported in Column (1) and second stage results in Columns (2)-(4). The dependent variables are reported on top of each column. *Basic financial literacy* measures the percentage of correct answers on 4 basic financial literacy questions, *Advanced I* on 5 advanced questions, and *Advanced II* on 7 advanced questions (see Section 2.3). Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.6: Single Financial Literacy Questions and Internet Use

Financial literacy question	Coef.	(S.E.)	[Marginal effect]
Compound interest I	0.039	(0.708)	[0.077]
Compound interest II	0.478	(0.579)	[0.087]
Inflation	0.259	(0.559)	[0.051]
Money illusion	1.324***	(0.451)	[0.101]
Diversification	1.027	(0.701)	[0.147]
Volatility (types of investment)	0.840*	(0.462)	[0.066]
Main function of stock market	1.555***	(0.568)	[0.126]
Mutual funds	1.031*	(0.594)	[0.182]
Bond prices	1.844***	(0.360)	[0.050]
Usage of pension insurance fund contribution	0.286	(0.450)	[0.024]
Contribution rate to statutory pension	0.171	(0.540)	[0.096]
<i>N</i>	1501		

Note: This table reports IV probit regression results of the effect of instrumented Internet use on single financial literacy questions. Coefficients, clustered standard errors on the district level (in brackets), and average marginal effects (in square brackets) are reported. The (binary) dependent variables are reported in the first column, and indicate whether the corresponding question is answered correctly. All specifications include following control variables according to the main model: male, age, school leaving qualification, vocational qualification, GDR, economics education during school, cognitive ability, and resident change before 2008. *Internet use* is a binary variable indicating whether the individual uses the Internet, and has been instrumented using *DSL*, the share of households with Internet access within the district. * $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.7: Financial Literacy and Internet Use: Financial Socialization

	Financial Literacy			
	(1)	(2)	(3)	(4)
Internet use	0.257** (0.119)	0.274** (0.127)	0.256** (0.116)	0.272** (0.123)
Male	0.037*** (0.013)	0.039*** (0.013)	0.037*** (0.013)	0.039*** (0.013)
ln(age)	0.109* (0.058)	0.103* (0.055)	0.107* (0.056)	0.102* (0.053)
School leaving qualification (base: basic)				
Secondary	0.018 (0.022)	0.018 (0.022)	0.020 (0.022)	0.020 (0.022)
<i>Abitur</i>	0.075** (0.032)	0.076** (0.031)	0.078** (0.031)	0.078** (0.031)
Vocational qualification (base: none/other)				
Vocational training	0.015 (0.023)	0.015 (0.024)	0.015 (0.023)	0.014 (0.023)
Master craftsman	0.055 (0.035)	0.053 (0.035)	0.055 (0.034)	0.053 (0.035)
University degree	0.005 (0.033)	0.002 (0.034)	0.004 (0.032)	0.001 (0.033)
GDR	-0.016 (0.016)	-0.017 (0.016)	-0.015 (0.016)	-0.016 (0.016)
Economics education (base: low)				
Medium	0.009 (0.012)	0.008 (0.012)	0.008 (0.013)	0.007 (0.013)
High	0.093*** (0.018)	0.092*** (0.018)	0.094*** (0.019)	0.094*** (0.019)
Mental exercises (base: 0 correct)				
1 correct	0.068*** (0.018)	0.066*** (0.019)	0.067*** (0.018)	0.066*** (0.018)
2 correct	0.138*** (0.020)	0.136*** (0.021)	0.139*** (0.020)	0.136*** (0.021)

Financial Literacy				
	(1)	(2)	(3)	(4)
Mental exercises (base: 0 correct)				
3 correct	0.157*** (0.028)	0.154*** (0.029)	0.157*** (0.027)	0.154*** (0.028)
Pocket money		-0.001 (0.002)		0.000 (0.002)
Spending habits		-0.004 (0.002)		-0.004* (0.002)
Parents' understanding (base: low)				
Medium			0.008 (0.019)	0.009 (0.019)
High			0.000 (0.021)	0.000 (0.021)
Parents' accounting			-0.018 (0.016)	-0.018 (0.016)
Resident change	Yes	Yes	Yes	Yes
Underidentification test	13.339	12.328	13.676	12.639
Chi-sq(1) P-val	0.0003	0.0004	0.0002	0.0004
First stage F-statistic	33.38	28.43	34.41	29.422
<i>N</i>	1501	1501	1501	1501

Note: This table reports IV regression results of the effect of instrumented Internet use on financial literacy. *Financial literacy* is defined as the percentage of correct answers to 11 financial literacy questions. *Internet use* is a binary variable indicating whether the individual uses the Internet, and is instrumented using *DSL*, the share of households with Internet access within the district. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.8: Financial Literacy, Wealth, and Employment

Financial Literacy					
	(1)	(2)	(3)	(4)	(5)
Internet use	0.257** (0.121)	0.244* (0.125)	0.295*** (0.110)	0.260** (0.117)	0.288** (0.112)
Male	0.037*** (0.013)	0.040*** (0.013)	0.038*** (0.013)	0.038*** (0.013)	0.043*** (0.013)
ln(age)	0.109* (0.060)	0.116** (0.052)	0.109** (0.054)	0.115** (0.057)	0.127** (0.050)
School leaving qualification (base: basic)					
Secondary	0.018 (0.022)	0.018 (0.022)	0.011 (0.021)	0.017 (0.022)	0.011 (0.021)
<i>Abitur</i>	0.075** (0.032)	0.074** (0.030)	0.066** (0.029)	0.074** (0.031)	0.064** (0.028)
Vocational qualification (base: none/other)					
Vocational training	0.015 (0.024)	0.015 (0.022)	0.010 (0.021)	0.015 (0.023)	0.010 (0.020)
Master craftsman	0.055 (0.035)	0.053 (0.034)	0.043 (0.033)	0.054 (0.035)	0.040 (0.032)
University degree	0.005 (0.033)	0.007 (0.031)	-0.004 (0.030)	0.005 (0.034)	0.000 (0.029)
GDR	-0.016 (0.017)	-0.016 (0.016)	-0.011 (0.015)	-0.014 (0.016)	-0.011 (0.015)
Economics education (base: low)					
Medium	0.009 (0.012)	0.009 (0.012)	0.010 (0.013)	0.008 (0.012)	0.012 (0.013)
High	0.093*** (0.018)	0.093*** (0.018)	0.094*** (0.018)	0.092*** (0.018)	0.097*** (0.018)
Mental exercises (base: 0 correct)					
1 correct	0.068*** (0.018)	0.067*** (0.018)	0.064*** (0.017)	0.067*** (0.018)	0.063*** (0.017)
2 correct	0.138*** (0.020)	0.137*** (0.020)	0.130*** (0.019)	0.137*** (0.020)	0.128*** (0.019)

	Financial Literacy				
	(1)	(2)	(3)	(4)	(5)
Mental exercises					
3 correct	0.157*** (0.027)	0.157*** (0.028)	0.146*** (0.025)	0.156*** (0.027)	0.142*** (0.024)
Non-employed		-0.001 (0.019)			-0.013 (0.022)
White collar		0.029 (0.020)			0.027 (0.020)
Civil servants		-0.006 (0.036)			-0.014 (0.034)
Self-employed		-0.003 (0.033)			-0.027 (0.032)
ln(income)			-0.003 (0.002)		-0.005** (0.002)
Homeowner			0.033* (0.019)		0.034* (0.018)
Windfall 1 (fin. assets)				0.002 (0.032)	0.003 (0.032)
Windfall 2 (real estate)				0.051 (0.092)	0.049 (0.089)
Windfall 3 (gift)				0.048 (0.030)	0.042 (0.030)
Financial support				0.027 (0.025)	0.028 (0.026)
Resident change	Yes	Yes	Yes	Yes	Yes
First stage regression					
Underidentification test	13.339	12.156	15.057	13.521	14.213
Chi-sq(1) P-val	0.0003	0.0005	0.0001	0.0002	0.0002
First stage F-statistic	33.38	30.09	38.76	33.80	36.59
<i>N</i>	1501	1501	1501	1501	1501

Note: This table reports IV regressions of financial literacy on Internet use. *Financial literacy* is defined as the percentage of correct answers to 11 financial literacy questions. *Internet use* is a binary variable indicating whether the individual uses the Internet, and is instrumented using *DSL*, the share of households with Internet access within the district. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic. * $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.9: Financial Literacy and Regional Centers

	First stage		Second stage	
	Internet Use		Financial Literacy	
	(1)	(2)	(1)	(2)
DSL	0.897*** (0.182)	1.048*** (0.226)		
Internet use			0.273** (0.133)	0.282* (0.144)
Main controls	Yes	Yes	Yes	Yes
Municipality size	Yes	Yes	Yes	Yes
<i>N</i>	1161	800	1161	800
Underidentification test	11.031	8.604		
Chi-sq(1) P-val	0.0009	0.0034		
First stage F-statistic	19.48	19.44		

Note: This table reports IV regression results of the effect of Internet use on financial literacy. *Financial literacy* is defined as the percentage of correct answers to 11 financial literacy questions. *Internet use* is a binary variable indicating whether the individual uses the Internet, and is instrumented using *DSL*, the share of households with Internet access within the district. The sample of specification (1) excludes all observations living in municipalities larger than 500,000 inhabitants, the sample of specification (2) excludes all observations living in municipalities larger than 100,000 inhabitants and outskirts of municipalities larger than 500,000 inhabitants. All specifications include following control variables according to the main model: male, age, school leaving qualification, vocational qualification, GDR, economics education during school, cognitive ability, and resident change before 2008. Further, all specifications include municipality size dummies. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic. * $p < .1$. ** $p < .05$. *** $p < .01$

Table 2.10: Financial Literacy and Resident Change

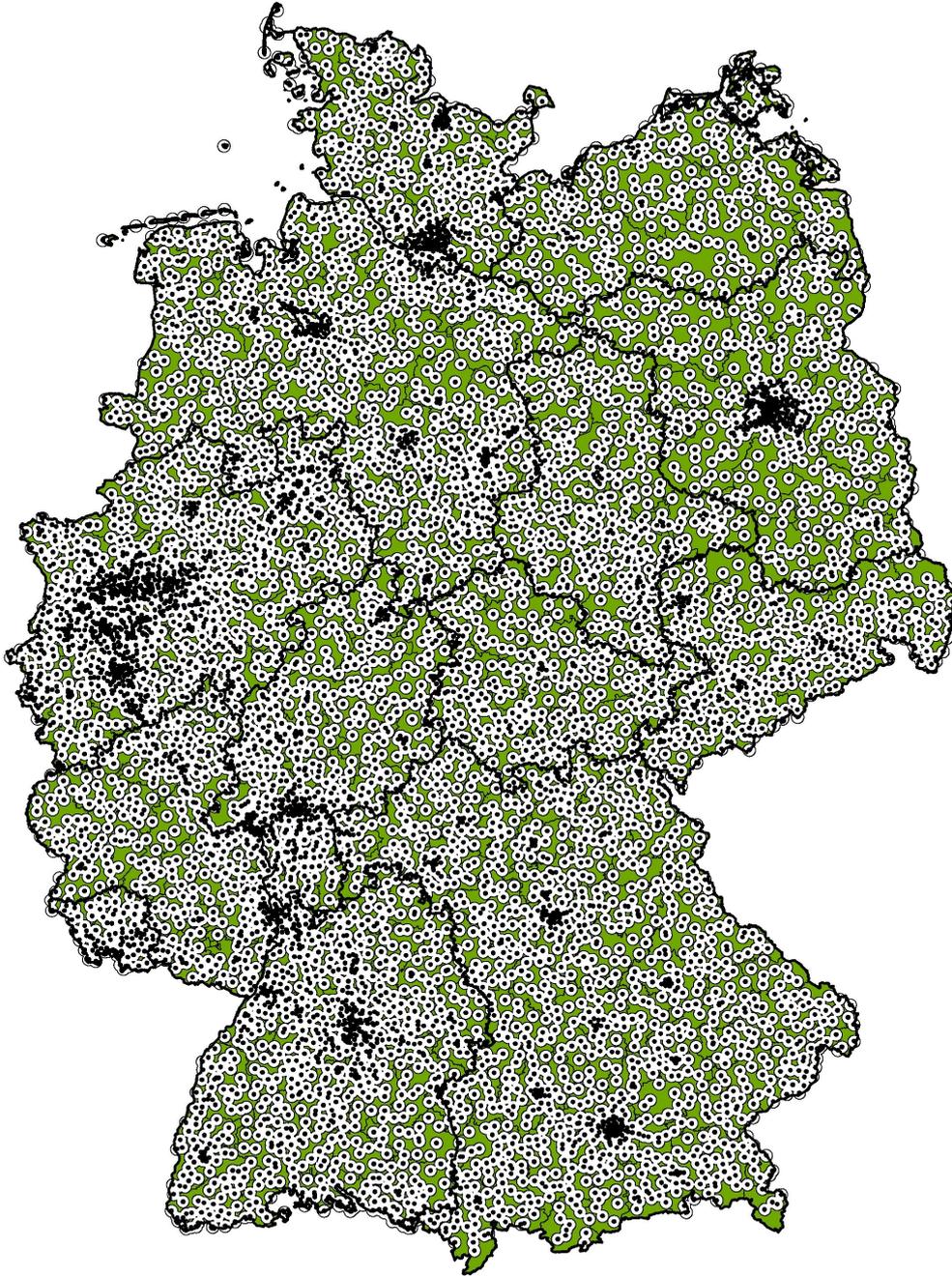
	Financial Literacy			
	(1)	(2)	(3)	(4)
Internet use	0.257** (0.119)	0.258** (0.124)	0.260** (0.119)	0.262** (0.118)
Main controls	Yes	Yes	Yes	Yes
Resident change	Yes			
Move to higher			Yes	
Move to lower			Yes	
<i>N</i>	1501	1509	1501	1483
Underidentification test	13.339	12.558	13.343	13.348
Chi-sq(1) P-val	0.0003	0.0004	0.0003	0.003
First stage F-statistic	33.38	29.95	33.41	33.25

Note: This table reports IV regression results of the effect of Internet use on financial literacy. *Financial literacy* is defined as the percentage of correct answers to 11 financial literacy questions. *Internet use* is a binary variable indicating whether the individual uses the Internet, and is instrumented using *DSL*, the share of households with Internet access within the district. Specification (1) includes a control variable for resident change before 2008, (2) excludes the control variable for resident change before 2008, (3) includes two control variables indicating a resident change to a municipality with higher and lower Internet availability, and (4) excludes all individuals who have changed their resident before 2008. All specifications include following control variables according to the main model: male, age, school leaving qualification, vocational qualification, GDR, economics education during school, cognitive ability. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

2.7 Figures

Figure 2.1: Main Distribution Frames (MDF) and areas covered, Germany.



Note: The black dots represent the about 8,000 MDFs in Germany, the 4,200m-radius of each of the MDFs is colored white. Authors' own graph; data source: Federal Ministry of Economics and Technology (BMWFi, 2009).

3 Financial Literacy and Self-Employment ¹

3.1 Introduction

Standard economic models assume that individuals are well equipped with the skills to manage financial risks and to optimize consumption and savings over the life cycle. However, we know from empirical studies that many individuals lack the skills to understand basic financial concepts and, thus, are financially illiterate (Jappelli, 2010; Lusardi and Mitchell, 2007; Van Rooij et al., 2011a). Several studies show that financially illiterate individuals are more likely to fail at making efficient decisions about financial markets, especially in regard to savings and investments, indebtedness and mortgages, retirement planning, and wealth accumulation (Agarwal et al., 2009; Alessie et al., 2011; Banks et al., 2010; Gathergood, 2012; Jappelli and Padula, 2013; Lusardi and Tufano, 2015). While many scholars have investigated the importance of financial literacy for households' financial decision-making, the relationship between financial literacy and self-employment has been found to be under-researched.

The study of entrepreneurship is attracting the interest of scholars and policymakers. Considerable research is devoted to the unique characteristics of entrepreneurs, factors that affect the entry decision, and entrepreneurial survival. Several studies reveal that entrepreneurs differ from wagedworkers in terms of their personality characteristics and preferences. However, most characteristics - such as personality traits or risk attitudes - that are found to be associated with self-employment are classified as relatively stable over time

¹ This chapter is co-authored with *Walter Hyll*. A version of the article has been published in *Journal of Consumer Affairs* (Ćumurović and Hyll, forthcoming).

and are therefore beyond the control of policymakers (Caliendo et al., 2014; Cobb-Clark and Schurer, 2012, 2013).

Financial literacy, which is acquirable, has not been focus of analysis in the past, but there is reason to assume that it does play a role in self-employment.² On the one hand, there are important financial reasons why businesses fail: poor financial management, lack of capital, or misjudgment of risks. On the other hand, persons who are considering taking the step into self-employment are likely aware of the special challenges and risks of an own business. If individuals are uncertain about their ability to handle those challenges and to manage an own business, they might prefer to work as wagers. Considering individuals who have a business idea, are willing to take risks, and meet other decisive conditions, we expect that those with higher levels of financial literacy are more likely to take the step into self-employment and survive in self-employment than those with lower levels of financial literacy. This assumption is based on the idea that people with a better understanding of financial concepts and issues have better opportunities for realizing business ideas, financing their ventures, and leading their companies to success.

Literature shows that financially literate persons are more likely to have higher household disposable income, more formal than informal credit and to be more effective with regard to saving and investments (Disney and Gathergood, 2013; Jappelli and Padula, 2013; Klapper et al., 2013). If financially literate persons are more efficient on the financial market, there is reason to assume that they are also more aware of sources of information, advice, and capital for entering into and surviving self-employment. They might also be more aware of different financing options or sponsorships and might have a better understanding of the terms and conditions of those options. Being more

² Based on descriptive statistics of 39 observations, Kojo Oseifuah (2010) examines financial literacy levels among young entrepreneurs in South Africa.

aware of financial risks and opportunities, they might not only have a better understanding of the profitability of a business but also be more willing to take the step into self-employment than those who do not have a deep understanding of how to handle the challenges, risks, and responsibilities of an own business. Canadian data show that an increase in financial literacy leads to more frequent production of financial statements (Wise, 2013). A higher number of financial statements, in turn, leads to a higher probability of loan repayment and a lower probability of involuntary venture closure.

In this paper, we investigate the link between financial literacy and self-employment. German survey data allow us to generate an index for the level of financial literacy based on nine questions on financial topics. We control for important factors such as education, cognitive abilities, personality traits, preferences, and economic factors, and we take into account parental characteristics and social background. Financial literacy appears to have a positive effect on self-employment. However, causality might also run the other direction: Not being self-employed might lower the incentive to invest in financial skills. To address the direction of causality, we apply instrumental variable techniques. We instrument financial literacy using the educational attainment of the mother. Our results suggest a positive impact of financial literacy on self-employment. The mother's educational attainment, however, could be correlated with self-employment or both financial literacy and self-employment. Therefore, we explicitly address potential channels that may influence the exclusion restriction, such as (parental) wealth and financial support or an inter-generational transfer of entrepreneurial spirit. The data set provides a variety of information and allows, for example, controlling for different types of financial aid (ranging from inheritances to regular support payments and occasional support payments) to account for the wealth channel.

We contribute to the existing literature in several respects. We augment

the studies on financial literacy beyond financial decision-making by focusing on the role of financial literacy for self-employment. Thereby, we contribute to the entrepreneurship literature and point to a new characteristic of the self-employed that is not taken into account in previous studies. Consequently, we add to the nature-nurture debate on the characteristics of entrepreneurs.

As financial literacy is acquirable, our findings suggest that entrepreneurial activities might be encouraged by enhancing financial literacy. This finding also adds to the literature suggesting that what you learn - rather than years of education - is important for entrepreneurial success. For example, Unger et al. (2011) find that human capital is most important if it is task-related. Martin et al. (2013) show that entrepreneurship education and training have a positive impact on increasing interest in and attitudes toward entrepreneurship and in improving financial performance as an entrepreneur. Moreover, Elert et al. (2015) show that entrepreneurship education during high school increases the long-term probability of starting a firm, it also increases entrepreneurial incomes.

The next section of the paper (3.2) gives a brief overview of previous findings on the subjects of financial literacy and the characteristics of entrepreneurs. Section 3.3 describes the underlying data. We define the index for financial literacy and provide summary statistics. In Section 3.4, we present the identification strategy and regression results, and in Section 3.5, we present several extensions that address relevant channels that may influence the exclusion restriction. In the last section (3.6), we draw some initial conclusions and discuss potential policy implications.

3.2 Literature

Our paper relates to two strands of the existing literature. We briefly review seminal studies on financial literacy and studies that focus on the characteristics of entrepreneurs.

First, research on financial literacy analyses the effects of financial literacy on individual behavior, especially concerning financial matters. The results reveal that individuals' net wealth increases with increasing financial literacy (Behrman et al., 2012; Disney and Gathergood, 2011; Van Rooij et al., 2012). Jappelli and Padula (2013) derive an economic inter-temporal consumption model implying that the stock of financial literacy accumulated early in life is positively correlated with the individual's wealth and portfolio allocations later in life. Using microeconomic cross-country data, the authors find support for their predictions.

Financial literacy has positive effects on rates of return and cost efficiency with regard to saving and investments. Higher levels of financial sophistication are correlated with higher interest incomes and lower credit costs, greater availability of unspent income, and a higher ratio of formal over informal credit (Deuffhard et al., 2015; Disney and Gathergood, 2013; Klapper et al., 2013).

Further, financial literacy is related to stock market participation. First, investors who are more financially literate are more likely to consult an advisor, but they delegate their portfolio choice less often (Calcagno and Monticone, 2015). Second, compared to their less literate peers, financially literate individuals are more likely to hold stocks (Christiansen et al., 2008; Jappelli and Padula, 2015; Van Rooij et al., 2011a). Third, financially literate individuals show higher portfolio diversification (Guiso and Jappelli, 2008; Jappelli and Padula, 2015). Finally, during financial crises, literate investors perform better

and obtain higher returns in the long run (Bucher-Koenen and Ziegelmeyer, 2013; Guiso and Viviano, 2014; Klapper et al., 2013).

Another channel through which wealth is affected by financial sophistication is retirement planning. In light of demographic changes and accompanying pension reforms, supplementary private pensions have become an important way of ensuring sufficient retirement income. Lusardi and Mitchell (2007, 2011) evaluate how successful individuals plan for retirement. They show that financial literacy is important for planning behavior that, in turn, increases wealth. Similarly, Bucher-Koenen and Lusardi (2011) demonstrate that financial literacy has a positive impact on retirement planning in Germany, Van Rooij et al. (2011b) provide similar evidence for the Netherlands, and Klapper and Panos (2011) find similar patterns in the Russian case. Ultimately, successful retirement planning positively affects individuals' total wealth accumulation (Van Rooij et al., 2012).

Most prior studies link financial literacy and wealth accumulation. Yet, we know relatively little about the impact of financial literacy on self-employment, although much research is devoted to the question of what makes an entrepreneur. Scholars find that personality traits and characteristics differ across employment groups (for example, Caliendo et al., 2009, 2014; Carter et al., 2003; Fairlie and Robb, 2009; Feldman and Bolino, 2000).

Several personality traits are found to influence the decision to make the move into self-employment. Zhao and Seibert (2006) find that across the 23 studies they examined, entrepreneurs score higher than other managers on conscientiousness and openness to experience and lower on neuroticism and agreeableness. Caliendo et al. (2014) find a positive effect of extra-version on the probability of entering self-employment.³

³ Agreeableness, conscientiousness, extra-version, neuroticism, and openness to experience are defined as the Big Five personality traits.

Entrepreneurs are more willing to take risks (Cramer et al., 2002). Ekelund et al. (2005), using psychometric data from the Northern Finland 1966 Birth Cohort Study that collected data on individuals from the prenatal period up to age 31, show that risk aversion affects the entry decision. Caliendo et al. (2009) confirm that individuals with lower risk aversion are more likely to enter self-employment.

Most of the personality traits and risk preferences that affect the decision to enter self-employment are shown to be relatively stable over time (Andersen et al., 2008; Cobb-Clark and Schurer, 2012, 2013; Specht et al., 2011). These traits are, thus, beyond the control of scholars and policy makers.

A recent strand of literature has begun to evaluate the impact of entrepreneurship education on entrepreneurship activity. Yet, these studies evaluate participation in training programs but do not focus on financial knowledge itself. For example, Drexler et al. (2014) compare the impact of two programs by using data from a randomized controlled trial in the Dominican Republic. Whereas the standard accounting training has no effect on business outcomes, a simplified, rule-of-thumb training that teaches basic financial heuristics produces significant improvements in financial practices, objective reporting quality, and revenues of firms. Bruhn and Zia (2013) evaluate the effect of business and financial literacy programs on the firm outcomes of young entrepreneurs in the context of emerging markets and find that a training program (in Bosnia and Herzegovina) significantly improved business practices, investments, and loan terms for surviving businesses. Karlan and Valdivia (2011) measure the impact of adding business training to a Peruvian village-banking program for female micro-entrepreneurs. The training led not only to improved business knowledge, practices, and revenues but also to higher repayment and client retention rates.

3.3 Data

3.3.1 The German SAVE Study

For our empirical analysis, we use the German SAVE study. The representative household panel covers the period 2001-2013 and focuses on the saving behavior and asset accumulation of private households (Börsch-Supan et al., 2008). We draw our main data from the 2009 survey, which includes a set of questions on financial concepts. For our study, we restrict the sample to individuals between 18 and 65 years of age, and we exclude non-working individuals and assisting family members.⁴ This leaves us with 1,039 observations.⁵

One of the key characteristics of this survey for the purposes of our study is the type of employment. The SAVE study queries whether respondents fall into any of the following categories: Blue-collar worker/White-collar worker/Civil servant/Farmer/Self-employed as member of the respective chamber (e.g., pharmacist, doctor, lawyer)/Other freelancer/Trader or other form of self-employment. We cluster blue-collar workers, white-collar workers, and civil servants into the group of wageworkers.⁶

Due to limitations of the data, we cannot observe entries into and exits from self-employment, and we have no information on the aims and objectives of the self-employed. Like almost all empirical studies on entrepreneurship, we therefore use self-employment as proxy for entrepreneurship (Caliendo et al.,

⁴ The term non-working here refers to all respondents who state not employed or not applicable when asked about their type of employment.

⁵ The initial number of observations in 2009 is 2,222. We exclude 1,107 non-working observations, 13 assisting family members, and 53 observations older than 65 years.

⁶ Some studies on entrepreneurship exclude civil servants from the sample examined (e.g., Caliendo et al., 2014). As a robustness check, we also provide main regression results on a subsample that excludes civil servants.

2010; Carland et al., 1984; Rauch and Frese, 2000; Stewart Jr and Roth, 2001; Unger et al., 2011; Zhao and Seibert, 2006).⁷

In the basic model, we aggregate all types of self-employment to a self-employment indicator. The binary variable self-employment is one if an individual indicates that he or she is self-employed and zero otherwise. To check the robustness of our results, we later exclude farmers, the self-employed as members of a respective chamber, and other freelancers from the sample, and we cluster only traders or other forms of self-employment, giving us a very narrow definition of the self-employed. Table 3.1 provides summary statistics of the main variables in this study. For example, the share of women in the total sample and among wageworkers is slightly higher than the share of men, while it is lower among self-employed individuals.

Educational levels are classified into four groups in compliance with existing research and according to the International Standard Classification of Education (ISCED): Vocational training, master craftsman, university degree, and a fourth group that captures response categories *no vocational education* and *other* (e.g., Van Rooij et al., 2012). The data indicate that, on average, self-employed individuals have higher vocational qualifications than wageworkers. The majority of wageworkers have a vocational training qualification (67%), and relatively small fractions have a master craftsman qualification (5%) or a university degree (16%). Among the self-employed observations, 46% have a vocational training qualification while one third hold a university degree.

Additionally, we present a proxy for cognitive abilities. Following existing literature, we use answers on mental exercises (Christelis et al., 2010). The indicator gives the number of correct answers on three questions. Although

⁷ Regarding Schumpeterian entrepreneurship, several scholars emphasize focusing on measures that adequately capture innovative and growth-oriented entrepreneurship (Shane, 2009; Henrekson and Sanandaji, 2014).

the groups seem to differ in vocational qualifications, both groups perform similarly well on the mental exercises. However, the average household income of self-employed respondents is higher compared to that of wageworkers.

3.3.2 Measuring Financial Literacy

The 2009 SAVE survey contains a set of nine questions related to basic numeracy and more advanced financial topics.⁸ The first four financial literacy questions measure a basic understanding of interest rates (simple compound interest calculations), purchasing power (effects of inflation), and portfolio diversification (risk of stocks vs. mutual bonds). Further questions that are more advanced cover knowledge of money illusion (relation between income and inflation), volatility (fluctuations of different assets), the stock market (its main function), mutual funds (features/operating principle), and bond prices (features). These questions are similarly applied in other studies on financial literacy and serve as a measure of the degree to which individuals have an understanding of the concepts and products of financial markets (e.g., Van Rooij et al., 2011a, 2012).

In line with existing studies, we exploit the complete potential of the above questions to construct an index of financial literacy. Similarly, Behrman et al. (2012) and Van Rooij et al. (2011a, 2012) exploit the range of eight to 16 questions, respectively, available in the underlying data. Following the existing literature, our financial literacy indicator yields the total number of correct answers given in response to the nine financial literacy questions.

The answers to the financial literacy questions according to employment group are provided in Figure 3.1. A relatively high fraction of individuals is able to give correct answers to the basic questions (1-4). Self-employed

⁸ The precise wording of the questions is given in the Appendix A.

individuals are more likely to answer each of these basic questions correctly compared to wagedworkers. However, the proportion of correct answers decreases considerably from the first (89% correct among wagedworkers and 92% among self-employed) to the fourth question (60% and 68% correct, respectively). Concerning the advanced questions (5-9), we find a similar pattern of response behavior: self-employed individuals give correct answers more frequently than do wagedworkers, and the share of correct answers differs strongly across questions.

In sum, the average number of correct answers on all questions is significantly higher among self-employed individuals (6.5) compared with wagedworkers (5.7). The analysis suggests that self-employed individuals tend to be more financially literate compared to wagedworkers.

The results raise the question of whether self-employed workers are more literate because of their activity or whether more financially literate individuals tend to make the move into self-employment and survive in self-employment better than less financially literate individuals do. At least in Germany, self-employed individuals are more likely to be confronted with activities that require financial knowledge. Engagement in these activities, in turn, might affect the level of financial literacy. To address the concern of reverse causality, we resort to instrumental variables estimation, which is explained in more detail in the following section.

3.4 Identification Strategy and Results

In estimating the effect of financial literacy on the probability of being self-employed, we need to address several concerns with regard to endogeneity issues. Self-employment itself might affect financial literacy, and bias might

arise due to reverse causality. Additionally, estimates might be subject to measurement error and omitted variable bias.

We apply an instrumental variables (IV) approach and exploit information on the education of the mother. By definition, this predetermined variable cannot be influenced by the entry into self-employment. The education of parents is not under the control of respondents, but it is likely to influence respondents' financial literacy.

On the one hand, empirical studies find that the relationship between parents' education and the financial literacy of their children is strong and monotonic (Mandell, 2008). In particular, maternal educational is highly correlated with financial literacy (Lusardi et al., 2010). On the other hand, a large literature on entrepreneurship and gender shows that compared to men, women are less likely to work in self-employment instead of wage employment (Boden, 1996; Burke et al., 2002; Verheul et al., 2012).

The family background of individuals is frequently used to instrument financial literacy in existing studies, and a number of studies find that the literacy level of parents is a valid instrument for respondents' financial literacy (Agnew et al., 2013; Alessie et al., 2011; Bucher-Koenen and Lusardi, 2011; Van Rooij et al., 2011a). Behrman et al. (2012) use the schooling attainment of the mother to isolate the causal effect of financial literacy on wealth accumulation.

The 2013 SAVE also contains information on the schooling attainment of the mother. Based on the response categories no graduation, secondary education (8 grades), high school diploma (10 grades), GDR graduation after 8 or 10 grades, and higher education entrance qualification (after 12 grades), we generate a variable for the schooling attainment of the respondent's mother

according to those grades.⁹

Even if maternal education does predict financial literacy and the instrumental variable resolves major methodological issues with respect to the exclusion restriction, some major challenges remain. For example, better-educated mothers are likely to be wealthier and, thus, more likely to provide financial support to their children. As the data set provides a variety of information on financial support, we can account for the wealth channel and address issues related to parental wealth and financial support. We further address a channel related to the intergenerational transfer of self-employment by exploiting information on the origin of the mother. We discuss these and other concerns extensively in Section 5.

3.4.1 Identification Strategy

In all subsequent regressions, we apply IV techniques and run IV-probit models.¹⁰ The dependent variable is always a binary self-employment variable. The schooling attainment of the mother serves as the instrumental variable for the literacy index. We are aware of endogeneity concerns due to unobserved factors. To address the concern that the effect might arise from other channels, we include further relevant controls.

The mother’s schooling attainment may influence the education and cognitive abilities of the child. Further, educational attainment (of the individual) has an impact on financial literacy. To rule out the possibility that the instru-

⁹ We treat the response categories foreign graduation and do not know as missing values. For mothers with no school-leaving qualification, we have no precise information on the duration of education. We assign 7 grades to these observations. The results remain stable and robust when we vary the years of education between 0 and 7.

¹⁰ We also perform simple probit estimations for the main specifications (see A.4 in the Appendix). Results show a positive highly statistically significant effect. Simple probit effects are slightly higher than IV effects. Performing IV-probit estimations, we apply the STATA “ivprobit” command using STATA version 14.2.

mental variable affects the outcome variable through (unobserved) education factors, we control for respondents' educational attainment. First, we include educational variables according to the ISCED standard: vocational training, master craftsman qualification, university degree, and *other* or *no vocational qualification*.

Still, unobserved factors with regard to cognitive skills might affect the variables of interest, too (Van Rooij et al., 2011a; Lusardi and Mitchell, 2014). Additionally, we include a variable measuring the number of correct answers to the mental exercises as proxy for cognitive abilities.

Furthermore, health problems could be correlated with parental education through the transmission of socio-economic status over generations, and health problems are shown to affect entrepreneurship negatively. We include a variable for the self-assessed state of health. The data set does not provide an objective measure for health status, however, a large number of studies find that self-ratings represent a source of very valuable data on actual health status.¹¹ Our variable measures health status on a scale from low (1) to high (3).

Additionally, we include various personality traits, taking into account that self-employed individuals might differ from wagedworkers in several personality traits. According to the literature, the willingness to take risks is an important determinant of self-employment. The data allow controlling for self-assessed risk attitudes with respect to career. Dohmen et al. (2011b) show that self-assessed willingness to take risks is a significant explanatory variable for risk behavior. Furthermore, they verify the behavioral validity of a survey measure in a complementary, incentive-compatible field experiment. The willingness to take risks with respect to the career is measured on a ten-point scale, ranging

¹¹ See Idler and Benyamini (1997) for a review of 27 community studies.

from complete unwillingness (0) to complete willingness (10). Following studies on risk attitudes and entrepreneurship, we group answers 0-2 into a low risk-category, answers 3-7 into a medium risk-category, and answers 8-10 into a high risk-category (Caliendo et al., 2009).

We use further self-assessed personality traits that were queried in 2007: respondents assess (on a scale ranging from 0 to 10) whether they are (i) creatures of habit, (ii) open to changes, (iii) optimistic, and (iv) self-assured. Further, we use information on whether they (v) are living for the moment or are making exact plans for the future, and whether they (vi) react rather impulsively and quickly or judiciously and observantly. Moreover, respondents were asked how often they (vii) engage in voluntary activities. Evaluating the four options daily, weekly, monthly, and less frequently, we use this information as proxy for altruism and agreeableness. Several additional extensions are discussed in section 5.

Table 3.2 presents these personality traits for self-employed respondents and wagers. Self-employed respondents assess themselves to be significantly more willing to take risks compared to wagers. They are significantly less likely to assess themselves to be creatures of habit, but they are more open to changes, more optimistic, and more self-assured than wagers are. At the same time, self-employed persons are more likely to be focused on the future and to know what they want to be and do in the future, but they more rarely report reacting impulsively and quickly rather than judiciously and observantly.

3.4.2 Results

In Tables 3.3 and 3.4, we present several model specifications of our main regressions. The first column presents the results of a specification including basic control variables only, the second specification (Column 2) includes

further socio-demographic and socio-economic control variables such as risk attitudes and health status, in the third specification (Column 3), we additionally include personality traits.

As a robustness analysis, in Column 4, we exclude civil servants from the sample, and in Column 5, we re-define self-employment as an additional robustness check. Thereby, we exclude types of self-employment that might also be performed in regular employment, that is, self-employed farmers, self-employed as member of the respective chamber, and other freelancers from the sample.

Table 3.3 presents the results from the first stage regressions. The table displays the results of regressions estimating the effects of the schooling attainment of the mother on the financial literacy index. In all specifications, the instrumental variable is positive and statistically significant. The schooling attainment of the mother has strong predictive power for the financial literacy index. Including additional control variables or changing the sample does not change this finding. The results are in line with existing literature on the impacts of parental education on children's financial literacy later in life (Behrman et al., 2012; Lusardi et al., 2010; Mandell, 2008).

Table 3.4 presents the main regression results of the effect of the instrumented financial literacy index on the probability of self-employment. With respect to our variables of interest, the results suggest that financial literacy has a positive and highly significant effect on the probability of being self-employed. Higher literacy scores lead to higher self-employment rates. The effect is robust across all specifications and samples. Our main regression (including the full set of controls) results (Column 3 in Table 3.4) indicate that the probability of self-employment rises by approximately 1.4 percentage

points with each additional correct answer.¹² Compared to the relevance of education, financial literacy plays an important role for being self-employed: A look at the effect of education shows that compared to the base category of education (vocational training), having master craftsman qualification is related to a 6.8 percentage point-higher likelihood of self-employment, and a university degree is related to a 1.3 percentage point-higher likelihood.¹³

3.5 Discussion and Extension

In this section, we investigate the robustness of our results. Although we address several concerns with regard to endogeneity issues, we cannot prove beyond a doubt that our instrumental variable meets the exclusion restriction. In addition, we use other waves of the SAVE survey and examine several extensions.

The instrumental variable relies on the interaction of parents and their children. It is based on the assumption that the educational level of the mother directly affects her children's financial literacy levels. There is reason to assume that mothers influence their children's literacy through other channels, for instance through their personality traits, wealth, or employment characteristics.

Further, a mother's educational level is related to her type of employment.

¹² Marginal effects for the main regression models are depicted in Table A.5 in the Appendix.

¹³ Exhibiting medium or high risk attitudes is related to a higher likelihood of self-employment by 5 percentage points. However, it is unclear whether there is a way to shape risk attitudes in the long run. The marginal effects for math skills are negative and amount to approximately 0.3 percentage points, suggesting that math skills play a minor (albeit insignificant) role in being self-employed. And, in our sample, having ever been unemployed increases the probability of being self-employed by 5 percentage points. Note, however, that the variable also includes individuals having been unemployed for less than one month and therefore also accounts for frictional unemployment. Results are depicted in Table A.5 in the Appendix.

If the mother is self-employed, her choice of employment, in turn, might affect her children’s self-employment choice (Lindquist et al., 2015), so that a mother’s education drives her children’s entrepreneurship decisions through her own entrepreneurship.¹⁴ However, studies show that there is no effect of parental education on the entrepreneurship of children when controlling for the entrepreneurship of parents (Djankov et al., 2006; Lindquist et al., 2015).

We first investigate whether our results are robust once we re-estimate our model using a subsample for which the likelihood of self-employed parents is low. We focus on East German observations. In the German Democratic Republic (GDR), nearly all firms were owned by the state.¹⁵ Self-employment was regarded as an “unwanted remnant of the capitalist society” (Fritsch et al., 2010, p.2).

We limit the sample to persons from East Germany and therefore likely observe persons with non-self-employed mothers. In this subsample, mothers cannot affect the self-employment decisions of their children by their own self-employment. Due to the sample size, we include persons who have graduated (general school-leaving certificate) in the former GDR and persons who lived in the federal states of the former GDR in 2009.¹⁶ Further, we exclude civil servants, and we use only the group of freelancers and traders or other forms of self-employment. This narrow definition of self-employment holds an ad-

¹⁴ Note that women are less likely to be self-employed than men.

¹⁵ In 1972, private industry was completely expropriated, self-employment was permitted only in a few economic fields, and prior to the reunification, the rate of self-employed individuals in the GDR was below 2% (Fritsch et al., 2010) compared to 11% in 2012 in the whole of Germany (Mai and Marder-Puch, 2013). The few remaining private companies were strongly controlled by the state: For example, the profits and the size of a company (up to 10 employees) were limited by the state.

¹⁶ The data do not allow restricting the sample only to those individuals with a school-leaving qualification from the former GDR. We observe only 11 self-employed individuals when estimating the IV model and restricting the sample only to individuals with a school-leaving qualification from the former GDR.

ditional advantage: we exclude (self-) employment groups (such as farmers, lawyers, and doctors) for which the likelihood is higher that parental self-employment affects the self-employment of children (Djankov et al., 2006). We are aware that a direct channel from the education of parents to the self-employment decisions of children is not perfectly excluded, but we come close to excluding the intergenerational transfer of self-employment.

Table 3.5 (Column 1) presents the main regression results of the effect of the instrumented financial literacy index on the probability of being self-employed for the East German subsample. Although more than two thirds of the observations are lost in the restricted sample, our results remain robust. The estimates of instrumented financial literacy on the self-employment index remain positive and highly statistically significant. Therefore, the effect remains when we consider only a sample in which the likelihood of an intergenerational entrepreneurship transfer is low.

Secondly, we investigate whether our results are affected once we control for a set of characteristics of parents. Parental education is likely correlated with parents' own characteristics and, thereby, with the characteristics of their children.

In the 2008 survey, respondents were asked whether they had lived together with both parents at the age of ten, whether they came from single parent families, or whether they had not lived together with their parents. We include (i) a binary variable that indicates that respondents have not lived together with both parents (reference: lived together with both parents). Further, respondents were asked whether their mothers and fathers were (ii) adventurous persons and whether they (iii) made detailed plans for the future. For both questions, the response scales ranged from 0 (inapplicable) to 10 (fully applicable). The variables serve as proxies for conscientiousness and risk acceptance, common traits that are likely passed on from parents to children and that

could affect investments in financial literacy and employment choice (Dohmen et al., 2011a; Kitamura et al., 2009; Webley and Nyhus, 2006). We use the characteristics as control variables in our model. Finally, respondents were asked whether their parents (iii) (did) keep private accounting records. We include a binary variable that serves as proxy for the financial habits of the parents.

The results are presented in Table 3.5, Column 2. We find that the characteristics of parents do not directly matter for self-employment. Having a father with detailed plans for the future seems to affect self-employment negatively. Furthermore, self-employment appears to be affected by parents' financial habits, though the results are not statistically significant. Having parents who (did) keep private accounting records increases the probability of self-employment.

Although insignificant, the results suggest a negative correlation between growing up with only one parent or without parents and self-employment. Moreover, first stage regressions also show a significant (at the 0.05 level) negative relation between growing up without parents or with one parent only and financial literacy (see Table A.6 in the Appendix).

The IV estimates are barely affected by the addition of the control variables. The estimates for financial literacy remain statistically significant, while estimates of other coefficients do not change qualitatively. Financial literacy affects self-employment beyond the potential transmission effects of particular parental characteristics.

Another channel through which maternal education might affect self-employment is the wealth of parents. The education of parents is related to their wealth, and individuals might benefit from parents' wealth with regard to becoming self-employed (e.g., Blanchflower and Oswald, 1998; Fairlie and Krashinsky, 2012). For example, better-educated mothers are likely to be

wealthier and, thus, more likely to provide financial support to their children. However, the size of the gift plays an important role: only at the very top of the wealth distribution is there a strong and positive relationship between household wealth and business entry, suggesting that only large windfall gains diminish liquidity constraints (e.g., Blanchflower and Oswald, 1998; Hurst and Lusardi, 2004). Moreover, Monticone (2010) shows that wealth has a positive but small effect on the degree of financial knowledge. Thus, we next analyze whether our estimates change when controlling for financial support. The SAVE data set (2007-2009) provides information on whether respondents received (i) financial support from parents or children in the previous year. It also contains information about (ii) regular support payments and (iii) occasional support payments in general. Further, we control for (iv) inheritance receipts of financial assets and (v) inheritance receipts of real estate in the past and (vi) the self-assessed likelihood of an inheritance receipt in the future. In addition, we include the respondents' personal assessment of (vii) parents' understanding concerning financial matters.

In Table 3.5, Column 3, we report IV estimates of the effect of financial literacy on the probability of being self-employed while controlling for various wealth and support proxies. We do not find that support payments (regular or occasional) have a positive or significant effect on self-employment. Yet, the results suggest a positive relation between inheritance receipts (of both financial assets and real estate) and self-employment, though the effects are not statistically significant. However, the results in the first stage suggest a positive relation between the inheritance of financial assets and financial literacy (see Table A.6 in the Appendix). This result is consistent with the findings of Monticone (2010).

Furthermore, the negative associations between not growing up with both parents (single parent/no parent-background) and both financial literacy and

self-employment remain.

Our IV-probit results, however, are barely affected by the additional variables. The positive effect of financial literacy on self-employment, as well as our first stage results, remain robust.

Other omitted factors that could be correlated to self-employment, financial literacy, and our instrument, are devoted to the questions of how individuals have dealt with money during childhood and whether they learned to manage money at all. Jorgensen and Savla (2010) and Grohmann et al. (2015) show that financial socialization by parents plays a major role in financial literacy. Sansone et al. (forthcoming) show that individuals who regularly received pocket money during their childhood are more financially confident adults. Even after controlling for the fact that parents have taught budgeting, the effect of pocket money remains significant.

SAVE 2008 provides information on statements regarding whether respondents received pocket money regularly and whether they spent that money immediately. Both variables are measured on an 11-point scale, where 0 indicates absolutely inapplicable and 10 indicates absolutely applicable. We include both measures as control variables in the model (Table 3.5, Column 4).

In accordance with the literature, in our first stage regressions, we find that receiving pocket money during childhood regularly plays a role in future financial literacy, while spending habits seem not to have an effect on financial literacy (see Table A.6 in the Appendix). We do not find a correlation between financial socialization during childhood and self-employment.

Yet, the negative relation between self-employment and not growing up with both parents (albeit not statistically significant) and financial literacy and not growing up with both parents (still statistically significant at the 0.10 significance level) remain. Still, the inclusion of both pocket money variables

barely changes our main results. After controlling for financial socialization, the effect of instrumented financial literacy on self-employment is still statistically significant, and the first stage regression results are robust as well.

Finally, we re-estimate our model including all additional control variables. Column 5 in Table 3.5 presents regression results from an IV-Probit regression including basic control variables, socio-demographic and socio-economic variables, personality traits, attitudes, and preferences, parental characteristics, family background, and proxies for wealth, financial support, and financial socialization.

Including all control variables hardly changes the results found in the basic model: the statistically significant and positive effect of financial literacy on self-employment remains unchanged, and the marginal effect is similar in magnitude to the values in previous specifications.

The included control variables still indicate a relation with self-employment, although most effects are not statistically significant. Growing up with a single parent or without parents is negatively associated with self-employment, while having parents who (did) keep private accounting records is positively associated with self-employment. In addition, while the self-employed tend to be more likely to inherit financial assets or real estate, they tend to be less likely to receive regular support payments. In sum, financial literacy seems to have an effect on self-employment above and beyond the potential effects of socialization and transmission.

3.6 Conclusion

Recent studies show that financial sophistication has an impact on household financial decision-making. However, even beyond financial decisions, financial

sophistication seems to have an impact on individuals' behavior. For example, entrepreneurial activities require a certain level of financial sophistication.

This empirical investigation reveals a positive relationship between financial literacy and self-employment. Our results are based on German data, including various basic and advanced questions on financial matters. We use an instrumental variable based on the schooling attainment of the mother to tackle the problem of endogeneity.

For most individuals, the analysis of the SAVE data documents a relatively low level of practical financial literacy beyond simple calculations of interest rates or rates of return. Furthermore, wagedworkers achieve even lower scores than self-employed respondents. Less financially literate individuals are more likely to work as wagedworkers than to take steps towards self-employment. The effect of financial literacy on the probability of self-employment is robust across different specifications. Financial sophistication might lead to more efficient acquisition of fundamental information and processing of information on financial issues, to confident risk assessments, to better opportunities for realizing business ideas, and ultimately to more self-employment.

Our findings add to the nature vs. nurture discussion. Several researchers have examined the extent to which personality affects the decision to be self-employed, and most of the characteristics found to be relevant for self-employment are found to be relatively stable over time. Our analysis shows that financial literacy, which is acquirable, is positively associated with being self-employed. However, although we address several concerns with regard to endogeneity issues, we cannot prove without a doubt that our instrument meets the exclusion criterion. If one is willing to believe that our results are valid, the findings suggest that enhancing financial literacy could be a trigger for self-employment. Furthermore, several scholars have analyzed why and how entrepreneurs evaluate potential opportunities to introduce new products,

services or business models. While a common idea is that individuals discover an opportunity prior to their decision to exploit it (Shane and Venkataraman, 2000), a growing body of research is looking at the bridge between the discovery and the exploitation stage: the opportunity evaluation (Wood and McKelvie, 2015). It is likely that financial literacy is relevant at this stage.

Due to restrictions in our data set, we cannot evaluate transitions into self-employment, survival in self-employment, or success of new businesses separately. There is a need for experimental work in this area, and future research should provide further support for the link observed.

Moreover, it is not clear which type of financial education is the most suitable for our context. There is indeed a burgeoning literature studying the effects of financial education on financial literacy and behavior, and, in general, policy makers, scholars, and researchers agree that financial education for youth is of vital importance for the long-term fiscal well-being of individuals (Totenhagen et al., 2015).¹⁷ In a systematic literature review of financial-literacy education programs, Amagir et al. (2018) conclude that school-based financial education programs can improve both children's and adolescents' financial knowledge and attitudes. Above all, experiential learning using practical examples can be a promising method to teach financial literacy. Similarly, Totenhagen et al. (2015) conclude that active learning experiences and activities seem to be the most promising strategies for financial education targeting youth. As far as adult education is concerned, Bernheim and Garrett (2003), for example, find that employer-based financial education in the workplace stimulates saving, both in general and for retirement. Also, Bayer et al. (2009) find positive effects of employer-based retirement seminars on contributions

¹⁷ For a detailed discussion of financial education interventions, see, for example, Bernheim and Garrett (2003); Fernandes et al. (2014); Hastings et al. (2013); Mandell (2008); Mandell and Klein (2009); Moreno-Herrero et al. (2018); Walstad et al. (2010).

to voluntary savings plans. In turn, Fernandes et al. (2014) suggest that the effects of financial education interventions are weak, which can partly be explained because the effects of interventions decay over time. They suggest real but narrower “just-in-time” financial education tied to specific behaviors.

Based on these findings, we argue that more experimental studies on the effects of (different) financial education interventions or specific programs, particularly in the form of small-business trainings, are required.

3.7 Tables

Table 3.1: Characteristics of Individuals

	Total Sample		Self-Employed		Wageworkers	
	N	Share/ Mean	N	Share/ Mean	N	Share/ Mean
Female	536	0.52	44	0.42	492	0.53
Age	1,039	45.8	104	47.7	935	45.6
Education, vocational qualification (ISCED)						
Vocational training	674	0.65	48	0.46	626	0.67
Master craftsman	62	0.06	12	0.12	50	0.05
University degree	187	0.18	35	0.34	152	0.16
Other/none	116	0.11	9	0.09	107	0.11
Graduation in GDR	293	0.28	36	0.35	257	0.28
Mental exercises						
0 correct	306	0.29	33	0.32	273	0.29
1 correct	280	0.27	22	0.21	258	0.28
2 correct	265	0.26	29	0.28	236	0.25
3 correct	20	0.18	20	0.19	168	0.18
Sum	1,039	1.32	104	1.35	935	1.32
Marital status						
Single	206	0.20	22	0.21	184	0.20
Married	649	0.63	67	0.64	582	0.62
Else	184	0.18	15	0.14	169	0.18
Number of children	1,039	1.64	104	1.39	935	1.66
Homeowner	1,039	0.56	104	0.59	935	0.56
Unemployed	1,039	0.61	104	0.65	935	0.61
Household income	1,039	2,689	104	3,335	935	2,615

Notes: This table reports descriptive statistics of the main variables for the full sample of 104 self-employed and 935 wageworkers. Shares do not sum up to 1 because of rounding.

Table 3.2: Personality Traits

Traits	Total	Wageworker	Self- Employed	t-test
Risk attitude				
Low	0.47	0.49	0.32	0.0009
Medium	0.49	0.48	0.60	0.0292
High	0.04	0.03	0.09	0.0023
Sum (average)	1.56	1.54	1.77	0.0001
Creature of habit				
Open to changes	6.47	6.42	7.24	0.0003
Optimistic	6.78	6.79	7.38	0.0103
Self-assured	6.62	6.55	7.10	0.0145
Exact future plan	6.87	6.88	7.29	0.0405
Impulsive vs. weighing	5.71	5.83	5.09	0.0026
Voluntary activities				
Daily	0.10	0.09	0.09	0.9033
Weekly	0.29	0.30	0.34	0.4748
Monthly	0.20	0.21	0.14	0.1076
Less frequently	0.41	0.40	0.44	0.4757
<i>N</i>	1039	934	105	

Notes: This table reports the descriptive statistics of the personality traits for the full sample of 104 self-employed and 935 wageworkers. The definitions of variables are given in Section 3.3. t-test: $H_a : diff \neq 0$.

Table 3.3: Self-Employment and Financial Literacy: First Stage Regressions

	Financial Literacy				
	(1)	(2)	(3)	(4)	(5)
Mother's schooling attainment	0.282*** (0.067)	0.228*** (0.062)	0.234*** (0.067)	0.261*** (0.071)	0.221*** (0.078)
Age	0.138 (0.085)	0.018 (0.086)	-0.045 (0.092)	-0.029 (0.100)	-0.015 (0.111)
Age ²	-0.002 (0.001)	-0.000 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Male	0.633*** (0.184)	0.222 (0.181)	0.193 (0.197)	0.212 (0.212)	0.101 (0.226)
Education GDR	-0.241 (0.199)	0.332 (0.241)	0.234 (0.259)	0.281 (0.277)	0.313 (0.328)
Vocational qualification:					
Master craftsman		0.759*** (0.262)	0.776*** (0.273)	0.704*** (0.273)	0.604** (0.298)
University degree		0.113 (0.248)	0.004 (0.248)	-0.073 (0.278)	-0.075 (0.279)
None/other		-0.062 (0.306)	0.208 (0.338)	0.261 (0.347)	0.305 (0.368)
Unemployment		-0.129 (0.172)	-0.042 (0.183)	-0.143 (0.196)	-0.100 (0.214)
Mental exercises		0.634*** (0.080)	0.615*** (0.084)	0.560*** (0.087)	0.624*** (0.095)
Marital status: married		-0.265 (0.288)	-0.221 (0.300)	-0.261 (0.321)	-0.389 (0.349)
Marital status: other		0.434 (0.345)	0.701** (0.357)	0.801** (0.386)	0.635 (0.422)
Number of children		-0.030 (0.077)	-0.059 (0.084)	-0.066 (0.084)	-0.123 (0.098)
Homeowner		0.133 (0.193)	0.122 (0.212)	0.180 (0.217)	0.073 (0.241)
ln (income)		-0.942*** (0.332)	5.111 (4.531)	4.520 (4.768)	4.994 (5.288)
ln ² (income)		0.126*** (0.035)	-0.256 (0.290)	-0.210 (0.306)	-0.243 (0.339)
Health status: medium		0.085 (0.371)	0.133 (0.428)	0.219 (0.456)	0.328 (0.487)
Health status: high		0.000 (0.367)	0.009 (0.426)	0.039 (0.453)	0.199 (0.485)

Financial Literacy					
	(1)	(2)	(3)	(4)	(5)
Risk attitude:					
medium			0.107 (0.189)	0.063 (0.200)	0.064 (0.217)
high			-0.701 (0.539)	-0.715 (0.544)	-0.631 (0.658)
Creature of habit			0.029 (0.042)	-0.003 (0.043)	-0.011 (0.048)
Open for changes			0.026 (0.053)	0.045 (0.058)	0.055 (0.066)
Optimistic			-0.048 (0.050)	-0.048 (0.053)	-0.059 (0.062)
Self-assured			0.020 (0.058)	0.028 (0.060)	0.038 (0.069)
Living for the day vs. exact future plan			0.002 (0.051)	-0.005 (0.055)	0.010 (0.060)
React impulsive and fast vs. weighing and observantly			-0.046 (0.040)	-0.025 (0.042)	-0.049 (0.047)
Voluntary:					
low			0.205 (0.231)	0.251 (0.236)	0.232 (0.238)
medium			0.263 (0.221)	0.240 (0.237)	0.257 (0.244)
high			-0.060 (0.342)	0.157 (0.316)	
Federal states		Yes	Yes	Yes	Yes
<i>N</i>	591	583	530	474	410
First stage F-statistic	17.38	12.77	11.24	12.34	7.31

Notes: This table reports first stage regression results of financial literacy on the instrumental variable *mother's schooling attainment* and control variables. In specification (4), civil servants are excluded from the sample, in specification (5), additionally, the very narrow definition of self-employment is applied. Robust standard errors are reported in brackets.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 3.4: Self-Employment and Financial Literacy: IV-Probit Results

Self-Employment					
	(1)	(2)	(3)	(4)	(5)
Financial literacy	0.352***	0.432***	0.399**	0.400**	0.579***
	(0.109)	(0.118)	(0.164)	(0.162)	(0.043)
Age	0.068	0.100	0.111	0.082	-0.026
	(0.072)	(0.077)	(0.085)	(0.087)	(0.084)
Age ²	-0.001	-0.001	-0.001	-0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.163	-0.143	-0.101	-0.133	-0.029
	(0.158)	(0.152)	(0.173)	(0.189)	(0.175)
Education GDR	0.264*	-0.032	0.077	0.064	-0.187
	(0.151)	(0.195)	(0.256)	(0.253)	(0.204)
Vocational qualification:					
Master craftsman		0.168	0.282	0.271	-0.103
		(0.322)	(0.386)	(0.370)	(0.224)
University degree		0.175	0.096	0.196	-0.237
		(0.214)	(0.220)	(0.231)	(0.236)
None/other		0.551**	0.533	0.485	0.080
		(0.266)	(0.349)	(0.355)	(0.280)
Unemployment		0.342**	0.417**	0.408**	0.156
		(0.163)	(0.206)	(0.208)	(0.172)
Mental exercises		-0.265**	-0.203	-0.162	-0.324***
		(0.106)	(0.139)	(0.140)	(0.077)
Martial status:					
married		-0.150	-0.283	-0.306	0.274
		(0.269)	(0.300)	(0.313)	(0.274)
other		-0.295	-0.511	-0.594*	-0.094
		(0.273)	(0.317)	(0.342)	(0.354)
Number of children		-0.119	-0.150	-0.170*	-0.053
		(0.075)	(0.096)	(0.103)	(0.091)
Homeowner		-0.131	-0.046	0.008	0.043
		(0.151)	(0.175)	(0.188)	(0.174)
ln (income)		-0.187	-5.382**	-5.805**	-6.044*
		(0.377)	(2.584)	(2.593)	(3.152)
ln ² (income)		0.014	0.346**	0.374**	0.365*
		(0.044)	(0.166)	(0.168)	(0.205)
Health status:					
medium		-0.525	-0.683*	-0.697*	-0.265
		(0.325)	(0.385)	(0.387)	(0.365)
high		-0.191	-0.330	-0.265	-0.132
		(0.287)	(0.332)	(0.330)	(0.345)

Self-Employment					
	(1)	(2)	(3)	(4)	(5)
Risk attitude:					
medium			0.342 (0.209)	0.451** (0.211)	0.264 (0.191)
high			0.584 (0.467)	0.591 (0.481)	0.580 (0.424)
Creature of habit			-0.057* (0.034)	-0.033 (0.035)	-0.076 (0.048)
Open for changes			0.094 (0.068)	0.100 (0.075)	-0.004 (0.055)
Optimistic			0.002 (0.061)	-0.011 (0.064)	0.035 (0.055)
Self-assured			0.020 (0.050)	0.011 (0.053)	0.057 (0.058)
Living for the day vs. exact future plan			0.057 (0.050)	0.049 (0.051)	0.001 (0.042)
Reacting impulsive and fast vs. weighing and observantly			-0.028 (0.039)	-0.046 (0.039)	-0.012 (0.039)
Voluntary:					
low			-0.263 (0.230)	-0.137 (0.235)	-0.036 (0.193)
medium			0.002 (0.203)	0.095 (0.218)	0.021 (0.184)
high			-0.506 (0.421)	-0.515 (0.405)	
Federal states		Yes	Yes	Yes	Yes
<i>N</i>	591	583	530	474	410

Notes: This table reports IV Probit regression results of self-employment on financial literacy and control variables. Financial literacy is instrumented using *mother's schooling attainment*. In specification (4), civil servants are excluded from the sample, in specification (5), additionally, the very narrow definition of self-employment is applied. Robust standard errors are reported in brackets.

* p < .10, ** p < .05, *** p < .01

Table 3.5: Self-Employment and Financial Literacy: Extensions

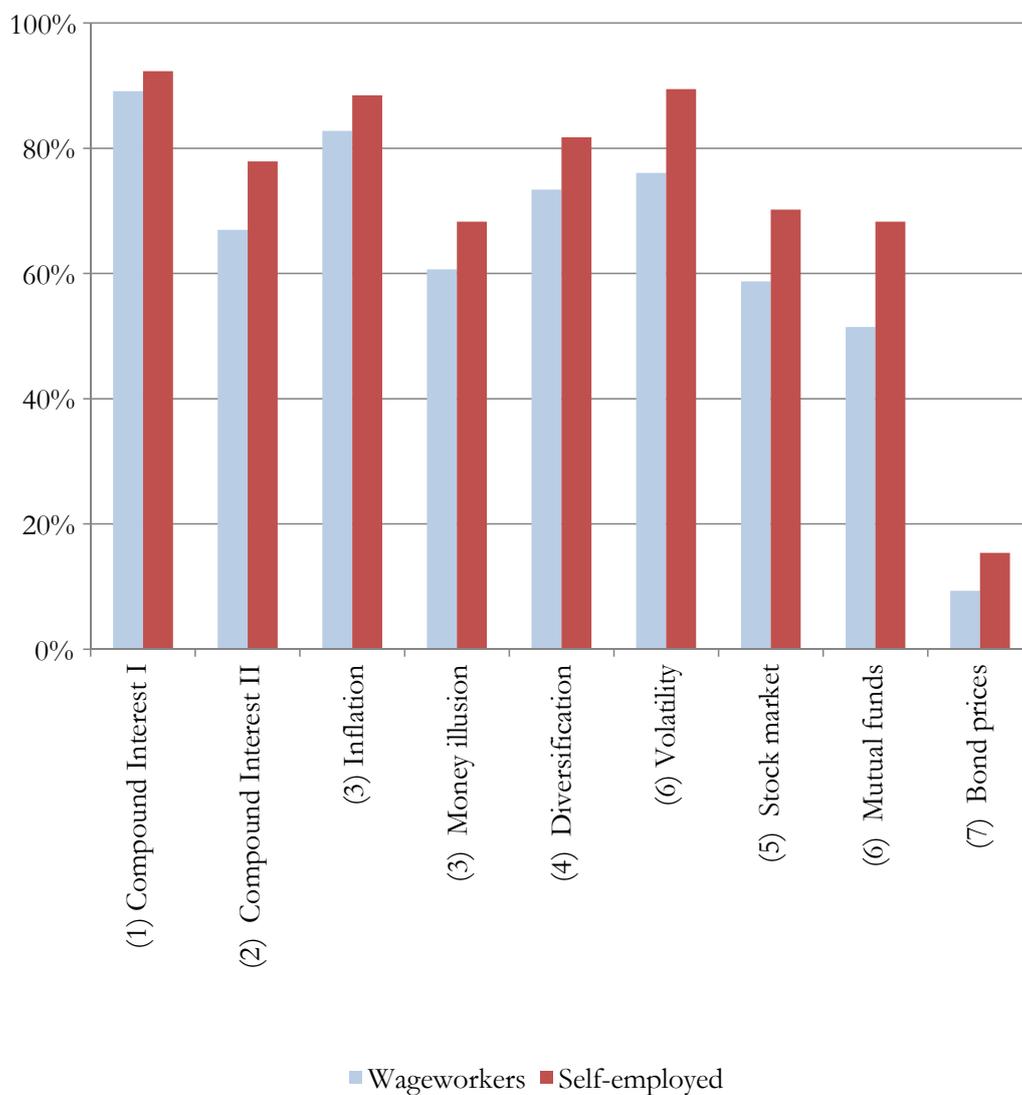
	Self-Employment				
	(1)	(2)	(3)	(4)	(5)
	GDR sample				
Financial literacy	0.459*** (0.165)	0.436*** (0.113)	0.440*** (0.106)	0.412*** (0.136)	0.449*** (0.104)
Socio-demographic, socio-economic control variables	Yes	Yes	Yes	Yes	Yes
Federal states	Yes	Yes	Yes	Yes	Yes
Personality traits, attitudes		Yes	Yes	Yes	Yes
Single-parent/no parents		-0.567 (0.466)	-0.448 (0.458)	-0.504 (0.452)	-0.458 (0.513)
Mother: adventurous		-0.002 (0.038)			0.010 (0.040)
Mother: plan for future		0.013 (0.030)			0.016 (0.030)
Father: adventurous		0.031 (0.029)			0.034 (0.032)
Father: plan for future		-0.060* (0.034)			-0.069* (0.036)
Parents: accounting		0.162 (0.182)			0.148 (0.177)
Financial support, previous year			-0.167 (0.294)		-0.211 (0.322)
Regular support payments			-0.096 (0.262)		-0.152 (0.273)
Occasional support payments			0.065 (0.166)		0.057 (0.166)
Inheritance, financial assets			0.129 (0.287)		0.152 (0.301)
Inheritance, real estate			0.087 (0.425)		0.155 (0.441)
Likelihood of inheritance			0.006 (0.039)		0.016 (0.039)
Parents' financial understanding			-0.069 (0.114)		-0.019 (0.120)
Regular pocket money				0.000 (0.027)	0.001 (0.024)
Spending pocket money				0.004 (0.028)	0.017 (0.027)

	(1)	(2)	(3)	(4)	(5)
GDR sample					
First stage regression (Outcome variable: financial literacy)					
Mother's schooling attainment	0.341*** (0.120)	0.248*** (0.068)	0.260*** (0.073)	0.239*** (0.068)	0.260*** (0.075)
First stage F-statistic	6.84	12.04	15.59	11.32	10.72
<i>N</i>	173	517	506	517	497

Notes: This table reports IV Probit regression results of self-employment on financial literacy and control variables. Financial literacy is instrumented using *mother's schooling attainment*. Full first stage regressions are provided in Table A.6. Robust standard errors are reported in brackets. * $p < .10$, ** $p < .05$, *** $p < .01$

3.8 Figures

Figure 3.1: Financial Literacy by Type of Employment



Note: This figure reports the share of correct answers on financial literacy questions by type of employment.

4 Socio-Demographic Differences in Retirement after Wealth Shocks: Evidence from Germany

4.1 Introduction

Economic theory suggests reservation wage to rise and labor supply to fall following a wealth shock. Yet, empirical studies show a rather differentiated picture on the effects of windfall gains on labor market behavior. On the one hand, data and methods do not allow for causal interpretation, in particular because relevant unobservable characteristics are not taken into account. On the other, new findings indicate that the institutional setting in a country, especially with respect to social security, makes a decisive contribution to the response to wealth shocks so that findings are not necessarily applicable to any other economy.

Against this background, my paper contributes to the literature by shedding light on the relationship between wealth shocks and labor market exit due to retirement entry focusing on Germany - a developed country with a strong social security system. I use German survey data to address the following research questions: First, do wealth shocks increase the probability to leave the labor market and enter retirement? Whose labor supply decisions are affected in particular? What may be the driving forces for leaving or not leaving the labor force to retire?

It is of essential interest of policy makers to understand the labor market effects of wealth shocks. In the light of demographic changes, especially in developed countries, economies face a shortage of skilled labor. This shortage does not only put pressure on the labor market but also on the statutory pen-

sion system in many economies. Not only, but especially for designing pension and social reforms, it is important to understand how changes in income and wealth affect labor supply. Since both the number of inheritances and the size of these are expected to increase further in the next decades (Braun, 2015), and the proportion of households that inherit or receive gifts increase with age (von Westermeier et al., 2016), the elderly are of particular interest in this debate. I expect persons close to retirement age to respond to wealth shocks stronger than younger persons who will change their consumption path rather than their labor supply (Imbens et al., 2001).

I proceed in this direction by studying the effect of windfall gains on retirement entry and focus on socio-demographic differences because factors such as age, gender, and education are decisive factors of labor supply. There are existing studies on the effect on labor supply. The findings, however, are not straightforward. Differentiated findings seem to result from lack of data and their ability to allow reliable estimates. The most relevant shortcoming of the studies is that they do not address potential endogeneity issues when studying the relation between wealth changes and labor supply. An investigation by Brown et al. (2010) can overcome some of the weakness points of previous studies and is the closest to our study. However, the authors do not consider differences in male and female labor supply or other decisive demographic factors, and apply linear regressions only. Furthermore, the question arises of the transferability of their results to any other economy because another explanation for divergent results discussed in the literature is that the response depends to a large extent on the social system in the respective country. Discussing their findings, Bø et al. (2018) draw the conclusion that the institutional setting (here, the design of the Norwegian pension scheme) makes a decisive contribution to the response. A burgeoning literature shows that social security has a strong impact on individual behavior and labor supply

decisions. In particular for retirement, social security regulations are found to affect entry decisions.¹ Börsch-Supan and Schnabel (1998) conclude that the German public pension system is a prime example of negative incentive effects on old-age labor supply. Consequently, - as in most European countries - German employees still strongly rely on statutory (and company) pension provision. Transferring results based on US data to countries with strong social systems, should be done with caution as it is likely to observe different results for the labor supply effects after wealth shocks in countries with clearly differing social systems.

In this paper, I provide empirical evidence for the impact of wealth shocks on retirement in Germany - a prime example for a developed country with strong social security. By focusing on socio-demographic differences in the effect, I add to the understanding of rationales of the issue. Using survey panel data that allow to control for decisive retirement factors, I apply, in the first step, a propensity score matching to generate a matched sample with and without windfall gains. In the second step, a discrete time proportional hazards model estimates retirement hazards on the matched sample of recipients and non-recipients. The estimates are performed for women and men separately. In order to obtain a more comprehensive picture of the effect, I re-estimate the effect on subgroups to account for socio-demographic factors of labor supply and to learn more about the sociodemographic differences in retirement response. Furthermore, I examine whether the effect is influenced by whether a future inheritance is expected.

¹ Early studies by, to name only a few examples, Boskin (1977), Boskin and Hurd (1978), Sheshinski (1978) are the first to show a strong influence of social security on early retirement. Later, Gruber and Wise (1998) provide an international comparison investigating where and why social-security provisions provide (enormous) incentive to leave the labor force early. Fenge and Pestieau (2005) draw on evidence from the European Union (with comparisons to other industrialized countries including the United States and Canada), and illustrate that an effective retirement age is affected by social security regulations.

In contrast to previous findings (e.g., Bø et al., 2018), the results indicate considerable gender differences. I find a strong positive retirement effect for women after windfall gains, and no effect for men. The odds of entering retirement for female recipients are about two times the odds of entering retirement for female non-recipients. Moreover, the magnitude of the estimated effect differs considerably by social groups. First, I find sharp distinctions according to education. Whereas the effect diminishes when examining highly educated women, it is stronger when considering low-educated women. I further find a relation to income that partly results from the education. Yet, the retirement effect found is not only based on the potentially resultant income differences, albeit the retirement effect is strongest for low educated women with below-median income. Finally, it plays an important role whether women have grown up in West Germany or the former (socialist) GDR. Here, again, the retirement effect disappears when having a closer look at the group of East German women, while it is even stronger when West German women are in focus. This suggests that the state-dependent socialization significantly contributes to labor supply responses, and is consistent with findings on East/West differences in labor supply (e.g. Holst and Wieber, 2015). Overall, the evidence supports the idea that gender, education, and socialization contribute substantially to retirement response to wealth shocks. Eventually, the analysis corroborates the conjecture that wealth shocks have larger effects when they are not anticipated.

This paper is organized as follows: in Section 4.2, I provide an overview of the literature on the effect of wealth shocks on labor supply. The data used for the empirical analysis and descriptive statistics are presented in Section 4.3, and in Section 4.4, the econometric strategy and the results are presented. The main conclusions are summarized in the final section (4.5).

4.2 Related Literature

A burgeoning literature deals with the employment effects of wealth. First empirical studies examined the effects of savings and household wealth (e.g., Bloemen, 2002; Stancanelli, 1999). However, wealth is not randomly assigned, and parts of the variation in wealth are reflecting individual heterogeneity in preferences, which is also correlated with labor supply. Hence, younger studies use changes in income and wealth such as stock market booms (Coronado and Perozek, 2003), housing wealth fluctuations (Henley, 2004), or lottery winnings (e.g., Cesarini et al., 2017; Imbens et al., 2001) to investigate the effects of income shocks on labor supply. But the evidence is far from unambiguous (e.g., Coile and Levine, 2006; Sevak, 2002). The changes in income are either relatively small or very rare and, thus, less suitable to measure economically relevant changes in labor supply.

Inheritance receipts seem to be more relevant (in size) and likely, and therefore more appropriate to study labor supply effects. Few existing studies use inheritances as wealth shocks to study labor market effects. However, even their results are not straightforward. For instance, in one of the first studies, Holtz-Eakin et al. (1993) find decreasing labor force participation after inheritances, and Joulfaian and Wilhelm (1994) find no large reduction in labor supply. Similarly, some younger studies provide contrary findings. For example, whereas Peters and Schwarz (2013) find an effect on yearly working hours, Bø et al. (2018) find only a very small probability of reducing working hours after inheritance receipt, and Doorley and Pestel (2016) find no decrease in hours of work among men at all. Furthermore, while Doorley and Pestel (2016) find no effect on the extensive margin, Sila and Sousa (2014) find that the effect is even stronger at the extensive than at the intensive margin.

In much of previous literature the age of the heirs is not taken into account, and other studies exclude older individuals (e.g., Holtz-Eakin et al., 1993; Joulfaian, 2006). Those who consider differences in behavior according to age also come to different conclusions. When considering older individuals in the US, Joulfaian and Wilhelm (1994), for example, find only a small and statistically insignificant association with inheritances, whereas Sila and Sousa (2014) find a stronger response for older individuals than for younger when examining European data. Analyzing Swedish tax data, Elinder et al. (2012) find a higher decline in labor income after inheritances for older than for younger individuals.² The study by Bø et al. (2018) presents only a statistically insignificant effect on the probability to receive a pension instead of wage income using Norwegian administrative data.

Two other studies directly focus on retirement effects of inheritance receipts. First, Brown et al. (2010) find an increase in the probability of retirement after wealth shocks. The results are based on data from the US and a linear Probit model. The second applies the model proposed by Brown et al. (2010) on a European sample, and finds labor effects which bear out findings by the former only partly (Eder, 2016).

This paper differs from Brown et al. (2010) and Eder (2016) in several points. First, on account of the relevant differences in the social security systems (as discussed in 4.1), and since the labor supply decision depends to a large extent on the social system, I can expect to find divergent results when studying German population compared to the results based on US data by Brown et al. (2010). The relevance of the institutional setting in this debate may help explain the differences in results why, to name only a few examples at this point, Holtz-Eakin et al. (1993) and Joulfaian and Wilhelm (1994)

² It should be mentioned that Elinder et al. (2012) exclude individuals older than 59.

find no large reduction in labor force (in the USA), whereas using Swedish or Norwegian data, respectively, Elinder et al. (2012) and Bø et al. (2018) do find reductions in labor income after inheritances. Further, considering older individuals, for instance, US data (Joulfaian and Wilhelm, 1994) and European data (Sila and Sousa, 2014) imply contrary findings. In addition, I will discuss differences in socialization within the research group by taking advantage of the unique circumstance of the decade-long separation of East and West Germany.

Second, neither of the two studies account for differences in labor supply of women and men. However, female and male labor supply still differ considerably (e.g., Killingsworth and Heckman, 1986; Smith, 2014). This study provides separate estimates of the retirement hazard for women and men, and finds relevant differences in results.

Third, I do not only account for gender differences in retirement response. I focus on socio-demographic differences in labor response and have a closer look at the differences between social groups. For example, I find relevant differences in retirement response by social background and education. This allows a deeper insight in the background of the effect and more concrete recommendations for scholars and policy makers.

Finally, in order to take the relevant endogenous relation of wealth and labor supply into consideration, I combine a matching method, which allows to define a study sample, with discrete time duration models. I take into account that wealth is not randomly assigned, and that individual heterogeneity in preferences - which is correlated with labor supply- is reflected by some of the variation in wealth. Estimates of simply comparing outcomes among observations that received a treatment versus those that did not can induce bias due to confounding variables. Applying the matching method allows to take the covariates that predict receiving the windfall gain into consideration and

reduce the bias due to confounding variables.

4.3 Data and Descriptive Analysis

The empirical analysis is based on data of the German Socio-economic Panel (SOEP). Started in 1984, the representative annual panel survey conducts information on about 30,000 individuals of nearly 11,000 private households (in the latest waves).³ The data provide information on socio-demographic and socio-economic characteristics, self-assessed personality traits, and household characteristics. Using survey panel data enables controlling for a rich set of demographic characteristics that are decisive for labor supply such as the family background or health and satisfaction indicators.

However, using survey data can also lead to measurement errors. To start with retirement, the variable can be measured in different ways. Whereas the official labor market status of a person can be *in pension*, she might still work (a few hours a week) and generate an additional income. To address the issues with regard to measurement errors, various information is used to clearly define the retirement status. The SOEP data contain information on the labor market status, the occupational status, working hours, labor market exits, retirement entries, and labor income. Since the analysis is based on the spells of employment until the event of retirement entry happens, all information available are used to generate a variable for the retirement status. Therefore, the outcome is a binary variable that indicates the retirement (non-employment) status in the individual spell, i.e., being one if the individual is retired in the given period and zero otherwise.

Since 2001, respondents have been asked whether they have received in-

³ See Wagner et al. (2007) for more information on the German Socio-economic Panel.

heritances, gifts, or lottery winnings (in the previous year). Furthermore, the survey queries the size of the windfall gain. For the empirical analysis, all windfall gains that occurred between 2000 and 2012 are considered as wealth shocks if the size of the windfall gain is €10,000 or larger.

Since it is the aim of this analysis to investigate the effects of wealth shocks on retirement decisions, only employed respondents who are eligible to retire (early) in the period of observation are considered. The sample therefore is restricted to person-year-observations between age 60 and 66 throughout 1998 and 2014 (born between 1938 and 1952). 0.55% of the sample retire before reaching age of 61 years. I exclude these observations from the sample. Furthermore, respondents who are not employed in the wave prior to inheritance receipt, in the wave of the receipt, or the wave of the survey are excluded from the sample. The final sample consists of 56,790 person-year-observations that correspond to 3,155 individual spells.

Table 4.1 presents the descriptive statistics for all relevant variables that will be included in the empirical analysis. The statistics show the means of selected socio-demographic and job-related variables for recipients and non-recipients in the year prior to the windfall receipt. On the one hand, labor supply is mainly determined by gender, age, and education (e.g., Blundell and MaCurdy, 1999). Furthermore, labor force participation strongly differs between East and West Germany (e.g. Bonin and Euwals, 2005; Krueger and Pischke, 1995). On the other hand, empirical evidence shows that the likelihood to inherit rises with age (e.g., von Westermeier et al., 2016) and education (e.g., Szydlik and Schupp, 2004). Women and men are equally likely to receive gifts or inheritances, but there are gender differences in size (e.g., Künemund et al., 2006; Leopold, 2008). For historical reasons, households in East Germany have accumulated fewer assets. Therefore, inheritances are much rarer than in West Germany (Braun, 2015).

Beginning with socio-demographic characteristics that affect both windfall receipt and labor supply, I find some significant differences between the groups of recipients and non-recipients. In my sample, 17% of the total sample are heirs. Whereas the share of women is only slightly lower among recipients than non-recipients⁴ and recipients are slightly older, individuals with an East-German background are significantly less likely to receive an inheritance, gift or lottery winning (18%) compared to West German persons (26%). This observation reflects actual inheritances patterns of the total German population (Braun, 2015). Furthermore, both recipients and their fathers are significantly better educated compared to non-recipients and their fathers. So, we can already see at this point that the groups of recipients and non-recipients are not homogeneous with respect to basic socio-demographic characteristics. This fact underpins the relevance of a particular consideration of the differences between the groups that are studied in the empirical analysis.

Furthermore, I find differences in household variables and job characteristics. Incentives for joint retirement play a crucial role in determining individual choices (e.g. Atalay and Barrett, 2016; Casanova, 2010; Coile, 2004). For example, recipients are slightly more likely to be married than non-recipients are, and to have a partner that is retired.

Turning to the job characteristics, I find further significant differences. First of all, there is a relatively large difference in income. The mean of the household income of households with windfall gains is 20% higher compared to households without positive income shocks. There are also differences between occupational groups. Literature has already shown that individuals in self-employment or in civil service face different employment biographies.

⁴ The share of women is 41% and 42% among recipients and non-recipients respectively. Since I have restricted the sample to observations who are employed in the year prior to receipt, the sample is not representative to the global sample.

For example, self-employed individuals remarkably differ in characteristics and traits from wages workers, and also have different motives, incentives, and factors determining labor supply (e.g., Hochguertel, 2015; Parker, 2004; Parker et al., 2005; Wales, 1973). Furthermore, retirement behavior differs between manual and non-manual laborers, in particular among male workers (Giesecke and Okoampah, 2014). In our sample, I find that recipients work only half as often as manual laborers (but twice as often as civil servants) compared to non-recipients. Also are recipients significantly less likely to be self-employed and more likely to work in small and medium-sized enterprises. While they have remarkably higher income levels, recipients work substantially less working hours, on average.

Finally, I report statistics on health and satisfaction indicators. Windfall recipients consider their health status to be slightly better than non-recipients. Whereas individuals in both groups are similarly satisfied with their jobs, recipients are more satisfied with their household income than non-recipients.

In sum, I find that the groups of windfall recipients and non-recipients differ in socio-demographic, household, and job-related characteristics. It is therefore necessary to account for these differences in the following empirical investigation.

4.4 Econometric Analysis

In estimating the effect of windfall gains on retirement behavior, I need to address the issue that the difference in outcome between treated and non-treated individuals may depend on characteristics that affect whether or not an individual received the given treatment (windfall gain) instead of due to the effect of the treatment per se. To identify the effect on the retirement haz-

ard, I combine a matching approach with a duration analysis in the following econometric analysis.

4.4.1 Propensity Score Matching

Against the backdrop of the comparison of individual traits (Table 4.1), which showed that characteristics differ significantly between recipients and non-recipients, I conduct a propensity score matching to define a study sample, in the first step of the empirical analysis. I perform 1-to-1 nearest neighbor propensity score matching without replacement, and condition on covariates that may jointly affect both the retirement decision and windfall gain. To avoid conditioning on covariates which may be affected by the windfall gain, I condition and match on variables with respect to the pre-treatment period, i.e., in the year prior to the windfall receipt.

As covariates for the computation of the propensity score I include the socio-demographic characteristics gender, age, education, education of the father, and whether the respondent lived in East or West Germany in 1989 (before German reunification). These characteristics are likely to affect both the probability of a windfall receipt and labor supply. In the summary statistics we saw that recipients and non-recipients substantially differ in these characteristics. Per definition, these variables should not be affected by a windfall gain later in life. Furthermore, I condition on whether in 2001, the respondent expected to receive a larger inheritance in the future to control for anticipation effects.

Furthermore, I condition on various household characteristics. I take the family context in which retirement decisions are made into consideration and condition on the marital status and - in case of a partnership - on the retirement status of the spouse. Moreover, I condition on whether the respondent is household head, whether children are living in the household, and the house-

hold income.

Lastly, I take labor characteristics of the respondent into account. I condition on self-employment, employment in civil service, and manual labor. Furthermore, I condition on firm size (small or medium-sized enterprises) and working hours. Dwyer and Mitchell (1999) show that health problems affect retirement decisions more strongly than do particular economic variables. Hence, I use information on self-assessed health status of the respondents and condition on health. Finally, I condition on self-assessed satisfaction with the job and the household income.

Table 4.2 presents the quality of matching. Before matching, the differences in means are statistically significant for a number of variables. After the matching procedure, all differences in means are statistically insignificant. Except for few variables, all means are more similar between the treated and the untreated.⁵

The summary results on the matching procedure are presented in the lower part of Table 4.2. I find that before matching, the likelihood of being treated is explained by the chosen characteristics. Using the matching procedure, the p-value is increased from 0.0 to 1.0 indicating that after the matching procedure the probability model is no longer appropriate for explaining the probability of being treated. Moreover, the median (mean) of the standardized bias is reduced from 17.1 (12.5) in the unmatched sample to 3.6 (3.4) in the matched sample implying a well sufficient reduction of the standardized bias.⁶ Rubin's B, the absolute standardized difference of the means of the linear index of the

⁵ The standardized mean differences (%bias in Column 4 in Table 4.2) of *married*, *children*, *partner pensioner*, *self-employed*, and *satisfaction with job* are less similar after the matching procedure. However, the differences in means of these variables are not statistically significant and economically relatively small.

⁶ A bias reduction below 3% or 5% is seen as sufficient, in most empirical studies (Caliendo and Kopeinig, 2008, p.48).

propensity score in the treated and (matched) non-treated group, is reduced to 17.0 (from 77.7), and Rubin's R, the ratio of treated to (matched) non-treated variances of the propensity score index, to 1.0 being within the recommended ranges (below 25 and close to 1, respectively) to be considered sufficiently balanced (Rubin, 2001, pp.174-177).

4.4.2 Duration Analysis

Based on the matched sample, discrete time proportion hazard models are applied to study the difference in retirement hazards between windfall recipients and non-recipients since these are most suitable to model transition behavior (e.g., Lancaster, 1979; Meyer, 1988). In our context, the complementary log-log model is appropriate as it takes the discrete measurement of time in years and right-censored spells into account (Jenkins, 2005). Against the backdrop that labor supply differs substantially between males and females, I estimate the retirement hazard on the matched sample separately for men and women in the following empirical investigation (e.g., Holst and Wieber, 2015; Killingsworth and Heckman, 1986). In all specifications, I perform household-level cluster in order to account for different covariance structures within the data that vary by households.⁷

Table 4.3 presents the hazard ratio of the recipient group to the non-recipient group from the complementary log-log model.⁸ The upper part of the table presents the results for women, the lower for men. All specifications include duration dummies, i.e., the years after receipt, and an age control variable to control for time-specific ties in retirement (see, e.g., Giesecke, 2018).

⁷ To check the robustness of the results, all specifications are also run on individual-level cluster. The results remain robust.

⁸ The exponentiated coefficients from a complementary log-log model are interpreted as hazard ratios, i.e., the proportional change in the hazard (the probability to retire) given the change from non-treatment to treatment (e.g., Jenkins, 2005).

Starting with the female sample, I find that the odds of entering retirement for recipients are 1.8 the odds of entering retirement for non-recipients. Females who receive a windfall gain have a 80% higher retirement hazard compared to women who do not receive windfall gains. Hence, women with positive wealth shocks are substantially more likely to enter retirement in the following years than without wealth shocks. Turning to the male sample, I find that the hazard ratio is close to one and statistically insignificant. This implies that there is no difference in retirement hazard between male recipients and male non-recipients, that is, there is no effect of windfall receipt on retirement among men.

The complementary log-log estimation gives strong indication that women with windfall gains face a higher likelihood of labor market exit for retirement, while men seem not to adjust labor supply to wealth changes.

Anticipation Theory suggests that unexpected income increases will lead to adjustments in marginal utility and life time labor supply. With perfect capital markets adjustments would follow directly even if the wealth shock is expected to happen in the future. Existing studies exploit inheritances as unexpected wealth shocks arguing that inheritances are never perfectly expected, since, for example, anticipated inheritance receipts are uncertain with respect to timing and size, or recipients may be liquidity constrained (e.g., Bø et al., 2018; Brown et al., 2010). In fact, there are hardly any changes in income, which are undoubtedly completely unexpected. In 2001, the SOEP asked whether inheritances (the largest fraction of windfall gains in the SOEP data set) are expected in the future. I use this information to actually come closer to unexpected income changes. To check the robustness of the results, I identify male and female groups who do not expect to receive an inheritance in the future, and re-estimate the model on two non-anticipating sub-samples.

Column (2) in Table 4.3 shows the results of the core model that further includes an anticipation control variable, and Column (3) results of samples restricted to non-anticipating women and men. When including inheritance anticipation in the empirical specification, I find that the estimates of the variables of interest hardly change. For women, the estimates of windfall gains remain positive and statistically significant. Also for men, the figures are almost identical and point to no effect of windfall gains on retirement entry.

When excluding individuals who expect a future inheritance, roughly one third of women and more than half of men drop out of the sample. Despite the strong reduction in observations, excluding anticipating individuals yields results similar to those found in the baseline specifications. First, I do not find an effect for men. The odds ratio is close to one and not statistically significant. Second, the robustness specification for women indicates - on a considerably smaller sample - a statistically significant positive effect of wealth shocks on retirement entry. The odds of entering retirement after windfall gains for female recipients are more than two times the odds of entering retirement for female non-recipients.

Table 4.3 also presents the corresponding marginal effects after complementary log-log. These allow for comparing the effects of different samples. The marginal effects for women in the core sample indicate that the retirement hazard is about 3 percentage points larger for recipients compared to non-recipients, and even 4.5 percentage points higher when focusing on recipients and non-recipients who do not expect any future inheritances. For men, the marginal effects are economically and statistically insignificant. The results confirm that female recipients retire substantially earlier than non-recipients, whereby the effect is even larger when controlling for the anticipation of future inheritances.

Education and Income Labor supply is mainly determined by gender, age, and education (e.g., Blundell and MaCurdy, 1999). The educational level might have an impact not only on labor supply but also on the probability of a windfall gain. For example, the intergenerational transfer of both education and wealth is one potential channel. Higher educated parents are more likely to have higher levels of wealth and, thus, to transfer both high education and wealth to their children. So far, I control for age in the regressions and estimated the retirement hazard for women and men separately. In the next step, I test for the effects among low and highly educated individuals.

The educational level *Abitur* is the highest school-leaving qualification and the university entrance qualification in Germany. It is conferred on students usually after twelve years of schooling. Therefore, I define high education as having 12 or more than 12 years of education, and low education otherwise. I re-estimate the effect for low and highly educated women and men, respectively. Table 4.4 presents estimates of the retirement hazard on the sub-samples. The upper part shows the results for low and highly educated women. Whereas the odds ratio is close to 1 (and statistically insignificant) for highly educated women, it is about 2.7 for low educated peers. This means that low educated female recipients are more likely to enter retirement in the years following a windfall gain compared to low educated female non-recipients. In contrast, I find no significant difference in the retirement hazard of highly educated female recipients and highly educated female non-recipients. The marginal effects confirm the interpretation of the results. While there is no statistically and economically significant effect of windfall gains for highly educated women, for low educated women the effect is even higher than in the baseline specification. The retirement hazard is 5.4 percentage points higher for recipients compared to non-recipients among low educated women. This finding is in line with theory that implies that opportunity costs for working

are higher for low-skilled than for highly skilled workers. The results suggest that the negative effect on labor supply among women is in part driven by low-educated recipients.

However, the finding is true for women only. For men I find no evidence. As in the baseline estimations, the odds ratios - close to one and statistically insignificant - indicate that there is no difference between the retirement hazard of male windfall recipients and of male non-recipients in both cases, low and highly educated groups (Panel B, Table 4.4).

Despite the strong reduction in observations, the estimates for non-anticipating observations confirm the results. For both low and highly educated men, and for highly educated women, I find no significant effects. Among low educated women a considerable higher retirement hazard for recipients compared to non-recipients can be confirmed. As seen before, the marginal effect is even larger when accounting for bequest anticipation.

Since education has a major effect on income, and income strongly relates to labor supply, next, I take a look at the effect linked to income. I define a low income and a high income group that are based on the median income of the matched female and male sample.⁹ Women/men in the low (high) income group have a yearly income below (above) the median income of women/men. Table 4.5 presents results of different subsamples considering both education and income. Columns (3) and (4) in Table 4.5 present the results of the high and low income samples. These indicate that there is no significant effect of windfall gains on retirement in the high income sample for both women and men, whereas the retirement hazard of female recipients of the low income group is about more than two times the hazard of female non-recipients of the low income group. The marginal effect indicates a 5.9 percentage points higher

⁹ All specifications are also run based on the mean income of the sample. The results are robust.

hazard for low income recipients compared to low income non-recipients.

Taking both education and income into account, I re-estimate the effect on four sub-groups: (i) high education/high income, (ii) high education/low income, (iii) low education/high income, (iv) low education/low income.¹⁰ First, we see that among (i) high education/high income - women there is no significant difference in retirement hazard of recipients and non-recipients. Second, I find that the effect is strongest among (iv) low education/low income - women. The marginal effect of that sample suggests that windfall gains increase the retirement hazard by 8.4 percentage points. The likelihood that a women with a windfall gain rather leaves the labor market for retirement than a women without windfall gain is increased most in this group. Finally, the marginal effects for the samples of (ii) high education/low income and (iii) low education/high income - women are quite similar. Yet, the effects are not statistically significant. However, the sample size is reduced to 288 and 106 observations, respectively, what could be the reason for the statistical insignificance. In this case, this would mean that a low income despite a high education and a high income despite low education would retain the positive effect of wealth shocks on retirement entry in part. Since the effects are remarkably lower than for the (iv) low education/low income sample, it seems to be the case that higher (lower) income can offset the effect of low (higher) education partly. Thus, both education and income play a decisive role in the response to wealth shocks.

East and West Germany In the next step, I look at potential differences between workers in East and West Germany. During the German separation the labor supply in the countries differed strongly. The ideals of family and employment in the former socialist GDR were different from the more traditional ideals in the Federal Republic of Germany (FRG) (Holst and Wieber,

¹⁰ It must be noted that the number of observations in the samples decreases strongly.

2015). While the traditional marriage (with the husband as breadwinner and the wife being responsible for the household) was supported by various laws and policies in the FRG, full time employment was a duty for both men and women in the GDR, resulting in a female labor force participation rate of more than 90% for many years (Holst and Wieber, 2015). For comparison, in 1988, shortly before German re-unification, female labor force participation was at approximately 50% in West-Germany and 81% in East Germany (Krueger and Pischke, 1995). Holst and Wieber (2015) show that the different ideals and statutory frameworks concerning female labor force participation during the time of separation contribute to present differences in East and West Germany. Even after more than 25 years after reunification there are still significant differences in female labor supply between the regions, today (e.g. Bonin and Euwals, 2005; Grundig, 2008; Hanel and Riphahn, 2012; Wyrwich, 2015)

In addition to this, the assets of East German households are still significantly smaller than in West Germany for historical reasons (Braun, 2015). This is why in East Germany inheritances are much rarer, and the volume significantly lower. The observations in this study sample are in accordance with actual evaluations of inheritances in Germany (Braun, 2015) Since inheritances represent a major share of windfall gains in our investigation, it may be relevant to account for these differences.

Using information on the residence of respondents in 1989, I re-estimate the model separately on an East and a West German subsample. Table 4.6 illustrates the results for female and male East and West samples. In line with the baseline results, I find no significant effect for men. The results for women show a more conclusive picture: Among East German women, the magnitude of the odds ratio is remarkably lower than in the baseline case and statistically not significant. East-German women who receive a windfall gain have no significant different retirement hazard than East-German women

who do not receive a windfall gain. By contrast, I find a substantially higher retirement hazard among female West recipients compared to female West non-recipients.¹¹ The odds of entering retirement for the female recipients are about two times the odds of entering retirement for female non-recipients in West-Germany. The marginal effect indicates that the overall positive effect is driven by West German women to some extent. The results confirm previous findings that the labor supply of East and West German women differs, and I show that women's retirement hazards are less related to wealth (shocks) in East Germany compared to West Germany.

Occupational Status Theory suggests and empirical studies confirm that not only gender, age, education and, also income determine labor supply behavior. In addition, different occupational groups also show varying labor supply models even after controlling for education. Therefore, I use information on occupational positions and re-estimate the model on different samples.

As discussed in Section 4.3, determinants of labor supply differ between self-employed and employees (e.g., Parker, 2004). For example, self-employed individuals have different motives and incentives, for example, they are more flexible in their allocation of hours, work longer hours for fewer average wages, and retire later (Hochguertel, 2015; Parker et al., 2005). In the first specification of the extensions, I exclude self-employed women and men from the respective samples. Next, I exploit information on company shares and exclude individuals owning firm capital. In the last specification, I exclude both self-employed and company shareholders.

The results from complementary log-log regressions excluding self-employed and company shareholders are presented in the upper part of Table 4.7. The

¹¹ It should be noted that in this specification the sample size shrinks to 310 observations in the case of East German women and to 1125 in the West German case. This change has also an impact on the statistical significance.

results for both men and women hardly change after excluding these groups. The statistically significant positive effect for women remains. Windfall gains show the expected effect. With respect to the changed samples, the odds of entering retirement of women with windfall gains are about two times the odds of entering retirement for women without windfall gains. The marginal effects confirm an even somewhat stronger effect for the sample excluding self-employed women. These findings are in line with theoretical and empirical findings on differing labor supply models for self-employed and support the interpretation that opportunity costs for working are lower for self-employed individuals.

However, this effect is true only for women, not for men. Although odds ratios are somewhat above one after excluding self-employed and company shareholders, the results show no statistical significance for men. Also the marginal effects - close to zero - are not only statistically but also economically insignificant.

Giesecke and Okoampah (2014) show that average retirement ages differ considerably between manual and non-manual workers. Due to different physical demands of occupations manual workers decide to retire earlier than do non-manual workers. In order to take different retirement patterns between physical demands of occupations into account, I exclude manual workers in the next specifications (Table 4.7). A relatively small fraction of female employees are manual workers so that this occupational group does not play an important role. Hence, the results hardly change after excluding manual workers from the female sample. The effect found remain positive and statistically significant, and the marginal effect is of similar magnitude as in in the baseline regression.

In contrast to the barely changed results for women, I find an interesting tendency for men. Since the proportion of manual workers among men is not quite as low as among women, I estimate the effect for both manual and

non-manual workers. However, the size of samples differs strongly between the groups (237 and 1893 observations, respectively). Yet, the magnitude of the odds ratio differs remarkably between the groups. While the odds ratio is close to 1 for the sample without manual laborers (which indicates no difference between the odds of entering retirement for male recipients and non-recipients), the ratio increases to 1.4 for the sample including manual laborers only. Also the marginal effects point to effects among manual workers. However, none of the estimates is statistically significant. The results for this sample also indicate high standard errors pointing to missing statistical significance due to high standard errors rather than low effects. The propensity score matching and the strong reduction in sample size might account for low significance. Thus, it cannot be ruled out that there is an effect among the relatively small group of male manual workers.

All of the specifications are re-estimated on a sample including non-anticipating individuals only (Columns 3 and 4 in Table 4.7). Although the sample size decreases strongly in each of the specifications after excluding certain groups, results are robust, and indicate even higher effects compared to the base models.

4.5 Summary

A number of recent studies have dealt with the question whether wealth shocks affect labor supply. Under perfect capital markets, individuals adjust reservation wages and consequently life-cycle labor supply after income shocks - according to standard economic theory. Yet, empirical research does not produce unambiguous evidence.

This paper provides new evidence of the effect of windfall gains on retire-

ment in Germany using the Socio-economic Panel. In the first step, I apply a matching method to address the endogeneity of wealth and labor supply, and estimate the retirement hazard of recipients and non-recipients, in the second step. To shed light on drivers of potential effects, I address differences in response between demographic and social groups.

The first finding is that women are substantially more likely to enter retirement after windfall gains: The retirement hazard of female recipients is almost twice as high as the retirement hazard of female non-recipients. However, I find no difference in the retirement hazard between male recipients and non-recipients. Second, for women who do not expect a future inheritance the effect is even higher. This result is in line with life-cycle theory suggesting larger effects of unexpected wealth shocks under perfect capital markets, and contributes to the literature that provides ambiguous findings (e.g., Brown et al., 2010; Eder, 2016). A closer look at the social background helps to understand what might explain the effect: Third, education, income, and socialization play a decisive role in entering retirement after income shocks. While there is no effect for women with high education and high income, the strongest increase in the likelihood that women with windfall gains rather leave the labor market for retirement than women without windfall gains is found among low educated women with low income. This finding is in accordance with theory that implies higher opportunity costs for working for low-skilled than for highly skilled individuals. The results further indicate that high (low) income can offset low (high) education, suggesting that both education and income affect the retirement effect. Lastly, and in accordance with research showing that the different ideals and statutory frameworks concerning female labor force participation during the time of separation contribute to present differences in East and West Germany, women's retirement hazards are less related to wealth shocks in East Germany compared to West Germany. Apart from the

socio-demographic and -economic factors, also the socialization affects future labor supply decisions.

4.6 Tables

Table 4.1: Descriptive Statistics

	Full Sample			Non-Recipients			Recipients			t-test
	N	Mean	S. D.	N	Mean	S. D.	N	Mean	S. D.	
Anticipating inheritance	41,202	.163	.369	34,164	.126	.332	7,038	.338	.473	0.0000
Female	56,790	.421	.494	46,980	.423	.494	9,810	.413	.492	0.0642
Age	56,790	56.97	6.76	46,980	56.92	6.76	9,810	57.20	6.77	0.0002
East (1989)	56,268	.243	.429	46,566	.257	.437	9,702	.176	.381	0.0000
Father <i>Abitur</i>	53,676	.109	.312	44,244	.096	.294	9,432	.172	.377	0.0000
Years of education	32,183	12.66	2.94	25,477	12.43	2.88	6,706	13.50	3.02	0.0000
Married	34,295	.792	.406	27,287	.789	.408	7,008	.804	.397	0.0062
Household head	36,152	.657	.475	28,978	.657	.475	7,174	.657	.475	0.8999
Children	34,651	.168	.497	27,584	.167	.492	7,067	.171	.516	0.5875
Partner pensioner	32,536	.174	.379	25,907	.171	.377	6,629	.182	.386	0.0395
Household income	34,651	45141	34093	27,584	43364	34538	7,067	52077	31349	0.0000
Working hours	32,872	32.59	19.22	26,197	32.85	19.02	6,675	31.57	19.95	0.0000
Self-employed	33,781	.120	.324	26,942	.123	.328	6,839	.107	.309	0.0002
Civil servant	33,781	.095	.294	26,942	.080	.271	6,839	.156	.362	0.0000
Manual laborer	33,781	.208	.406	26,942	.237	.425	6,839	.095	.294	0.0000
Small and medium-sized enterprise	56,790	.260	.439	46,980	.254	.435	9,810	.290	.454	0.0000
Health status	34,271	2.71	.86	27,273	2.71	.854	6,998	2.73	.87	0.0569
Satisfaction with job	27,804	6.97	2.06	22,375	6.96	2.06	5,429	6.98	2.09	0.0727
Satisfaction with income	33,945	6.58	2.18	27,002	6.48	2.21	6,943	6.97	2.02	0.0000

Note: This table reports means of selected variables of windfall recipients and non-recipients. t-test: $H_a : dif f \neq 0$.

Table 4.2: Propensity Score Matching

	Unmatched	Mean		%bias	%reduct bias	t-test		V(T)/ V(C)
	Matched	Treated	Control			t	p>t	
Female	U	.4071	.4267	-4.0		-0.60	0.547	0.98
	M	.4071	.3964	2.2	45.2	0.26	0.796	1.02
Age	U	55.039	54.454	12.5		1.86	0.063	0.86
	M	55.039	55.161	-2.6	79.3	-0.31	0.759	0.86
East (1989)	U	.2321	.2801	-11.0		-1.64	0.101	0.83
	M	.2321	.2536	-4.9	55.3	-0.59	0.555	1.02
Father <i>Abitur</i>	U	.1393	.0795	19.2		3.20	0.001	1.67*
	M	.1393	.1393	0.0	100.0	0.00	1.000	1.00
Years of education	U	13.266	12.009	45.3		7.05	0.000	1.22
	M	13.266	13.166	3.6	92.0	0.40	0.691	0.86
Anticipating inheritance	U	.3571	.1357	53.1		9.14	0.000	1.38*
	M	.3571	.3643	-1.7	96.8	-0.18	0.861	1.00
Married	U	.8179	.8096	2.1		0.32	0.749	0.97
	M	.8179	.8393	-5.5	-160.4	-0.67	0.502	1.08
Household head	U	.6250	.6419	-3.5		-0.54	0.593	1.03
	M	.6250	.6179	1.5	57.7	0.17	0.862	0.98
Children	U	.2036	.2028	0.2		0.02	0.982	0.92
	M	.2036	.1893	2.7	-1686.3	0.33	0.738	1.09
Partner pensioner	U	.1000	.1050	-1.7		-0.25	0.802	0.95
	M	.1000	.1107	-3.5	-112.9	-0.41	0.680	0.88
Household income	U	4845	4005	37.6		5.85	0.000	1.17
	M	4845	4768	3.4	90.9	0.37	0.708	0.86
Self-employed	U	.1071	.1065	0.2		0.03	0.974	1.01

	Unmatched	Mean		%bias	%reduct	t-test		V(T)/
	Matched	Treated	Control		bias	t	p>t	V(C)
Civil servant	M	.1071	.0857	6.9	-3190.4	0.86	0.391	1.17
	U	.1679	.0715	30.0		5.23	0.000	1.96*
Manual laborer	M	.1679	.1464	6.7	77.8	0.70	0.487	1.14
	U	.1464	.3363	-45.5		-6.37	0.000	0.65*
Small and medium-sized enterprise	M	.1464	.1500	-0.9	98.1	-0.12	0.906	0.98
	U	.4607	.5325	-14.4		-2.19	0.029	1.06
Working hours	M	.4607	.4750	-2.9	80.1	-0.34	0.735	0.97
	U	41.193	39.703	12.8		1.94	0.052	0.99
Health	M	41.193	40.661	4.6	64.3	0.55	0.583	1.06
	U	2.636	2.678	-4.9		-0.76	0.447	1.08
Satisfaction with job	M	2.636	2.679	-4.9	-0.6	-0.59	0.556	1.16
	U	7.0500	6.966	4.2		0.64	0.519	1.09
Satisfaction with income	M	7.0500	6.896	7.6	-82.2	0.89	0.372	1.13
	U	6.932	6.460	23.0		3.43	0.001	0.86
	M	6.932	6.886	2.3	90.2	0.28	0.780	1.03
Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
Unmatched	0.090	135.98	0.000	17.1	12.5	77.7*	1.33	0
Matched	0.005	4.05	1.000	3.6	3.4	17.0	1.00	0

Notes: This table reports covariate imbalance testing after 1- to- 1 nearest neighbor propensity score matching on individual variables in the pre-treatment period. The lower part of the table provides summary results on the matching procedure. B refers to Rubins' B (the absolute standardized difference of the means of the linear index of the propensity score in the treated and (matched) non-treated group), and R to Rubin's R (the ratio of treated to (matched) non-treated variances of the propensity score index).

Table 4.3: Windfall Gains and Retirement Entry

Panel A: Female Sample			
	(1)	(2)	(3) Not Anticipating
Windfall, exp. (coef.)	1.803** (0.463)	1.790** (0.457)	2.346*** (0.739)
marginal effects	0.0301** (0.0131)	0.0298*** (0.0131)	0.0454*** (0.0168)
Age	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes
Anticipation		Yes	
<i>N</i>	1570	1570	1008
Panel B: Male Sample			
	(1)	(2)	(3) Not Anticipating
Windfall, exp. (coef.)	1.083 (0.227)	1.081 (0.227)	1.144 (0.288)
marginal effects	0.00386 (0.0102)	0.00377 (0.0102)	0.0101 (0.0190)
Age	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes
Anticipation		Yes	
<i>N</i>	2333	2333	1035

Notes: This table reports exponentiated coefficients and average marginal effects from complementary log-log regressions of retirement entry on windfall receipt, age, and 16 duration dummies. The dependent variable is a dummy indicating whether an individual enters retirement. Clustered standard errors on the household level are reported in brackets. Panel A reports results for the female sample, Panel B for the male sample. Columns (1) and (2) report results from the full sample of women and men, respectively. Specification in Column (3) excludes observations expecting future gifts and inheritances (in 2001).

* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 4.4: Retirement Entry, Windfall Gains and Education

Panel A: Female Sample				
	High Educ.	Low Educ.	Not Anticipating	
			High Educ.	Low Educ.
	(1)	(2)	(3)	(4)
Windfall, exp. (coef.)	1.040	2.660**	1.228	3.796***
	(0.310)	(1.049)	(0.455)	(1.732)
marginal effects	0.00256	0.0544**	0.0140	0.0835***
	(0.0196)	(0.0215)	(0.0260)	(0.0267)
Age	Yes	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes	Yes
<i>N</i>	668	639	385	419

Panel B: Male sample				
	High Educ.	Low Educ.	Not Anticipating	
			High Educ.	Low Educ.
	(1)	(2)	(3)	(4)
Windfall, exp. (coef.)	1.056	1.175	1.183	1.149
	(0.280)	(0.421)	(0.400)	(0.469)
marginal effects	0.00270	0.0107	0.0129	0.0100
	(0.0132)	(0.0238)	(0.0264)	(0.0296)
Age	Yes	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes	Yes
<i>N</i>	1358	683	536	492

Notes: This table reports exponentiated coefficients and average marginal effects from complementary log-log regressions of retirement entry on windfall receipt, age, and 16 duration dummies. The dependent variable is a dummy indicating whether an individual enters retirement. Clustered standard errors on the household level are reported in brackets. Panel A reports results for the female sample, Panel B for the male sample. Columns (1) and (3) present highly educated, Columns (2) and (4) low educated women and men, respectively. Columns (3) and (4) exclude observations expecting future gifts and inheritances (in 2001).

* $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 4.5: Retirement Entry, Windfall Gains, Education and Income

	<u>Education</u>		<u>Income</u>		<u>Education</u>			
	High	Low	High	Low	High Education		Low Education	
					<u>Income</u>		<u>Income</u>	
	High	Low	High	Low	High	Low	High	Low
Panel A: Female Sample								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Windfall, exp. (coef.)	1.040 (0.310)	2.660** (1.049)	1.266 (0.558)	2.316*** (0.752)	0.634 (0.344)	1.522 (0.554)	1.578 (1.180)	3.085** (1.461)
marginal effects	0.00128 (0.00981)	0.0231** (0.00953)	0.0126 (0.0263)	0.0590*** (0.0228)	-0.0366 (0.0424)	0.0368 (0.0328)	0.0331 (0.0593)	0.0836** (0.344)
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	668	639	475	478	208	288	106	352
Panel B: Male Sample								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Windfall, exp. (coef.)	1.056 (0.280)	1.175 (0.421)	1.397 (0.477)	1.019 (0.281)	1.558 (0.535)	0.774 (0.341)	2.662 (2.044)	1.382 (0.527)
marginal effects	0.00270 (0.0132)	0.0107 (0.0238)	0.0132 (0.0137)	0.00142 (0.0203)	0.0169 (0.0134)	-0.0331 (0.0567)	0.0571 (0.0465)	0.0285 (0.0334)
Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duration dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1358	683	984	975	1006	209	249	331

Notes: This table reports exponentiated coefficients and average marginal effects from complementary log-log regressions of retirement entry on windfall receipt, age, and 16 duration dummies. The dependent variable is a dummy indicating whether an individual enters retirement. The regressions are run on education and income subsamples. High (Low) education is associated with a schooling attainment of 12 and more (less than 12) years. High (low) income is associated with a yearly income above (below) the median yearly income of women and men, respectively, in the matched sample. Clustered standard errors on the household level are reported in brackets. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 4.6: Retirement Entry: East and West Germany.

Panel A: Female Sample				
	East	West	Not Anticipating	
			East	West
	(1)	(2)	(3)	(4)
Windfall, exponentiated coef.	1.371	2.035**	1.780	2.839***
	(0.587)	(0.611)	(0.930)	(1.090)
marginal effects	0.0248	0.0347**	0.0484	0.0521***
	(0.0337)	(0.0145)	(0.0442)	(0.0192)
N	310	1125	224	685

Panel B: Male Sample				
	East	West	Not Anticipating	
			East	West
	(1)	(2)	(3)	(4)
Windfall, exponentiated coef.	1.492	1.063	1.025	1.129
	(0.601)	(0.249)	(0.461)	(0.318)
marginal effects	0.0227	0.00366	0.00185	0.0102
	(0.0229)	(0.0140)	(0.0330)	(0.0239)
N	395	1492	222	718

Note: This table reports exponentiated coefficients and marginal effects from complementary log-log regressions of retirement entry on windfall receipt, age, and 16 duration dummies. The dependent variable is a dummy indicating whether an individual enters retirement. Clustered standard errors on the household level are reported in brackets. The regressions are run on subsamples. Panel A reports results for the female sample, Panel B for the male sample. Columns (1) and (3) present East German, Columns (2) and (4) West German women and men, respectively. Columns (3) and (4) exclude observations anticipating future gifts and inheritances (in 2001). * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

Table 4.7: Retirement Entry, Windfall Gains and Occupational Status

Sample	Female	Male	Not Anticipating	
			Female	Male
	(1)	(2)	(3)	(4)
No self-employed				
Windfall, exp. (coef.)	1.974*** (0.521)	1.095 (0.247)	2.534*** (0.828)	1.153 (0.317)
marginal effects	0.0360*** (0.0138)	0.00466 (0.0116)	0.0522*** (0.0181)	0.0108 (0.0210)
N	1421	2056	904	921
No company shares				
Windfall, exp. (coef.)	1.920** (0.500)	1.222 (0.278)	2.318*** (0.729)	1.329 (0.366)
marginal effects	0.0349** (0.0139)	0.0104 (0.0118)	0.0464*** (0.0174)	0.0220 (0.0213)
N	1448	2051	959	920
No self-employed, share holders				
Windfall, exp. (coef.)	2.075*** (0.556)	1.138 (0.265)	2.483*** (0.813)	1.188 (0.340)
marginal effects	0.0398*** (0.0144)	0.00690 (0.0125)	0.0516*** (0.0183)	0.0136 (0.0225)
N	1346	1935	881	865
No manual laborer				
Windfall, exp. (coef.)	2.018*** (0.542)	1.021 (0.231)	2.768*** (0.950)	1.051 (0.292)
marginal effects	0.0359*** (0.0138)	0.00102 (0.0112)	0.0535*** (0.0183)	0.00383 (0.0213)
N	1436	1893	895	803
Manual laborer				
Windfall, exp.(coef.)		1.379 (0.803)		2.033 (0.150)
marginal effects		0.0250 (0.0465)		0.0646 (0.0679)
N		237		162

Note: This table reports exponentiated coefficients and average marginal effects from complementary log-log regressions of retirement entry on windfall receipt, age, and 16 duration dummies. The dependent variable is a dummy indicating whether an individual enters retirement. The regressions are run on subsamples. Columns (3) and (4) exclude observations anticipating future gifts and inheritances (in 2001). Clustered standard errors on the household level are reported in brackets. * $p < 0.1$. ** $p < 0.05$. *** $p < 0.01$

5 Conclusive Remarks

5.1 Summary and Implications

The recent financial crisis has put the focus of attention to the relevance of the household sector and individual decision making in many areas. Individual and household decisions and the quality of financial decision-making contribute to the stability of financial systems. Empirical studies show that many individuals lack the skills to understand basic financial concepts and, thus, tend to make financial mistakes that can put the stability of the financial system at risk (e.g., Agarwal et al., 2009; Gerardi, 2010; Gerardi et al., 2013; Jappelli, 2010). The relevance of informed financial decision making and behavior of individuals for economy and society is largely discussed, and the relevance of financial education is increasingly becoming a matter of public interest.

This dissertation addresses the importance of individual financial decision making and behavior. It is devoted to the questions how information access can shape financial literacy, and how, in turn, financial literacy, on the one hand, and changes in wealth, on the other hand, influence individual decision making. It consists of three self-explaining studies. Starting with research on financial literacy, the first two provide new insights on (1) how Internet use affects financial literacy and (2) how, in turn, financial literacy affects self-employment. Continuing with individual decision making, the third sheds light on the effect wealth shocks have on retirement decisions of German workers.

The study “Going Online, Being Financially Literate?” shows that financial literacy is affected by the use of Internet. Using financial knowledge-based questions that are widely applied in the literature to measure financial literacy

levels, I find that individuals who use the Internet regularly achieve considerably higher scores than non-users. The findings imply that the Internet as information and communication technology (ICT) can be used to improve financial literacy. This finding can be explained by an information channel: Once individuals have access to the Internet they use it regularly. Regular users are more likely to be exposed to information on economic relations and financial issues, or business news. The regular exposure seems to improve the understanding and knowledge of economic issues. My results further show that Internet users are more literate in particular concerning advanced knowledge about economic concepts (for instance, types of investments and the characteristics thereof), and less with regard to abilities or skills (for instance, interest calculation). This underlines the reasoning that the Internet as source of information can contribute to improving knowledge on financial issues as a result of the exposure to economic and financial information.

This study contributes to the existing literature in several respects. First, I shed light on a potential mechanism of individual use of new ICT on the promotion of financial literacy. While socio-demographic differences (age, gender, education) in financial literacy are well-documented, the current literature provides little evidence on how to improve financial literacy. Research has so far been restricted to two strands: studies on financial education and financial socialization. This paper augments the research field by identifying a previously unexplored channel, and provide evidence that the use of new ICT can help to improve financial knowledge.

Thereby, I further add to the literature on the effect of new media use. Existing research shows, for example, that Internet access affects political participation, civic engagement, and social capital (e.g., Bauernschuster et al., 2014; Boulianne, 2009; Falck et al., 2014). Bauernschuster et al. (2014), for instance, find in clear contrast to evidence on TV consumption a positive ef-

fect of Internet on social capital, and argue that in contrast to the passive entertainment-character of TV the Internet rather provides a platform for active information and communication. My findings add to this debate by showing that the Internet appears to provide a platform for gathering information on economic topics and improving financial literacy.

In addition, this study adds to the discussions on information, digitization, and (in-)equality. There is an enormous amount of research being conducted today on the effects of information access and digitization. In particular, in the context of digitalization of financial services the effects of Internet use reveal highly relevant research questions. Accessing the Internet changes the set of financial investment opportunities, so that financial literacy is more important as soon as the Internet is accessed. Since the Internet can reduce cost of compensating information asymmetries, there are various reasons why it is called for the Internet access to be universally provided.

Effective financial decisions can increase wealth, and individual financial mistakes can put the financial stability at risk. Hence, it is of substantial interest to researchers and policy makers to enhance financial literacy. If the widespread diffusion of Internet availability can be used to foster financial literacy, this might increase wealth, and thereby maintaining the efficiency of financial markets and the stability of the financial system.

Although, today, the fraction of the population having access to the Internet is relatively high, at least in the developed countries, these results offer relevance for policy implications nevertheless. First, even in developed countries the average level of financial literacy is low. The results can be seen as an impulse for the discussion about how to foster financial literacy. In addition to having access to the Internet, the question on how to use it to promote financial literacy should be discussed. Second, the level of financial literacy is even lower in developing countries. In general, these countries also suffer from

financial instability. Raising financial literacy may increase the prosperity of the society and promote financial stability. Third, today we are discussing about the Internet as primary medium for information and communication. In the past, research has intensively dealt with the effects of the consumption of other media, such as newspapers, radio, and TV (e.g., Gentzkow et al., 2011; Olken, 2009; Putnam, 2001). The results of the individual research projects can be used pro-actively for designing effective reactions on the emerge of new forms of media.

My findings suggest future research on two aspects. Like other studies on the impact of the Internet (e.g., Bauernschuster et al., 2014; Falck et al., 2014), this analysis can not provide conclusive evidence for which online activities in particular affect financial literacy. Since the data do not allow for examining what exactly people are reading online, we are not able to identify the drivers, and do not learn which web-contents can help to foster financial literacy. Which online activities and what kind of web content affect and can foster financial knowledge? What kind of online forums, programs, and platforms can be effective in improving understanding financial concepts and products and develop the skills to make informed decision to improve the financial well-being? Which kind of online tools may be provided in order to improve individual financial literacy? To come closer to an answer, more research should be devoted to the exact circumstances of Internet use.

Secondly, using financial knowledge-based questions to measure financial literacy provides no guidance on the actual financial behavior of the individuals. Yet, there is evidence that financially literate individuals are more likely to participate in financial markets, invest in stocks, hold precautionary savings, undertake retirement planning, and accumulate wealth (e.g., de Bassa Scheresberg, 2013; Jappelli, 2010; Van Rooij et al., 2011a, 2012). Thus, we can only presume that financial literate individuals do not only have the understand-

ing and knowledge of financial concepts and risks, and the skills to apply the knowledge in order to make effective financial decisions across a range of financial contexts, but that they also do make informed and effective decisions. Does Internet use affect financial behavior apart from the effect on financial literacy? Do Internet users behave differently on the financial market from non-users? Do people who use the Internet regularly save, invest, or borrow more effectively? This study cannot provide evidence on the effect of Internet use on financial decision making. Consequently, researchers should take interest in further research on the effect on financial behavior.

However, given that evidence on the returns to the use of web content and on the formation of financial literacy is rare thus far, I consider this work a suitable starting point for further investigation.

The second study “Financial Literacy and Self-Employment” provides evidence for a positive effect of financial literacy on the probability of being self-employed. While previous studies on the effects of financial (il-)literacy have focused on (purely) financial decision-making, we augment the literature by raising the question whether financial literacy does also have influence on employment decisions. We observe that self-employed individuals are disproportionately more financially literate than employees, and propose an instrumental variable approach to analyze the link. We show that financial literacy has a positive effect on the probability of self-employment. On average, the probability of self-employment increases by 1.4 percentage points with each additional question (of 9) that is answered correctly. In comparison: the highest (non-tertiary) vocational qualification is associated with a 6.8 percentage point higher likelihood of self-employment relative to a vocational training. This implies that compared to the relevance of education, financial literacy plays an important role for being self-employed.

The contribution to the literature is twofold: First, we augment the under-

standing of the effects of financial literacy on decision making. So far, research produced ample evidence that financially literate individuals are more likely to make informed, effective decisions regarding private capital investment decisions than less literate. We argue that financially literate individuals might be also more likely to be aware of sources of information, advice, and capital for entering and surviving in self-employment. A better understanding of financing options, the profitability of a business, the risks and responsibilities of owning a business, may increase the likelihood of choosing self-employment rather than employment. Alongside decision making relating to household financial matters, we provide evidence for the influence of financial literacy on employment decision making.

Second, we contribute to the entrepreneurship literature and to the nature-nurture debate on the characteristics of entrepreneurs by suggesting a characteristic of self-employed that has not been taken into consideration previously. Besides - mostly stable - personality traits such as risk tolerance or the Big Five¹, studies further provide evidence that not the quantity of education but the learning content is a relevant driver for entrepreneurship and its success. We augment the understanding for the relevance of task related human capital, entrepreneurship education, and training for entrepreneurial activities and performance (Elert et al., 2015; Martin et al., 2013; Unger et al., 2011). In line with these ideas our findings imply that improving financial literacy can encourage entrepreneurial culture.

The interest in the understanding of entrepreneurial culture and activities is highly relevant among scholars and policy makers. Entrepreneurship in connection with wealth creation, job creation, and economic growth is seen as driving force within the economy. Thus, the relation of financial liter-

¹ The Big Five personality traits are agreeableness, conscientiousness, extra-version, neuroticism, and openness to experience. See Section 3.2.

acy and self-employment is not only of key importance for individuals (and their wealth) but also for societies (since occupational decisions affect structural change and productivity growth (e.g., Nahuis and Smulders, 2002)) and financial stability (that is directly connected to financial decision making). With the help of various instruments, politicians are attempting to engage in entrepreneurial activities. Our findings provide an attempt to support in particular those who have a business idea, the willingness to take risks and meet other decisive conditions, but who do not have the resources to launch (financially) successfully a business.

However, it is not possible from our results to assess the effects of financial literacy on entering and succeeding in self-employment. Further, our study does not allow any conclusions for the effective type of financial education in the context of self-employment. In general, the evidence on the effectiveness of financial education is not straightforward. However, a number of studies shows that active and experiential learning processes and programs that are based on specific content are most promising strategies for financial education (e.g., Bayer et al., 2009; Bernheim and Garrett, 2003; Totenhagen et al., 2015). Future research should look deeper in the effectiveness of content-based financial education for those who have a business idea, or who are willing to take risks, or meet other decisive conditions, and how financial education can contribute to successful entrepreneurship. In the course of this, future research should define what is relevant knowledge for setting up an own business safely and managing the business successfully. In what areas exactly is knowledge needed for a save business set-up? What skills and knowledge contribute to a successful enterprise? Hence, more evidence should be provided on effective financial education for entrepreneurs and those on the path to entrepreneurship.

The third study provides evidence for the impact of windfall gains on retirement in Germany. I focus attention on socio-demographic differences in the

retirement responses to wealth shocks, and find that windfall gains are relating to a significant increase in the likelihood of retirement entry among specific socio-demographic groups. Women are substantially more likely to enter retirement in the years following windfall gains compared to a control group of women who have not received windfall gains. The strong positive effect appears to be driven by low education, low income, and socialization. The findings can be explained by (i) higher opportunity costs for working for low-skilled than for highly skilled individuals and (ii) an impact of (state-dependent) socialization on labor supply.

I contribute to the literature that neglecting potential socio-demographic differences in labor supply finds ambiguous results on the question whether wealth shocks affect labor supply. My findings suggest that the question cannot be answered uniquely without taking into account differences in individual and social background. Contrary to findings for the United States (e.g., Joulfaian and Wilhelm, 1994), I find retirement effects of wealth shocks in Germany, which has a strong social system. This finding matches with evidence for a strong effect of social security on individual behavior and labor supply, in particular on retirement decision making.²

As has literature on general labor supply shown, gender differences, age structure, and the social and economic background also have to be considered when evaluating response effects to income changes.³ In contrast to existing literature, I provide evidence for relevant differences in retirement effects when considering these factors. First, the analysis shows strong differences between women and men. While the positive retirement effect of wealth shocks is robust for women, the analysis provides no evidence for an effect for men. In line with

² See, e.g., Boskin (1977); Boskin and Hurd (1978); Fenge and Pestieau (2005); Gruber and Wise (1998); Sheshinski (1978).

³ See, e.g., Blundell and MaCurdy (1999); Krueger and Pischke (1995); Smith (2014).

economic theory suggesting that low-skilled individuals have higher opportunity costs for working than skilled, the results suggest that both education and income play - mutually reinforcing - a decisive role in the decision to retire after income shocks. In addition, my results indicate a relevant contribution of the social background of individuals as I find substantial differences between East and West German women. That is in line with research showing that ideals and statutory frameworks concerning female labor force participation in the past contribute to present differences (e.g. Bonin and Euwals, 2005). Finally, the analysis provide evidence for an anticipation effect. In all specifications, the positive retirement effect is stronger for a subsample of women who do not expect a future inheritance or gift.

In principal, findings on labor supply responses to income shocks are important to understand the effects when reforming benefit systems, tax regulations, or social security schemes. Furthermore, for the taxation of intergenerational transfers the findings are of high relevance. My findings suggest that positive income shocks lead to decreasing labor supply under certain conditions. For policy makers, this means that interventions will not affect all workers uniformly.

However, the external validity of the findings may be limited. In particular, low-educated women, women with low income, and women from West Germany low response to wealth shocks. It should be recalled that the effects are estimated on a German sample, and that the analysis is based on the argument that the social system of a country plays an important role in the labor supply response. Therefore, the results may vary substantially when evaluating other countries, so that we can not simply transfer the results to any other economy.

One potential factor that might influence the interpretation of my findings is the size of wealth shocks. I cannot assess the necessary size of wealth changes that would have an effect on labor supply and retirement decisions. It would

be helpful to know the level of wealth before wealth shocks occur and the size of the wealth shock, since it is unlikely that each income level will have the same impact on each recipient.

A further factor that might be an issue are liquidity constraints that would lead to a more similar effect of expected and unexpected inheritances. I would over-estimate the effect of the non-anticipating observations in the case when individuals know about future wealth shocks but cannot adapt labor supply before they actually receive the non-earned income due to liquidity constraints.

Furthermore, this study does not answer the question, why and what for individuals decide to exit the labor market. It does not observe, what retired persons do instead of market labor, whether they, for example, do unpaid work in a family-run business.

Future research should provide further support for the link observed since wealth, the number of inheritances, and the size of inheritances will increase in the future, whereas demographic changes indicate a further decreasing labor supply in developed countries.

5.2 Empirical Limitations

All three studies in this dissertation have the objective to provide causal effects - either *of* individual behavior (Internet use) or *on* behavior (self-employment, retirement). In respect of the causal interpretation of the results, I face limitations of technical nature. In all three cases, the appropriate method to assess a clear identification would be a natural experiment. In the first chapter, this might be the case in which households were randomly assigned to receive an Internet connection. In the second chapter, a possible scenario would be if individuals were randomly chosen to receive a training in financial literacy.

Similarly, in the third chapter, persons were randomly chosen to receive a relative large windfall gain.

Yet, there are no experiments with a perfectly random allocation of treatment (Internet access, financial education, wealth shock) that would allow a causal interpretation of the estimated effects. Therefore, I suggest regression-based, non-experimental designs and take selection bias into account, or identify a comparison group that is as similar as possible to the treatment group in terms of baseline (pre-intervention) characteristics. In the first and second chapter an instrumental variables (IV) approach is chosen, in the third a propensity score matching (PSM) for creating a valid comparison group. Applying an IV estimation, a random assignment to the treatment is imitated under the assumption that the chosen IV (share of households with Internet access, mother's schooling attainment) exhibit meaningful correlation with the endogenous explanatory variables (Internet use, financial literacy), but no correlation with the error term, and affect the outcome variable (financial literacy, self-employment) only through this channel and not through other unobserved factors. While the correlation between the IV and the endogenous explanatory variables can be measured, and the strength of the instrument can be assessed, the identifying assumption (that the instruments are not correlated with the error term in the equation of interest) cannot be tested. The results of my estimations point to strong instruments with strong predictive power for the explanatory variables. I perform robustness checks in which I address potential channels that may influence the exclusion restriction. For example, I include control variables that should offset potential effects, and define sub-samples that should exclude groups that are potentially affected. However, without random assignment, I cannot perfectly rule out unobserved factors that are correlated with the treatment.

In the third chapter, I apply a propensity score matching. This method

allows creating a sample consisting of two groups (treatment and comparison) with similar characteristics, consequently with similar likelihood that the individual will receive the treatment (windfall gain). The matching variables must be variables that are unaffected by the treatment. This should be ensured with conditioning and matching on variables with respect to the pre-treatment period. To test for balance, the characteristics of the treatment and comparison groups are compared. Ideally, there are no significant differences in average observable characteristics between the groups. The main shortcoming of the PSM method is that it relies on matching on the basis of observable characteristics linked to predicted likelihood of participation. Hence, estimates are biased if unobserved factors affect the treatment and change over time. Further, I cannot perfectly rule out that windfall gains are not anticipated. Nevertheless, a positive retirement effect is found among women, and it is rather downward biased than upward biased, since under perfect capital markets, the anticipation of a wealth shock would lead to an adjustment of labor supply before the shock actually happened. Potential channels are addressed in extensions and robustness checks by applying sub-samples. However, also in this case, without a randomized experiment the estimated effect can not be interpreted causally unambiguously. Besides the content-related suggestions for future research (in Section 5.1), I further propose more experimental work on the questions raised.

A Appendix

A.1 Selected SAVE Survey Questions

Basic Financial Literacy Questions

1) **Compound interest I.** 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? [1] More than €102; [2] Exactly €102; [3] Less than €102; [4] Do not know/Refusal.

2) **Compound interest II.** 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 five years, how much would you have on this account in total? [1] More than €200; [2] Exactly €200; [3] Less than €200; [4] Do not know/Refusal.

3) **Inflation.** Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? [1] More than today; [2] Exactly the same, [3] Less than today, [4] Do not know/Refusal.

4) **Money illusion.** Suppose that in the year 2012, your income has doubled and prices of all goods have doubled as well. In 2012, how much will you be able to buy with your income? [1] More than today; [2] As much as today; [3] Less than today; [4] Do not know/Refusal.

Advanced Financial Literacy Questions

5) **Risk diversification.** Buying a company fund usually provides a safer t than a stock mutual fund. True or false? [1] True; [2] False; [3] Do not know/Refusal.

6) **Volatility.** Normally, which of the following assets displays the highest fluctuations over time? [1] Savings accounts; [2] Bonds; [3] Stocks; [4] Do not know/Refusal.

7) **Stock market.** Which of the following statements describes the main function of the stock market? [1] The stock market helps to predict stock earnings; [2] The stock market results in an increase in the price of stocks; [3] The stock market brings people who want to buy stocks together with those who want to sell stocks; [4] None of the above; [5] Do not know/Refusal.

8) **Mutual funds.** Which of the following statements is correct? [1] Once one invests in a mutual fund, one cannot withdraw the money in the first year; [2] Mutual funds can invest in several assets, for example, in both stocks and bonds; [3] Mutual funds pay a guaranteed rate of return which depends on their past performance; [4] None of the above; [5] Do not know/Refusal.

9) **Bond prices.** If market interest rates fall, what should happen to bond prices? [1] Rise; [2] Fall; [3] Stay the same; [4] None of the above; [5] Do not know/Refusal.

10) **German statutory pension insurance I.** What is the current rate of contributions to the statutory pension insurance for employees subject to social security contributions (employee and employer's contribution together) in 2009? If you do not know the exact contribution rate, please estimate it.

11) **German statutory pension insurance II.** What do you think the contributions paid into the statutory pension scheme are used for? [1] Exclusively for the future pension of today's contributors; [2] The greater part for the future pension of today's contributors; the smaller part for the pensions of today's pensioners; [3] The smaller part for the future pension of today's contributors, the greater part for the pensions of today's pensioners; [4] Exclusively for the pensions of today's pensioners.

Mental Exercise Questions

1) The price of a racket and a ball is 110 Euro-cents. The price of the racket is 100 Euro-cents higher than the price of the ball. How much does the ball cost?

2) 5 machines take 5 minutes to produce 5 products. How long does it take 100 machines to produce 100 products?

3) A pond is covered with water lilies. The lily pad grows so that each day it doubles the pond's surface it covers. It takes 48 days for the lily pad to cover the pond completely. How long does it take for the lily pad to cover half of the pond?

A.2 Tables

A.2.1 Going online, being financially literate? Tables

Table A.1: Advanced Financial Literacy and Internet Use: Extensions

	<u>Advanced Financial Literacy</u>						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Internet use	0.398** (0.173)	0.427** (0.184)	0.394** (0.168)	0.395** (0.185)	0.438*** (0.160)	0.403** (0.170)	0.451*** (0.167)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pocket money		Yes					Yes
Parents			Yes				Yes
Occupation				Yes			Yes
Income & Wealth					Yes		Yes
Wealth transmission						Yes	Yes
Underidentification test	13.339	12.328	13.676	12.156	15.057	13.521	13.79
Chi-sq(1) P-val	0.0003	0.0004	0.0002	0.0005	0.0001	0.0002	0.0002
First stage F-statistic	33.38	28.43	34.41	30.09	38.76	33.80	33.50
<i>N</i>	1501	1501	1501	1501	1501	1501	1501

Note: This table reports IV estimates of advanced financial literacy on the set of controls and Internet use. The dependent variable *Advanced financial literacy* gives the percentage of correct answers to five advanced financial literacy questions (see Section 2.3). *Internet use* is a binary variable indicating whether the individual uses the Internet, and is instrumented using *DSL*, the share of households in a district that have access to the Internet. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic. * $p < .1$. ** $p < .05$. *** $p < .01$

Table A.2: Financial Literacy and Internet Use: Financial Socialization. First Stage Results

	<u>Internet use</u>			
	(1)	(2)	(3)	(4)
DSL	0.919*** (0.159)	0.867*** (0.163)	0.929*** (0.158)	0.879*** (0.162)
Male	0.047** (0.022)	0.038* (0.022)	0.048** (0.023)	0.040* (0.022)
ln(age)	-0.498*** (0.037)	-0.448*** (0.044)	-0.488*** (0.039)	-0.442*** (0.044)
School leaving qualification (base: basic)				
Secondary	0.141*** (0.029)	0.131*** (0.029)	0.143*** (0.029)	0.134*** (0.029)
<i>Abitur</i>	0.171*** (0.041)	0.157*** (0.040)	0.169*** (0.041)	0.157*** (0.040)
Vocational qualification (base: none/other)				
Vocational training	0.143*** (0.031)	0.137*** (0.031)	0.138*** (0.031)	0.132*** (0.031)
Master craftsman	0.208*** (0.050)	0.205*** (0.049)	0.201*** (0.050)	0.199*** (0.050)
University degree	0.263*** (0.051)	0.256*** (0.051)	0.258*** (0.051)	0.252*** (0.051)
GDR	0.027 (0.024)	0.031 (0.024)	0.029 (0.024)	0.032 (0.025)
Economics education (base: low)				
Medium	-0.047** (0.022)	-0.043* (0.022)	-0.056** (0.023)	-0.051** (0.023)
High	-0.066* (0.034)	-0.061* (0.034)	-0.077** (0.035)	-0.071** (0.035)
Mental exercises (base: 0 correct)				
1 correct	0.081*** (0.026)	0.082*** (0.026)	0.079*** (0.026)	0.080*** (0.026)
2 correct	0.128*** (0.030)	0.127*** (0.030)	0.128*** (0.030)	0.127*** (0.030)
3 correct	0.168*** (0.031)	0.169*** (0.031)	0.168*** (0.032)	0.169*** (0.031)

<u>Internet use</u>				
	(1)	(2)	(3)	(4)
Pocket money		0.011*** (0.004)		0.011*** (0.004)
Spending habits		0.004 (0.003)		0.004 (0.003)
Parents' understanding (base: Low)				
medium			0.055 (0.035)	0.049 (0.034)
high			0.070* (0.039)	0.062 (0.038)
Parents' accounting			0.002 (0.027)	-0.002 (0.028)
Resident change	Yes	Yes	Yes	Yes
Underidentification test	13.339	12.328	13.676	12.639
Chi-sq(1) P-val	0.0003	0.0004	0.0002	0.0004
First stage F-statistic	33.38	28.43	34.41	29.42
<i>N</i>	1501	1501	1501	1501

Note: This table reports first stage regression results of Internet use on the instrumental variable *DSL* (measuring the share of households with Internet access within the district) and control variables. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

Table A.3: Financial Literacy, Wealth, and Employment: First Stage Results

	<u>Internet use</u>				
	(1)	(2)	(3)	(4)	(5)
DSL	0.919*** (0.159)	0.857*** (0.156)	1.004*** (0.161)	0.921*** (0.158)	0.960*** (0.159)
Male	0.047** (0.022)	0.042* (0.023)	0.037* (0.022)	0.048** (0.023)	0.040* (0.023)
ln(age)	-0.498*** (0.038)	-0.418*** (0.041)	-0.498*** (0.040)	-0.492*** (0.039)	-0.450*** (0.043)
School leaving qualification (base: basic)					
Secondary	0.141*** (0.029)	0.132*** (0.029)	0.130*** (0.028)	0.143*** (0.029)	0.128*** (0.028)
<i>Abitur</i>	0.171*** (0.041)	0.152*** (0.041)	0.160*** (0.040)	0.167*** (0.041)	0.140*** (0.040)
Vocational qualification (base: none/other)					
Vocational training	0.143*** (0.031)	0.124*** (0.032)	0.114*** (0.032)	0.144*** (0.031)	0.110*** (0.032)
Master craftsman	0.208*** (0.050)	0.183*** (0.051)	0.181*** (0.049)	0.206*** (0.049)	0.166*** (0.050)
University degree	0.263*** (0.051)	0.227*** (0.051)	0.238*** (0.051)	0.266*** (0.050)	0.222*** (0.051)
GDR	0.027 (0.024)	0.023 (0.023)	0.052** (0.024)	0.030 (0.024)	0.050** (0.024)
Economics education (base: Low)					
Medium	-0.047** (0.022)	-0.044** (0.022)	-0.055** (0.022)	-0.050** (0.022)	-0.054** (0.021)
High	-0.066* (0.034)	-0.069** (0.034)	-0.068** (0.033)	-0.070** (0.034)	-0.075** (0.033)
Mental exercises (base: 0 correct)					
1 correct	0.081*** (0.026)	0.076*** (0.026)	0.076*** (0.026)	0.079*** (0.026)	0.073*** (0.026)
2 correct	0.128*** (0.030)	0.115*** (0.029)	0.112*** (0.029)	0.129*** (0.029)	0.106*** (0.029)
3 correct	0.168*** (0.031)	0.159*** (0.031)	0.144*** (0.031)	0.168*** (0.031)	0.140*** (0.030)
Non-employed		-0.058 (0.040)			-0.031 (0.041)
White collar		0.070* (0.036)			0.060* (0.036)
Civil servants		0.129*** (0.043)			0.099** (0.044)

<u>Internet use</u>					
	(1)	(2)	(3)	(4)	(5)
Self-employed		0.161*** (0.042)			0.153*** (0.042)
ln(income)			0.012*** (0.003)		0.007* (0.004)
Homeowner			0.135*** (0.020)		0.125*** (0.021)
Windfall 1 (Fin. assets)				0.121** (0.052)	0.108** (0.054)
Windfall 2 (Real est.)				0.078 (0.089)	0.031 (0.090)
Windfall 3 (Gift)				0.049 (0.051)	0.022 (0.051)
Financial support				0.073** (0.036)	0.086** (0.035)
Resident change	Yes	Yes	Yes	Yes	Yes
Underidentification test	13.339	12.156	15.057	13.521	14.213
Chi-sq(1) P-val	0.0003	0.0005	0.0001	0.0002	0.0002
First stage F-statistic	33.38	30.09	38.76	33.80	36.59
<i>N</i>	1501	1501	1501	1501	1501

Note: This table reports first stage regression results of Internet use on the instrumental variable *DSL* (measuring the share of households with Internet access within the district) and control variables. Clustered standard errors on the district level are reported in brackets. The F-test of excluded instruments refers to the Kleibergen-Paap F-statistic, the underidentification test to the Kleibergen-Paap rk LM statistic.

* $p < .1$. ** $p < .05$. *** $p < .01$

A.2.2 Financial Literacy and Self-Employment Tables

Table A.4: Financial Literacy and Self-Employment: Probit Regressions

	Self-Employment		
	(1)	(2)	(3)
Financial Literacy	0.125*** (0.046)	0.138** (0.054)	0.135** (0.061)
Marginal effects	[0.017]	[0.017]	[0.015]
Basic control variables	Yes	Yes	Yes
Socio-demographic, socio-economic controls		Yes	Yes
Personality traits, attitudes			Yes
Federal states		Yes	Yes
N	591	583	530

Notes: This table reports Probit regression results of self-employment on financial literacy and control variables. The average marginal effects on the probability of being self-employed are reported in square brackets. Robust standard errors are reported in brackets.

* $p < .10$, ** $p < .05$, *** $p < .01$

Table A.5: Self-Employment and Financial Literacy. IV-Probit Marginal Effects

	Self-Employment		
	(1)	(2)	(3)
Financial literacy	0.016	0.016	0.014
Age	0.017	0.017	0.013
Age ²	-0.0001	-0.0001	-0.0001
Male	-0.0004	-0.0110	-0.0059
Education GDR	0.0332	0.0126	0.0194
Vocational qualification:			
None/other		0.085	0.079
Master craftsman		0.068	0.068
University degree		0.034	0.013
Unemployed		0.048	0.054
Mental exercises		-0.009	-0.003
Marital status: married		-0.038	-0.046
Marital status: other		-0.024	-0.040
Number of children		-0.021	-0.022
Homeowner		-0.014	-0.0014
Ln (Income)		-0.081	-0.514
Ln ² (Income)		0.009	0.036
Health status: medium		-0.080	-0.085
Health status: high		-0.031	-0.044
Risk attitude:			
medium			0.050
high			0.050
Creature of habit			-0.006
Open for changes			0.013
Optimistic			-0.002
Self-assured			0.004
Living for the day vs. exact future plan			0.008
React impulsive and fast vs. weighing and observantly			-0.006
Voluntary:			
low			-0.027
medium			0.011
high			-0.070
<i>N</i>	591	583	530

Notes: This table presents average marginal effects after IV-probit models of self-employment on financial literacy and control variables. Specifications (1)-(3) correspond to specifications (1)-(3) in Table 3.4.

Table A.6: Self-Employment and Financial Literacy: Extensions. First Stage Regression Results for Financial Literacy

	Financial Literacy				
	(1)	(2)	(3)	(4)	(5)
	GDR sample				
Mother's schooling attainment	0.341*** (0.120)	0.248*** (0.068)	0.260*** (0.073)	0.239*** (0.068)	0.260*** (0.075)
Age	0.163 (0.172)	-0.041 (0.093)	-0.005 (0.098)	-0.029 (0.094)	0.000 (0.098)
Age ²	-0.001 (0.002)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Male	-0.179 (0.319)	0.216 (0.198)	0.203 (0.204)	0.149 (0.201)	0.215 (0.205)
Vocational qualification:					
None/other	0.808* (0.414)	0.243 (0.344)	0.245 (0.355)	0.270 (0.338)	0.412 (0.348)
Master craftsman	1.106** (0.534)	0.708** (0.275)	0.777*** (0.276)	0.793*** (0.276)	0.690** (0.286)
University degree	-0.324 (0.461)	-0.014 (0.251)	-0.137 (0.249)	-0.061 (0.246)	-0.151 (0.253)
Unemployment	-0.354 (0.368)	-0.020 (0.188)	-0.080 (0.192)	-0.013 (0.184)	-0.084 (0.193)
Marital status: married	-0.537 (0.602)	-0.225 (0.300)	-0.251 (0.309)	-0.168 (0.301)	-0.198 (0.310)
Marital status: other	0.332 (0.700)	0.734** (0.364)	0.680* (0.381)	0.831** (0.356)	0.746** (0.380)
Number of children	-0.041 (0.156)	-0.086 (0.091)	-0.071 (0.089)	-0.086 (0.087)	-0.102 (0.096)
Homeowner	-0.270 (0.344)	0.069 (0.217)	0.124 (0.216)	0.089 (0.215)	0.072 (0.218)
ln (income)	-0.738 (6.879)	5.012 (4.608)	5.101 (4.429)	5.815 (4.585)	4.974 (4.636)
ln ² (income)	0.109 (0.454)	-0.247 (0.293)	-0.254 (0.282)	-0.300 (0.291)	-0.244 (0.295)
Health status: medium	-0.186 (0.663)	0.093 (0.435)	0.321 (0.491)	0.214 (0.415)	0.292 (0.492)
Health status: high	-0.045 (0.669)	-0.095 (0.437)	0.145 (0.492)	0.003 (0.415)	0.059 (0.493)
Mental exercises	0.652*** (0.160)	0.615*** (0.085)	0.618*** (0.085)	0.605*** (0.086)	0.623*** (0.087)

	Financial Literacy				
	(1)	(2)	(3)	(4)	(5)
	GDR sample				
Education GDR		0.230 (0.257)	0.186 (0.257)	0.244 (0.257)	0.212 (0.258)
Risk attitude:					
medium		0.063 (0.193)	0.143 (0.192)	0.113 (0.191)	0.097 (0.193)
high		-0.613 (0.541)	-0.283 (0.563)	-0.654 (0.536)	-0.233 (0.578)
Creature of habit		0.037 (0.043)	0.020 (0.045)	0.025 (0.043)	0.024 (0.045)
Open for changes		0.032 (0.054)	0.024 (0.056)	0.024 (0.054)	0.031 (0.057)
Optimistic		-0.054 (0.050)	-0.071 (0.051)	-0.057 (0.050)	-0.076 (0.050)
Self-assured		0.030 (0.058)	0.006 (0.060)	0.023 (0.057)	0.015 (0.060)
Living for the day		-0.003 (0.051)	0.012 (0.052)	0.001 (0.050)	0.004 (0.053)
exact future plan					
React impulsive and fast vs.		-0.043 (0.040)	-0.054 (0.040)	-0.039 (0.041)	-0.050 (0.041)
weighing and observantly					
Voluntary:					
low		0.222 (0.231)	0.200 (0.238)	0.256 (0.230)	0.262 (0.240)
medium		0.233 (0.227)	0.151 (0.224)	0.250 (0.226)	0.209 (0.227)
high		-0.097 (0.358)	-0.192 (0.344)	-0.083 (0.356)	-0.219 (0.353)
Single-parent/no parents		-0.646** (0.305)	-0.624** (0.314)	-0.598* (0.305)	-0.781** (0.314)
Mother: adventurous		0.053 (0.039)			0.049 (0.042)
Mother: plan for future		0.002 (0.040)			-0.009 (0.041)
Father: adventurous		-0.057* (0.035)			-0.061* (0.037)
Father: plan for future		0.032 (0.039)			0.032 (0.042)
Parents: accounting		-0.092 (0.219)			-0.173 (0.222)

Financial Literacy					
	(1)	(2)	(3)	(4)	(5)
GDR sample					
Financial support, previous year			-0.250 (0.323)		-0.263 (0.338)
Regular support payments			0.066 (0.330)		0.064 (0.341)
Occasional support payments			0.139 (0.195)		0.101 (0.198)
Inheritance, financial assets			0.707*** (0.234)		0.750*** (0.231)
Inheritance, real estate			-0.137 (0.554)		-0.041 (0.568)
Likelihood of inheritance			0.051 (0.040)		0.037 (0.040)
Parents' financial understanding			0.096 (0.141)		0.111 (0.148)
Regular pocket money				0.043* (0.026)	0.024 (0.029)
Spending pocket money				0.020 (0.031)	0.023 (0.032)
Federal states	Yes	Yes	Yes	Yes	Yes
N	173	517	506	517	497

Notes: This table reports first stage regression results of financial literacy on the instrumental variable Mother's schooling attainment and control variables. Specifications (1)-(5) correspond to specifications (1)-(5) in Table 3.5. Robust standard errors are reported in brackets. * $p < .10$, ** $p < .05$, *** $p < .01$

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