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Aida Ćumurović, Walter Hyll

## Authors

**Aida Ćumurović**
Halle Institute for Economic Research (IWH) – Member of the Leibniz Association
Department of Structural Change and Productivity
E-mail: Aida.Cumurovic@iwh-halle.de
Tel: +49 345 7753 741

**Walter Hyll**
Halle Institute for Economic Research (IWH) – Member of the Leibniz Association
Department of Structural Change and Productivity
E-mail: Walter.Hyll@iwh-halle.de
Tel: +49 345 7753 850

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Halle Institute for Economic Research (IWH) – Member of the Leibniz Association

Address: Kleine Maerkerstrasse 8
D-06108 Halle (Saale), Germany
Postal Address: P.O. Box 11 03 61
D-06017 Halle (Saale), Germany

Tel +49 345 7753 60
Fax +49 345 7753 820

www.iwh-halle.de

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# Financial Literacy and Self-employment*


## Abstract

In this paper, we study the relationship between financial literacy and self-employment. We use established financial knowledge-based questions to measure financial literacy levels. The analysis shows a highly significant correlation between self-employment and financial literacy scores. To investigate the impact of financial literacy on being self-employed, we apply instrumental variable techniques based on information on economic education before entering the labour market and education of parents. Our results reveal that financial literacy positively affects the probability of being self-employed. As financial literacy is acquirable, findings suggest that entrepreneurial activities may be raised via enhancing financial knowledge.


*Keywords: financial literacy, financial sophistication, self-employment*

*JEL Classification: A20, D03, J23, J24*

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# 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 for basic financial concepts and, thus, are financially illiterate (Lusardi and Mitchell, 2007; Jappelli, 2010; van Rooij et al., 2011a). Several studies show that financially illiterate individuals are more likely to miss making efficient decisions on financial markets, especially when it comes to saving and investment, indebtedness and mortgages, retirement planning and wealth accumulation (Agarwal et al., 2009; Banks et al., 2010; Disney and Gathergood, 2011). While many scholars investigate the importance of financial literacy for households' financial decision making, the interaction of financial literacy and entrepreneurial activity is largely ignored.

The study of entrepreneurship is of gaining interest to scholars and policymakers and a lot of research is devoted to the unique characteristics of entrepreneurs, to factors that affect the entry decision, and to entrepreneurial survival. Several studies reveal that entrepreneurs differ in personality characteristics or in preferences from employed people. However, most characteristics as the Big Five personality traits, specific personality characteristics, or risk attitudes, which are found to have an impact on being self-employed, are classified as relatively stable over time and therefore are out of control for policymakers (see Caliendo et al., 2013; Cobb-Clark and Schurer, 2012a; 2012b).

Financial literacy, which is acquirable, has not been focus of the analysis so far, but there is reason to assume that it plays a role for entrepreneurial activity. Besides non-financial and non-economic reasons other important factors why businesses fail are poor financial management, lack of capital, or misjudgement of risks. Persons who are considering going into self-employment likely are aware about the existence of special challenges and risks of an own business. If persons are uncertain about their ability to handle those challenges and to manage an own business, they may prefer to work as employee. Considering persons who have a business idea, who have the willingness to take risks, and who meet other decisive conditions, we assume that those persons 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. The reason for this assumption is the idea that people with better understanding of financial products and financial concepts have better opportunities for realizing business ideas and to finance their venture. Literature shows that financially literate persons are more likely to have formal credits, a higher disposability of unspent income, higher rates of return, and are cost efficient concerning 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 in private matters, there is reason to assume that literate people are also more aware of sources of information, sources of advice, and sources of capital for entering self-employment. They may also be rather aware of different financing options or financial sponsorships and may have a better understanding of terms and conditions of financing those options. If more literate persons are more likely to develop the skills and the confidence to become more aware of financial risks and opportunities they may not only have a better understanding of the profitability of a business but may also be rather willing to take the step into self-employment than those who do not have a deeper

understanding of how to handle challenges, risks, and responsibilities of an own business.

But causality may also run the other direction: Not being self-employed may lower the incentive to invest into financial skills. In case of positive correlation between financial literacy and self-employment, the question arises if the link runs from financial literacy to self-employment or vice versa.

To study the link between financial literacy and self-employment, we use the German SAVE data set which allows generating an index for the level of financial literacy based on basic and advanced questions on financial concepts. To address the direction of causality, we apply instrumental variable techniques. Our results reveal that financial literacy positively affects the probability of being self-employed. We contribute to the existing literature in several respects. We are the first who 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 entrepreneurs which was not taken into account in previous studies. Consequently, we add to the discussion on *nature vs. nurture* in characteristics of entrepreneurs. As financial literacy is acquirable, our findings suggest that entrepreneurial activities may be raised via enhancing financial literacy.

The next section of the paper gives a brief overview of previous findings on the subject of financial literacy, on the one hand, and of characteristics of entrepreneurs, on the other hand. Section 3 describes the underlying data; we define the index for financial literacy and provide summary statistics. In section 4, we present our identification strategy and the regression results and in section 5, we discuss the results and present several extensions. In the last section, we draw some initial conclusions and discuss potential policy implications.

## 2. Literature review

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

First, research on financial literacy analyses the effects of financial literacy on individual behaviour especially concerning financial matters. Results reveal that individuals' net wealth increases with increasing financial literacy level (Disney and Gathergood, 2011; van Rooij et al., 2012; Behrman et al., 2012). This relationship is analysed by Jappelli and Padula (2013) who derive an economic intertemporal consumption model for this outcome. Financial literacy is shown to have positive effects on rates of return and on cost efficiency with regard to saving and investments. Higher levels of financial sophistication are correlated with higher interest incomes and lower credit costs (Deuflhard et al., 2015). Individuals with higher levels of financial sophistication are also more likely to have formal credits and a higher disposability of unspent income and they are less likely to have informal credits (Disney and Gathergood, 2013; Klapper et al., 2013). Christiansen et al. (2008) and van Rooij et al. (2011a) study the impact of financial literacy on stock market participation and they find that individuals with a low level of financial literacy are less likely to hold stocks. Moreover, Guiso and Jappelli (2009) find a strong correlation between the level of financial literacy and portfolio diversification. Another channel through which wealth is affected by financial sophistication is retirement planning. Several studies address the link of financial

sophistication on retirement planning. In light of demographic changes and accompanied pension reforms, supplementary private pensions become an important pillar to gain sufficient retirement income. Lusardi and Mitchell (2005; 2007) evaluate how successful individuals plan for retirement. They show that financial literacy is important for planning behaviour which, in turn, increases wealth. Similarly, Bucher-Koenen and Lusardi (2011) demonstrate that financial literacy has a positive impact on retirement planning in Germany and van Rooij et al. (2011b) provide similar evidence for the Netherlands. In turn, successful retirement planning positively affects the individuals' total wealth accumulation (van Rooij et al., 2012). What all these studies have in common is that they link financial literacy and wealth accumulation.

Yet, we know relatively little about the impact of financial literacy on entrepreneurship although a lot of research is devoted to the question what makes an entrepreneur. Fairly and Robb (2009) show that women are less likely to be self-employed. Several personality traits are found to have influence on the decision to make the move into self-employment. Scholars find that the *Big Five* personality traits affect the decision to enter self-employment. Zhao and Seibert (2006) show that entrepreneurs differ from employed managers in terms of neuroticism, openness to experience, conscientiousness, and agreeableness. Caliendo et al. (2013) confirm the results and they find a positive effect of extraversion on the probability of being in self-employment and on the entry probability into self-employment. Furthermore, research results show that entrepreneurs are more willing to take risks. Cramer et al. (2002) find a negative correlation between risk aversion and entrepreneurship. Ekelund et al. (2005) show that risk aversion affects the decision to enter entrepreneurship using psychometric data from the Northern Finland 1966 Birth Cohort Study which collected data on individuals from the prenatal period up to age 31. Caliendo et al. (2009) confirm that individuals with lower risk aversion are more likely to enter self-employment. Another specific personality characteristic is locus of control. The internal locus of control, i.e. the assurance that one's own actions reach rewards, reinforcements, or outcomes in life (see Spector, 1988; Rotter, 1966), is found to be positively correlated with self-employment (Caliendo et al., 2009). Caliendo et al. (2013) show that the willingness to trust others also affects entry decisions. Other scholars point out that the need for autonomy drives self-employment (Feldman and Bolino, 2000; Carter et al., 2003). Most of these traits, like Big Five, risk preferences, or locus of control, are shown to be relatively stable over time (Specht et al., 2011; Andersen et al., 2008; Cobb-Clark and Schurer 2012a; 2012b). These traits are, thus, out of control for scholars and policy makers. Financial literacy, which is acquirable, has not been focus of research so far.

# 3. Data

## 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 saving behaviour and asset accumulation of private households (Boersch-Supan et al., 2009). We draw our main data from the 2009

survey which includes a set of questions on financial knowledge. In the 2009 survey, 2,222 households participated. For our study we restrict the sample to individuals at the age between 18 and 65 years. We exclude non-working individuals and assisting family members.[1] This leaves us with 1,039 observations.

One of the key characteristics for our study is the type of employment. The SAVE study queries whether respondents are *Blue collar worker / White collar worker / Civil servant / Farmer / Self-employed as member at the respective chamber (e.g. pharmacist, doctor, lawyer) / Other freelancer / Trader or other form of self-employment*. We cluster the first three employment groups (blue collar worker, white collar worker, civil servants) as the group of employees and the subsequent professions (farmer, self-employed as member at the respective chamber, other freelancer, trader or other forms of self-employment) as the group of self-employed individuals. In what follows, we use information about the type of employment for constructing the variable *self-employment* which is 1 if an individual is self-employed and 0 otherwise.

As controls we use the age of respondents, gender, marital status, number of children, and dummy variables for graduation in the former GDR and homeownership. Education levels are classified in compliance with existing research (e.g. van Rooij et al., 2012) according to ISCED in four groups: Intermediate vocational education (ISCED level 3), higher vocational education (level 5), university education (level 6/7), and a fourth group that captures no vocational education and other vocational education. We include a proxy for cognitive abilities as control variable. Following existing literature we make use of answers on mental exercises. The indicator measures the skills for simple numerical calculations; it gives the number of correct answers on a total of three questions.[2]

We further include economic factors: earnings from wage and salary from the previous year, total monthly net household income, and earlier periods of unemployment. Since 57 % of all self-employed state to have an income equal to zero, compared to 5 % of regularly employed, incomes of self-employed are well below incomes of regularly employed respondents. Risk attitudes are measured on the basis of self- assessments on the willingness to take risks with respect to the career on a scale of 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 (cf. Caliendo et al., 2009). The evaluation of the socio-demographic and socio-economic characteristics of the total sample and by employment groups is provided in Table 1.

[1] The term "non-working" here refers to all respondents who state to be *currently not employed / not applicable* when asked about their type of employment.

[2] See Appendix for the precise wording of these questions.

**Table 1**
Characteristics of individuals

| | Total sample | | Self-Employed | | Employed | |
|---|---|---|---|---|---|---|
| | N | Share/ Mean | N | Share/ Mean | N | Share/ Mean |
| Male (Dummy) | 503 | 0.48 | 60 | 0.58 | 443 | 0.47 |
| Female (Dummy) | 536 | 0.52 | 44 | 0.42 | 492 | 0.53 |
| Age (mean) | 1039 | 45.8 | 104 | 47.7 | 935 | 45.6 |
| Education | | | | | | |
| Intermediate | 62 | 0.06 | 12 | 0.12 | 50 | 0.05 |
| Higher level | 674 | 0.65 | 48 | 0.46 | 626 | 0.67 |
| University | 116 | 0.11 | 9 | 0.09 | 107 | 0.11 |
| Other | 187 | 0.18 | 35 | 0.34 | 152 | 0.16 |
| Graduation in GDR (Dummy) | 293 | 0.28 | 36 | 0.35 | 257 | 0.28 |
| Mental exercises | | | | | | |
| 0 correct answer | 56 | 0.05 | 8 | 0.08 | 48 | 0.05 |
| 1 correct | 398 | 0.38 | 41 | 0.39 | 357 | 0.38 |
| 2 correct | 495 | 0.48 | 49 | 0.47 | 446 | 0.48 |
| 3 correct | 90 | 0.09 | 6 | 0.06 | 84 | 0.09 |
| 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 (average) | 1039 | 1.64 | 104 | 1.39 | 935 | 1.66 |
| Homeowner (Dummy) | 1039 | 0.56 | 104 | 0.59 | 935 | 0.56 |
| Unemployed (Dummy) | 1039 | 0.61 | 104 | 0.65 | 935 | 0.61 |
| Risk- career | | | | | | |
| Low | 489 | 0.47 | 33 | 0.32 | 456 | 0.49 |
| Medium | 547 | 0.49 | 62 | 0.60 | 452 | 0.48 |
| High | 36 | 0.04 | 9 | 0.09 | 27 | 0.03 |
| Net income (average) | 1039 | 1380 | 104 | 642 | 935 | 1462 |
| Household income (average) | 1039 | 2686 | 104 | 3334 | 935 | 2614 |
| Total | 1039 | 100.0 | 104 | 100.0 | 935 | 100.0 |

*Notes.* Shares and means do not sum up to 100% because of rounding.

## Measuring financial literacy

The 2009 SAVE survey contains eleven financial knowledge-based questions. The set of questions consists of two parts. Three basic financial knowledge questions cover a simple interest computation, a short calculation on real rate of return, and a question on risk diversification.[3] These questions were developed by Lusardi and Mitchell (2005) and implemented in the Health and Retirement Study 2004 and they are applied by most studies on financial literacy.[4] The second part is a set of eight advanced questions. The advanced questions cover fixed interest rate, purchasing power, volatility (types of investment), stock market, mixed funds, price of a bond, pension insurance fund contribution, and contribution

[3] See Appendix for the precise wording of these questions.

[4] See, for example, Alessie et al. (2011), Agnew et al. (2013), or Bucher-Koenen and Lusardi (2011).

rate to pension insurance fund.[5] These questions allow measuring the degree to which individuals have an understanding for concepts and for products of financial markets. We use the responses to all eleven questions to construct an index of financial knowledge. Following existing literature, our financial literacy indicator counts the number of financial knowledge questions answered correctly (e.g.: Alessie et al., 2011; Bucher-Koenen and Lusardi, 2011; Klapper et al., 2013). Previous researchers have measured financial literacy using the three basic financial knowledge questions only, but as the 2009 SAVE data enable to make use of a set of a total of eleven financial knowledge-based questions, we exploit the complete potential. Similarly, Lusardi and Mitchell (2009), Behrman et al. (2012), and van Rooij et al. (2011a; 2012) exploit the range of 12 and 16 questions, respectively, available in the underlying data. In the following, our financial literacy index gives the number of correct answers given on the total of eleven financial knowledge-based questions.

The answers to the financial knowledge-based questions by employment groups are provided in Table 2. As displayed in the upper part of the table, a relative high fraction of individuals is able to give correct answers to the basic financial knowledge questions. Self-employed individuals are more likely to answer each of these basic questions correctly compared to regularly employed individuals. Questions 4- 11 in Table 2 refer to advanced knowledge-based literacy questions. We find a similar pattern of response behaviour as before: self-employed individuals gave correct answers to advanced questions more frequently than employees. The difference is particularly high regarding the knowledge on fixed interest rates, the volatility of different types of investments, the function of the stock market, and mixed funds.[6]

In sum, the average number of correct answers on basic and on advanced financial knowledge-based questions is higher among self-employed individuals. The analysis reveals that self-employed individuals tend to be more financially literate than employed individuals. The results raise the question whether self-employed workers are more literate because of their employment activity or whether more financially literate individuals tend to make the move into self-employment and survive in self-employment rather than less literate individuals. In order to address the concern of reverse causality, we resort to instrumental variables estimation which is explained in more detail in the subsequent section.

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[5] See Appendix for the precise wording of these questions.

[6] Two sample t-test: Question 4: $t = -2.27$, $Pr(T<t) = 0.023$; Question 6: $t = -3.11$, $Pr(T<t) = 0.002$; Question 7: $t = -2.27$, $Pr(T<t) = 0.024$; Question 8: $t = -3.28$, $Pr(T<t) = 0.001$.

The question concerning the contribution to the statutory pension scheme was the only one answered correctly more frequently by employed than by self-employed individuals. The difference in the means between the groups is far away from any statistically significance ($p>0.78$). For both employment groups holds: roughly half of participants were not able to give the correct answer.

**Table 2**

Distribution of correct answers on financial literacy questions.

| Financial Literacy Question | Total | Employed | Self-Employed |
|---|---|---|---|
| (1) Fixed Interest Rate, 2% | 89.4 | 89.1 | 92.3 |
| (2) Real Rate of Return | 83.3 | 82.8 | 88.5 |
| (3) Diversification | 74.2 | 73.4 | 81.7 |
| (4) Fixed Interest Rate, 20% | 68.0 | 67.0 | 77.9 |
| (5) Purchasing Power | 61.4 | 60.6 | 68.3 |
| (6) Volatility (types of investment) | 77.4 | 76.0 | 89.4 |
| (7) Stock market | 59.9 | 58.7 | 70.2 |
| (8) Mixed funds | 53.1 | 51.4 | 68.3 |
| (9) Price of a bond | 9.9 | 9.3 | 15.4 |
| (10) Pension insurance fund contribution | 52.3 | 52.4 | 51.0 |
| (11) Contribution rate to pension insurance fund | 33.5 | 33.3 | 35.6 |
| Financial literacy index | 6.6 | 6.5 | 7.4 |
| Observations | 1039 | 935 | 104 |

*Notes.* See Appendix for the exact wording of the questions.

# 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 may affect financial literacy and bias may arise due to reverse causality. At least in Germany, self-employed individuals are more likely confronted with activities that require financial literacy. Engagement in these activities, in turn, may affect the level of financial literacy. Therefore the estimation model has to take account of this issue. Estimates may be subject to omitted variable bias, too.

To address these concerns, we apply an instrumental variables (IV) approach. A valid instrument must be correlated with the level of financial literacy and uncorrelated with the error term. To identify the effect of being financially literate on being self-employed, we exploit information on individual economic education when young as proxy for financial literacy before entering the labour market and information on the education of parents. By definition, none of these predetermined variables can be influenced by the entry into self-employment.

Jappelli and Padula (2013; 2015) show that the stock of financial literacy before entering the labour market is a robust and valid instrument for the current stock of financial literacy. In their analyses on the effect of financial literacy on saving decisions and on household portfolio choice, they use information on the performance in mathematics at age 10

as proxy for financial literacy before entering the labour market. Based on these findings, Disney and Gathergood instrument financial literacy using information on *how much of the respondents' education was devoted to finance, economics, and business* when respondents were in full time education to estimate the effect of financial literacy on indebtedness (cf. Disney and Gathergood, 2011, p. 26). Similarly, van Rooij et al. use information on *how much the respondents' education was devoted to economics* to estimate the effect of financial literacy on retirement planning and on wealth accumulation (cf. van Rooij et al. 2011b; 2012). The authors show that the instrument based on economics education is a strong predictor for financial literacy. Following existing studies, Deuflhard et al. (2015) employ the same instrumental variable based on the question on economics education to identify an impact of financial literacy on savings account returns.

Also, the 2010 SAVE data set contains information on economic education before entering the labour market. Respondents were asked: *How intensively have you dealt with economic issues –e.g. during classes in social studies- during your education and training period?* Respondents can answer on a scale of 1 (*not at all*) to 7 (*very intensively*). In line with the existing literature, we group the variable on economic education into three categories: *low* (1-2, as base category), *intermediate* (3-5), and *high* (6-7). This variable measures exposure to education before entering the job market. We merge that information to SAVE 2009 and in accordance with the literature, we use the variable to instrument the financial literacy index.

Family background is also frequently used to instrument financial literacy in existing studies (e.g. Alessie et al., 2011; Bucher-Koenen and Lusardi, 2011; Agnew et al., 2013). A number of studies have found that the literacy level of parents is a valid instrument for respondents' financial literacy (van Rooij et al., 2011a). Behrman et al. (2012) use *mother's schooling attainment* and *father's schooling attainment* to isolate the causal effect of financial literacy on wealth accumulation. The education of parents is not under the control of respondents, but respondents' financial literacy may be positively influenced by the parents' education. The 2013 SAVE also contains information on parental schooling attainment. Based on the response categories (no graduation, secondary education (8 grades), high school diploma (10 grades), GDR graduation after 8 or 10 grades, higher education entrance qualification after 12 grades)[7] we generate variables for mother's schooling attainment and father's schooling attainment according to their grades. [8]

## Financial literacy and self-employment

In all subsequent regressions we apply IV techniques.[9] We run IV probit models using maximum likelihood estimation. The dependent variable is always a self-employment dummy

[7] We treat the response categories "foreign graduation" and "don't know" as missings.

[8] For parents with no school leaving qualification we have no precise information on details of the duration of education. We assign 7 grades to these observations. Results remain stable and robust when varying years of education between 0 and 7.

[9] Similar to the existing literature, we find that the effect of financial literacy is larger in the IV estimation than in an OLS or a Probit specification. This holds for at least 11 recent studies listed by Lusardi and Mitchell (cf.

variable. We use exposure to economic education before entering the job market, mother's schooling attainment, and father's schooling attainment as instrumental variables for the literacy index.

We are aware of endogeneity concerns due to unobserved variables and we include controls to address these issues. Following Jappelli and Padula (2013) we control for other education variables in order to rule out the possibility that the instrumental variables affect the outcome variable through (unobserved) education factors. Moreover, unobserved factors with regard to cognitive skills may affect the variables of interest, too (cf. van Rooij et al., 2011a; Lusardi and Mitchell, 2014). Therefore we control for math skills as proxy for cognitive abilities. Furthermore, there is reason to assume that the level of financial literacy may affect the willingness to take risks and therefore entrepreneurial activity. So we use self-assessed risk attitudes with respect to the career to control for respondents' risk attitudes. Several additional extensions are discussed in section 5.

Table 3 presents the results from the first-stage regressions. The table displays results of regressions estimating effects of economics education (IV 1), the schooling attainment of the mother (IV 2), and the schooling attainment of the father (IV3) on the financial literacy index. In all specifications the instruments have strong predictive power for the financial literacy index. Individuals who had dealt more intensively with economic issues before entering the labour market are more likely to give more correct financial literacy answers. The effect is highly statistically significant. Mother's and father's education are also statistically significant and correlate positively with financial literacy. Individuals whose parents attended more years of schooling have higher literacy scores. The first-stage regressions reported show that not only are our instruments statistically significant, but the values for the F-test of excluded instruments allow rejecting the null hypothesis, that the equations are weakly identified.

Furthermore, regression results in column 1 show that male individuals are more financially literate. There are several studies suggesting a gender gap concerning the level of financial literacy; on average, women are less financially literate than men (Agnew et al., 2008; Lusardi and Mitchell, 2008). The estimations also confirm that individuals with higher-level vocational qualification (postsecondary, non-tertiary) compared to intermediate vocational qualification are more financially literate. This is in line with previous research. Jappelli (2010) findings suggest that PISA test scores and college attendance (measured at the national level) are positively correlated with financial literacy. Other studies show that higher educated individuals are more likely to answer financial literacy questions correctly (Lusardi and Mitchell 2007; Christelis et al., 2010; van Rooij et al., 2011).

Table 4 presents the main regression results of the effect of the instrumented financial literacy index on the probability of being self-employed. With respect to our variable of interest, we find that financial literacy has a positive and highly significant effect on being self-employed. This applies to all three specifications with the respective instrumental variable. With higher literacy scores the likelihood of self-employment rises.

2014, p. 28). Potential reasons are measurement errors and local average treatment effects in IV estimates versus average treatment effects in OLS.

**Table 3**

Financial literacy: First-stage regressions

Estimates of the first-stage regressions of financial literacy on the set of controls and variables indicating economics education before entering the labour market (IV1), schooling attainment of the mother (IV2), and the father (IV3). The data are from the SAVE survey 2009–2013.

| | IV1 | IV2 | IV3 |
|---|---|---|---|
| Financial literacy | | | |
| Economic education: medium | -0.034 | | |
| | (0.153) | | |
| Economic education: high | 0.749*** | | |
| | (0.242) | | |
| Mother's schooling attainment | | 0.278*** | |
| | | (0.069) | |
| Father's schooling attainment | | | 0.201*** |
| | | | (0.057) |
| Age | -0.022 | 0.039 | 0.008 |
| | (0.077) | (0.100) | (0.103) |
| Age $^2$ | 0.000 | -0.000 | -0.000 |
| | (0.001) | (0.001) | (0.001) |
| Male | 0.615*** | 0.338 | 0.429* |
| | (0.184) | (0.236) | (0.236) |
| Education: Other | -0.382 | -0.230 | -0.278 |
| | (0.280) | (0.352) | (0.366) |
| Education: Higher level | 0.690** | 0.930*** | 0.824** |
| | (0.272) | (0.340) | (0.347) |
| Education: University | 0.474** | 0.344 | 0.280 |
| | (0.239) | (0.294) | (0.292) |
| Education GDR | 0.357 | 0.619** | 0.630** |
| | (0.221) | (0.281) | (0.284) |
| Mental exercises score: 1 | 0.517 | 0.589 | 0.583 |
| | (0.388) | (0.536) | (0.527) |
| Mental exercises score: 2 | 0.142 | 0.141 | 0.158 |
| | (0.384) | (0.534) | (0.525) |
| Mental exercises score: 3 | -0.496 | -0.934 | -0.724 |
| | (0.451) | (0.630) | (0.613) |
| Martial status: married | -0.350 | -0.516 | -0.577* |
| | (0.267) | (0.332) | (0.326) |
| Marital status: other | 0.346 | 0.129 | 0.079 |
| | (0.292) | (0.390) | (0.391) |
| Number of children | -0.021 | 0.026 | 0.014 |
| | (0.076) | (0.091) | (0.090) |
| Homeowner | 0.389** | 0.312 | 0.235 |
| | (0.182) | (0.230) | (0.231) |
| Unemployed | 0.012 | -0.185 | -0.246 |
| | (0.166) | (0.205) | (0.204) |
| Risk attitude: medium | 0.251 | 0.245 | 0.232 |
| | (0.166) | (0.203) | (0.203) |
| Risk attitude: high | -0.635 | -0.569 | -0.298 |
| | (0.463) | (0.676) | (0.721) |
| Ln (Income from wages and salaries) | 0.163 | 0.084 | 0.430 |
| | (0.955) | (1.199) | (1.295) |
| Ln $^2$ (Income) | -0.063 | -0.040 | -0.132 |
| | (0.275) | (0.344) | (0.371) |
| Ln $^3$ (Income) | 0.006 | 0.004 | 0.010 |
| | (0.020) | (0.025) | (0.027) |
| Ln (Household income) | -3.886** | -4.918** | -4.820** |
| | (1.578) | (2.404) | (2.398) |
| Ln$^2$ (Household income) | 0.941** | 1.147* | 1.146* |
| | (0.402) | (0.609) | (0.609) |
| Ln$^3$ (Household income) | -0.054** | -0.064* | -0.065* |
| | (0.026) | (0.039) | (0.039) |
| Controls for federal states | Yes | Yes | Yes |
| Observations | 858 | 586 | 581 |
| F-statistic first-stage regression | 6.01 | 15.13 | 11.48 |
| | (0.003) | (0.000) | (0.001) |

*Notes.* Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

**Table 4**
Probability of being self-employed
IV estimates of the effect of financial literacy and the set of controls on self-employment. The literacy index has been instrumented using variables indicating the economics education before entering the labour market (IV1), schooling attainment of the mother (IV2), and the father (IV3). The data are from the SAVE survey 2009–2013.

| | IV1 | IV2 | IV3 |
|---|---|---|---|
| Self-employment | | | |
| Financial literacy | 0.378*** | 0.367*** | 0.366*** |
| | (0.065) | (0.106) | (0.137) |
| Financial literacy: Marginal Effect | [0.078] | [0.056] | [0.055] |
| | (0.036) | (0.038) | (0.048) |
| Age | 0.054 | 0.132* | 0.134 |
| | (0.048) | (0.079) | (0.088) |
| Age squared | -0.000 | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.001) |
| Male | -0.114 | -0.162 | -0.185 |
| | (0.150) | (0.183) | (0.190) |
| Education: Other | 0.227 | 0.658** | 0.670** |
| | (0.227) | (0.315) | (0.330) |
| Education: Higher level | 0.286 | 0.453 | 0.470 |
| | (0.298) | (0.385) | (0.478) |
| Education: University | 0.227 | 0.320 | 0.328 |
| | (0.263) | (0.273) | (0.307) |
| Education GDR | 0.034 | -0.246 | -0.245 |
| | (0.154) | (0.205) | (0.215) |
| Mental exercises score: 1 | -0.401* | -0.576 | -0.581 |
| | (0.232) | (0.350) | (0.354) |
| Mental exercises score: 2 | -0.284 | -0.231 | -0.244 |
| | (0.245) | (0.352) | (0.354) |
| Mental exercises score: 3 | -0.398 | -0.168 | -0.220 |
| | (0.349) | (0.486) | (0.504) |
| Martial status: married | 0.024 | -0.093 | -0.079 |
| | (0.181) | (0.299) | (0.335) |
| Marital status: other | -0.236 | -0.442 | -0.434 |
| | (0.202) | (0.290) | (0.296) |
| Number of children | -0.159** | -0.177** | -0.169** |
| | (0.080) | (0.071) | (0.082) |
| Homeowner | -0.007 | -0.123 | -0.102 |
| | (0.140) | (0.172) | (0.174) |
| Unemployed | 0.049 | 0.294* | 0.317* |
| | (0.117) | (0.171) | (0.176) |
| Risk attitude: medium | 0.144 | 0.325 | 0.344 |
| | (0.157) | (0.200) | (0.227) |
| Risk attitude: high | 1.045*** | 0.951** | 0.936* |
| | (0.378) | (0.448) | (0.512) |
| Ln (Income from wages and salaries) | 0.185 | 0.585 | 0.560 |
| | (0.626) | (0.810) | (0.873) |
| $Ln^2$ (Income) | -0.069 | -0.192 | -0.187 |
| | (0.187) | (0.243) | (0.261) |
| $Ln^3$ (Income) | 0.002 | 0.011 | 0.011 |
| | (0.014) | (0.018) | (0.019) |
| Ln (Household income) | 9.824 | 11.394 | 9.469 |
| | (14.241) | (25.117) | (24.997) |
| $Ln^2$ (Household income) | -1.413 | -1.786 | -1.552 |
| | (1.820) | (3.202) | (3.186) |
| $Ln^3$ (Household income) | 0.067 | 0.090 | 0.081 |
| | (0.077) | (0.135) | (0.134) |
| Controls for federal states | Yes | Yes | Yes |
| Observations | 857 | 585 | 580 |

*Notes.* Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

The results also show that the probability of being self-employed generally rises with the willingness to take risks with respect to the career. These results are very much in line with existing studies on determinants of self-employment. The number of children is negatively correlated with being self-employed.

We have also estimated average marginal effects on the probability of being self-employed for all three specifications, which are depicted in the squared bracket in table 4. The probability of self-employment increases with each additional correct answer. For our financial literacy coefficient the average marginal effects are between 5.5 and 7.8 percentage points. However, as not all financial knowledge questions are equally difficult to answer, we can not interpret the precise effect of every single question separately. Yet, given that there are eleven questions, the probability of self-employment increases by more than 60 percentage points when knowing all questions compared to knowing no financial literacy question.

## 5. Discussion and Extension

In this section, we investigate the robustness of our results. Thereby we make use of different waves of the SAVE survey and examine several extensions.

A potential concern with our economic education variable is that it might be a choice variable that depends on unobserved factors or omitted variables which also affect the type of employment. Individuals might have chosen economic education at young age because of the desire to become self-employed. These individuals might also likely be willing to study business studies. Ideally, we should exclude individuals attending business studies to see whether our results change after we change the sample. Due to the lack of information on subjects of studies, we exclude all individuals with university education to remedy this issue. Furthermore, we also expect that having economic education is more exogenous to individuals with lower education.

In Table 5, we report IV estimates of the effect of financial literacy on self-employment after we exclude all respondents with a university degree from the sample. We find very similar results for the effect of financial literacy on the probability of self-employment despite the sample restriction. The estimates in the first-stage and second-stage remain positive and statistically significant. Thus, excluding university graduates does not influence the effect of financial literacy on self-employment.

**Table 5**

Probability of Self-Employment: Excluding university graduates

IV estimates of financial literacy on self-employment after excluding university graduates. The literacy index has been instrumented using variables indicating the economics education (IV1), schooling attainment of the mother (IV2), and the father (IV3).

| | IV1 | IV2 | IV3 |
|---|---|---|---|
| Self - Employment | | | |
| Financial Literacy | 0.411*** | 0.415*** | 0.361* |
| | (0.058) | (0.105) | (0.198) |
| Full set of control variables (Table 1) | Yes | Yes | Yes |
| Observations | 696 | 473 | 467 |
| F-statistic first-stage regression | 7.30 | 18.03 | 17.47 |

*Notes*. Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

Our instruments on parental education rely on the interaction with parents. These are based on the assumption that the financial literacy level of individuals is affected by the literacy of parents. There is reason to assume that parents affect the literacy of children through other channels, for instance through personality traits. We next investigate if our results are affected once we control for a set of characteristics of parents. In the 2008 survey, respondents were asked whether their mother / father planned for future and whether they were adventurous. For both questions the response scales run from 0 (absolutely inapplicable) to 10 (absolutely applicable). We use these information for our regression as control variables for characteristics of parents. These variables are also proxies for carefulness, a common trait which is likely passed on from parents to children and which could affect investments in financial literacy and employment choice. Additionally, we make use of further information about traits of the parents as respondents were asked whether their parents keep or did keep private accounting records. We include this information as dummy variables which also serve as proxies for financial habits of the parents. The results are presented in Table 6 (Panel A). When we account for these controls in our regressions, we find that the additional personality traits have no significant effect on the probability of self-employment and that the estimates of financial literacy remain statistically significant. The first-stage F-statistic remains significant and similar to the results in the core estimates, too.

**Table 6**

Probability of Self-Employment

IV estimates of financial literacy on self-employment including a set of control variables on the characteristics of parents and controls for wealth and support. The literacy index has been instrumented using variables indicating the economics education (IV1), schooling attainment of the mother (IV2), and the father (IV3).

| Panel A : Characteristics of parents | IV1 | IV2 | IV3 |
|---|---|---|---|
| Self-employment | | | |
| Financial Literacy | 0.389*** | 0.357*** | 0.391*** |
| | (0.061) | (0.124) | (0.105) |
| Mother adventurous | -0.015 | -0.024 | -0.030 |
| | (0.024) | (0.036) | (0.034) |
| Mother- plan for future | -0.010 | -0.015 | -0.018 |
| | (0.024) | (0.034) | (0.031) |
| Father adventuresomely | 0.007 | 0.040 | 0.039 |
| | (0.023) | (0.037) | (0.035) |
| Father- plan for future | -0.002 | -0.016 | -0.011 |
| | (0.025) | (0.035) | (0.032) |
| Parents- accounting | -0.047 | 0.326 | 0.309 |
| | (0.138) | (0.204) | (0.192) |
| Full set of control variables (Table 1) | Yes | Yes | Yes |
| Observations | 813 | 546 | 541 |
| F-statistic first-stage regression | 6.32 | 11.87 | 9.51 |
| Panel B: Wealth and support | IV1 | IV2 | IV3 |
| Self-employment | | | |
| Financial Literacy | 0.413*** | 0.417*** | 0.427*** |
| | (0.074) | (0.065) | (0.066) |
| Monetary support from relatives, in previous year | -0.028 | -0.098 | -0.093 |
| | (0.244) | (0.248) | (0.247) |
| Regular support payments, in general | -0.425 | -0.315 | -0.304 |
| | (0.387) | (0.273) | (0.275) |
| Occasional support payments, in general | -0.208 | -0.220 | -0.231 |
| | (0.165) | (0.167) | (0.159) |
| Inheritance of financial assets | 0.013 | 0.093 | 0.074 |
| | (0.283) | (0.228) | (0.253) |
| Inheritance of real estate | -0.073 | -0.065 | -0.094 |
| | (0.311) | (0.320) | (0.321) |
| Likelihood of inheritance in next 2 years | 0.001 | 0.008 | 0.009 |
| | (0.039) | (0.043) | (0.042) |
| Parents' financial understanding | 0.043 | 0.046 | 0.048 |
| | (0.122) | (0.118) | (0.114) |
| Single-parent family/ No parents | -0.833* | -0.807 | -0.837 |
| | (0.461) | (0.535) | (0.567) |
| Full set of control variables (Table 1) | Yes | Yes | Yes |
| Observations | 570 | 542 | 536 |
| F-statistic first-stage regression | 6.34 | 14.43 | 10.27 |

*Notes.* Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

Another channel through which parental education may affect self-employment is wealth of parents. The education of parents likely is correlated to their wealth and individuals might

also benefit from parents' wealth for becoming self-employed. Thus, we now analyse whether our estimates change when controlling for monetary support by relatives. SAVE 2008 provides information on whether respondents received monetary support by parents or children in the previous year. Furthermore, it contains information about regular support payments and occasional support payments in general. Moreover, we can control for inheritance of financial assets and for inheritance of real estate in the past and we control for the likelihood of inheritance in the future. In addition, we include the personal assessment of respondents on the understanding of parents concerning financial matters. Finally, we make use of information on whether respondents come from single-parent families or whether they did not live together with their parents at age 10.

In Table 6 (Panel B), we report IV estimates of the effect of financial literacy on the probability of being self-employed controlling for various wealth and support proxies. We find that regular monetary support and occasional support payments do not matter for self-employment. Similarly, neither the inheritance of both financial assets and real estate, nor the expectances of an inheritance in the future have an effect on the probability of self-employment. Finally, results do not indicate an effect of parents' financial understanding assessed by the respondent on the probability of self-employment. Our estimates of financial literacy, however, are not affected by these additional variables. The estimates of financial literacy remain significant and the first-stage regression F-statistic remain virtually unchanged.

**Table 7**

Probability of being self-employed: The role of pocket money in early childhood

IV estimates of financial literacy on self-employment including variables to control for receiving pocket money and dealing with money. The literacy index has been instrumented using variables indicating the economics education (IV1), schooling attainment of the mother (IV2), and the father (IV3).

| | IV1 | IV2 | IV3 |
|---|---|---|---|
| Self-employment | | | |
| Financial Literacy | 0.389*** | 0.362*** | 0.388*** |
| | (0.064) | (0.122) | (0.115) |
| Received pocket money regularly | -0.021 | -0.012 | -0.013 |
| | (0.016) | (0.023) | (0.022) |
| Spent pocket money immediately | -0.005 | 0.001 | -0.001 |
| | (0.018) | (0.025) | (0.024) |
| Full set of control variables (Table 1) | Yes | Yes | Yes |
| Observations | 813 | 546 | 541 |
| F-statistic first-stage regression | 5.73 | 10.92 | 8.54 |

*Notes.* Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

Other omitted factors that could be correlated to self-employment, financial literacy, and our instruments are how individuals dealt with money when young or whether they learned to deal with money at all. To address this issue we use information on receiving and spending money in childhood. SAVE 2008 provides information on the regularity of

receiving pocket money and whether respondents immediately spent this money. Both variables are measured on an 11 point scale, where 0 indicates absolute inapplicable and 10 indicates absolute applicable. While pocket money itself does not affect self-employment, the inclusion of these variables barely changes our regression results.

We also test the robustness of our findings to a different measure of self-employment. We exclude types of self-employment that can also be performed in regular employment, that is, we drop farmers, self-employed regulated by a professional association (pharmacists, doctors, lawyers), and freelancers (see section 3) from the sample. We again attain estimation results pointing to a strongly significant and positive correlation between financial literacy and self-employment (Table 8).

**Table 8**

Probability of Self-Employment: Sample restriction

IV estimates of financial literacy on self-employment excluding farmers, self-employed regulated by a professional association, and freelancers. The literacy index has been instrumented using variables indicating the economics education (IV1), schooling attainment of the mother (IV2), and the father (IV3).

| | IV1 | IV2 | IV3 |
|---|---|---|---|
| Self - Employment | | | |
| Financial Literacy | 0.440*** | 0.480*** | 0.487*** |
| | (0.060) | (0.029) | (0.030) |
| Full set of control variables (Table 1) | Yes | Yes | Yes |
| Observations | 813 | 563 | 558 |
| F-statistic first-stage regression | 5.47 | 13.94 | 10.70 |

*Notes*. Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

**Table 9**

Probability of being self-employed: Using two instrumental variables

IV estimates of financial literacy on self-employment. The literacy index has been instrumented using variables indicating economics education and schooling attainment of the mother (IV A) and economics education and schooling attainment of the father (IV B).

| | IV A | IV B |
|---|---|---|
| Self-employment | | |
| Financial Literacy | 0.362*** | 0.370*** |
| | (0.086) | (0.090) |
| Full set of control variables (Table 1) | Yes | Yes |
| Observations | 545 | 539 |
| F-statistic first-stage regression | 7.24 | 6.93 |
| Hansen J statistic | 1.922 | 1.967 |
| | (0.383) | (0.374) |

*Notes*. Robust standard errors in parentheses; * p < .1, ** p < .05, *** p < .01.

Finally, we present regression results for specifications when we include two instrumental variables in one estimation (Economic education with Mother's schooling

attainment (IV A) and Economic education with Father's schooling attainment (IV B). As shown in table 9, these specifications still demonstrate a statistically significant effect of financial literacy on the probability of self-employment.

## 6. Conclusion and implications

Recent studies show that financial sophistication has an impact on household financial decision making. But even beyond financial decisions, it has impact on individuals' behaviour. It is obvious that entrepreneurial activities require a certain financial sophistication base. This empirical investigation shows a positive relationship between financial literacy and self-employment. Our results are based on German data including a various number of basic and advanced questions on financial matters. We use different instrumental variables based on economic education before entering the labour market and parents' schooling attainment to tackle the problem of endogeneity.

The analysis of SAVE data documents a relative low level of practical financial literacy beyond simple calculations on interest rates or rates of return. On top of that, employees achieve even lower scores than self-employed respondents. Less financially literate individuals rather work as employees than decide to take the step towards self-employment. The effect of financial literacy on the probability of self-employment is robust across different specifications. Financial sophistication may lead to more efficient acquisition of fundamental information and processing of information, to confident risk assessments, better opportunities for realizing business ideas, and finally to more entrepreneurial activities.

Our findings add to the discussion on nature vs. nurture in characteristics of entrepreneurs. Several researchers examined to what extend personality affects the decision to be self-employed and most of the characteristics found to have an impact are also found to be stable over time. Our analysis shows that financial literacy, which is acquirable, is positively associated with being self-employed. However, although we have addressed several concerns with regard to endogeneity issues, we cannot prove without doubt that our instruments meet the exclusion criterion. If one is willing to believe that our results are valid, findings suggest that enhancing financial literacy could be a trigger for entrepreneurial activity.

Due to restrictions in our data set we can not evaluate transitions into entrepreneur-ship and survival in entrepreneurship separately. Future research should provide further support for the link observed.

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# Appendix

**Basic Financial Literacy Questions**

1) "Interest Rate 2% p.a." 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 / Refuse to answer
2) "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 / Refuse to answer
3) "Risk diversification" Buying a single company's stock usually provides a safer return than a stock mutual fund. True or false? [1] True, [2] False, [3] Do not know / Refuse to answer

**Advanced Financial Literacy Questions**

4) "Fixed Interest Rate 20% p.a." Assume that you have €100 in a savings account and the interest rate you earn on this money is 20% a year. If you keep this money in the account for 5 years, how much would you have after 5 years? [1] Over €200; [2] Exactly €200; [3] Less than €200; [4] I can not / I don't want to asses
5) "Purchasing power if prices and income double" Money illusion: Suppose that until the year 2012, your income would have doubled and prices of all goods would have doubled too. In 2012, how much will you be able to buy with your income? [1] More than today; [2] Exactly the same; [3] Less than today; [4] Do not know / Refuse to answer
6) "Volatility depending on asset allocation" Normally, which asset displays the highest fluctuations over time? [1] Savings accounts; [2] Fixed-interest securities; [3] Stocks; [4] Do not know / Refuse to answer
7) "Main function of 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 / Refuse to answer
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 invest 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 / Refuse to answer
9) "Falling interests and price of a bond" What happens to fixed-interest bond prices if market interest rates fall? [1] Rise; [2] Fall; [3] Stay the same; [4] None of the above; [Do not know / Refuse to answer
10) "Usage of pension insurance fund contribution" What are the contributions to the pension insurance funds used for? [1] Solely for the future pensions of current contributors; [2] The major part of the amount for future pensions of current contributors, the minor part for the pensions of current pensioners; [3] The minor part of the amount for future pensions of current contributors, the major part for the pensions of current pensioners; [4] Solely for the pensions of current pensioners
11) "Value of contribution to statutory pension insurance" [1] contribution in %__; Do not know / Refuse to answer

**Mental Exercise Questions, indicator for cognitive abilities**

1) The price of a racket and a ball is 110 euro cents. The price of the racket is 100 eurocent 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?

Halle Institute for Economic Research –
Member of the Leibniz Association

Kleine Maerkerstrasse 8

D-06108 Halle (Saale), Germany

Postal Adress: P.O. Box 11 03 61

D-06017 Halle (Saale), Germany

Tel +49 345 7753 60

Fax +49 345 7753 820

www.iwh-halle.de

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