Financial Literacy and Self-Employment

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Abstract

In this paper, we study the relationship between financial literacy and self-employment. 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. As financial literacy is acquirable, findings suggest that entrepreneurial activities might be raised via enhancing financial literacy.

Keywords: Financial literacy; Financial sophistication; Self-employment; Entrepreneurship; Instrumental variable estimation

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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, with the exception of few studies, the interaction of financial literacy and occupational choice 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 preferences from employed people. However, most characteristics as personality traits or risk attitudes, which are found to be associated with self-employment, are classified as relatively stable over time and therefore are out of control for policymakers (Caliendo et al., 2013; Cobb-Clark and Schurer, 2012a; 2012b).

Financial literacy, which is acquirable, has not been focus of the analysis in the past, but there is reason to assume that it does play a role for self-employment. Besides non-financial and non-economic reasons, other important factors why businesses fail are poor financial management, lack of capital, or misjudgment of risks. Persons who are considering taking the step into self-employment likely are aware about the existence of 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 employees. Considering individuals who have a business idea, who have the willingness to take risks, and who meet other decisive conditions, we assume 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. The reason for this assumption is the idea that people with better understanding of financial issues have better opportunities for realizing business ideas, financing their venture, and leading the company to success.

Literature shows that financially literate persons are more likely to have a higher disposability of unspent income, rather formal credits than informal borrowing, and to behave more effective 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, there is reason to assume that they are also more aware of sources of information, advice, and capital for entering and surviving in self-employment. They might also be rather aware of different financing options or sponsorships and they might have a better understanding of terms and conditions of those options. And if literate persons are more aware of financial risks and opportunities, they might not only have a better understanding of the profitability of a business, they might 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.

However, causality might also run the other direction: Not being self-employed might 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.

We study the link between financial literacy and self-employment. We use German survey panel data.[1] The data allows (a) generating according to existing literature an index for the level of financial literacy based on established basic and advanced questions on financial topics, (b) controlling for important individual characteristics, and (c) taking into account biographic data on socialization. To address the direction of causality, we apply instrumental variable techniques. Moreover, we control for several additional potential determinants and channels of self-employment.

[1] According to the Human Development Index (HDI), Germany is the fourth most developed country and also the most industrialized and largest national economy in Europe. However, it's entrepreneurship rate is one of the lowest among OECD countries. In 2016 (first quarter), in Germany only 81% new enterprises entered compared to 2007 (first quarter)- besides Spain the lowest rate measured.
OECD (2017). Timely Indicators of Entrepreneurship (ISIC4): New enterprise creations. http://stats.oecd.org/index.aspx?queryid=74181.
United Nations Development Programme, 2015. Human Development Index and its components. http://hdr.undp.org/en/composite/HDI.

The results suggest a positive impact of financial literacy on self-employment. Given that we do not observe any entries and exits into and out of self-employment, we cannot analyze the impact on performance.

However, 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 self-employed that was 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 raised via 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 in increasing interest and attitudes toward entrepreneurship, and in improving financial performance as entrepreneur. Moreover, Elert et al. (2015) show that entrepreneurship education during high school increases the long-term probability of starting a firm as well as entrepreneurial incomes.

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 analyzes the effects of financial literacy on individ-

ual behavior 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). 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 the predictions.

Financial literacy has 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, higher disposability of unspent income and a higher ratio of formal credits over informal credits (Deuflhard et al., 2015; Disney and Gathergood, 2013; Klapper et al., 2013).

Christiansen et al. (2008), van Rooij et al. (2011a), and Jappelli and Padula (2015) show that individuals with higher level of financial literacy are more likely to hold stocks. Moreover, Guiso and Jappelli (2009) and Jappelli and Padula (2015) find a strong correlation between the level of financial literacy and portfolio decisions.

Another channel through which wealth is affected by financial sophistication is 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 (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 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).

Most of the studies link financial literacy and wealth accumulation. Yet, we know relatively little about the impact of financial literacy on self-employment although a lot of research is devoted to the question what makes an entrepreneur. Scholars have found that personality traits and characteristics differ, in part, strongly between employment groups (see, for example, Feldman

and Bolino, 2000; Carter et al., 2003; Caliendo et al., 2009; Fairlie and Robb (2009); Caliendo et al., 2013).

Several personality traits are found to have influence on the decision to make the move into self-employment. Zhao and Seibert (2006) show that entrepreneurs differ from employed managers in terms of neuroticism, openness to experience, conscientiousness, and agreeableness. Confirm the results, Caliendo et al. (2013) also find a positive effect of extroversion not only on the probability of being self-employed but also the entry probability. Entrepreneurs are more willing to take risks (see e.g. Cramer et al., 2002). 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.

Most of the personality traits and risk preferences that are found to affect the decision 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.

A young strand of research has begun to evaluate the impact of entrepreneurship education on entrepreneurship. For example, Drexler et al. (2014) compare the impact of two programs using data from a randomized control trial in the Dominican Republic. Wheres the standard accounting training has no effect on business outcomes, a simplified, rule-of-thumb training that teaches basic financial heuristics produced significant improvements in financial practices, objective reporting quality, and revenues of firms.

Bruhn and Zia (2013) evaluate effects of business and financial literacy programs on firm outcomes of young entrepreneurs in the context of emerging markets. Conducting a randomized control trial in Bosnia and Herzegovina they find that, the training programme 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 leads not only to improved business knowledge, practices and revenues, but also to higher repayment and client retention rates. Based on descriptive statistics of 24 observations, findings by Oseifuah (2010) suggest that financial

literacy levels among young entrepreneurs in South Africa are above average.

Canadian data show that 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 to involuntary venture closure.

3 Data

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 saving behaviour and asset accumulation of private households (Boersch-Supan et al., 2009). We draw our main data from the 2009 survey that includes a set of questions on financial knowledge. 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.[2] This leaves us with 1,039 observations.[3]

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.[4]

Due to limitation in 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. As in most empirical studies on entrepreneurship, we therefore use self-employment as measurable proxy for entrepreneurship (Carland et al., 1984; Rauch and Frese, 2000; Stewart and Roth, 2001; Zhao and Seibert, 2006; Caliendo et al., 2010; Unger et al. 2011).[5]

[2]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.

[3]In the 2009 survey, 2,222 households participated.

[4]Some studies on entrepreneurship exclude civil servants from the sample examined (e.g. Caliendo et al., 2013). As a robustness check we also provide main regression results on a subsample excluding civil servants.

[5]Regarding Schumpeterian entrepreneurship, several scholars emphasize to focus on measures that adequately capture innovative and growth oriented entrepreneurship (Shane, 2009; Henrekson and Sanandaji, 2014).

In the basic model, we aggregate all types of self-employment to a self-employment indicator (i.e. farmer / member at the respective chamber / other freelancer / trader or other form of self-employment). To check the robustness of our results, we later exclude farmers, self-employed as member at a respective chamber, other freelancers from the sample and we cluster only traders or other forms of self-employment for a very narrow definition for self-employed. In what follows, we use information about the type of employment for constructing the variables self-employment and self-employment (narrow) that are 1 if an individual is self-employed and 0 otherwise.

Table 1 provides summary statistics of the main variables of the total sample and by employment groups. The table presents the average share of female-male respondents, mean of the age, share of married respondents, singles, and else, average number of children in the household, and an indicator for a school-leaving qualification in the former GDR. 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, higher vocational education, university education, and a fourth group that captures response categories no vocational education and other vocational education. Additionally, we include a proxy for cognitive abilities. Following existing literature, we use an indicator that gives the number of correct answers on mental exercises.[6]

We further include economic factors. We control for home ownership and earlier periods of unemployment (both indicators are measured using binary variables) and we include the household average monthly net income from the previous year.

3.2 *Measuring financial literacy*

The 2009 SAVE contains a set of nine questions related to basic numeracy and more advanced concepts of financial knowledge. The first set of financial knowledge-based questions was developed by Lusardi and Mitchell (2011) and applied by most studies on financial literacy.[7] These questions measure the ability to perform simple calculations (compound interest), the effect of inflation (inflation), and risk levels of stocks vs. mutual bonds (diversification).[8] In 2009 SAVE, six

[6] The precise wording of these questions is given in the appendix.
[7] See for example, Alessie et al., 2011; Agnew et al., 2013; Bucher-Koenen and Lusardi, 2011.
[8] The precise wording of these questions is given in the appendix.

additional financial knowledge-based questions are included. These questions cover interest compounding, money illusion, volatility (fluctuations of different assets), stock market, balanced funds, and bond prices. These questions mainly allow measuring the degree to which individuals have an understanding for concepts and products of financial markets.

Previous researchers have measured financial literacy using the first financial knowledge-based questions only. As our data set enables to evaluate a set of nine questions, we exploit the complete potential to construct an index for financial knowledge. Similarly, Lusardi and Mitchell (2009), Behrman et al. (2012), and van Rooij et al. (2011a; 2012) exploit the range of 8 - 16 questions, respectively, available in the underlying data. Following existing literature,[9] our financial literacy indicator gives the total number of correct answers given on the nine financial knowledge-based questions.

Lusardi and Mitchell (2009) and van Rooij et al. (2011a) apply similar questions to evaluate financial literacy. In both studies the questions Compound interest I, Compound interest II, Inflation, and Money Illusion are defined as basic financial literacy questions. The questions Volatility, Risk diversification, Stock market, Balanced fund, and Bond prices are classified as advanced questions. Following the literature, we evaluate financial literacy in the same way.

The answers to all questions by employment groups are provided in Figure 1. A relative high fraction of individuals is able to give correct answers to the basic financial knowledge questions (questions 1-4). Self-employed individuals are more likely to answer each of the basic questions correctly compared to regularly employed individuals. However, the proportion of correct answers decreases considerably from the first question (89% among regularly employed and 92% among self-employed) to the fourth one (60% and 68% respectively). Concerning advanced financial literacy topics (questions 5-9) we find a similar pattern of response behavior: self-employed individuals give correct answers more frequently than employees do and the share of correct answers differs strongly across questions.

In sum, the average number of correct answers on all financial knowledge-based questions is significantly higher among self-employed individuals (6.5) compared with employed individuals

[9] See for example, Alessie et al., 2011; Bucher-Koenen and Lusardi, 2011; Klapper et al., 2013.

(5.7). Self-employed individuals tend to be more financially literate than employed individuals are.

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

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. Estimates might be subject to omitted variable bias, too.

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. Mandell (2008) shows that students with parents who had college degrees are more financially literate compared to those students whose parents had no college degree. Similarly, Lusardi et al. (2010) find that the educational level of the mother is highly correlated with the financial literacy of the children.

Family background itself is 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) make also use of the schooling attainment of the mother to isolate the causal effect of financial literacy on wealth accumulation. The education of parents is not under the control of respondents, but the education of parents is likely to influence respondents financial literacy.

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, higher education entrance qualification after 12 grades)[10] we generate a variable for the schooling attainment of the respondents mother according to the grades.[11] When accounting for family background, we end up with a regression sample consisting of about 580 observations.

4.1 *Financial literacy and self-employment*

In all subsequent regressions, we apply IV techniques and run IV- probit models using maximum likelihood estimation.[12] The dependent variable is always a self-employment dummy variable. The schooling attainment of the mother serves as instrumental variable for the literacy index. We are aware of endogeneity concerns due to unobserved variables. To address the issue that the effect is likely coming though other channels, we include further controls.

Following Jappelli and Padula (2013), we control for respondents' educational attainment. In order to rule out the possibility that the instrumental variable affects the outcome variable through (unobserved) education factors we include educational levels. Further, we include a variable measuring the number of correct answers on mental exercises as proxy for cognitive abilities.[13]

According to the literature, the willingness to take risks is an important determinant for self-employment. Therefore, we use self-assessed risk attitudes with respect to the career to control for a potential channel. The data only allows to control for self-assessed risk attitudes, however, Dohmen et al. (2011) show that, the (self-assessed) willingness to take risks is a significant explanatory variable for risky behavior; and, furthermore, they verify behavioral validity of a survey measure in a complementary, incentive-compatible field experiment conducted.[14] The willingness to

[10] We treat the response categories foreign graduation and dont know as missing values.

[11] For mothers 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.

[12] We find that the effect of financial literacy is of similar size in the IV estimation as in the probit specification.

[13] Unobserved factors with regard to cognitive skills might affect the variables of interest. (van Rooij et al., 2011a; Lusardi and Mitchell, 2014)

[14] Dohmen et al. (2011) show that not only the willingness to take risks in general but also e.g. in financial matters, career, or health highly significantly correlate with risky behavior as investment in stocks, self-employment,

take risks with respect to the career is measured 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 (Caliendo et al., 2009).

Further, health problems could be correlated with parental education through the transmission of socio-economic status through generations, and health problems have been shown to negatively affect entrepreneurship. We include a variable for self-assessed state of health. The data set does not provide an objective measure for health status, however, a large number of studies found that self-ratings represent a source of very valuable data on actual health status.[15] 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 employed individuals in several characteristics. We use self-assessed personality traits queried in 2007: respondents assess on a scale running from 0 to 10 whether they are creatures of habit, open to changes, optimistic, and self-assured. Further, we use information whether they rather are living for the moment or are making exact plans for the future, whether activities with immediate results are more important than those with results that are realized in the future, and whether they react rather impulsive and fast or weighing and observantly. Furthermore, respondents are asked how often they engage in voluntary activities. Evaluating the four options daily, weekly, monthly, less frequently, we use this information as proxy for altruism and agreeableness. Several additional extensions are discussed in section 5.

Table 2 presents the evaluation of these traits for self-employed and regularly employed respondents. Self-employed respondents assess themselves to be significantly more willing to take risks with respect to their career compared to regularly employed respondents. They are significantly less likely to assess themselves to be creatures of habit, but more open to changes, more optimistic,

or smoking. All measures are significant explanatory variables for at least some of the behaviors, providing further confirmation of their behavioral validity. The general risk question is significant in all contexts, with relatively large coefficients and goodness of fit. Each context-specific risk question explains behavior in its respective context, and is typically the strongest risk measure for this context. (See Dohmen et al. (2011) p.540.) In a experimental study, subjects first went through a detailed questionnaire (as part of the questionnaire the general risk question was asked); after completion of the questionnaire, participants took part in a paid lottery experiment. The authors find that the answers to the general risk attitude question predict actual behavior in the lottery.

[15] See for example Idler and Benyamini (1997) for a review of 27 community studies.

and more self-assured than employed individuals are. At the same time, self-employed persons rather deal with the future and do know what they want to be and to do in the future and they are less likely to assess themselves as reacting impulsively and quickly rather than weighing and observantly.

In our main regressions, we perform several model specifications. The first column presents the results of a model including basic control variables only; the second model includes further socio-demographic and socio-economic control variables; the third further includes the self-assessed personality traits. In the fourth specification, we re-define the type of self-employment. We test the robustness of our results by excluding types of self-employment that also might be performed in regular employment, i.e. we drop self-employed farmers, self-employed as member at the respective chamber, and other freelancers from the sample and cluster only traders or other forms of self-employment as the group of self-employed. As additional robustness check, in model 5, we further exclude civil servants from the sample.

Table 3 presents the results from the first-stage regressions. The table displays results of regressions estimating effects of the schooling attainment of the mother on the financial literacy index. In all specifications, the instrumental variable is positively associated with financial literacy and statistically significant. The schooling attainment of the mother has strong predictive power for the financial literacy index. Including additional control variables (as education, cognitive abilities, attitudes, and characteristics) or changing the sample does not change our results; the positive effect of maternal schooling attainment remains statistically significant. The results are in line with existing literature on impacts of parental education on children's financial literacy later in life (e.g. Mandell, 2008; Lusardi et al., 2010; Behrman et al., 2012).

Furthermore, regression results show that individuals with higher-level vocational qualification (postsecondary, non-tertiary) compared to individuals with intermediate vocational qualification are more financially literate. This is in line with previous research (e.g. Jappelli, 2010; van Rooij et al., 2011a, 2011b).[16]

[16] Jappelli's (2010) findings suggest that both PISA test scores and college attendance (measured at the national level) are positively correlated with financial literacy. Similarly, other studies show that higher educated individuals are more likely to answer financial literacy questions correctly (e.g. Lusardi and Mitchell, 2007; Christelis et al.,

Table 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 self-employment. With higher literacy scores the likelihood of self-employment rises. The effect is robust across all specifications and samples.

The average marginal effects on the probability of being self-employed for all specifications are depicted in squared brackets in Table 4. On average, the probability of self-employment rises by about 1.4 percentage points with an additional correct answer. Given nine financial knowledge-based questions, the probability of self-employment increases by about 13 percentage points when knowing all questions compared to knowing none of these questions.

5 Discussion and Extension

In this section, we investigate the robustness of our results. Although we have addressed several concerns with regard to endogeneity issues, we cannot prove without doubt that our instrument meets the exclusion criterion. We now make use of different waves of the SAVE survey and examine several extensions.

The instrumental variable relies on the interaction between 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 have influence on their children's literacy through other channels, for instance through their personality traits or employment characteristics. Further, the type of employment of the mother might be correlated with her own educational level. 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 mother's education drives children's entrepreneurship decision through her own entrepreneurship.[17] However, studies show, that there is no effect of parental education on entrepreneurship of children when controlling for entrepreneurship of parents (Djankov et al., 2006; Lindquist et al., 2015).

2010; van Rooij et al., 2011a, 2011b).

[17] Note that there is a lot of evidence suggesting that women are much less likely to be self-employed than men.

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. Thereby, we focus only on East German observations. In the German Democratic Republic (GDR), nearly all firms were owned by the state.[18] Self-employment was regarded as unwanted remnant of the capitalist society (see Fritsch et al. 2010, p. 2). We limit the sample to persons from East Germany and therefore likely observe persons with mothers who were not self-employed. These would not affect self-employment decisions of their children by their own self-employment. Due to the sample size, we include both persons that have graduated (general school leaving certificate) in the former GDR and those persons who lived in the federal states of the former GDR in 2009.[19]

Further, we use only the group of traders or other forms of self-employment. This very narrow definition of self-employment holds an additional advantage: we exclude (self-) employment groups such as farmers, lawyers, and doctors where it is more likely that parental (self-) employment might affect that of their children (Djankov et al., 2006). We are aware that thereby a direct channel from education of parents on self-employment decisions of children is not perfectly excluded, but we come close to exclude an intergenerational transfer of self-employment.

Table 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 self-employment index remain positive and highly statistically significant. So, the effect found remains when considering a sample in which the likelihood of an intergenerational entrepreneurship transfer should be low.

Secondly, we investigate whether our results are affected once we control for a set of characteristics of parents. Parental education is likely to be correlated with their own characteristics

[18] In 1972, the private industry has been 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 ten employees) were limited by the state.

[19] 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 (using mother's or father's schooling attainment) and restricting the sample only to individuals with a school leaving qualification from the former GDR.

and, thereby, with the characteristics of their children.

In the 2008 survey, respondents were asked whether their mothers and fathers were adventurous persons and whether the parents used to plan for the future. For both questions, the response scales run from 0 (absolutely inapplicable) to 10 (absolutely applicable). We include this information as control variables for characteristics of parents. The variables serve as proxies for carefulness 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. Moreover, in 2008, respondents were asked whether their parents keep or did keep private accounting records. We include a binary variable that serves as proxy for financial habits of the parents. Finally, we include a binary variable that indicates whether respondents come from single parent families or whether they did not live together with parents at age 10 (reference: lived together with both parents at age 10).

The results are presented in Table 5 (Column 2). We find that the characteristics of parents do not affect self-employment of children directly and beyond the effects of financial literacy and respondents' own characteristics. IV estimates are barely affected by the addition of the control variables. Thus, financial literacy has an effect on self-employment above and beyond the effects of transmission of particular characteristics. The first-stage F-statistics and the estimates for financial literacy remain statistically significant, while estimates of other coefficients do not change qualitatively.

Another channel through which maternal education might affect self-employment is the wealth of parents. The education of parents likely is correlated to their wealth and individuals might benefit from parents' wealth for becoming self-employed (Hurst and Lusardi, 2004; Fairlie and Krashinsky, 2012). Furthermore, Monticone (2010) shows that wealth has a positive, though small effect on the degree of financial knowledge. Thus, we next analyze whether our estimates change when controlling for monetary support by relatives. The SAVE data set (2007-2009) provides information on whether respondents received monetary support by parents or children in the previous year. It also contains information about regular support payments and occasional support payments in general. Further, we control for inheritance receipts of financial assets and for inher-

itance receipts of real estate in the past and we can control for the self-assessed likelihood of an inheritance receipt in the future. In addition, we include the personal assessment of respondents on the understanding of their parents concerning financial matters.

In Table (Column 3), 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 are not related to self-employment. Similarly, neither the inheritance of both financial assets and real estate, nor the expectation of an inheritance in the future have an effect on the probability of self-employment. Results in the first stage suggest a positive relation between the inheritance of financial assets and financial literacy. Our IV-probit estimates of financial literacy, however, are barely affected by the additional variables.

Other omitted factors that could be correlated to self-employment, financial literacy, and our instrument, are how individuals dealt with money when young or whether they learned to deal with money at all. Jorgensen and Salva (2010) and Grohmann et al. (2014) have shown that the financial socialization by parents plays a major role for financial literacy. SAVE 2008 provides information on the regularity of receiving pocket money in childhood and on statements whether respondents used to spend this money immediately. Both variables are measured on an eleven- point scale, where 0 indicates absolute inapplicable and 10 indicates absolute applicable. We include both variables in model 4. In accordance with the literature, receiving pocket money regularly in childhood seems to play a role for future financial literacy (see first stage regression, Table 5, Column 4). While both variables do not affect self-employment, the inclusion of these barely changes our regression results.

Finally, we re-estimate our model including all additional control variables. Column 5 in Table 5 presents regression results from IV-probit including basic control variables, all socio-demographic and socio-economic variables, self-assessed personality traits and attitudes, all proxies for parental characteristics, proxies for family background, wealth, and financial support, and for financial socialization. Including all variables hardly changes the results found in the basic model (table 3 and 4): the statistically significant and positive effect of financial literacy on self-employment remains unchanged and the marginal effect is equal to the values in most previous specifications.

Financial literacy seems to have an effect on self-employment above and beyond potential effects of socialization and transmission.

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 an impact on individuals' behavior. It seems 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 an instrumental variable based on the schooling attainment of the mother to tackle the problem of endogeneity.

The analysis of the SAVE data documents a relative low level of practical financial literacy beyond simple calculations on interest rates or rates of return. Employees achieve lower scores than self-employed respondents. It implies that 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 might 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 self-employment.

Our findings add to the nature vs. nurture- discussion. 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 found to be relatively stable over time. Studies on the impact of entrepreneurship programs show a differentiated picture. 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 instrument meets 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 self-employment.

Furthermore, several scholars analyze 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 Venkatamaran, 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 not unlikely that financial literacy is relevant in 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. Future research should provide further support for the link observed.

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Appendix

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?
   o More than 102 o Exactly 102 o Less than 102 o Do not know/ Refusal

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?
   o More than today o Exactly the same o Less than today o Do not know/ Refusal

3. *Compound interest II*: 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?
   o More than 200 o Exactly 200 o Less than 200 o Do not know/ Refusal

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

Advanced Financial Literacy Questions

5. *Volatility*: Normally, which of the following assets displays the highest fluctuations over time?
   o Savings accounts o Fixed-interest securities o Stocks o Do not know/ Refusal

6. *Risk diversification*: Buying a company stock usually provides a safer return than a stock mutual fund. True or false?
   o True o False o Do not know/ Refusal

7. *Stock market*: Which of the following statements describes the main function of the stock market?

   - o The stock market helps to predict stock earnings
   - o The stock market results in an increase in the price of stocks
   - o The stock market brings people who want to buy stocks together with those who want to sell stocks
   - o None of the above o Do not know/ Refusal

8. *Balanced funds*: Which of the following statements is correct?

   o Once one invests in a mutual fund, one cannot withdraw the money in the first year

   o Mutual funds can invest in several assets, for example invest in both stocks and bond

   o Mutual funds pay a guaranteed rate of return which depends on their past performance

   o None of the above o Do not know/ Refusal

9. *Bond prices*: If the if market interest rates fall, what should happen to bond prices?
   o Rise o Fall o Stay the same o None of the above o Do not know/ Refusal

Mental Exercise Questions

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

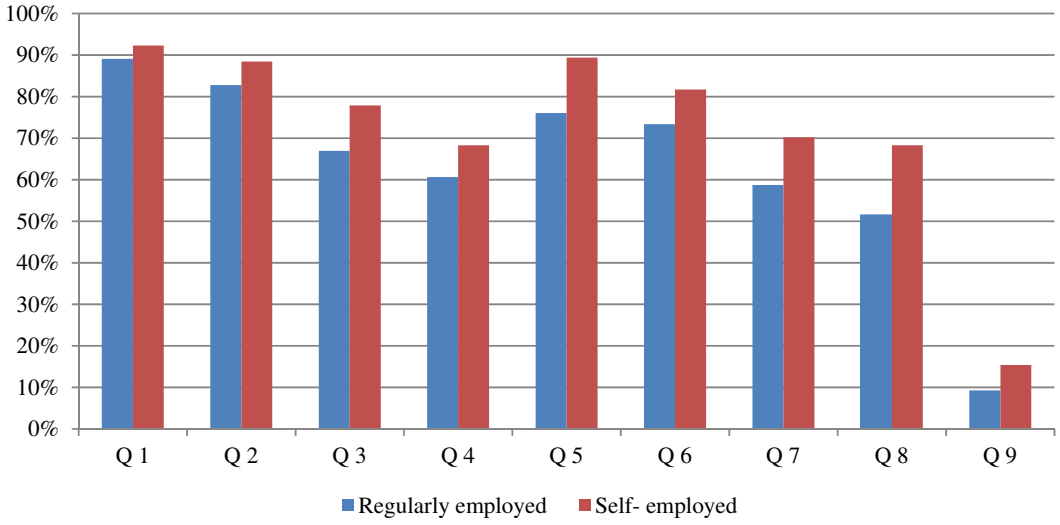
Tables and Figures

Table 1: Characteristics of individuals

	Total sample		Self-Employed (Wide)		Employees	
	N	Share/Mean	N	Share/Mean	N	Share/Mean
Female	536	0.52	44	0.42	492	0.53
Age	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	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	1039	1.64	104	1.39	935	1.66
Homeowner	1039	0.56	104	0.59	935	0.56
Unemployed	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
Total net income	1038	2689	104	3335	934	2617

Note: Shares and means do not sum up to 100% because of rounding. Source: SAVE panel.

Figure 1: Correct answers on financial literacy questions.



Note: See Appendix for the exact wording of the questions. Source: authors' own graph; data source: SAVE panel.

Table 2: Personality traits

Traits	Total	Regularly employed	Self-employed	t-test(Ha_diff !=0)
Mental exercises	1.60	1.61	1.51	0.2002
Risk attitudes	1.56	1.54	1.77	0.0001
Health status	2.60	2.59	2.65	0.3138
Creature of habit	5.99	6.26	5.30	0.0001
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

Table 3: First stage regressions of financial literacy

Probability of self-employment	(1)	(2)	(3)	(4)	(5)
Mother's schooling attainment	0.282***	0.274***	0.273***	0.236***	0.291***
	(0.067)	(0.061)	(0.066)	(0.073)	(0.076)
Age	0.138	0.046	-0.025	0.003	0.017
	(0.085)	(0.086)	(0.093)	(0.101)	(0.113)
Age^2	-0.002	-0.001	0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	0.633***	0.303	0.301	0.260	0.200
	(0.184)	(0.189)	(0.202)	(0.212)	(0.230)
Education GDR	-0.241	0.434*	0.293	0.262	0.359
	(0.199)	(0.253)	(0.264)	(0.306)	(0.329)
Education: Other		-0.151	0.138	0.180	0.217
		(0.323)	(0.349)	(0.361)	(0.373)
Education: Higher level		0.895***	0.921***	0.795**	0.779**
		(0.276)	(0.289)	(0.320)	(0.326)
Education: University		0.300	0.209	0.162	0.091
		(0.251)	(0.252)	(0.259)	(0.289)
Unemployed		-0.192	-0.116	-0.082	-0.135
		(0.180)	(0.190)	(0.204)	(0.221)
Mental exercises score: 1		0.331	0.259	0.385	0.309
		(0.482)	(0.479)	(0.518)	(0.553)
Mental exercises score: 2		-0.123	-0.169	-0.256	-0.331
		(0.483)	(0.480)	(0.515)	(0.548)
Mental exercises score: 3		-1.014*	-1.249**	-1.316**	-1.323*
		(0.567)	(0.580)	(0.637)	(0.682)
Martial status: married		-0.303	-0.253	-0.433	-0.474
		(0.291)	(0.300)	(0.316)	(0.349)
Marital status: other		0.332	0.651*	0.481	0.548
		(0.350)	(0.354)	(0.376)	(0.415)
Number of children		0.021	-0.019	-0.048	-0.058
		(0.078)	(0.085)	(0.092)	(0.099)
Homeowner		0.240	0.228	0.173	0.203
		(0.198)	(0.215)	(0.237)	(0.244)
Ln (Income)		-0.947**	7.494	8.703*	8.388
		(0.375)	(4.658)	(5.124)	(5.311)
Ln^2 (Income)		0.132***	-0.401	-0.476	-0.455

		(0.038)	(0.298)	(0.327)	(0.340)
Risk attitude: medium		0.250	0.203	0.245	0.142
		(0.181)	(0.193)	(0.207)	(0.220)
Risk attitude: high		-0.626	-0.723	-0.459	-0.439
		(0.579)	(0.622)	(0.748)	(0.743)
Health status: medium		0.199	0.290	0.324	0.492
		(0.373)	(0.405)	(0.433)	(0.457)
Health status: high		0.059	0.066	0.202	0.317
		(0.370)	(0.405)	(0.436)	(0.457)
Creature of habit			0.021	0.001	-0.017
			(0.043)	(0.046)	(0.048)
Open for changes			0.025	0.039	0.057
			(0.055)	(0.062)	(0.067)
Optimistic			-0.014	-0.016	-0.023
			(0.052)	(0.061)	(0.064)
Self-assured			0.015	0.007	0.024
			(0.057)	(0.065)	(0.068)
Living for the day vs.			-0.024	-0.011	-0.015
exact future plan			(0.051)	(0.056)	(0.060)
Reacting impulsive and fast vs.			-0.021	-0.021	-0.006
weighing and observantly			(0.041)	(0.044)	(0.046)
Voluntary: low			0.126	0.096	0.163
			(0.240)	(0.243)	(0.245)
Voluntary: medium			0.170	0.164	0.202
			(0.227)	(0.234)	(0.250)
Voluntary: high			-0.069	0.000	0.000
			(0.333)	(.)	(.)
Controls for federal states		Yes	Yes	Yes	Yes
Observations	591	583	530	461	410
F-statistic first-stage regression	17.38	18.64	15.80	9.61	13.16

Note: The dependent variable is a financial literacy index counting the number of correct answers on financial knowledge-based questions. Robust standard errors in brackets; ***, **, * indicate significance at the 1%, 5%, and 10% level, respectively. In model (4), the very narrow definition of self-employed is applied; in model (5) additionally, civil servants are excluded from the initial sample.

Table 4: IV (2SLS) estimations

Self-Employment	(1)	(2)	(3)	(4)	(5)
Financial Literacy	0.352***	0.416***	0.402***	0.534***	0.553***
	(0.109)	(0.097)	(0.127)	(0.042)	(0.049)
Financial Literacy: Marginal Effects	[0.016]	[0.014]	[0.014]	[0.016]	[0.020]
Age	0.068	0.077	0.085	-0.009	-0.056
	(0.072)	(0.075)	(0.081)	(0.075)	(0.085)
Age ^{2}	-0.001	-0.000	-0.001	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Male	-0.163	-0.246*	-0.108	-0.098	-0.061
	(0.158)	(0.147)	(0.170)	(0.158)	(0.184)
Education GDR	0.264*	-0.010	0.083	-0.200	-0.186
	(0.151)	(0.203)	(0.248)	(0.188)	(0.213)
Education: Other		0.613**	0.519	0.166	0.133
		(0.267)	(0.325)	(0.270)	(0.283)
Education: Higher level		0.136	0.200	-0.131	-0.184
		(0.316)	(0.363)	(0.222)	(0.233)
Education: University		-0.009	-0.039	-0.424*	-0.403
		(0.206)	(0.217)	(0.230)	(0.247)
Unemployed		0.415**	0.462**	0.201	0.183
		(0.166)	(0.198)	(0.164)	(0.182)
Mental exercises score: 1		-0.539*	-0.539	-0.237	-0.461
		(0.311)	(0.335)	(0.330)	(0.325)
Mental exercises score: 2		-0.306	-0.335	0.056	-0.258
		(0.323)	(0.373)	(0.333)	(0.353)
Mental exercises score: 3		0.151	-0.011	0.500	0.287
		(0.399)	(0.513)	(0.453)	(0.501)
Martial status: married		-0.135	-0.254	0.273	0.372
		(0.269)	(0.294)	(0.262)	(0.299)
Marital status: other		-0.288	-0.484	-0.005	0.067
		(0.274)	(0.317)	(0.326)	(0.381)
Number of children		-0.135**	-0.153*	-0.079	-0.107
		(0.065)	(0.083)	(0.079)	(0.090)
Homeowner		-0.149	-0.075	-0.055	-0.012
		(0.152)	(0.175)	(0.165)	(0.180)
Ln (Income)		-0.356	-6.028**	-7.040**	-7.814***

		(0.393)	(2.541)	(2.783)	(2.943)
Ln ^{2} (Income)		0.026	0.387**	0.428**	0.481**
		(0.044)	(0.161)	(0.180)	(0.190)
Risk attitude: medium		0.277	0.304	0.122	0.272
		(0.185)	(0.205)	(0.173)	(0.186)
Risk attitude: high		0.646	0.586	0.435	0.501
		(0.418)	(0.452)	(0.417)	(0.437)
Health status: medium		-0.561*	-0.753**	-0.273	-0.299
		(0.309)	(0.363)	(0.321)	(0.354)
Health status: high		-0.208	-0.401	-0.173	-0.168
		(0.274)	(0.317)	(0.305)	(0.325)
Creature of habit			-0.047	-0.078*	-0.083*
			(0.033)	(0.044)	(0.046)
Open for changes			0.095	0.010	0.002
			(0.067)	(0.052)	(0.057)
Optimistic			-0.002	0.022	0.013
			(0.059)	(0.054)	(0.059)
Self-assured			0.013	0.068	0.072
			(0.048)	(0.052)	(0.055)
living for the day vs.			0.069	0.024	0.022
exact future plan			(0.050)	(0.040)	(0.044)
react impulsive and fast vs.			-0.034	-0.011	-0.042
weighing and observantly			(0.035)	(0.032)	(0.038)
Voluntary: low			-0.215	-0.033	0.031
			(0.228)	(0.187)	(0.205)
Voluntary: medium			0.033	0.024	0.097
			(0.193)	(0.171)	(0.193)
Voluntary: high			-0.448	0.000	0.000
			(0.381)	(.)	(.)
Controls for federal states		Yes	Yes	Yes	Yes
Observations	591	583	530	461	410

Note: The dependent variable is a financial literacy index counting the number of correct answers on financial knowledge-based questions. Robust standard errors in brackets; **, **, * indicate significance at the 1%, 5%, and 10% level, respectively. In model (4), the very narrow definition of self-employed is applied; in model (5) additionally, civil servants are excluded from the initial sample.

Table 5: Extensions

Self-employment	GDR	Parental Characteristic	Monetary Support	Pocket Money	All
Financial Literacy	0.377***	0.424***	0.439***	0.392***	0.444***
	(0.130)	(0.094)	(0.093)	(0.133)	(0.091)
Financial Literacy: Marginal Effects	[0.010]	[0.011]	[0.011]	[0.012]	[0.011]
Basic control variables	Yes	Yes	Yes	Yes	Yes
Advanced control variables	Yes	Yes	Yes	Yes	Yes
Controls for federal states	Yes	Yes	Yes	Yes	Yes
Personality traits and attitudes		Yes	Yes	Yes	Yes
Mother adventurous		-0.000			0.013
		(0.036)			(0.038)
Mother- plan for future		0.007			0.011
		(0.030)			(0.030)
Father adventuresomely		0.021			0.022
		(0.030)			(0.032)
Father- plan for future		-0.053			-0.060
		(0.034)			(0.037)
Parents- accounting		0.173			0.158
		(0.183)			(0.178)
Single-parent/ No parents		-0.547	-0.424		-0.431
		(0.425)	(0.416)		(0.459)
Monetary support previous year			-0.199		-0.204
			(0.293)		(0.303)
Regular support payments, in general			-0.042		-0.123
			(0.261)		(0.274)
Occasional support payments			0.073		0.057
			(0.170)		(0.165)
Inheritance of financial assets			0.230		0.235
			(0.276)		(0.280)
Inheritance of real estate			0.119		0.144
			(0.404)		(0.426)
Likelihood of inheritance			0.017		0.025
			(0.039)		(0.038)
Parents' financial understanding			-0.026		0.013

			(0.111)		(0.118)
Regular pocket money				-0.000	-0.006
				(0.028)	(0.024)
Spending money immediately				0.014	0.023
				(0.027)	(0.026)
Observations	160	517	506	517	497
F-statistic first-stage regression	14.76	16.54	13.46	14.06	12.47

Note: The dependent variable is a self-employment dummy variable. The literacy index has been instrumented using variables indicating schooling attainment of the mother. Robust standard errors in brackets; ***, **, * indicate significance at the 1%, 5%, and 10% level, respectively.