



## Investment in financial literacy and saving decisions



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### ABSTRACT

We present an intertemporal consumption model of investment in financial literacy. Consumers benefit from such investment because financial literacy allows them to increase the returns on wealth. Since literacy depreciates over time and has a cost in terms of current consumption, the model delivers an optimal investment in literacy. Furthermore, literacy and wealth are determined jointly, and are positively correlated over the life-cycle. The model drives our empirical approach to the analysis of the effect of financial literacy on wealth and saving and indicates that the stock of financial literacy early in life is a valid instrument in the regression of wealth on financial literacy. Using microeconomic and aggregate data, we find strong support for the model's predictions.

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### 1. Introduction

The standard model of intertemporal choice posits that people maximize expected utility and choose consumption and saving at each point in time on the basis of expected lifetime resources and preference parameters. The model assumes that individuals are rational and fully informed, are able to project future income and interest rates and to discount them appropriately. In reality, many studies provide convincing evidence that a large proportion of the adult population knows little about finance and that many individuals are unfamiliar with basic economic concepts, such as risk diversification, inflation, and interest compounding. There is also considerable evidence that financial literacy affects saving and portfolio decisions. [van Rooij et al. \(2011b\)](#) find that financial sophistication is associated with greater wealth, a higher probability to invest in the stock market and a higher propensity to plan for retirement. In related papers, [Christelis et al. \(2010\)](#) and [McArdle et al. \(2009\)](#) find that the accuracy of responses to simple mathematical questions is a strong predictor of total wealth, financial wealth, stockholding and the fraction of wealth held in stocks. [Ameriks et al. \(2003\)](#) and [Lusardi and Mitchell \(2007\)](#) also provide evidence of a link between financial literacy and saving decisions. Some of these studies recognize the endogeneity of financial literacy, but do not provide a model to

discuss the possible sources of endogeneity. For instance [van Rooij et al. \(2011a\)](#) and the recent study on Chile by [Behrman et al. \(2010\)](#) tackle the endogeneity issue empirically, using an IV approach, but do not provide an explicit framework to integrate financial literacy in an intertemporal consumption model.

In this paper we emphasize that, like other forms of human capital, financial information can be accumulated, and that the decision to invest in financial literacy has costs and benefits. To discuss these costs and benefits, building on the insight of [Arrow \(1987\)](#), we propose an intertemporal consumption model which assumes that investing in financial literacy increases the net returns to saving, but requires money, time and effort. We posit that people are endowed with an initial stock of financial literacy, which they acquire before entering the labor market. The model implies that the very same factors drive both the decision to invest in financial literacy and saving decisions.<sup>1</sup>

Our model implies that, in a cross-section of households, financial literacy and wealth are positively correlated (as estimated in some of the empirical studies mentioned), and that literacy and wealth are correlated over the consumer's life-cycle. The relation

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<sup>1</sup> Three other papers relate portfolio returns to financial literacy. [Calvet et al. \(2009\)](#) show that the portfolios of more financially sophisticated households yield higher returns. [Delavande et al. \(2008\)](#) assume that the maximum expected return on assets depends on financial literacy, financial advice and risk, and estimate a human capital production function for financial knowledge using data from the US Cognitive Economic Survey. More recently, [Lusardi et al. \(2013\)](#) make a similar assumption and calibrate a life-cycle model multi-period model to study how financial knowledge affects wealth inequality.

between financial literacy and saving is not causal, however, because both variables depend on preference parameters, households' resources, and the costs of literacy. For instance, other things being equal, more patient consumers save more and end up with a larger stock of financial literacy. Higher returns to literacy and a larger initial endowment of literacy or of resources are also associated with higher levels of saving as well as a greater current stock of literacy. The model also implies that the correlation between financial literacy and wealth depends also on the generosity of the social security system. A system in which saving decisions are intermediated by the government provides little incentive to save and to accumulate financial literacy, while a less generous system in which people rely on private wealth raises the incentive to invest in financial literacy. In comparing literacy across countries it is important therefore to consider that different social security arrangements may lead to different levels of literacy and saving.

We investigate the empirical implication of our theoretical model using microeconomic and aggregate cross-country data. In both data we estimate two equations: the relation between current financial literacy and initial financial literacy (before entering the labor market), and the relation between wealth (or saving in the aggregate data) and financial literacy. Our empirical approach recognizes the endogeneity of financial literacy in the wealth and saving regressions, and that the OLS estimates of the wealth regression are biased. To address the endogeneity issue, we exploit a restriction that naturally arises from the model, i.e. that initial literacy affects wealth and saving only insofar as it affects current literacy. Using this restriction, we obtain the IV estimates of the wealth and saving regressions using initial literacy as an instrument for current literacy.

The microeconomic data are drawn from the Survey of Health, Ageing, Retirement in Europe (SHARE) for individuals aged 50+ and SHARELIFE, a retrospective survey of the same individuals. We define an indicator of current financial literacy based on a series of specific questions available in SHARE. We measure initial literacy in SHARELIFE as mathematical skills at school age. We find that our indicator of current financial literacy is strongly correlated with the indicator of initial literacy, which explains about 30% of the variability of current literacy. Comparison of OLS and IV estimates shows that current literacy is strongly associated with current wealth, and that OLS estimates are downward biased.

We apply a similar approach to the aggregate data. We merge international data on saving and other macroeconomic variables with the IMD World Competitiveness Yearbook summary indicators of financial literacy. This indicator is computed based on a survey of senior business leaders, that asks about their level of financial literacy. We measure initial literacy with the PISA score test in math (at the age of 15) in each country. We find that PISA test scores are strongly positively correlated with economy-wide indicators of financial literacy, and that countries with more generous pension systems feature lower literacy, confirming one of the model's predictions. In addition, we relate national saving to financial literacy. As with the microdata, to address the endogeneity of financial literacy, we provide IV estimates of the saving regression using the PISA test scores as instrument for financial literacy. Also in this case we compare IV and OLS estimates, and find that OLS estimates tend to underestimate the coefficient of literacy in the saving regression.

Overall, the microeconomic and aggregate data highlight the effect of two important determinants of financial literacy: (i) mathematical skills early in life has a positive effect on financial literacy and wealth accumulation later on; (ii) raising the incentive to invest in financial literacy – for instance reducing the generosity of the social security system – leads also to higher financial literacy and saving.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature, with a particular focus on studies that consider the endogeneity of literacy with respect to saving decisions. Section 3 develops a multi-period model of financial literacy

and wealth accumulation. Sections 4 and 5 present the econometric estimates obtained, respectively, using the microeconomic and aggregate data. Section 6 concludes.

## 2. Financial literacy and asset accumulation

Several empirical studies find that poor financial literacy is associated with poor risk diversification, inefficient portfolio allocations and low wealth accumulation. Banks and Oldfield (2007) look at numerical ability and other dimensions of cognitive function in a sample of older adults in England (the English Longitudinal Study of Ageing) and find that numeracy levels are strongly correlated with measures of retirement savings and investment portfolios, understanding of pension arrangements, and perceived financial security. In subsequent work, Banks et al. (2010) look at the extent to which differences in numeracy and broader cognitive ability predict trajectories for key economic outcomes such as wealth, retirement income and retirement expectations.<sup>2</sup> Christelis et al. (2010) study the relation between cognitive abilities and stockholding using SHARE data, and find that the propensity to invest directly and indirectly in stocks (through mutual funds and retirement accounts) is strongly associated with mathematical ability, verbal fluency, and recall skills.

van Rooij et al. (2011b) estimate the relation between financial sophistication and wealth, relying on specific measures of financial literacy available in a special module of the Dutch DNB Household Survey. The module contains questions on the ability to perform simple calculations and to understand compound interest, inflation, and money illusion, and more advanced questions on stock market functioning, characteristics of stocks, mutual funds and bonds, equity premiums, and the benefits of diversification. The authors find that financial sophistication is associated with higher wealth, higher probability to invest in the stock market and higher propensity to plan for retirement. Guiso and Jappelli (2008) use the 2007 Unicredit Customer Survey (UCS), which has detailed indicators of investors' portfolio choice and financial literacy, and find that literacy is strongly correlated to the degree of portfolio diversification, even controlling for other socioeconomic characteristics and proxies for risk aversion. Stango and Zinman (2009) analyze the pervasive tendency to linearize exponential functions. Using the 1977 and 1983 Surveys of Consumer Finances, they show that exponential growth bias can explain the tendency to underestimate an interest rate given other loan terms, and the tendency to underestimate a future value given other investment terms. They find also that more biased households borrow more, save less, favor shorter maturities, and use and benefit more from financial advice.<sup>3</sup>

Since the true stock of financial literacy is not observed, empirical studies face also a measurement error problem. The endogeneity and the measurement issues are similar to those arising in the literature that tries to estimate the returns to schooling: any attempt to estimate the structural relation between schooling and wages has to deal with the omitted variable bias, the endogeneity

<sup>2</sup> In a related paper, McArdle et al. (2009) find that numeracy, measured by the accuracy of the responses to three simple mathematical questions, is a strong predictor of total wealth, financial wealth, and the fraction of wealth held in stocks. Gerardi et al. (2010) focus instead on the liability side, and show that numerical ability is a strong predictor of delinquency and default in the sub-prime market.

<sup>3</sup> In the context of developing countries, Cole et al. (2011) analyze the relation between economic literacy and participation in formal financial markets. Using survey data on India and Indonesia, they show that financial literacy is a powerful predictor of the demand for financial services. Hastings and Tejada-Ashton (2008) use survey responses and the results of an experiment involving participants in Mexico's privatized social security system, and find that the way that information is presented to workers can have a substantial impact on the optimal fees that firms can charge in the marketplace.

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