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ORIGINAL PAPER

Know More, Spend More? The Impact of Financial Literacy on Household Consumption

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Abstract
This paper examines the relationship between household consumption and financial literacy. The economic framework is a simple life-cycle model of consumption in which financial literacy affects the rate of return on assets. The theoretical predictions are that, for plausible values of the intertemporal elasticity of substitution, financial literacy is positively related to both the level of consumption and consumption growth. We empirically test these theoretical predictions with Dutch data from the LISS household panel. Our results provide evidence in favour of a positive association between non-durable consumption, and in particular food consumption, and financial literacy. No evidence is, however, found in favour of an association between consumption growth and financial literacy.

Keywords Life-cycle model · Financial literacy · Self-assessed financial literacy · Household consumption

JEL Classification D14 · D91 · G11 · E21

1 Introduction

Insights into household saving and consumption decisions are important for understanding households' financial preparation for retirement and the role in this of investment decisions. Procrastination may be responsible for people to postpone saving for retirement: they value present consumption more than future consumption leading—without intervention—to insufficient retirement income (Laibson, 1997;

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Laibson et al., 1998). Krijnen et al. (2014) discuss the issues around postponing retirement planning in the Netherlands and conclude that many people do not recognise why they should save now and how they should do so. The consequences of postponing planning for retirement can be that a household enters retirement with too few financial means to satisfy consumption needs. In a study exploring whether the Dutch can meet their own retirement expenditure goals, de Bresser and Knoef (2015) find that for 20% of the households the expected financial situation at age 65 falls short of minimum expenditures.

Thaler and Benartzi (2004) recognise that procrastinating agents do not act as predicted by standard life-cycle theory and propose a savings program called Save More Tomorrow™ in which people commit in advance to allocate a share of their future salary increases to retirement savings. A programme as designed by Thaler and Benartzi could be an effective approach but probably brings along substantial implementation costs. A different and arguably less paternalistic approach could be to stimulate individuals to become more active financial planners by increasing their financial knowledge which, in turn, may as well increase their confidence in making sound financial decisions, with the aim to exploit better returns on investment. O'Donoghue and Rabin (1999) argue that usually, if an action involves immediate costs and future benefits, people procrastinate. However, if a person is (financially) sophisticated, then "[he or she] does the activity sooner than does a naiver person with the same preferences" (p. 104). Planning for retirement can undoubtedly be regarded as an action involving current costs and future benefits.

Several studies have confirmed that more financially literate people are more likely to engage in financial planning (Lusardi & Mitchell, 2007b, 2011; van Rooij et al., 2011a). In its basic form, financial literacy "relates to a person's competency to manage money" (Remund, 2010, p. 279). Remund (2010) also offers a synthesised conceptual definition that combines multiple dimensions in order to create a holistic image of what financial literacy is, namely that it is not only about knowledge of financial concepts but comprises also the ability to use that knowledge for financial planning. The classical approach to measure financial literacy in the economic literature has been developed by Lusardi and Mitchell (2007a) and consists of questions essentially testing numeracy and the knowledge of (basic) financial concepts such as interest compounding, inflation, investing in stocks and the relationship between bond prices and interest rates. These questions were implemented in, e.g., the Health and Retirement Study (HRS) (Lusardi & Mitchell, 2007a, 2008), the RAND American Life Panel (Lusardi & Mitchell, 2007c) and the Dutch DNB Household survey (DHS) (van Rooij et al., 2011a, 2011b).

The economic literature on financial literacy has often focused on the role of financial literacy in savings behaviour and stock market participation (Deuflhard et al., 2018; van Rooij et al., 2011b), retirement planning (Bucher-Koenen & Lusardi, 2011; Lusardi & Mitchell, 2007c; van Rooij et al., 2011a), and financial well-being (Xue et al., 2019). The latter study shows that financial literacy can improve financial well-being and strengthen the positive associations of meeting non-essential consumption needs and financial well-being. Van Rooij et al. (2011b) shows that a low level of financial literacy acts as a significant deterrent to stock ownership. They also extend their empirical model with risk aversion, cognitive

ability (as a complement to financial literacy) and peer effects and still find positive and statistically significant estimates. Lusardi et al. (2017) develop a stochastic life cycle model that features endogenous financial knowledge and a sophisticated saving technology allowing for uncertainty and imperfect insurance. Their intuition is that better financial knowledge enables individuals to better allocate resources over their lifetime: financially savvy individuals can use sophisticated financial products which, in turn, raise the return on savings. They find that 30–40 per cent of US wealth inequality can be attributed to differences in financial knowledge and that the optimal financial literacy profile is hump-shaped over the life cycle. Further, related work by Deuflhard et al. (2018) shows that more financially literate investors earn on average higher savings returns and that more literate households are more able to identify bank accounts yielding higher rates of return across banks. In other words, the rate of return on investments is an increasing function of financial literacy. These studies share the common assumption supported by economic theoretical models that, ultimately, financial literacy positively affects lifetime consumption.

To our knowledge, Jappelli and Padula (2017) is, however, the only study that links financial literacy to consumption. They derived the Euler equation in a life cycle setting, linking financial sophistication and non-durable consumption growth.[1] In their theoretical model, Jappelli and Padula (2017) allows for individuals to invest in financial literacy. Subsequently, they test the prediction of their model using the Italian Survey of Household Income and Wealth. As financial literacy is an endogenous variable in this setting, they use an instrumental variables (IV) approach to tackle this issue and find that having a one point higher financial sophistication score (on a scale from 0–3) is associated with a 5.3 percentage point higher non-durable consumption growth.

Our study contributes to the discussion of the importance of financial literacy for the consumption decisions of individuals or households. In line with Jappelli and Padula (2017), we derive the Euler equation in a life cycle setting. In contrast to Jappelli and Padula, who introduce uncertainty to their model, we first derive the Euler equation assuming full certainty. The assumption of full certainty makes it possible to analyse the effect of an increase in the rate of return (due to a higher financial literacy level) on the level of consumption. We first graphically present the theoretical predictions of our model. Subsequently, we empirically test the predictions of the model, namely a positive association between financial literacy and consumption growth and a positive association between financial literacy and the level of consumption. For our empirical analysis we use data from the LISS panel, a representative survey of Dutch households that contains data on financial literacy, household consumption, and demographics. Our main empirical findings are in support of a positive association between financial literacy and consumption levels and do not support a positive association between financial literacy and consumption growth.

Furthermore, to our knowledge, we are the first to analyse the financial literacy level of a household head and his or her partner and relate this to household

[1] They refer to financial literacy as financial sophistication and use three questions to measure it: interest rate compounding, portfolio diversification and understanding of mortgage contracts.

consumption. In addition, we extend the concept of financial literacy by adding self-assessed financial literacy to our analysis. When asked to assess one's financial knowledge, people will provide their subjective assessment that might deviate from the objective measures that Lusardi et al. have used in their work. Van Rooij et al. (2011b) have recognized in their work the importance of self-assessed financial knowledge and included this dimension in their analysis and observed a strong correlation between both measures. Furthermore, a recent study by Anderson et al. (2017) on precautionary savings and retirement planning find that self-perceptions of financial literacy drive decision-making, especially of low-literacy individuals. Finally, self-assessed financial literacy can be related to confidence (see Bucher-Koenen et al, 2021). Our empirical results suggest that for couple both husband's financial literacy and self-assessed financial literacy are positively associated with the level of non-durable consumption. However, (self-assessed) literacy of the wife does not seem to affect non-durable consumption expenditures of couples and single females. When restricting our analysis to food consumption, the findings suggest strong evidence in favour of a positive association of financial literacy with the level of food consumption.

The structure of this paper is as follows: Sect. 2 outlines the theoretical model, derives the Euler equation, and a closed-form solution for consumption. Section 3 presents descriptive statistics on financial literacy and household consumption (growth). The empirical framework is presented in Sects. 4 and 5 presents the estimation results. The last section summarizes the results and concludes.

2 Theoretical Framework

We present a simple life-cycle model with full certainty to obtain theoretical insights into the interaction between financial literacy, the rate of return, and consumption patterns. The model predicts that consumers smooth marginal utility over time (Hall, 1978). Following Jappelli and Padula (2017), financial literacy enters the model through the interest rate: a higher financial literacy level is reflected in a higher rate of return on investment. Hence, compared to less financially literate households, the more literate households are assumed to have a higher return on savings, therefore save more now and postpone current consumption, which leads to higher lifetime consumption. Jappelli and Padula (2017) and Deuflhard et al. (2018) provide evidence in support of this assumption.

By considering a model with full certainty, a relatively simple closed-form solution for consumption can be derived and which makes it possible to provide transparent insights into the relationship between different financial literacy and household consumption. Following Jappelli and Padula (2017) in their baseline model, we assume perfect capital markets and that there are no liquidity constraints.[2] Finally,

[2] Jappelli and Padula found that even when taking borrowing constraints into account by adding the logarithm of lagged disposable household income, the coefficient of financial literacy was barely affected.

we can assume without loss of generality that household income is constant over time, i.e. $y_t = y$.

We formulate the following value function:

$$V_0(A_0) = \max_{c_t} \sum_{t=1}^{T} (1+\rho)^{1-t} u(c_t) \tag{1}$$

subject to the dynamic budget constraints

$$A_t = (1 + r(\varphi))A_{t-1} + y - c_t,\ \mathrm{t} = 1, \ldots, \mathrm{T}$$

where A_t is wealth at the end of period t and A_0 is set to zero. We assume that there is no bequest motive, hence $A_T = 0$, where T is the last period in the life cycle $r(\varphi)$ is the real rate of return which is a strictly increasing function of the financial literacy level φ. Unlike Jappelli and Padula (2017) we make the simplifying assumption that φ is exogenous. ρ is the rate of time preference, y being labour income and c_t being consumption at period t. Finally, a constant relative risk aversion (CRRA) within period utility function is assumed: $U(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma}$ where γ is the coefficient of relative risk aversion with $\gamma > 0$. (e.g., Attanasio & Weber, 1989).

Formulating the Bellman equation, optimising it with respect to A_{t+1} (wealth at the beginning of period $t+1$) and using the Envelope Theorem, yields the following Euler equation for a broader time horizon linking consumption growth and financial literacy (Deaton, 1992):

$$u'(c_t) = \left(\frac{1 + r(\varphi)}{1 + \rho}\right)^{\tau - t} u'(c_\tau), \tau = t + 1, \ldots, T \tag{2}$$

Plugging in the specified form of the utility function and rewriting the Euler equation for two subsequent periods: period t and $\tau = t + 1$ gives

$$\mathrm{c}_{t+1} = \left(\frac{1 + r(\varphi)}{1 + \rho}\right)^{\frac{1}{\gamma}} c_t \tag{3}$$

or, when taking the logarithm on both sides:

$$\Delta \log(c_t) = \frac{1}{\gamma} \log\left(\frac{1 + r(\varphi)}{1 + \rho}\right) = \sigma \log\left(\frac{1 + r(\varphi)}{1 + \rho}\right) \cong \sigma(r(\varphi) - \rho) \tag{4}$$

where $\Delta \log(c_t) = \log(c_{t+1}) - \log(c_t)$ and $\sigma = \frac{1}{\gamma}$. σ is the intertemporal elasticity of substitution (IES) measuring the willingness to postpone current consumption. Risk aversion plays no role in our model because we assume complete certainty.

We can make the following observations about the change of consumption growth $\Delta \log(c_t)$: it is positive if $r(\varphi) > \rho$ and the steepness of the slope is increasing in $r(\varphi)$ for $r(\varphi) > 0$ and for $\sigma > 0$. Hence, the highly literate have a steeper consumption profile than individuals with low literacy provided they all have a positive IES: A higher level of financial literacy makes future consumption relatively less expensive compared to consumption today. Also, to have the same amount of future

consumption, relatively higher literate households need to sacrifice relatively less consumption today because of their relatively higher rate of return on assets.

Rewriting the Euler Eq. (3) using $r \equiv r(\varphi)$, the preferences defined above, and plugging these into the intertemporal budget constraint of the maximisation problem given by

$$\sum_{\tau=t}^{T} \frac{c_\tau}{(1+r)^{\tau-t}} \leq (1+r)A_{t-1} + y \sum_{\tau=t}^{T} \frac{1}{(1+r)^{\tau-t}} \tag{5}$$

yields the following expression for household consumption:

$$c_t = \Lambda_t^{-1} \left((1+r)A_{t-1} + y \frac{1 + r - \left(\frac{1}{1+r}\right)^{T-t}}{r} \right), \tag{6}$$

where $\Lambda_t := \sum_{\tau=t}^{L} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \left(\frac{1}{1+\rho}\right)^{\frac{\tau-t}{\gamma}}$.

The intertemporal budget constraint (5) is valid because we have assumed absence of a bequest motive ($A_T = 0$). For our analysis, we set the coefficient of time preference equal to zero, $\rho = 0$, which simplifies our computations and does not affect the mechanisms we want to study. Then, $r \geq \rho$ is always fulfilled as we can assume that financial literacy yields non-negative returns.[3] The closed form solution for consumption simplifies to:

$$c_t = \left(\sum_{\tau=t}^{T} (1+r)^{\frac{(1-\gamma)(\tau-t)}{\gamma}} \right)^{-1} \left((1+r)A_{t-1} + y \frac{1 + r - \left(\frac{1}{1+r}\right)^{T-t}}{r} \right) \tag{7}$$

See the Online Appendix for a detailed derivation of the Euler equation and the closed-form solution, including a full listing of the underlying assumptions.

There are numerous studies that estimated the consumption growth equation using micro and macro data and subsequently differed in their parameter estimates of the IES: Hall (1988) estimated an IES close to zero using US non-durables consumption data (excluding services) derived from the US National Income and Product Accounts. Again, using US aggregate panel data, Beaudry and Van Wincoop (1996) estimate the IES for non-durable consumption to be "significantly different from zero and probably close to 1" (p. 509). Their estimates of the IES differ depending on how consumption is being defined (non-durable consumption excluding or including services). In a study relating intertemporal substitution, risk aversion and estimating the Euler equation using UK micro data from the Family Expenditure Survey, Attanasio and Weber (1989) estimated the coefficient of relative

[3] Suppose that r is so low that $r < \rho$. For these impatient households, life-time utility is higher than for households with $r = \rho$. Note that for $r = \rho$, $c_t = y$. An extended model with liquidity constraints such as $A_t \geq 0$, would ensure that impatient low-literacy households with $r < \rho$, $c_t = y$ for all periods.

risk aversion to be 1.46, which corresponds to an IES of 0.68. Jappelli and Padula (2017) estimate the IES to be 0.53 for the full sample and 0.45 for a subsample of 20–65 years old. The common denominator of the cited studies using micro data is a positive IES that is between 0.5 and 0.7 for non-durable consumption excluding services derived from micro data. As will be discussed in Sect. 3, we have detailed data on household consumption allowing us to exclude expenditures on mortgage, rent and insurances. The short literature overview on the different parameter estimates of IES and the disposal of data on non-durable consumption allow us to focus on an IES between 0.4 and 0.8 (a broader range than IES estimates from the literature would suggest) when using simulations to investigate the relation between household consumption and financial literacy in Figs. 1 and 2.

Figure 1 provides simulations of life-cycle consumption for different values of the IES and non-negative rates of return. The consumption profiles are increasing for all rates of return and are steeper for a higher rate of return. A high IES implies that a consumer is more willing to substitute present consumption for future consumption (values future consumption relatively more) than a consumer with a low IES. This results in steeper consumption profiles for consumers with a high IES.

At (very) young ages and high IES, consumption profiles for highly literate households appear to start at a lower level than for lower literate households. At older ages, this initial trade-off is more than compensated. See the Online Appendix for a derivation of the partial derivative of the closed-form solution with respect to the rate of return: consumption is not strictly increasing in r and depends on the IES.

Figure 2 plots the undiscounted sum of the consumption levels for age, that is lifetime consumption, for different values of IES and rates of return. The figure shows an increase in lifetime consumption with increasing rates of return, holding IES constant. Differences in rates of return are reflected in higher levels of life-time consumption for higher IES suggesting that financial literacy—entering through the rate of return—has a larger impact on consumption levels for higher IES than for lower IES if we restrict the IES between zero and one.

The theoretical predictions that follow from this section are that financial literacy and consumption levels are positively correlated for plausible values of the IES and that financial literacy and consumption growth are positively correlated.

3 Data Description and Summary Statistics

3.1 Data Description

3.1.1 Dataset Composition

We use data from the LISS panel administered by CentERdata (www.lissdata.nl). This panel is a representative household survey and consists of 4500 Dutch households and 7000 individual respondents since 2007. Knoef and de Vos (2009) provide statistics in favour of the representativeness of the LISS panel of the Dutch population. The data has information on the socioeconomic situation of the individual

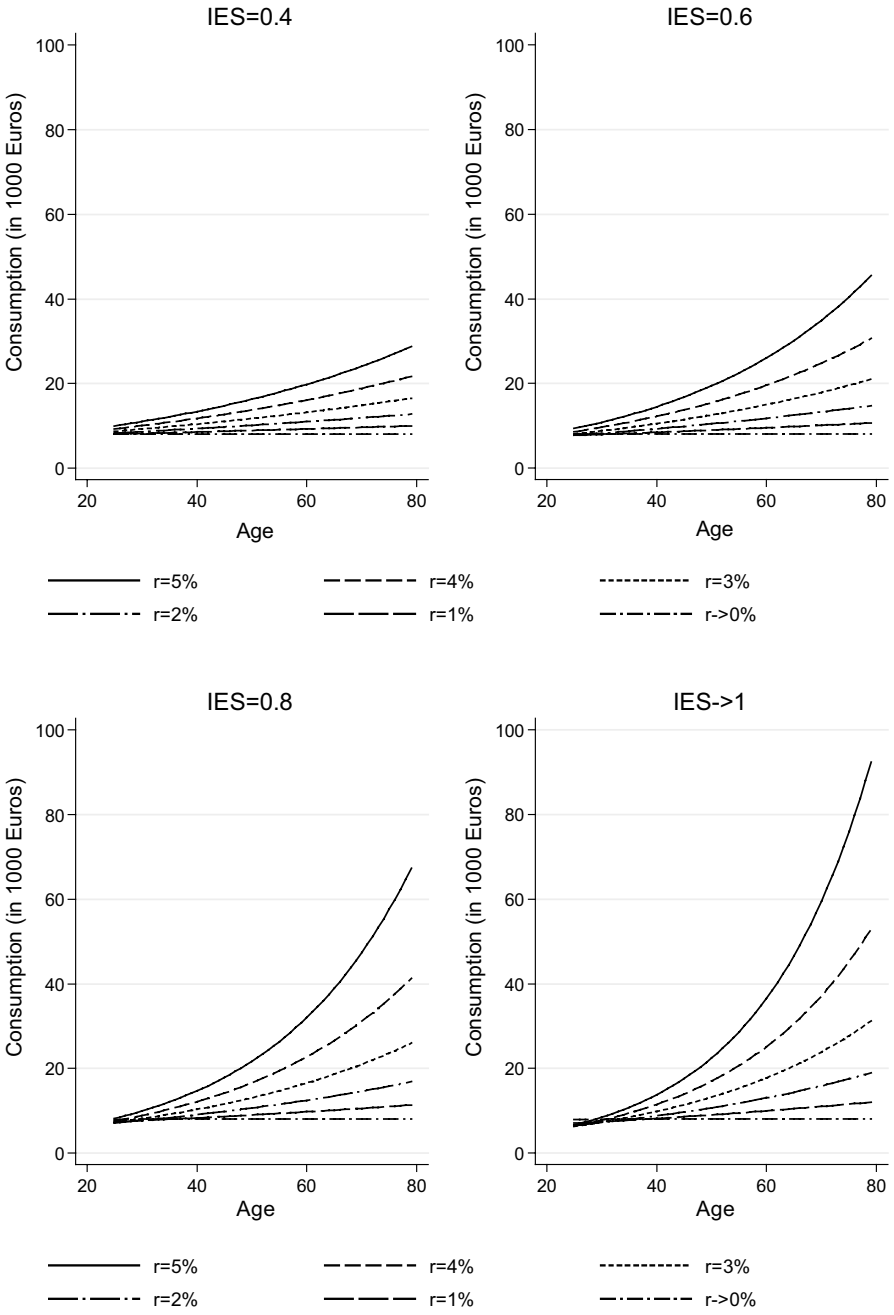

Fig. 1 Consumption profiles for different intertemporal elasticities of substitution (IES). For the simulations, we used as an approxation of r = 0.0001 for $r \to 0$ and $A_0 = 0$. Furthermore, for $IES \to 1$, we used a value of 0.999

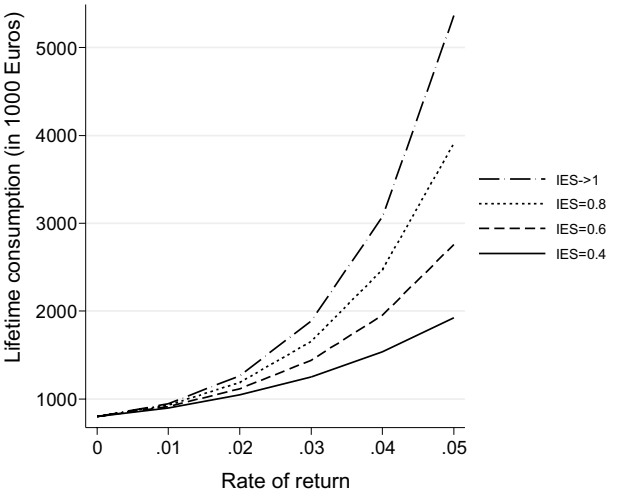

Fig. 2 Life-time consumption for different IES. The lifespan (T) is equal to 80 years

respondents, their financial literacy level (and their perception about their knowledge), and household consumption.

3.1.2 Objective and Subjective Financial Literacy Measures

The single wave study from August 2011 on financial literacy was used. 4858 respondents (from 3298 households) first had to self-assess their financial knowledge (subjective measure of financial literacy) and subsequently answered four questions on financial literacy (objective measures of financial literacy).[4] For 58% of the households, more than one respondent answered the questions. The question on subjective financial knowledge is on a 7-point Likert scale which we have recoded to five categories (the first and last two categories) due to the low number of observations at the tails of the distribution. The four questions on objective financial literacy test knowledge on interest compounding, inflation, risk diversification and the relationship between bond prices and interest rates. For the exact wording of all financial literacy questions please refer to the Online Appendix. The questions are multiple choice questions and include the option for respondents to answer with "don't know" or "refuse". The financial literacy module also includes data on how interesting people found the subject of financial literacy.

[4] Once respondents answered the question about their self-assessed financial knowledge and started answering the first question on financial literacy, they could not go back to adjust their answer to the self-assessment.

3.1.3 Consumption

Consumption data have been retrieved from the *Consumption and Time Use* longitudinal study comprising five waves collected in the years 2009, 2010, 2012, 2015 and 2017. There can be multiple respondents per household: we considered the answers of household head, partner and (if any) children. On average, there are 5200 observations per wave. The LISS panel has asked repondents to indicate (in Euro) their expenditures[5] per month while distinguishing between consumption of assignable (including expenditures on children living in the household) and non-assignable goods. We have borrowed this terminology from Bourguignon et al. (1993) who defined expenditures to be "assignable" if the "financial beneficiary of these expenditures in the family is identified" (p. 147). We first focus our analysis on consumption of non-durable goods. We have aggregated reported expenditures on non-assignable goods for the following subcategories: transport and means of transport, daytrips and holidays with the whole family, expenditures on cleaning the house or maintaining the garden, eating at home and other non-assignable expenditures. Expenditures on assignable goods include food and drinks outside the house, cigarettes, clothing, personal care, leisure time expenditures (film, theater, hobbies etc.). It should be noted that the wording of the questions on assignable expenditures has changed since 2015. To circumvent a possible questionnaire effect in our estimation results, we have added time dummies to our regression models explaining consumption (growth). Moreover, we have computed consumption growth for the periods 2009–2013 (before the change in wording) and 2015–2017 (after the change in wording) separately.

In order to obtain a more complete measure of non-durable consumption, we have taken the answers of the household head concerning non-assignable expenditures and we have added assignable expenditures of the household head together with the assignable expenditures of the partner and children (if present). To be able to compare consumption across households of different sizes, we have equivalised consumption using the square root scale (OECD, 2018a).

Next to non-durable consumption, we have used two alternative consumption measures in a sensitivity analysis: food consumption and total consumption. Food consumption is supposed to be relatively stable in times of crisis—note that the first waves cover the immediate post-financial- crisis period which might change people's perception on their monthly expenditures. Total consumption is an aggregate of non-durable consumption (assignable and non-assignable), expenditures on children and durable consumption (mortgages, insurances etc.). The Online Appendix provides more details on the exact wording of the questions used and how all consumption measures have been computed.

[5] We use the terms 'consumption' and 'expenditures' interchangeably.

3.1.4 Background Characteristics

Information is available on the age of all household members, their position in the household (e.g. a child, household head or (un)wedded partner), type of dwelling, the level of education of the respondent, household size, net monthly household income, occupation and marital status. Those variables are part of the *Background variables* module of the LISS panel and are available for every month between 2009 and 2017. In case that respondents have participated in modules during different months within the same year (for instance the questions on consumption and assets), we have computed the average net household income within each year yielding one representative value of monthly net household income per year. The *Health Core Study* of the LISS panel contains data on objective and subjective health measures for 2009 through 2017. The Online Appendix provides more information about all covariates used in our empirical analysis.

3.1.5 Sample Selections

After merging and appending all relevant modules from the LISS panel, our gross sample comprises 27,640 observations (of 10,741 individuals from 7290 households). The observation unit is the household. We have added the children's responses to the non-assignable consumption questions to the answers of the parent(s) and subsequently dropped the children's observations. This way, we have kept the responses of household heads and, if applicable, of their partners without losing information on the children's consumption. We also chose to drop households with children above 25 years old still living at home. We consider those households to possibly have a different life-cycle consumption: The chance is higher that, in such households, adult children financially support their parents for instance (or possibly the other way around) which can affect the dynamics of household consumption. So far, we are left with 89% of our gross sample.

As in the financial literacy module a smaller group of panel participants were sampled, the overlap with the consumption data is rather small. This leaves us with only 25% of the gross sample. Cleaning the data for missing information on (at least) one of the variables we study, including recoding the don't know answers to the consumption questions to missing, results in dropping 390 observations from 53 households. Finally, to avoid our results to be affected by outliers, we remove the top and bottom first percentiles of the total consumption distribution which makes us lose only 4 households (less than 0.5% of the households). Our final sample consists of 5508 observations across all consumption waves from 1820 households and 2620 individuals.

3.2 Summary Statistics

3.2.1 Financial Literacy (Objective)

We first present some simple summary statistics of the objective financial literacy questions at the individual level. Table 1 gives the percentage shares for

Table 1 Financial literacy scores by gender

	Interest (%)	Inflation (%)	Risk (%)	Bonds (%)
Female (n = 1223)				
Correct	88.8	73.4	32.1	13.2
Incorrect	5.7	12.2	17.0	30.7
Don't know	4.4	12.8	49.5	54.8
Refuse	1.1	1.5	1.4	1.4
Total	100.0	100.0	100.0	100.0
Male (n = 1397)				
Correct	91.7	85.9	54.5	25.8
Incorrect	5.0	7.9	16.3	39.6
Don't know	2.6	5.1	28.0	33.9
Refuse	0.7	1.1	1.3	0.7
Total	100.0	100.0	100.0	100.0

Results from testing gender differences using SUR are not reported in this table

Table 2 Summary of responses to the four financial literacy questions

	Frequency distribution of the number of correct, incorrect, don't know and refuse answers (out of four questions)						
	None	1	2	3	All four	Total	Total
	%	%	%	%	%	%	Mean
Correct	5.04	14.20	38.13	30.04	12.60	100.0	2.31
Incorrect	48.66	37.33	12.25	1.76	0.00	100.0	0.67
DK	42.75	26.91	23.02	4.96	2.37	100.0	0.97
Refuse	97.94	0.72	0.61	0.19	0.53	100.0	0.05

each financial literacy question by answer type (correct, incorrect, don't know or refuse) for women and men. For both male and female respondents, there is a large difference in the percentage of correct answers for the first two questions and the last two questions (see Table 1). We have tested for gender differences for each question using the seemingly unrelated regression model (SUR) with clustered standard errors at the individual level and find that gender differences are statistically significant.

Judging by the percentage of correct answers, the questions about interest compounding and inflation were perceived as easier than the questions on risk diversification and bond prices. The percentage of correct answers for female respondents is consistently lower than their male counterparts for all questions. Also, the share of *don't know* (DK) answers is two times larger for females. This is consistent with the findings of Bucher-Koenen et al. (2017) who point out that women have lower knowledge and may lack confidence about their financial knowledge.

Table 2 provides an overview of the shares of how many financial literacy questions (out of four) were answered correctly, incorrectly or with DK or refuse. The last column returns the mean value of how many questions were answered correctly, incorrectly etc. The most important information that can be retrieved from this table is that 12.6% of the respondents answered all four questions on financial literacy correctly. On average, 2.31 out of the four questions were answered correctly. The share of correct answers is very low and there is a high share of respondents that chose the DK option providing evidence for lack of confidence regarding their knowledge of the financial concepts being tested. When glancing at Table 1, the high shares of incorrect and "don't know" answers come from the questions on risk diversification and bond prices (questions 3 and 4) respectively. Those observations are consistent with van Rooij et al. (2011b), who used data from the DNB Household Survey from 2005 and found comparable shares of correct, incorrect and "don't know" answers.

3.2.2 Consumption

In what follows, we provide summary statistics of the consumption measures (and their components) over time at the household level. In Table 3, we present the (geometric) mean of equivalised consumption levels over time (in euro). We choose for the geometric mean as the distribution of the consumption variables is rightly skewed. Consistent with our theoretical model and the previous literature, our main analysis is based on non-durable consumption. For the first three waves (years 2009–2012), mean non-durable consumption declined. The relatively big jump between 2009 and 2010 can be explained by the financial crisis of 2008: Respondents were asked to report monthly expenditures based on the previous year so that the effect of the crisis on people's perceptions becomes visible in the wave of 2010. As discussed in Sect. 3.1, the wording of the question on assignable consumption has been changed as of 2015. This also shown in Table 3 by the drop in mean non-durable consumption. This finding can be explained by the fact that the share of assignable consumption in total non-durable consumption is relatively large as compared to the share of assignable consumption in total household consumption. For this reason, we perform a robustness check of our results using food consumption only.

In Table 4, we present mean annualised consumption growth over time. We have annualised consumption growth due to the gaps between the waves. Those computations are based on the observations from Table 3 and do not account for the trend-break. Throughout the years, consumption growth appears to be zero or slightly negative, except for the categories miscellaneous and assignable consumption. For 2015, consumption growth declined by 14% with respect to the previous waves. Having analyzed household consumption over time, we can already identify two implications for our empirical analysis: 1) we should separate the pre-change and post-change period when computing consumption growth and 2), we do not observe a clear trend in consumption (growth) over time.

In Table 5, we present for singles and couples separately mean non-durable consumption (in logs) by age category, education level, financial literacy level (a simple index based on the number of correctly answered four financial literacy

Table 3 Consumption levels over time

	Consumption components	Wave 1 (2009) Mean	Wave 2 (2010) Mean	Wave 3 (2012) Mean	Wave 4 (2015) Mean	Wave 5 (2017) Mean
Total household consumption	Non-assignable consumption	1167.53	1146.57	1170.93	1138.89	1152.35
	Assignable consumption	262.06	246.37	236.07	155.58	164.78
	Total consumption	1438.61	1376.18	1394.98	1294.87	1340.91
Non-durable consumption	Food	196.06	190.34	192.01	187.38	196.01
	Transport	74.19	73.50	76.67	72.42	71.50
	Cleaning	27.23	25.86	26.03	25.85	25.59
	Holidays	93.67	89.41	95.05	91.68	103.86
	Misc	99.57	73.67	69.82	69.12	78.03
	Assignable consumption	262.06	246.37	236.07	155.58	164.78
	Total Non-durables	735.44	704.24	701.95	607.43	644.55
	Observations	1154	1315	1204	1074	761

All means are geometric means. Deviations are due to household transitions. The trend-break due to the questionnaire effect from 2015 onwards can be detected by comparing mean assignable consumption across the waves

Table 4 Annualized consumption growth over time

		Wave 2 (2010)	Wave 3 (2012)	Wave 4 (2015)	Wave 5 (2017)
	Consumption components	Mean	Mean	Mean	Mean
Total household consumption	Non-assignable consumption	− 0.015	0.006	− 0.006	− 0.023
	Assignable consumption	− 0.022	− 0.024	− 0.137	− 0.002
	Total household consumption	− 0.020	0.007	− 0.032	− 0.031
Non-durable consumption	Food	− 0.003	− 0.004	− 0.003	0.013
	Transport	0.003	− 0.004	− 0.029	− 0.023
	Cleaning	− 0.018	0.012	0.005	0.000
	Assignable consumption	− 0.022	− 0.024	− 0.137	− 0.002
	Holidays	− 0.015	0.000	− 0.012	− 0.011
	Misc	− 0.169	− 0.022	− 0.008	0.008
	Total non-durables	− 0.016	− 0.006	− 0.046	0.006
	Observations	944	1088	959	723

All means are arithmetic means of annualised growth rates of equivalised consumption. See the Online Appendix for more details on how consumption growth has been computed

Table 5 Non-durable consumption single households and couples

		Log(equivalised household consumption)			
		Singles		Couples	
		n	Mean	n	Mean
A. Age categories	18–40 years	499	6.347	339	6.504
	40–64 years	1488	6.395	1197	6.688
	65 + years	1020	6.422	965	6.728
	Total	3007		2501	
	H_0: Equal means (*p*-value)		0.072		0.000
B. Education level	Low education	1126	6.265	738	6.562
	Medium education	857	6.360	819	6.595
	High education	1024	6.570	944	6.843
	Total	3007		2501	
	H_0: Equal means (*p*-value)		0.000		0.000
C. Financial literacy level (0–4)	0	187	6.215	46	6.431
	1	508	6.222	167	6.431
	2	1143	6.373	770	6.556
	3	845	6.466	1004	6.750
	4	324	6.670	514	6.826
	Total	3007		2501	
	H_0: Equal means (*p*-value)		0.000		0.000
D. Self-assessed financial literacy level (1–5)	1	146	6.214	67	6.458
	2	250	6.311	152	6.537
	3	609	6.387	292	6.619
	4	1014	6.381	815	6.619
	5	988	6.466	1175	6.766
	Total	3007		2501	
	H_0: Equal means (*p*-value)		0.000		0.000

For couples the characteristics refer to the household head

questions) and self-assessed financial literacy (on a scale of 1–5). All variables at the individual level are observations of the household head. Panel A of Table 5 reveals that mean consumption is higher for older individuals (belonging to single or couples household). Panel B shows that mean consumption is higher for more educated individuals in couples households (see F-tests at the bottom of each panel). Regarding financial literacy, we can observe in Panel C that a higher financial literacy level is associated with a higher consumption level. The last part of Table 5, panel D, shows a positive association between the self-assessed financial literacy level and consumption. Note that those observations hold for singles and couples households. All differences within the groups are statistically significant save for singles in panel A. Table 5 provides suggestive

Table 6 Non-durable consumption growth for single households and couples

		Consumption growth (annual growth rate): Δlog (consumption)			
		Singles		Couples	
		n	mean	n	Mean
A. Age categories	18–40 years	228	− 0.003	180	− 0.008
	40–64 years	993	− 0.022	809	− 0.007
	65 + years	777	− 0.023	727	− 0.020
	Total	1998		1716	
	H_0: Equal means (*p*-value)		0.744		0.686
B. Education level	Low education	789	− 0.011	489	0.005
	Medium education	534	− 0.017	565	− 0.027
	High education	675	− 0.032	662	− 0.014
	Total	1998		1716	
	H_0: Equal means (*p*-value)		0.518		0.231
C. Financial literacy level (0–4)	0	119	− 0.031	23	− 0.012
	1	340	0.002	103	0.032
	2	762	− 0.029	520	− 0.016
	3	559	− 0.018	707	− 0.017
	4	218	− 0.020	363	− 0.014
	Total	1998		1716	
	H_0: Equal means (*p*-value)		0.741		0.644
D. Self-assessed financial literacy(1–5)	1	94	− 0.057	42	− 0.030
	2	164	− 0.076	99	− 0.009
	3	405	− 0.034	192	0.007
	4	665	− 0.017	547	− 0.006
	5	670	0.005	836	− 0.022
	Total	1998		1716	
	H_0: Equal means (*p*-value)		0.068		0.734

For couples the characteristics refer to the household head

evidence in support of the first empirical implication of our theoretical model—a positive association between household consumption level and financial literacy.

Subsequently, Table 6 reports on mean consumption growth for groups based on the same key variables as described above. Consumption growth is defined as the annualized change in the logarithm of equivalised household consumption-lized. In general, the Table shows negative consumption growth across all key variables, with no significant differences across age categories, education levels and (self-assessed) financial literacy levels respectively. These trends suggest no empirical support for the theoretical prediction of a positive association between consumption growth and financial literacy.

4 Methodology

In this section, we present the empirical specifications for testing our empirical predictions formulated in the theoretical section. Lusardi and Mitchell (2008) and Bucher-Koenen et al. (2017) pointed out the importance of the gender gap when researching financial literacy. We have confirmed gender differences when exploring the financial literacy data in Table 1. Following this line, we have estimated the consumption and consumption growth equations for singles and couples separately. All specifications were estimated using least squares and the standard errors were clustered at the household level.

4.1 Consumption Level and Financial Literacy

We turn to estimating Eq. (7), the closed-form solution for consumption in terms of financial literacy. We estimate this equation for single men, women (see Eq. (8)) and couples (Eq. (9)) separately. The dependent variable is (the logarithm of) non-durable consumption. The main independent variable is the total score on each of the classic four financial literacy questions (*FL*) and self-assessed financial knowledge (*SAFL*). We have included time dummies captured by τ_t and a set of individual and household characteristics summarised by the vector Z_{it} for singles and by the vector $Z_{it,j}$ for couples where j denotes partner 1 or partner 2. For couples, we include the set of covariates that we observe at the individual level for both adults.

$$\text{Singles}: \quad \log\left(cons_{it}\right)^{\text{singles}} = \alpha_1 FL_i + \alpha_2 SAFL_i + \delta' Z_{it} + \tau_t + v_{it}^{\text{singles}} \tag{8}$$

$$\text{Couples}: \quad \log\left(cons_{it}\right)^{couples} = \sum_{j=1}^{2} \beta_j FL_{i,j} + \sum_{j=1}^{2} \beta_{j+2} SAFL_{i,j} + \sum_{j=1}^{2} \mu' Z_{it,j} + \tilde{\tau}_t + v_{it}^{couples} \tag{9}$$

As income and consumption are positively correlated when considering levels, we control for income in Eqs. (8) and (9). By including income, we made sure that our results were not driven by income effects. Note that we are interested in eliciting the role of (self-assessed) financial literacy on household consumption for a *given* level of income. Furthermore, we control for other socio-economic factors like health, education level, demographic variables (e.g. the presence of children, type of dwelling, marital status, and occupation. For a detailed description of all covariates included, see the Online Appendix.

4.2 Consumption Growth and Financial Literacy

As we have seen in our simulations in Sect. 2, the slopes of the consumption profiles differ due to different financial literacy levels: slopes are steeper for a higher financial literacy level. We include (self-assessed) financial literacy on the right-hand side of the consumption growth equation despite that we only observe financial

literacy once. The empirical translation of the consumption growth (Euler) equation derived in Sect. 2 is given by Eq. (10). We pool singles and couples when estimating the Euler equation which relates consumption growth and financial literacy as the estimation results did not differ when we estimated the equations separately for singles (men and women separately as well) and for couples.[6] The dependent variable is annualised equivalised non-durable consumption growth in logs—hence we look at the variation of consumption growth in percentages. See the Online Appendix for the formulae used to compute consumption growth.

We have included a set of time-invariant controls (in levels) and time-variant controls (in first differences) captured by the vectors $D_{i,j}$ and $\Delta Z_{it,j}$ respectively. $D_{i,j}$ includes education of the household head (and partner) and gender of the household head. $\Delta Z_{it,j}$ includes health transitions, the change in whether there are children living at home, change in occupation, change in type of dwelling, and change in marital status. We excluded income, as the life cycle-permanent income hypothesis posits that (lagged) income should not have any explanatory power with respect to consumption (Hall, 1978). This is also suggested by the Euler equation we derived in our theoretical model (see Eq. 2):

$$\Delta \log\left(cons_{it}\right) = \sum_{j=1}^{2} \gamma_j FL_{i,j} + \sum_{j=1}^{2} \gamma_{j+2} SAFL_{i,j} + \sum_{j=1}^{2} \beta' D_{i,j} + \sum_{j=1}^{2} \mu' \Delta Z_{it,j} + v_{it} \tag{10}$$

For single households, we set the characteristics of the second adult to zero by default. Finally, we recognise that estimating the Euler equation using consumption data is problematic due to the availability of short panels—see Attanasio and Low (2004) for a technical discussion on the assumptions needed to consistently estimating Euler equations.

5 Results

In this section, we present two sets of results: First, the estimations of the consumption Eqs. (8) and (9). And next, the estimates of the Euler Eq. (10). All results reported in the main text concern non-durable consumption or food consumption. Results based on total household consumption can be found in the Online Appendix.

5.1 The Level of Consumption

We have estimated Eq. (8) for single households (men and women separately) and (9) for couples. In Table 7, we present the estimated coefficients for three sets of specifications: the first specification (columns 1–3) excludes self-assessed financial literacy, the second (columns 4–6) excludes the objective financial literacy measure

[6] The estimation results of the separate estimations are available upon request from the corresponding author.

Table 7 Non-durable consumption, Eqs. (8) and (9), estimation results

	(1) Singles F	(2) Singles M	(3) Couples	(4) Singles F	(5) Singles M	(6) Couples	(7) Singles F	(8) Singles M	(9) Couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
Financial literacy index (0–4), women	0.041*		− 0.012				0.040*		− 0.009
	(0.021)		(0.016)				(0.021)		(0.016)
Self-assessed financial knowledge (1–5), women				0.013		− 0.011	0.011		− 0.008
				(0.015)		(0.011)	(0.015)		(0.011)
Financial literacy index (0–4), men		0.041	0.064***					0.035	0.056***
		(0.026)	(0.015)					(0.026)	(0.015)
Self-assessed financial knowledge (1–5), men					0.033	0.039***		0.026	0.028**
					(0.020)	(0.013)		(0.021)	(0.014)
Low education dummy, women	− 0.027		0.046	− 0.039		0.047	− 0.029		0.048
	(0.049)		(0.033)	(0.048)		(0.033)	(0.049)		(0.033)
High education dummy, women	0.061		0.044	0.076		0.045	0.064		0.049
	(0.045)		(0.037)	(0.046)		(0.037)	(0.046)		(0.036)
Low education dummy, men		− 0.048	− 0.011		− 0.072	− 0.023		− 0.050	− 0.004
		(0.057)	(0.035)		(0.053)	(0.035)		(0.057)	(0.035)
High education dummy, men		0.023	0.078**		0.037	0.085***		0.024	0.077**
		(0.060)	(0.032)		(0.060)	(0.032)		(0.060)	(0.032)
1st quintile income	− 0.432***	− 0.404***	0.018	− 0.435***	− 0.406***	0.009	− 0.431***	− 0.401***	0.017
	(0.057)	(0.071)	(0.069)	(0.057)	(0.070)	(0.073)	(0.058)	(0.071)	(0.070)
2nd quintile income	− 0.130***	− 0.184***	− 0.104**	− 0.124***	− 0.187***	− 0.105**	− 0.128***	− 0.185***	− 0.099**
	(0.047)	(0.056)	(0.047)	(0.047)	(0.057)	(0.047)	(0.047)	(0.057)	(0.047)

Table 7 (continued)

	(1) Singles F	(2) Singles M	(3) Couples	(4) Singles F	(5) Singles M	(6) Couples	(7) Singles F	(8) Singles M	(9) Couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
4th quintile income	0.186***	0.227***	0.204***	0.195***	0.220***	0.204***	0.188***	0.220***	0.204***
	(0.060)	(0.063)	(0.034)	(0.060)	(0.063)	(0.034)	(0.060)	(0.063)	(0.035)
5th quintile income	0.138	0.286***	0.414***	0.157	0.280***	0.418***	0.143	0.272***	0.407***
	(0.102)	(0.099)	(0.040)	(0.099)	(0.098)	(0.040)	(0.102)	(0.099)	(0.040)
Observations (number of households)	1728 (598)	1279 (434)	2501 (816)	1728 (598)	1279 (434)	2501 (816)	1728 (598)	1279 (434)	2501 (816)
R-squared	0.334	0.278	0.308	0.331	0.277	0.303	0.335	0.280	0.310

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Clustered standard errors at the household level are in parentheses. Non-durable consumption has been equivalised and is in logs. Medium education, paid employment, self-owned dwelling, and the 3rd quintile of the income distributions respectively are the reference categories. Time dummies are included. Moreover, we control for other factors like health, the presence of children, type of dwelling, marital status, and occupation. The complete set of estimated coefficients are available upon request from the corresponding author

Table 8 Food consumption, Eqs. (8) and (9), estimation results

	(1)		(2)		(3)	
	Singles F	SE	Singles M	SE	Couples	SE
Financial literacy index (0–4), women	0.064***	(0.023)			− 0.041*	(0.021)
Financial literacy index (0–4), men			0.085***	(0.029)	0.059***	(0.021)
Self-assessed financial knowledge (1–5), women	0.008	(0.019)			− 0.010	(0.014)
Self-assessed financial knowledge (1–5), men			0.016	(0.024)	0.018	(0.019)
Low education dummy, women	− 0.016	(0.059)			− 0.025	(0.043)
High education dummy, women	− 0.024	(0.052)			0.001	(0.043)
Low education dummy, men			− 0.118*	(0.071)	− 0.032	(0.045)
High education dummy, men			0.029	(0.065)	0.085**	(0.041)
1st quintile income	− 0.326***	(0.064)	− 0.317***	(0.087)	− 0.055	(0.080)
2nd quintile income	− 0.084	(0.055)	− 0.127*	(0.072)	− 0.133**	(0.064)
4th quintile income	0.153**	(0.067)	0.170**	(0.074)	0.124***	(0.046)
5th quintile income	− 0.037	(0.108)	0.132	(0.116)	0.232***	(0.052)
Observations (Number of clusters)	1728 (598)		1279 (434)		2501 (816)	
R-squared	0.175		0.170		0.172	

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Clustered standard errors in parentheses (at the household level). The same covariates and reference categories are used as in previous analyses. The full set of results are in Table 7 of the Online Appendix

and the third (columns 7–9) contains both financial literacy measures. In line with our first theoretical prediction, for men in a couple household we find strong evidence for a positive association between financial literacy and consumption levels and self-assessed financial literacy and consumption levels (columns 3, 6 and 9). For single women, we find only weak evidence of such associations (columns 1 and 7). Overall, including self-assessed financial literacy does not change the magnitude of the association between financial literacy and consumption.

Interestingly, education appears not to be an important covariate. For singles, there are no statistically significant differences in consumption levels across education levels. For couples, we find that higher educated men are associated with higher household consumption relative to medium-educated men. Table 7 also indicates that consumption levels are sensitive to income: Households belonging to the richer part of the income distribution (last two quintiles) have a higher consumption level and household belonging to the lower part of the income distribution (first two quintiles)—a lower consumption level. As mentioned above, we have also controlled for other background characteristics such as health. Please refer to Table 6 of the Online Appendix for the reported coefficients.

Next, we have estimated the same model using food consumption instead of (total) nondurable consumption because, arguably, the former consumption measure is closer related to the concept of consumption in our theoretical model. It turns out that for all household types (single male, single female, couples) only 'objective'

Table 9 Non-durable consumption growth (Euler), Eq. (10), estimation results

	(1) Coeff. (SE)	(2) Coeff. (SE)	(3) Coeff. (SE)
Financial literacy index (0–4), women	− 0.005		− 0.005
	(0.007)		(0.008)
Financial literacy index (0–4), men	0.007		0.004
	(0.007)		(0.009)
Self-assessed financial knowledge (1–5), women		− 0.001	0.001
		(0.005)	(0.005)
Self-assessed financial knowledge (1–5), men		0.007	0.006
		(0.007)	(0.008)
Low education dummy, women	0.011	0.012	0.012
	(0.016)	(0.016)	(0.016)
High education dummy, women	− 0.004	− 0.006	− 0.003
	(0.018)	(0.018)	(0.018)
Low education dummy, men	0.016	0.014	0.014
	(0.019)	(0.020)	(0.020)
High education dummy, men	0.025	0.024	0.024
	(0.017)	(0.017)	(0.017)
Observations	2755	2755	2755
R-squared	0.013	0.013	0.014

***$p<0.01$, **$p<0.05$, *$p<0.1$. Clustered standard errors in parentheses (at the household level, 1426 clusters). Medium education, paid employment, self-owned dwelling are the reference categories. Consumption growth between 2015 and 2009, 2010, 2012 respectively were excluded for the estimations because of a change in the wording of the question on assignable consumption

financial literacy is associated with food expenditures and not self-assessed financial literacy (Table 8).[7] These findings provide strong empirical support for a positive association of financial literacy with food consumption.

The association between (self-assessed) financial literacy and total consumption appears to be rather weak (see Table 8 of the online appendix). However, it should be realised that total expenditures includes expenditures on durable goods. The simple lifecycle model presented in Sect. 2 on which our empirical model is based, does not take into account the existence of durable goods. This implies that the 'total consumption' results should be taken with a grain of salt.

5.2 Consumption Growth Equation

Next, Table 9 presents the estimation results of the Euler equation for non-durable consumption. There were no significant differences between the models for singles and couples, and we therefore present the results for the pooled sample and

[7] See Table 7 of the online appendix for full set of estimation results.

control for the household type instead. We do not find evidence for an association between (self-assessed) financial literacy and non-durable growth. We obtain similar results if we consider alternative consumption measures (total consumption and food consumption, see Table 9 of the online appendix. Those results are consistent with the raw correlations we discussed in Sect. 3.2 (Table 6).

5.3 Robustness Check: Different Stages in Life Cycle (Age Groups)

We check the sensitivity of our results by testing whether households belonging to different age groups have different consumption profiles. Our complete sample comprises the ages 18 until 93 suggesting that the households we examined can be at numerous stages of the life cycle. We examine very young workers who are more likely to be financially constrained simultaneously with individuals of older age with fixed income and face no income uncertainty. We have repeated our analyses for the following sub-samples: In the first sub-sample we excluded households with a household head above 65 and below 20 years old focusing on the general working population (we still include occupational dummies); the second sub-sample comprises households with a household head between 40 and 65 years old representing the age where people probably financially invest most during their life; the last sub-sample included only the households with a household head of above 65 years old, which was the statutory retirement age during the survey period.

The estimation results of this sensitivity analysis are presented in Table 10. For single women, there is no association between the financial literacy measures and consumption levels except for women above 65 years old. For senior single women, a higher financial literacy index is associated with a higher consumption level. In the baseline results in Table 7, we have estimated a positive association (though only significant at the 10%-level) for single women. Hence, the latter result can be explained by the important role that financial literacy plays for senior women. Note that this also includes women who were first part of a couples' household and are divorced or widowed. As the subsample of the above 65 years old is relatively small, the association became weaker once we look at all single women.

For single men, we find weak evidence of positive associations between the financial literacy index and consumption levels for the 20–65 years old and the 40–65 years old and no association for the above 65 years old. This association disappeared when considering the entire sample (cf. Table 7) due to the lack of precision of the estimates for the subsamples. Regarding couples, we find a strong positive association between the financial literacy level of men and consumption levels for all subsamples except for the above 65 years old. For the above 65 years old, we find a positive association between self-assessed financial literacy of men and consumption. The significant coefficients for the financial literacy measures of men in couples' households in Table 7 can hence be explained by two factors: the financial literacy of men is relevant for men younger than 65 years and their self-assessed knowledge is relevant for men above 65 years old.

Table 10 Closed-form estimations non-durable consumption (different age groups)

	Ages 20–65			Ages 40–65			Ages 65–93		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Singles F	Singles M	Couples	Singles F	Singles M	Couples	Singles F	Singles M	Couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
Financial literacy index (0–4), women	0.024		− 0.001	0.005		− 0.012	0.089**		− 0.033
	(0.025)		(0.018)	(0.031)		(0.021)	(0.036)		(0.031)
Self-assessed financial knowledge (1–5), women	0.018		− 0.003	0.024		− 0.002	− 0.002		− 0.021
	(0.019)		(0.014)	(0.022)		(0.015)	(0.023)		(0.017)
Financial literacy index (0–4), men		0.055*	0.070***		0.061*	0.078***		− 0.009	0.016
		(0.031)	(0.018)		(0.036)	(0.021)		(0.043)	(0.026)
Self-assessed financial knowledge (1–5), men		0.011	0.026		0.026	0.016		0.056	0.055**
		(0.023)	(0.016)		(0.027)	(0.018)		(0.048)	(0.022)
Low education dummy, women	− 0.041		0.054	− 0.053		0.072*	0.035		0.120**
	(0.064)		(0.039)	(0.069)		(0.043)	(0.080)		(0.056)
High education dummy, women	0.096*		0.024	0.130**		− 0.000	− 0.002		0.224***
	(0.051)		(0.041)	(0.063)		(0.048)	(0.090)		(0.070)
Low education dummy, men		− 0.047	− 0.026		− 0.057	− 0.047		− 0.000	0.031
		(0.064)	(0.043)		(0.072)	(0.049)		(0.114)	(0.054)
High education dummy, men		− 0.058	0.049		− 0.080	0.066		0.284**	0.134**
		(0.065)	(0.036)		(0.077)	(0.041)		(0.115)	(0.064)
1st quintile income	− 0.373***	− 0.414***	− 0.013	− 0.408***	− 0.358***	− 0.012	− 0.536***	− 0.399***	0.193
	(0.070)	(0.075)	(0.077)	(0.082)	(0.091)	(0.086)	(0.091)	(0.145)	(0.131)
2nd quintile income	− 0.105*	− 0.195***	− 0.124**	− 0.093	− 0.188***	− 0.130*	− 0.183**	− 0.167	− 0.053

Table 10 (continued)

	Ages 20–65			Ages 40–65			Ages 65–93		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Singles F	Singles M	Couples	Singles F	Singles M	Couples	Singles F	Singles M	Couples
	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)	Coeff. (S.E.)
	(0.053)	(0.059)	(0.061)	(0.063)	(0.069)	(0.067)	(0.086)	(0.130)	(0.074)
4th quintile income	0.182**	0.292***	0.241***	0.170*	0.294***	0.229***	0.210**	0.051	0.147***
	(0.075)	(0.069)	(0.047)	(0.088)	(0.075)	(0.055)	(0.099)	(0.118)	(0.054)
5th quintile income	0.090	0.299**	0.427***	0.087	0.264**	0.423***	0.292*	0.173	0.390***
	(0.119)	(0.121)	(0.048)	(0.123)	(0.132)	(0.054)	(0.149)	(0.156)	(0.067)
Observations (Number of households)	1133 (441)	928 (351)	1614 (598)	850 (319)	718 (257)	1275 (497)	591 (215)	349 (133)	887 (345)
R-squared	0.320	0.273	0.332	0.320	0.281	0.313	0.388	0.361	0.343

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Clustered standard errors in parentheses (at the household level). categories as in previous analyses. Time dummies are included. The maximum age in the sample is 93 years

6 Conclusion and Discussion

Does knowing more about financial concepts imply consuming more? Based on our findings we can provide a positive answer for consumption levels.

Based on our theoretical model, we predict a positive relationship between consumption growth and financial literacy and between consumption levels and financial literacy. Our empirical findings concerning these relationships are threefold: Firstly, we find a positive association between (self-assessed) financial literacy and non-durable consumption levels for men in couples. Sensitivity checks show that the financial literacy of men appears to be relevant for men younger than 65 years and their self-assessed knowledge is relevant for men above 65 years. For single women, and not for women in couples, our empirical evidence is only in weak support of an association between financial literacy and non-durable consumption, and which is mainly driven by single women over 65 years of age. Secondly, our findings are in strong support of an associations between 'objective' financial literacy and the level of food consumption for all household types (single male, single female, couples). We find no evidence for an association between self-assessed financial literacy and food consumption. Thirdly, based on single and couples' households combined, the estimation results of the Euler equation do not provide evidence in favour of a positive association between consumption growth and (self-assessed) financial literacy.

The consumption growth estimates computed by Jappelli and Padula (2017) were much higher than ours: Jappelli and Padula found a positive and statistically significant correlation between consumption growth and financial literacy scores, which implies that one more correct financial literacy question is associated with 5.3 percentage points higher consumption growth. In contrast, we do not find evidence for a (negative or positive) correlation between consumption growth and financial literacy. A possible explanation could be that our observation period was longer—it included five waves within eight years whereas Jappelli and Padula used two waves of consumption data observed within three years, albeit that they had a large sample. Furthermore, although the observation periods of our study and the one of Jappelli and Padula partially overlap, household consumption patterns in the Netherlands and Italy are quite different in the post-crisis period. According to OECD data (OECD, 2018b), aggregate household consumption growth in the Netherlands has been volatile between 2008 and 2014, ranging from − 2% to 1% and being relatively stable around 2% from 2014 onwards. The trend for Italy looks similar: Between 2008 and 2010, annual consumption growth ranged from − 1.6% to 1.2%. In 2012, consumption growth experienced a deep of − 4% and from 2014 on, like in the Netherlands, and Italian consumption growth remained positive albeit at least 0.2 percentage points lower than in the Netherlands. Comparing those figures to our results makes us confident that the estimates of the Euler equation are quite plausible. It is rather surprising that the estimates of Jappelli and Padula (2017) for the period of 2008–2010 turn out so high at times with unusually low interest rates.

In the light of Deuflhard et al. (2018) who found that financial literacy is responsible for an increase of 12% (compared to the median interest rate of 2.5% in 2005) in Dutch households' individual returns on savings accounts, our

estimates (which ranged from 2.8 per cent till 5.6%) did not deviate much considering that the interest rates dropped significantly since the financial crisis. Naturally, we cannot translate the estimates of Deuflhard et al. directly to our estimates as the latter concern returns to savings and the former encompass returns to savings and other investments. However, the majority of investment activities concerns savings accounts: Deuflhard et al. (2018) state that in the DNB Household Survey (DHS), "savings accounts are owned by 82% of all Dutch households" (p. 1) and that the ownership rate for directly held stocks is merely 12%.

We would like to stress that we do not claim to estimate causal effects because we do not have suitable instruments for financial literacy to do so. Further research should pay more attention to the endogeneity problem surrounding financial literacy. However, we chose to put the focus in this paper on the theory behind the relation between consumption (growth) and financial literacy and to carefully construct different consumption measures. As briefly mentioned in the results section of this paper, we already conducted some analyses using several instruments (number of books in the household, occupation of mother and father of the respondent) and came to similar conclusions as when applying a least squares estimator. As with most studies using consumption data, the period we studied was relatively short, which brings along econometric issues when estimating the Euler equation (Attanasio & Low, 2004). Furthermore, as the first years of our observation period were immediately after the financial crisis and we dispose of self-reported (not observed) consumption data, respondents might have been influenced by the unstable economic climate and under- or over-reported expenditures.

Financial literacy and financial education constitute a relevant topic from a policy perspective, especially given that more financial decisions need to be borne by individuals rather than the state. We would advise to financially educate women: In Sect. 6 (Table 10), when analysing consumption levels for different age groups, we found that for single senior women, it could pay off to have a higher financial literacy level. As we found that the financial literacy level of men is dominant for couples, the shock is arguably even higher when a man leaves the couples household (be it by choice or unfortunate circumstances) leaving the woman alone. That implies that the education should start already at the beginning of the life cycle so that women could acquire more knowledge and most of all confidence for making financial decisions jointly with their partner or on their own. It is hard to say though whether the focus should lay more on conveying knowledge or on teaching independence and confidence. We believe that accumulating knowledge also has an independent impact on one's confidence.

Finally, we would like to share some directions for future research. Relaxing the assumption of full certainty as in Lusardi et al. (2017)—but applied to consumption levels rather than wealth inequality—and controlling for time preferences and risk preferences, can help to distinguish between different types of households. This, in turn, could help crystallise the effect of financial literacy on financial decision making even better. One could distinguish then between rational and myopic households, risk-averse and risk-loving households. Furthermore, observing financial literacy and its self-assessment in several waves as in Jappelli and Padula (2017)

could enable us to endogenize financial literacy and analyse the returns to investing in financial literacy.

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