Women, confidence, and financial literacy

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Abstract
The literature documents robust evidence of a gender gap in financial literacy: Women consistently show lower levels of financial literacy than men. We have devised two surveys to investigate whether this gender gap is the result of lack of knowledge or lack of confidence. Our findings show that women are less confident in their knowledge than men. They disproportionately answer "do not know" to financial knowledge questions, even if they know the correct answer. We develop an empirical strategy to consistently estimate whether the respondent knows the correct answer. Using this improved metric for knowledge, the gender gap diminishes by about half but does not disappear. An important implication of our findings is that traditional financial literacy measures are plagued by confidence bias or measurement error. We show that it is important to include improved knowledge measures in regression analyses. Corrected measures of financial literacy are important to explain household financial behaviors such as stock market participation and retirement planning.

Keywords: financial literacy, gender difference, financial decision-making, measurement error
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1. Introduction

Women show consistently low levels of financial literacy. They are less likely to answer simple financial knowledge questions correctly, they are more likely to answer "do not know" to those questions, and they rate themselves lower than men in terms of self-assessed financial literacy. This is true across countries and measures of financial knowledge, as well as across socio-demographic characteristics (see, e.g., Bucher-Koenen, Lusardi, Alessie, and Van Rooij, 2014, and OECD, 2013, for overviews). It is particularly striking that financial literacy levels seem to be low among young women who are well educated and have strong labor market attachment. Even women from an elite American college show considerable lack of financial expertise (Mahdavi and Horton, 2014).

The persistent gender gap in financial literacy may be the result of women feeling less confident in their financial knowledge and thus more inclined to answer "do not know." There is ample evidence that women are less confident than men in many situations, in particular in situations related to finance (see, e.g., Beyer, 1990; Barber and Odean, 2001). Some studies indicate that while men appear to be over-confident, women seem under-confident (see Dahlbom et al., 2011). In the context of financial knowledge, Chen and Volpe (2002) find that female college students are less confident and enthusiastic about financial topics. Webster and Ellis (1996) provide evidence that, even among financial experts, women show lower self-confidence in financial analyses compared to men.

This is consistent with the evidence provided by the self-assessed knowledge responses in our surveys, which shows that some of the women who respond with at least one "do not know" give themselves high knowledge assessments (see Bucher-Koenen, Lusardi, Alessie, and Van Rooij, 2014). Thus, irrespective of the fact that they have the inclination not to answer specific financial literacy questions, women still consider themselves financially competent. So the central question is, do those (women) who answer "do not know" know the answer but lack confidence in their knowledge?

In order to investigate this question, we designed a simple experiment with the Dutch DNB household Survey (DHS). The objective is to understand what drives the gender gap in financial literacy and in particular what drives the gender difference in the "do not know" responses. Our first hypothesis is that by offering a "do not know" option among the multiple-

choice answers to the financial knowledge questions, we introduce noise in that other characteristics (specifically gender) that affect the propensity to reply with "do not know" enter the literacy measure. Specifically, we ran two surveys among the DHS respondents with a six weeks difference in between. In the first survey, we ask respondents the financial literacy questions with the option (as part of the multiple choice answers) of a "do not know" reply. We then follow these respondents over time and ask the same knowledge questions again, but this time taking away the "do not know" option and adding a follow-up question to assess how confident respondents are in their answers. These new set of data will allow us to dissect the answers to the financial literacy questions and examine the drivers of women's "do not know" responses. Our second hypothesis is that by improving the measurement of financial literacy we can estimate the effect of financial literacy on financial behavior more precisely and eliminate some of the bias plaguing those estimates.

Thus, the central contribution of this paper is that we develop a strategy, based on two survey waves, to consistently estimate whether the respondent truly knows the correct answers to the financial literacy questions. In doing so, we improve the measurement of financial literacy and can solve some of the problems existing in the current literature. Our main result is that women know less than men but they know more than they think they know. That is, if we take away the "do not know" option, women are very likely to give correct responses to the financial literacy questions. At the same time, women appear to be less confident in their answers. Thus, the gender gap in financial literacy is driven by both lower knowledge and lack of confidence. Our results have two implications: First, there should be financial education programs that are tailored to women. They should convey information as well as instill confidence in women of their knowledge and decision-making abilities. The second implication is methodological: when measuring financial literacy in surveys, researchers have to consider systematic bias induced by different response behavior.[1] We suggest alternative strategies to improve financial literacy measurement.

The paper proceeds as follows. In the next section we present the data and the experimental design. In section 3 we show descriptive results. In section 4 we propose a strategy for measuring financial literacy if there are differences in confidence that are heterogeneous

[1] This problem has already been widely discussed in the context of cross-national variation of self-reported health due to different answering scales and reporting styles (see, e.g., Kapteyn et al. 2007; Jürges 2007)

across gender. We explore different financial literacy measures in section 5 and present results for financial behavior in section 6. Section 7 presents some robustness checks and section 8 concludes.

2. The data

2.1 The CentERpanel

We use data from the CentERpanel to investigate financial literacy and confidence among a representative set of Dutch-speaking households. The CentERpanel is an online household panel run by CentERdata, a survey agency at Tilburg University. Participants without internet connection are provided with the equipment enabling them to participate.[2] We include all panel members who are household heads and their partners in the sample. Respondents are age 18 and older. The data used in our study are collected between May and July 2012. We are able to merge our data with DNB household survey (DHS). The DHS is an annual survey among the CentERpanel on income, assets and debt, work, health and economic and psychological concepts related to savings behavior.

2.2 The experiment

The experimental design is as follows. We ask the same three quiz-like questions on financial literacy to the same respondents twice (see Appendix A1 for the wording of the questions).[3] When we ask the questions for the first time in May 2012 respondents are offered "do not know" and "refuse to answer" options. When we ask the same questions for the second time about six weeks later at the end of June/beginning of July 2012 those options are deleted and respondents have to guess the answer if they do not know it. In this survey, respondents are required to rate the confidence they have in their answer on a scale from 1 – not confident at all to 7 – completely confident after each question.

[2] For more information, see www.centerdata.nl.

[3] These questions have been developed by Annamaria Lusardi and Olivia Mitchell and were first asked to respondents of the American Health and Retirement Study in 2004 (Lusardi and Mitchell 2011a). Since then they have been used widely to measure financial literacy in surveys around the world (see Lusardi and Mitchell 2011b and the papers in two special issues of the JPEF Vol. 104 2011 and Numeracy Vol. 6 2013 for some examples).

2.3 The sample

In the first survey we have 1,748 and in the second survey we have 1,973 participants, including a refresher. For our main analysis we restrict the sample to the respondents who participate in both waves (balanced panel). We allow the household head and their partner to participate, thus for a number of households we have two individual observations (and in the regression analysis we compute standard errors which are clustered at the household level). We drop respondents who did not complete the literacy surveys (30 respondents; 1.35% of the initial raw sample). The reduced sample contains 1,532 respondents for all our analyses; 861 (56.2%) are men and 671 (43.8%) are women.[4]

Before we show our results we would like to make two important points based on the unrestricted, i.e. unbalanced, sample:

1. Attrition: We test for attrition between the waves conditional on financial literacy. Specifically, we look at the average number of correct answers in the first wave and partition the sample into those who participate only in the first wave and those who participate in both waves. We do not find a systematic difference in the financial literacy of those groups. Thus, we conclude that respondents do not drop out systematically after the first survey because they are uncomfortable with answering the financial literacy questions. The same is true for attrition based on gender. Men and women both drop out after the first wave with equal probability.

2. Learning: Since we ask the same questions twice to the same respondents with only a six weeks difference one might be worried about learning effects. We can test for learning by comparing the probability to give correct answers in the second wave for the refresher sample who participate only in the second wave with the panel cases who participate in both waves. There is no significant difference in the answering behavior of those two groups in the second week. Thus, we feel confident that learning effects are not confounding our results.

3. Descriptive results

3.1 Comparing answers across waves

[4] The sample used in the regression analyses may vary slightly due to missing values for some control variables.

In table 1 we present the answers to all financial literacy questions for both the first and the second survey separately for men and women.[5]

[Table 1 - Tabulation of literacy responses in wave 1 and 2 - about here]

In the May survey for the interest question, men report more correct answers than women (91.9 % vs. 84.4%, see table 1 panel A). Thus the gender gap in giving the correct answer is around 7.5 percentage points. Women are more often incorrect, but more importantly they report a higher number of do not know (DK) answers. In the July survey we ask the same question without the DK option. The number of correct answers increases significantly to 94.7% for men and 91.2% for women. The number of incorrect answers also increases. However, overall the gender difference decreases to 3.5 percentage points. Note that the number of refusals is very limited. Hence, in the further analysis we lump this category together with the 'do not know' responses. If we condition the answers of wave 2 on the wave 1 responses, it is of particular interest how accurate the wave 2 responses are for those who stated do not know in wave 1 (see table 2). It appears that the majority of this group is able to provide the correct answer when forced to provide an answer, which suggests that they are not simply guessing the answer.[6] Around 70% of both men and women who said "do not know" in the first survey are able to correctly answer the interest question in the second survey.

[Table 2 - Tabulation of wave 2 responses conditional on wave 1 responses - about here]

The inflation question appears to be somewhat more difficult to answer. The number of correct answers is lower and the gender gap is larger at more than 9 percentage points (see table 1 panel B). Two thirds of the gender gap is driven by the DK's although also the number of incorrect answers is somewhat higher among women. When forced to answer, the gender gap diminishes from 9 to 6 percentage points. This is a result from the fact that the group that provides a DK answer is often able to provide the correct answer, when forced to make a

[5] The statistics presented in this paper are not weighted. We also used sampling weights but found only very small differences.

[6] We use a χ^2-test to test for random answering. Random answering is rejected at 0.1% significance.

choice.[7] Nevertheless, the men within the DK provide more often a correct answer when forced to make a choice (67% for men versus 62 % for women).

The third question relates to risk diversification. The proportion of DK's is high for both men and women, but especially for the latter group. More than half of the women report they do not know the answer (54.7 %) compared to 30.1% for men. As a result, we measure a gender gap of 27.5 percentage points in the probability to give a correct answer for this question. Strikingly, when forced to make a choice the gap shrinks to 9 percentage points. Both the majority of women and men who state DK appear able to answer the question correctly.[8] The proportion of correct is higher for men than women (72.6 versus 67.7 %).

All in all, the probability to give a correct answer significantly increases for men and women after deleting the DK option. Panel D of table 1 shows the number of correctly answered questions. The probability of giving three correct answers increases from 58.1% to 74.9% for men and from 29.4% to 60.1% between the first and the second survey. The gender gap in financial literacy decreases by about half from almost 29 to around 15 percentage points. Conditional on responding with "do not know" in the first week both men and women are likely to give a correct answer in the second week for the three questions.

We confirm a gender gap for financial literacy. Partly, this is due to the fact that women more often state they do not know when given the option. When men and women are forced to answer, the gender gap decreases (but it does not disappear). This could be due to two reasons. First, those who say they do not know may actually signal that they are not absolutely sure about the correct answer, while at the same time have a high likelihood of being correct. Second, the gender gap may decrease simply because people really do not know but may provide the correct answer by chance. As the group of women stating do not know is larger the gender gap will also decrease because more women than men are forced to guess and thus also the number of additional correct answers will increase more for women than for men. Thus in the next section we would like to understand the relationship between answering behavior and confidence a bit better.

[7] Random answering is rejected at 0.1% significance.
[8] Random answering is rejected at 0.1% significance.

3.2 Confidence in financial literacy

As mentioned in the experimental design in the second survey (without the do not know option) after each of the three questions respondents evaluate how confident they feel about their answer. Evaluations are on a scale from 1 – not confident to 7 – completely confident. We report answers for all three questions separately for men and women in table 3. Overall we confirm that women are significantly less confident in the answers that they give to the financial literacy questions than men (see column "Total" for men and women). While among men a large fraction is very certain about giving the correct answer (ratings of 6 or 7), this is not true for women. They report much lower levels of confidence. Comparing the ratings for the three questions shows that respondents are fairly certain about their answers to the interest and inflation questions. What is a bit surprising is that ratings for the risk question are relatively low, even though many respondents give the correct response. Overall, the lower confidence ratings of women are consistent with the finding that women provide more often a DK answer.

[Table 3 - Confidence - about here]

We evaluate the confidence levels given after the second survey conditional a respondent's answers to the same questions in the first second survey. This allows us to see if those responding with DK in the first survey are less confident in their answer after the second survey, when they are forced to reply. The results of this exercise can be summarized as follows: Conditional on giving a correct answer in the first survey, women are significantly less confident than men in their answer in the second survey for all three questions. Thus, even when they give the correct answer women are not confident. For the more difficult risk question, conditional on giving an incorrect answer in the first wave women are significantly less confident in their answer in the second wave compared to men. Thus, even when they do not know men are more confident than women. The effect is not significant for the first two questions due to the small number of incorrect answers. Finally, conditional on a DK answer in the first survey, women are much less confident in their reply in the second survey compared to men for the risk question. Again the effect is not significant for the first two questions due to the much lower number of DK responses. Finally, we ran regressions using DK responses to the questions as dependent variables and the confidence rating as well as various background characteristics as controls. There is a high correlation in the probability to

answer with "do not know" in the first survey and the level of confidence in ones answer when forced to pick an option in the second survey for all three financial literacy questions.[9]

Summarizing, the financial literacy scores in May reflect both knowledge and confidence in answering. In July, respondents are forced to answer, providing a knowledge measure that is not confounded by confidence. However, at the same time people who do not know the answer are forced to guess an answer, thus the July measure also contains measurement error and is upward biased. Below, we propose measures for true knowledge with less measurement error using information from both surveys.

4. Modeling true financial knowledge and confidence

The descriptive statistics show that the respondents and in particular women are often uncertain about their answer. If offered a Do not know option respondents seem to pick this option if they actually know the answer but are not sure about it. This leads to a systematic bias in the measurement of financial literacy. On the other hand sometimes respondents seem to pick an answer randomly. As these answers may be either correct or incorrect by chance, just counting the number of correct answers creates noisy knowledge measures. We need to differentiate 'true knowledge', 'confidence', and 'guessing' by respondents to calculate an index with minimal measurement error. For this purpose, we construct a measure of 'true financial knowledge' based upon the specific structure of the two surveys using respondents' confidence in their anwers to correct for guessing. We define the following two latent variables:

$\tilde{y}_{ik} = 1$ if respondent i 'knows' the correct answer to question k ("true knowledge"),

$\tilde{y}_{ik} = 0$ otherwise;

$sure_{ik} = 1$ if respondent i is sure about his/her answer on question k; $sure_{ik} = 0.5$ some intuition but not completely sure; $sure_{ik} = 0$ totally not sure ('random guessers').

The sure variable discriminates respondents who are confident/sure about their answer, from those who have a strong intuition but are not completely confident to those who are clueless and can only guess for the correct answer.

[9] In addition, lower educated and lower income respondents are more likely to choose the DK option in the third literacy question.

4.1 The identification of true knowledge

We are ultimately interested in explaining $P(\tilde{y}_{ik}=1)$ ('true knowledge'). Obviously, we do not observe $\tilde{y}_{ik}$ nor do we observe exactly $sure_{ik}$, but we do observe proxies for this variable (see below) and we do observe the three following dummy variables: $y_{ik}^{m}=1$ if respondent i answers the 'May' literacy question k correctly, $y_{ik}^{m}=0$ otherwise; $dk_{ik}^{m}=1$ if respondent i answers the 'May' literacy question k with 'don't know', $dk_{ik}^{m}=0$ otherwise. Notice that by construction $P(y_{ik}^{m}=1, dk_{ik}^{m}=1)=0$; $y_{ik}^{j}=1$ if respondent i answers the 'July' literacy question k correctly, $y_{ik}^{j}=0$ otherwise.

Suppose we make the reasonable assumption that if people know the answer they do not randomly guess:[10]

$$P(\tilde{y}_{ik}=1, sure_{ik}=0)=0 \tag{1}$$

Now, we assume that the following relationships exist between the latent variables $\tilde{y}_{ik}$ and $sure_{ik}$ on the one hand and the three easily observable variables $\left(y_{ik}^{j}, y_{ik}^{m}, dk_{ik}^{m}\right)$ on the other hand:

1. $\tilde{y}_{ik}=0, sure_{ik}=1 \Rightarrow y_{ik}^{j}=0, y_{ik}^{m}=0, dk_{ik}^{m}=0$
2. $\tilde{y}_{ik}=1, sure_{ik}=1 \Rightarrow y_{ik}^{j}=1, y_{ik}^{m}=1, dk_{ik}^{m}=0$
3. $\tilde{y}_{ik}=1, sure_{ik}=0.5 \Rightarrow \begin{cases} \text{a) } y_{ik}^{j}=1, y_{ik}^{m}=1, dk_{ik}^{m}=0 \\ \text{b) } y_{ik}^{j}=1, y_{ik}^{m}=0, dk_{ik}^{m}=1 \end{cases}$
4. $\tilde{y}_{ik}=0, sure_{ik}=0.5 \Rightarrow \begin{cases} \text{a) } y_{ik}^{j}=0, y_{ik}^{m}=0, dk_{ik}^{m}=0 \\ \text{b) } y_{ik}^{j}=0, y_{ik}^{m}=0, dk_{ik}^{m}=1 \end{cases}$
5. $\tilde{y}_{ik}=0, sure_{ik}=0 \Rightarrow \begin{cases} \text{a) } y_{ik}^{j}=1, y_{ik}^{m}=1, dk_{ik}^{m}=0 \\ \text{b) } y_{ik}^{j}=1, y_{ik}^{m}=0, dk_{ik}^{m}=0 \\ \text{c) } y_{ik}^{j}=1, y_{ik}^{m}=0, dk_{ik}^{m}=1 \\ \text{d) } y_{ik}^{j}=0, y_{ik}^{m}=1, dk_{ik}^{m}=0 \\ \text{e) } y_{ik}^{j}=0, y_{ik}^{m}=0, dk_{ik}^{m}=0 \\ \text{f) } y_{ik}^{j}=0, y_{ik}^{m}=0, dk_{ik}^{m}=1 \end{cases}$

[10] This also implies that respondents who know the correct answer do not give an incorrect answer by mistake, e.g. if they do not read the question carefully. We are planning to relax this assumption in a future version.

The first two cases consider respondents who are confident on their answer. We assume that confident respondents answer the May and July consistently. The answers are either correct or incorrect, discriminating between confident respondents displaying true knowledge (case 1) or no knowledge (case 2). In addition, there are respondents who are truly knowledgeable but not confident about their answer (case 3). These respondents provide the correct answer or decide not to reveal their intuition and choose the DK option in May. Case 4 considers the respondents who are not confident about the answer and righly so having an incorrect intuition. These respondents provide a wrong answer or decide not to reveal their intuition and choose the DK option in May. Finally, case 5 considers the random guessers, those who are not knowledgeable, yet may decide to pick a random answer. As a result, this group of respondents may display any possible response pattern. For example, they may provide two inconsistent answers in May and July, but by chance they may be correct in both surveys as well.

We are able to identify true knowledge once we have a way to identify $sure_{ik}$, as we will do below. Moreover, it follows from these assumption that the probability that indivual i truly knows the correct answer to question k (subtracting the correct answers that result from random quessing) is equal to:

$$\begin{aligned} P(\tilde{y}_{ik}=1) = P(\tilde{y}_{ik}=1, sure_{ik}=1) + P(\tilde{y}_{ik}=1, sure_{ik}=0.5) = \\ P(y_{ik}^{j}=1, y_{ik}^{m}=1) + P(y_{ik}^{j}=1, y_{ik}^{m}=0, dk_{ik}^{m}=1) - \\ P(y_{ik}^{j}=1, y_{ik}^{m}=1, dk_{ik}^{m}=0, sure_{ik}=0) - \\ P(y_{ik}^{j}=1, y_{ik}^{m}=0, dk_{ik}^{m}=1, sure_{ik}=0) \end{aligned} \tag{2}$$

4.2 The identification of confidence ($sure_{ik}$)

In the July questionnaire we observe the variable $confidence_{ik}^{j}$ (which results from the 7-point scale literacy item specific confidence question). Using this information, we propose the following definition for $sure_{ik}$:

1. $sure_{ik}=1$ if the following criteria are jointly met

   (a) $dk_{ik}^{m}=0$ (a 'sure' person does not use the do not know option)

   (b) $y_{ik}^{j}=y_{ik}^{m}$ (one should answer consistently over time. Notice that we need the May and July data to check this requirement)

(c) $confidence_{ik}^{j} = 6,7$ [11]

2. $sure_{ik} = 0.5$ if

(a) $((dk_{ik}^{m} = 0, y_{ik}^{j} = y_{ik}^{m})$ and $confidence_{ik}^{j} = 3,4,5)$ OR

(b) $(dk_{ik}^{m} = 1$ and $confidence_{ik}^{j} \geq 3)$

3. $sure_{ik} = 0$ otherwise

Thus a sure respondent answers consistently over the two surveys and has high confidence in the answer. A respondent with consistent answers and medium confidence or with medium or high confidence but answering do not know in May is identified as having some intuition, without being sure. The remainder category of random guessing consists of those respondents who provide an inconsistent answer in the two surveys or indicate that they have low confidence in their answer. We can also come up with a more simple definition of the 'sure' variables $sure_{ik}^{j}$ based only on the July information, which enables us to crosstab the variables $sure_{ik}$ and $sure_{ik}^{j}$ in order to have an alternative assessment of the value added of the May information:

1. $sure_{ik}^{j} = 1$ if $confidence_{ik}^{j} = 6,7$
2. $sure_{ik}^{j} = 0.5$ if $confidence_{ik}^{j} = 3,4,5$
3. $sure_{ik}^{j} = 0$ if $confidence_{ik}^{j} = 1,2$

Given the 'observed' value for $sure_{ik}$ we also 'observe' $\tilde{y}_{ik}$ which is defined as follows (in stata language):

$$\tilde{y}_{ik} = (y_{ik}^{j} == 1) * ((y_{ik}^{m} == 1 \& sure_{ik} \geq 0.5) + (dk_{ik}^{m} == 1 \& sure_{ik} == 0.5)) \quad (7)$$

Alternatively, we may proxy true knowledge $\tilde{y}_{ik}^{j}$ using July information only:

$$\tilde{y}_{ik}^{j} = (y_{ik}^{j} == 1 \& sure_{ik}^{j} \geq 0.5) \quad (8)$$

Below, we will compare the measures of true knowledge and the May and July answers to learn about the best way to measure financial knowledge.

5. Exploring different financial literacy measures

5.1 Empirical estimation of 'true knowledge'

[11] We are changing the thresholds for the confidence measure in the robustness checks.

We present the different measures of financial literacy in table 4. Column 1 presents the probability to observe a correct answer from the May questionnaire for each of the three financial literacy questions. As proposed previously this measure could underestimate financial knowledge since individuals with low confidence pick the do not know response even if they know the correct answer. On the other hand illiterate respondents could abstain from using the "do not know" option and just guess. It is then likely that such people give inconsistent answers in the two waves.

[Table 4 – Alternative financial literacy measures - about here]

In column 2 we present the probability of observing a correct answer in July. Since all respondents have to answer the question there is no confounding with confidence, however there might be some random guessing. Thus, some individuals might guess the right answer without actually having the knowledge. Thus, this financial literacy measure is overestimating levels of 'true financial knowledge'. The comparison of column 1 and 2 has been discussed extensively in section 3.

We would like to correct this financial literacy measure by recoding those who correctly guessed an answer without actually knowing the correct answer. This means we construct a combined measure $\tilde{y}_{ik}$ based upon the responses in the May and July questionnaire as defined in the previous section. The result of this correction is presented in column 3. We use information on cross-survey consistency and confidence for the calculation of the new measure. As expected compared to the July measure presented in column 2 this adjustment reduces the probability to observe a correct answer for all of the three questions. The inflation, interest, and risk question are adjusted each by about 3 to 4 percentage points.

In addition to the adjustment for the individual questions we also adjusted the aggregate measure using the same procedure. In May 45.5% of the respondents answered all three questions correctly; this fraction is substantially higher in July (68.4%). The combined May-July ($\tilde{y}_{ik}$) measure is in between: 54.4% of the respondents know the correct answers to all three questions.

In column 4 we provide an additional corrected measure where we do not use information on cross-question consistency, but only confidence and answers in July. This might be a more adequate alternative to measure financial literacy in surveys where running two waves is not feasible. We are discussing results for this measure in section 7.3.

5.2 Exploring different literacy measures: a multivariate regression analysis

To further investigate the different literacy measures, we run ordinary least squares regressions to display the relation between the different financial literacy measures and a number of background variables including gender, marital status, education and income. The three literacy measures are: 1) the July measure (measures literacy but not confidence; contains a non-classical measurement error), 2) the May measure (measures literacy and (implicitly) confidence, and 3) the $\tilde{y}_i$ measure (based on the May and July questionnaire). All financial literacy variables are standardized so that they have mean 0 and variance 1 which facilitates the comparison of the regression results across specifications. Table 5 reports the results.

Focusing on the gender differences in columns 1 to 4, we can infer that the raw gender differential is largest for the May measure and smallest for the July measure. As women are less confident than men, they more often use the 'don't know option' than men. According to the July (May) measure, men answered on average 2.71 (2.44) questions correctly (out of 3) and women 2.52 (2.00) questions, i.e. a difference of 0.19 (0.44). The raw gender differential is equal to 0.32 for the combined May-July measure.

Next, we include personal background variables to explain the variation in the literacy measures (columns 5 to 8). For all literacy measures we find that financial literacy is highest for the middle age categories and lowest for the younger (below 35 years) and older (above 65 years) respondents. While we cannot differentiate time and cohort effects based on our cross-section, this is consistent with a pattern of accumulating knowledge due to schooling and experience when young while the process of declining cognitive abilities start to dominate when old. This hump-shaped pattern is typically found in the empirical literature on age and knowledge accumulation (Agarwal et al., 2009, Lusardi and Mitchell 2011b).

Apart from age, marital status, education, income and gender contribute to the explanation of the variation in the measures of financial literacy as well. Singles (without children) and those with higher income and higher education display better scores. Single parents (predominantly divorced female respondents), however, display low literacy and are thus vulnerable to poor financial decision-making. For all measures of literacy, we still find that women score worse than men. However, not surprisingly, the gender differentials have become smaller due to the inclusion of socioeconomic background variables as women on average have lower education and income.

It appears that the education and income gradient are the strongest (weakest) for the May (July) measure. The higher educated/income are more confident/use less often the DK option in May than the lower educated/lower income respondents.[12] This is confirmed by a regression of the difference between the July and May literacy measure on background characteristics (column 9). Women, lower educated and lower income respondents display a larger improvement in literacy scores in July when forced to give an answer. We obtain a similar result when we consider the difference between the July and the combined May-July measure (column 11). This is consistent with a higher level of illiteracy for those groups. By guessing, women, lower educated and lower income groups are able to improve their scores relatively much. Interestingly, the difference between the May-July and May measure only depends on the female dummy: women fare worse in May while this is not the case for lower income and lower educated groups. This suggests that women state DK too frequently (if their knowledge is compared to men), but lower educated and lower income groups are correct to state they do not know.

Summarizing. The financial literacy scores in May reflect both knowledge and confidence in answering. In July, respondents are forced to answer, providing a more clean measure of knowledge. However, the July measure is likely to be a noisy proxy for true knowledge as respondents who do not know the answer are required to guess an answer. The combined May-July measure minimizes both the measurement error and the bias due to confidence which in particular makes a difference for female respondents.

[12] See Footnote 10.

6. Estimating the effect of true knowledge on economic decisions

The complications in measuring knowledge may not be innocuous for research on household economic decision-making. Our next step is to find out whether the different measures of literacy behave differently in estimating the effect of financial literacy on stock market participation and retirement planning. The objective is to check how our different measures of financial literacy perform in these estimations and what we can learn about the measurement error plaguing these estimates. The literature firmly documents an effect of financial literacy on economic outcomes. Financial literacy is empirically shown to increase stock market participation, planning for retirement and contribute to wealth accumulation. However, the evidence in this paper suggests that the traditional financial literacy measures employed in these studies jointly measure true knowledge and confidence. Therefore, the coefficients found in previous studies do not necessarily reflect the impact of true knowledge alone.

Below, we will investigate how the use of different measures of literacy impacts the association between financial literacy and economic outcome variables. We use stock market participation and retirement planning as economic outcome variables as these relationships have been extensively documented in the literature. First, we run a regression using the traditional measure of financial literacy (our May measure) and thereafter we compare the results with alternative regressions based on the improved measures for true financial literacy. In discussing the results, we focus on the literacy coefficient as well as the gender coefficient as the error in the traditional measure due to differences in confidence is shown to be related gender.

6.1 True knowledge and stock market participation

Financial literacy has been shown to influence stock market participation previously (see, e.g., Van Rooij et al., 2011). We define a dummy for stock market participation that equals 1 if the respondents hold investments in stocks and/or mutual funds and 0 zero otherwise. There is a strong negative correlation between gender and stock market participation: 33.9% of men in our sample own stocks and 20.2% of women (Table 6; column 1). If we control for the usual background characteristics and the traditional financial literacy measure, we find a strong association between financial literacy and stock market participation, while the gender effect becomes much smaller but still significant (column 3). Compared to men, women have a 4.69 percentage point lower chance to own stocks after controlling for the usual background

information including income, education, literacy etc. A 1 standard deviation higher level of literacy results into a 9.14 percentage point higher probability to own stocks (comparable to the effect found in the literature). While this is a sizeable effect, this coefficient may reflect both confidence as well as knowledge.

Next, we run a regression using the financial literacy measure from July which is a pure measure of knowledge and is not impacted by a lack of confidence confounded by confidence. While still significant the literacy effect reduces to a 5.41 percentage point higher likelihood of investing in the stock market for a 1 standard deviation higher level of literacy (column 2). Note that the female coefficient becomes more negative as it is now likely to pick up part of the confidence effect; women being less confident have a lower chance to invest in stocks. The July measure for financial literacy is surrounded with measurement error due to guessing by respondents who are obliged to provide an answer. As a result, the literacy coefficient may be biased towards zero behavior. Indeed, once we use the corrected May-July measure, the literacy coefficient is somewhat higher (column 4). The difference with the coefficient for the July literacy measure in column 2 is statistically significant.

6.2 True knowledge and planning for retirement

Financially more sophisticated individuals are more likely to plan for retirement than those with low levels of literacy. This relation has been documented for many different countries (see Lusardi and Mitchell, 2011b for an overview). This is important for the financial wellbeing of the elderly as planning literacy is shown to be an important predictor for wealth accumulation (Ameriks et al., 2003, Lusardi and Mitchell, 2007, Van Rooij et al., 2012).

We have included the following question in our survey: *How much have you thought about retirement: A lot, some, little, or hardly at all?* We create a dummy variable that takes the value 1 if the respondent has thought 'a lot' or 'some' about retirement (indicated by 69 percent out of 1528 respondents), and 0 otherwise.[13] While one may argue that this is a crude measure of retirement preparation, it is shown to be related to typical retirement planning activities such as calculating retirement savings needs (Van Rooij et al., 2011b) and it enables us to compare our findings with previous results (Alessie et al., 2011).

[13] There were very few DK responses.

Table 7 shows the results for a regression of retirement planning on financial literacy and background variables follows the same format as before. The raw correlation between gender and retirement planning reveals that women plan significantly less often for retirement: 73.9% of men versus 62.2% of women (column 1). Part of the difference is explained by financial literacy and the other background variables. The female coefficient halves in the regression using the May measure for financial literacy (column 3). One standard deviation higher level of literacy corresponds with a 5.17 percentage point higher likelihood to think about retirement. Yet, the knowledge effect may be contaminated by a confidence effect as both lack of knowledge and lack of confidence shy individuals away from retirement planning (Van Rooij et al., 2012). Using the number of correct answers in the July survey, the literacy coefficient becomes smaller and statistically insignificant (column 2). The gender coefficient shows a larger negative effect for women on the likelihood to plan for retirement, which may be related to the lower confidence among women. Including the combined May-July measure for financial literacy that is less sensitive to measurement error, the literacy coefficient increases to 0.0436 and is statistically significant at all conventional significance levels (column 4). All in all, the differences between the regression outcomes are qualitatively similar to those for the stock market participation regressions. These outcomes are in line with the hypothesis that the traditional literacy measure is measuring both knowledge and confidence and that the alternative July measure does capture pure knowledge but at the cost of measurement error due to guessing. The corrected measure combining the information from both surveys seems best fit to measure knowledge with less measurement error.

7. Extensions

7.1 Robustness

We have included the basic demographic background variables that are typically included in regressions explaining stock market participation and retirement planning. A possible criticism is that a number of potentially important explanatory variables are missing. Arguably, heterogeneity in risk aversion may explain an important part of the variation in stock market participation. Similarly, individuals are characterized by large differences in patience and ability to sacrifice current for future consumption which can explain a different propensity to plan for retirement. Moreover, wealthier individuals are more likely both to invest in stocks and to plan for retirement. The richness of the annual DHS-modules enables us to include household wealth and variables measuring risk and time preferences. However,

there is a cost in terms of a loss of observations as a result of merging our own survey with different survey modules.

The DNB household Survey contains a number of questions in the psychological concepts module that may serve as a proxy for risk aversion. Respondents are asked to indicate for a number of statements to what extent they agree or disagree on a scale from 1 to 7 where 1 indicates 'totally disagree' and 7 indicates 'totally agree'. In Table 8 we incorporate the responses to the statements 'I am prepared to take the risk to lose money, when there is also a chance to gain money' (the variable *spaar6*).[14] While this type of questions has been used regularly in regressions on stock market investments (e.g. Kapteyn and Teppa, 2011), one may argue that these are endogenous to stock market participation and one should be careful with the interpretation of the results. We do however not focus on the risk aversion coefficients as our objective is to investigate whether the estimates for the literacy coefficients are sensitive to the inclusion of risk aversion. Note that we do lose some observations as we do not have a full match between the participants in our literacy surveys and the psychological module. We followed the following strategy: we first merge our dataset with the 2012 psychological questionnaire which is filled in in the same year as the May and July financial literacy questionnaires. Next, in order to gain observations we replaced missing values in the spaar1 questions with answers from the two adjacent waves (first, the 2011 wave and after that 2013 wave). In the end we end up with 1449 observations and lose a limited amount of observations (83).[15] Due to a low number of observations in the two top categories (6 and 7) containing the respondents who are most willing to take risk we merge these respondents together with those respondents choosing the next highest category 5.

Table 8 shows that the estimates of the financial literacy coefficients are quite similar, albeit slightly smaller, and show qualitatively the same patterns among the different measures compared to the previous estimates. However, we obtain smaller and insignificant estimates

[14] We performed similar robustness tests using the responses to the statements 'I think it is more important to have safe investments and guaranteed returns, than to take a risk to have a chance to get the highest possible returns' (the variable *spaar1* in DHS) and 'I do not invest in shares, because I find it too risky' (the variable *spaar2*). The conclusions are similar for both stock market participation and retirement planning with the most important difference that the gender coefficient is somewhat more negative and mostly significant once we include spaar1 in the stock market participation regression.

[15] This is partly due to the restriction that only respondents with net household income in excess of 10000 euro are given these questions.

for the gender effect. Apparently, the gender effect can be explained by risk aversion. While insignificant, the pattern is the same as before. The gender coefficient in the regression with the May measure for literacy is higher than when the other measures are included. This is consistent with the May measure being affected by confidence while the gender effect is affected by confidence in the other regressions. The results also indicate that less risk averse people have a higher tendency to invest in the stock market. In the retirement planning equations the risk aversion measures do enter significantly as well (Table 10). More risk averse households are more likely to plan for retirement. Again the financial literacy coefficients are somewhat smaller (and insignificant for the noisy July measure), but qualitatively the pattern remains unchanged. The same applies to the gender coefficient. Women are less likely to engage in retirement planning than men. Using the May measure of financial literacy (which incorporates the lower confidence of women), the gender coefficient is insignificant.[16]

Next, we investigate the sensitivity of the literacy coefficients once we control for time preferences. As for risk preferences we use information from the psychological concepts module in the annual DNB household Survey to proxy individual time preferences. After respondents are explained in a short introduction that some people spend their income immediately and others save money in order to have something to fall back on, they are asked to indicate what they 'do with money that remains after having paid for food, rent and other necessities', on a 7-points scale where 1 means 'I spend all my money immediately' and 7 means 'I save as much as possible' (the variable *uitgeven*).[17] Tables 10 and 11 show that time preferences do not enter significantly in the stock market participation equations, but they do in the retirement planning equations. As expected, patience and planning for retirement are positively correlated. In both cases the differences in the financial literacy estimates are marginal and the gender coefficients become slightly more negative without changing the differences across the specifications using different literacy measures.

[16] As in the stock participation regressions, the results are barely affected, once we include the spaar1 or spaar2 variables as proxy for risk aversion in the retirement planning regressions.

[17] We performed similar robustness tests using the information from one of the questions in which respondents are asked to indicate to what extent they agree or disagree that these statements are characteristic of their personality. Response categories are on a scale from 1 to 7 where 1 indicates 'extremely uncharacteristic' and 7 indicates 'extremely characteristic'. In particular we incorporated the responses to the statement 'I think about how things can change in the future, and try to influence those things in my everyday life' (the variable *toek01* in DHS) with qualitatively similar conclusions for the literacy and gender coefficients.

Apart from including risk and time preferences, we run additional robustness tests. For example including numeracy, as a proxy for ability (which could be an omitted variable), or taking account of who is responsible for the household decisions. While some of these variables do help explaining the heterogeneity in stock market participation and retirement planning, they do not affect the main conclusions on the literacy estimates and gender.

7.2 Instruments for financial literacy

Knowledge may increase as a result of investing in the stock market or planning for retirement. Investors for instance are likely to gather information before they buy or sell stocks and mutual funds and will more closely follow the stock market than non-investors. Retirement planners may try to calculate how much they need to save for retirement and inform themselves about ways to do so. Thus, one cannot give a causal interpretation to the positive financial literacy coefficient in the OLS regressions of stock market participation and retirement planning. Below, we report the results of regressions similar to the previous regressions but now based on GMM models using financial education in high school as instruments for financial literacy to identify the causal effect of financial literacy on financial behavior. The instruments we are using are similar to the instruments used in Van Rooij et al. (2012) and are based upon information on exposure to economic education when young. First, respondents are asked how much attention has been paid to economics during their high school education. The difference to the question used previously is that we specifically refer to high school which makes the instrument more precise. Second, respondents report if economics was part of their final high school exam.

We measure exposure to education before entering the job market using the responses to the questions 'How much of your education in high school was devoted to economic subjects?' with the following answer categories: 'a lot', 'some', 'little', 'hardly at all', 'not applicable, I did not complete high school', 'do not know' or 'refuse to answer'. We distinguish three groups. The first group consists of respondents who did not get economics in high school answering 'hardly at all' or 'not applicable'. This is the reference group in our empirical analysis. Second, based on the 'a lot', 'some' and 'little' responses we create a dummy variable for respondents who were exposed to economics during high school. The third group consists of those who answered with 'don't know' or ' refusal' (very few respondents refused

to answer this question). These two groups have high predictive power for financial literacy as shown by the F-values in the first stage regression which are mostly above 10 (columns 2, 4, 6 and 8 in Tables 12 and 13).

Unless respondents indicate they did not complete high school, they receive the next follow-up question: 'Did you have at least one economics subject in your final examination year?' with the response options 'yes', 'no', 'not applicable, I didn't do a final exam', 'do not know' or 'refuse to answer'. We create an additional instrument dummy variable that takes the value 1 for those respondents who answer 'yes' and the value 0 otherwise. Inclusion of this variable increases the F-value of the first stage regression to well above 10 for most regressions (columns 1, 3, 5 and 7 in Tables 12 and 13). One may argue, however, that the third instrument dummy is not valid as for some students the economic subject in their final exam may have been a choice variable and thus is likely to be correlated with interest in financial matters (interest in financial matters is an omitted variable in our regression) which in turn may affect financial decision making. Therefore, we present the results including and the results excluding this variable in the information set to instrument financial literacy.

Tables 12 and 13 present the GMM results for stock market participation and retirement planning, respectively. Both sets of instruments predict the endogenous financial literacy variable reasonably well. We obtain F-values close to 10 for the July measure and in excess of 10 (which serves as the recommended threshold value to avoid weak instruments problems in the literature, see Staiger and Stock (1997)) for the other measures. We interpret this as another sign that the July measure contains considerable measurement error which makes it more difficult to find valid instruments. The Hansen J test results indicate that the overidentifying restrictions cannot be rejected in any of the specifications. The GMM C tests (see Hayashi, 2000) indicate that the financial literacy variable is endogenous to retirement planning. For stock market participation the GMM C tests show mixed results. Using the extended set of instruments, the test suggests that financial literacy is endogenous to stock market participation while using the smaller set of instruments it cannot be rejected that financial literacy is exogenous. The latter result is consistent with previous findings (Van Rooij et al., 2011a).

Focusing on the effect of financial literacy on stock market participation, we find that the GMM estimate of the literacy coefficient is statistically significant at the 5 percent level and

quite similar across specifications (around 0.20). This seems a comforting result as apparently the instruments take care of the measurement error and the differences between the literacy measures become less important when good instruments are available. However, finding good instruments is easier for more accurate measures. Note that the predictive value of the instruments is lowest for the July measure which translates into a less precise estimate for the GMM literacy coefficient. Note that the gender effect is insignificant in all specifications, which suggests that once literacy and socio-demographic variables are controlled for females are as likely to invest in stocks as men. Note however, while being insignificant, the patterns remain unchanged: in the regressions including the May literacy (which jointly measures knowledge and confidence), the impact of the female coefficient is lower than in the other specifications. Turning to the effect of financial literacy on retirement planning, we find largely similar results: the GMM estimate of the literacy coefficient is positive, statistically significant and higher than the OLS estimates. The coefficient estimate is somewhat below 0.5 using the extended set of instruments and somewhat above 0.5 using the limited set of instruments. Now the gender coefficient is positive, suggesting women proportionally more often plan for retirement, although it is mostly insignificant. We have also run the GMM regressions on the extensions discussed in section 7.2 (not reported). The main conclusions are not affected.

7.3 How to measure financial literacy?

From a survey methodology point of view, our findings establish that financial literacy is best measured by combining the two surveys and a confidence measure. In practical applications, having two surveys among the same group of respondents is not always feasible or is simply less attractive in terms of the available research budget. A possible way out is to combine the two surveys into a single survey. The researcher may for instance first provide the literacy question including the DK option. If the respondent chooses the DK options, the same question is offered but excluding the DK option. After providing an answer, either the first or the second time, the respondent is asked for his or her confidence in the answer chosen. However, when a number of financial literacy questions are subsequently offered according to this scheme respondents will learn that they are required to answer the same question when answering DK. As a behavioral response respondents may want to avoid the DK option and answer the literacy questions right away which takes away the value added of the DK option for the researcher. Moreover, this methodology does not capture the information that was retrieved from the inconsistent answers in the two surveys. Another disadvantage of this

approach is that one needs to include three questions in the survey design to learn about the response on one literacy question, which may be problematic if there are constraints to the length of the survey in terms of costs or the duration of filling in the survey.

Alternatively, one could base a literacy measures solely on the information content as contained in the second questionnaire that we fielded in our experiment. This requires two responses per literacy question. A disadvantage is that we lose the information content of inconsistent answering. However, the number of inconsistent responses is limited and the DK answers show a strong correlation with the confidence questions (see Table 3). The extent to which our combined measure based on two surveys is better able to capture true knowledge than a measure using the questions in the second survey only (both the literacy question plus the confidence question) is an empirical question. Below, we will investigate the difference between these two approaches. First, we construct a measure for literacy based upon the literacy and confidence questions in wave two only (as discussed in Section 4.2). Basically, we assume that respondents indicating they are very unsure about their answers are not knowledgeable even if they guess the answer correctly. The analysis in Table 4 shows that this measure is closely related to the measure based on both survey waves. In addition the regression results for stock market participation and retirement planning show that the literacy coefficient becomes somewhat smaller in the OLS regressions (compare column 5 and 4 in Tables 6 and 7). This is consistent with the fact that the measure employing both surveys is better able to filter out guessing and thus has less measurement error. However, note that the measurement error is much lower than in using only the July literacy questions and not the confidence questions (compare column 5 and 2 in Tables 6 and 7). The literacy questions are economically and statistically significantly higher than for the July measure. Overall the results for the alternative methods of measurement based on only the July answers plus confidence are quite similar to those based upon the measure combining both surveys. These findings show that the alternative measure might provide an adequate proxy for true knowledge as measured by the combined measure while it is much easier to integrate in new research designs and with less costs.[18]

[18] In principle one may consider to include a whole lot of literacy questions as well. The distorting effect of measurement error due to random guessing is likely to diminish when respondents have to guess many questions. However, this strategy would most likely require so many questions that it is either not feasible to implement or very costly in terms of question load.

8. Concluding remarks

The literature has documented large and robust gender differences in financial literacy. For example, Lusardi and Mitchell (2011b) find that 22.5% of female respondents in the US were able to answer 3 simple questions on inflation, interest and risk diversification correctly versus 38.3% of the male respondents. These findings are robust across different surveys and different countries (Lusardi and Mitchell, 2011a). This is especially worrisome as women who tend to outlive their husband are at risk of being left on their own in managing their financial security after retirement (Lusardi and Mitchell, 2008). We find that the gender gap diminishes once we force women to answer as they are more likely to state they do not know the answer otherwise. The higher propensity to choose DK is related to a lack of confidence in knowledge. Our results show that conditional on their level of knowledge, women are less confident than men. The gender gap diminishes significantly once we correct the traditional financial literacy measures to get improved measures for knowledge, but the gap does not disappear. By and large, we find that half of the gender gap cannot be explained by confidence and other background variables such as income and formal schooling.

Our findings have important implications both methodological and for the interpretation of economic research and related policy advice. Traditional literacy measures, including a do not know option, capture both confidence and knowledge. This has consequences for the gender coefficient when both gender and literacy are included in regressions explaining financial decisions. Thus one needs to be careful in interpreting literacy and gender effects in this type of regressions. When respondents are forced to answer, literacy measures are not contaminated by confidence and better able to proxy true knowledge. However, this introduces measurement error as respondents who are not knowledgeable are forced to guess the correct answer. We propose an adjusted metric to measure pure knowledge which suffers less from measurement error and show that the different literacy measures have different impact on financial decisions. One could argue that for economic decision-making both knowledge and confidence are important, so that the traditional measures that combine knowledge and confidence are better able to explain the variation in household financial decisions. However, in terms of policy interventions it is also crucial to disentangle true knowledge from confidence. For example, for an effective design of initiatives raising financial education and increasing awareness it is important to figure out whether limited knowledge or low confidence explains a lack of retirement planning. Using our improved measure, we confirm that true financial knowledge contributes to explain the observed

heterogeneity in important household financial decisions as illustrated for investing in the stock market and planning for retirement.

References

Agarwal, S., Driscoll, J., Gabaix, X. and Laibson, D. (2009). The age of reason: Financial decisions over the life cycle and implications for regulation, *Brookings Papers on Economic Activity*, Fall 2009, pp. 51-117.

Alessie, R., Van Rooij, M. and Lusardi, A. (2011). Financial literacy and retirement preparation in the Netherlands, *Journal of Pension Economics and Finance*, vol. 10(4), pp. 527–546.

Ameriks, J., Caplin, A. and Leahy, J. (2003). Wealth accumulation and the propensity to plan, *Quarterly Journal of Economics*, vol. 118(3), pp. 1007–1047.

Barber, B. and Odean, T. (2001), "Boys will be boys: gender, overconfidence and common stock investment", *Quarterly Journal of Economics*, February 2001, pp. 261-292.

Beyer, Sylvia (1990), "Gender differences in the accuracy of self-evaluations of performance", *Journal of Personality and Social Psychology*, 59(5), pp. 960-970.

Bucher-Koenen, T., Lusardi, A., Alessie, R. And Van Rooij, M. (2014), "How financially literate are women? An overview and new insights", Working Paper.

Chen, Haiyang and Ronald P. Volpe (2002), "Gender differences in personal financial literacy among college students", *Financial Services Review*, 11, pp. 289-307.

Dahlbom, L., A. Jakobsson, N. Jakobsson, and A. Kotsadam (2011), "Gender and overconfidence: are girls really overconfident?", *Applied Economics Letters*, 18, 325-327.

Kapteyn, A., and Teppa F. (2011). Subjective measures of risk aversion, fixed costs, and portfolio choice, *Journal of Economic Psychology*, vol. 32(4), pp. 564–580.

Lusardi, A. and Mitchell, O. (2007). Baby boomers retirement security: the role of planning, financial literacy and housing wealth, *Journal of Monetary Economics*, vol. 54(1), pp. 205–224.

Lusardi, Annamaria, and Olivia S. Mitchell (2008). Planning and financial literacy: How do women fare?, *American Economic Review*, 98(2), pp. 413-417.

Lusardi, Annamaria and Olivia S. Mitchell (2011a), "Financial literacy and planning: Implications for retirement wellbeing", in Olivia S. Mitchell and Annamaria Lusardi (eds.), *Financial Literacy: Implications for Retirement Security and the Financial Marketplace*. Oxford: Oxford University Press, pp. 17-49.

Lusardi, A. and Mitchell, O. (2011b). Financial literacy around the world: an overview, *Journal of Pension Economics and Finance*, vol. 10(4), pp. 497–508.

Lusardi, A. and Mitchell, O. (2011c). Financial literacy and retirement planning in the United States", *Journal of Pension Economics and Finance*, 10(4), pp. 509-525.

Mahdavi, M. and Horton, N. (2014), Financial Knowledge among Educated Women: Room for Improvement, *Journal of Consumer Affairs*, 48 (2), pp. 403–417.

OECD (2013), Women and Financial Education: Evidence, Policy Responses and Guidance, OECD Publishing. http://dx.doi.org/10.1787/9789264202733-en

Staiger, D. and Stock, J. (1997). Instrumental variables regression with weak instruments, *Econometrica*, vol. 65(3), pp. 557–86.

Van Rooij, M., Lusardi, A. and Alessie, R. (2011a). Financial literacy and stock market participation, *Journal of Financial Economics*, vol. 101(2), pp. 449–472.

Van Rooij, M., Lusardi, A. and Alessie R. (2011b). Financial literacy and retirement planning in the Netherlands, *Journal of Economic Psychology*, 32, 593-608.

Webster, Robert L. and T. Selwyn Ellis (1996), "Men's and women's self-confidence in performing financial analysis," *Psychological Reports*, 79, pp. 1251-1254.

Appendix

A1. Financial Literacy Questions

1. Set Up Week 1 (May 2012):

1. **Interest:** *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? More than $102 / Exactly $102 / Less than $102 / Do not know/ Refuse to answer*
2. **Inflation:** *Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? More than today / Exactly the same / Less than today / Do not know / Refuse to answer*
3. **Risk:** *Please tell me whether this statement is true or false. "Buying a single company's stock usually provides a safer return than a stock mutual fund." True / False / Do not know / Refuse to answer*

2. Set Up Week 2 (July 2012):

Questions 1 to 3 without the "Do not know" and "refuse to answer" options

After each question – **Confidence**:
On a scale from 1 to 7, How confident are you in this answer? 1-not confident at all ... 7-completely confident

Figures and Tables

Table 1: Descriptive Results (Observations: Men – 861, Women – 671, Total - 1532)

	Survey 1: May 2012			Survey 2: July 2012		
A. Interest:						
	Men	Women	Total	Men	Women	Total
More than 102 euro	91.9	84.4	88.6	94.7	91.2	93.2
Exactly 102 euro	3.0	4.0	3.5	3.7	6.0	4.7
Less than 102 euro	2.0	3.9	2.8	1.6	2.8	2.2
Do not know	2.8	6.7	4.5	-	-	-
Refuse	0.4	1.0	0.7	-	-	-
Total	100	100	100	100	100	100
B. Inflation:						
	Men	Women	Total	Men	Women	Total
More	2.1	2.4	2.2	2.2	2.7	2.4
Exactly the same	3.3	5.4	4.2	4.1	9.8	6.6
Less	89.8	80.6	85.8	93.7	87.5	91.0
Do not know	4.7	10.7	7.3	-	-	-
Refuse	0.2	0.9	0.5	-	-	-
Total	100	100	100	100	100	100
C. Risk Diversification:						
	Men	Women	Total	Men	Women	Total
Incorrect 'right'	7.6	9.7	8.5	17.7	27.0	21.7
Correct 'false'	61.9	34.4	49.9	82.4	73.0	78.3
Do not know	30.1	54.7	40.9	-	-	-
Refuse	0.5	1.2	0.8	-	-	-
Total	100	100	100	100	100	100
D. Overall No. of correct answers:						
	Men	Women	Total	Men	Women	Total
0	3.6	6.6	4.9	0.5	0.8	0.6
1	7.3	16.8	11.5	3.3	6.9	4.8
2	31.0	47.2	38.1	21.4	32.3	26.2
3	58.1	29.4	45.5	74.9	60.1	68.4

Table 2: Answers in July (Wave 2) conditional on answers in May (Wave 1) (Observations: Men – 861, Women – 671, Total – 1532)

A. Interest:		**Men**			**Women**	
Survey May	**incorrect**	**correct**	**don't know**	**incorrect**	**correct**	**don't know**
Survey July						
incorrect	23.26	3.54	29.63	28.3	4.95	30.77
correct	76.74	96.46	70.37	71.7	95.05	69.23
Total	100	100	100	100	100	100
B. Inflation:						
incorrect	41.3	2.72	33.33	30.77	7.02	38.46
correct	58.7	97.28	66.67	69.23	92.98	61.54
Total	100	100	100	100	100	100
C. Risk Diversification:						
incorrect	38.46	10.32	27.38	47.69	12.55	32.27
correct	61.54	89.68	72.62	52.31	87.45	67.73
Total	100	100	100	100	100	100

Table 3: Confidence and Answering behavior in May

	Men (N = 861)				Women (N = 671)			
A. Interest	**incorrect**	**correct**	**DK**	**Total**	**incorrect**	**correct**	**DK**	**Total**
completely unconfident - 1	7.0	1.9	3.7	2.2	3.8	1.4	15.4	2.7
2	2.3	0.9	3.7	1.1	3.8	0.9	5.8	1.5
3	7.0	0.9	7.4	1.4	1.9	1.2	13.5	2.2
4	11.6	1.8	33.3	3.3	18.9	5.5	23.1	7.9
5	4.7	2.3	18.5	2.9	17.0	5.8	11.5	7.2
6	27.9	7.1	11.1	8.3	17.0	19.3	15.4	18.8
completely confident - 7	39.5	85.2	22.2	81.0	37.7	65.9	15.4	59.8
Total	100	100	100	100	100	100	100	100
B. Inflation								
completely unconfident – 1	6.5	1.7	4.8	2.1	7.7	2.2	15.4	4.2
2	10.9	0.7	7.1	1.5	7.7	1.9	15.4	3.9
3	6.5	1.6	9.5	2.2	5.8	4.1	11.5	5.1
4	13.0	2.7	40.5	5.1	17.3	9.8	30.8	12.8
5	15.2	4.8	19.1	6.0	25.0	14.1	15.4	15.1
6	15.2	9.8	4.8	9.9	11.5	19.8	5.1	17.4
completely confident – 7	32.6	78.8	14.3	73.2	25.0	48.2	6.4	41.6
Total	100	100	100	100	100	100	100	100
C. Risk								
completely unconfident – 1	1.5	2.1	6.5	3.4	4.6	3.9	13.9	9.5
2	1.5	0.8	9.1	3.4	6.2	4.8	11.5	8.6
3	0.0	2.6	8.8	4.3	15.4	5.2	13.3	10.7
4	24.6	8.6	34.2	17.7	23.1	23.4	32.3	28.3
5	27.7	20.5	17.1	20.0	33.9	25.1	17.9	21.9
6	20.0	22.7	12.9	19.5	7.7	21.7	7.5	12.4
completely confident – 7	24.6	42.8	11.4	31.8	9.2	16.0	3.7	8.5
Total	100	100	100	100	100	100	100	100

Table 4: Alternative Financial Literacy Measures (N= 1532)

	Prob (May)	Prop (July)	Y_tilde	Y_tilde_j
Panel A: 3 Questions				
Interest	88.58%	93.15%	86.23%	90.60%
Inflation	85.77%	90.99%	83.29%	86.81%
Risk	49.87%	78.26%	65.99%	70.43%
Panel B: Number correct				
0	4.90%	0.59%	3.98%	2.94%
1	11.49%	4.83%	10.90%	7.38%
2	38.12%	26.17%	30.74%	28.59%
3	45.50%	68.41%	54.37%	61.10%

Table 5 Explaining financial literacy: four measures

	(1)	(2)	(3)	(4)
VARIABLES	July	May	May-July	corr. July
	measure	measure	measure	measure
female	-0.189***	-0.441***	-0.323***	-0.299***
	(0.0291)	(0.0386)	(0.0393)	(0.0363)
Marital status (ref. Single)				
married, no child				
married, child				
single parent, other				
Age (ref. <=35)				
36-50				
51-65				
>65				
Education level (ref. 'primary education)				
lower secondary VMBO				
upper secondary:MBO				
upper secondary: HAVO/VWO				
Tertiary: HBO				
Tertiary: University				
Income quartiles (reirst quartile)				
1902<x<=2600				
2600<x<=3471				
x>3471				
refuse/dk				
Constant	2.708***	2.438***	2.498***	2.610***
	(0.0187)	(0.0266)	(0.0260)	(0.0234)
Observations	1,528	1,528	1,528	1,528
R-squared	0.024	0.068	0.038	0.038
Robust standard errors in parentheses;	*** p<0.01, ** p<0.05, * p<0.1			

	(5)	(6)	(7)	(8)
VARIABLES	July	May	May-July	corr. July
	measure	measure	measure	measure
female	-0.146***	-0.359***	-0.245***	-0.234***
	(0.0301)	(0.0393)	(0.0404)	(0.0372)
Marital status (ref. Single)				
married, no child	-0.0988**	-0.0462	-0.109*	-0.0900
	(0.0444)	(0.0679)	(0.0620)	(0.0570)
married, child	-0.112**	-0.0620	-0.145**	-0.108*
	(0.0519)	(0.0752)	(0.0700)	(0.0626)
single parent, other	-0.294***	-0.265**	-0.442***	-0.416***
	(0.106)	(0.131)	(0.120)	(0.118)
Age (ref. <=35)				
36-50	0.163**	0.231**	0.209**	0.169*
	(0.0749)	(0.110)	(0.101)	(0.0986)
51-65	0.175**	0.208*	0.220**	0.177*
	(0.0749)	(0.110)	(0.101)	(0.0998)
>65	0.101	0.167	0.138	0.0999
	(0.0808)	(0.115)	(0.109)	(0.108)
Education level (ref. 'primary education)				
lower secondary VMBO	0.0276	0.255**	0.0529	0.0304
	(0.114)	(0.130)	(0.136)	(0.131)
upper secondary:MBO	0.113	0.218	0.165	0.153
	(0.117)	(0.134)	(0.140)	(0.135)
upper secondary: HAVO/VWO	0.252**	0.512***	0.448***	0.338**
	(0.119)	(0.133)	(0.141)	(0.137)
Tertiary: HBO	0.263**	0.434***	0.362***	0.299**
	(0.116)	(0.130)	(0.138)	(0.134)
Tertiary: University	0.398***	0.661***	0.622***	0.495***
	(0.119)	(0.135)	(0.138)	(0.134)
Income quartiles (reirst quartile)				
1902<x<=2600	0.0718	0.258***	0.208***	0.144**
	(0.0510)	(0.0717)	(0.0692)	(0.0638)
2600<x<=3471	0.125**	0.351***	0.229***	0.186***
	(0.0530)	(0.0761)	(0.0747)	(0.0684)
x>3471	0.176***	0.446***	0.343***	0.264***
	(0.0568)	(0.0778)	(0.0740)	(0.0687)
refuse/dk	0.147	0.104	0.236	0.296*
	(0.135)	(0.237)	(0.201)	(0.173)
Constant	2.365***	1.628***	1.922***	2.160***
	(0.135)	(0.170)	(0.172)	(0.167)
Observations	1,528	1,528	1,528	1,528
R-squared	0.103	0.167	0.142	0.122
Robust standard errors in parentheses;	*** p<0.01, ** p<0.05, * p<0.1			

	(9)	(10)	(11)	(12)
VARIABLES	July	May	May-July	corr. July
	measure	measure	measure	measure
female	0.212***	0.113***	0.0991***	0.0110
	(0.0415)	(0.0411)	(0.0288)	(0.0184)
Marital status (ref. Single)				
married, no child	-0.0527	-0.0627	0.0100	0.0188
	(0.0650)	(0.0616)	(0.0446)	(0.0273)
married, child	-0.0501	-0.0835	0.0334	0.0370
	(0.0739)	(0.0723)	(0.0472)	(0.0291)
single parent, other	-0.0291	-0.177	0.148	0.0258
	(0.141)	(0.119)	(0.0910)	(0.0459)
Age (ref. <=35)				
36-50	-0.0677	-0.0217	-0.0460	-0.0395
	(0.108)	(0.0992)	(0.0609)	(0.0424)
51-65	-0.0327	0.0118	-0.0445	-0.0430
	(0.107)	(0.100)	(0.0600)	(0.0419)
>65	-0.0660	-0.0282	-0.0378	-0.0384
	(0.112)	(0.107)	(0.0648)	(0.0450)
Education level (ref. 'primary education)				
lower secondary VMBO	-0.228*	-0.202*	-0.0254	-0.0225
	(0.123)	(0.118)	(0.0828)	(0.0518)
upper secondary:MBO	-0.105	-0.0528	-0.0521	-0.0116
	(0.131)	(0.123)	(0.0877)	(0.0571)
upper secondary: HAVO/VWO	-0.260**	-0.0644	-0.195**	-0.110**
	(0.127)	(0.126)	(0.0886)	(0.0527)
Tertiary: HBO	-0.171	-0.0723	-0.0987	-0.0634
	(0.124)	(0.119)	(0.0856)	(0.0528)
Tertiary: University	-0.263**	-0.0388	-0.224***	-0.127**
	(0.129)	(0.122)	(0.0842)	(0.0531)
Income quartiles (reirst quartile)				
1902<x<=2600	-0.187***	-0.0505	-0.136***	-0.0638**
	(0.0708)	(0.0662)	(0.0477)	(0.0289)
2600<x<=3471	-0.226***	-0.122*	-0.104**	-0.0437
	(0.0727)	(0.0723)	(0.0511)	(0.0308)
x>3471	-0.270***	-0.103	-0.167***	-0.0789**
	(0.0767)	(0.0702)	(0.0498)	(0.0326)
refuse/dk	0.0429	0.132	-0.0895	0.0595
	(0.185)	(0.175)	(0.143)	(0.129)
Constant	0.737***	0.295*	0.443***	0.237***
	(0.170)	(0.160)	(0.110)	(0.0682)
Observations	1,528	1,528	1,528	1,528
R-squared	0.053	0.020	0.050	0.029
Robust standard errors in parentheses;	*** p<0.01, ** p<0.05, * p<0.1			

Table 6 Stock market participation

		July	May	May-July	corr. July
		measure	measure	measure	measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	stock_mut	OLS	OLS	OLS	OLS
financial literacy		0.0541***	0.0914***	0.0671***	0.0626***
		(0.00973)	(0.0105)	(0.0102)	(0.00978)
female	-0.137***	-0.0729***	-0.0469**	-0.0660***	-0.0666***
	(0.0207)	(0.0213)	(0.0212)	(0.0214)	(0.0215)
Marital status (ref. Single)					
married, no child		-0.0890***	-0.0928***	-0.0890***	-0.0904***
		(0.0327)	(0.0321)	(0.0325)	(0.0326)
married, child		-0.115***	-0.119***	-0.114***	-0.116***
		(0.0377)	(0.0371)	(0.0376)	(0.0377)
single parent, other		-0.132**	-0.129**	-0.122**	-0.124**
		(0.0557)	(0.0548)	(0.0558)	(0.0557)
Age (ref. <=35)					
36-50		0.149***	0.139***	0.147***	0.150***
		(0.0473)	(0.0476)	(0.0471)	(0.0473)
51-65		0.208***	0.201***	0.206***	0.209***
		(0.0461)	(0.0465)	(0.0461)	(0.0463)
>65		0.210***	0.201***	0.208***	0.211***
		(0.0491)	(0.0498)	(0.0491)	(0.0493)
Education level (ref. 'primary education)					
lower secondary VMBO		-0.0621	-0.0875*	-0.0640	-0.0622
		(0.0517)	(0.0510)	(0.0527)	(0.0526)
upper secondary:MBO		-0.0115	-0.0251	-0.0147	-0.0140
		(0.0565)	(0.0556)	(0.0573)	(0.0573)
upper secondary: HAVO/VWO		-0.0333	-0.0664	-0.0470	-0.0387
		(0.0596)	(0.0589)	(0.0602)	(0.0600)
Tertiary: HBO		0.0172	-0.00651	0.0114	0.0161
		(0.0567)	(0.0557)	(0.0575)	(0.0574)
Tertiary: University		0.173***	0.137**	0.159**	0.168***
		(0.0623)	(0.0619)	(0.0629)	(0.0627)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0662**	0.0445	0.0558*	0.0607*
		(0.0312)	(0.0306)	(0.0312)	(0.0311)
2600<x<=3471		0.120***	0.0933***	0.113***	0.116***
		(0.0352)	(0.0353)	(0.0351)	(0.0350)
x>3471		0.211***	0.179***	0.199***	0.205***
		(0.0386)	(0.0382)	(0.0386)	(0.0385)
refuse/dk		0.200*	0.202**	0.194*	0.189*
		(0.109)	(0.100)	(0.107)	(0.109)
Constant	0.339***	0.101	0.145*	0.113	0.104
	(0.0162)	(0.0732)	(0.0754)	(0.0750)	(0.0750)
Observations	1,528	1,528	1,528	1,528	1,528
R-squared	0.023	0.125	0.146	0.131	0.129
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 7 Retirement planning

		July measure	May measure	May-July measure	corr. July measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	thought_reti	OLS	OLS	OLS	OLS
financial literacy		0.0215	0.0517***	0.0436***	0.0410***
		(0.0133)	(0.0136)	(0.0133)	(0.0132)
female	-0.107***	-0.0712***	-0.0543**	-0.0635***	-0.0637***
	(0.0231)	(0.0241)	(0.0247)	(0.0241)	(0.0241)
Marital status (ref. Single)					
married, no child		0.0204	0.0197	0.0226	0.0217
		(0.0348)	(0.0348)	(0.0348)	(0.0348)
married, child		-0.00592	-0.00609	-0.00225	-0.00403
		(0.0420)	(0.0419)	(0.0420)	(0.0419)
single parent, other		-0.0361	-0.0302	-0.0232	-0.0239
		(0.0680)	(0.0666)	(0.0684)	(0.0679)
Age (ref. <=35)					
36-50		0.189***	0.181***	0.184***	0.186***
		(0.0619)	(0.0611)	(0.0615)	(0.0618)
51-65		0.314***	0.308***	0.309***	0.311***
		(0.0595)	(0.0584)	(0.0590)	(0.0594)
>65		0.253***	0.246***	0.249***	0.251***
		(0.0625)	(0.0615)	(0.0620)	(0.0625)
Education level (ref. 'primary education)					
lower secondary VMBO		0.163**	0.148**	0.161**	0.162**
		(0.0676)	(0.0672)	(0.0675)	(0.0673)
upper secondary:MBO		0.152**	0.143**	0.147**	0.148**
		(0.0727)	(0.0720)	(0.0726)	(0.0724)
upper secondary: HAVO/VWO		0.195***	0.172**	0.180**	0.185**
		(0.0731)	(0.0727)	(0.0732)	(0.0729)
Tertiary: HBO		0.229***	0.212***	0.220***	0.223***
		(0.0683)	(0.0679)	(0.0683)	(0.0680)
Tertiary: University		0.265***	0.239***	0.247***	0.253***
		(0.0718)	(0.0715)	(0.0720)	(0.0716)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0630*	0.0496	0.0546	0.0577
		(0.0369)	(0.0370)	(0.0370)	(0.0369)
2600<x<=3471		0.0161	-0.00107	0.00850	0.0105
		(0.0393)	(0.0398)	(0.0394)	(0.0393)
x>3471		0.0825**	0.0614	0.0708*	0.0745*
		(0.0412)	(0.0417)	(0.0414)	(0.0412)
refuse/dk		0.0590	0.0578	0.0518	0.0482
		(0.133)	(0.132)	(0.133)	(0.134)
Constant	0.739***	0.238**	0.267***	0.252***	0.246***
	(0.0150)	(0.0934)	(0.0934)	(0.0936)	(0.0936)
Observations	1,528	1,528	1,528	1,528	1,528
R-squared	0.013	0.066	0.075	0.072	0.071
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 8 Stock market participation: Including risk preferences

		July	May	May-July	corr. July
		measure	measure	measure	measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	stock_mut	OLS	OLS	OLS	OLS
Financial literacy		0.0468***	0.0798***	0.0554***	0.0501***
		(0.00986)	(0.0105)	(0.0105)	(0.0101)
2.spaar6		0.141***	0.135***	0.139***	0.140***
		(0.0290)	(0.0286)	(0.0288)	(0.0289)
3.spaar6		0.228***	0.223***	0.227***	0.227***
		(0.0392)	(0.0393)	(0.0398)	(0.0396)
4.spaar6		0.302***	0.300***	0.299***	0.299***
		(0.0345)	(0.0341)	(0.0344)	(0.0343)
5.spaar6		0.385***	0.373***	0.383***	0.381***
		(0.0455)	(0.0451)	(0.0451)	(0.0455)
female	-0.136***	-0.0180	0.00321	-0.0137	-0.0149
	(0.0207)	(0.0215)	(0.0216)	(0.0217)	(0.0217)
Marital status (ref. Single)					
married, no child		-0.0909***	-0.0944***	-0.0900***	-0.0916***
		(0.0315)	(0.0310)	(0.0314)	(0.0315)
married, child		-0.114***	-0.115***	-0.113***	-0.116***
		(0.0375)	(0.0374)	(0.0376)	(0.0376)
single parent, other		-0.104*	-0.0998*	-0.0948	-0.0962
		(0.0615)	(0.0597)	(0.0611)	(0.0614)
Age (ref. <=35)					
36-50		0.138***	0.126***	0.136***	0.139***
		(0.0473)	(0.0475)	(0.0474)	(0.0474)
51-65		0.237***	0.231***	0.236***	0.239***
		(0.0453)	(0.0457)	(0.0457)	(0.0457)
>65		0.262***	0.255***	0.260***	0.262***
		(0.0479)	(0.0483)	(0.0482)	(0.0482)
Education level (ref. 'primary education)		-0.0543	-0.0759	-0.0577	-0.0547
lower secondary VMBO		(0.0526)	(0.0522)	(0.0537)	(0.0535)
upper secondary:MBO		0.0130	-0.000235	0.00841	0.0109
		(0.0575)	(0.0570)	(0.0586)	(0.0584)
upper secondary: HAVO/VWO		-0.0474	-0.0769	-0.0588	-0.0497
		(0.0604)	(0.0598)	(0.0613)	(0.0609)
Tertiary: HBO		0.0142	-0.00841	0.00727	0.0140
		(0.0573)	(0.0564)	(0.0583)	(0.0580)
Tertiary: University		0.127**	0.0990	0.115*	0.125**
		(0.0626)	(0.0626)	(0.0638)	(0.0631)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0774**	0.0588*	0.0685**	0.0725**
		(0.0314)	(0.0308)	(0.0314)	(0.0314)
2600<x<=3471		0.118***	0.0959***	0.112***	0.114***
		(0.0342)	(0.0341)	(0.0342)	(0.0342)
x>3471		0.218***	0.191***	0.208***	0.213***
		(0.0381)	(0.0373)	(0.0380)	(0.0381)
refuse/dk		-0.0180	-0.0334	-0.0242	-0.0353
		(0.136)	(0.132)	(0.130)	(0.136)
Constant	0.339***	-0.0835	-0.0441	-0.0717	-0.0802
	(0.0161)	(0.0739)	(0.0761)	(0.0758)	(0.0753)
Observations	1,532	1,449	1,449	1,449	1,449
R-squared	0.023	0.215	0.230	0.218	0.216
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 9 Retirement planning: Including risk preferences

		July	May	May-July	corr. July
		measure	measure	measure	measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	thought_reti	OLS	OLS	OLS	OLS
Financial literacy		0.0137	0.0410***	0.0331**	0.0316**
		(0.0137)	(0.0141)	(0.0137)	(0.0138)
2.spaar6		0.0611*	0.0562*	0.0577*	0.0579*
		(0.0334)	(0.0332)	(0.0332)	(0.0332)
3.spaar6		0.0487	0.0431	0.0438	0.0431
		(0.0390)	(0.0389)	(0.0388)	(0.0390)
4.spaar6		0.0869**	0.0844**	0.0826**	0.0821**
		(0.0345)	(0.0344)	(0.0345)	(0.0344)
5.spaar6		0.0936**	0.0856**	0.0894**	0.0881**
		(0.0402)	(0.0402)	(0.0402)	(0.0401)
female	-0.106***	-0.0478*	-0.0348	-0.0424*	-0.0426*
	(0.0230)	(0.0254)	(0.0261)	(0.0255)	(0.0253)
Marital status (ref. Single)					
married, no child		0.0124	0.0120	0.0149	0.0141
		(0.0351)	(0.0351)	(0.0351)	(0.0351)
married, child		-0.0223	-0.0206	-0.0189	-0.0205
		(0.0432)	(0.0432)	(0.0432)	(0.0431)
single parent, other		-0.0561	-0.0488	-0.0435	-0.0434
		(0.0715)	(0.0702)	(0.0718)	(0.0716)
Age (ref. <=35)					
36-50		0.203***	0.194***	0.197***	0.199***
		(0.0640)	(0.0633)	(0.0637)	(0.0640)
51-65		0.337***	0.330***	0.332***	0.333***
		(0.0611)	(0.0602)	(0.0608)	(0.0611)
>65		0.281***	0.275***	0.277***	0.278***
		(0.0638)	(0.0631)	(0.0636)	(0.0639)
Education level (ref. 'primary education)					
lower secondary VMBO		0.184***	0.172**	0.180**	0.182**
		(0.0710)	(0.0703)	(0.0710)	(0.0707)
upper secondary:MBO		0.174**	0.165**	0.168**	0.169**
		(0.0758)	(0.0751)	(0.0758)	(0.0756)
upper secondary: HAVO/VWO		0.201***	0.181**	0.188**	0.192**
		(0.0762)	(0.0756)	(0.0765)	(0.0761)
Tertiary: HBO		0.242***	0.225***	0.231***	0.234***
		(0.0716)	(0.0711)	(0.0717)	(0.0714)
Tertiary: University		0.270***	0.248***	0.253***	0.258***
		(0.0746)	(0.0742)	(0.0749)	(0.0744)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0631*	0.0524	0.0562	0.0583
		(0.0379)	(0.0382)	(0.0381)	(0.0380)
2600<x<=3471		0.0108	-0.00215	0.00472	0.00586
		(0.0407)	(0.0411)	(0.0408)	(0.0407)
x>3471		0.0870**	0.0703	0.0773*	0.0798*
		(0.0426)	(0.0432)	(0.0429)	(0.0427)
refuse/dk		0.356***	0.352***	0.358***	0.351***
		(0.0698)	(0.0709)	(0.0719)	(0.0724)
Constant	0.740***	0.165*	0.192*	0.182*	0.178*
	(0.0150)	(0.0985)	(0.0983)	(0.0990)	(0.0988)
Observations	1,532	1,449	1,449	1,449	1,449
R-squared	0.013	0.075	0.080	0.078	0.078
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 10 Stock market participation: Including time preferences

		July	May	May-July	corr. July
		measure	measure	measure	measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	stock_mut	OLS	OLS	OLS	OLS
financial literacy		0.0549***	0.0913***	0.0666***	0.0611***
		(0.00970)	(0.0107)	(0.0103)	(0.00990)
2.uitgeven		-0.151	-0.123	-0.148	-0.154
		(0.134)	(0.130)	(0.132)	(0.133)
3.uitgeven		-0.0927	-0.0717	-0.0903	-0.0896
		(0.129)	(0.124)	(0.126)	(0.127)
4.uitgeven		-0.00941	0.00915	-0.00732	-0.00806
		(0.125)	(0.120)	(0.122)	(0.123)
5.uitgeven		0.0224	0.0280	0.0217	0.0213
		(0.124)	(0.119)	(0.120)	(0.122)
6.uitgeven		0.0751	0.0752	0.0737	0.0731
		(0.124)	(0.119)	(0.121)	(0.122)
7.uitgeven		-0.00409	-0.0220	-0.00736	-0.00466
		(0.127)	(0.123)	(0.124)	(0.126)
female	-0.137***	-0.0787***	-0.0514**	-0.0723***	-0.0733***
	(0.0207)	(0.0213)	(0.0212)	(0.0214)	(0.0215)
Marital status (ref. Single)					
married, no child		-0.102***	-0.105***	-0.102***	-0.104***
		(0.0329)	(0.0324)	(0.0327)	(0.0328)
married, child		-0.122***	-0.125***	-0.121***	-0.124***
		(0.0380)	(0.0375)	(0.0379)	(0.0381)
single parent, other		-0.128**	-0.124**	-0.118**	-0.121**
		(0.0559)	(0.0547)	(0.0557)	(0.0557)
Age (ref. <=35)					
36-50		0.123***	0.114**	0.121***	0.125***
		(0.0467)	(0.0473)	(0.0465)	(0.0468)
51-65		0.186***	0.183***	0.185***	0.189***
		(0.0457)	(0.0465)	(0.0458)	(0.0459)
>65		0.172***	0.169***	0.171***	0.175***
		(0.0492)	(0.0501)	(0.0494)	(0.0495)
Education level (ref. 'primary education)					
lower secondary VMBO		-0.0713	-0.0956*	-0.0730	-0.0708
		(0.0514)	(0.0509)	(0.0523)	(0.0523)
upper secondary:MBO		-0.0223	-0.0368	-0.0255	-0.0245
		(0.0562)	(0.0555)	(0.0570)	(0.0570)
upper secondary: HAVO/VWO		-0.0356	-0.0680	-0.0483	-0.0395
		(0.0595)	(0.0591)	(0.0601)	(0.0599)
Tertiary: HBO		0.0156	-0.00836	0.00935	0.0151
		(0.0565)	(0.0557)	(0.0573)	(0.0572)
Tertiary: University		0.164***	0.129**	0.150**	0.160**
		(0.0623)	(0.0622)	(0.0629)	(0.0628)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0785**	0.0555*	0.0678**	0.0728**
		(0.0315)	(0.0309)	(0.0315)	(0.0314)
2600<x<=3471		0.133***	0.104***	0.125***	0.129***
		(0.0353)	(0.0356)	(0.0352)	(0.0352)
x>3471		0.219***	0.186***	0.207***	0.214***
		(0.0389)	(0.0384)	(0.0388)	(0.0387)
refuse/dk		0.222**	0.224**	0.213*	0.206*
		(0.112)	(0.101)	(0.109)	(0.112)
Constant	0.339***	0.122	0.155	0.133	0.124
	(0.0162)	(0.145)	(0.143)	(0.144)	(0.145)
Observations	1,528	1,495	1,495	1,495	1,495
R-squared	0.023	0.142	0.162	0.147	0.145
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 11 Retirement planning: Including time preferences

		July	May	May-July	corr. July
		measure	measure	measure	measure
	(1)	(2)	(3)	(4)	(5)
VARIABLES	thought_reti	OLS	OLS	OLS	OLS
finlit2		0.0196	0.0440***	0.0396***	0.0381***
		(0.0134)	(0.0137)	(0.0133)	(0.0133)
2.uitgeven		-0.00597	0.00506	-0.00881	-0.0126
		(0.141)	(0.143)	(0.141)	(0.140)
3.uitgeven		0.0951	0.104	0.0949	0.0952
		(0.134)	(0.136)	(0.134)	(0.132)
4.uitgeven		0.175	0.183	0.174	0.173
		(0.122)	(0.125)	(0.123)	(0.120)
5.uitgeven		0.238**	0.238*	0.233*	0.232*
		(0.121)	(0.123)	(0.121)	(0.119)
6.uitgeven		0.256**	0.254**	0.251**	0.250**
		(0.121)	(0.123)	(0.121)	(0.119)
7.uitgeven		0.256**	0.246*	0.251**	0.252**
		(0.125)	(0.128)	(0.126)	(0.124)
female	-0.107***	-0.0766***	-0.0617**	-0.0697***	-0.0697***
	(0.0231)	(0.0243)	(0.0250)	(0.0244)	(0.0243)
Marital status (ref. Single)					
married, no child		0.0184	0.0179	0.0205	0.0195
		(0.0350)	(0.0350)	(0.0350)	(0.0349)
married, child		-0.0101	-0.0103	-0.00722	-0.00884
		(0.0424)	(0.0424)	(0.0424)	(0.0423)
single parent, other		-0.0348	-0.0297	-0.0227	-0.0233
		(0.0667)	(0.0658)	(0.0672)	(0.0668)
Age (ref. <=35)					
36-50		0.184***	0.178***	0.179***	0.181***
		(0.0635)	(0.0628)	(0.0632)	(0.0635)
51-65		0.299***	0.295***	0.294***	0.296***
		(0.0611)	(0.0601)	(0.0607)	(0.0610)
>65		0.226***	0.224***	0.223***	0.225***
		(0.0644)	(0.0636)	(0.0641)	(0.0645)
Education level (ref. 'primary education)					
lower secondary VMBO		0.151**	0.139**	0.149**	0.151**
		(0.0669)	(0.0667)	(0.0668)	(0.0666)
upper secondary:MBO		0.146**	0.138*	0.141*	0.142**
		(0.0722)	(0.0718)	(0.0721)	(0.0721)
upper secondary: HAVO/VWO		0.190***	0.171**	0.177**	0.181**
		(0.0727)	(0.0724)	(0.0727)	(0.0725)
Tertiary: HBO		0.214***	0.200***	0.205***	0.207***
		(0.0678)	(0.0676)	(0.0678)	(0.0676)
Tertiary: University		0.256***	0.235***	0.239***	0.245***
		(0.0711)	(0.0711)	(0.0713)	(0.0709)
Income quartiles (reirst quartile)					
1902<x<=2600		0.0605	0.0487	0.0527	0.0554
		(0.0369)	(0.0372)	(0.0371)	(0.0370)
2600<x<=3471		0.0163	0.000996	0.00898	0.0106
		(0.0394)	(0.0399)	(0.0395)	(0.0394)
x>3471		0.0829**	0.0651	0.0725*	0.0756*
		(0.0414)	(0.0420)	(0.0417)	(0.0415)
refuse/dk		0.0117	0.0108	0.00269	-0.00245
		(0.137)	(0.136)	(0.136)	(0.136)
Constant	0.739***	0.0538	0.0749	0.0698	0.0656
	(0.0150)	(0.151)	(0.153)	(0.152)	(0.150)
Observations	1,528	1,495	1,495	1,495	1,495
R-squared	0.013	0.083	0.089	0.088	0.088
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1					

Table 12 Stock market participation: GMM results

	July measure		May measure		May-July measure		corr. July measure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
financial literacy	0.228***	0.190**	0.201***	0.176**	0.203***	0.170**	0.196***	0.164**
	(0.0846)	(0.0953)	(0.0684)	(0.0838)	(0.0723)	(0.0825)	(0.0701)	(0.0791)
female	-0.0309	-0.0399	-0.000887	-0.0112	-0.0259	-0.0356	-0.0253	-0.0352
	(0.0309)	(0.0323)	(0.0374)	(0.0423)	(0.0313)	(0.0331)	(0.0315)	(0.0331)
Marital status (ref. Single)								
married, no child	-0.0607*	-0.0662*	-0.0873***	-0.0881***	-0.0720**	-0.0752**	-0.0750**	-0.0780**
	(0.0367)	(0.0367)	(0.0330)	(0.0326)	(0.0344)	(0.0341)	(0.0341)	(0.0338)
married, child	-0.0838**	-0.0889**	-0.110***	-0.111***	-0.0910**	-0.0946**	-0.0985**	-0.101***
	(0.0417)	(0.0412)	(0.0382)	(0.0377)	(0.0399)	(0.0395)	(0.0393)	(0.0388)
single parent, other	-0.0467	-0.0641	-0.0944	-0.101*	-0.0506	-0.0661	-0.0510	-0.0669
	(0.0746)	(0.0746)	(0.0608)	(0.0610)	(0.0696)	(0.0707)	(0.0701)	(0.0708)
Age (ref. <=35)								
36-50	0.104*	0.113**	0.108*	0.115**	0.113**	0.121**	0.120**	0.127**
	(0.0582)	(0.0575)	(0.0553)	(0.0559)	(0.0543)	(0.0538)	(0.0545)	(0.0536)
51-65	0.160***	0.169***	0.173***	0.180***	0.170***	0.178***	0.178***	0.185***
	(0.0569)	(0.0563)	(0.0531)	(0.0534)	(0.0533)	(0.0529)	(0.0536)	(0.0526)
>65	0.182***	0.187***	0.178***	0.183***	0.186***	0.190***	0.193***	0.197***
	(0.0564)	(0.0547)	(0.0553)	(0.0548)	(0.0545)	(0.0533)	(0.0552)	(0.0536)
Education level (ref. 'primary education)								
lower secondary VMBO	-0.0715	-0.0676	-0.122**	-0.114*	-0.0749	-0.0705	-0.0704	-0.0662
	(0.0594)	(0.0565)	(0.0570)	(0.0585)	(0.0582)	(0.0564)	(0.0581)	(0.0562)
upper secondary:MBO	-0.0446	-0.0368	-0.0559	-0.0492	-0.0437	-0.0363	-0.0434	-0.0355
	(0.0662)	(0.0639)	(0.0597)	(0.0605)	(0.0643)	(0.0630)	(0.0645)	(0.0632)
upper secondary: HAVO/VWO	-0.106	-0.0887	-0.134*	-0.118	-0.122	-0.103	-0.101	-0.0838
	(0.0749)	(0.0752)	(0.0724)	(0.0783)	(0.0751)	(0.0774)	(0.0717)	(0.0726)
Tertiary: HBO	-0.0591	-0.0414	-0.0658	-0.0517	-0.0509	-0.0345	-0.0397	-0.0247
	(0.0735)	(0.0743)	(0.0675)	(0.0725)	(0.0704)	(0.0718)	(0.0689)	(0.0694)
Tertiary: University	0.0584	0.0846	0.0499	0.0698	0.0546	0.0809	0.0784	0.102
	(0.0892)	(0.0925)	(0.0830)	(0.0913)	(0.0868)	(0.0915)	(0.0821)	(0.0851)
Income quartiles (reirst quartile)								
1902<x<=2600	0.0453	0.0489	0.00973	0.0165	0.0221	0.0291	0.0354	0.0407
	(0.0349)	(0.0340)	(0.0369)	(0.0388)	(0.0369)	(0.0371)	(0.0347)	(0.0345)
2600<x<=3471	0.0858**	0.0911**	0.0477	0.0566	0.0778*	0.0840**	0.0856**	0.0908**
	(0.0410)	(0.0403)	(0.0451)	(0.0480)	(0.0408)	(0.0406)	(0.0394)	(0.0391)
x>3471	0.161***	0.171***	0.121**	0.133**	0.144***	0.157***	0.159***	0.170***
	(0.0479)	(0.0483)	(0.0517)	(0.0573)	(0.0489)	(0.0509)	(0.0462)	(0.0472)
refuse/dk	0.155	0.166	0.187**	0.190**	0.154	0.164	0.135	0.149
	(0.105)	(0.106)	(0.0917)	(0.0929)	(0.101)	(0.103)	(0.108)	(0.109)
Constant	0.175**	0.159*	0.229**	0.210**	0.186**	0.168*	0.163*	0.148*
	(0.0886)	(0.0878)	(0.0947)	(0.101)	(0.0912)	(0.0916)	(0.0890)	(0.0882)
Observations	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528
R-squared		0.042	0.096	0.116	0.052	0.085	0.051	0.083
F stat first stage	9.185	7.599	13.75	10.48	11.59	10.32	12.04	10.27
chi2-value Hansen overid test	0.690	0.204	0.907	0.686	0.778	0.258	0.729	0.172
p-value Hansen overid test	0.708	0.652	0.636	0.408	0.678	0.612	0.695	0.678
p-value GMM C exogeneity test	0.0204	0.105	0.0898	0.286	0.0372	0.167	0.0345	0.155
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1								

Table 13 Retirement planning: GMM results

	July measure		May measure		May-July measure		corr. July measure	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
financial literacy	0.479***	0.582***	0.409***	0.533***	0.441***	0.522***	0.426***	0.504***
	(0.126)	(0.186)	(0.0920)	(0.140)	(0.0996)	(0.137)	(0.0967)	(0.134)
female	0.0392	0.0644	0.1000**	0.151**	0.0551	0.0782	0.0551	0.0794
	(0.0436)	(0.0567)	(0.0494)	(0.0681)	(0.0421)	(0.0520)	(0.0428)	(0.0534)
Marital status (ref. Single)								
married, no child	0.0966*	0.112*	0.0483	0.0454	0.0771	0.0855	0.0697	0.0767
	(0.0518)	(0.0603)	(0.0454)	(0.0524)	(0.0480)	(0.0531)	(0.0469)	(0.0516)
married, child	0.0811	0.0980	0.0216	0.0258	0.0695	0.0815	0.0532	0.0622
	(0.0616)	(0.0711)	(0.0528)	(0.0602)	(0.0557)	(0.0616)	(0.0538)	(0.0587)
single parent, other	0.185	0.237	0.0899	0.117	0.188*	0.232*	0.184*	0.230*
	(0.119)	(0.148)	(0.0870)	(0.103)	(0.103)	(0.121)	(0.102)	(0.122)
Age (ref. <=35)								
36-50	0.0700	0.0380	0.0860	0.0473	0.0880	0.0629	0.106	0.0823
	(0.0895)	(0.106)	(0.0771)	(0.0926)	(0.0786)	(0.0889)	(0.0816)	(0.0919)
51-65	0.185**	0.152	0.221***	0.188**	0.207***	0.182**	0.227***	0.203**
	(0.0890)	(0.106)	(0.0747)	(0.0891)	(0.0781)	(0.0886)	(0.0813)	(0.0920)
>65	0.179**	0.159	0.177**	0.149*	0.185**	0.169*	0.205**	0.190**
	(0.0898)	(0.103)	(0.0770)	(0.0902)	(0.0807)	(0.0895)	(0.0851)	(0.0944)
Education level (ref. 'primary education)								
lower secondary VMBO	0.148	0.138	0.0447	0.00387	0.136	0.131	0.149	0.144
	(0.103)	(0.119)	(0.0884)	(0.107)	(0.0919)	(0.102)	(0.0907)	(0.100)
upper secondary:MBO	0.0675	0.0478	0.0535	0.0192	0.0690	0.0534	0.0707	0.0542
	(0.112)	(0.130)	(0.0905)	(0.106)	(0.0990)	(0.110)	(0.0983)	(0.110)
upper secondary: HAVO/VWO	0.00763	-0.0392	-0.0431	-0.121	-0.0325	-0.0777	0.0169	-0.0212
	(0.120)	(0.149)	(0.104)	(0.132)	(0.110)	(0.129)	(0.105)	(0.122)
Tertiary: HBO	0.0318	-0.0149	0.0310	-0.0358	0.0475	0.0113	0.0720	0.0402
	(0.119)	(0.147)	(0.0954)	(0.120)	(0.102)	(0.118)	(0.0994)	(0.115)
Tertiary: University	-0.0326	-0.104	-0.0343	-0.138	-0.0481	-0.112	0.00447	-0.0499
	(0.138)	(0.178)	(0.111)	(0.149)	(0.120)	(0.147)	(0.113)	(0.137)
Income quartiles (reirst quartile)								
1902<x<=2600	0.01000	-0.00392	-0.0618	-0.100	-0.0474	-0.0665	-0.0160	-0.0303
	(0.0551)	(0.0641)	(0.0559)	(0.0707)	(0.0565)	(0.0650)	(0.0525)	(0.0594)
2600<x<=3471	-0.0795	-0.100	-0.156**	-0.202**	-0.103*	-0.124*	-0.0841	-0.103
	(0.0601)	(0.0715)	(0.0653)	(0.0829)	(0.0593)	(0.0687)	(0.0565)	(0.0647)
x>3471	-0.0537	-0.0810	-0.135*	-0.194**	-0.0980	-0.128	-0.0628	-0.0866
	(0.0686)	(0.0831)	(0.0724)	(0.0942)	(0.0694)	(0.0818)	(0.0634)	(0.0735)
refuse/dk	-0.0645	-0.0775	-0.0140	-0.00199	-0.0787	-0.0847	-0.118	-0.132
	(0.163)	(0.178)	(0.157)	(0.179)	(0.163)	(0.176)	(0.165)	(0.177)
Constant	0.427***	0.479***	0.520***	0.622***	0.455***	0.502***	0.400***	0.441***
	(0.140)	(0.170)	(0.134)	(0.170)	(0.133)	(0.154)	(0.130)	(0.149)
Observations	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528
R-squared								
F stat first stage	9.185	7.599	13.75	10.48	11.59	10.32	12.04	10.27
chi2-value Hansen overid test	0.908	0.00702	2.814	0.488	1.184	0.0298	1.070	9.56e-05
p-value Hansen overid test	0.635	0.933	0.245	0.485	0.553	0.863	0.586	0.992
p-value GMM C exogeneity test	3.12e-07	8.33e-07	4.62e-06	3.61e-06	8.46e-07	1.64e-06	7.45e-07	1.60e-06
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1								