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# The effect of financial literacy on the adequacy of post-retirement income

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# The effect of financial literacy on the adequacy of post-retirement income

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**Abstract**

Current literature finds that for households with the least amount of assets there still is an unexplained drop in non-durable consumption as they enter retirement. Other studies show that households with few assets usually have a low financially literacy and hardly plan for retirement. This leads to the hypothesis that the unexplained drop in non-durable consumption for some households is due to their inability to plan for retirement as they do not possess the required financial knowledge. This paper tests this hypothesis by utilizing the LISS Panel, a true panel which contains data on several consumption categories for Dutch households. Furthermore, in an additional module four financial questions were asked, which allows me to construct two financial literacy indices. After evaluating the evolution of non-durable consumption for several groups of households based on their financial literacy around retirement, I employ the predictions of the Life Cycle Hypothesis on the data. I use the unexplained part of the change in non-durable consumption as the households retire as a proxy for the unanticipated shock at retirement. After assessing the effect of financial literacy on the unanticipated shock I find that basic financial knowledge is an important determinant of the size of the unanticipated shock at retirement. Furthermore, I find that the amount of assets of the household has a mitigating effect on the relationship between basic financial literacy and the size of the unanticipated shock. The results imply that the lack of basic financial knowledge seriously hinders these households from planning adequately for their retirement and that this effect is largest for households with a low amount of assets. This implies that policymakers should try to increase the basic financial knowledge of its population as this seriously affects the social welfare. Furthermore, the paper advocates that the degree of financial knowledge should be seriously considered when policymakers try to devise reforms for the current financially stressed Dutch pension system.

**JEL classification** D14, D91, J26
**Keywords** Life Cycle Hypothesis, Retirement Consumption Puzzle, Financial literacy

# 1 Introduction

The Life Cycle Model of Modigliani and Brumberg (1954) and Friedman (1957) proposes that households should smooth their consumption over their lifetime to maximize their overall welfare. This implies that households should save during the working part of their life such that they have sufficient income during their retirement. However, Banks et al. (1998), Bernheim et al. (2001) and Battistin et al. (2009) find that there is a significant unexplained drop in non-durable consumption as households enter retirement. This phenomenon is called the Retirement Consumption Puzzle (RCP) as it is inconsistent with the predictions of the Life Cycle Hypothesis. This puzzle, however, has been resolved for most households as the transition into retirement changes their consumption preferences (Aguiar and Hurst, 2005, 2007). Once a household retires, work-related expenditures are no longer necessary. Moreover, the increased time available may lead households to produce more goods at home and shop more efficiently. Although this explanation seems to solve the RCP for the average household, the puzzle for households with a low amount of assets remains (Hurst, 2008). Hurd and Rohwedder (2008) also find that there is a large drop in non-durable consumption for households with the least amount of assets, but find indications that this observation is mainly driven by households with a short planning horizon. According to Hurd and Rohwedder (2008) this does not imply that these households are relatively impatient and as such consume early in life, but that these households are simply unable to plan properly for their retirement.

In another field of research, Lusardi and Mitchell (2010) and Van Rooij et al. (2011) find that the degree of financial knowledge is positively related to the amount of assets of the households. Furthermore, they find that the degree of financial knowledge is a significant predictor of the degree of retirement planning of the household. Combining these findings leads to the hypothesis that the RCP is still found for households with the least amount of assets as they are unable to properly plan for their retirement due to their lack of required financial knowledge.

To test this hypothesis, this paper uses data from the Longitudinal Internet Studies for the Social sciences (LISS) panel which is a true panel and contains data on consumption,

financial knowledge and multiple demographic and labour variables. More specifically, the LISS panel contains a module with data on several consumption categories for the years 2009, 2010, 2012 and 2015. Furthermore, an additional module was sent out to participating households in 2011 containing four financial questions.

From the responses to the financial questions this paper constructs two financial literacy indices which proxy for basic and advanced financial knowledge. Using these measures, I create several groups of households and evaluate their evolution of non-durable consumption around retirement. From this analysis it becomes clear that financially illiterate households decrease their consumption substantially once they retire. This drop is only observed for the households in the lowest quartile of basic financial literacy. This result points towards the confirmation of the aforementioned hypothesis. As Banks et al. (1998) show, these results are indicative but it does not imply that there is a RCP for these households. It might be that these households are relatively impatient and as such consume relatively early in life and reduce their consumption once they retire. In order to take these preferences into account, this paper employs the predictions of the LCH on the data and finds that the general predictions of the LCH including demographics hold for the Netherlands. As in Banks et al. (1998), I will use the residual of the LCH model around the time of retirement as a measure for unanticipated shocks. Since the LISS panel is a true panel, I can determine for each household the period in which they retire. By evaluating the residual at the time of retirement, I find that for the average Dutch household there does not appear to be a RCP. This does not seem too strange as the individual responsibility for an adequate pension in the Netherlands is relatively low and the income replacement rate is relatively high. When splitting the sample according to the degree of basic financial literacy, however, another picture emerges. Here I find that there does appear to be a significant unexplained drop in consumption for households in the lowest quartile of basic financial literacy as they transition into retirement. These results are substantiated by regressing the obtained residual on the indices of financial literacy, while controlling for the average amount of assets of the household. Here I again find that basic financial literacy significantly impacts the size of the unanticipated shock around retirement. Furthermore, I find that the effect of financial literacy is largest for

households with the least amount of assets. The results in this thesis contrast the findings of Lusardi and Mitchell (2010) and Van Rooij et al. (2011) who find that advanced financial literacy is the main determinant of the degree of retirement planning as I find that basic financial literacy determines the adequacy of post-retirement income.

This thesis adds to the literature in three ways. First, to my knowledge this is the first paper to check the validity of the LCH model including demographics for the Netherlands. Second, previous research (Bernheim et al., 2001; Hurd and Rohwedder, 2008) only investigated whether consumption declines after retirement for specific households. This does not necessarily imply that this consumption path is suboptimal for these households. By checking the deviation of actual consumption from the predicted path by the LCH, this paper gives a more conclusive picture as to whether households with little financial knowledge save enough for their retirement. Third, previous research (Lusardi and Mitchell, 2010; Van Rooij et al., 2011) only investigated the relationship between financial literacy and the self-assessed degree of retirement planning. More specifically, they investigate this relationship by regressing their financial literacy indices on the answer the respondents gave to the question on how much they had thought about retirement. The answer to this question, however, does not determine whether households experience adverse unanticipated shocks at retirement. By using consumption data of each household around retirement, I obtain a clearer view on the effect of financial literacy on the unanticipated shock.

The implications of these findings are threefold. First, policymakers should consider increasing the basic financial knowledge of its population as this seriously hinders some households in devising proper retirement plans. As a result, these households are unable to smooth their consumption over their lifetime, which diminishes their overall welfare. As Lusardi and Mitchell (2010) point out, increasing the degree of advanced financial knowledge might be problematic as households with little financial knowledge are probably not very interested in this topic. However, since I find that basic rather than advanced financial knowledge influences the unanticipated shock at retirement, this might be less problematic. Basic financial literacy concerns relatively easy topics which can be made part of a compulsory course during high school. Second, the financial sus-

tainability of the Dutch pension system is currently under threat and several reforms have been proposed. In devising these proposals policymakers should seriously consider the financial knowledge of its population as this affects the degree to which households are able to plan for their retirement. If the responsibility for an adequate post-retirement income shifts towards the individual, the observed drop in non-durable consumption at the period of retirement might increase. Third, the fact that these results are found in the Netherlands might indicate that this problem is even larger in other countries. This is due to the fact that the Netherlands has a pension system where the individual responsibility for an adequate retirement income is relatively small. The effect of financial literacy should, therefore, be larger in other countries like the US or UK.

This paper continues as follows; section 2 contains a literature review on the evolution of the Life Cycle Hypothesis, the Retirement Consumption Puzzle and the effect of financial literacy on retirement planning. As this is the first paper to check the validity of the LCH for the Netherlands in this way, it is vital to understand the Dutch pension system as it differs substantially from other countries. Section 3 will therefore elaborate on this. Next, section 4 describes the methodology used in this thesis, after which section 5 discusses the data used. Section 6 elaborates on the results of this paper. Finally, section 7 provides a discussion of the results and a conclusion.

# 2 Literature review

This section will briefly discuss the literature on the Life Cycle Hypothesis, the Retirement Consumption Puzzle (RCP) and its relation to financial literacy. The interested reader is recommended to refer to Attanasio and Weber (2010) who provide an elaborate critical review of the literature on the life cycle model of consumption or Hurd and Rohwedder (2008) who critically review the literature on the RCP.

## 2.1 The Life Cycle Hypothesis

### 2.1.1 The development of the Life Cycle Hypothesis

In 1937 Keynes (1937) introduced his "fundamental psychological law" that stated that consumption should be a certain fraction of disposable income. This fraction should be equal for all individuals given their current income. There were, however, several empirical observations that were hard to reconcile with this theory of Keynes. Katona (1949) was one of the first to challenge this "fundamental psychological law" of Keynes (1937) that current consumption could be explained by current disposable income. By using the Survey of Consumer Finances, conducted by the University of Michigan, from both 1946 and 1947 Katona was able to construct four different groups. A group who had experienced no income change, a negative income change, a positive income change, and an extreme positive income change (an increase of over 25 percent). By looking at the saving behaviour of these groups he found that the saving rate was different among these groups despite the fact that they had similar incomes. This was a clear violation of the Keynesian formulation, which states that positive and negative income changes should be treated equally. Another empirical observation that was in clear contrast with the proposition of Keynes was the fact that groups of individuals with, on average, lower levels of income (blacks) had higher saving rates than other groups with, on average, higher levels of income (whites) at any income level. This implied that the share of income consumed is not a constant, but rather a variable which depended on, among others, the average income of the individual.

All these contradictions of the Keynesian approach where reconciled in a new theory of consumption; the Life Cycle Hypothesis of Consumption by Modigliani and Brumberg (1954) and Friedman (1957). In their model an individual takes into account future income streams and optimizes its utility by setting intertemporal consumption and saving choices in the optimal way. As such, it could explain the empirical observations discussed in the previous paragraph. For instance, the observations by Katona (1949) could be explained by a difference in expected future income streams. If the individuals in the group with a large positive income change believed this change was temporary, they

would adjust their saving behaviour by saving more. Conversely, consumers in the group with a negative income change might believe that the shock is only temporary and as such it is optimal to dissave in the current period of temporarily lower income (Modigliani and Brumberg, 1954; Friedman, 1957). Also, the difference in saving rates between blacks and whites could be explained within the theory of the Life Cycle Hypothesis as blacks in general had a lower permanent income than whites. As such, it is optimal for blacks to save more than whites if they have the same income in the current period.

It was, however, not until Hall (1978) that the model could be properly tested. Until then, researchers had tried to estimate expected future income streams through past and current observed income. By doing this, however, it is assumed that income and consumption are exogenous, an assumption which has been effectively criticized by Lucas (1976). By taking the first order conditions of the intertemporal optimization problem, Hall (1978) showed that the marginal utility of next period consumption should only depend on the interest rate, a subjective discount rate and the marginal utility of current consumption. By assuming a specific utility function, he could then test the Life Cycle Hypothesis. This approach has become known as the Euler approach. Ever since, the model has been tested rigorously using both macro and micro data. As this paper will utilize micro data, the focus is on the literature which employ the predictions of the LCH on micro data.

### 2.1.2 Tests of the Life Cycle Model

One method of assessing the validity of the Life Cycle Hypothesis is by plotting the average income and consumption of a household against the age of the household head as is done by Carroll and Summers (1991). Their plots of consumption and income have a so-called hump shape over the lifetime of the household, that is consumption and income increase during the first stages of life, reach a peak near retirement and decline afterwards. Next to that, they observe that groups and countries exhibiting relatively steep income profiles usually have relatively steep consumption profiles. From this they conclude that consumption tracks income which is a clear contradiction to the prediction of the LCH. However, as is rightfully pointed out by Attanasio and Browning (1993a,b) and Attanasio

and Weber (1995), the drawback of this type of graph is that they average over individuals over age, irrespective of their year of birth. It might be that different cohorts experience different economic situations and as such have different permanent incomes. Therefore, it is not appropriate to average over these different cohorts. These papers take cohort sizes of 5 years (The paper of Attanasio and Browning (1993a) partitions the sample according to the year of birth) and find that there is still income tracking, although it is now less clear cut. The aforementioned papers proceed by arguing that demographics should be considered as consumption has to change as the household composition evolves. When plotting the number of children against the age of the household head, Attanasio and Weber (1995) find that this variable follows the same hump-shaped pattern as income and consumption. One way to correct for these changes in demographics is by equivalizing consumption based on the size of the household. Another method is by regressing the level of consumption on various demographic variables and then plot the residuals of this regression. When controlling for this change in demographics, a large part of the hump shape of consumption disappears and therefore the tests by Carroll and Summers (1991) cannot be regarded as evidence against the LCH (Attanasio and Browning, 1993a,b; Attanasio and Weber, 1995).

As discussed in section 2.1.1, Hall (1978) was the first to derive Euler equations for the evolution of marginal consumption over time. Until then, researchers had tried to derive closed form solution which included income or the wage rate (see e.g. Ghez and Becker (1975); Smith (1977)). This practice was effectively criticized by Lucas (1976), who stated that income cannot be assumed to be exogenous when using it to predict consumption. Hall was able to circumvent this problem by using the Euler equation directly. Hall (1978) shows that according to the LCH, if the consumer maximizes expected utility the marginal utility of consumption in next period should be given by equation 1.

$$E_t(u'(c_{t+1})) = \frac{1+\rho}{1+r}u'(c_t) \tag{1}$$

where $\rho$ represents the rate of time preference and r the interest rate. Note that in this equation Hall (1978) does not incorporate the effect of uncertainty regarding the interest

rate or the rate of time preference. Hall (1978) proceeds by pointing out that the derivation of a closed form solution is very tedious and results in an equation which is hard to estimate. Therefore, Hall assumes a quadratic utility function and that the rate of time preference is equal to the interest rate. As such, Hall finds that next period consumption should be equal to current period consumption plus an error term reflecting unexpected shocks. From this it follows that consumption should not depend on consumption with more than two lags once the consumption of previous period is included. When using quarterly data of the U.S. National Income and Product Accounts data, he indeed finds that lags of an order higher than one are insignificant. However, when regressing consumption on lagged values of income he finds a statistically marginal negative effect. Furthermore, he finds that the stock market is valuable in predicting next period consumption. This is a rejection of the pure life-cycle permanent income hypothesis, but by slightly adjusting this hypothesis Hall is still able to reconcile his empirical findings with the theory of the LCH. He states that some part of consumption takes time to adjust to a change in permanent income. In that case, any variable that is correlated with permanent income in period *t-1* will help predict consumption in period *t*. This effect might be especially true for his data as he uses quarterly data. As such, there seems little reason to doubt the life cycle hypothesis. However, the main assumption of Hall (1978), where he assumes a quadratic utility function, has been often criticized as the degree of prudence of this utility function is equal to zero. As a result, a household will not have any precautionary savings as the volatility of future income streams is irrelevant for households with this utility function. Therefore, this model of Hall (1978) is often called the certainty equivalence model.

MaCurdy (1981) had extended the LCH by incorporating the labour supply decision of the households. He showed that these decisions are also made in a life-cycle setting and should thus be modelled as such. However, in this paper MaCurdy (1981) tries to predict permanent income, a very imprecise approach. Not much later, the Euler approach was used to model labour supply by Heckman and MaCurdy (1982)[1]. They recognize that instead of trying to estimate the Lagrange multiplier associated with the budget

1. This paper was actually a revised version of the earlier published paper in 1980.

constraint, they can combine the Euler approach with fixed effects to circumvent the estimation of permanent income. They use an eight year panel of the Michigan Panel Survey of Income Dynamics consisting of 672 white women from the US. Using this approach, they are able to circumvent the estimation of omitted life cycle variables and still test the LCH appropriately. They find that their results are consistent with the LCH as married female labour supply does not depend on transitory income shocks. They conclude that labour decisions should be modelled simultaneously with consumption.

Another prominent paper using the Euler equation is that of Blundell et al. (1994). They use a sample of 70,292 UK households from 1970 until 1986, whose oldest adult is more than 18 and less than 60 years old and is not self-employed. Their measure of non-durable consumption consists of expenditures on food, alcohol, fuel, clothing, transport, services and other goods. Instead of making the same assumption as Hall (1978) they assume a utility function exhibiting constant Relative Risk Aversion, which depends on household characteristics. Their dataset is not a panel, but rather a time series of cross-sections. This requires them to construct a pseudo-panel, using cohort averages to estimate the model. This approach was suggested by Browning et al. (1985) and has been used extensively ever since. This approach, however, introduces a possible MA(1) structure of the error term, something which is extensively discussed by Attanasio and Browning (1993b). Blundell et al. (1994) proceed by deriving the consumption equation by using the Euler approach and test whether demographics influence observed consumption growth. Instead of modelling labour supply separately, as suggested by Heckman and MaCurdy (1982), they allow preferences to be influenced by variables which depend on the labour market status of the household. They find that demographics and labour market status have a significant effect on the evolution of non-durable consumption and should thus be considered when testing the LCH. Furthermore, they conclude that using a single price index or a Stone Price Index gives similar results as those obtained when using their more complex price index. Finally, they find that after controlling for demographic and labour variables, the sensitivity of consumption to anticipated changes in income, as observed by e.g. Carroll and Summers (1991), largely disappears. As such they cannot reject the LCH.

A similar study was conducted by Attanasio and Weber (1995) who utilize the Consumer Expenditure Survey, a micro dataset of US households with detailed consumption information on different categories. These categories are eating at home, eating away from home, alcohol and tobacco, services, heating fuel, transport, personal services, clothing and footwear. First, they show that aggregate data should not be used to test the LCH, as incorrect aggregation might lead to spurious rejections. Next, they estimate the Euler equation using cohort averages and allow labour variables to affect the within period scaling parameter. Here they show that the allocation of expenditures on non-durables is affected by both household composition and the labour supply of the household. Furthermore, they consider previous studies which study the LCH using datasets which contain only data on food consumption. They show that studies using only data of food consumption to test predictions of the LCH should be interpreted with great care. They state that the preferences between food and other non-durable consumption are non-separable and therefore food consumption cannot be used solely in a test of the LCH. When accounting for this non-separability they show that the LCH cannot be rejected from food data. They conclude that the LCH is appropriate to predict household consumption and state that the behaviour of the elderly should be one of the topics of further research as these households were until then frequently excluded from the sample.

## 2.2 The Retirement Consumption Puzzle

One of the main predictions of the LCH is that households should save part of their income during the time of their life where they work, such that they can maintain the same marginal utility of consumption after retirement. However, Hamermesh (1982) pointed out that data on married, fully retired couples from the US showed that consumption exceeded income early in retirement and that they quickly reduce this high amount of consumption a few years after retirement. This leads him to conclude that households do not save enough to maintain their standards of living after retirement. One of the explanations he gives for this result is that households may be unable to plan optimally for consumption during retirement due to imperfect information available.

However, as Banks et al. (1998) rightfully point out, only showing that consumption

drops after retirement is not sufficient evidence to state that savings of households are too low, as the LCH predicts that marginal utility of consumption should be held constant rather than consumption itself. It might very well be that changes in demographics or labour market status of the household affect the marginal utility of consumption in such a way that it is optimal for these households to decrease their consumption once the head of the household enters into retirement. To test this, Banks et al. (1998) use data of the Family Expenditure Survey from 1968 to 1992. This survey is an annual cross section survey comprising about 7,000 households. As this again is a time series of cross sections, they have to create a pseudo-panel. As they take averages over households to construct different cohorts, they cannot determine explicitly when the cohort retires. As a result, they use the mean age of the heads of the household for each cohort as a reference age. This paper also uses the Euler approach in combination with a utility function exhibiting Constant Relative Risk Aversion. The degree of risk aversion and the rate of time preference are proxied by demographic variables. Due to endogeneity concerns and the presence of MA(1) errors, they estimate their model by the Generalized Method of Moments estimation procedure using Instrumental Variables with instruments lagged at least two periods. They proceed by showing that the error term should reflect the sum of the annuity value of the transitory shock and the permanent shock and conclude that since income shocks resulting from retirement are anticipated they should not enter the error term. However, when plotting the predicted values of consumption growth against actual consumption growth, they find that the model reflects actual growth well except at the age of retirement. Around this age they find that actual consumption growth on average is up to 1.5 percent lower than predicted by the LCH on an annual basis. This adds up to an accumulated consumption shortfall of around 10 percent. After they find this result the authors try to resolve this Retirement Consumption Puzzle by first looking at the effect of including mortality risk. They do this by including the change in the survival probability of each cohort. The reason for this is that households with a higher survival probability will be more likely to postpone consumption than households with a lower survival probability. The extra variable enters the equation positively and significantly, but does not decrease the observed gap between actual and predicted

consumption. They proceed by including a dummy which takes the value of one if the head of the household is currently unemployed or retired. This is done in order to take into account the fact that consumption preferences might simply change as the household's head moves out of the labour market. They find that this extension fits the data better, but that there is still a gap of one percent between actual and predicted consumption growth during retirement. Furthermore, they shortly distinguish non-durable consumption into spending on necessities and work-related items and find that work-related spending decreases after retirement, as should be expected. However, they also find that the spending on necessities such as food decreases after retirement, something which seems at odds with the prediction of the LCH. The authors conclude that the remaining drop in observed consumption must be due to unanticipated income shocks as households enter retirement. Similar research by Bernheim et al. (2001) in the US and Battistin et al. (2009) in Italy also find a drop in consumption during retirement with the same order of magnitude. This result leads Bernheim et al. (2001, p. 854) to conclude that *"Contrary to the central tenets of life-cycle theory, there is little evidence that households use savings to smooth effects on consumption of predictable income discontinuities such as retirement"*.

Ever since, much research has been devoted to this apparent contradiction of the LCH. Aguiar and Hurst (2013) use the Consumer Expenditure Survey, a micro data set within the US which contains broad measures of consumption. More specifically, this dataset allows them to decompose non-durable consumption in 11 different categories. Overall, they find that non-durable consumption falls by roughly 5 percent. When looking at the different categories, however, large differences emerge. On the one hand, spending on food, clothing and transportation falls by 7, 18 and 15 percent respectively. On the other hand, spending on housing services, utilities, charities and entertainment increase or remain constant. Aguiar and Hurst (2013) reconcile these findings with the LCH through the increased amount of available time after retirement. As more time is available, complements to time, i.e. entertainment, should increase whereas spending on substitutes to time, i.e. food, should fall after retirement.

These results lead Hurst (2008) to conclude that the RCP is a bit of a misnomer as it is

in no sense puzzling that work-related expenses decrease after retirement. The fact that expenditure on food decreases as well, however, might be puzzling if actual food intake decreases as well. As Becker (1965) pointed out, consumption is the product of both market expenditures and time. Once retired, households may have more time available to search more intensively for bargains or produce more food at home. As a result, food expenditure might fall but food intake may stay the same. Aguiar and Hurst (2005) investigate this issue by using data on actual food intake of US households from the Continuing Survey of Food Intake of Individuals. From this they conclude that actual food intake does not decline once households enter retirement. Furthermore, by using the National Human Activity Pattern Survey and the American Time Use Survey they show that this constant food intake is made possible due to increased time spent on food production. In a follow-up study, Aguiar and Hurst (2007) show that this increased time spent on food production is spent on both more frequent shopping and on more production at home. Using household data from the ACNielsen company they conclude that roughly 20 percent of the decline in food expenditure is due to increased shopping intensity and that the remaining 80 percent can be attributed to increased time spent on home production. Overall, it therefore appears that the Retirement Consumption Puzzle has been solved, in the sense that the drop in consumption during retirement is fully expected or is compensated with increased production at home (Hurst, 2008).

There is, however, a large heterogeneity in the size of the change in consumption among retirees. Bernheim et al. (2001) use panel data from the PSID which enables them to follow each household as they enter retirement. As mentioned above, they find similar to Banks et al. (1998) that non-durable consumption decreases as households enter retirement. They proceed, however, by assessing the drop in consumption by creating 4 quartiles based on the amount of assets of each household. For the first three pre-retirement quartiles the drop in expenditures when entering retirement ranged between 8.9 and 13.9 percent. For the lowest pre-retirement quartile, however, the households experienced a decline in expenditures of 31.2 percent after retirement. The impressive size of this decline is hard to explain with the explanation of increased home production by Becker (1965). Aguiar and Hurst (2005) also find that only households with very lit-

tle assets at retirement experienced a decline in the quantity and quality of food intake. They state that the LCH does well in predicting the evolution of consumption over the lifetime of the household for the average household, but that there might be a segment with low wealth that do not fit the model that well as they retire. Given these results, Hurst (2008) concludes that the focus of changes in expenditures in retirement should be limited to the minority of households who enter retirement with very low wealth.

Similar results to those of Bernheim et al. (2001) are found by Hurd and Rohwedder (2008) who use data from the Health and Retirement Studies in combination with a supplementary survey, the Consumption and Activities Mail Survey (CAMS). This dataset is a true panel which allows them to follow each household during their transition into retirement. When comparing consumption before and after retirement, they find that non-durable consumption as well as food consumption drops as the household retires. However, this drop is not very large and can be explained with an increased amount of time available and an increase in mortality risk. Nonetheless, when splitting their sample according to the amount of assets each household possessed, they also find that the expenditure drop is much larger for the households with the least amount of assets. Interestingly, in the CAMS there is an additional question on the planning horizon of the household. The authors proceed by controlling for the planning horizon of each household and find in fact that the drop in consumption of the households with the least amount of assets is mainly driven by the part that has a short planning horizon. The authors state that this variable does not capture the rate of time preference of the household, but rather the ability and willingness to plan for retirement. Nonetheless, when they control for the health status of the individuals, they find that a large part of the decline can be explained by unanticipated early retirement due to poor health. These results are also found by Smith (2006) who finds that, by using data on food spending by British men, that there is only a drop in food consumption for those that retire involuntarily. Although this study of Hurd and Rohwedder (2008) only looks at actual changes in consumption rather than the marginal utility of consumption the finding on the length of the planning horizon is interesting. These findings might imply that, after accounting for involuntary retirement, the inability to plan for retirement might explain

the drop in consumption observed for the households in the lowest wealth quartile.

## 2.3 Financial literacy and retirement planning

In a survey of recent studies concerning financial literacy in different countries, Lusardi and Mitchell (2007) show that consumers are poorly informed about financial products and practices. They conclude that this might be problematic as workers and retirees have increasingly been asked to take an unprecedented degree of responsibility for their retirement. In a follow up study, Lusardi and Mitchell (2010) designed several questions on financial literacy for an additional module in the American Life Panel (ALP), which was filled in by 989 respondents. Next to that, they also included the question as to how much effort the individual put into planning for his retirement. Here the respondent had to indicate on a scale of 1 to 4, how much it had thought about retirement. Their module included 5 basic financial questions which covered topics such as compounding, money illusion and time value of money. Furthermore, they included 8 more advanced financial questions. These questions covered topics such as the functioning of the stock market and mutual funds, diversification and the link between bond prices and interest rates[2]. They use the answers to these questions in a factor analysis and find two different factors with different loadings on the basic and advanced financial questions. This leads them to construct two different factors, one for basic and one for advanced financial knowledge. They proceed by regressing their measure of retirement planning on the measures of basic and advanced financial knowledge, while controlling for a host of socioeconomic factors. From this they conclude that financial literacy has an important effect on the degree to which individuals plan for retirement. This effect is most pronounced for advanced financial literacy. Next, they consider the possibility that the fact that individuals plan for retirement makes them more financially literate and as such their results might suffer from endogeneity. To account for this, they recognize that over the last decades several states in the US had mandated financial education during high school. They use this variable, among some other socioeconomic controls, as instruments for advanced financial literacy and use these values in a second stage regression on retirement planning. They

2. For the precise list of questions, please refer to Lusardi and Mitchell (2010).

find that the effect of advanced financial literacy is now even larger. More specifically, they find that increasing the financial literacy index from the first to the third quartile would move individuals up one level in the retirement scale.

This lack of financial knowledge is not limited to the US, but has also been observed in the Netherlands. By using a similar approach, Van Rooij et al. (2011) show that sophisticated financial knowledge also has a significantly positive effect on the degree of planning for retirement in the Netherlands. What is striking, is that Van Rooij et al. (2012) when using the same measures of financial literacy, show that financial illiteracy in the Netherlands is mainly present among households with very low assets. The same results were found by Lusardi and Mitchell (2007) in the US. This might indicate that the remaining Retirement Consumption Puzzle found for low net-worth households, might indeed be due to their lack of retirement planning as they don't possess the skills to do so.

As shown in this literature review, there has been much research regarding the change in consumption at the time of retirement for different wealth groups. This research indicates that the Retirement Consumption Puzzle has been solved for the average household and that the puzzle only remains for households with the least amount of assets. The exact explanation as to why this puzzle still exists only for this group is yet unclear. Aguiar and Hurst (2005) state that these household might simply not fit the model as well as the average household. Moreover, Hurd and Rohwedder (2008) find some evidence that it might be due to the short planning horizon of these households. In another stream of research, Lusardi and Mitchell (2007) and Van Rooij et al. (2012) find that households with a low amount of assets usually have little financial knowledge. Furthermore, financial knowledge is positively related to the degree of retirement planning (Lusardi and Mitchell, 2010; Van Rooij et al., 2011). Therefore, in this paper I advocate that the households with the least amount of assets indeed do not fit the LCH model as the model assumes rational and perfectly informed agents, an assumption which might be too strict for low net-worth households as, in general, they do not possess the necessary financial skills.

# 3 The Dutch Pension System

Previous research on the Retirement-Consumption Puzzle was conducted in the UK (Banks et al., 1998), the US (Bernheim et al., 2001) and Italy (Battistin et al., 2009). The Dutch pension system differs in several aspects when compared to the pension systems of these countries and it is therefore vital to understand the differences between these systems. Therefore, section 3.1 will evaluate the Dutch pension system to facilitate the understanding of the context in which the households make their decisions. Furthermore, section 3.2 will compare the Dutch system to other European systems and to that of the US. Finally, the financial sustainability of the current Dutch pension system is under threat due to the ageing of the Dutch population and the recent financial crisis. Therefore, section 3.3 will highlight some of the current reforms in the Dutch pension system.

## 3.1 The Dutch pension system

### 3.1.1 Public pensions

Public pensions in the Netherlands were established in 1956 in the General Old-age Act (Algemene Ouderdoms Wet). The law introduced compulsory Pay-As-You-Go (PAYG) old-age insurance for all residents. Pension benefits were payable at age 65 and the received benefit was flat, i.e. it did not depend on premiums paid. The entitlement to the public pensions does not require the retiree to have actively participated in the labour force during his working life. Hence, also homemakers receive the public pension once they reach the eligible age (Börsch-Supan and Miegel, 2012). Also, inhabitants of the Netherlands who were not born in the Netherlands are entitled to a public pension. For every additional year they live in the Netherlands they receive 2 percent more of the public benefit. So after 50 years they are entitled to the same public benefit as Dutch retirees[3].

The public benefit that singles receive is higher as compared to married persons. A single

3. https://www.rijksoverheid.nl/onderwerpen/algemene-ouderdomswet-aow/vraag-en-antwoord/krijg-ik-aow-als-ik-later-in-nederland-ben-komen-wonen Accessed: 2017 - 05 - 09

person collects a benefit which is equal to 70 percent of the after-tax statutory minimum wage, which is around €1,000 per month. For married persons the public benefit is equal to 50 percent of the after-tax statutory minimum wage per individual, which is currently around €700 per month (Reichert, 2014). The fact that the public benefit is linked to the after-tax minimum wage rate moderates the increase in the public benefit if ageing persists as this raises the tax burden on the labour force. Thus, elderly in effect share in the costs of financing their own benefits (Börsch-Supan and Miegel, 2012). In 2007, 2.7 million individuals received a public benefit, which amounted to €25.2 billion.
During the years, the funding has changed slightly as it is not completely paid out of the contributions of the PAYG system, but in the 2000s part of the funding was covered with general tax revenues. The second modification of the PAYG system is the introduction of a special fund in 1996 to deal with temporarily high spending on public benefits once the babyboom generation retires (Börsch-Supan and Miegel, 2012).

### 3.1.2 Occupational pensions

The second pillar is relatively important in the Netherlands. The provisions within this pillar are set in collective bargaining by employers' organizations and trade unions in the private sector. The legal framework is specified under the Pensions and Savings Funds Act (Pensioen- en Spaarfondsen Wet). Under this law, a pension fund must be legally separate from the sponsoring firm and is obliged to provide detailed information on benefit payments and its investments to the Insurance Board. Furthermore, it is compulsory for firms to participate in the supplementary pension provisions if requested by the employers' organizations and trade unions. This obligation creates economies of scale which increases the efficiency of these funds and it eliminates competition on wages within a sector as each firm in the same sector is obliged to pay the same premium. Furthermore, it facilitates the movement of an employee within the same sector (Reichert, 2014). Since participation is compulsory most workers are covered by an occupational pension scheme. Indeed, 90 percent of all workers were covered by this scheme in 2012. As of World War II, the size of the pension funds has grown remarkably such that the total value of the assets owned by the pension funds in 2012 amounted to around 160

percent of GDP (Bovenberg and Gradus, 2014).

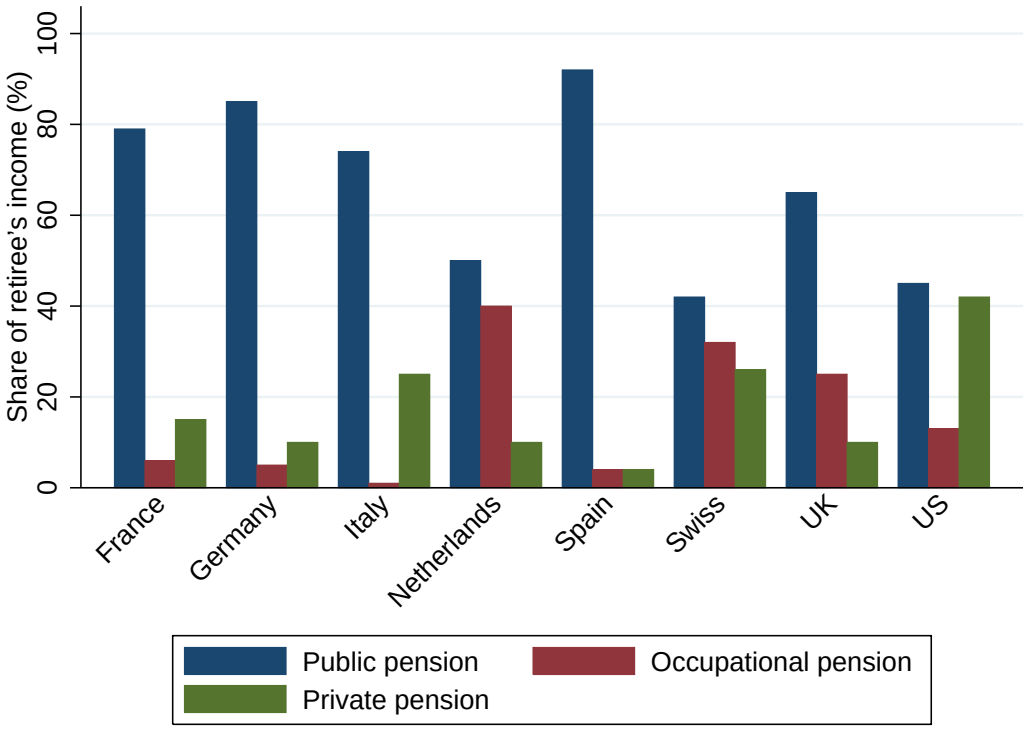
The benefit received from this pillar is of the defined-benefit type. This implies that the benefits the individual receives is not equal to the discounted sum of his contributions, but rather to a fixed amount which is linked to the wage of the individual. In the Netherlands, this amount is either linked to the wages at the end of the career or to the average wage earned over the entire career. There has been a major switch away from final salary schemes in the Netherlands in the last two decades. In 1998, around 70 percent had a final salary pension plan, whereas in 2005 this number has fallen to 9 percent (Ponds and van Riel, 2007). In 2013, pension funds aimed at providing an annuity level of around 80% of the reference income after 40 years of service. This share includes the income derived from the flat public benefit of the first pillar (Bovenberg and Gradus, 2014).

The third pillar consists of individual savings to provide for post-retirement consumption. In the Netherlands, this pillar amounts to only 10 percent of the retiree's income (Börsch-Supan, 2009).

## 3.2 The Dutch pension system in a global perspective

Almost all pension systems in Europe and the USA consist of the three pillars as described above. The relative size of each pillar, however, differs significantly. As can be seen from figure 1, the first pillar is relatively large in Southern Europe and Germany. In these countries this pillar consists of a PAYG pension scheme. Like the Netherlands, these countries face an ageing society, which in their case puts a large pressure on the financial sustainability of this pillar (Börsch-Supan and Miegel, 2012). Furthermore, from figure 1 the difference between the pension system of the US and the Netherlands also becomes apparent. In the Netherlands the size of the second pillar is relatively large, whereas in the US the third pillar is largest. This indicates that the individual responsibility for a sufficient income during retirement is larger in the US when compared to the Netherlands. This might also explain why Van Rooij et al. (2011) find that only 12.9 percent of the Dutch households indicate that they thought a lot about retirement as opposed to 30 to 40 percent in the US.

Figure 1: Relative importance of the three pillars in several countries




Source: Börsch-Supan (2009)

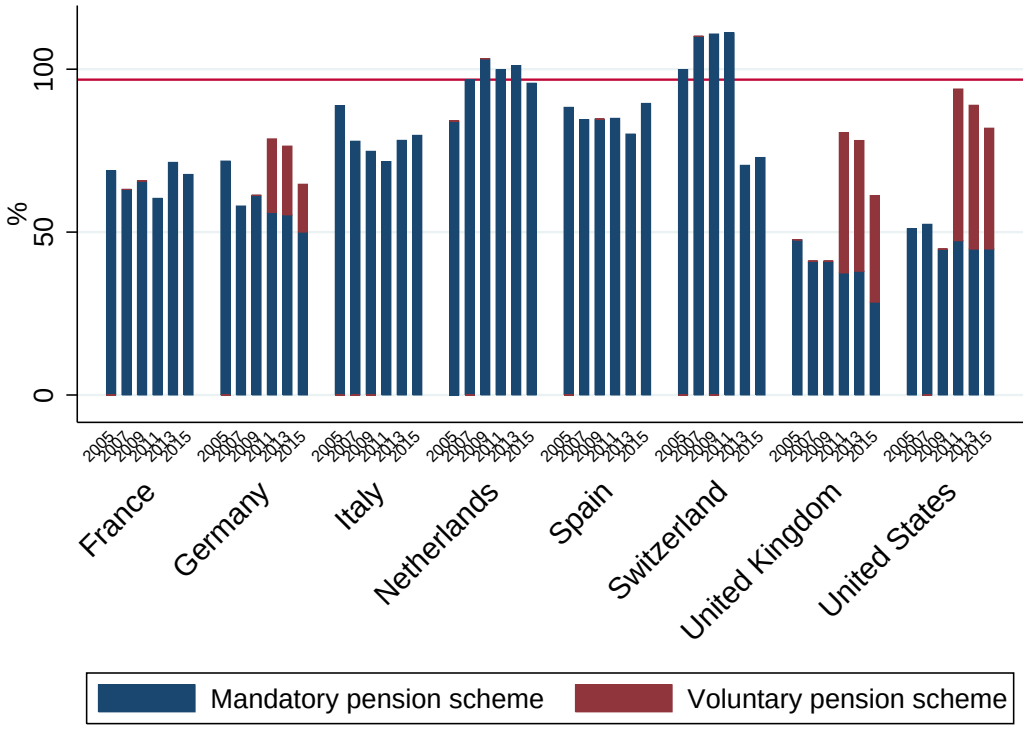
To get a better grasp on the impact of the different pension systems on the replacement rate, figure 2 depicts the net replacement rates for the same countries. For the years 2011, 2013 and 2015 the income from own savings is also available, which is relatively large for the UK and the US. From figure 2 it becomes clear that despite the individual savings in the US and the UK, the net replacement rate in Italy, the US and the UK are lower than those in the Netherlands. This, in combination with the fact that the individual responsibility for an appropriate post-retirement income is larger in these countries implies that the probability of unanticipated shocks around the age of retirement is larger in these countries as it is in the Netherlands. Indeed, Mitchell and Shea (2016) state that due to the obligated participation in the second pillar individuals are largely protected against myopia and other behavioural biases. Therefore, if there do appear to be adverse shocks when financially illiterate household retire in the Netherlands, this problem should only be larger in the aforementioned countries.

## 3.3 Current reforms

Due to the ageing of the population in the Netherlands and the recent financial crisis, the financial sustainability of the current Dutch pension system is under threat. Therefore, the government has implemented and is considering additional measures in order to sustain the financial sustainability. In 2012, parliament passed a law that increases the age at which individuals become eligible for the public pension. This age is increased gradually such that the eligible age in 2021 will be 67 years. After this, the retirement age will increase with the life expectancy of the population. This reform will ensure the financial sustainability of the first pillar of the Dutch pension system (Bovenberg and Gradus, 2014).

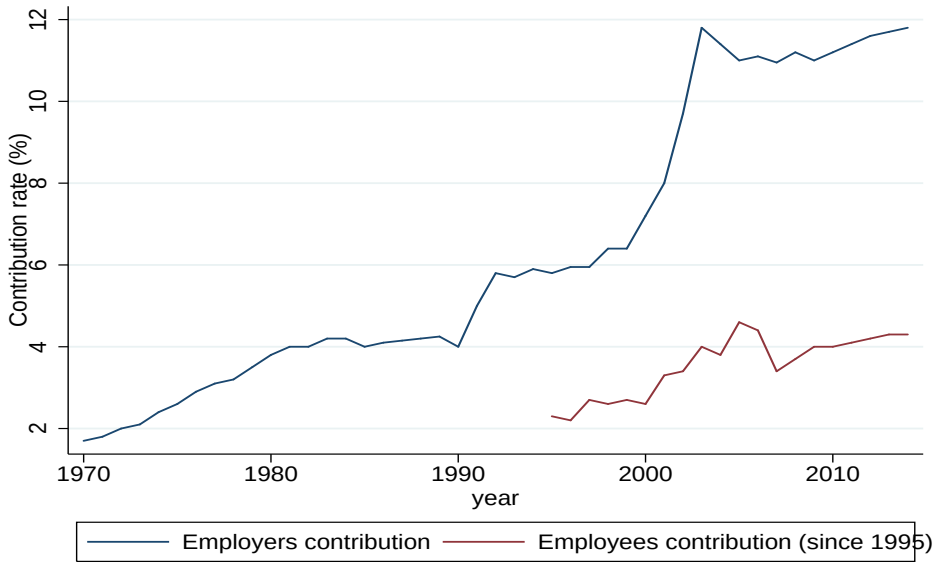
The second pillar in the Netherlands, however, is still subject to several weaknesses which seriously endanger its financial sustainability. One method applied by pension funds to remain solvent is to increase the contribution rate in order to cover the value of its liabilities. As can be seen from figure 3, this rate has increased significantly in the last two decades and current consensus is that further increases might be problematic due to its high current level (Bovenberg and Gradus, 2014). As this method is no longer a viable

Figure 2: The evolution of the net replacement rates of several countries




This figure shows the evolution of the net replacement rates of several countries for the years 2005, 2007, 2009, 2011, 2013 and 2015. For the years 2011, 2013 and 2015 there is also data available on the income derived of voluntary pension schemes, which are relatively large in the US and the UK. The red line is the average net replacement rate in the Netherlands. Source: Data from CESIFO

Figure 3: Contribution rate over the years in the Netherlands




This figure shows the evolution of the contribution rate in the Netherlands. The contribution rate is defined as a fraction of gross labour income that is needed to be paid into the pension fund. As of 1995 there is also data available on the employees' contribution rate.
Source: Bovenberg and Gradus (2014)

option for the pension funds, other measures are being considered. One of the most extreme measures taken yet was in 2012 and 2013, where 68 out of 415 pension funds were required to cut nominal pension rights. More than 5 million members were confronted with this measure (Bovenberg and Gradus, 2014). Furthermore, there is the ongoing discussion in Europe whether pension systems should move from a defined benefit system towards a defined contribution system. These reforms imply that the post-retirement income of households is becoming less certain and as a result households are increasingly expected to take their own responsibility for their retirement income.

This might be quite problematic as financial literacy in the Netherlands is currently low and only 12.9 percent of the Dutch population indicated that they thought a lot about retirement (Van Rooij et al., 2011). If there indeed appears to be an effect of financial literacy on the adequacy of post-retirement income, policymakers have to seriously consider the degree of financial literacy of its population when alternating the design of the second pillar.

# 4 Theoretical framework

This paper will begin by assessing the change in log non-durable consumption as the household transitions into retirement. This is done in similar fashion as Hurd and Rohwedder (2008) except for the fact that I split the households according to their degree of financial literacy rather than their amount of assets. Simply showing that consumption drops for specific households, however, is no evidence that this behaviour is suboptimal (Banks et al., 1998). Therefore, this paper will construct a life cycle model for all households, after which it can be checked whether the observed consumption path of some households is suboptimal or not. As Banks et al. (1998) show, the residual of a life-cycle model presents unanticipated shocks and since retirement is fully anticipated it should not feature in the residual. If, however, the hypothesis that households with the least amount of financial knowledge are unable to plan for their retirement is valid, the residual should be negative and largest for this group. In what follows, Euler equations will be derived to come up with a consumption function for each household. As such, the residual of this model can be assessed around the time where households retire.
As in Hall (1978), the Euler equations are derived for the optimization problem given by equation 2.

$$Max_{c_{it}..c_{iT}} E_t\Big[\sum_{\tau=t}^{T} \frac{U(c_{i\tau})}{(1+\rho_{i\tau})^{\tau-t}}\Big] \tag{2}$$

$$s.t. \sum_{\tau=t}^{T} \frac{c_{i\tau}}{(1+r_\tau)^{\tau-t}} = (1+r_t)A_{it-1} + \sum_{\tau=t}^{T} \frac{y_{i\tau}}{(1+r_\tau)^{\tau-t}}$$

Here $t$ denotes the current period and $T$ the final period in which the individual $i$ is alive. Furthermore, $\rho_{i\tau}$ denotes the rate of time preference of individual $i$ at time $\tau$, $r_\tau$ the real interest rate at time $\tau$, $A_{it-1}$ the assets the individual $i$ owns at time $t-1$ and $y_{i\tau}$ the income of individual $i$ at time $\tau$, where $\tau \in \big[\text{t, T}\big]$. Equation 2 states that given the expectations on future income, the interest rate and the rate of time preference, an individual should set its consumption in such a way that overall utility is maximized. In this thesis I will not model uncertainty explicitly. Solving this problem leads to the

Euler equation given by equation 3.

$$\frac{\partial U(c_{it})}{\partial c_{it}} = E_t\left[\frac{1+r_{t+1}}{1+\rho_{it+1}}\frac{\partial U(c_{it+1})}{\partial c_{it+1}}\right] \tag{3}$$

where t $\in \big[1,\ \mathrm{T}\big]$. Instead of assuming a quadratic utility function as in Hall (1978), a utility function exhibiting Constant Relative Risk Aversion will be used as is done by among others Attanasio and Weber (1995) and Banks et al. (1998). To allow households characteristics to scale within-period consumption, the CRRA function given by equation 4 will be used.

$$U(C_{it}) = \frac{exp(\theta_{it})}{(1-\gamma_i)}C_{it}^{(1-\gamma_i)} \tag{4}$$

Here $\theta_{it}$ captures the way in which each household scales within-period consumption and $\gamma_i$ represents the degree of risk aversion of the household. By combining equation 3 with equation 4, it can be shown that optimal consumption growth should be given by equation 5.

$$exp(\theta_{it})(C_{it})^{-\gamma_i} = E_t\left[\frac{1+r_{t+1}}{1+\rho_{it+1}}exp(\theta_{it+1})(C_{it+1})^{-\gamma_i}\right] \tag{5}$$

As I will not incorporate uncertainty expectations are modelled as described by equation 6.

$$E_t\big[X_{it+1}\big] = X_{it+1} + \upsilon_{it+1} \tag{6}$$

Here $E_t\big[\upsilon_{t+1}\big] = 0$. Loglinearizing equation 5 then gives equation 7.

$$\gamma_i\big[ln(C_{it+1}) - ln(C_{it})\big] = ln(1+r_{t+1}) - ln(1+\rho_{it+1}) + \Delta(\theta_{it+1}) + \upsilon_{it+1} \tag{7}$$

As is common in literature I will proxy for the rate of time preference, $\rho_{it+1}$ and the within-period scaling parameter $\theta_{it+1}$, using demographic variables. The proxy for $\rho_{it+1}$ is the age of the household head and the proxy for $\Delta(\theta_{it+1})$ will be the change in the size of the household. As MaCurdy (1981), Heckman and MaCurdy (1982) and Blundell and MaCurdy (1999) point out, consumption and labour decisions are made simultaneously and therefore labour supply should be modelled explicitly as well. In this paper, however, I will follow the method of among others Attanasio and Weber (1995) and Banks

et al. (1998) who allow the within-period scaling parameter to be influenced by variables related to employment. As such, the labour decision still affects the consumption decisions, but it does not have to be modelled separately. I will use as an indicator the actual number of hours worked by the head of the household. This variable might be better able to capture the effect of labour on preferences than the variable used by Banks et al. (1998) who use a dummy whether the household head is in the labour force or not. It might very well be that the preferences of someone working part-time differs significantly from someone who is working full-time, something which is not captured by the dummy but which is captured by my variable. Essentially, this variable will indicate whether non-durable consumption is a substitute or a complement to leisure. As my measure of non-durable consumption consists of eating at home, transportation and entertainment I expect my measure to be a complement to leisure. Therefore, I expect the estimate for the number of hours worked to enter negatively. Including this measure is crucial in this thesis as I try to grasp the impact of retirement on the observed consumption path. Finally, in accordance with previous research (see e.g. Banks et al. (1998)) I include the change in the mortality rate to influence the consumption decision through the rate of time preference. If the mortality rate of the household goes up, the household is more likely to consume now rather than next period. As a result, I expect that the estimate enters negatively. For the interest rate, the yield on the 3-month Dutch bond will be used. For this variable there are two possible effects. On the one hand, a higher interest rate leads to an increase in income, i.e. the income effect. On the other hand, the higher interest rate might lead households to postpone consumption and as such benefit from the higher interest rate, i.e. the substitution effect. However, as most research (Attanasio and Weber, 1995; Banks et al., 1998) find a positive estimate for this variable, I expect it to enter positively here as well. In the base line specification I use the demographic variables as given above to proxy for the measure of Relative Risk Aversion, $\gamma$, as well.

This leads to the baseline specification as given by equation 8.

$$\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(Age\,of\,Head_{it+1}) + \alpha_2\Delta(Number\,of\,household\,members_{it+1}) + \alpha_3(Hours\,worked_{it+1}) + \alpha_4\Delta(Mortality\,rate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1} \tag{8}$$

This equation will be estimated for each household $i$. To control for the effect of different household sizes, I equivalize consumption by dividing total non-durable consumption by the square root of the number of household members.[4] Furthermore, to exclude the effect of inflation on the amount of consumption all observations are deflated to 2008 prices. Browning et al. (1985) showed that the results are similar when using a complex price index or simply a Stone Index Price Index. Therefore, I refrain from using this complex price index and use the Stone Price Index instead. In my case, however, the inflation figures for transportation and entertainment are hard to define from the data provided by CBS Statline. Therefore, in the main section of this thesis the data on non-durable consumption is deflated by using the general CPI index of the Netherlands. Despite this, the results are robust to using the Stone Price Index as deflator.[5].

It is common in literature to estimate the Euler equation using the General Method of Moments as some of the variables might be endogenous (Attanasio and Weber, 1995; Banks et al., 1998). In my case this concerns the change in the size of the household, the number of hours worked by the household head and the interest rate. First, the change in the number of household members might be endogenous in this equation for several reasons. One might be that there is an unobserved vector of variables $\mathbf{X}_{it}$ that affects both the evolution of consumption and the evolution of the household size. One possible unobserved variable might be the fertility of the household. As shown by Becker and Barro (1988), households indeed make the decision whether or not to have an additional child in conjunction with its current consumption decision. Second, the decision on leisure is made simultaneously with the decision on consumption (MaCurdy, 1981;

4. The results are robust to using the OECD equivalence scales
5. The inflation rates used are extracted from CBS Statline and the categories used to construct the Stone Price Index are '01000 Food', '07000 Transportation' and '09000 Recreational and cultural activities'.

Heckman and MaCurdy, 1982; Blundell and MaCurdy, 1999). Therefore, the number of hours worked in period $t$ and *t-1* should be endogenous with the change in consumption at time $t$. Third, the reason why the interest rate might be endogenous with the change of consumption has a macroeconomic explanation. If for instance, a country is experiencing economic growth, aggregate consumption will increase and as such the demand for money will increase. In turn, this increase in demand will increase the price of money, i.e. the interest rate (Giavazzi et al., 2010). Finally, there might be large measurement error in the dependent variable as the consumption data of the LISS panel is based on recall data (Battistin et al., 2003).

Next to the measurement error, there might be persistent individual differences in the subjective discount rate or inter-period scaling parameter. Therefore, I use panel data regression techniques in conjunction with Instrumental Variables in estimating the Euler equations. The instrument that I use are the lagged value of the change in the mortality rate, of the interest rate and of the age of the household member will be used as instruments together with the average change in the number of household members per year and cohort. To ensure the exogeneity of the last instrument, the average for each household is calculated by excluding its own observation. As such, this variable can vary within a cohort in a given year. Although these variables are predetermined, they are not strictly exogenous as future values might be correlated with the error term (Keane and Runkle, 1992). This is true for all instruments, except for the change in the size of other households.

As is shown by Keane and Runkle (1992), random effects should be used in estimating the Life Cycle Model as it is not legitimate to use fixed effects unless strict exogenous instruments are available[6]. Therefore, random effects will be used when estimating equation 8. Since this dataset is rather short (three periods after first differencing) Baltagi's EC2SLS random effects estimator will be used as this estimator will lead to an increase in the efficiency of the estimates in relatively small samples[7] (Baltagi and Liu, 2009).

6. Using this method restricts the observations that I can use when estimating this model, as I have to exclude outliers of the dependent variable. A short explanation why is included in appendix G.
7. Baltagi and Liu (2009) define the size of the sample as $N * T$, so small can in this case mean either few households or few time periods.

Finally, to control for any negative serial correlation, induced by measurement error (Bernheim et al., 2001), not accounted for yet, clustered Huber-White standard errors at the household level will be used to further account for the correlated structure of the covariance matrix.

After estimating equation 8 the residual for households around the time of retirement is used to assess the degree of unexplained consumption growth. By regressing the measure of financial literacy on this residual the hypothesis that the unanticipated shock as the household retires is larger for financially illiterate households can be validated. If this indeed appears to be the case this proportion of households might not fit very well in the theory of the lifecycle model, which assumes rational forward looking consumers.

# 5 Data

This section elaborates on the data that will be used in the remainder of this thesis. First, in section 5.1 the Longitudinal Internet Studies for the Social sciences (LISS) panel and the sample selection process will be described. Section 5.2 discusses the operationalization of the main variables, non-durable consumption and financial literacy. As this is the first paper to utilize the consumption data of the LISS panel in a life-cycle setting[8] subsection 5.2.1 will first give my definition of non-durable consumption and proceeds by an exploratory analysis of the data and compares it to previous empirical findings. Furthermore, this paper is the first to use the financial questions from the additional module in the LISS panel to construct financial literacy indices. Therefore, the method of obtaining the factors is first carefully explained after which the factors will be tested using similar methods used in previous research in subsection 5.2.2. Next, section 5.3 will elaborate on the control variables used in this thesis. Finally, appendix A includes a table including summary statistics for all variables for the entire sample and for the subsample of 148 households whose head retires while in the sample.

8. Until now, this dataset has only been used to assess the impact of household composition on labour supply and home production (Cherchye et al., 2012).

## 5.1 LISS Panel

In this thesis I will use the LISS panel for two reasons. First, this dataset contains detailed information on consumption for the years 2009, 2010, 2012 and 2015. By using this dataset in conjunction with the host of demographic variables included in the LISS panel I can estimate the LCH model as described by equation 8. Second, the LISS panel contains an additional module which was administered in 2011 which enables me to measure financial literacy, such that I can assess the impact of financial literacy on the unanticipated shock at the time of retirement.

The panel is gathered by CentERdata and is based on a true probability sample of households drawn from the population register by Statistics Netherlands. The survey is administered through the Internet, but to avoid a selection-bias individuals that don't have access to the Internet are provided with a computer and Internet connection. The main advantage of this administration through the Internet is that the respondent can consult different resources, such as income statements, receipts, but also a calculator before it gives a response. The downside of the administration through the Internet is that for the financial questions the respondent might be inclined to search for the answer online before answering. However, since a lot of respondents did not enter the correct answers, this is not deemed to be a problem.

As I am interested in the evolution of consumption of a household, I only include the observations of the household head. After appending the four waves of consumption and merging them with the relevant demographic and economic variables, I have data on all relevant consumption categories and demographic variables for 1,219 households. From this dataset I exclude the households whose head is older than 87 years old (2 households), as this data is very noisy. As explained in appendix G the estimation technique used does not allow for too much variance in the dependent variable relative to the independent variables. Therefore, I exclude the upper 2 percent and lower 1 percent of the distribution of the change in the log of equivalized, deflated non-durable consumption from my sample. Deleting these observations leaves a sample consisting of 1,184 households with on average 2.0 periods of observations. Note that one period

is lost due to the first differencing of both consumption and the size of the household. As I use the lag of the change in the mortality rate as an instrument, I also include demographic information of 2008 for each household such that further reduction of the sample size is not necessary.

## 5.2 Operationalization of variables

### 5.2.1 Non-durable consumption

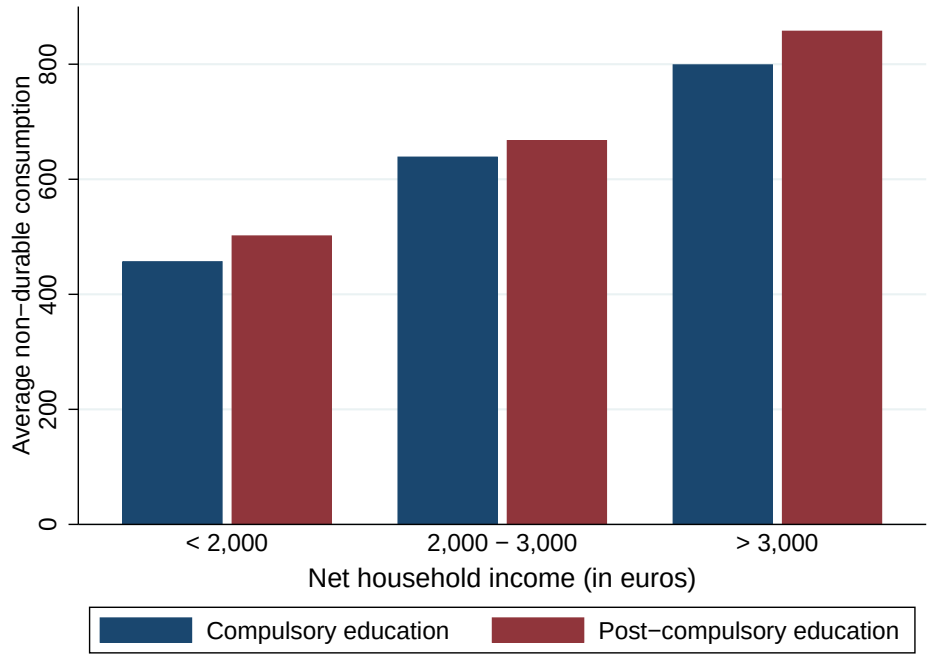
In this section the definition of non-durable consumption will be discussed and some exploratory analyses will be presented and compared to previous empirical findings.
The additional module of the LISS panel asks the households to indicate how much they spend on the following categories; a) mortgage and rent, b) electricity, gas and water, c) transportation, d) insurances, e) child daycare, f) alimony, g) debts, h) entertainment, i) cleaning the house and garden, j) eating at home and k) other. I define non-durable consumption as the sum of a) transportation, b) entertainment and c) eating at home.
There are two major drawbacks with this module. First, this additional module was not administered every consecutive year. Instead it was conducted in the years 2009, 2010, 2012 and 2015. Therefore, when taking the first difference of non-durable consumption I do not get an annual change in non-durable consumption. To overcome this problem, the interest and inflation rate are compounded over the missing years. Second, the categories as mentioned above do not cover all spending possibilities, thus important non-durables like restaurant meals and clothing do not feature in my measure of non-durable consumption. Essentially, I assume that the preferences between the included non-durable goods and those not measured are additively separable. The remainder of this section will perform some exploratory analyses on the consumption data provided by the LISS panel and assess whether it is consistent with the predictions of the LCH of Modigliani and Brumberg (1954).
One of the first findings that contradicted the "fundamental psychological law" of Keynes was the fact that different groups had a different saving rate, even though they had the same income. More specifically, it was found that in the US the saving rate for blacks was

higher as compared to whites for any level of income. This fact could not be explained by the theory of Keynes, but was rather easy to explain when using the LCH. As blacks in the US usually have a lower level of permanent income relative to whites, they will save more at any income level when compared to whites. I also find this result in the LISS panel when comparing average non-durable consumption for lower and higher educated households[9]. The sample is split in two categories for education, one group contains all individuals who only finished compulsory schooling and the other group contains all individuals who continued studying after secondary school. The relative size of the two groups is 33 percent and 67 percent, respectively. The average income of the post-compulsory education group (€3,255) is significantly higher than the average income of the compulsory education group (€2,831) at all significance levels. This indicates that the group with more education might indeed have a higher permanent income. In figure 4 total non-durable consumption per income group and education group is depicted. From figure 4 it follows that non-durable consumption is higher for higher educated individuals for every income group. When testing the actual difference between observed consumption for the two education groups, consumption is significantly higher for the higher educated group for all income groups[10]. From this we may conclude that the results found in the US also hold in the Netherlands and that this observation is consistent with the predictions of the LCH.

Next, non-durable consumption is used in constructing the graphs presented as evidence against the LCH by Carroll and Summers (1991) in figure 5 for both educational groups. Here the familiar hump shape of both income and consumption can be observed and it appears as if consumption is tracking income. The reduction in income and non-durable consumption after retirement, however, appears to be less significant than what is found for other countries. This might be due to the generous pension system of the Netherlands as explained in section 3. Also, it appears as if non-durable consumption increases significantly at the age of 65 after which it drops at the age of 73 for the

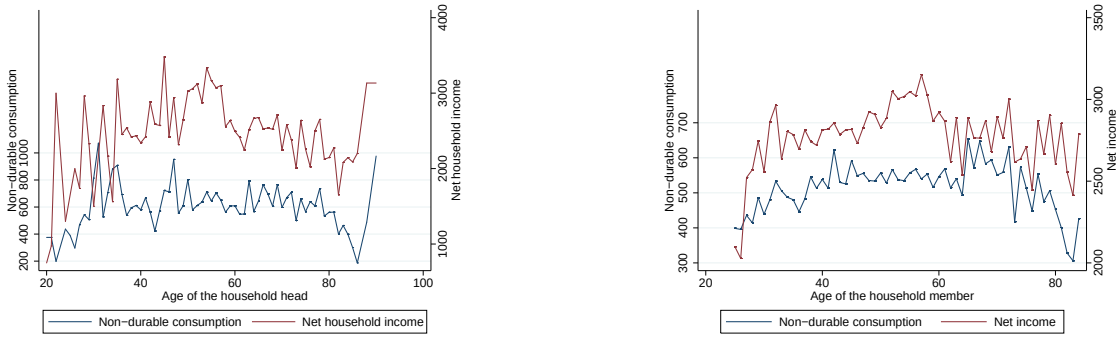
9. Note that the number of observations on consumption is higher than the number of observations on the change in consumption. In total there are 3,501 observations on total non-durable consumption.
10. Non-durable consumption is not normally distributed (Indeed, when testing for normality I find a $p$-value of 0.000). Therefore, the difference is tested using the two-sample Wilcoxon rank-sum (Mann-Whitney) test (Sawilowsky, 2005). For every income group the null is rejected at the 5 percent level.

Figure 4: Average non-durable consumption per income group and educational attainment




This figure shows average non-durable consumption per income group and level of educational attainment for the households in the sample. There are 3,501 observations on 1,184 household for non-durable consumption and income. 33 percent of the sample only passed compulsory education and 67 percent of the sample passed some form of post-compulsory education. The difference between the two educational groups is statistically significant for all income groups.

Figure 5: Non-durable consumption and income over the lifetime of the household head by education




(a) Compulsory education

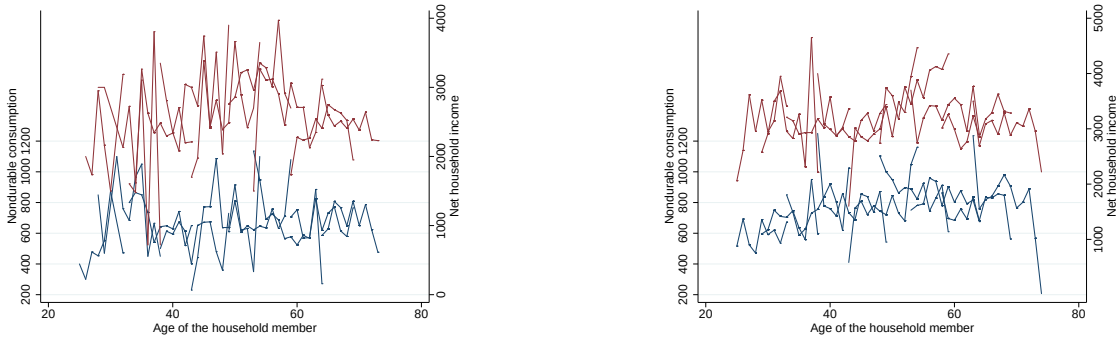
(b) Post-compulsory education

This figure shows average non-durable consumption(left scale) and net household income(right scale) over the lifetime of the household head for the dataset used in this thesis. Panel a shows the evolution of non-durable consumption for households whose head only passed compulsory education, whereas panel b does this for households whose head passed some form of post-compulsory education. The households that are also used in the remainder of the thesis have been used to construct these graphs. There are 3,501 observations on 1,184 household for non-durable consumption and income. 33 percent of the sample only passed compulsory education and 67 percent of the sample passed some form of post-compulsory education.

post-compulsory education group. However, in figure 5 the average is taken over all individuals irrespective of their year of birth, which might lead to erroneous conclusions (Attanasio and Browning, 1993a,b; Attanasio and Weber, 1995). In figure 6, the same graphs are reproduced, but now the individuals are grouped in year of birth cohorts[11]. The size of the cohorts are 5 years and if a cohort at a specific year consists of less than 15 households, the cohort is dropped. This leads to a total number of observations of 2,975 on 1,000 households. Comparing figure 6a with figure 6b we see that there is more noise for the first group, which is mainly due to the lower number of observations for this group. Moreover, from figure 6b the puzzling increase in non-durable consumption at the age of 65 has now largely disappeared. Consumption, however, still seems to track income. Furthermore, from figure 6b it also becomes clear that the differences between cohorts can be large. For instance for the age of 58 years the average income of the eighth cohort is €3,015, whereas the average income of the tenth cohort at this age is €4,076.

11. The exact definition of the cohorts is given in appendix A.

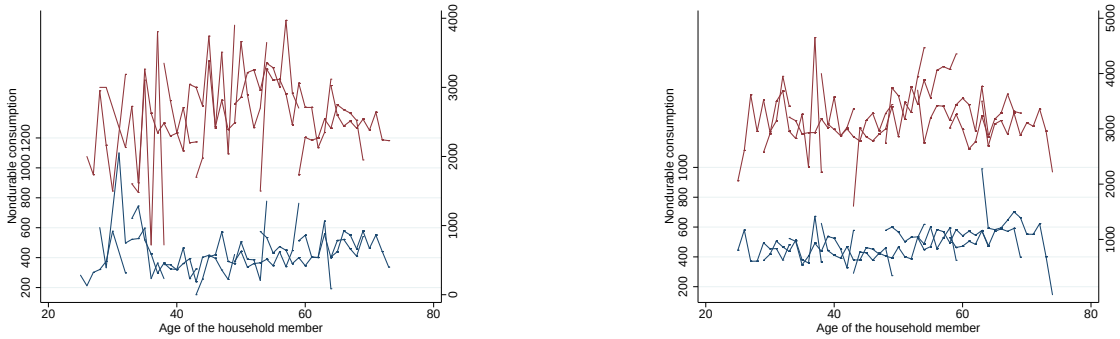
Figure 6: Non-durable consumption and income over the lifetime of the household head by education and cohort




(a) Compulsory education (b) Post-compulsory education

This figure shows average non-durable consumption(left scale) and net household income(right scale) over the lifetime of the household head per cohort for the dataset used in this thesis. Panel a shows the evolution of non-durable consumption for households whose head only passed compulsory education, whereas panel b does this for households whose head passed some form of post-compulsory education. Cohorts with less than 15 observations in a given year are excluded. There are 2,975 observations on 1,000 household for non-durable consumption and income. 32 percent of the sample only passed compulsory education and 68 percent of the sample passed some form of post-compulsory education.

Figure 7: Per capita consumption and income over the lifetime of the household head by education and cohort




(a) Compulsory education (b) Post-compulsory education

This figure shows average non-durable consumption(left scale) and net household income(right scale) over the lifetime of the household head per cohort for the dataset used in this thesis. Panel a shows the evolution of non-durable consumption for households whose head only passed compulsory education, whereas panel b does this for households whose head passed some form of post-compulsory education. Consumption is equivalized by the square root of the size of the household. Cohorts with less than 15 observations in a given year are excluded. There are 2,975 observations on 1,000 household for non-durable consumption and income. 32 percent of the sample only passed compulsory education and 68 percent of the sample passed some form of post-compulsory education.

Figure 7 presents the consumption per capita and income by cohort and education, where expenditure is equivalized with the square root of household size as is done by Attanasio and Weber (2010). As can be seen from figure 7 consumption is now much more stable over the lifetime of the household, implying that demographics are important and that the LCH cannot be rejected based on the previous figures as is done by Carroll and Summers (1991)[12]. The results obtained in these exploratory analyses are consistent with the predictions of the LCH and earlier empirical findings. I therefore proceed with formally testing the predictions of the LCH given by equation 8 with this data in section 6.

### 5.2.2 Financial literacy

In an additional module administered in 2011 all households were asked to complete a few problems of financial nature. From this the degree of financial literacy of each household can be determined and as such it can be checked whether the unexplained drop in consumption is larger for these households. The assumption here is that the degree of financial literacy does not change over the years. This assumption is not a very strict one to make, as individuals near retirement are not very likely to engage in further financial education. This assumption is validated by using an additional module which documents the amount of time the respondent spends on further education. From this module I find that individuals older than 60 years spend on average 0.94 hours per week on education and that the median value is equal to zero. As a result, I conclude that the assumption of constant financial literacy for the elderly is not a very strict one.

In order to derive an index for the degree of financial literacy of the individual, the methodology of Lusardi and Mitchell (2010) will be followed. More specifically, I perform a factor analysis on the financial questions from the financial literacy module of the LISS Panel. The respondents were given multiple choice questions concerning interest compounding, money illusion, diversification and bond prices. Please consult appendix

12. Another method to account for demographics is to regress the cohort year average consumption on cohort year averages of demographic variables and plot the residuals over the lifetime or against each year (Attanasio and Browning, 1993b). This is done in appendix B, where similar results are found as by Attanasio and Browning (1993b), which confirms the results found here.

C for the exact wording of the questions. Note that the questions were originally posed to the respondents in Dutch. I create a dummy which equals one if the respondent answered the question correctly. Next to that, I create another dummy if the respondent answered that it did not know the answer to the question. Taking this response explicitly into account is of vital importance, as such response characterize those who know the least (Van Rooij et al., 2011). In total this leads to the creation of 8 dummies. The Kaiser-Meyer-Olkin measure of sampling accuracy (KMO=0.69) and Barlett's test of sphericity ($p<0.000$) indicate that it is appropriate to use a factor analysis. Performing a factor analysis with the principal-factor method indicates that there are four different factors underlying the responses of the households. This is in stark contrast to Lusardi and Mitchell (2010) and Van Rooij et al. (2011, 2012) who find, using similar questions, only two factors. Their first factor has heavy loadings on the basic financial questions and the second factor is more heavily loaded on the more advanced questions. As a result, they interpret these two factors as basic financial literacy and advanced financial literacy respectively. When I plot the eigenvalues after factors together with the mean I find that in my sample only two factors should be included (Jolliffe, 2002)[13]. Also, there are only two factors with an eigenvalue above 1, indicating again that only two factors should be included (Jolliffe, 2002). When performing the factor analysis again with the principal component method I do obtain two factors which can be readily interpreted. The first factor has a large loading on the first two basic questions, whereas the second factor is more heavily loaded on the other two questions. These questions concern diversification and the relationship between interest rates and bond prices and can be interpreted as more advanced questions. As such, two interpretable factors are found in this panel consistent with previous literature. For the specific factor loadings please refer to appendix D. The factors are predicted by using Bartlett's method, as this method produces unbiased factors (Bartlett, 1937)[14]. From here I depart from the methodology of Lusardi and Mitchell (2010) who run a separate factor analysis on both the basic and advanced questions in order to determine the measure for both

13. Please refer to figure D1 in the appendix for the screeplot
14. The results are robust to using the method as proposed by Thomson (1939).

basic and advanced financial literacy. Instead, I perform one factor analysis on the basic and advanced questions combined and construct the basic and advanced literacy index as such. The LISS panel only contains two basic and two advanced financial questions, whereas the dataset of Lusardi and Mitchell (2010) contains 6 basic and 8 advanced financial questions. Therefore, I choose to keep as much information possible and determine the indices jointly[15]. As can be seen from table D1, the factor scores for giving the correct answer enter negatively and for indicating that you do not know the answer enters positively. This indicates that the underlying factors might be financial illiteracy, rather than financial literacy. Therefore, I take the negative of the retrieved indices to obtain a measure which is increasing with the degree of financial literacy. Next, I reshape the index such that it ranges from 0 to 10.

To assess the validity of the factors obtained several analyses are included in appendix D. First, as in the questionnaire of Lusardi and Mitchell (2010), the module in the LISS panel also asked the individuals to rank their own understanding of financial concepts before they had to answer the questions of financial nature. They had to score their own understanding of financial matters on a scale of 1 to 7, where 1 means 'very poor' and 7 'very good'. Lusardi and Mitchell (2010) start with creating financial literacy quartiles and show the relative frequency of each quartile for each score on the question on financial literacy. In my case it is not possible to create strict quartiles, due to the clustering of scores around specific values. Due to this and the fact that this is merely an exploratory analysis I refrain from repeating this analysis here. To ensure the validity of the obtained factors I perform an ordered logistic regression as described by Verbeek (2008), instead. This allows me to check the significance of the relationship between self-assessed literacy and the two literacy indices while controlling for other variables. The results of this analysis are presented in table D2. Here, I find that the derived indices for basic and advanced financial have a significant positive effect on self-assessed literacy ($p = 0.000$)[16]. Furthermore, when regressing the average amount of

15. The results are robust to constructing the financial literacy indices separately.
16. The Brant test of the parallel regression assumption indicates that for the basic financial literacy index, assets and age the parallel assumption is violated. However, after relaxing the assumption of parallel regressions for these three variables I obtain similar results. These results are not presented due to space considerations.

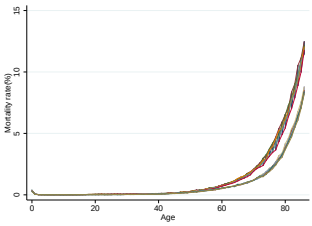
assets of the household, the net income of the household and education on the financial literacy indices I find strong significant effects in the expected direction. Furthermore, demographics such as age, gender and being married significantly affect the score on the index. The results of this estimation can be found in table D3. All these results confirm the assumption that the obtained underlying factors measure the financial knowledge of each individual. Therefore, I proceed by using the obtained factors to assess the impact of financial proficiency on post-retirement income adequacy.

## 5.3 Control variables

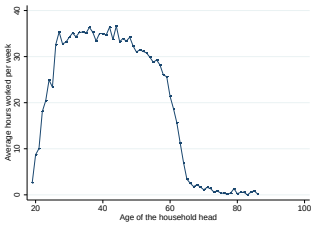
In this subsection some descriptive graphs are included to give the reader insight into the control variables used.

Data on the mortality rate is extracted from CBS Statline. This database has data on the probability of dying and on life expectancy for every year, for every age and for both males and females. The mortality rates are depicted in figure 8a. The LISS

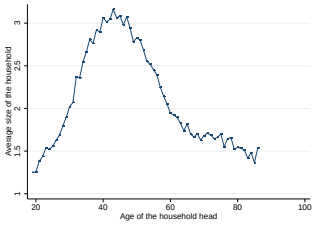
Figure 8: Control variables over the lifetime of the household




(a) Mortality rate per gender, time period and age.




(b) Average weekly hours worked per age




(c) Average size of the household over the lifetime of the household head

Figure a is constructed by using data provided by CBS Statline, which contains data on the mortality rate for every time period and every age differentiated by gender. Figure b and c contain the evolution of the average number of hours worked and the average size of the household over the lifetime of the household head. Figures b and c have been constructed based on the LISS panel. The total number of observations are 2,320.

panel also contains data on the number of hours the individual works on average per week. The average per age is depicted in figure 8b. From this figure it becomes clear that the number of hours worked in this sample follows the commonly-observed hump shape. The final variable used in equation 8 is the size of the household to proxy for

the within-period scaling parameter. The average size of the household over the lifetime of the household head has been depicted in figure 8c. Again we observe this variable to follow a hump shaped pattern.

By using an additional module of the LISS panel[17] where individuals have to indicate whether they were retired or not, the moment when the household head transitions into retirement can be determined. To determine this transition for every available year I use the waves for 2008, 2009, 2010, 2012 and 2015. During my sample there are 173 households whose household head enters into retirement. 5 of these households, however, retired early due to adverse health shocks and 17 households retired due to a reorganization in the business. As among others Smith (2006) shows that the shock is mainly present for these households and these findings can be perfectly reconciled with the predictions of the LCH, I exclude these households. Furthermore, there are 3 households for which I only have data on consumption for one period, so I end up with 148 households whose head retires in the sample.

As Hurd and Rohwedder (2008) points out, the drop in consumption after retirement is largest for households with little assets. To control for this possible effect I include the average amount of assets of each household while it is in the sample. The LISS panel contains an additional module[18] that asks households for their total balance of their current accounts, savings accounts, term deposits accounts, savings bonds or saving certificates and bank savings schemes. This module was administered in 2008, 2010, 2012 and 2014. To obtain a clear view of the amount of assets of each household, I combine the four databases and determine for each household the average amount of assets it owned during its presence in the sample. This is mainly done as many households only filled in this question once or twice and as such the amount of assets at a specific time relative to retirement can be determined for only a few households[19]. Moreover, I remove the upper 5 percent of the households from the sample as the imputed values are unreasonably

17. Module 6, Work and Schooling
18. Module 9, Economic situation: Assets
19. The lack of consumption data for the years 2011, 2013 and 2014 prohibits me from estimating assets for the missing years as proposed by Bernheim et al. (2001). More specifically, Bernheim et al. (2001) estimate wealth holdings for the missing years by $W_{t-1} = \frac{W_t - Y_{t-1} + C_{t-1}}{1+r_{t-1}}$, a strategy which is not possible with my dataset.

high as the values of this upper 5 percent range between €124,086 and €4,109,525. Next to this, there were some households that indicated that they either did not know how much assets they had or that they did not want to answer. This leaves me with 957(128) households (retiring households) for which I have observations for the amount of assets which is 81(86) percent of the original sample. As this variable will only be used for the retiring households, this is not deemed to be a major problem.

# 6 Results

This section presents the main results of this thesis. In section 6.1 the procedure of Hurd and Rohwedder (2008) is replicated by plotting actual consumption before and after the moment of retirement. This is done for several groups, based on their basic financial knowledge. To my knowledge, the life-cycle profile of consumption including demographics has never been estimated on data from the Netherlands. Therefore, the section 6.2 will begin by assessing the validity of the predictions of the LCH for the Netherlands in the common way, i.e. by creating cohort averages. Afterwards, I exploit the fact that the LISS panel is an actual panel and apply the predictions of the LCH on a household level. As only showing that consumption drops after retirement is not enough evidence for the existence of a Retirement-Consumption Puzzle, the section 6.3 substantiates the findings found in section 6.1 by comparing the observed drop with the predicted drop. This is done by assessing the residual around the time of retirement.

## 6.1 The consumption drop around retirement

This section highlights the change in consumption as different households enter retirement. This is done in the same fashion as Hurd and Rohwedder (2008) as described in section 2.2, except that I use financial literacy instead of assets to split the sample of retiring households. The retiring households are split into two groups, one group with low basic financial literacy and another group with a higher basic financial literacy score. As the score on the financial literacy index is not continuous and there are only 148 observations, the financial literacy scores centre around specific values. Therefore,

it is impossible to create percentiles at conventional levels with any meaningful interpretation. Thus, in the remainder of this section cut-off values are used that approach certain percentiles. Appendix F presents the histogram of the basic financial literacy for the retiring households to give some insights into the distribution of this variable for this subsample. In this section I classify households with little basic financial knowledge as households with a score lower than 8, as 27.8 percent of the retiring households are in this range. Therefore, using this cut-off value approaches that of using the first quartile. In the figures below I compare the evolution of the log of equivalized, deflated non-durable consumption for the lowest quartile with the households in the other quartiles.

As mentioned in section 5, one of the drawbacks of the LISS panel is that the survey on consumption was not administered yearly. Therefore, I adjust for this when plotting the evolution of consumption before and after retirement as the amount of time between two periods is not equal for every household. If for instance a household retires in 2010, the previous observation on consumption is made in 2009 whereas for a household retiring in 2015 the previous observation of consumption is in 2012. Neglecting to take this into account might bias the results obtained here as it might very well be that all the relatively financially illiterate households retired in 2015 and all relatively financially literate households in 2010. Consumption three years before retirement relative to consumption during the year of retirement might be much higher than consumption one year before retirement relative to consumption during retirement. As a result, the drops in consumption might not be comparable. Therefore, I construct annual changes for the years 2011, 2013 and 2014 through interpolation. Here I assume that the change of consumption over the period 2010 - 2012 and 2012 - 2015 is linear.

Figure 9 displays the levels of log non-durable consumption versus the year before retirement. This figure is constructed as follows. First, I create eight different groups based on the financial literacy score of the household and their year of retirement (2 literacy groups x 4 periods). I proceed by computing the median value for all eight groups for every year and then divide the observations of each year by the observation for that group at time *-1*. Finally, I take the mean value of each observation per year and financial literacy group to end up with the evolution of consumption for the two groups around

retirement. I choose to do it this way, as this way ensures that the levels of consumption of the households that retire in 2015 do not interfere with the relative consumption after year 0. Also, I take the median value for the eight groups as the effects of observational error on spending can lead to large outliers once it is put in a ratio (Hurd and Rohwedder, 2008). To take into account the effect of retirement on non-durable consumption of the households in all 4 groups I take the average of these 4 values for every year. In these figures the range for the years is from 3 years before retirement until 3 years after retirement. There are observations for more years, but as the number of observations get smaller after 3 years I exclude those from these figures[20].

From figure 9 it becomes clear that the values for the drop in non-durable consumption obtained here[21] are smaller as compared to previous findings for the US. The usual range for the drop in non-durable consumption is between -2.5 percent (Fisher et al., 2008) and -16 percent (Laitner and Silverman, 2005). These studies, however, do not use a true panel and use cohort analysis instead. Therefore, the study by Hurd and Rohwedder (2008) is more comparable. Using the same measure, Hurd and Rohwedder (2008) finds a drop of 2.4 percent for non-durable consumption at the household level. The reason why the drop in the Netherlands is smaller might be due to the higher replacement rate in the Netherlands as discussed in section 3. Furthermore, their measures of non-durable consumption comprises more categories, such as eating at restaurants.

When comparing the two groups, it appears that the households in the lowest quartile of financially literate tend to experience a decline in consumption in the year they retire. This shock is not observed for the more financially literate households. This observed shock seems to persist and non-durable consumption is 8 percent lower after 3 years for the lowest quartile. From table 7 it should be noted, however, that the number of observations on consumption decreases significantly in year 1, so as of this year the results should be interpreted with care. Despite this, figure 9 points towards the notion that households with little basic financial knowledge indeed experience unanticipated adverse

20. Note that for there to be an observation for over 3 years after retirement, the household had to retire in 2009 or 2010 and still be in the panel in 2015. The opposite holds for observations 3 years before retirement.

21. The drop in non-durable consumption at retirement for the entire sample is equal to 0.2 percent.

Table 1: Number of observations on consumption for each time period

| Year relative to retirement | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| Low basic financial literacy | 27 | 32 | 41 | 42 | 15 | 15 | 14 |
| Higher basic financial literacy | 78 | 86 | 107 | 109 | 55 | 55 | 50 |
| Total | 105 | 118 | 148 | 151 | 70 | 70 | 64 |

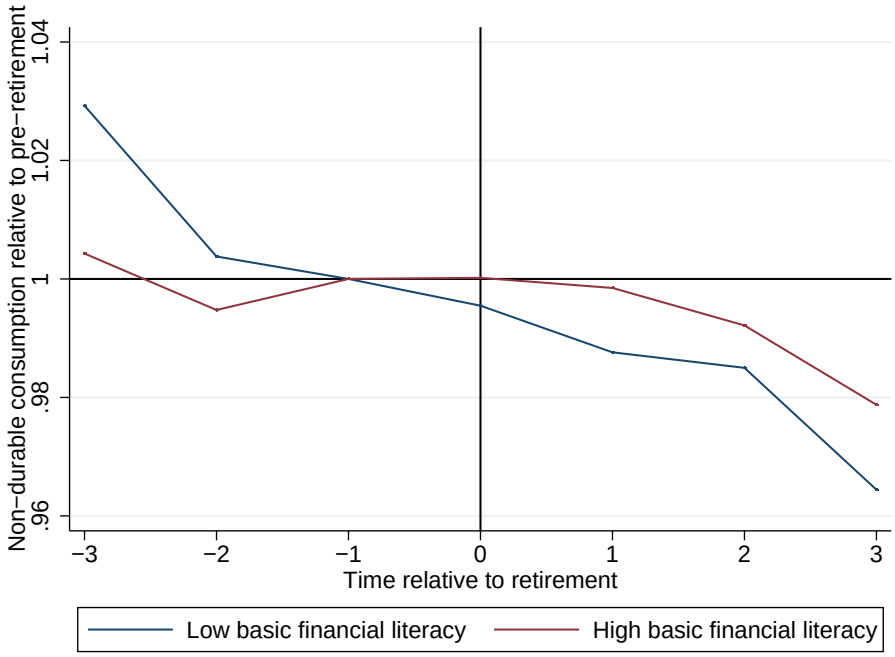
This table present the number of observations on equivalized, deflated consumption for both the lowest basic financially literate quartile and the households in the other three quartiles for each of the years used in figure 9, 10 and 11. Consumption for missing years relative to retirement are obtained by interpolating between two observations.

shocks once they transition into retirement. Furthermore, this finding is consistent with those of Hurd and Rohwedder (2008) who finds that the drop in consumption is larger for households with a short planning horizon, albeit only for households with low assets.

Although this first finding is indicative, it is in no way conclusive that there are unanticipated income shocks for households with little financial knowledge. As Aguiar and Hurst (2013) show, the drop in non-durable consumption is mainly driven by a decrease in the expenditure on food, something which can be perfectly explained with the model of Becker (1965) as explained in section 2.2. Therefore, two components of non-durable consumption, food and entertainment will be examined separately. According to the model of Becker (1965) we should observe that expenditure on food, being a substitute of time available, should decline and expenditure on entertainment, a complement to time available, should increase as households retire. My measure of food consumption only includes eating at home so on the one hand, I expect this measure to increase as retirees will probably have more meals at home, as compared to when they were working. On the other hand, due to more efficient shopping and more home production, I expect this measure to decrease. In figure 10 food expenditure is plotted relative to the period before retirement, which is determined in the same manner as overall non-durable consumption. As becomes clear from figure 10 expenditure on food for my sample is relatively stable when comparing these results to previous literature[22]. Battistin et al.

22. The consumption of food at the time of retirement relative to the previous year is 1.4 percent higher for the entire sample.

Figure 9: Non-durable consumption relative to the period before retirement




This figure present non-durable consumption relative to the year before retirement. Non-durable consumption consists of the categories eating at home, transportation and entertainment. Data on these categories has been obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. Data on missing years is obtained through interpolation. Consumption has been deflated to 2008 prices by using the CPI index provided by CBS Statline. The total number of observations for each year are given by table 7

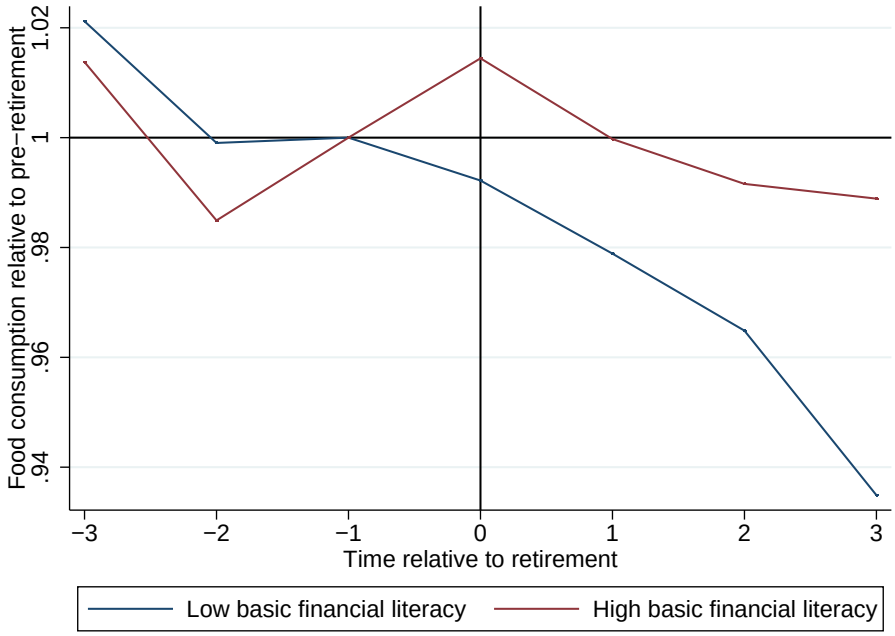
(2009) finds a drop of 14 percent for the entire sample of US households and 31 percent for the subsample with the least amount of assets, whereas Fisher et al. (2008) finds a less severe drop of 5.7 percent for the entire sample of US households. Furthermore, Hurd and Rohwedder (2008) finds a drop in food consumption of 3.0 percent[23]. This difference in findings might again be explained by the difference in pension systems as explained in section 3. Furthermore, all these studies include both eating at home and eating away from home. This might also explain the obtained difference here. Nonetheless, the difference between the lowest quartile and the other quartiles is large. The evolution of food consumption is stable for the financially literate households and it even increases in the year in which they retire. The food consumption path of the lowest quartile, however, shows a significant decline of over 6 percent after three years. This vast difference between the evolution of food consumption as households transition into retirement is hard to reconcile with the predictions of the model of Becker (1965). This again might point towards the conclusion that financially illiterate households experience unanticipated income shocks as they transition into retirement.

Next, the expenditure on entertainment is examined. According to the model of Becker (1965) I expect that the consumption of entertainment should increase once the household has more time available. However, when looking at figure 11 this does not seem to hold for the households in this sample. For the entire sample, there is a drop in expenditure on this category of 0.6 percent at the year of retirement. Despite this, it becomes clear from figure 11 that this drop again is mainly due to the financially illiterate households. As argued by Aguiar and Hurst (2013), a drop in the consumption of entertainment might indicate that households experience negative income shocks as they transition into retirement as households are in this case more likely to cut spending on luxury goods than on necessities. This apparent drop in the consumption of entertainment for the lowest quartile confirms the results found previously.

These graphs have also been replicated for the measure of advanced financial knowledge, by again comparing the lowest quartile[24] with the other households, but there appears

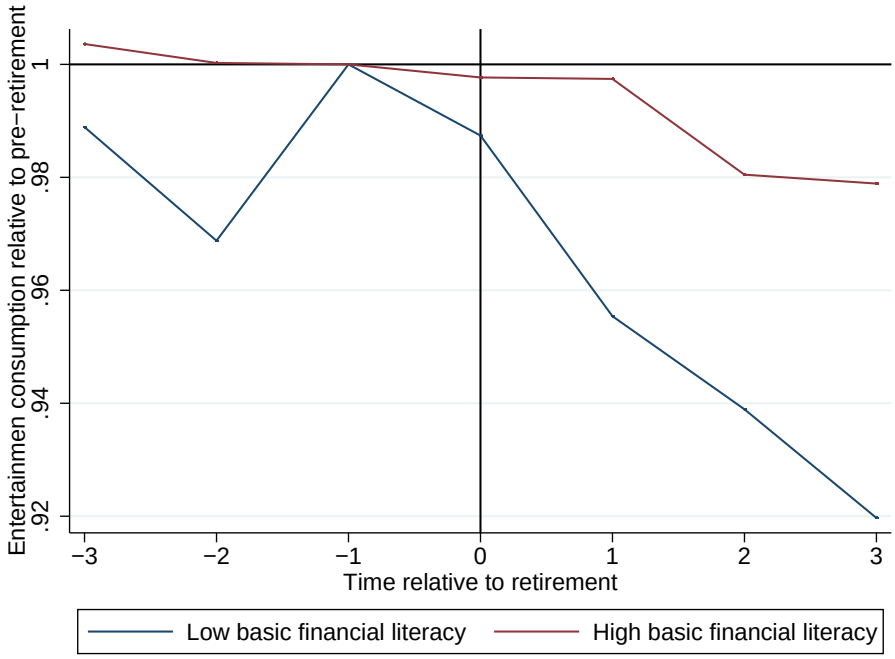
23. For an entire overview of the range of values concerning the drop in food consumption after retirement please refer to Fisher et al. (2008).
24. Again, this quartile can only be approximated and here it is equal to 23.0 percent.

Figure 10: Food expenditure relative to the period before retirement




This figure present food consumption relative to the year before retirement. Data on this category has been obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. Data on missing years is obtained through interpolation. Food consumption has been deflated to 2008 prices by using the inflation rates for the category '01000 Food' provided by CBS Statline. The total number of observations for each year are given by table 7

Figure 11: Entertainment expenditure relative to the period before retirement




This figure present entertainment consumption relative to the year before retirement. Data on this category has been obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. Data on missing years is obtained through interpolation. Food consumption has been deflated to 2008 prices by using the inflation rates for the category '09000 Recreational and cultural activities' provided by CBS Statline. The total number of observations for each year are given by table 7

to be no significant difference in the evolution of consumption between the two groups of households as they transition into retirement.

Combining the results obtained in this section points towards the conclusion that a lack of basic financial literacy hinders households to plan optimally for retirement. This might indicate that even though Lusardi and Mitchell (2010) and Van Rooij et al. (2011) find that advanced financial literacy is the main predictor of the degree of retirement planning of households, it is in fact basic financial knowledge that determines the adequacy of income for retiring households. Although these results are indicative it might very well be that for households in the lowest quartile of basic financial knowledge it is optimal to decrease their consumption after retirement. Therefore, in subsection 6.2 the optimal path of consumption is determined for every household by employing the predictions of the LCH on the data. As such, it can be checked whether this drop indeed is sub-optimal, which is done in subsection 6.3.

## 6.2 Assessing the validity of the LCH for the Netherlands

In a first attempt, the predictions of the LCH are tested by using the conventional method, i.e. by creating cohorts. I use cohorts of 5 years as in section 5.1[25]. However, it is impossible to find strong instruments for the change in number of household members. Even after narrowing the cohorts size to 3 years or by splitting them according to their educational attainment, which is also done by Attanasio and Browning (1993a), there are no instrumental variables that pass the rule of thumb that the F-statistic of the first stage regression should exceed 10. Therefore, the model as described by equation 8 cannot be estimated by using cohorts as there are too few years of data available.

The main advantage of the LISS panel is that it contains data on households for multiple years. As such, the predictions of the LCH can be tested on an individual level. I begin by testing the relevance of the instruments that are mentioned in section 4. The results of these regressions are included in appendix E. From this it becomes clear that all instruments are highly relevant as the lowest F-statistic is 25.73, which is well above the conventional rule of thumb where the F-statistic should exceed 10. Therefore, I

25. For the exact definition please refer to appendix A

proceed with estimating the model as given by equation 8. As indicated by a Hausman test, the model should indeed be estimated using random effects, rather than fixed effects ($p = 0.221$)[26]. This result confirms the validity of the empirical strategy chosen in section 4. The results of several regressions are included in table 2. As the model includes more instruments than endogenous variables it is overidentified, which implies that I can test for the exogeneity of the instruments. The test statistics are included for every model at the bottom of table 2. Despite the fact that the instruments are not strictly exogenous as motivated in section 4, the the null hypothesis of the Sargan test is not rejected. The difference between the first two models is the instruments that are used. In both models, the lagged value of the change in mortality rate, of the interest rate and of the age of the household head are included. Next to these instruments the average change in number of household members per cohort and year is included as instrument. In Model 1, however, the average change in number of household members per cohort and year is calculated by including the observation of the own household. To remove possible endogeneity concerns, the observation of the own household is removed from each average in Model 2. As can be seen, the estimates and the $p$-values change slightly. Next to that, the Sargan statistic decreases indicating that indeed some of the endogeneity has been removed. Most remarkable is the fact that the estimate for the change of the household size now becomes insignificant at all significance levels, whereas the interest rate becomes significant at the 10 percent level. Finally, Model 3 is similar to Model 2, except for the fact that this model includes Huber-White robust standard errors to further account for the measurement error in the dataset which induces negative serial correlation. As model 3 is the most preferred model, this model will be used in subsection 6.3 to assess the impact of financial literacy on post-retirement income adequacy[27].

All estimates in table 2 enter with the expected sign. Non-durable consumption is, in my case, defined as the sum of eating at home, entertainment and transportation. Therefore,

26. In fact, Keane and Runkle (1992) show that the Hausman test when using this kind of data is biased towards the use of fixed effects. This is due to the biased estimates produced by the fixed effects model in the absence of strictly exogenous variables. Despite this bias the Hausman test shows that random effects should be used. This increases my confidence in the chosen empirical approach.
27. Similar results are found when using Model 1. Obviously, the same results are found when using Model 2 instead as the robust standard errors do not change the residual.

Table 2: Results for the estimated Life Cycle Model

| $\Delta$ Log of non-durable consumption | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Total hours worked | -0.0076** | -0.0078** | -0.0080** |
| | (0.0035) | (0.0038) | (0.0041) |
| Interest rate | 0.0499 | 0.0540* | 0.0540* |
| | (0.0313) | (0.0317) | (0.0324) |
| $\Delta$ Number of household members | -0.3532* | -0.3757 | -0.3757 |
| | (0.2048) | (0.2342) | (0.2656) |
| Age of the household head | -0.0089** | -0.0093** | -0.0093** |
| | (0.0039) | (0.0042) | (0.0045) |
| $\Delta$ Mortality rate | -7.8142*** | -8.0645*** | -8.0645*** |
| | (2.7601) | (2.8327) | (2.0588) |
| Constant | 0.6083** | 0.6392** | 0.6392* |
| | (0.2895) | (0.3131) | (0.3343) |
| Number of households | 1,184 | 1,184 | 1,184 |
| Observations | 2,320 | 2,320 | 2,320 |
| Sargan test $\chi^2(1)$ | 1.133 | 0.741 | 0.756 |
| Sargan test $p$-value | (0.287) | (0.389) | (0.385) |

This table provides the results of the following regression ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(Ageof Head_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$ using different instruments. All models include as instruments the lag of the interest rate, of the age of the household head and of the change in the mortality rate. Model 1 also includes the cohort year average of the change in the size of the household. Model 2 removes possible endogeneity concerns by excluding the household's own observation from the final instrument. Model 3 is similar to Model 2, but now Huber-White robust standard errors have been included in order to account for the negative serial correlation induced by the observational error of the survey. The estimates are obtained by using the EC2SLS random effects estimator of Baltagi and Liu (2009). The statistics related to the test of overidentifying restrictions is included at the bottom of the table. The degrees of freedom for every model is 1. The results are based on consumption data of the LISS panel for the years 2009, 2010, 2012 and 2015. Data on the mortality rate and the interest rate has been extracted from CBS Statline and Bloomberg respectively. Non-durable consumption is equivalized by using the square root of the size of the household and deflated by using the CPI index provided by CBS Statline. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

I expect my measure of non-durable consumption to be a complement to leisure. Indeed, the estimate for the number of hours worked enters negatively. Next to that, the change in household composition and the age of the household head were included as to proxy for the rate of time preference and the way each household scales within-period consumption together with the degree of relative risk aversion. For the age of the household head I find an estimate of approximately -0.009 which is quite close to the estimate of Banks et al. (1998) who find an estimate of -0.006. This estimate indicates that households prefer to consume in the early stages of life, keeping everything else constant, as the change in non-durable consumption decreases and ultimately becomes negative as the household ages. For the most preferred model, the change in the number of household members does not enter significant at any conventional significance level and can therefore not be interpreted in any meaningful way. As indicated in section 4, the estimate of the interest rate could be either positive or negative, depending on which effect would dominate. For the interest rate, I find a positive estimate indicating that the income effect dominates. This is in accordance with Banks et al. (1998) who also find this. The size, however, differs remarkably as Banks et al. (1998) find an estimate of 0.494 whereas my estimate is 0.0540 for the most preferred model. This might be due to the fact that Banks et al. (1998) use a more comprehensive measure of non-durable consumption. Their measure includes more luxurious goods like personal services and restaurant meals, which might be more responsive to the interest rate. Finally, the change in the mortality rate enters negatively as expected, which is consistent with the findings of Banks et al. (1998) who find a positive estimate for the change in the survival probability.

Thus, as is common in literature I also find that demographic variables are important determinants of the evolution of consumption over the lifetime of the household. The results found in this section are consistent with the predictions of the LCH including demographic and labour status variables of among others Attanasio and Weber (1995) and it can therefore be concluded that the predictions of this version of the LCH also hold for the Netherlands.

## 6.3 Assessing the impact of financial literacy

The households used in section 6.1 will be used here as well to assess whether financial literacy indeed has an impact on the size of the unanticipated shock once they retire. From the regression results of Model 3, the residuals are stored. Note that the residuals here consist of both the random error component ($u_i$) and the overall error component ($e_{it}$) as I estimate the model using the random effects estimator[28].

For all households the change in log non-durable consumption during the period when they retire is on average equal to -0.0287 and the median change is 0.0087, which implies that consumption is on average 2.87 percent lower and for the for median household 0.87 percent higher when they retire as compared to previous period[29]. By obtaining the predicted values of Model 3 I can determine what the LCH would predict for these households as they transition into retirement. In this model the LCH predicts that on average consumption should fall by 4.16 percent and the median predicted fall amounts to 1.51 percent. So overall, there does not appear to be a Retirement-Consumption Puzzle at all as I find that there is an unexplained positive shock once households retire, rather than a negative one. Finding this result for the Netherlands, however, might not be too surprising due to the high replacement rate in this country.

However, when assessing the unanticipated shock for different groups of households based on their financial literacy I find the results as presented in table 3. From table 3 it becomes clear that there is a large heterogeneity in the shock experienced during the transition into retirement among households based on their financial literacy. For the lowest quartile of basic financial literacy the unexplained part of the evolution of the log of non-durable consumption amount to -0.0606, indicating that for these households

28. One might argue that only $e_{it}$ should be used when assessing the impact of financial literacy on the unanticipated shock during retirement as $u_i$ captures the error made by household $i$ over the entire sample period. However, since there are on average only 2 observations for each retiring household I choose to use the combined residual as this should capture the overall shock experienced by the household as it transitions into retirement.
29. Here one period is hard to define, as it can be either 1 year for households retiring in 2010 or 3 years for households retiring in 2015. In section 6.1 an attempt has been made to deal with this issue. The main point here, however, is to compare these values to the predictions of the LCH.

Table 3: Unanticipated shocks around retirement and financial literacy

| Unanticipated shocks at retirement | Basic financial literacy | Advanced financial literacy |
|---|---|---|
| Lowest | -0.0606 | 0.0954 |
| | (0.0610) | (0.0858) |
| Intermediate | 0.0026 | -0.0200 |
| | (0.0555) | (0.0523) |
| Highest | 0.1353 | 0.0137 |
| | (0.0883) | (0.0634) |
| Difference Highest - Lowest | 0.1959** | -0.0817 |
| (Z-statistic) | (-2.053) | (1.047) |

This table provides the observed residual of the regression of Model 3 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$) by financial literacy quartile. For the lowest and highest quartile and the intermediate group, the average is presented jointly with the standard errors in parentheses unless otherwise indicated. The rows at the bottom of the table show the difference between the highest and lowest quartile and the Z-statistic of the corresponding two-sample Wilcoxon rank-sum (Mann-Whitney) test. The results are based on consumption data of the LISS panel for the years 2009, 2010, 2012 and 2015. The financial literacy indices are determined using an additional module of the LISS panel administered in 2011. The number of observations equals 148. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

there is an unexplained drop of 6.06 percent in non-durable consumption[30]. Contrarily, for the highest quartile there is a positive unexplained part of consumption of 0.1353. I test for the statistical difference between these two observations by using the two-sample Wilcoxon rank-sum (Mann-Whitney) test instead of the student t-test. The reason for this is that although the residual should be normally distributed for the entire sample, for this sub-sample this does not need to be the case. Indeed, when testing for the normality of the residual for these 148 households, I find a Doornik-Hansen statistic of 6.818 and a corresponding $p$-value of 0.033. Therefore, the student t-test cannot be used as it assumes a normal distribution. Using the Wilcoxon rank-sum test I find a Z-statistic of -2.053 and a corresponding $p$-value of 0.040, indicating that the difference between the highest and lowest quartile is statistically different. When doing the same analysis for the advanced financial literacy index I do not find a statistical significant difference between the quartiles. These results again seem to confirm the hypothesis that basic financial literacy is an important determinant of post-retirement income adequacy.

Although these results are indicative, it might be that the shock depends on other variables as well. As Hurd and Rohwedder (2008) point out, the RCP is mainly concentrated among low net-worth households. In order to control for this, the measures of financial literacy together with the amount of assets and educational attainment are regressed on the residual at the moment the households enter retirement. The results are presented by table 4. From table 4 it becomes clear that basic financial literacy indeed appears to affect the size of the unanticipated shock as households retire. From column 2 and 3 it becomes clear that in my dataset, the amount of assets of the household or its educational attainment by itself do not have a significant effect on the unanticipated shock at retirement. This is in contrast to the findings of Hurd and Rohwedder (2008) who find that the drop is larger for households with the least amount of assets and that adding educational attainment significantly reduces the impact of having a short planning horizon on the observed post-retirement consumption drop. The most interesting results,

30. Due to the clustering of financial scores it is impossible to construct the second and third quartile, therefore I combine these two quartiles. Interestingly, for this group the residual is for both basic and advanced financial literacy close to zero, indicating that the model works quite well for this group during retirement.

however, are found in column 6 where assets are allowed to interact with the degree of financial literacy. From this column it becomes clear that the amount of assets does appear to have an influence on the size of the unanticipated shock. In fact, the size of the adverse shock decreases as the household's basic financial literacy increases, but this effects becomes smaller as the household has more assets. The same reasoning holds for the amount of assets. To investigate this relationship a little further a marginsplot has been used to determine the significance of basic financial literacy on the residual for different amount of assets. From the marginsplot it becomes clear that the effect of basic financial literacy is significant for household with assets worth less than €19,300. In my sample, this is 46 percent of the retiring households. Furthermore, the effect of the amount of assets is only significant for the households in the lowest quartile of basic financial literacy.

In sum, I find that the lack of basic financial knowledge hinders households from properly planning for retirement and that this lack of planning causes the most problems for households with little assets. Interestingly, this contradicts the findings of Lusardi and Mitchell (2010) and Van Rooij et al. (2011) who find that advanced rather than basic financial literacy is the main determinant of retirement planning. In my case, this variable is nowhere significant.

## 6.4 Robustness checks

### 6.4.1 Recall bias

As pointed out by Battistin et al. (2003), recall data on non-durable consumption might be seriously affected by so-called recall bias. As a result, the results found might be erroneous. First, I will check the effect of basic financial literacy on the size of the residual at any time. It might be that households with a low basic financial literacy are less likely to properly recall how much they consumed. The results of these regressions show that the there is no significant effect of basic financial literacy on the overall residual. This indicates that the results are probably not driven by the fact that households with little basic financial knowledge are less likely to properly recall their expenditures.

Table 4: The effect of financial literacy on the unanticipated shock at retirement

| | Residual | Residual | Residual | Residual | Residual | Residual |
|---|---|---|---|---|---|---|
| Basic financial knowledge | 0.0582** | | | 0.0575** | 0.0580* | 0.1033*** |
| | (0.0288) | | | (0.0289) | (0.0316) | (0.0385) |
| Advanced financial knowledge | 0.0048 | | | 0.0039 | 0.0017 | -0.0166 |
| | (0.0144) | | | (0.0147) | (0.0161) | (0.0222) |
| Educational attainment | | 0.0276 | | 0.0283 | | |
| | | (0.0766) | | (0.0771) | | |
| Average assets | | | 1.03e-6 | | 9.29e-7 | 2.07e-5* |
| | | | (1.47e-6) | | (1.47e-6) | (1.19e-5) |
| Basic financial knowledge × Avg. assets | | | | | | -2.70e-6** |
| | | | | | | (1.25e-6) |
| Advanced financial knowledge × Avg. assets | | | | | | 4.14e-7 |
| | | | | | | (5.37e-7) |
| Constant | -0.4900* | -0.0295 | -0.0016 | -0.5230* | -0.4833 | -0.7507* |
| | (0.2857) | (0.1235) | (0.0645) | (0.3003) | (0.3117) | (0.3822) |
| Observations | 148 | 148 | 120 | 148 | 120 | 120 |

This table contains the results of the OLS regression of financial literacy, the average amount of assets(Avg. assets) and educational attainment on the residual obtained from the IV regression specified by equation 8 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$). The original regression is run on consumption data of the Netherlands obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. By using an additional module on financial literacy administered in 2011, proxies for financial literacy are determined by using Principal Component analysis. The educational attainment variable is a dummy which is equal to one if the household head continued studying after the compulsory education. The average amount of assets are determined for every household by using an additional module of the LISS panel asking the respondent to indicate the total balance of their current accounts, savings accounts, term deposits accounts, savings bonds or saving certificates and bank savings scheme. This additional module was administered in the years 2008, 2010, 2012 and 2014. The average of each household is determined by averaging over the available observations. The coefficients are reported along with the corresponding standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Furthermore, Battistin et al. (2003) show that recall data on food suffers relatively little from recall bias. Therefore, the LCH model will be re-estimated by only using data on food consumption. There are several papers who use only data on food consumption to test the LCH (Keane and Runkle, 1992; Smith, 2006). However, this requires the assumption that the preferences between food and other non-durable consumption categories are additively separable. As advocated by Attanasio and Weber (1995) this assumption might be too hard to make. They also have data on other consumption categories and allow the change in log other non-durable consumption to influence the inter-temporal preferences of the household by including it as one of the explanatory variables. However, when they control for this the estimates of the model are not seriously affected. What is affected, however, is the excess sensitivity of consumption to income which largely disappears once this additional variable is included[31] Here, I will first estimate the LCH on food consumption only by using equation 8, which is for convenience replicated here.

$$\begin{aligned}\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) \\ + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}\end{aligned} \quad (8 \text{ rev.})$$

Now, the dependent variable is replaced by the change in log food consumption. The estimates of this model are presented in table 5 column 1, from which it can be seen that only the interest rate and the mortality rate enter significantly. The estimate for the interest rate is negative, which is consistent with Attanasio and Weber (1995). The explanation for this is that the dependent variable is a necessity and as the budget share of food falls as the budget rises, the effects of the interest rate should be negative (Attanasio and Weber, 1995). Note, however, that this estimate is only significant at the 10 percent level and should therefore be interpreted with care. What is striking is that none of the demographic variables enter significantly except for the change in the mortality rate. This implies that the rate of time preference and the within-period scaling parameter is not affected by demographic or labour status variables. As the dependent variable,

31. In food data it was commonly found that there was excess sensitivity to income, thereby rejecting the LCH. Attanasio and Weber (1995) show here, however, that this is due to the non-separability of preferences.

Table 5: Results for the estimated Life Cycle Model , using only food data

| | Model 4 | Model 5 |
|---|---|---|
| Total hours worked | 0.0018 | -0.0028 |
| | (0.0036) | (0.0052) |
| Interest rate | -0.0571* | 0.2780* |
| | (0.0318) | (0.1611) |
| Δ Number of household members | 0.0481 | -0.3227 |
| | (0.2589) | (0.3934) |
| Age of the household head | 0.0007 | -0.0058 |
| | (0.0035) | (0.0071) |
| Δ Mortality rate | -6.665*** | 8.1068 |
| | (2.4573) | (7.6961) |
| Δ log(Other non-durable consumption) | | 0.0024 |
| | | (0.0379) |
| Constant | -0.1692 | 0.4520 |
| | (0.2678) | (0.5389) |
| Number of households | 1,893 | 719 |
| Observations | 3,701 | 1,119 |
| Sargan test $\chi^2$ ($p$-value) | 1.628 (0.202) | |

This table includes the results of the regressions using the change in the log of equivalized food consumption as dependent variable in equation 8 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$. The estimates are obtained by using the EC2SLS random effects estimator of Baltagi and Liu (2009). The results are based on consumption data of the LISS panel for the years 2009, 2010, 2012 and 2015. Data on the mortality rate and the interest rate has been extracted from CBS Statline and Bloomberg respectively. Huber-White robust standard errors have been included in order to account for the negative serial correlation induced by the observational error of the survey. Food consumption is equivalized by using the square root of the size of the household. Expenditure on food and other non-durable consumption are deflated to 2008 prices, by using the inflation of food products, transportation and recreational and cultural activities provided by CBS Statline. Model 4 includes as instruments the lag of the interest rate, the age of the household head and of the change in the mortality rate and the cohort year average of the change in the size of the household. The cohort year average is calculated by excluding the household's own observation. Model 5 includes the change in other non-durable consumption as a dependent variable. This variable is instrumented for by using the lag of the change in non-durable consumption. Due to multicollinearity issues, the lag of the interest rate is dropped as an instrument for Model 5. The statistics related to the test of overidentifying restrictions is included at the bottom of the table. The degrees of freedom for Model 4 is 1. As Model 5 is not overidentified, the Sargan test can not be performed for this model. Standard errors in parentheses unless otherwise indicated. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

eating at home, is in this case an absolute necessity this might not be too strange. This might be especially true for the Netherlands where the unemployment benefits and replacement rate after retirement is relatively high, such that the responsiveness to labour status is insignificant. The result, however, remains odd as it rejects the common finding that preferences for food are affected by demographic and labour status variables. The exact explanation as to why this result is found, however, is beyond the scope of this paper.

The advantage here, is that I still do have data on the spending on the other categories and can as such include the change in the log of other non-durable consumption as additional explanatory variable as is done by Attanasio and Weber (1995). The motivation is that the preference between food and other non-durable consumption is additively non-separable. As such, excluding this might lead to biased estimates. This non-separability also implies that the change in other non-durable consumption is endogenous as the effect works both ways. Therefore, I instrument for this endogeneity by adding the lag of the change in other non-durable consumption. This is the only instrument that is valid, in the sense that it produces a F-statistic in the first stage regression which is larger than 10. Using this instrument, however, seriously reduces the size of the sample as this requires at least three observations for each household, before it can be included. Furthermore, the lag of the interest rate is dropped due to multicollinearity with the other instruments. As such, the model is no longer over-identified and the exogeneity of the instruments can not be tested. The validity of the instruments, however, remains as the F-statistic in the first-stage regression ranges between 21.84 and 342.04. The results of this model are included in table 5 column 2. This model also suffers greatly from the problem outlined in appendix G. Due to large outliers in the sample, the outer 5 percent of the distribution are excluded. As such, I only have observations on 726 households for on average 1.56 periods. From column 2 of table 5 it becomes clear that only the interest rate enters positively and significantly at the 10 percent level. Attanasio and Weber (1995) show that having this extreme short panel might result in inflated estimates when compared to datasets that comprise a larger time frame. Furthermore, the interest rate in Model 5 is no longer instrumented with its own lag, which might

also cause this change in the estimate. Moreover, the estimate for the change in other non-durable consumption does not enter significantly. Therefore, I refrain from making any inferences from Model 5 and proceed by only testing the residual of Model 4. As Attanasio and Weber (1995) find that the size of the estimates are not largely affected by excluding the change in other non-durable consumption, I do not deem this to be a very large problem for this robustness check.

When regressing the residual of Model 4 around the time of retirement I find the results as presented in table 6. From table 6 it becomes clear that the results obtained in section 6.3 are also found here. Again, the residual at the time of retirement is significantly affected by the degree of basic financial literacy. Furthermore, the level of educational attainment does not seem to influence the size of the shock households experience as they retire. From column 3, however, it appears that there is no mitigating effect of the amount of assets of the household on the effect of basic financial literacy. Despite this, this robustness check confirms the result found in this thesis that households with little basic financial knowledge indeed experience unanticipated adverse income shocks around retirement. This shock is so large that it even requires these households to cut their consumption of necessities, i.e. eating at home.

### 6.4.2 Period of retirement

The LISS panel only includes data on consumption for the years 2009, 2010, 2012 and 2015. As such, the change in non-durable consumption can only be determined for the years 2010, 2012 and 2015. This unequal spacing in years poses two possible problems. First, the observed drop in consumption in 2015 might be much larger than in 2010 for a retiring household as the change in 2015 comprises three years rather than one. Although I am confident that I appropriately dealt with this issue, as all variables used in the regression models are adjusted for the difference in time between the two periods, this section will investigate this issue further. From table 7 it becomes clear that the main part of the lowest basic quartile of households retires in 2015. Therefore, the results obtained may be biased as the model might not be as good in predicting the change over a larger time period. Second, I only infer whether a household retired between two

Table 6: The effect of financial literacy on the unanticipated shock at retirement, using food data only

| | Residual Model 4 | Residual Model 4 | Residual Model 4 |
|---|---|---|---|
| Basic financial knowledge | 0.0785*** | 0.0779*** | 0.0978** |
| | (0.0293) | (0.0295) | (0.0376) |
| Advanced financial knowledge | 0.0202 | 0.0194 | 0.0339 |
| | (0.0152) | (0.0156) | (0.0230) |
| Educational attainment | | 0.0234 | |
| | | (0.0820) | |
| Basic fin. literacy × Avg. assets | | | -1.62e-6 |
| | | | (1.22e-6) |
| Adv. fin. literacy × Avg. assets | | | -2.97e-7 |
| | | | (5.55e-7) |
| Average assets | | | 1.64e-5 |
| | | | (1.16e-5) |
| Constant | -0.6219** | -0.6480** | -0.8647** |
| | (0.2904) | (0.3054) | (0.3735) |
| Observations | 136 | 136 | 110 |

This table contains the results of the OLS regression of basic and advanced (Adv.) financial literacy (fin. literacy), educational attainment and the average amount of assets(Avg. assets) on the residual obtained from the IV regression specified by equation 8 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$. The original regression is run on food consumption data of the Netherlands obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. By using an additional module on financial literacy administered in 2011, proxies for financial literacy are determined by using Principal Component analysis. The educational attainment variable is a dummy which is equal to one if the household head continued studying after the compulsory education. The average amount of assets are determined for every household by using an additional module of the LISS panel asking the respondent to indicate the total balance of their current accounts, savings accounts, term deposits accounts, savings bonds or saving certificates and bank savings scheme. This additional module was administered in the years 2008, 2010, 2012 and 2014. The average of each household is determined by averaging over the available observations. The coefficients are reported along with the corresponding standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

observations. So if a household indicates that it is not retired in 2012 and indicates that it is retired in 2015, I know that this household retired somewhere in the period between 2012 and 2015. However, it might very well be that the household retires in 2013 and that I only observe consumption two periods later, in 2015. Both these effects might bias the previously obtained results. Therefore, I exclude the observations of households retiring in 2015 and again regress the measures of financial literacy on the residual obtained from model 3 as given in section 6.3. After excluding these households,

Table 7: Period of retirement per financial literacy quartile

| | Basic | | | Advanced | |
|---|---|---|---|---|---|
| Retirement year | Lowest quartile | Highest quartile | | Lowest quartile | Highest quartile |
| 2009-2010 | 0.2439 | 0.1935 | | 0.2059 | 0.2759 |
| 2010-2012 | 0.2927 | 0.4516 | | 0.4114 | 0.3103 |
| 2012-2015 | 0.4634 | 0.3548 | | 0.3824 | 0.4138 |
| Observations | 42 | 39 | 42 | 30 | |

This table shows for each period the proportion of households of the lowest and highest quartile of basic and advanced financial knowledge that retired.

the effect of basic financial literacy only becomes stronger as both the estimate and its significance increase. Besides this, the effect of advanced financial literacy now also becomes marginally significant at the 10 percent significance level. The sign of this estimate is also positive, indicating that advanced financial literacy might also mitigate the probability of adverse unanticipated shocks during retirement. The mitigating effect of the amount of assets, however, again becomes insignificant at all significance levels. This indicates that possible issues described above do not seriously affect the results, concerning basic financial literacy. The effect of the amount of assets, however, seems to be less robust. Next, I exclude the households that retire in 2010 as the opposite reasoning for the first issue might also hold. After excluding these observations the estimates and significance of all variables are hardly affected, indicating that all results are robust to leaving out these observations. The results of these regressions are included in appendix H. From this robustness check it can be concluded that the unequal amount

of time between two observations does not influence the results concerning basic financial literacy as the finding is robust to excluding households based on the period of retirement.

### 6.4.3 Effect of Risk Aversion

As becomes clear from the derivation of the estimated equation in section 4, the change in non-durable consumption is also determined by the measure of Relative Risk Aversion, $\gamma$. The LISS panel contains some questions on preferences regarding a certain outcome and a risky outcome in an additional module[32]. From this, I am able to determine $\gamma$ for each individual which is done in appendix H. Unfortunately, there are not enough respondents such that I can properly include it in the estimation of the Euler equation[33]. Bajtelsmit and VanDerhei (1997) advocate in their paper that the risk aversion of a household affects its replacement rate. This is due to the fact that households with a higher risk aversion are less likely to invest and as such have a lower return on their savings. If this is true, it might also be that households with little basic financial knowledge are also very risk averse and therefore have to cut back consumption once they transition into retirement. To check the robustness of my results against this possibility I regress the measure of Relative Risk Aversion on the residual at the time of retirement and include it in the regressions performed in section 6.3. The results of these regressions are presented in table H4. As can be seen from column 1 the measure of RRA does not affect the size of the unanticipated shock at retirement. When including the measure in the previous regressions I find that none of the variables are significant anymore. This might, however, be due to the part that filled in the questionnaire inconsistently. Indeed, when removing these households I find that basic financial literacy is robust to the inclusion of $\gamma$. The diminishing effect of assets, however, does not seem robust to the inclusion of $\gamma$.

From this robustness check it can be concluded that the main conclusion towards basic financial literacy is not caused by a lower replacement rate due to a higher risk aversion.

32. Module 38, Measuring higher order risk attitudes of the general population
33. The estimable equation in that case would have been$\gamma_i \Delta(ln(C_{it+1})) = \beta_0 + \beta_1(Ageof Head_{it+1}) + \beta_2 \Delta(Numberofhouseholdmembers_{it+1}) + \beta_3(Hoursworked_{it+1}) + \beta_4(Mortalityrate_{it+1}) + \beta_5 r_{t+1} + \zeta_{it+1}$.

# 7 Discussion and conclusion

## 7.1 Discussion

Banks et al. (1998) was one of the first to test the Life Cycle Hypothesis (LCH) on data which also included retirees. Until then, research on the LCH had only included households whose head was still in the labour force. By including retirees, Banks et al. (1998) find that the predictions of the LCH overall fits the data well. Around the age of retirement, however, there appears to be an anomaly. The size of this anomaly amount to 1.5 percent per year and adds up to a total shortfall of 10 percent. After including several other variables, the size of the anomaly remained significant, i.e. 1 percent. Consecutive research also found this anomaly of similar size for data on the US (Bernheim et al., 2001) and Italy (Battistin et al., 2009). This anomaly is called the Retirement-Consumption Puzzle (RCP). Ever since, much research is devoted to this topic and for the average household this drop can now be explained for the average household. As retirees have more time available, they can spend less and still be able to consume the same amount of food, through more efficient shopping and increased home production. Moreover, work-related expenses are no longer required when moving out of the labour force (Aguiar and Hurst, 2005, 2007). However, when Bernheim et al. (2001) and Hurd and Rohwedder (2008) examined the evolution of consumption as households retired, they find that households with little assets experience a significant drop in consumption at the time of retirement. Similar results are obtained by Aguiar and Hurst (2005) who find that actual food intake reduces significantly after retirement for the group of households with the least amount of assets. This leads them to conclude that these households might not fit the model of the LCH as well as the average household. A possible explanation for this observation is the fact that these households might not be able to plan for their retirement. Indeed, when Hurd and Rohwedder (2008) controls for the planning horizon of the households he finds that the observed drop is largest for the group with the shortest planning horizon. In another steam of research, Lusardi and Mitchell (2007) and Van Rooij et al. (2012) show that households with the least amount of assets in general have the lowest level of financial sophistication. Moreover, research by Lusardi

and Mitchell (2010) and Van Rooij et al. (2011) indicates that the households with the least amount of financial knowledge are the group that do not plan for their retirement. This leads to the hypothesis that the observed drop in non-durable consumption for the households with the least amount of assets is due to their lack of financial knowledge.
The results in this paper show that households with little basic financial knowledge indeed experience a relatively large decline in non-durable consumption. This paper proceeds by examining the evolution of expenditures on food and entertainment separately. Here, the consumption of food is relatively stable for the households from the highest three quartiles of basic financial knowledge, whereas there is a significant drop for households with little basic financial knowledge. Also the expenditure on entertainment seems to decrease more for the financially illiterate households. I employ similar analyses by comparing the first quartile of advanced financial knowledge with households in the other quartiles, but here I do not find any significant differences. This is the first indication that the lack of basic financial knowledge indeed prohibits these households from smoothing their consumption over the lifetime. This paper proceeds by stating that observing this drop does not necessarily imply that there is a Retirement-Consumption Puzzle as it might be optimal for these households to decrease their consumption once they retire. One reason might be that these households are relatively impatient and as such want to consume as much as possible in the earlier stages of life. In order to control for this, this paper employs the predictions of the Life Cycle Model on the data. After the construction of a theoretical model for the evolution of consumption, this model is brought to the data. The model seems to hold for the Netherlands if I allow demographics to affect the within-period scaling parameter and the rate of time preference. After this, the residual at the time of retirement is examined as this is the proxy for unanticipated shocks. In general, I do not find proof for the existence of a Retirement-Consumption Puzzle as the residual for the average household is positive, rather than negative. However, when comparing the residual for the households within the lowest quartile of basic financial knowledge with the highest quartile, the residual is significantly different. Again, these results are not found when using the advanced financial literacy index. After this analysis, I acknowledge that assets or educational attainment might

also affect the unexplained drop in consumption at retirement. Therefore, I regress the obtained residual on educational attainment and the average amount of assets of the household as well. From this analysis it becomes clear that the educational attainment of the household head does not affect the size of the unexplained drop of non-durable consumption. Moreover, there appears to be a mitigating effect of the amount of assets on the effect of basic financial literacy. This indicates that the lack of basic financial knowledge is mainly a problem for those households who also do not have many assets.
The consumption data in this thesis is obtained from a retrospective module of the LISS panel. The disadvantage of this type of consumption data is that it might suffer from recall bias. According to Battistin et al. (2003) observations on food consumption are less sensitive to recall bias, as compared to other categories of non-durable consumption. Therefore, I check the robustness of the results by replicating the analysis with food consumption as dependent variable. Here I find that the included variables do not seem to influence the evolution of consumption, except for the interest rate and the mortality rate. Despite this, I find again that the residual is significantly influenced by the degree of basic financial knowledge of the household. The mitigating effect of the amount of assets, however, disappears in this robustness check. Moreover, the data on non-durable consumption in the LISS panel is collected in non-consecutive years. Therefore, I check the results by removing certain years in which the households retire such that the data becomes more regularly spaced. The result concerning basic financial literacy is robust to these exclusions. The mitigating effect of assets, however, is not robust to every subsample of years. Moreover, I check the robustness of the results by including a measure of Relative Risk Aversion to account for the fact that more risk averse individuals may have lower replacement rates (Bajtelsmit and VanDerhei, 1997). Again I find that basic financial literacy is robust to the inclusion of this variable, whereas the mitigating effect of the assets is no longer significant. Finally, the results are robust to different specifications of parameters, such as the degree of financial literacy, the inflation rate and the equivalence scales.
These findings indicate that basic financial knowledge is an important determinant as to whether households save enough for their retirement. These findings contradict the

findings of Lusardi and Mitchell (2010) and Van Rooij et al. (2011) who find that advanced financial literacy is the main determinant of whether or not households plan for retirement. Furthermore, I do not find the result of Bernheim et al. (2001) and Hurd and Rohwedder (2008) that the RCP only exists for low households with little assets. There does appear to be a mitigating effect of the amount of assets although this effect is not robust to every alternative specification. This result, however, makes sense since a household with a large amount of assets is probably less likely to cut consumption relative to a household with no assets, given their basic financial knowledge.

The findings of this paper have several implications for policymakers. First, as highlighted in section 3 the pension system of the Netherlands is doing relatively well as the average net replacement rate is much higher when compared to most other countries. Despite these findings, there is still a fraction of the Dutch population that experiences large unexpected declines in consumption at the time of retirement. This paper finds that this drop is due to the lack of basic financial knowledge of these households. As indicated by Lusardi and Mitchell (2010) it might be hard to educate individuals in advanced financial topics, as the individuals with little financial knowledge are probably not interested in these programs. This paper, however, finds that basic financial knowledge determines the adequacy of post-retirement income. These topics are relatively easy to learn and might become part of a compulsory course during high school. As a result, future households might be better able to smooth their consumption over their lifetime and as such enjoy a higher overall utility. Second, as the financial sustainability of the Dutch pension system is currently under threat, several reforms are considered. These reforms imply that the responsibility for an adequate retirement income shifts from the state and the employer towards the individual. As the results in this paper show, it might currently be hard for some households to devise an adequate savings plan for retirement. If the individual responsibility is due to increase in the future, the drop in consumption as a result of unexpected shocks might become larger. Therefore, policymakers should take the financial literacy of their population seriously into account when devising reform plans for their pension system. Third, the fact that the individual responsibility for an adequate retirement income is relatively low in the Netherlands might imply that the

results might be even more dramatic for countries with pension systems that rely more on the individual responsibility of the household, i.e. the US.

There are some limitations of this paper which provide avenue for further research. First, this paper does not take into account the effect of liquidity constraints in modelling the LCH. This is since there is no proper proxy available in the LISS panel which could be used to model the possible liquidity constraint of the household. This might be problematic as the liquidity constraint might be most relevant for the households in the lowest quartile of basic financial literacy. Second, the size of the sample is relatively small in both dimensions. If a larger sample would be available it might be interesting to check the robustness of the results when using more households. Furthermore, the data used here does not comprise an entire business cycle. It might be interesting to check the results over different parts of the business cycle. Third, the irregular amount of time between two observations might seriously affect the results. Even though I check the results against this shortcoming by excluding several years, I can not be completely sure whether this limitation significantly influences the results. Furthermore, the lack of data on consumption for the years 2013 and 2014 hinders me in investigating the effect of the nominal cuts in pension rights on the consumption of Dutch retirees. It might be interesting to check if the residual of the LCH model for retirees is larger for those years and to what extent this is influenced by the degree of financial literacy of the household. Fourth, there are only a few questions on which the financial literacy index is based as compared to studies using different databases (see e.g. Lusardi and Mitchell (2010) and Van Rooij et al. (2011)). Having more question on financial topics might lead to a clearer measure of financial literacy and as such more robust conclusions can be drawn. Fifth, the conclusions of this paper are based on recall data. Over the entire lifetime basic financial knowledge has no significant effect on the residual. Furthermore, the results are robust to using food data only, which in general suffers less from recall bias (Battistin et al., 2003). Despite these robustness checks, the effect of recall bias can not be taken out completely. This implies that the results might also show how well the household is able to give consistent answers over the different years. It might for instance be that retiring households with little basic financial knowledge are less likely to recall

properly how much they spend on several categories. If this recall bias indeed is larger for these households, my results might actually be driven by this miscalculation of actual expenditures. Future research might improve on this by using e.g. consumption data based on diary entries rather than on recall data. Sixth, the LISS panel only contains data on a few consumption categories and as such important elements of non-durable consumption are not included. Essentially, in this thesis I assume that the preferences between the included and excluded categories are additively separable. This assumption might be a too hard one to make and might influence the results found in this thesis. By using a dataset with more categories, future research might evaluate the effect of this assumption. Finally, the measure of the amount of assets is imperfect as there is no data available for all years. As such, I have to take the average of the available observations to come up with a reliable indicator for the wealth of the household. Ideally, the amount of assets should be available for each year such that the relationship between the unanticipated shock and the amount of assets can be assessed more properly.

Finally, an interesting recent paper by Jappelli and Padula (2016) directly includes financial literacy in the LCH model. More specifically, they allow the return on savings to depend on the degree of financial knowledge. They use data from the Survey of Household Income and Wealth conducted by the Bank of Italy for the years 2006 until 2010 and show that financial literacy positively affects the expected growth rate of consumption. They explain this finding by the assertion that financially more sophisticated households can access better performing portfolios and as such have a higher rate of return on their savings. This novel method of allowing financial literacy to enter the Euler equation directly might also be interesting in this research. Therefore, future research might be able to estimate a Euler equation where the elasticity of intertemporal substitution directly depends on the financial knowledge of the household and check the residual around retirement for this model. It might be that this model is better able to explain the evolution of consumption for households with little financial knowledge and as such obtain different results for the drop in consumption around retirement.

## 7.2 Conclusion

Current literature finds that for households with the least amount of assets there still is an unexplained drop in non-durable consumption as they transition into retirement (Bernheim et al., 2001; Aguiar and Hurst, 2005; Hurd and Rohwedder, 2008). This drop, however, seems to concentrate among those households with a short planning horizon (Hurd and Rohwedder, 2008). Lusardi and Mitchell (2010) and Van Rooij et al. (2011) show that households with little assets usually have little financial knowledge and hardly plan for retirement. This leads to the hypothesis that the unexplained drop in non-durable consumption for some households is due to their inability to plan for retirement. This paper tests this hypothesis by utilizing the LISS Panel, a true panel which contains consumption data on Dutch households for the years 2009, 2010, 2012 and 2014. In the sample there are in total 1,184 households which are observed for on average three periods. First, the evolution of non-durable consumption for the 148 retiring households is assessed and I find that there is a drop in consumption only for the households in the lowest quartile of basic financial knowledge. In this paper I recognize that only showing that consumption decreases after retirement is no proof of the existence of the Retirement Consumption Puzzle. This observed effect might also be due to changes in preferences after retirement. Therefore I employ the predictions of the Life Cycle Model on the consumption data and use the residual around retirement to measure the unanticipated shock around retirement. For the average household, there does not appear to be a negative shock around retirement. However, after regressing the obtained financial literacy indices on the unexplained part of the change in consumption as these households retire, I find that basic financial knowledge is an important determinant of the unanticipated shock around retirement. Moreover, I find that the amount of assets by itself does not explain the size of the unanticipated shock at retirement. The amount of assets do, however, appear to reduce the effect of basic financial literacy on the unanticipated shock. This finding indicates that the lack of basic financial knowledge seriously hinders households from planning adequately for their retirement and that this lack of planning causes the largest problems for households with the least amount of assets. This implies that

policymakers should try to increase the basic financial knowledge of its population as this might seriously affect the social welfare. Furthermore, the paper advocates that the degree of financial knowledge should explicitly be taken into account when policymakers try to devise reforms for the current financially stressed Dutch pension system. Finally, the effect of financial illiteracy might be larger for other countries, due to the relatively low individual responsibility for an adequate retirement income in the Netherlands.

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# Appendices

## A Cohort definitions and descriptive statistics

Table A1: Cohort definition and cell sizes

| Cohort | Year of birth | Age in 2009 | Age in 2015 | Minimum cell size | Maximum cell size | Mean cell size |
|---|---|---|---|---|---|---|
| 7 | 1941 - 1945 | 64 - 68 | 70 - 74 | 113 | 95 | 104.25 |
| 8 | 1946 - 1950 | 59 - 63 | 65 - 69 | 145 | 109 | 130.50 |
| 9 | 1951 - 1955 | 54 - 58 | 60 - 64 | 128 | 93 | 109.75 |
| 10 | 1956 - 1960 | 49 - 53 | 55 - 59 | 112 | 82 | 96.75 |
| 11 | 1961 - 1965 | 44 - 48 | 50 - 54 | 101 | 64 | 85.00 |
| 12 | 1966 - 1970 | 39 - 43 | 45 - 49 | 116 | 71 | 92.50 |
| 13 | 1971 - 1975 | 34 - 38 | 40 - 44 | 73 | 45 | 58.50 |
| 14 | 1976 - 1980 | 29 - 33 | 35 - 39 | 57 | 35 | 46.25 |
| 15 | 1981 - 1985 | 24 - 28 | 30 - 34 | 26 | 15 | 20.50 |

This table shows the definition of each cohort, the age range for each cohort at the begin and end of the sample and the minimum, maximum and average observations per cohort. Cohorts with less than 15 observations for any year are removed. The total number of observations is 2,972.

Table A2: Descriptive statistics

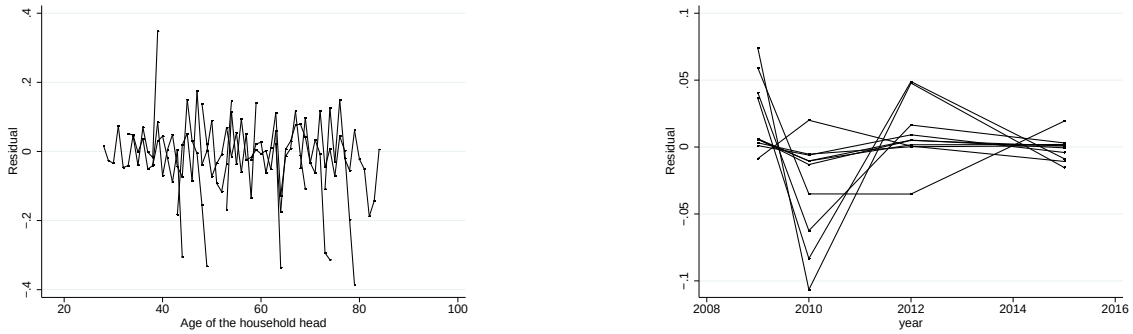
| Panel A. Main variables | Retirees only | Full sample |
|---|---|---|
| Δ Log non-durable consumption | | |
| Mean (SD) | -0.06 (0.44) | -0.06 (0.48) |
| Min | -2.13 | -3.67 |
| Max | 1.14 | 1.31 |
| Basic financial knowledge | | |
| Mean (SD) | 8.19 (1.48) | 7.75 (2.8) |
| Min | 6.1 | 0 |
| Max | 10 | 10 |
| Advanced financial knowledge | | |
| Mean (SD) | 5.58 (2.99) | 5.61 (3.03) |
| Min | 0 | 0 |
| Max | 10 | 10 |
| **Panel B. Control variables** | **Retirees only** | **Full sample** |
| Age | 67.02 (5.35) | 56.92 (13.47) |
| Δ Mortality rate | 0.0026 (0.0038) | 0.0016 (0.0043) |
| Hours worked | 4.34 (11.14) | 20.74 (20.77) |
| Interest rate | -0.24 (0.4) | -0.2 (0.42) |
| Δ Number of household members | -0.02 (0.17) | -0.03 (0.35) |
| Δ Number of household members | -0.04 (0.04) | -0.04 (0.09) |
| *(year cohort averages)* | | |
| Average assets | 31,929(29,693) | 25,579 (29,735) |

This table presents the main variables and the control variables in Panel A and B respectively for both the full sample and the retirees only. The consumption data is extracted from the LISS Panel for the years 2009, 2010, 2012 and 2015. The financial literacy indices are constructed using Principal Component Analysis on an additional module containing 4 financial questions administered in 2011. Average assets are computed over the years 2008, 2010, 2012 and 2014. Data on the mortality rate and the interest rate is extracted from CBS Statline and Bloomberg respectively. The full sample consists of 1,184 households with on average 2.0 observations per household and the sample with retirees consists of 148 households with on average 2.4 observations per household (Note: one period is lost due to first differencing). For average assets the full sample consists of 957 households with on average 1.95 observations per household and the retirees sample consists of 124 households with on average 2.4 observations per household. Standard deviations are provided in parentheses.

# B Consumption over the business cycle

As is pointed out by Attanasio and Browning (1993b), the evolution of demographic variables over the lifetime of a household can be accounted for by regressing the year cohort average of consumption on the cohort average of several demographic variables. Here, I use the number of hours worked by the household head and the log of the number of household members as demographic variables which I regress on the log of consumption. Although consumption still seems to vary over the years, the earlier observed hump

Figure B1: The evolution of consumption corrected for demographics over the lifetime and the business cycle




(a) Consumption over the lifetime (b) Consumption over the business cycle

This figure shows the evolution of corrected log non-durable consumption for different cohorts over the age of the household head (panel a) and over the years (panel b). Non-durable consumption is corrected for changing labour status and demographics by regressing non-durable consumption on the number of hours worked and the size of the household. The residual of this regression has been averaged for the cohorts as defined in table A1. In these figures no cohorts have been removed. The number of observations for both panels is on 3,501 observations comprising 1,184 households.

shape seems to have disappeared. This observation confirms the findings of Attanasio and Browning (1993b). Therefore, figure B1a provides supplementary evidence that consumption is indeed smoothed over the lifetime of a household. Furthermore, figure B1b plots the residuals of the previous regression against time and finds that all of the variation in figure B1b can be largely explained by year effects as all residuals seem to follow the same pattern over the years. According to Attanasio and Browning (1993b) this synchronization of movements over time is ripe for a macro explanation. The explanation for the pattern observed in figure B1b is probably the financial crash that started

in 2008 and the subsequent euro-crisis of which the Netherlands started to recover in 2012. The exact explanation, however, is beyond the scope of this paper.

# C Financial literacy questions

1. Suppose you have 100 euros on a savings account and the interest is 2 percent per year. How much do you think you will have on the savings account after five years, assuming that you leave all your money on this savings account: more than 102 euros, exactly 102 euros, less than 102 euros?
   (a) more than 102 euros
   (b) exactly 102 euros
   (c) less than 102 euros
   (d) I don't know
   (e) I would rather not say
2. Suppose that the interest on your savings account is 1 percent per year and that inflation amounts to 2 percent per year. After 1 year, would you be able to buy more, exactly the same, or less than you could today with the money on that account?
   (a) more than today
   (b) exactly the same as today
   (c) less than today
   (d) I don't know
   (e) I would rather not say
3. A share in a company usually offers a more certain return than an investment fund that only invests in shares.
   (a) True
   (b) Not true
   (c) I don't know
   (d) I would rather not say

4. If the interest rate goes up, what should happen to bond prices?

   (a) They should increase

   (b) They should decrease

   (c) They should stay the same

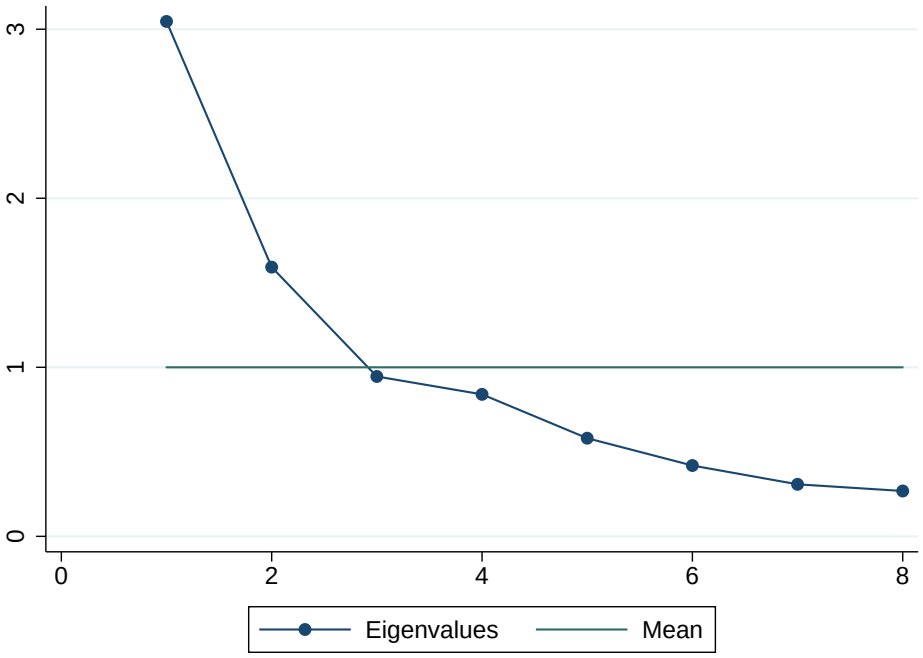
   (d) None of the above

   (e) I don't know

   (f) I would rather not say

# D Financial literacy indices

Figure D1: Screeplot of eigenvalues and mean of the obtained factors



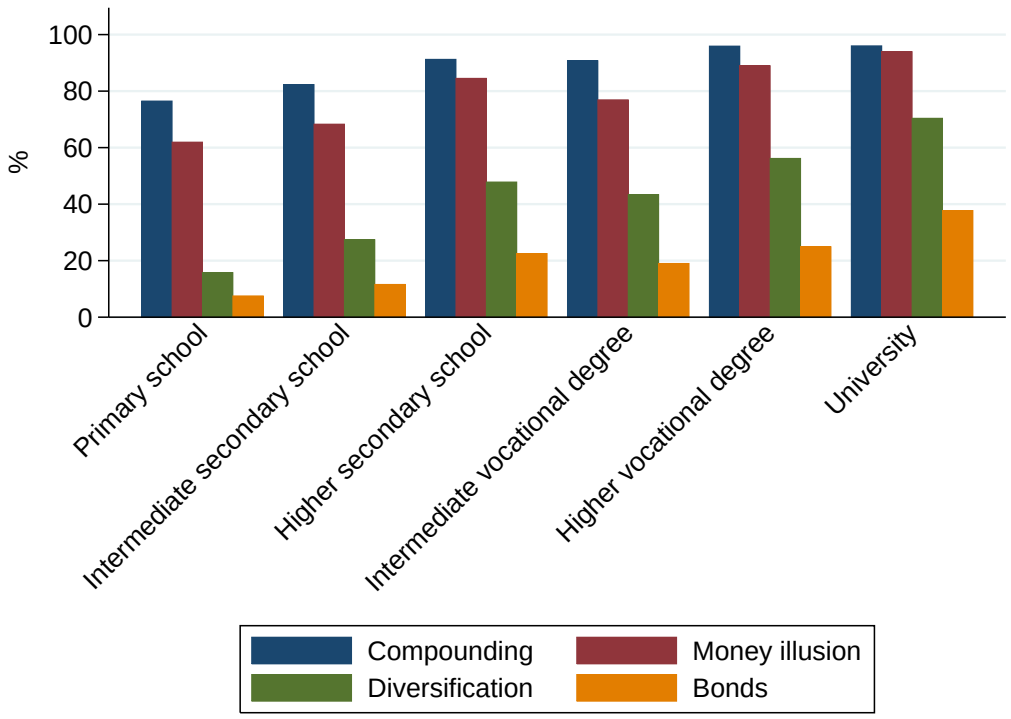

This figure shows the screeplot of the eigenvalues of the factor analysis employed on the financial literacy questions given by appendix C. Next to this, the mean of the eigenvalues is presented. The number of observations on which the factor analysis is employed is 4,860.

Table D1: Factor loadings

| | | Factor 1 | | Factor 2 | |
|---|---|---|---|---|---|
| Question | Factor | Correct | Don't know | Correct | Don't Know |
| Compounding | Basic | -0.772 | 0.797 | -0.023 | 0.047 |
| Money illusion | Basic | -0.710 | 0.757 | -0.234 | 0.225 |
| Diversification | Advanced | -0.164 | 0.150 | -0.775 | 0.807 |
| Interest rates and bonds | Advanced | -0.040 | 0.084 | -0.624 | 0.724 |

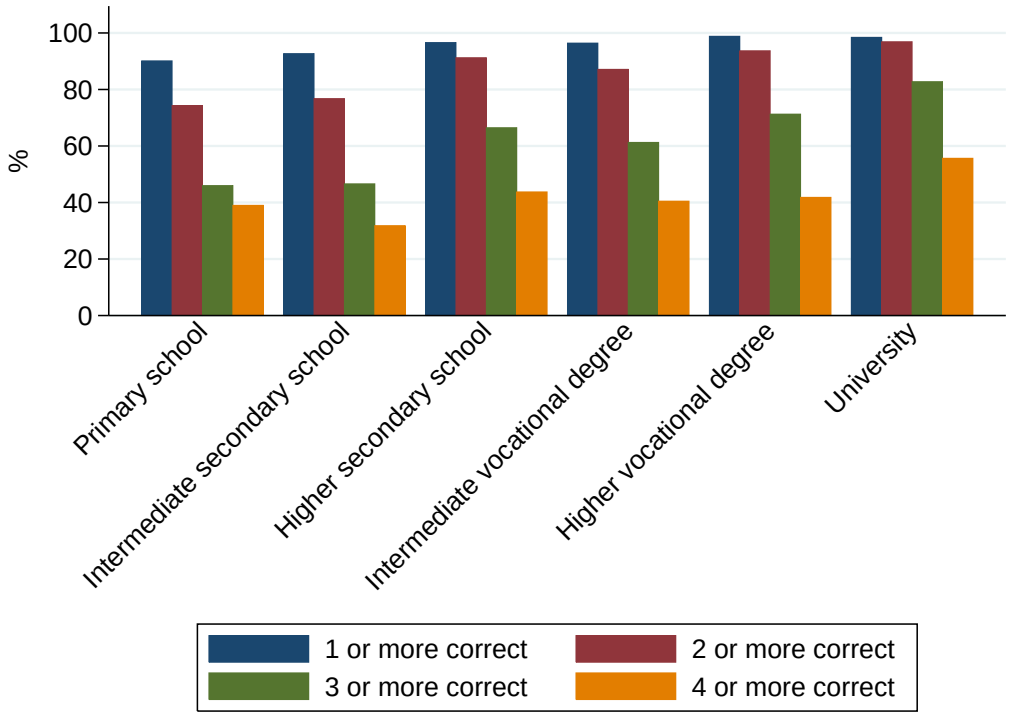
This table presents factor loadings on the financial literacy module of the LISS panel that was included in 2011. The wording of the questions are presented in appendix C. All questions also have a "I don't know" option. Choosing this option is also included separately in the factor analysis. The Principal Component method is used to obtain these factor loadings. From the loadings of the factor analysis I conclude that the first two questions measure basic financial knowledge and the third and fourth question advanced financial literacy.The number of observations are 4,860.

Figure D2: Percentage of individuals who gave the correct answers per question per education group




This figure shows the percentage of individuals who entered the correct answer per question and education group. For the exact wording of the questions please refer to appendix C. The total number of observations is 4,860.

Figure D3: Percentage of the amount of correct answers per education group




This figure how much of the respondents entered several correct answers per education group. For the exact wording of the questions please refer to appendix C. The total number of observations is 4,860.

Table D2: The relation between self-assessed and measured financial literacy, ordered logistic regression

| | Self-assessed financial literacy | Self-assessed financial literacy | Self-assessed financial literacy |
|---|---|---|---|
| Basic financial knowledge | 0.0664*** | 0.0675*** | 0.0671*** |
| | (0.0154) | (0.0159) | (0.0160) |
| Advanced financial knowledge | 0.1769*** | 0.1741*** | 0.1676*** |
| | (0.0136) | (0.0142) | (0.0151) |
| Average assets | | 3.85e-6*** | 3.76e-6*** |
| | | (1.19e-6) | (1.22e-6) |
| Net monthly income | | 2.65e-5* | 2.48e-5* |
| | | (1.43e-5) | (1.40e-5) |
| Educational attainment | | | 0.04880* |
| | | | (0.0286) |
| Male | | | -0.0448 |
| | | | (0.1189) |
| Age | | | -0.0013 |
| | | | (0.0033) |
| $\gamma_1$ | -3.836*** | -3.666*** | -3.600*** |
| $\gamma_2$ | -2.354*** | -2.246*** | -2.179*** |
| $\gamma_3$ | -1.242*** | -1.106*** | -1.038*** |
| $\gamma_4$ | -0.0215 | 0.0855 | 0.155 |
| $\gamma_5$ | 1.607*** | 1.759*** | 1.831*** |
| $\gamma_6$ | 3.972*** | 4.128*** | 4.202*** |
| Observations | 2,123 | 2,033 | 2,033 |
| Log likelihood | -2,972.9 | -2,829.7 | -2,828.0 |
| McFadden $R^2$ | 0.0296 | 0.0342 | 0.0348 |
| LR test $\chi^2_(7)$ ($p$-value | 181.6 (0.000) | 200.5 (0.000) | 203.9 (0.000) |

This table present the estimates for the ordered multinominal regression on self-assessed literacy. The dependent variable ranges from 1 to 7, where 1 is "very poor" and 7 "very good". The measures for basic and advanced financial literacy are obtained through Principal Component Factor Analysis, using the answers to four questions concerning financial matters. Standard errors are in parentheses.The Brant test of the parallel regression assumption indicates that for the basic financial literacy index, assets and age the parallel assumption is violated. However, after relaxing the assumption of parallel regressions for these three variables I obtain similar results.

Table D3: Financial literacy index and demographics

| | Basic financial knowledge | Advanced financial knowledge |
|---|---|---|
| Average assets | 1.38e-6** | 9.91e-6*** |
| | (6.21e-7) | (1.79e-6) |
| Net monthly income | 2.41e-5*** | 5.69e-5** |
| | (8.21e-6) | (2.26e-5) |
| Male | -0.7606*** | -2.0740*** |
| | (0.1152) | (0.1867) |
| Educational attainment | 0.3343*** | 0.4129*** |
| | (0.0299) | (0.0429) |
| Age of the household member | 0.0065** | -0.0088* |
| | (0.0032) | (0.0050) |
| Constant | 5.8681*** | 4.763*** |
| | (0.2494) | (0.3954) |
| Observations | 2,023 | 2,033 |

This table shows the results of the OLS regression on basic and advanced financial literacy. The dependent variables are obtained through Principal Component Factor Analysis, using the answers to four questions concerning financial matters. Standard errors are in parentheses.

# E Relevance of instruments

Table E1: Relevance of instruments

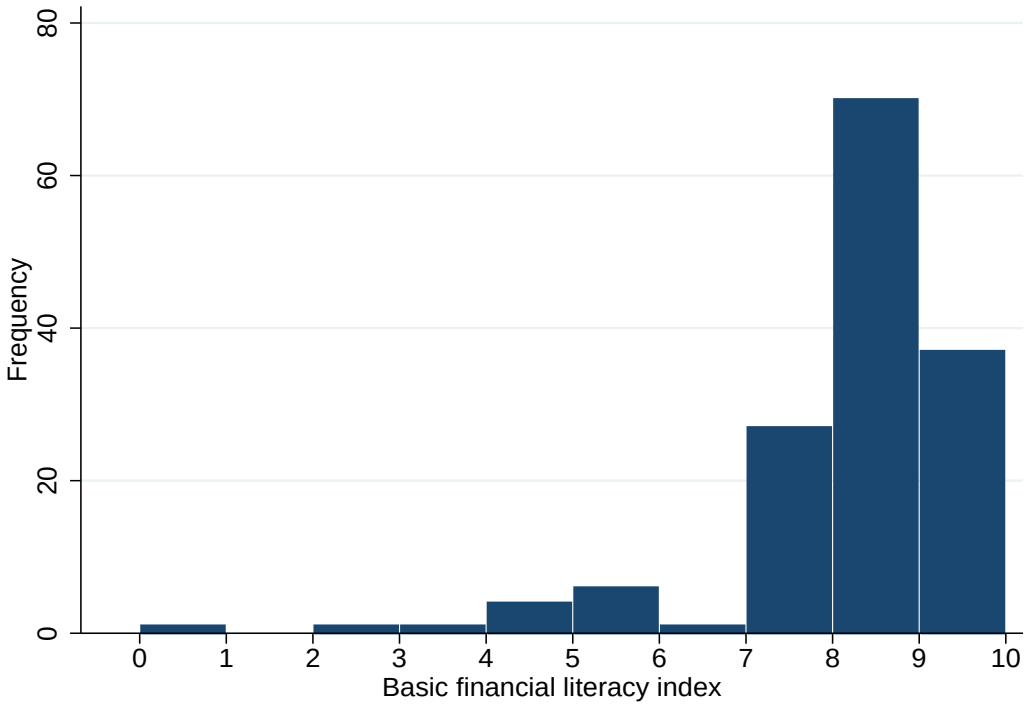
| | Hours worked | Interest rate | Δ Household members |
|---|---|---|---|
| Lagged interest rate | 5.656*** | 0.6839*** | -0.0422* |
| | (1.036) | (0.0228) | (0.0231) |
| Lagged Δ mortality rate | -14.94 | 0.7865 | -0.1534 |
| | (98.54) | (2.164) | (2.197) |
| Δ Number of household members | -43.65*** | 0.0199 | 0.8713*** |
| *(Cohort year average)* | (4.255) | (0.0934) | (0.0948) |
| Lagged age of household head | -1.051*** | -0.0020*** | -0.0007 |
| | (0.0263) | (0.0006) | (0.0006) |
| Constant | 76.59*** | -0.1485*** | 0.0470 |
| | (1.432) | (0.0315) | (0.0319) |
| Observations | 2,320 | 2,320 | 2,320 |
| F-statistic | 460.1 | 283.3 | 25.73 |
| $\chi^2$ (12) | 2,719 | 77,577 | 68 |

This table includes the estimates of the first stage regressions on the endogenous variables Hours worked, Interest rate and the change in household members. Δ Number of household members is calculated by taking the average for each cohort and time period, while excluding the household's own observation. Standard errors are in parentheses. The last but one row displays the F-statistic of the test that all estimated coefficient are equal to zero.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note that in this thesis the first stage regressions are not performed using pooled OLS, but rather using panel data regressions. Also, when using Baltagi's EC2SLS estimator the actual instruments used are the within-transformed and between-transformed variables (Baltagi and Liu, 2009). Applying panel data regressions does not yield F-statistics, but rather $\chi^2$ statistics as the degrees of freedom for an F-statistic are unknown. Therefore, the estimates here are merely presented to show that the F-statistic of these instrument exceeds the rule of thumb of 10. For completeness, the $\chi^2$ statistics of the actual first-stage regressions are presented in the final row.

# F Basic financial literacy of the retiring households

Figure F1: Histogram of the basic financial literacy index for the households that retire during the sample.




# G Estimation issues with random effects in noisy panel data

In this thesis I use the random effects estimator in conjunction with instrumental variables on panel data. In order to do this I had to remove the most extreme outliers as this estimation technique was not suitable for these outliers. In this section I will shortly highlight why this is the case. In the remainder of this section I will follow the explanation of Baltagi (2008) and the Stata help file on xtivreg. Here, I will only highlight the parts which are different from IV regressions in random effects panel data as compared to normal IV regressions.

I estimate the generalized equation, given by equation G.1.

$$y_{it} = Z_{it}\delta + \upsilon_{it} \tag{G.1}$$

Here $Z_{it}$ can contain both exogenous and endogenous variables. When using random effects, it is assumed that the error term consists of a time-variant and a time-invariant part, i.e. $\upsilon_{it} = \mu_i + \epsilon_{it}$. In order to increase the efficiency of the estimates we can exploit the structure of the error covariance matrix and deduct $\theta$ times the household from all observations. Here $\theta$ depends on the variances of both $\mu_i$ and $\epsilon_{it}$. As the variances are not available beforehand, they have to be estimated from the data. These variances can be obtained by first applying the within transformation on the variables and use these transformed variables in the regression first. In case of instrumental variables the within transformation of a variable $w$ is given by equation G.2.

$$\tilde{w_{it}} = w_i t - \bar{w_i} + \bar{w} \tag{G.2}$$

Where

$$\bar{w_i} = \frac{1}{n} \sum_{t=1}^{T_i} w_{it} \tag{G.3}$$

$$\bar{w} = \frac{1}{N} \sum_{i=1}^{n} \sum_{t=1}^{T_i} w_{it} \tag{G.4}$$

and n is the number of groups and N is the total number of observations on the variable. After applying this transformation on $y_{it}$ and $Z_{it}$, $\mu_i$ drops out and as a result $\widehat{\epsilon_{it}}$ can be determined and as such its variance can be determined by equation G.5.

$$\widehat{\sigma}_\epsilon = \frac{\sum_{i=1}^{n} \sum_{t=1}^{T_i} \widehat{\epsilon}_{it}^2}{N - n - K + 1} \tag{G.5}$$

Next, equation G.1 is transformed by using equation G.3 on each of the variables to obtain the between residuals $\varsigma_i = \mu_i + \hat{\epsilon_i}$. From this it can be shown that the variance of $\mu$ should be given by equation G.6

$$\hat{\sigma}_\mu^2 = \hat{\sigma}_\varsigma^2 - \frac{(n-K)\hat{\sigma}_\epsilon^2}{N - r} \tag{G.6}$$

where

$$r = trace\big[(\bar{Z_i}'\bar{Z_i})^{-1}\bar{Z_i}' Z_\mu Z_\mu' \bar{Z_i}\big] \tag{G.7}$$

where

$$Z_\mu = diag(i_{T_i} i_{T_i}') \tag{G.8}$$

And this is where the problem of extreme deviations in consumption comes in. If a household is observed for several years and in one of those years the respondent miscalculates or mistypes his consumption, the variance of $\epsilon$ increases dramatically as can be seen from equation G.5, whereas the effect on the between estimator is limited as it takes the average over all observed periods for this household. As a result, the variance of $\epsilon$ can become so large that the estimate for $\sigma_\mu^2$ becomes negative. As this is not possible, programs such as Stata will set this value to the corner solution of zero. As such, the model is no longer estimated by random effects but it reduces to a normal OLS regression (in this case a normal IV regression).

Some researchers recommend not to exclude any observations as it is hard to determine which ones are due to observational error and which ones are genuine responses. It has been shown, however, that in this case outliers have to be removed in order for the model to be estimated properly.

# H Robustness checks

This section presents supplementary material for the robustness checks performed in section 6.4.2 and 6.4.3. The estimation results discussed in section 6.4.2 are included in table H1. In what follows, some additional information will be provided how the index of Relative Risk Aversion is determined.

The LISS panel has an additional questionnaire[34] asking the individuals to choose between several lotteries. This allows me to operationalize these questions into a measure of relative risk aversion. The questionnaire asks the respondents to choose between the options presented by table H2. After completing this questionnaire, the respondent had a chance of 1 in 10 to receive the actual outcome of this lottery. In this paper utility of the form Constant Relative Risk Aversion is assumed. As such it is possible to infer in what range the coefficient of Relative Risk Aversion (RRA) should be, given the choice the respondent makes based on the options described in table H2. One way of constructing the degree of relative risk aversion of each individual is by following the approach of Noussair et al. (2014). They use the same dataset which is used in this paper, they

34. Module 38, 'Measuring higher order risk attitudes of the general population'

Table H1: Robustness check by excluding several years

| | Excluding 2015 | | | Exluding 2010 | | |
|---|---|---|---|---|---|---|
| | Residual | Residual | Residual | Residual | Residual | Residual |
| Basic financial knowledge | 0.1331** | 0.1333** | 0.2493** | 0.0643** | 0.0623** | 0.1047*** |
| | (0.0596) | (0.0596) | (0.1157) | (0.0292) | (0.0293) | (0.0375) |
| Advanced financial knowledge | 0.0388* | 0.0409* | 0.0312 | -0.0096 | -0.0124 | -0.0301 |
| | (0.0224) | (0.0225) | (0.0400) | (0.0155) | (0.0158) | (0.0240) |
| Educational attainment | | -0.0856 | | | 0.0809 | |
| | | (0.0976) | | | (0.0856) | |
| Basic fin. lit. × Avg. assets | | | -6.61e-6 | | | -2.50e-6** |
| | | | (4.99e-6) | | | (1.22e-6) |
| Adv. fin lit. × Avg. assets | | | -5.39e-7 | | | 3.17e-7 |
| | | | (1.44e-6) | | | (5.75e-7) |
| Average assets | | | 5.96e-5 | | | 1.90e-5* |
| | | | (4.96e-5) | | | (1.14e-5) |
| Constant | -1.2614** | -1.1459* | -2.2294* | -0.4287 | -0.5267* | -0.626* |
| | (0.5946) | (0.6098) | (1.1496) | (0.2905) | (0.3086) | (0.375) |
| Observations | 88 | 88 | 73 | 115 | 115 | 91 |

scriptsize This table contains the results of the OLS regression of basic and advanced (Adv.) financial literacy (fin. literacy), educational attainment and the average amount of assets(Avg. assets) on the residual obtained from the IV regression specified by equation 8 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(Ageof Head_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$ for two sub-samples. More specifically, to check the robustness of the results the observations for households retiring in 2015 or 2010 are excluded. The original regression is run on consumption data of the Netherlands obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. By using an additional module on financial literacy administered in 2011, proxies for financial literacy are determined by using Principal Component analysis. The educational attainment variable is a dummy which is equal to one if the household head continued studying after the compulsory education. The average amount of assets are determined for every household by using an additional module of the LISS panel asking the respondent to indicate the total balance of their current accounts, savings accounts, term deposits accounts, savings bonds or saving certificates and bank savings scheme. This additional module was administered in the years 2008, 2010, 2012 and 2014. The average of each household is determined by averaging over the available observations. The coefficients are reported along with the corresponding standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table H2: The set of options presented to the respondent

| Option 1 | Option 2 | Expected Payoff Difference |
|---|---|---|
| 1/2 of €65, 1/2 of €5 | €20 | €15 |
| 1/2 of €65, 1/2 of €5 | €25 | €10 |
| 1/2 of €65, 1/2 of €5 | €30 | €5 |
| 1/2 of €65, 1/2 of €5 | €35 | €0 |
| 1/2 of €65, 1/2 of €5 | €40 | - €5 |

This table shows the different options the respondents were presented when participating in Module 38 'Measuring higher order risk attitudes of the general population' of the LISS Panel.

construct their measure by simply adding the amount of save choices each individual makes. A problem with this questionnaire, however, is that there is no option indicating that you are indifferent between the two options, which is of vital importance according to Grether and Plott (1979). Accordingly, 30.6 percent has given an inconsistent series of choices. With inconsistent I mean a series of decisions that features more than one switching point or that prefers the save outcome when the payoff is low and switches to the uncertain payoff as the certain payoff increases. If these outcomes were interpreted as strict preferences the "more is better" principle would be soundly rejected. Another way, however, of interpreting these outcomes is as weak preferences. Obtaining the actual measures of RRA is done in accordance with . In this thesis I use a utility function of the form Constant Relative Risk Aversion, i.e. $U(C) = C^{1-\gamma}$. Here $\gamma$ is the measure of RRA. As I know for each individual when they choose option 1 and when option 2, I can determine in what range their risk aversion must be. The obtained values are included in table H3. For each of the respondents I take the midpoint of the range for $\gamma$. The results of the regressions are presented in table H4.

Table H3: Classification of Relative Risk Aversion

| Number of save choices | Range of $\gamma$ | Risk preference | Full sample | Reduced sample |
|---|---|---|---|---|
| 0 | $\gamma$ <-0.37 | risk loving | 0.2483 | 0.3578 |
| 1 | -0.37 <$\gamma$ <0.00 | risk neutral | 0.1064 | 0.0501 |
| 2 | 0.00 <$\gamma$ <0.30 | moderately risk averse | 0.1678 | 0.1022 |
| 3 | 0.30 <$\gamma$ <0.58 | risk averse | 0.1559 | 0.1054 |
| 4 | 0.58 <$\gamma$ <0.87 | highly risk averse | 0.1109 | 0.0809 |
| 5 | 0.87 <$\gamma$ | extremely risk averse | 0.2106 | 0.3035 |
| Observations | | | 1,353 | 939 |

This table shows the proportion of the sample for each number of save choices. In the reduces sample, the respondents that made inconsistent choices are removed. The measure of $\gamma$ has been determined using the utility function $U(C) = C^{1-\gamma}$.

Table H4: Robustness check by including measure of Relative Risk Aversion

| | Full sample | | | Reduced sample | | |
|---|---|---|---|---|---|---|
| | Residual | Residual | Residual | Residual | Residual | Residual |
| Relative Risk Aversion | -0.0623 | -0.1048 | -0.1043 | -0.0390 | -0.0805 | -0.0683 |
| | (0.1015) | (0.1060) | (0.1150) | (0.1068) | (0.109) | (0.115) |
| Basic financial knowledge | | 0.0793 | 0.1103* | | 0.0982* | 0.139* |
| | | (0.0481) | (0.0544) | | (0.0489) | (0.0562) |
| Advanced financial knowledge | | 0.0164 | 0.0044 | | -0.0041 | -0.00223 |
| | | (0.0219) | (0.0283) | | (0.0241) | (0.0307) |
| Average assets | | | 1.82e-6 | | | 3.20e-5 |
| | | | (6.07e-6) | | | (3.46e-5) |
| Avg. assets × Basic financial knowledge | | | -7.32e-7 | | | -3.61e-6 |
| | | | (5.81e-7) | | | (3.39e-6) |
| Avg. assets × Advanced financial knowledge | | | 4.88e-7 | | | -5.01e-7 |
| | | | (4.96e-7) | | | (1.08e-7) |
| Constant | 0.0291 | -0.6970 | -0.8301 | 0.0479 | -0.7149 | -0.9940 |
| | (0.0571) | (0.4741) | (0.5310) | (0.0642) | (0.4800) | (0.5515) |
| Observations | 88 | 83 | 77 | 64 | 60 | 57 |

This table contains the results of the robustness check when including the measure of Relative Risk Aversion in the regression. The original regression is an OLS regression of financial literacy, the average amount of assets(Avg. assets) and educational attainment on the residual obtained from the IV regression specified by equation 8 ($\Delta ln(C_{it+1}) = \alpha_0 + \alpha_1(AgeofHead_{it+1}) + \alpha_2\Delta(Numberofhouseholdmembers_{it+1}) + \alpha_3(Hoursworked_{it+1}) + \alpha_4\Delta(Mortalityrate_{it+1}) + \alpha_5 r_{t+1} + \epsilon_{it+1}$). The IV regression is run on consumption data of the Netherlands obtained from the LISS panel for the years 2009, 2010, 2012 and 2015. By using an additional module on financial literacy administered in 2011, proxies for financial literacy are determined by using factor analysis. The educational attainment variable is a dummy which is equal to one if the household head continued studying after the compulsory education. The average amount of assets are determined for every household by using an additional module of the LISS panel asking the respondent to indicate the total balance of their current accounts, savings accounts, term deposits accounts, savings bonds or saving certificates and bank savings scheme. This additional module was administered in the years 2008, 2010, 2012 and 2014. The average of each household is determined by averaging over the available observations. The coefficients are reported along with the corresponding standard errors in parentheses. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$