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**SUBJECTIVE MEASURES OF HOUSEHOLD
PREFERENCES AND FINANCIAL DECISIONS**

By Bas Donkers and Arthur van Soest

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Subjective measures of household preferences
and financial decisions.

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Abstract

In intertemporal models of household consumption or portfolio choice, household behaviour depends on, for example, the household's rate of time preference, the rate of risk aversion, and the household's information set. In this paper we use a survey of Dutch households which contains direct subjective information on risk aversion and time preference and on interest in financial matters. We first describe these data and analyze to which extent they can be explained from household characteristics and household income. We then investigate whether these variables are related to households' financial on home ownership, mortgages and ownership of risky assets. Our results are broadly in accordance with economic theory.

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1 Introduction

In models of household consumption or portfolio choice, household preferences play an important role in various ways. Mainstream economic theory of household consumption and saving behavior is based upon the life cycle hypothesis (see, e.g., Deaton, 1992, and Browning and Lusardi, 1996). Here household preferences depend, among other things, on the rate of time preference and the household's rate of risk aversion. In the standard two period Markowitz model of portfolio choice (Markowitz, 1952), the choice between holding risky and risk-free assets will depend on the agent's risk aversion parameter. In extensions of this model, risk aversion and the rate of time preference also play a role. See for example the model of Henderson and Ioannides (1983), which explains household consumption and investment in financial as well as housing wealth.

In empirical studies in the above fields, direct information on the household's rate of risk aversion or time preference is never used, at least to our knowledge. The reasons are twofold. First, such information is usually not available. We know of no previous survey with information on portfolio's or savings and consumption in which this type of subjective information is present. Second, according to Dominitz and Manski (1996), many economists are sceptical to the use of information based upon subjective survey questions in general. In various recent studies however, subjective information on income expectations is used (Guiso et al., 1992 and 1996, for example), suggesting that the tide is changing.

In this paper we use the first wave of a panel survey of Dutch households, the VSB panel, drawn in 1993. This data set has two properties which make it particularly useful for our purposes. First, it contains detailed information on many asset and liability holdings, including home ownership and mortgages. Second, it contains a number of 'psychological' variables. These contain subjective information which can be used to measure household preferences directly. We shall use three such variables, measuring time preference, risk aversion, and the household's interest in financial

matters.

The first purpose of our paper is to describe these data, to see whether they make sense, and to see to which extent they can be explained from household characteristics and household income. The second purpose is to investigate whether these variables are helpful to explain households' financial decisions. We focus on decisions related to home ownership and mortgages. As in many countries, investment in (owner occupied) housing is the most important component in household portfolios in the Netherlands. On average, it represents more than 60 percent of households' gross assets (see Alessie et al., 1996, for example). Similarly, mortgage debt is by far the largest type of liability: more than 80 percent of all debts is mortgage debt (Alessie et al., 1996). We also consider the choice whether or not to hold risky financial assets. While more than 80% of Dutch households hold financial assets, less than 10% hold risky assets like stocks and bonds. Why few people hold stocks and bonds has been the topic of studies for other countries (see Haliassos and Bertaut, 1995). Here we can test directly whether holding risky assets is related to the head of household's subjectively measured rate of risk aversion.

Throughout the paper, we rely on static reduced form univariate models. The cross-section nature of our data does not allow for a dynamic framework, or for estimating a structural economic model. Our equations explain financial decisions from the subjectively measured variables and other household characteristics, and we do not address the issue of potential endogeneity of the subjective variables. We focus on the question whether the correlations we find can be explained from economic theory. In most cases we find that they can, even when other variables are controlled for. This leads to the conclusion that the subjective information can also be valuable in estimating structural models of economic household behavior, in which endogeneity, dynamics, and causal relationships should be taken into account. This is left for future research.

The remainder of the paper is organized as follows. In Section 2, we present a

brief description of the data in general. Then we analyze the subjective measures of time preference, risk aversion, and interest in financial matters. Emphasis is put upon the rate of time preference, which can be measured in different ways, based upon nine different questions in the survey. In Section 3, we consider the home ownership decision, using a standard probit model. In Section 4, we explain the value of the house, conditional on home ownership, using a simple linear regression framework. In Section 5, we explain the mortgage as a fraction of the purchase value of the house, again conditioning on home ownership. Here we use a censored regression model, to take account of the fact that many home owners do not have a mortgage. In Section 6, we analyze financial wealth holdings with emphasis on the choice between risky and risk-free assets. Section 7 concludes.

2 Data and Description of Subjective Variables

The first wave of the VSB-Panel data, drawn in 1993, consists of 2780 households, divided into two panels. One panel is designed to be representative of the Dutch population, the other one is meant to be a random sample from households in the upper 10% of the income distribution in the Netherlands. All households participating have been provided with a personal computer and answer the survey questions directly on their PC; no personal interviews are held. The total numbers of households in the two panels are 1870 and 910 respectively. After removing the households that did not respond to all the questions we need,² 900 remained in the Representative Panel (REP) and 700 in the High Income Panel (HIP). The large number of missings is mainly due to the fact that many households do not answer any of the questions concerning the economic and psychological concepts. Due to an error in the routing of the questions, approximately 25% of the households never received this part of the questionnaire. A minor part of the non-response is caused by a question on risk

²We also deleted 12 households who lived in their house for free.

aversion, which is only asked if net household income is above Dfl. 20.000,=

The other parts of the questionnaire are concerned with household characteristics, housing, labor market status and pension entitlements, health, income, and assets and liabilities.

In this section, we pay attention to some variables derived from the subjective information in the questionnaire. These variables are the household's subjective interest rate, a measure of risk aversion and a measure of interest in financial matters. All are based upon questions answered by the head of the household only. Variables related to housing assets will be discussed in the next sections. Some descriptive statistics on background variables (relating to family income, age, education level, family composition and marital status, employment status) are presented in Appendix 1.

2.1 Subjective interest rates.

The survey collects information on how individuals evaluate a delay or speed-up of receiving or paying a certain amount of money. In total, nine (series of) questions are asked, differing on the following points (the codes that we use to name the variables are mentioned in parentheses)

- The money is payable in the future and the question refers to how much the household is willing to sacrifice to get the money now (S: speed-up), or the amount is payable immediately and the question refers to the additional amount the household requires to compensate for postponing the payment to some point of time in the future (D: delay).
- The household will receive the money (G: gain) or has to pay (L: loss).
- The time period that is covered: 3 months (03) or 12 months (12).
- The amount of money that is at stake: Dfl. 1000 (1) or Dfl.100,000 (100).

Nine out of the sixteen possible combinations are used in the survey (see Table 1 below). The precise wording of the questions DG12100 is as follows.

Imagine you win a cash prize in a lottery. The prize is worth Dfl. 100,000 and can be paid out AT ONCE. Imagine the lottery, which is a financially trustworthy organization, asks if you are prepared to wait a year before you get the prize. Would you agree to that proposal, or would you ask for more money if you had to wait for one year. What would you prefer:

- 1. I would agree to the waiting term of a year without requiring extra money for that. So after a year I receive Dfl. 100,000.*
- 2. I would agree to the waiting term of a year, but I want to receive extra money for that.*

If the respondent wants extra money, the following question is asked:

How much extra money would you want to receive AT LEAST, in addition to the Dfl. 100,000?

For the households requiring extra money for waiting on the payment, the subjective interest rate is calculated from the questions mentioned above as $r = \frac{\text{extra amount of money}}{100,000}$.

For households willing to wait without requiring additional money, we set the rate of time preference to zero (8.6% of the individuals in the REP and 9.2% in the HIP). It could be the case that the 'true' rate of time preference for these households is negative. An explanation might be that households want to restrain themselves from spending all the money at once, i.e. are prepared to pay a premium to enforce self-control (cf. the theory in Shefrin and Thaler (1988), and the empirical evidence in Kahneman and Thaler (1991)). The wording of the two other questions of the DG type (DG121 and DG031) are very similar, but lead to a much larger fraction of zero subjective interest rates (see Table 1).

For the question SG031 the first question was:

Imagine you win a cash prize in a lottery. The prize is worth Dfl. 1,000 and will be paid out in three months time. The lottery offers you to pay out the price immediately, but then you will receive a smaller amount of money. What would you prefer:

- 1. I will wait for three months and receive Dfl. 1,000 then.*
- 2. I want the money now and accept a smaller amount.*

Only those who choose the second option answer a follow-up question similar to that in the DG case:

How much less than Ffl 1,000 would you accept if the amount is paid now?

The other SG questions and the DL questions are similar. The first question does not specify how much the speed-up premium will be. Thus individuals who choose to wait do not necessarily prefer to receive the same amount later than receiving it now. This is different from the DG questions, which are formulated more precisely. The majority of individuals choose the first option and do not answer the question on the amount (see Table 1). These people may or may not prefer costless speeding up; Shelley (1993), extends the framing theory of Loewenstein (1988) and shows that in case of loss aversion it is possible that people with a positive rate of time preference prefer waiting to costless expediting. The explanation is that, compared to the original situation, expediting leads to a current loss and a future gain. The fact that losses are weighted heavier than gains can dominate the time preference. See Daniel (1994), who uses the same data as we do, and links the differences between the questions to various theories in economic psychology.

For the questions of the DG type, choosing the first option can be interpreted as a zero or negative subjective interest rate. The correlation between the subjective interest rates according to these three questions, with zeroes for those who chose the

Table 1: Subjective interest rates

Interest rate	Fraction ³	Mean ⁴
DL121	0.11	0.076
DL031	0.06	0.157
DG12100	0.91	0.089
DG03100	0.79	0.117
DG031	0.66	0.230
SG121	0.37	0.078
SG031	0.14	0.157
SG12100	0.46	0.049
SG03100	0.23	0.087

first option, are shown in Table 2. They are all significant at the 1% level. In the remainder of this paper we focus on the interest rate derived from DG12100, which refers to postponing payment of a realized gain, the largest amount of money, the longest difference in timing. It has the smallest number of zeroes and its mean value seems plausible, although lower values of our measure of time preference could be expected if risk aversion and/or loss aversion were taken into account (see Shelley, 1993).

Table 2: Correlation coefficients between observed interest rates (including zeroes).

	DG12100	DG03100	DG031
DG12100	1.000	0.526	0.345
DG03100	0.526	1.000	0.538
DG031	0.345	0.538	1.000

³Fraction of respondents who chose the second option and answered the follow-up question on the amount

⁴Only for those who answered the follow-up question.

The estimated probability density of the subjective interest rate based upon this question for the two panels REP and HIP separately is depicted in Figure 1. The households with a zero subjective interest rate are not included. This figure is drawn using non-parametric regression techniques as explained in Härdle and Linton (1994). The choice for the value of the smoothness parameter is based on visual inspection of the figures. The kernel that is used is the Quartic kernel.⁵

Figure 1: Estimated probability density of the subjective interest rate

The figure suggests that the density is skewed, with a substantial number of small values of the subjective interest rate in both panels. The mode is about 0.06 in the representative panel and about 0.09 in the high income panel. The average values in the two panels (excluding the zeroes, standard errors in parentheses) are similar: 0.082 (0.002) in REP and 0.086 (0.002) in HIP. The difference is significant at the 10% level.

Nonparametric regressions of the subjective interest rate on log family income and on age are drawn in Figure 2 (zeroes included; REP only).⁶ They suggest that the subjective interest rate is not related to income, and negatively related to

⁵This kernel is given by $K(x) = \frac{15}{16}(1 - x^2)^2 \cdot I(|x| < 1)$.

⁶See Appendix 1 for details on the explanatory variables such as family income and age.

age. To test whether this remains to be the case if other background variables are controlled for, we explain the subjective interest rate using a standard tobit model:

$$\begin{aligned} y^* &= x'\beta + \epsilon \\ y &= \max(y^*, 0) \\ \epsilon &\sim N(0, \sigma^2), \epsilon \text{ and } x \text{ independent} \end{aligned}$$

Here y^* is a latent variable, y is the observed subjective interest rate, β is a vector of unknown parameters, ϵ is an error term, and x is a vector of explanatory variables. We use age and family income variables, dummies for education levels, family composition and employment status variables. After eliminating the variables that are insignificant, the only variable that remains is Age. Its estimated coefficient is -0.0004 with a standard error of 0.0002. Thus a ten years age difference leads to a 0.4%-point difference in the subjective interest rate, on average. Older people are thus more patient. Thaler and Shefrin (1984) already expected this, since younger people yet have to master the techniques of self-control. The tobit regression had an R^2 of only 0.004, indicating that only a small part of the variation in the subjective interest rates can be explained by the usual variables.⁷

2.2 Risk aversion

The value of the variable Riskaverse is the answer to the following question:

I think it is more important to have safe investments and guaranteed returns, than to take a risk to have a chance to get the highest possible returns.

Disagree Strongly						Agree Strongly	
1	2	3	4	5	6	7	

⁷The R^2 in the Tobit model is defined as the estimate of $\frac{V(x'\beta)}{V(x'\beta) + \sigma^2}$

Figure 2: Estimated regression functions for the subjective interest rate

Figure 3: Percentage of answers in each category for Riskaverse

Figure 4: Estimated regression functions for riskaversion

Heads of household who agree strongly with this statement are not willing to take financial risks and are thus considered to be very risk averse.

The frequencies of outcomes for the two panels are shown in Figure 3. The representative panel contains more families who are willing to invest in risky assets than the high income panel. The average values of the variable Riskaverse in REP and HIP are 4.98 and 5.07, respectively. The difference is insignificant, with standard errors of 0.06 for each of the two (independent) estimates. Figure 4 shows the results of nonparametric regressions of Riskaverse on log family income and age, including uniform 95% confidence bands (REP only). No significant relation with income can be detected, but the figure suggests a positive relation between risk aversion and age.

We test this also with an ordered probit model explaining the household's risk aversion from the same variables that are used in the previous subsection:

$$\begin{aligned}
 y^* &= x' \beta + \epsilon \\
 y &= j \text{ if } m_{j-1} < y^* \leq m_j \quad (j = 1, \dots, 7), \\
 \epsilon &\sim N(0, 1), \quad \epsilon \text{ and } x \text{ independent.}
 \end{aligned}$$

Table 3: Ordered Probit Estimates for Riskaverse

	Estimate	Std. Error
Constant	18.205	5.058
Log(Age)	-9.734	2.723
Log ² (Age)	1.393	0.363
Log(Inc)	0.023	0.051
Log ² (Inc)	0.001	0.004
Work	0.230	0.101
Workp	-0.186	0.062
m ₂	0.419	0.047
m ₃	0.887	0.057
m ₄	1.394	0.061
m ₅	1.852	0.064
m ₆	2.649	0.069

Here y is the observed answer, the category bounds are $-\infty = m_0 < m_1 < \dots < m_6 < m_7 = \infty$. By means of normalization, m_1 is set to zero. $m_2, \dots, m_6$ and the vector β are the parameters to be estimated. The model is estimated using maximum likelihood. In this model the observations of REP and HIP are combined. The results can be found in Table 3. The income variables are jointly significant and imply a positive effect of income on risk aversion. The traditional literature on the theory of portfolio allocation suggests that relative risk aversion decreases with wealth, while absolute risk aversion increases with wealth (see Arrow, 1965, or Pratt, 1964). If household income is seen as a proxy for wealth, our result can be reconciled with this if household heads interpret the question in a relative sense: the amount they have in mind for a "safe investment" is some share of their income or wealth.

The effect of Age is significant and so is the effect of the square of Age. Risk aversion as a function of age reaches its minimum at the age of 33 and increases thereafter. This might be a pure age effect or a cohort effect. The signs of the labour market status variables can be explained as follows. Having a job exposes one to the risk of unemployment and thus to the possibility of a large drop in income. If there is a second member of the household with a job, the risk of a large fall in labor income is reduced. Income risk reduces the portfolio risk one is willing to take. This corresponds to Guiso et al. (1996) who find a negative relation between income uncertainty and investment in risky assets. It leads to an increase of our measure of risk aversion. This implies that the measure of risk aversion we use depends on the family's circumstances and income uncertainty, and does not reflect underlying preferences only. In that sense, it does not measure the 'true' risk aversion of the household's utility function, unconditional on labor market or health status. A drawback of our measure is that it not only determines, but also depends on the family's financial decisions. It is not clear whether a 'true' measure which does not suffer from this problem can be obtained; this would require much more from the wording of the questions and the respondents' ability to answer them.

2.3 Financial interest

For the question on interest in financial matters the same answering scheme was used as for the risk aversion variable. The exact question was:

I am very interested in financial matters (insurances, investments, etc.).

Disagree Strongly						Agree Strongly
1	2	3	4	5	6	7

The distributions of the answers to this question are presented in Figure 5 for HIP and REP separately. It is clear that, on average, the high income panel participants are significantly more interested in financial matters than the households in the

Figure 5: Percentage of answers in each category for Finint

representative panel. The average values of the resulting variable Finint are 3.20 for REP and 4.15 for HIP, with standard errors of 0.06 and 0.07 respectively.

Figure 6: Estimated regression functions for interest in financial matters.

Nonparametric regression results for the representative panel are displayed in Figure 6. Finint and age are not related, but there seems to be a positive relation between Finint and income. An ordered probit model reveals the relationship between interest in financial matters and various control variables. The specification

Table 4: Ordered Probit Estimates for Finint

	Estimate	Std. Error
Constant	5.617	4.642
$\text{Log}(\text{Age})$	-2.811	2.462
$\text{Log}^2(\text{Age})$	0.375	0.324
$\text{Log}(\text{Inc})$	-0.177	0.049
$\text{Log}^2(\text{Inc})$	0.018	0.004
Kids	-0.222	0.076
Famsize	0.204	0.068
m_2	0.592	0.032
m_3	0.965	0.037
m_4	1.394	0.041
m_5	1.804	0.046
m_6	2.286	0.053

is the same as that for risk aversion. Results are presented in Table 4. The age variables are jointly insignificant. The parameters for income and family composition are significant. The relation with income is positive across the whole income range. This can also explain the difference between REP and HIP in Figure 5. This positive relationship can have different explanations. First, high income families have more investment and portfolio allocation opportunities, and will therefore get more interested in financial matters. Second, people with a large interest in financial matters may have a larger preference for income compared to leisure or job characteristics than others. Therefore more often they accept the best paying job, and choose their portfolio efficiently to maximize asset income. The family composition variables jointly imply that the presence of children does not make any difference, whereas financial interest of the (head of the) household is positively correlated with the number of adult family members.

3 The Choice between Owning and Renting

Figure 7: Probability that a household owns its house

One of the most important financial decisions a household makes is the choice to buy a house or not. Wealth invested in the own house is by far the largest asset category in the Netherlands. All remaining households in the data answered the question whether they rented or owned their house. The exact question is:

Are you tenant, subtenant or owner or do you rent for free? If you live in more than one house, please report the most important one.

The largest group of households own a house, 76.1% of the households in the REP and 91.9% of the households in the HIP. 23.5%(7.9%)⁸ of the households are renting, while 0.4%(0.1%) are subtenants. We combine the subtenants with the renters. This results in 900(700) households of which 215(57) rent their house. In Figure 7 the probability that a household owns its residence is depicted as a function of age of the household head.⁹ The solid line refers to the REP, the broken line to the

⁸From now on the numbers corresponding with the HIP will be denoted in parentheses.

⁹The curve is smoothed using the same nonparametric regression techniques as in the previous

HIP. The probability of owning increases with age until the age of 30 and stabilizes thereafter.

In general the choice between renting and owning will depend on income and wealth, on the possibility to obtain a mortgage, on expected returns to housing and financial assets, on family composition, household preferences, etc. See, for example, Henderson and Ioannides (1983) for a theoretical model. Since many of the variables which would play a role according to theory are not measured, we do not consider structural models. Instead, we estimate a reduced form equation and focus upon the impact of the variables discussed in the previous section. The rate of time preference and the risk aversion rate are features of household preferences. Since owning a house generally requires a large investment expenditure at the time the house is bought, the probability of home ownership can be expected to decrease with the rate of time preference. The same holds for the risk aversion measure, because due to variation in housing prices, the returns to housing are usually more uncertain than average financial assets.¹⁰ Moreover, the cost of renting is largely fixed, while ownership costs may include a large fraction of uncertain maintenance costs. Finally, it is generally assumed that in the long run and on average, owning is cheaper than renting, also because of the tax rules which make owning relatively attractive. This makes it likely that households with more interest in financial matters own more often than others.¹¹

The choice between renting and owning is modelled with a standard probit model. Thus the probability that a household owns its house equals $\Phi(X_i'\alpha)$, where $\Phi(\cdot)$ is the standard normal distribution function and α is the vector of parameters to be estimated. The model is estimated with maximum likelihood. The results are in section.

¹⁰In the Netherlands, relatively few individual households hold risky assets such as stocks or bonds. The bulk of financial assets are saving accounts which are practically riskfree. See Section 6.

¹¹It could be argued that there is potential endogeneity here, since families who have taken a mortgage were forced to show some financial interest at that time.

Table 5.

Table 5: Estimation results for the home ownership decision

Variable	Estimate	Std. Error
Constant	-16.427*	6.985
Log(Age)	8.313*	3.760
Log ² (Age)	-1.046*	0.500
Log(inc)	-0.295*	0.080
Log ² (inc)	0.028*	0.007
Married	0.427*	0.111
Edu1	-0.285*	0.142
Edu2	-0.309 [†]	0.166
Edu3	-0.049	0.131
Edu4	0.026	0.126
Work	0.334*	0.141
Workp	0.110	0.104
Riskaverse	0.040	0.025
Finint	0.054*	0.021
Subintr	-1.223*	0.505

Note: *significant at 5%; [†]significant at 10%

The probability of ownership increases with age of the head of the household. Even though the standard errors are large, the total age effect is significant, as is shown by a likelihood ratio test. Household income also has a positive effect, as could be expected. Families with at least one working member (Work=1) have a significantly larger probability of owning than families consisting of nonworkers only. If the head of the household has a partner (Married=1), this increases the probability of ownership. If the partner also has a job (Workp=1), the probability of owning a house increases even more. All these variables are significant at the

5% level, except for the last one. The dummies for the education levels are jointly significant and strengthen the effect of income: the higher the education level, the higher the probability of ownership.

The estimate for the variable *Finint* indicates that people who are more interested in financial matters are more likely to own their home. This is consistent with our prior expectations given above: in the long run owning is cheaper than renting, mainly because interest on mortgages is fully tax-deductible, interest on financial assets is taxed apart from a small tax exempt amount, and capital gains (on housing or other assets) are not taxed at all. People who are more interested in financial matters will be more aware of this.

A higher subjective interest rate makes it less likely for a household to own its home. This can be explained by the fact that the short run costs of having a house and a mortgage are higher than the rent for a house with similar characteristics. The payments however are partly used to pay off the mortgage and thus increase wealth. This is a long run effect and people using a high discount rate will give it less weight. A second explanation is that households with a higher discount rate are more likely to face binding liquidity constraints, making it harder for them to buy a house.

The parameter estimate on the risk aversion variable is insignificant and positive. This could indicate that households do not see their house as a risky asset. For example, they may not plan to sell their house in the near future, so that they do not give much weight to uncertainty in future house prices. In the short run, rents may be more uncertain than the cost of owning. Due to the way in which risk aversion is measured, another explanation would also be possible: households owning their house face more risk than renters because of housing price volatility and uncertain maintenance costs, etc. This makes them less willing to take extra risks, and this is what the question on risk aversion refers to. This positive relation (higher risk aversion leads to a smaller ownership probability) and the reverse negative

relation could cancel. To investigate this further, it would be necessary to estimate a structural model. This is beyond the scope of the current paper.

4 The Value of the House.

Figure 8: Estimated probability density of the current value of the house.

Estimates of the probability densities of the current value of the house for the two panels separately are given in Figure 8. The average current values (home owners only; in 1000 Dfl) are 233 (REP) and 355 (HIP). The distributions in the two panels are also quite different. In the REP, it is strongly unimodal at about 200,000 Dfl. In the HIP, this peak is missing. The 95% uniform confidence bands (not shown) do not overlap everywhere, implying that the difference between the densities is significant.

To get an idea about the relationship between the current value of the house and the value of the house at the time it was bought, OLS is used to regress the logarithm of the current value on the logarithm of the purchase value and the number of years the household lives in its house. The results are as follows (standard errors

in parentheses):

$$\begin{aligned}
 \text{REP: } \log(\text{current value}) &= 1.0047 \log(\text{purchase price}) + 0.0442 \text{ years.} \\
 &\quad (0.0062) \quad (0.0018) \\
 \text{HIP: } \log(\text{current value}) &= 1.0062 \log(\text{purchase value}) + 0.0388 \text{ years.} \\
 &\quad (0.0015) \quad (0.0016)
 \end{aligned}$$

The estimates suggest that the value of the house increases by about 4% per year, on average. The R-squares of the regressions are 0.45 and 0.43, respectively, implying that 45% (43%) of the variance of the log current values is captured by differences in purchase values and the number of years the household owns its house.

A standard linear model is used to explain the log of the current value of the house, conditional on home ownership. The estimated coefficients and the corresponding standard errors can be found in Table 6. The R^2 of this regression was 0.24, and the estimated variance of the error terms was 0.20.

The effect of age on the current value of the house is positive, but insignificant. As expected, the effect of income is positive, implying that (owned) housing is a normal good. An income rise from 30,000 guilders to 200,000 guilders increases the value of the house with approximately 40%.

The coefficients for the education levels indicate a positive relation between the value of the house and education level. Having a job increases the expected value of the house significantly, with approximately 7%. Both of these findings can reflect a positive relation between (unobserved) permanent income and the value of the house. As expected, the value of the house increases significantly with family size. We also included the year the household moved into the house (Sincew). It appears that households who bought the house more recently, have more expensive houses, *ceteris paribus*. If the desired housing stock increases over the life cycle, this can be explained by heterogeneous adjustment costs.

The estimate for the variable indicating interest in financial matters has a sig-

Table 6: Results for the value of the house.

	Estimate	Std. Error
Constant	-16.110*	4.093
Log(Age)	1.352	1.367
Log ² (Age)	-0.102	0.182
Log(income)	-0.161*	0.025
Log ² (income)	0.015*	0.002
Edu1	-0.109*	0.045
Edu2	-0.231*	0.057
Edu3	-0.059	0.038
Edu4	-0.045	0.035
Famsize	0.179*	0.035
Work	0.066	0.046
Sincew	0.012*	0.002
Finint	0.037*	0.007
Riskaverse	0.016*	0.008
Subintr	-0.099	0.179

Note *significant at 5%; †significant at 10%

nificant positive sign. This suggests that the house is seen as a profitable asset. More risk averse households tend to live in more expensive houses. If this reflects a causal relation, it is probably in the reverse direction, relating to the way in which our measure of risk aversion is constructed: A valuable house is a risky asset, and people owning such a house will be less willing to take additional risk than others.

Finally, the rate of time preference is insignificant. Since we have conditioned on home ownership, there is no reason why the rate of time preference should have an impact.

5 The Amount of Mortgage

Households owning a house have first answered a question on whether or not they have a mortgage. In the REP (HIP), 77.1% (89.6%) of the home owning families answered affirmatively. The data contain information on the year the mortgage was taken as well as on the year the family moved into its current house.

Figure 9: Fraction as a function of the current value (HIP)

In Figure 9 the relation between the fraction of mortgage taken and the current value of the house is shown. Households without mortgage are not included here. The dotted lines are 95% uniform confidence bands. The figure shows that the fraction of mortgage taken and the value of the house are negatively related.

In Figure 10 the estimated density of the fraction of the purchase value of the house taken as mortgage by the households is drawn, together with the 95% uniform confidence bands. In this figure the REP and HIP are combined since the densities for the two panels are almost identical. Many households take almost the total amount of the value of the house as a mortgage. The probability that the fraction exceeds 1.4 is negligible. A plausible explanation for this is that households with a very high fraction of mortgage used the money to rebuild their house after they

Figure 10: Estimated probability density for the fraction of mortgage taken

bought it. This is confirmed if we compare the difference between the current value an the buying value for those with a higher mortgage with the others. The average yearly increase in the value of the house is more than 2% higher for households with a fraction of mortgage above 1.2. This difference is significant at the 5% level. Very small fractions of mortgage are also rare. Most of the density is concentrated between fractions of 0.75 and 1.25. The average fraction is 0.86 in the REP and 0.87 in the HIP (zeroes excluded).

Since the fraction of mortgage taken by a household will never be negative and there is a positive probability that a household has no mortgage, a standard tobit model is used to model the fraction of mortgage taken. In Table 7, we present the results. The estimated standard deviation of the error term is 0.420 (standard error of 0.011). This is larger than the sample variance in the fraction of mortgage, since the latter is affected by the censoring. The R^2 , as defined in footnote 7, equals 0.25.

In spite of our conclusion from Figure 9, the value of the house was not significant. We excluded it from the explanatory variables. The fraction of mortgage

Table 7: Estimation results for the fraction of mortgage taken.

Variable	Estimate	Std. Err.
Constant	-11.020*	2.618
Log(Age)	6.596*	1.412
Log ² (Age)	-0.945*	0.188
Log(inc)	-0.048 [†]	0.026
Log ² (inc)	0.005*	0.002
Married	0.135*	0.047
Work	0.184*	0.054
Riskaverse	-0.011 [†]	0.007
Finint	0.002	0.008
Subintr	-0.037	0.176

Note *significant at 5%; [†]significant at 10%

taken increases with age until the age of 32 and decreases thereafter. The latter corresponds to the notion that for many people, housing equity is the most important form of saving. Household income has a positive effect on the fraction of mortgage. This could be expected since households with higher incomes will less often face credit constraints and are allowed to pay a smaller downpayment than low income households. If the head of household is married, this increases the fraction of mortgage considerably. The effect of having a job is even stronger. The variable indicating whether or not the partner has a job, turned out to be insignificant, and was deleted from the model.¹²

Households reporting¹ to have a higher interest in financial matters take a larger fraction of the value of their house as mortgage than others, but the effect is insignif-

¹²Labour supply could also be endogenous to the mortgage decision, particularly for married females. Fortin (1995) uses the amount of mortgage remaining to explain female labor supply and finds a significant relationship. She assumes that the amount of mortgage is exogenous, however.

icant. The effect of the subjective interest rate is virtually zero with a small t -value. Apparently, the subjective interest rate affects home ownership and the value of the house in the expected way (see previous sections), but, conditional on these, has no effect on the mortgage. The rate of risk aversion has the expected negative sign and is significant at the 10% level. A high mortgage increases the risk of facing liquidity constraints and financial problems in the future. More risk averse people will tend to pay off their mortgage debts earlier than others. Less risk averse households may want to benefit optimally from the tax rules and hold mortgage debt (with tax deductible interest costs) and risky assets (taxed only partly) simultaneously. The decision to hold risky assets is discussed in the next section.

6 Financial risk taking

In this section we look at financial assets. We distinguish between risk-free and risky assets. Since there are not many households who do not own any form of riskfree assets (checking accounts, saving accounts, deposits, etc.),¹³ we focus on the category of risky assets, and in particular on the relation between the decision whether or not to hold risky assets and the subjective variables introduced in Section 2. Especially risk aversion is expected to have a strong effect.

In the risky assets we include stocks, bonds, options, growth funds, and mutual funds. We will also estimate a model based upon a more narrow definition of risky assets, in which bonds and bond-related growth funds¹⁴ are defined as riskless. Since the decision to invest in risky assets is likely to depend on the level of household wealth, some measure of wealth is needed. The data contain a very large number of detailed questions on assets. Of the sample of 1600 used in Section 2, 351 households

¹³Even these assets are strictly spoken not risk-free if the inflation risk is taken into account. In the Netherlands this is quite limited, however.

¹⁴Growth funds are safe mutual funds that invest only in bonds and exist mainly because some specific rules of the Dutch tax system make them attractive for many households.

had to be discarded because one or more wealth components could not be observed.¹⁵ The remaining households all gave complete answers to the questions on the assets. From these 1249 households, 353 have risky assets in their portfolio. We ignore the possible selection bias due to deleting the households with incomplete information on wealth.

Figure 11: Estimated regression functions for ownership of risky assets.

In Figure 11 nonparametric regressions of the dummy for possession of risky assets on age, log(income) and log(wealth) are drawn. All variables have a positive relationship with the probability of owning risky assets.

A probit model has been estimated to quantify the effects of income, wealth, age and the subjective variables on the probability of owning risky assets. The

¹⁵224 of these households reported 'Don't know' on one or more questions about the riskless assets, 81 households had a missing value on the risky assets and 46 households reported 'Don't know' on questions concerned with both types of assets.

results are presented in Table 8. In the first two columns, risky assets are defined as above. In the next two columns the more narrow definition of risky assets is used, excluding bonds and growth funds. According to this definition, the number of households holding risky assets drops from 353 to 302. In the last four columns of the table, the estimates for the same models are shown, but wealth is excluded from the explanatory variables. It could be argued that wealth itself is endogenous to the decision to hold risky assets or not, and the equation without wealth can be seen as a reduced form equation.

	All risky assets		Bonds excluded		All risky assets		Bonds excluded	
Variable	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Constant	-12.609	8.324	-10.605	8.555	-1.620	7.661	0.557	7.851
Log(age)	4.174	4.353	3.005	4.469	-1.005	4.010	-2.189	4.107
Log ² (age)	-0.457	0.569	-0.310	0.584	0.287	0.523	0.435	0.536
Log(inc)	-0.119	0.093	-0.014	0.096	-0.389*	0.083	-0.304*	0.086
Log ² (inc)	0.013	0.008	0.005	0.008	0.037*	0.007	0.030*	0.007
Edu1	-0.359*	0.155	-0.500*	0.164	-0.396*	0.144	-0.514*	0.152
Edu2	-0.740*	0.231	-0.664*	0.238	-0.685*	0.209	-0.617*	0.216
Edu3	-0.162	0.132	-0.081	0.134	-0.178	0.122	-0.094	0.124
Edu4	-0.118	0.118	-0.114	0.120	-0.091	0.110	-0.089	0.113
Log(Wealth)	-0.056 [†]	0.029	-0.035	0.033	—	—	—	—
Log ² (Wealth)	0.027*	0.003	0.027*	0.003	—	—	—	—
Riskaverse	-0.101*	0.029	-0.117*	0.029	-0.067*	0.027	-0.086*	0.027
Finint	0.148*	0.024	0.153*	0.024	0.204*	0.022	0.208*	0.023
Subintr	1.089 [†]	0.579	1.217*	0.585	0.781	0.5427	0.896	0.553
Log(L)	-533.55		-499.82		-616.75		-574.96	

Note *significant at 5%; [†]significant at 10%

Table 8: Results for the risk taking behavior.

We first discuss the results in columns 1 and 2. The age variables are jointly significant as is shown by a likelihood ratio test. The same holds for the income variables. The education dummies imply that investing in risky assets is more likely if the education level is higher. This might be due to the relation with lifetime income and wealth. Moreover, information costs related to investing in risky assets can be negatively related to education level. As expected, the effect of the level of wealth¹⁶ is positive and significant. The pattern corresponds to the convex curve in Figure 11.

The subjective measures of risk aversion and interest in financial matters have the expected signs and are significant. The subjective interest rate is positive and significant at the 10% level. In a simple (life cycle) model of household behavior, the subjective discount rate does not influence on the portfolio composition of a household. It only affects the amount of savings; effects caused by different savings attitudes are likely to be taken up by the level of household wealth. If, however, credit constraints are introduced, it could be that households with a higher discount rate, prefer to see these constraints relaxed as soon as possible. These households might then invest in riskier assets with a higher expected return.

From columns 3 and 4 it appears that these results are robust against the definition of risky assets. The estimates for the probit model are almost identical to those in the first columns, though the income variables are not jointly significant any more.

If wealth is excluded from the explanatory variables (columns 5–8), the magnitude of the effects changes, but the signs and significance levels of financial interest and risk aversion remain the same. The effect of the subjective interest rate becomes insignificant, which indicates that there is a relation between the subjective interest rate and wealth. Age and income effects change substantially, due to the large correlations with wealth.

¹⁶Since some households have a negative net wealth, $\text{Log}(\text{Wealth})$ is defined as $\text{sgn}(\text{Wealth})\text{Log}(|\text{Wealth}|)$.

7 Conclusions.

We have considered three subjective measures which can influence households' financial behavior: a measure of the rate of time preference, a measure of risk aversion, and a measure of interest in financial matters. These variables are available in a new survey of Dutch households. We have described these measures and tried to explain them from background variables. Second, we have analyzed their contribution to explaining financial behavior related to housing and holding risky financial assets.

Households' rates of time preference can be constructed from various questions in the survey relating to postponing or advancing payments. In most cases, we find many households having a zero rate of time preference. This can be the result of the way questions are framed and risk or loss aversion of the households. We focus upon the question which gives fewest zeros, referring to the additional amount somebody wants to receive if a payment of Dfl 100,000 is postponed by one year. The distribution of the household specific rates of time preference constructed from this question seems plausible. The rate of time preference is negatively correlated with age, and uncorrelated with other background variables or family income. This may either imply that it contains no information at all, or that it constitutes a useful independent source of information to explain households' financial behavior. The latter is suggested by most results in the second part of the paper. For example, the subjective interest rate has the expected negative effect on the home ownership decision. It has, however, no significant impact on the value of the house or the level of the mortgage on the house. The subjective interest rate is positively related to the decision to hold risky assets, but the significance level of this correlation is rather low.

Risk aversion is measured by a question on how important people think it is to invest in safe assets compared to aiming at a possibility of high returns. This way of measuring risk aversion implies that it may be endogenous to some housing and financial decisions, so that the explanation of our results can be unambiguous. For

example, the rate of risk aversion has no significant relation with the choice between owning and renting. This may be because two effects cancel: risk averse households tend to rent, but those who own will tend not to invest in more risky assets, so that their measured rate of risk aversion will be higher. The rate of risk aversion has the expected negative effect on the mortgage amount as a fraction of the value of the house, significant at the 10% level. It is positively related to the value of the house. As expected, the effect of risk aversion on the decision to invest in risky assets is negative and highly significant.

The measure of interest in financial matters has a strong and significant positive effect on home ownership. Conditional on home ownership, the same positive impact is found on the value of the house. Interest in financial matters makes it more likely for a household to own risky assets. In general we can conclude that the effects of the subjective variables in the model explaining ownership of risky assets are quite strong.

We conclude that the results are promising enough to stimulate further research in this direction. First, there are more subjective questions that could be used to measure the same concepts (such as the rate of time preference) or other concepts (such as expected income changes and income uncertainty). Second, more than one panel wave are now available, and could be used to increase the informational content of the data. Third, the ultimate goal is to include the type of information considered here in structural life cycle models.

Appendix 1: Some Details on the Data.

In this appendix, we discuss some explanatory variables included in some of the models and not discussed in the main text. Table 9 contains some definitions. Table 10 contain averages across the whole sample and across some subsamples. Some of the variables are not relevant for all subsamples.

Table 9: description of some variables

Variable	
Subintr	A subjective interest rate. 0 if the data indicate that it is less than or equal to 0.
Sincew	The year the household moved into their current house.
Mexp	Dummy; 1 if the household wanted to buy a more expensive house. ¹⁷
Valkn	Dummy; 1 if the value of the house is known. (Only defined for house owners.)
Bvalue	The price (in Dfl. 1000) the household payed when they bought their house.
Cvalue	Estimate of the current price (in Dfl. 1000) of the house. ¹⁸
Totmor	Total amount (in Dfl. 1000) of mortgage the household took at the time they bought their house.
Frac	Defined as Totmor/Bvalue
Yearend	The year the mortgage will end.
Work	Dummy; 1 if the head of the household has a job.
Workp	Dummy; 1 if the partner works.
Famsize	Family size.
Kids	Number of children in the household.
Edu1	Dummy; 1 if education level of the head of household is 1. The same for Edu2, ..., Edu5.
Inchh	Before tax income of the household (in Dfl. 1000).
Wealth	Current household wealth, excluding housing and mortgages (in Dfl 1000).
Married	Dummy; 1 if the head of the household is married.
Age	Age of the head of the household.
Finint	A measure of interest in financial affairs.
Riskaverse	A measure of risk-aversion.

¹⁷The exact question is: *-Would you have chosen to buy a more expensive house if you had been able to receive a larger mortgage loan on the basis of your income at that time?*

¹⁸The exact question is: *About how much do you expect to get for your residence, if you would sell it today (empty and not let)?*

Table 10: averages for some variables

	All households		House owners		Households with a mortgage	
N	REP(900)	HIP(700)	REP(685)	HIP(643)	REP(528)	HIP (576)
Sincew	1981	1984	1981	1984	1983	1985
Mexp	—	—	0.143	0.120	0.163	0.120
Valkn	—	—	0.949	0.986	0.968	0.991
Bvalue	—	—	144	247	149	253
Cvalue	—	—	235	350	233	355
Totmor	—	—	—	—	133	213
Frac	—	—	—	—	0.854	0.869
Yearend	—	—	—	—	2011	2010
Work	0.716	0.914	0.745	0.911	0.816	0.929
Workp	0.274	0.601	0.301	0.593	0.350	0.606
Famsize	2.464	3.011	2.537	3.061	2.650	3.076
Kids	0.679	1.011	0.720	1.058	0.811	1.068
Edu1	0.193	0.090	0.178	0.084	0.170	0.085
Edu2	0.146	0.011	0.139	0.009	0.140	0.009
Edu3	0.287	0.191	0.296	0.188	0.305	0.179
Edu4	0.262	0.369	0.276	0.372	0.271	0.378
Edu5	0.111	0.339	0.109	0.347	0.112	0.349
Inchh	55	109	58	111	57	110
Wealth	68	59	69	61	72	60
Married	0.784	0.947	0.819	0.950	0.847	0.958
Age	48.88	45.75	48.35	46.17	45.45	45.57

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