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The Role of Financial Literacy and Risk Aversion in the Mortgage Choice: the Netherlands.

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1. Abstract

In the Netherlands, how does risk aversion proxied by health factors and financial literacy proxied by pension attitudes affect the choice of mortgage type? To investigate this question 29 years of annual DNB Household Survey data gathered by Centerdata was used, spanning 1993 up until 2022. It was found that risk aversion proxied by health factors is associated with a higher likelihood of choosing a deferred mortgage type, while financial literacy proxied by pension factors is associated with a higher likelihood of choosing a traditional mortgage type. These results are both unexpected and contradictory, meaning that further research on this topic could help solidify these interesting findings, as limitations faced by this study call for discretion when interpreting these results.

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1. Introduction

Of all EU member states, the Netherlands has the highest total mortgage debt held by the population at 765 billion euros recorded in 2021. Two-thirds of Dutch households have a mortgage, and compared to other EU countries Dutch households are able to take out large debts even with a relatively small income and property value. Due to this, Dutch households run a larger risk of delinquency on their mortgage payments as well as accumulating residual debt when property values decline. A high national mortgage debt is also undesirable in economics terms as it can increase the volatility of prices on the housing market, which is an effect that can also be seen in the Dutch economy (DNB, n.d.). Therefore, it is highly important for the Dutch population as well as policymakers to have a good grip on the types of mortgages that exist as well as the drivers for potentially uninformed mortgage decisions. In this research the drivers of mortgage choice of homeowners in the Netherlands will be investigated. Specifically, the role of risk aversion and financial literacy in the choice of mortgage type is taken into account.

The mortgage choice is made when a property is bought and entails the financing of this purchase. Within mortgage types distinction is made when it comes to the pay off period, the principal amount and the interest rate as well as the timing of repayments. Higher-risk mortgage types involve higher interest payments near the end of the repayment period as well as interest-only constructions where repayment is done in the form of a lump-sum payment at the end of the mortgage term, while lower-risk mortgage types contain a more stable repayment pattern throughout the period with a regular principal payment scheme. Risk aversion encompasses the attitude individuals have towards risk and manifests in a person's propensity to take risk in all aspects of life, whereas financial literacy denotes a level of financial knowledge. The effects that risk aversion and financial literacy have on mortgage choice will be investigated on a household level within the Netherlands through the use of annual survey data.

The social relevance of this research stems from Dutch households potentially defaulting on their mortgage due to an uninformed mortgage choice. It is therefore relevant to policy makers to be aware of the drivers of such uninformed mortgage decisions. Moreover, scientific research on the effect of risk aversion and financial literacy on mortgage choice is lacking compared to their effect on stock investment decisions and could thus benefit from additional research.

This paper will use the same empirical setup and data sources as Cox et al. (2015). In their paper entitled "Financial Literacy, Risk Aversion and Choice of Mortgage type by Households", it is found

that households with higher financial literacy and lower risk aversion are 55% to 97% more likely to choose interest-only mortgages. Additionally they find that in general alternative mortgage types are more likely to be chosen by more sophisticated households with greater wealth and financial knowledge as opposed to traditional mortgage types.

In this thesis the abovementioned research will be replicated using alternative proxies to measure risk aversion and financial literacy. In the study conducted by Cox et al. risk aversion is proxied by self-reported behaviors of respondents, as they are asked to evaluate six statements that relate to the level of risk they are willing to take on in their investments. A drawback in using this type of proxy is the self-reported, and therefore subjective, nature of the responses. Therefore, health factors relating to smoking and drinking behavior and reported health-status and life expectancy will be used to proxy risk aversion. It is the expectation that such health indicators can signify respondent's engagement in risky behavior and are thus inherently unbiased, making for effective measures of risk aversion. As for financial literacy, established proxies in literature include level of education, investment activity and IQ to name a few. Instead, to proxy financial literacy the respondent's knowledge regarding their own pension structure will be applied. It is the expectation that respondent's comprehension of their own future pension plans can indicate their financial literacy level, as arranging pension plans requires an understanding of long-term financial concepts and consequences. Lastly, the independent variable that will measure the mortgage choice will be defined in the same way as done by Cox et al, namely a dummy variable denoting three overarching mortgage type groups: traditional amortizing mortgages, deferred amortizing mortgages and interest-only mortgages. To summarize, the research question is: In the Netherlands, how does risk aversion proxied by health factors, financial literacy proxied by pension attitudes and income volatility affect the choice of mortgage type?

To investigate this research question, survey data from the De Nederlandsche Bank (DNB) Household Survey will be used. This survey is administered to 2000 Dutch households from 1993 onwards by Centerdata, Tilburg University. Within the survey the same set of questions is used every year and the survey contains a wide variety of questions related to financial, health and psychological topics as well as general information on every household containing data on household makeup, gender, number of kids etc. To study the dataset a multinomial logistic regression model will be used. Several iterations of the regression formula will be brought forward, each including different parts of the full model, as well as the full model. Control variables for age, education level and gender will be introduced to minimize any omitted variable bias present in the sample.

It is expected that higher levels of risk aversion will on average increase the likelihood that households choose lower-risk mortgages, such as traditional- and deferred amortizing mortgages, as opposed to higher-risk interest-only mortgage types. Furthermore it is expected that higher levels of financial literacy will increase the likelihood of households choosing more sophisticated alternative mortgage products that take advantage of a tax-benefit, such as the deferred amortizing mortgage type.

2. Theoretical Framework

2.1 Mortgage Choice

To understand what the concept mortgage choice entails exactly a brief discussion on this financial instrument will be given first. The definition given by the Cambridge Dictionary states that a mortgage is “an agreement that allows you to borrow money from a bank or similar organization, especially in order to buy a house, or the amount of money itself” (Cambridge University Press & Assessment, 2023). According to the US Consumer Financial Protection Bureau: “A mortgage is an agreement between you and a lender that gives the lender the right to take your property if you fail to repay the money you’ve borrowed plus interest.” (Consumer Financial Protection Bureau, 2022). Joao F. Cocco (2013) states that a mortgage contract is used to finance the purchase of a house. Finally, the Dutch Rabobank defines it as a loan to buy a house with (Rabobank, n.d.). Generally, it can be inferred from the above definitions that a mortgage is a financial instrument that can be borrowed from a financial institution to finance the purchase of a home. Since this research is conducted in the Netherlands, it is relevant to understand the Dutch mortgage system in particular as mortgage systems vary widely between countries (Green, 2013). In the Netherlands there are several mortgage types that can be chosen from. Availability of specific mortgage types changes with legislation, but a few main elements remain relevant throughout time. Firstly, mortgages consist of repayment of the principal amount, which are amortization payments, and repayment of interest, which are the interest payments. The amount that can be borrowed by an individual depends on their annual income and is at most the value of the home to be bought. The maximum maturity term of Dutch mortgages is 30 years, which simultaneously is the standard repayment term. The home to be bought serves as collateral for the mortgage taken out. Secondly, in the Netherlands interest payments are fully tax-deductible whereas amortization payments are not (Belastingdienst, 2023). It is therefore favorable for deduction of the principal with amortization payments to be minimized, leaving a larger interest payment to be tax-deducted. Keeping this in mind, mortgages can be

categorized in two categories: those that take advantage of this tax benefit and those that do not. Mortgages that take advantage of this construct are mortgages that have deferred amortization and interest-only mortgages. Mortgages that do not take advantage of this construct are traditional amortizing mortgages such as regular linear- and annuity mortgages (Cocco, 2013). Linear- and annuity mortgages are also the two most frequently chosen mortgage types (NIBUD, 2023). Another important distinction within the mortgage market is the difference between adjustable-rate mortgages (ARMs) and fixed-rate mortgages (FRMs). The ARM has a non-fixed interest rate that is continuously adjusted, whereas the FRM has a fix pre-determined rate to be paid over a specified time (Coulibaly & Li, 2009).

2.2 Risk Aversion

Risk aversion theory knows many definitions, descriptions, and interpretations. Werner in his 2008 paper defines risk aversion as “An agent, perhaps an individual or firm, is said to be risk averse if the agent prefers a deterministic outcome equal to the expectation of a risky outcome over that risky outcome.” (Werner, 2008, p. 11728). The definition of absolute risk aversion is put forward by Pratt (1964) in the form of a function given by $A(x) = -\frac{u''(x)}{u'(x)}$, which is the second derivative of the utility function divided by its first derivative. Relative risk aversion, on the other hand, is defined using the function $A(x) = -x \frac{u''(x)}{u'(x)}$ (Arrow, 1965). In both functions, x denotes a person’s total wealth, and $u(x)$ denotes the utility function of this person’s wealth. Under the assumption that more wealth is preferred to less wealth, the risk aversion function is always positive, and greater values of $A(x)$ imply greater levels of risk aversion in individuals. Therefore, Arrow and Pratt’s definitions of risk aversion both suggest that risk aversion is the magnitude of change of an individual’s perceived utility as a reaction to changes in said individual’s wealth, corroborating Werner’s definition given above. Rabin and Thaler (2001) react to the Arrow-Pratt theorem, stating that the model set forward by Arrow and Pratt creates unrealistically severe risk aversion in the presence of very high stakes. They argue that missing from the model are loss aversion and mental accounting. Mental accounting entails the notion that individuals tend to keep track and evaluate their financial transactions. According to Rabin and Thaler this indicates that individuals do not assess a risk in isolation but rather but it in the context of their previous and expected transactions. Furthermore, loss aversion is an idea proposed by Kahneman and Tversky (1979) and implies that generally “losses loom larger than gains” (p. 279). This means that individuals react more positively risk averse to losses than they will react negatively risk averse to the same gain. Apparently, a model

of risk aversion that takes note of both mental accounting and loss aversion as well is a more complete description of risk aversion.

The concept of risk aversion can be dated back to the introduction of the St. Petersburg paradox by Daniel Bernoulli in 1713. The St. Petersburg game involves a participant flipping a fair coin until heads comes up for the first time, after which the participant earns $\$2^n$, where n is the number of times the coin has been flipped. The question is how much a participant should be willing to pay to play this game. Using expected outcome theory, one assumes that the best-case scenario is reached when the expected outcome is maximized. In a game where a fair coin is flipped, this is a fairly simple derivation and it is found that the maximized expected outcome is ∞ , making the amount a participant should be willing to pay for participation an infinite amount of money. However, any rational agent would not be willing to pay infinite amounts of money to play this game, giving rise to the St. Petersburg paradox and ultimately the concept of risk aversion (Martin, 2017). After the conceptualization of risk aversion by Bernoulli, the expected utility function that described lotteries was first introduced by von Neumann and Morgenstern (1944). Here they define a lottery as a set of possible situations, their associated probability of occurrence and payoff. Their proposed expected utility function in turn defines an individual's preferences over different lotteries according to 5 preference axioms: completeness, transitivity, continuity, monotonicity and substitution. These 5 axioms define how a rational agent should order their preferences.

Since its introduction many different methods have been utilized to quantify risk aversion. Both Arrow and Pratt use the slope of the utility function to quantify risk aversion. Rabin and Thaler use surveys and hypothetical settings to gather data on risk-averse behavior. Additionally, research has been done on risk aversion using data on behavior in auctions (Lu & Perrigne, 2008), on game shows (Post et al., 2008), portfolio choice behavior (Guiso & Paiella, 2008) and more. The concept of risk aversion has thus been explored in a myriad of ways in literature and many different measures of it exist. A paper by Zhang et al. (2014) explores the origin of risk aversion, asking the question whether humans have some biological predisposition to exhibit risk averse behavior. They link evolution to economic theory and suggest that risk averse behavior, not only in humans but in other species as well, has been able to further their survival. Hence, it seems that risk aversion is a quality innate to humans and might explain some of its success as a species.

2.3 The Relationship between Risk Aversion and Mortgage Choice

As explained above, any choice containing an element of risk will be affected by the level of risk aversion of the individual making the choice. It is therefore plausible that risk aversion might have an effect on the type of mortgage chosen, seeing as a plethora of mortgages are available to choose from. Previous research indeed indicates that risk aversion affects mortgage choice. Importantly, literature tends to focus on the amortization schedule chosen by the borrower. Cocco and Campbell (2003) investigate the ARM versus FRM choice. They explain that both types of mortgages entail different risks and thus are preferred or rejected due to risk attitudes related to different factors. The risk associated with the FRM contract is one tied to inflation rates. Depending on whether inflation rises or falls, the borrower might face potential gains or losses as a consequence of the difference between the agreed upon fixed rate and existing inflation rate. The negative side of this risk can be mitigated through prepayments to lower the principal amount prematurely in the face of falling inflation rates, assuming the borrower has the financial flexibility to obtain funds for such a lump sum payment on short notice. However, such prepayments are associated with extra costs as well in the form of a higher fixed rate or a prepayment penalty. The risk associated with ARMs is based on the month-to-month variability of interest repayments and thus is shorter-term in nature, however, protects the borrower from inflation associated risk. Cocco and Campbell conclude that FRMs impose a wealth-risk, while ARMs impose an income-risk. Coulibaly and Li (2009) conduct a survey-based study on mortgage choice and find that risk attitudes largely impact mortgage choice, where more risk-averse households tend to opt for fixed-rate mortgages. They also find that less risk-averse households tend to be less concerned with affordability factors of the mortgage than their more risk-averse peers, and they are inclined to take less heed of income volatility factors.

Combining the findings of the above studies makes for an interesting argument about risk aversion and mortgage choice. Apparently, FRMs are regarded as safer options than ARMs and thus more risk-averse households opt to take out FRMs. However we also know that FRMs contain a real capital value risk due to changing inflation rates; although monthly payments remain equal the value of these payments still varies as much as the inflation rate does. It therefore seems that this risk-averse attitude might manifest itself in choosing the option that *seems* the safest, but in fact brings about a similar level of risk as the ARM, albeit a different *type* of risk. ARMs bear risk in that they have fluctuating monthly interest repayments. The rate is continuously adjusted and the adjustment made depends on inflation rates as well. It thus seems that both FRMs and ARMs bear risk originating in inflation rates but reveal this risk in two distinct forms. Due to these findings, it is expected that risk aversion has an effect on mortgage choice through the variable for financial

literacy. It is plausible that risk attitudes are inherent to individuals, and financial knowledge dictates how these risk attitudes present themselves, as it might be the case that individuals genuinely think they are making a less risky choice but are in fact not financially knowledgeable enough to identify a less obvious financial risk. More generally, it is expected that risk-aversion will have an effect on mortgage choice, specifically in regard to the amortization structure of the mortgage as this tends to be the aspect of a mortgage that bears the most risk. It is expected that higher risk-aversion leads to a preference for traditional amortizing contracts while lower risk-aversion leads to a preference for interest-only contracts. As for deferred-interest mortgages the effect is less clear, as higher risk aversion might lead to choosing such a contract if short-term income is highly variable, while lower risk aversion might also lead to choosing this contract as deferred payments will make for rapidly increasing repayments in the future. Cox et al. find that household showing lower risk aversion tend to choose interest-only mortgages, meaning that the expectation is in line with the study to be replicated.

2.4 Financial Literacy

According to the President's Advisory Council on Financial Literacy (PACFL), financial literacy, is defined as "the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being." (PACFL, 2008). Hung et al. (2009) explain that the various definitions used in literature stray away from the definition given by the PACFL. They give five popular alternative definitions often used in literature, namely financial literacy as a form of specific knowledge, a form of perceived knowledge, an ability to apply this knowledge, good financial behavior, or financial experiences. Definitions range from being rather succinct, like the one given by Hilgert et al. (2003) who define financial literacy as "financial knowledge" (p. 311), to quite elaborate, such as one stating that "Individuals are considered financially literate if they are competent and can demonstrate they have used knowledge they have learned. Financial literacy cannot be measured directly so proxies must be used. Literacy is obtained through practical experience and active integration of knowledge. As people become more literate they become increasingly more financially sophisticated and it is conjectured that this may also mean that an individual may be more competent" (Moore, 2003, p. 29). Definitions generally converge in their mentioning of a certain level of financial command by an individual but seem to diverge in the bounds of this level of financial command.

To explore the origins of the concept of financial literacy it is necessary to consider the evolution of financial education, seeing as the former cannot be established without the latter. Formal education

on finances for the general public was first developed in the twentieth century, albeit in the form of home economics, household finances and family finances (Rose et al., 2023). One of the earliest works done on household and consumer economics was a paper written by Hazel Kyrk in 1923 entitled “A Theory of Consumption”. In this paper, Kyrk aims to humanize the rational agent often referred to in earlier works on choice theory. Kyrk provides context of home economics and social pressures, with which she paved the way to a deeper understanding of family economics. Early research on the effect of financial education includes a study conducted by Hansan (1985) investigating the effectiveness of economic education in adolescents. Hansan found that economic education starting in kindergarten- and primary-grades has a positive effect on financial literacy later on. A paper by Varcoe and Wright (1991) examines how financial education changes behavior. They found that financial education had favorable effects on spending and money management behavior of participants. By the definitions of financial literacy given above it can be inferred that this positive change in financial behavior can be deemed part of financial literacy. Driven by the growing interest in economic education for the public, research on the effects of such education, namely the level of financial literacy, started to gain traction as well with many papers written on the subject being published in the 90s. A few important examples include “An Analysis of Personal Financial Literacy among College Students” by Chen and Volpe (1998) and “Reading Financial Services: Texts, Consumers, and Financial Literacy” by Leyshon et al. (1998). Chen and Volpe conduct survey-based research to gauge the level of financial literacy among college students, finding that women, non-business majors and those under 30 with limited working experience are less financially knowledgeable and more prone to making wrong financial decisions. Leyshon et al. focus on the problem of information asymmetry in the market, and how more financially literate individuals might navigate such a market better than their less financially literate peers.

2.5 The Relationship between Financial Literacy and Mortgage Choice.

From the findings presented above it can be deduced that financial literacy might have an effect on individual’s behavior within the financial realm. We have also gathered that mortgages are complicated financial instruments whose features can have far-reaching effects on a person’s lifetime finances. It is thus conceivable that the extent of a person’s financial knowledge might affect to what extent they are able to compare different mortgage products and consequently influence what mortgage they ultimately choose. Exponential growth bias could lead to individuals being unable to correctly discount future cash flows. In relation to loans, they assess that individuals tend to underestimate interest rates and future values. Apparently, individuals tend to focus on the parts

of the loan contract they can easily understand and do not consider properly the full complexity of such contracts (Stango & Zinman, 2009). Furthermore, 32 percent of borrowers who would be considered as high-risk borrowers by lenders rate themselves as medium- to low-risk borrowers (Perry, 2008). In their paper Zahirovic-Herbert et al. (2016) investigate risky mortgages and mortgage defaults using survey data of more than 28,000 Americans during 2009. They find that financial illiteracy leads to borrowers choosing riskier mortgage types as well as a higher likelihood of delinquent mortgage payments. They define risky mortgages as adjustable-rate mortgages (ARMs) due to their fluctuating interest payment scheme. Additionally, research using survey data concludes that most borrowers with adjustable-rate mortgages often either underestimate or do not comprehend at all how much their interest rate could fluctuate (Bucks & Pence, 2008). Consolidating the above findings makes for a worrying picture; those less financially literate tend to choose riskier mortgages that they cannot understand fully whilst overestimating their creditworthiness, to consequently lag behind on interest payments causing them financial troubles. Keeping this in mind, it is expected that financial literacy will have an effect on household's mortgage choice. It is expected that those less financially literate will more often opt for the interest only mortgage, while more financially literate households will choose either the traditional amortizing contract or the deferred amortization contract which takes advantage of a tax benefit. This is in line with the findings by Cox et al. as they found that less financially literate households tend to choose interest-only mortgages more often than their more financially literate counterparts.

3. Data

In replicating the study done by Cox et al., the same database will be used, namely the annual DNB Household Survey (DHS). Every year 2000 households participate in this survey answering questions about their financial situation, health factors, psychological indicators and general information on the household makeup. In this paper, yearly survey data will be used from 1993 up until 2022, expanding the timeframe used by Cox et al. by 13 years' worth of data. The survey is held online and participant can personally answer the questions from their home computers. Every member of the household that is over the age of 16 fills out the survey. In a similar fashion to Cox. et al, to get data on a household level the responses of the household head will be considered. The household head is the person in the household with the highest share in total household income. Cox et al. justify this intervention with the argument that this household member likely has the most influence on financial decision making within the household. Considering that the mortgage choice is to be

investigated this seems to be a reasonable expectation and thus this construction will be used in this research as well.

3.1 Mortgage Choice Data

The dependent variable **Mortgage Choice** is measured identically to how it is measured in the study done by Cox et al. **Mortgage Choice** is grouped in to three categories: traditional amortizing mortgages, deferred amortizing mortgages and interest-only mortgages.

In table 3.1.1 below it can be seen how the different mortgages are grouped, where the number next to the mortgage type denotes the numbered response alternatives the respondents choose from when answering this question. When referring to the different mortgages the corresponding number will be used to keep this discussion concise. Appendix A includes a discussion on translation problems in grouping these mortgages as well as how the grouping used in this study differs from the grouping used by Cox. et al.

Traditional Amortizing Mortgage	Deferred Amortizing Mortgage	Interest-Only Mortgage
Annuity Mortgage (1)	Savings and Life Mortgage (3)	Interest-Only Mortgage (7)
Linear Mortgage (4)	Traditional Life Insurance Mortgage (2)	Home Equity Loan (5)
	Investment Mortgage (6)	Interest-only with term life insurance (9)
	Bank Savings Mortgage (10)	
	Annuity Construction Mortgage (8)	

Table 3.1.1: Summary of mortgage grouping.

As done by Cox et al. in their study, only **Mortgage Choice** observations for which the mortgage was taken out in the year of the survey will be considered. This is to counteract any possible endogeneity that could arise from learning effects. Learning effects could develop due to respondents learning from their past mortgage choice and therefore their self-assessed financial literacy might be influenced. Furthermore, it is useful to investigate a respondent's disposition with respect to their risk aversion at the moment of the mortgage choice as opposed to at a different time. Again, a learning effect could influence respondent's future risk aversion. With these restrictions in place we are left with N = 628 observations.

Mortgage Group	Frequency	Percent	Cumulative
Traditional Amortizing Mortgage	142	22.77 %	22.77%
Deferred Amortizing Mortgage	308	49.04%	71.82%
Interest-Only Mortgage	177	28.18%	100%
Total	628	100%	

Table 3.1.2: Mortgage Group summary statistics.

From table 3.1.2 it can be seen that the majority of respondents has a deferred amortizing mortgage at 49.04%, whereas the traditional amortizing mortgage seems to be the least popular at 22.77%.

3.2 Risk Aversion Data

The independent variable **Risk Aversion** is measured differently to how Cox. et al measure it in their study. Whereas Cox. et al use the respondent's answers to the survey's hypothetical scenarios regarding taking financial risk, in this study health factors will be used. We will use data on the respondent's smoking and drinking behavior, as well as the respondent's self-assessed health and life expectancy. To measure the **Risk Aversion** variable 5 survey questions from the DHS will be used, the questions and their answer options are included in Appendix B.

Reasoning for using health factors as risk aversion indicators rather than participant's responses to hypothetical scenarios lies in the unreliable nature of risk-averse responses in laboratory setting. Kahneman and Tversky raise the issue of low stakes and repetitiveness of 'laboratory gambling'. They suggest that presenting participants with hypotheticals is more effective as 'people often know how they would behave in actual situations of choice' and that 'the subjects have no special reason to disguise their true preferences' (Kahneman & Tversky, 1979). Holt and Laury put this assumption into question by conducting an experiment to measure risk aversion, comparing results of the same gambles with hypothetical and real payoffs. They find that when real payoffs are involved participant's risk aversion increases sharply when being presented with the same gambles (Holt & Laury, 2002). Hence there is empirical evidence to suggest that risk aversion measured by hypothetical statements does not deliver results applicable to real-world outcomes. In using respondent's health factors such as smoking or drinking behavior these concerns are circumvented, as this presents real-life evidence of risky behavior that is not prone to bias.

To measure **Risk Aversion** four different proxies in the form of survey questions are used. A quick overview will be provided below and the full summary statistics table will be included in Appendix B. **Risk Aversion 1** denotes the survey question "In general would you say your health is": "Excellent" (N=110, 23%), "Good" (N=302, 62%), "Fair" (N=62, 13%), "Not so good" (N=12, 2%), "Poor" (N=1,

0%). **Risk Aversion 2** denotes the survey question “Do you smoke cigarettes at all?”: “Yes, I smoke every now and then” (N=35, 7%), “Yes, I smoke everyday” (N=100, 21%), “No” (N=352, 73%). **Risk Aversion 3** denotes the survey question “On average do you have more than 4 alcoholic drinks per day?”: “Yes” (N=43, 9%), “No” (N=444, 91%).

As for **Risk Aversion 4** (*total_probability*) this variable is calculated by adding up the different probabilities a respondent has given for reaching a certain age. Since each respondent gives two probabilities; one for living for 10 more years and another for living for 20 more years, the maximum value of this variable is 20 (N=304, Mean=12.760).

From tables 9.B.1 – 9.B.4 it can be seen that 85% of respondents think they are in good or excellent health, while 28% identify as smokers and 9% consumes more than 4 alcoholic drinks a day. Furthermore, respondents on average believe they have a positive probability to live for 20 more years across all age groups.

3.3 Financial Literacy Data

Lastly, whereas Cox. et al make use of respondent’s self-assessed financial literacy as well as their level of financial activity, in this study the independent variable **Financial Literacy** will be measured by means of the survey’s pension structure questions. Appendix C includes the exact question phrasing as included in the DHS as well as the corresponding answers the respondents can choose. A paper by Xia et al. studies the relation between stock market participation and financial literacy overconfidence using data from the 2012 Chinese Survey of Consumer Finance. Their results show that financial literacy overconfidence is positively correlated with stock market participation, meaning that stock market participation might not be an accurate measure of financial literacy (Xia et al., 2014). As for self-assessed financial literacy, Porto & Xiao find that 11% of their representative national survey respondents display financial literacy overconfidence, meaning that 89% of respondents were able to accurately indicate their financial literacy level (Porto & Xiao, 2022). This empirical evidence shows that self-assessed financial literacy is a good indicator of actual financial literacy and thus this measure will also be included in this study.

Since pension arrangements require an individual to possess long term financial planning abilities it is plausible that the extent to which someone has planned out their pension could indicate their financial literacy level. Not only the respondent’s pension plans are surveyed, but also their perspective on how much importance they tie to their future pension arrangements as well as the extent to which they understand their own pension. The respondent’s involvement in their own

pension arrangements could also indicate a level of financial literacy, as individuals that thoroughly understand the long-term financial benefits of a well-structured pension plan might have made more extensive plans, indicate that they find those plans important and might have a high-level understanding of their own pension plans.

To measure **Financial Literacy** six different proxies in the form of survey questions are used. A quick overview will be provided below and the full summary statistics table will be included in Appendix C. **Financial Literacy 1** is denoted by the survey question “How knowledgeable do you consider yourself w.r.t. financial matters?”: “Not knowledgeable” (N=44, 13%), “More or less knowledgeable” (N=199, 57%), “Knowledgeable” (N=92, 26%), “Very knowledgeable” (N=17, 5%). **Financial Literacy 2** is denoted by the survey question “Do you feel adequately informed about your (future) pension arrangements?”: “Well informed” (N=29, 16%), “More than adequately informed” (N=43, 24%), “Adequately informed” (N=59, 33%), “Moderately informed” (N=33, 18%), “Not well informed”, (N=8, 4%), “Feel no need to be informed, we’ll see by then” (N=8, 4%). **Financial Literacy 3** is denoted by the survey question “How is your pension built up?”: “Don’t know” (N=43, 26%), “Based on final pay” (N=27, 17%), “Based on average pay” (N= 65, 40%), “Available premium” (N=25, 15%), “Otherwise” (N=3, 2%). **Financial Literacy 4** is denoted by the survey question “Have you made alternative pension arrangements?”: “Yes” (N=47, 29%), “No” (N=114, 71%). **Financial Literacy 5** is denoted by the survey question “Which statement applies to you the most?”: “I keep well informed about any developments regarding my pension” (N=21, 15%), “It is important to know that my pension is taken care of, without knowing the details” (N=75, 52%), “I do not worry about my pension arrangements, we’ll see by then” (N=43, 30%), “I don’t know” (N=4, 3%). **Financial Literacy 6** is denoted by the survey question “Is your (future) retirement pension indexed to inflation?”: “Yes” (N=131, 53%), “No” (N=28, 11%), “I don’t know” (N=90, 36%).

From tables 9.C.1 – 9.C.6 it can be seen that 69% of respondents would not say that they are knowledgeable on financial topics, with 30% stating they do not worry about their pension arrangements as they believe it is a proem of the future. Notably, 26% of respondents claim not to know how their pension is built up.

4. Methodology

To analyze the data described above a multinomial logistical regression approach will be applied. The multinomial logistical regression method can be used in case of a categorical dependent variable which contains three or more non-ordered categories. The model is the estimated using maximum likelihood as opposed to minimizing the sum of squared errors in an ordinary least squares regression. To appropriately apply the multinomial logistical model, the data to be used has to conform to six key assumptions, the first two stating that the dependent variable be a nominal variable and that the independent variables be continuous, ordinal or nominal variables. Our dependent variable **Mortgage Choice** is a nominal variable seeing as it is composed of three unordered categories of mortgages, and our independent variables for **Risk Aversion** and **Financial Literacy** made up of ordinal variables as well. The third assumption states independence of observations, meaning that each respondent is only counted once in the data. This is true in our case since only the head of each household is considered, as well as only the first mortgage taken out by a household is considered. Fourthly there should be no multicollinearity present in the independent variables, which will be circumvented in our data set by grouping our **Risk Aversion** and **Financial Literacy** proxies into overarching scoring variables, which is explained in more detail below. Assumption 5 states that there should be a linear relationship between any continuous independent variable and the logit transformation of the dependent variable, however no continuous independent variable is included in the model so this assumption can be disregarded. Lastly, assumption 6 states that there should be no outliers present which is controlled for by analyzing summary statistics for each included variable. As for the output of a multinomial logistical regression, the beta estimators do not denote an absolute change in the dependent variable, but rather a relative change in likelihood. This means that a beta estimator denotes the change in likelihood of a respondent's preference of the category in question over all other categories. In our case, the formulated betas will denote for each explanatory variable whether a change in the explanatory variable will make the respondent more likely to favor a different mortgage type.

Since four proxies measure **the Risk Aversion** variable and six proxies measure the **Financial Literacy** variable these proxies will be grouped into two overarching proxies for **Risk Aversion (Risk Aversion Score and Health Score)** and one overarching proxy for **Financial Literacy (Financial Literacy Score)**. **Risk Aversion** will be grouped into a **Health Score** and **Risk Aversion Score**, where the **Health Score** gives a score based on an individual's self-perceived health status and the **Risk Aversion Score** will give a score based on an individual's risky behavior. **Financial Literacy** is grouped into a singular **Financial Literacy Score** based on an individual's reported financial knowledge. The exact calculation

of the scores per explanatory variable will be included in the appendix. Grouping the proxies together in this way limits the number of variables included in the model which can reduce the likelihood of overfitting as well as multicollinearity.

The full model used to study the effects of **Financial Literacy** and **Risk Aversion** on **Mortgage Choice** will be as follows:

$$\begin{aligned}
 MortgageChoice_i &= \beta_0 + \beta_1 RiskAversionScore + \beta_3 HealthScore + \beta_4 FinancialLiteracyScore \\
 &+ \beta_5 \mathbf{Controlvariables} + \varepsilon_i
 \end{aligned}$$

In addition to the full model, several partial iterations of the model will be included such that the effect of adding variables can be seen. A partial model only including the **Risk Aversion Score** variable will be included as well as a partial model only including the **Financial Literacy Score** variable. Furthermore, a full model with and without the control variables will be included. The summary statistics of the three grouping variables are included in the table below.

Variable	Obs	Mean	Std. dev.	Min.	Max.
Health Score	304	16.770	4.281	1	25
Risk Aversion Score	487	3.341	1.030	0	4
Financial Literacy Score	114	6.272	2.366	1	13

Table 4.1: Grouping variables summary statistics.

5. Results

Four different iterations of the model are included in table 5.1 below.

	Model 1	Model 2	Model 3	Model 4
Mortgage Group 1: Traditional Amortizing				
<i>baseline</i>				
Mortgage Group 2: Deferred Amortizing				
Health_Score	0.0020 (0.33)		-0.0349 (-0.55)	-0.0120 (-0.16)
RiskAversion_Score	-0.1714 (0.15)		0.857* (2.02)	0.971* (2.34)
FinancialLiteracy_Score		-0.130 (-1.30)	-0.185 (-1.72)	-0.339* (-2.54)
Female				-1.275 (-1.77)
Pre-university education (HAVO/VWO)				-13.65*** (-10.28)
Senior vocational training (MBO)				-1.709 (-1.31)
Vocational college (HBO)				-0.682 (-0.62)
University education (WO)				0.380 (0.30)
Age				0.0782* (2.22)
Constant	0 (.)	-0.163 (-0.26)	-2.426 (-1.41)	-5.403* (-2.02)
Mortgage Group 3: Interest-only				
Health_Score	0.0020 (0.36)		0.00455 (0.08)	0.0410 (0.65)
RiskAversion_Score	-0.0413 (0.165)		0.137 (0.49)	0.191 (0.63)
FinancialLiteracy_Score		0.115 (1.22)	0.109 (1.16)	-0.0963 (-0.81)
Female				-0.445 (-0.80)
Pre-university education (HAVO/VWO)				-1.216 (-0.79)
Senior vocational training (MBO)				-0.801 (-0.87)
Vocational college (HBO)				-0.962 (-1.07)
University education (WO)				-0.180 (-0.18)
Age				0.117*** (4.51)
Constant	-0.0509 (-0.07)	-0.869 (-1.34)	-1.456 (-1.20)	-6.529*** (-3.68)
Observations	304	114	110	109
Pseudo R²	0.0056	0.0187	0.0409	0.2171

Table 5.1: Regression Results. Model 1 and 2 separately include effects of Risk Aversion and Financial Literacy, Model 3 includes both and Model 4 includes both plus control variables. For all models Mortgage Group 1 is taken as the base case. *t* statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5.1 includes the regression results of the four different models. For all four models Mortgage Group 1 is taken as the base case, thus the results are to be interpreted relative to Mortgage Group 1.

Seeing as a multinomial logistics model is used only a pseudo- R^2 is given. As opposed to the normal R^2 , the pseudo- R^2 cannot be used to measure the explanatory power of a model as a percentage but rather only holds value when compared to different pseudo- R^2 values of models using the same data and measuring the same effect. Keeping this in mind it is clear from table 5.1 that Model 4 holds the highest explanatory power; its independent variables best explain any variation in the dependent variable, namely mortgage choice. Model 4 includes the scores for Risk Aversion and Financial Literacy and includes all control variables Age, Gender and Education.

Results from the regression should be interpreted as follows: the estimated coefficients in the table represent the expected change in log odds when varying x . To arrive at an interpretable probability the estimator should be taken as an exponent of e which is known as the odds ratio. Since we are dealing with a multinomial logit model, all odds ratios represent probabilities relative to the base case, which is Mortgage Group 1 (traditional amortizing mortgages). To illustrate: let's say the estimator for 'Female' gives $e^\beta = 2$ for Mortgage Group 2, then that could be interpreted as: women on average are twice as likely as men to choose a deferred mortgage type over a traditional mortgage type. Note that this example does not correspond to the actual output of Table 5.1.

From Table 5.1 it can be seen that only models 3 and 4 include significant results at the 5%, 1% and 0.1% level. Firstly, Model 3 shows a significant value of 0.857 for **Risk Aversion Score**. Since $e^{0.857} \approx 2.356$, it can be said that on average a one-point increase in one's **Risk Aversion Score** increases one's likelihood to choose a deferred amortizing mortgage type over a traditional mortgage type by 136% at the 5% significance level without accounting for controls. When accounting for controls in Model 4, this likelihood increases to 2.641, giving on average a 164% increase in probability of choosing mortgage type 2 over mortgage type 1 at the 5% significance level. Seeing as the pseudo R^2 is higher for Model 4 than Model 3, the result of the **Risk Aversion Score** variable of Model 4 will be taken into account.

Furthermore, as for **Financial Literacy Score** it can be seen from table 5.1 that this variable has a significant coefficient in Model 4 at -0.339. Seeing as $e^{-0.339} \approx 0.712$ it can be said that on average a one-point increase in one's **Financial Literacy Score** results in a 29% decrease in likelihood of choosing a deferred amortizing mortgage type over a traditional amortizing mortgage type.

As for the control variables it can be seen that a one-year increase in **Age** is a significant determinant in **Mortgage Choice** with an 8% increase in likelihood of choosing a deferred amortizing mortgage and a 12% increase in likelihood of choosing an interest-only mortgage over a traditional amortizing mortgage, at the 5% and 0.1% significance levels respectively. Lastly, it seems that **Pre-university education** is a significant determinant in **Mortgage Choice**, however the magnitude of this effect rounded to 3 decimal points is null and thus not relevant for interpretation.

From the summary of regression results given above it can be seen that the expectations of this research have not been met and in one instance even contradicted. The first expectation of this research was that higher levels of risk aversion would translate into a higher likelihood of choosing a traditional or deferred amortizing mortgage over an interest-only mortgage. However, from table 5.1 no significant results are present for the interest-only mortgage type, meaning that statistically there is no effect of risk aversion when it comes to individuals choosing between a traditional mortgage type and an interest-only mortgage type. The results do show an effect when it comes to deferred mortgage types, however deferred mortgage types are not generally considered safer or riskier than traditional mortgage types and thus this effect does not corroborate our expectation either. Secondly, it seems that the second expectation was contradicted by the regression results, seeing as a negative effect was found for increasing financial literacy levels on the probability of choosing a deferred mortgage type over a traditional mortgage type. If our expectation were to be corroborated, a positive effect should have been found here.

6. Discussion

The findings presented above are not in line with previous research on the topic. When it comes to Risk Aversion, previous research has shown that indeed risk attitudes can have significant effects on Mortgage Choice. Cocco and Campbell (2003) and Coulibaly and Li (2009) in their research show that risk aversion leads to households choosing a mortgage that diminishes income-volatility risk. The results presented above show no such relationship between risk aversion and mortgage choice. Although an effect is found for deferred amortizing mortgages, these mortgages do not bear a different month-to-month income volatility risk than traditional amortizing mortgages as the amount to be paid per month is the same for both mortgage types. The only real difference between these mortgage types is the prepayment schedule; a deferred amortizing mortgage makes a lump sum payment at the end of its term while the traditional amortizing mortgage makes continuous monthly prepayments. Since there is no reasonable argument to be made as for differing risk levels

between these two mortgage types, the culprit of the results might lie in how **Risk Aversion** has been measured in this study. To circumvent the subjective nature of measuring risk aversion, health factors have been used. The logic behind this being that when it comes to health decisions, risky behavior, such as smoking and drinking, is inherently unbiased. This approach was utilized as Holt and Laury (2002) show that risk aversion measures are much more reliable in the presence of real payoffs versus hypothetical payoffs. However, the decision not to drink alcoholic beverages or smoke cigarettes might not only be tied to risk attitudes but also the degree of awareness of the consequences of such behavior. Let's say that people who are much more capable of considering the long-term consequences of their actions might decide against smoking and drinking, seeing as the effects of such behavior usually manifest in long-term illness, an argument could be made that these people are also more likely to envision the long-term consequences of their financial decisions. If this is the case it makes logical sense that such people would choose a deferred amortizing mortgage over a traditional amortizing mortgage, as they might be more aware of the long-term tax benefit associated with such mortgages. Thus, the **Risk Aversion Score** variable might in fact measure individual's long-term decision-making skills through its proxies next to risk attitudes. It does not seem that the results from this study discredit previous studies on the effect of risk aversion on mortgage choice, but rather shows that the proxies used in this study might not be effective in measuring risk aversion and alternatives should be considered in the attempt to make risk aversion measures less subjective and more reliable.

As for **Financial Literacy** an interesting finding presented itself in the results; apparently those who are more financially literate are less likely to choose a deferred amortizing mortgage and more likely to alternatively choose a traditional amortizing mortgage. We know from previous research conducted by Stango & Zinman, Zahirovic-Herbert et al. and Bucks & Pence that financial ignorance can lead to misunderstanding of the terms of a complex loan contract, choosing riskier mortgages, delinquency on mortgage payments and the inability to accurately estimate future fluctuations in interest payments. From these findings the expectation was formed that those more financially literate, through their ability to oversee the long-term consequences of their mortgage choice, would choose a deferred amortizing mortgage type over a traditional mortgage type. This is because at face value a deferred amortization scheme does not differ from a traditional amortization scheme when it comes to monthly payments, however the intricacy in this contract lies in the ability to leverage the tax-benefit that comes with deferred amortization. Since it was found that those less financially literate are less able to understand complex terms of a loan contract, the expectation was that these individuals would tend not to opt for a deferred amortization contract. However, in this study the exact opposite effect was found: the more financially literate a person is the more likely

they are to choose a traditional amortizing mortgage over a deferred amortizing mortgage. Since no support of this finding can be found in literature, it is necessary to consider how **Financial Literacy** is measured in this study. Four out of the six proxies used to measure **Financial Literacy** are regarding individual's pension. One's **Financial Literacy Score** increases as one reports to have more knowledge of their pension or reports to have a more intricate pension structure. It is plausible that these proxies measure to some degree an individual's financial literacy, however due to the results from the model it could be the case that these proxies simply do not measure financial literacy to the extent that was expected. Another explanation for this result could be bias in the panel. The topic of possible bias in the panel of this study is discussed in detail below.

For completeness the full model including all proxy variables is included in Appendix D. When looking at the results it becomes clear why including each proxy creates results that are uninterpretable, and why grouping them makes for a better picture of the effects at play. Table 9.D shows multiple significant estimators, even at the 0.01% level. For example, for Mortgage Group 2 we see that for the survey question "Do you smoke at all?" the answer option "Yes, I smoke everyday" has a value of -23.224 which is significant at the 0.01% level. When taking this value as the exponent of e we get: $e^{-23.224} \approx 8.202 * E^{-11}$, which for all intents and purposes can be regarded as null. When interpreting an odds ratio that tends to zero the conclusion would be that the event is an impossibility, which in this case would mean that individuals that report to smoke everyday will never choose a deferred mortgage type over a traditional mortgage type. This, of course, is not a realistic outcome, and is likely due to the makeup of the data rather than being an empirical truth. Apart from this particular estimator, Table 9.D shows many more estimator for which the odds ratio tends to zero. The most likely explanation of this effect is a high correlation between the independent variables. High correlation can be present due to characteristics inherent to the tested population, for example smoking and drinking behavior might go hand in hand, or simply because a limited sample might make for coincidental high correlation between different variables that does not stem from actual characteristics in the population. The population used in this study should reflect the Dutch population by randomization, however since only the head of the household is considered a considerable risk of sample bias is present. Namely, it could be said that within the population that is head of the household certain characteristics are much more prevalent than in the general Dutch population. To gather whether this risk could be present in our data at a glance, the summary statistics of the control variable **Gender** are included below. Since the first step towards a balanced panel is having an equal number of participants for each gender to represent the general population, this is an effective way to see whether a panel might be biased.

Gender	<i>Frequency</i>	<i>Percent</i>
Male	471	77.47%
Female	137	22.53%
Total	608	

Table 6.1: Summary statistics of Gender in the panel.

From Table 6.1 we see that 77% of participants are male, and only 23% are female. This poses an inherent risk to the accuracy of all other estimators in the model. Although **Gender** is controlled for in the model, since the possibility exists that **Gender** is correlated to various other explanatory variables in the model the precision of the estimators could be reduced. Furthermore, the above example showcases that even more bias might be present in our panel that can further obfuscate the true population estimators. Seeing as the response rate for some of the survey questions is considerably low, the dataset used in this thesis is not large enough to effectively solve the abovementioned issues.

7. Conclusion

In this thesis the effect of financial literacy and risk aversion on mortgage choice in the Netherlands is studied. Although financial literacy and risk aversion have been studied in relation to stock investment at length, their relation to the mortgage choice has been explored to a lesser extent in literature. Furthermore, academic opinions vary on how risk aversion and financial literacy should be measured effectively which is why alternative proxies have been proposed in this research in an attempt to create a new effective benchmark for these variables. By replicating a study done by Cox et al. on this topic the efficacy of these proxies becomes more explicit. The main research question this thesis aims to answer is: In the Netherlands, how does risk aversion proxied by health factors and financial literacy proxied by pension attitudes affect the choice of mortgage type?

To conduct a quantitative study to this end yearly data from a household survey created by De Nederlandsche Bank (DNB) and given out by Centerdata is used. The survey is distributed to 2000 Dutch households and gathers data on financial topics such as income, accommodation, pension, assets, as well as social and psychological indicators, and has been given out on an annual basis since 1993. All household member above the age of 16 are invited to participate and the survey is to be completed on a home PC or laptop. Through quantitative study of the data waves from 1993 up until 2022 it was found that a higher degree of risk aversion does not lead to choosing safer mortgages and vice versa, and that higher levels of financial literacy is linked to choosing traditional amortizing

mortgage types over deferred amortizing mortgage type, with no effect found for interest-only mortgages.

Despite these findings, conclusive statements cannot be made with the results presented in this study, reason being the limitations this study faces as well as contradictory findings of previous research that are generally accepted within academia. However, valuable deductions can still be made from the results reached within this study. Firstly, through this study it has become clear that health factors such as smoking or drinking indicators, self-perceived health status and life expectancy might not be effective proxies for risk aversion. Therefore, future research that aims to use risk aversion as an explanatory factor should perhaps use other proxies should be used that yield more robust results. Secondly, an inverse relationship between pension-related financial literacy and choosing a deferred mortgage type seems to exist through the results of this study. However, this result should be interpreted with proper discretion as it contradicts previously accepted findings in research and simultaneously is difficult to reconcile with real-world outcomes. Perhaps further research is needed to arrive at conclusive evidence to support or refute this result. Lastly, in grouping the variables into three separate scores the information for each individual survey question is lost. Although an attempt is made in this thesis to include a full model with all explanatory variables, the results showcase issue with regards to possible multicollinearity and sample size. However, exploring this topic further would be a valuable addition to the research done in this thesis as a full model will shed light on the efficacy of the proxies used, as well as creates the opportunity to compare the different proxies used to benchmark financial literacy and risk aversion with each other. To do this, however, the validity of the results would benefit from a larger sample size, by for example including more waves of data, balancing the panel using survey questions with higher response rate, or by including not only observations on the first mortgage taken out by a household but considering all mortgages taken out.

7.1 Limitations

This thesis has faced several limitations that could be improved in further research. Although this paper was able to extend the dataset used by Cox et al. by including a decade worth of additional data points, because of the rather limited response rate in the survey the sub-sample that was used turned out to be substantially smaller than the number of participants of the survey. Because of this, an improvement on this study could be made by expanding the sample. This could be done when additional waves of the survey data become available in the upcoming years. Furthermore, because of limitations on which observations were valid to use in this survey, most importantly the

respondent being the head of the household as well as only counting observations made in the year the mortgage was taken out by a household, this has made for a sub-sample that is prone to bias. To improve on this research an attempt should be made to utilize a more balanced panel. A suggestion to improve these issues would be to use different proxies for **Risk Aversion** and **Financial Literacy** for which the response rate is higher within the data set, and perhaps investigating further the validity of pension-related financial literacy proxies and thereby the relationship between traditional amortizing mortgages, deferred amortizing mortgages, interest-only mortgages and financial literacy.

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9. Appendix

Appendix A: Mortgage Type Grouping

The DHS survey lets its participants choose from 10 different mortgage types or an 'other' option where the participant can manually type out their mortgage type if it is not included in the provided answer alternatives. Below the description per mortgage type used by the DHS is included, as from these descriptions the different mortgages are grouped.

1. **Annuity Mortgage:** with an annuity mortgage, the total amount of your periodic payments on interest and repayment remains the same (at least) during the period for which the interest rate was fixed. During the first part of this period, the amount due consists of a relatively large part of interest and
2. **Traditional Life Insurance Mortgage:** this sort of mortgage consists of a loan and a life-insurance policy. The idea is that there is no repayment, but only paying interest on the loan, and paying a premium for the life-insurance policy. There is no direct relation between the interest rate of the mortgage loan and the savings interest rate of the life-insurance policy (in contrast with an improved life-insurance mortgage, where there is a relation between those two interest rates).
3. **Savings and Life Mortgage:** this is a certain type of a traditional lifeinsurance mortgage. An improved life-insurance mortgage consists of a loan and a life-insurance policy. The idea is that there is no repayment, but only paying interest on the loan, and paying a premium for the life-insurance policy. In this case, the interest rate of the mortgage-loan and the savings interest rate of the life-insurance policy are related, which causes monthly net-costs to be rather stable.
4. **Linear Mortgage:** with this sort of mortgage, the periodic payments include paying off a fixed percentage of the total mortgage loan, and paying interest on the loan that is left at that moment. Over time, the amount you pay on interest becomes less and less, such that total monthly costs go down through the years. In the first period of the term of the mortgage, the costs of a linear mortgage are higher than the costs of an annuity mortgage.
5. **Endowment Mortgage:** with an endowment mortgage it is possible, during the term of the mortgage, to get a new loan on (part of) the amount that you have already paid off.
6. **Investment Mortgage:** this is a variation on the (traditional) life-insurance mortgage. As is the case with the other life-insurance mortgages, also for most of the investment mortgages the loan is paid off out of the benefits of a whole life-insurance policy linked to the mortgage

at the end of the mortgage period. Contrary to a(n improved) life-insurance mortgage, the returns of the life insurance policy are based on the returns of an investment portfolio.

7. **Interest Only:** With this mortgage one only pays interest during the term of the mortgage with a balloon payment due at the end.
8. **Annuity Construction:** During the term of the mortgage one pays interest only, but at the same time one contributes to an annuity, which becomes available at the end of the mortgage period. The annuity does not have to be used to pay off the mortgage at the end of the mortgage period. It can be used as a supplementary pension provision.
9. **Life Insurance:** the lifelong mortgage with life-insurance is a variation on the interest only mortgage. This mortgage is taken out for an indefinite period. To be sure that the mortgage is paid off after death (at the latest), the mortgage holds a term life-insurance policy.
10. **Bank Savings Mortgage:** Compared with a traditional improved life insurance mortgage the bank savings mortgage uses no life insurance. One uses a blocked savings account or an escrow investment account that is linked to the mortgage.

From this list it can be seen that the naming used in this paper differs from the one used by the DHS. This is done since the original survey is given out in Dutch and after comparing the terminology used in the Dutch survey with the English survey several changes seemed necessary.

Firstly, mortgage (5) is denoted as 'home equity loan' in this paper rather than 'endowment mortgage'. This is done since the Dutch survey denotes this mortgage as 'krediethypotheek', which according to Dutch bank ABN-AMRO is a loan that can be taken out on the equity of the purchased home and only requires monthly interest payments (ABN-AMRO, n.d.). An endowment mortgage, on the other hand, is defined by Cambridge Dictionary as "a mortgage (= a loan to buy a house) on which you pay only the interest, and also have an endowment (= insurance policy) that is intended to provide money to pay back the mortgage in the future." (Cambridge University Press, 2023). Furthermore, when looking at the description provided by the DHS it is clear that a home equity loan is described and not an endowment mortgage.

Secondly, mortgage number 9 is denoted by the DHS as a 'life insurance mortgage' while in this paper it is denoted as 'interest-only mortgage with term life insurance'. The main reason for this name change is the confusion that arises when using the term 'life insurance mortgage', as mortgage number 2 is denoted as 'traditional life insurance mortgage'. By denoting number 9 as an interest-only mortgage with term life insurance it becomes clear that this mortgage belongs in the

interest-only mortgage group, as well as the fact that this mortgage in fact does not include a life insurance but rather a term life insurance.

Apart from translation issues described above, the grouping used in this paper differs from the grouping used by Cox et al. in 2 ways. Firstly, Cox et al. include the 'savings mortgage' (number 3) in the traditional amortizing mortgages group. However, this mortgage type as described by the DHS requires borrowers to make monthly life-insurance payments that will ensure repayment of the principal at the end of the mortgage term. This is precisely how deferred amortization mortgage types are defined in this paper which is why mortgage (3) is included in this group in this study. Secondly, mortgage (9) is grouped into the deferred amortization group by Cox. et al. However, analyzing the description of this mortgage given by the DHS it clearly states that this mortgage is a variant on the interest-only mortgage in that it includes a term life insurance. Compared to a life insurance mortgage, the payments made for the term life insurance are not used to repay the principal amount at the end of the term but rather are used to pay off the mortgage debt in case the borrower passes away. It is therefore more appropriate to group this mortgage in the interest-only group rather than the deferred amortization group, as principally no deferred amortization payments are made in this type of mortgage.

Appendix B: Risk Aversion & Risk Aversion Score

Risk Aversion 1

In general would you say your health is:

- *Excellent*
- *Good*
- *Fair*
- *Not so good*
- *Poor*

Risk Aversion 2

Do you smoke cigarettes at all?

- *Yes, I smoke every now and then*
- *Yes, I smoke everyday*
- *No*

Risk Aversion 3

One average, do you have more than four alcoholic drinks a day?

- Yes
- No

Risk Aversion 4

The following 1 or 2 questions concern life-expectancy and are to be answered by respondents under 91 years old. KANS1 is presented to people aged 16 thru 65, KANS2 is presented to people aged 16 thru 70, KANS3 is presented to people aged 65 thru 75, KANS4 to people aged 70 thru 80, KANS5 to people aged 75 thru 85, and KANS6 to people aged 80 thru 90. The following 1 or 2 questions concern your life-expectancy. Please indicate for each age mentioned below how big you think is the chance that you will attain (at least) that age. Please indicate your answer on a scale of 0 thru 10, where 0 means 'no chance at all' and 10 means 'absolutely certain'.

KANS 1: How big do you think is the chance that you will attain (at least) the age of 75?

KANS 2: How big do you think is the chance that you will attain (at least) the age of 80?

KANS 3: How big do you think is the chance that you will attain (at least) the age of 85?

KANS 4: How big do you think is the chance that you will attain (at least) the age of 90?

KANS 5: How big do you think is the chance that you will attain (at least) the age of 95?

KANS 6: How big do you think is the chance that you will attain (at least) the age of 100?

In general would you say your health is:	Frequency	Percent	Cumulative	Score
Excellent	110	22.59%	22.59%	5
Good	302	62.01%	84.60%	4
Fair	62	12.73%	97.33%	3
Not so good	12	2.46%	99.79%	2
Poor	1	0.21%	100%	1
Total	487			

Table 9.B.1: Risk Aversion 1 summary statistics

Do you smoke cigarettes at all?	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative</i>	<i>Score</i>
Yes, I smoke every now and then	35	7.19%	7.19%	1
Yes, I smoke everyday	100	20.53%	27.72%	0
No	352	72.28%	100%	2
Total	487			

Table 9.B.2: Risk Aversion 2 summary statistics

On average, do you have more than 4 alcoholic drinks a day?	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative</i>	<i>Score</i>
Yes	43	8.83%	8.83%	0
No	444	91.17%	100%	2
Total	487			

Table 9.B.3: Risk Aversion 3 summary statistics

Variable	<i>Obs</i>	<i>Mean</i>	<i>St. Dev.</i>	<i>Min</i>	<i>Max</i>
Total_probability	304	12.75987	4.058756	0	20

Table 9.B.4: Risk Aversion 4 summary statistics

Risk Aversion Score = Risk Aversion 2 + Risk Aversion 3

Health Score = Risk Aversion 1 + Risk Aversion 4

Appendix C: Financial Literacy & Financial Literacy Score

Financial Literacy 1

How knowledgeable do you consider yourself with respect to financial matters?

- *Not knowledgeable*
- *More or less knowledgeable*
- *Knowledgeable*
- *Very knowledgeable*

Financial Literacy 2

Do you feel adequately informed about your (future) pension arrangements?

- *Well informed*
- *More than adequately informed*
- *Adequately informed*
- *Moderately informed*
- *Not well informed*
- *Feel no need to be informed, we'll see by then*

Financial Literacy 3

How is/was your pension built up?

- *A pension based on final pay*
- *A pension based on average pay earned during my working career*
- *Available premium*
- *Otherwise*
- *I don't know*

Financial Literacy 4

Have you made any other arrangements for your pension apart from the customary pension you build up through your pension fund or insurer?

More than one answer possible

- *Yes, through annuities*
- *Yes, through whole life policies*
- *Yes, through buying extra pension rights via employer*
- *Yes, through extra periodical payments via employer*
- *Yes, through bank savings for retirement*
- *Yes, otherwise*
- *No*

Financial Literacy 5

Which of the following below mentioned statements applies to you most?

- *I do not worry about my pension arrangements, we'll see by then*
- *It is important to know that my pension is taken care of, without knowing the details*
- *I keep well informed about any developments regarding my pension*
- *I don't know*

Financial Literacy 6

Has your pension been indexed?

- *Yes*
- *No*
- *I don't know*

How knowledgeable do you consider yourself with respect to financial matters?	Frequency	Percent	Cumulative	Score
Not knowledgeable	44	12.50%	12.50%	0
More or less knowledgeable	199	56.53%	69.03%	1
Knowledgeable	92	26.14%	95.17%	2
Very knowledgeable	17	4.83%	100%	3
Total	352			

Table 9.C.1: Financial Literacy 1 summary statistics

Do you feel adequately informed about your (future) pension arrangements?	Frequency	Percent	Cumulative	Score
Well informed	29	16.11%	16.11%	4
More than adequately informed	43	23.89%	40.00%	3
Adequately informed	59	32.78%	72.78%	2
Moderately informed	33	18.33%	91.11%	1
Not well-informed	8	4.44%	95.56%	0
Feel no need to be informed, we'll see by then	8	4.44%	100%	0
Total	180			

Table 9.C.2: Financial Literacy 2 summary statistics

How is your pension built up?	Frequency	Percent	Cumulative	Score
Don't know	43	26.38%	26.38%	0
Based on final pay	27	16.56%	42.94%	1
Based on average pay	65	39.88%	82.82%	1
Available premium	25	15.34%	98.16%	1
Otherwise	3	1.84%	100%	1
Total	163			

Table 9.C.3: Financial Literacy 3 summary statistics

Have you made alternative pension arrangements?	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative</i>	<i>Score</i>
Yes	47	29.19%	29.19%	3
No	114	70.81%	100%	0
Total	161			

Table 9.C.4: Financial Literacy 4 summary statistics

Which statement applies to you most?	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative</i>	<i>Score</i>
I keep well informed about any developments regarding my pension	21	14.69%	14.69%	3
It is important to know that my pension is taken care of, without knowing the details	75	52.45%	67.14%	1
I do not worry about my pension arrangements, we'll see by then	43	30.07%	97.21%	0
I don't know	4	2.80 %	100%	0
Total	272			

Table 9.C.5: Financial Literacy 5 summary statistics

Is your (future) retirement pension indexed to inflation?	<i>Frequency</i>	<i>Percent</i>	<i>Cumulative</i>	<i>Score</i>
Yes	131	52.61%	52.61%	1
No	28	11.24%	63.85%	1
I don't know	90	36.14%	100%	0
Total	249			

Table 9.C.6: Financial Literacy 6 summary statistics

Appendix D: Full regression model

	<i>Mortgage_Group</i>	
	<i>Beta</i>	<i>Std. Err.</i>
Mortgage Group 1		
<i>Omitted</i>		
Mortgage Group 2		
<i>In general would you say your health is:</i>		
Excellent	0	(.)
Good	1.001	(0.56)
Fair	-16.900 ^{***}	(-6.38)
Not so good	-11.698 ^{**}	(-2.71)
Poor	-2.553	(-0.47)
<i>Do you smoke cigarettes at all?</i>		
Yes, I smoke every now and then	0	(.)
Yes, I smoke every day	-23.224 ^{***}	(-5.55)

No	-1.443	(-0.87)
<i>On average, do you have more than four alcoholic drinks a day?</i>		
yes	0	(.)
no	0.821	(0.27)
Total_probability	-0.048	(-0.19)
<i>Do you feel adequately informed about your (future) pension arrangements?</i>		
well informed	0	(.)
more than adequately informed	-1.368	(-0.42)
adequately informed	-1.763	(-0.64)
moderately informed	0.507	(0.17)
not well-informed	1.468	(0.47)
feel no need to be informed, we'll see by then	3.123	(0.85)
<i>How is your pension built up?</i>		
final pay	0	(.)
average pay	2.687	(1.24)
available premium	-6.688**	(-2.65)
otherwise	0.771	(0.17)
dont know	-2.433	(-1.44)
<i>Which statement applies to you most?</i>		
Do not worry about pension	0	(.)
Do not know the details of pension	-0.901	(-0.68)
keep well informed about my pension	-19.115***	(-6.85)
Don't know	-15.693***	(-5.70)
dnb911_total	7.026**	(3.08)
<i>Is your (future) retirement pension indexed to inflation?</i>		
yes	0	(.)
no	5.191	(1.76)
don't know	-1.060	(-0.65)
<i>How knowledgeable do you consider yourself with respect to financial matters?</i>		
not knowledgeable	0	(.)
more or less knowledgeable	-6.093**	(-2.62)
knowledgeable	-12.219***	(-3.48)
very knowledgeable	-13.983**	(-2.84)
Male	0	(.)
Female	-3.289*	(-2.01)
Pre-vocational education (VMBO)	0	(.)
Pre-university education (HAVO/VWO)	-20.055***	(-6.40)
Senior vocational training (MBO)	-2.910	(-1.38)
Vocational college (HBO)	-3.208	(-1.79)
University education	1.045	(0.46)
Age	-0.006	(-0.06)
Constant	10.882	(1.25)

Mortgage Group 3

In general would you say your health is:

Excellent	0	(.)
Good	5.271**	(2.93)
Fair	5.171*	(2.31)
Not so good	3.306	(1.36)
Poor	15.220***	(3.58)

<i>Do you smoke cigarettes at all?</i>		
Yes, I smoke every now and then	0	(.)
Yes, I smoke every day	-5.453*	(-2.27)
No	-4.060*	(-2.07)
<i>On average, do you have more than four alcoholic drinks a day?</i>		
yes	0	(.)
no	-1.529	(-0.62)
Total_probability	0.217	(1.85)
<i>Do you feel adequately informed about your (future) pension arrangements?</i>		
well informed	0	(.)
more than adequately informed	0.528	(0.39)
adequately informed	-4.078**	(-2.79)
moderately informed	1.515	(0.90)
not well-informed	-13.866***	(-4.26)
feel no need to be informed, we'll see by then	6.317**	(2.92)
<i>How is your pension built up?</i>		
final pay	0	(.)
average pay	1.466	(1.07)
available premium	-7.174**	(-3.00)
otherwise	15.333***	(4.84)
Don't know	-3.417*	(-2.28)
<i>Which statement applies to you most?</i>		
Do not worry about pension	0	(.)
Do not know the details of pension	-1.742	(-1.14)
keep well informed about my pension	-0.019	(-0.01)
Don't know	5.438	(0.90)
dnb911_total	2.023	(0.90)
<i>Is your (future) retirement pension indexed to inflation?</i>		
yes	0	(.)
no	4.294*	(2.38)
don't know	1.593	(1.44)
<i>How knowledgeable do you consider yourself with respect to financial matters?</i>		
not knowledgeable	0	(.)
more or less knowledgeable	17.759***	(3.81)
knowledgeable	13.478**	(3.06)
very knowledgeable	13.773**	(2.95)
Male	0	(.)
Female	-1.780	(-1.46)
Pre-vocational education (VMBO)	0	(.)
Pre-university education (HAVO/VWO)	-3.291	(-1.44)
Senior vocational training (MBO)	-3.170	(-1.31)
Vocational college (HBO)	-4.740*	(-2.18)
University education	0.340	(0.12)
Age	0.197**	(2.92)
Constant	-24.100***	(-3.34)
Observations	109	

Table D.1: Regression results of the full model. This model includes all variables used to proxy Risk Aversion and Financial Literacy, as opposed to the scoring variables. Individual effects of each survey question are shown here. t statistics in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.