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**Trends in Risk Tolerance:  
 Exploring the Dynamic Influence of Determinants of Risk Tolerance among  
 Dutch Retail Investors**

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## **Abstract**

This thesis focuses on the significance of the determinants of recent year risk tolerance of retail investors in the Netherlands. Using determinants like risk perception, financial knowledge, and numerous demographic factors, research is conducted on the significance of the impact of these determinants on risk tolerance. Changes in the influence of these determinants on risk tolerance are sought by using a multiple-year timeframe and considering the impacts of external influences such as market volatility on risk tolerance. This thesis concludes that for retail investors risk perception is the most influential determinant of risk tolerance, impacting it negatively. Financial knowledge is less important than the education level of respondents, both having a positive impact on the risk tolerance of respondents. Being a female and of older age has a minor negative impact on risk tolerance. Furthermore, wealth was shown to have a significant effect and has a positive impact on risk tolerance, whilst the net income of respondents did not have a significant impact. For real estate investors, age is the most important determinant of risk tolerance, with gender and risk perception being influential as well.

Keywords: Risk Tolerance, Risk Perception, Financial Knowledge, Dutch Retail Investors, Dutch Real Estate Investors

## **Preface**

Completing this master's thesis has deepened my understanding of the risk tolerance of Dutch retail investors and thus the people around me. As I reflect on the process of research, analysis and writing of this thesis I feel grateful for the help I have gotten along the way.

I would like to thank my supervisor Prof. Dr. Xiaolong Liu for helping me complete this thesis and giving feedback when needed. The constructive feedback and help I received have been instrumental in shaping the direction and quality of this thesis.

This thesis represents the results of months of research, analysis, and reflection, and I hope that it contributes meaningfully to the field of knowledge about Dutch retail investor behaviour. While every effort has been made to ensure accuracy and clarity in this thesis, I am accountable for any errors made. May you find great enjoyment in reading my work!

*Coen Hannink*

10 april, 2024

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## 1. Introduction

The financial landscape of the Netherlands is marked by its vibrancy and diversity, characterized by a thriving retail investment sector that plays an important role in wealth accumulation and economic growth (Dutch Ministry of Finance, 2021). Retail investors, representing a wide spectrum of heterogeneous individuals who allocate personal financial resources, exert substantial influence over a nation's financial markets (Eaton, Green, Roseman, & Wu, 2022). The same is true for the Netherlands (Baker & Wurgler, 2006). In recent years there has been a shift in market behaviour, as a recession was looming in the global economy (Curry, 2023). In prior years, retail investors' sentiment would be enhanced by positive or negative events, which could be simple things like the weather, soccer matches but also market movements (Hirshleifer & Shumway, 2003; Bos & Zwinkels, 2015). This resulted in more irrational investment decisions based on emotions and financial illiteracy (Summa, 2004). However, retail investor behaviour has not changed accordingly as it did in the past. The opposite is happening: investor confidence appears to grow during the more recent uncertain times (Chmiel, 2023). As the Dutch financial ecosystem continues to evolve and adapt to the complexities of the global financial arena, it is necessary to systematically explore the determinants underpinning Dutch retail investors' risk tolerance.

Retail investors in the Netherlands have access to the same digital sources for financial information that other people in the developed world have, which could create the assumption that the Dutch retail investor reflects the broader trends observed in developed financial markets worldwide. The arrival of digital technology, increased access to financial information, and a growing interest in sustainable and socially responsible investing have transformed the investor landscape, offering many investment options and decision-making variables (Li, Watts, & Zhu, 2023). Understanding the factors that steer the investment risk preferences of Dutch retail investors within this evolving context has major implications for investors, financial institutions, and policymakers alike.

The current financial environment presents a complex array of investment choices, and Dutch retail investors face a challenging task in navigating this terrain. Numerous determinants have been studied in their impacts on investors' risk tolerance, such as risk perception, financial knowledge, but also the wealth of investors (Hermansson & Jonsson, 2021). With investor behaviour changing in recent times, one can question what determinant would be most impactful on the risk tolerance of investors these days, and how big the impact of influential determinants can be. However, as time goes on, many events can intervene with overall investor composure, such as market volatility which has been proven to induce irrational investor behaviour (Huber et al., 2022). Consequently, underlying constructs of risk assessment may also be influenced.

With retail investors growing more familiar with investing, the growing ease of investing, and platforms actively promoting investing for retail, there has been a growing number of retail investors in various sectors in the Netherlands (DNB, 2022; Sterling, 2021; Dutch Ministry of Finance, 2021). These self-directed investors have different market behaviour and appear to be more impulsive in their decision-making (Sterling, 2021). With said rapidly changing demographics, changes in what determinants are most impactful for retail investors' risk tolerance may also change as demographic differentiators such as age, gender, and education are shown to have internal differences in their impacts (Charles & Kasilingam, 2013; Charness & Gneezy, 2012). For example, men and women were shown to be impacted differently in their risk tolerance merely due to a gender difference (Charness & Gneezy, 2012). Furthermore, the financial world is characterized by a degree of volatility and unpredictability that can disrupt even the most well-established patterns of investment behaviour (Huber et al., 2022). Consequently, it is crucial to find out if the findings on the determinants identified as influential are significant over multiple years.

## 1.1 Research Questions

The primary objective of this thesis is to unveil the most influential determinants that affect the investment choices of Dutch retail investors, whilst ensuring that these findings are not a singular year event. To achieve this goal, this research aims to:

1. Conduct a comprehensive analysis of the diverse determinants that influence risk tolerance among Dutch retail investors.
2. Deploy regression analysis to identify the determinants that exert the most significant influence on risk tolerance in recent years.
3. Evaluate the importance of the identified determinants of risk tolerance.

In pursuit of the research objectives, this study seeks to address the following fundamental research question:

***What are the most influential determinants shaping the risk tolerance of Dutch retail investors?***

To seek an answer to the research question and to pursue the research questions, firstly a literature review will be conducted to analyse the determinants of risk tolerance. After this, a quantitative study will be conducted in the form of a regression analysis to find results regarding the influence of said determinants of risk tolerance. Finally, findings will be evaluated to gain insights into the importance of the determinants of risk tolerance for Dutch retail investors. As this thesis is written on behalf of the real estate studies master, the same form of research will be conducted on real estate investors specifically to see what determinant impacts are for this subcategory of Dutch investors.

## 1.2 Significance of Study

Existing research has investigated numerous factors that may influence investors' risk tolerance such as financial knowledge, risk perception, income, and wealth (Hermansson & Jonsson, 2021; Summa, 2004; Aleknyte et al., 2019; Chavali, 2016), and there are some partial findings showing hierarchy and relative significance of these determinants within the more recent Dutch context (Hoffmann, Post, & Pennings, 2013). However, a substantial knowledge gap remains regarding the hierarchy of these determinants' influence on risk tolerance specifically in the Dutch context, as well as in the recent time context which may have impacted said determinants of risk tolerance of Dutch retail investors in their influence. This study aims to fill this gap using recent data from the Dutch society.

There is evidence already that cultural differences exist in levels of confidence in response to the way that probabilities of uncertain outcomes are assessed, and that there are differences in risk preferences in general. Therefore it is also reasonable to expect that cultural variations will affect an investor's financial risk tolerance (Brooks & Williams, 2023). In addition to cultural differences, there are several unique factors that set the Dutch apart from other nationalities in terms of risk tolerance. Firstly, the Dutch have a tendency to save more than individuals from most other countries. For instance, the gross savings as a percentage of the GDP is approximately 18% in the US, while it is around 31% in the Netherlands (Worldbank, 2024). Furthermore, a study conducted by Ferreira (2018) reveals that, overall, Dutch individuals exhibit greater risk aversion compared to those from the US and the UK. The study found that investments in shares, mutual funds, and bonds are considered highly risky by Dutch, German, and Austrian investors on average, whereas the opposite is true in many other countries. It is also worth mentioning that the Netherlands operates as a welfare state, providing assistance to its population through the insurance principle (WPR, 2024). As a result, Dutch retail investors view investment risks differently compared to countries that do not have a welfare state.

Furthermore, the answers to the research question offer insights into the current dynamics of retail investment behaviour in the Netherlands. These findings can provide practical guidance for investors, financial institutions, and policymakers operating within the Dutch financial landscape. Whilst the specific determinants identified may not be universally applicable in all market conditions, they can still serve as a valuable reference point for understanding the prevailing factors influencing investment decisions and how these determinants' significance scores for risk tolerance are being shaped over the years. This can benefit retail investors in supporting their financial well-being by learning about common shortfalls. Furthermore, the research aims to contribute to the knowledge of impacts on and from the dynamic nature of the market, helping researchers have a better understanding of behavioural changes which determine investors' decision-making process. Ultimately, this research aims to contribute to a deeper understanding of the multifaceted relationship between determinants and investment decision-making, enriching the body of knowledge surrounding Dutch retail investments and their dynamics within the global financial context.

### **1.3 Research Methodology**

To achieve the research objectives, this study will use a quantitative data approach. Using a literature review, common concepts can be integrated into the thesis. It is important to note that retail investors include real estate investors, as this is a sub-category of retail investors. After this, data will be retrieved from the DNB household survey, which solely contains Dutch respondents. By stratifying this data into investors only, this thesis can focus on Dutch retail investors and real estate investors. Regression analysis will serve as the primary statistical tool for identifying the influence of determinants against risk tolerance. Using the literature review and results from the regression, the findings on the impacts of determinants on risk tolerance can be presented and discussed. In this study, multiple years of data will be used to create an analysis that is representative of recent years for the influence of risk tolerance determinants.

### **1.4 Organization of the Thesis**

The subsequent chapters of this thesis are organized as follows: Chapter 2 provides a review of the existing literature on risk tolerance, determinant analysis, and external influences. Chapter 3 elaborates on the research methodology, whilst also expanding upon the data source and statistical techniques. Chapter 4 presents the empirical findings combined with a comprehensive discussion of said findings. Ultimately, Chapter 7 concludes the thesis by presenting the findings, implications, limitations, and suggests avenues for future research.

## 2. Literature Review

To understand what determinants can impact the risk tolerance of retail investors, this chapter will focus on the first research goal; conducting a comprehensive analysis of the diverse determinants that influence the risk tolerance of Dutch retail investors. Overall, the literature reveals that several determinants play a significant role in shaping the risk tolerance of Dutch retail investors:

- Risk perception
- Investor experience
- Financial literacy
- Demographic factors
- Psychological biases

These determinants have been identified as the most influential factors in influencing investment decisions (Bui et al., 2021; Hermansson & Jonsson, 2021; Thanki & Baser, 2021). Apart from being significant individually, it is important to understand how these determinants impact one another when a determinant changes to fully understand why certain changes in influence may occur between different years. In this paper, risk tolerance will be used as a means to explain how much risk an individual is willing to take on when investing, which could be in relatively safe and steady low-return investments or high-risk with potentially high-reward investments. To gain a comprehensive understanding, risk tolerance will first be explored, followed by an examination of how risk tolerance and its determinants can be impacted by external influences such as market volatility in the investment context.

### 2.1 Risk Tolerance

Risk tolerance is *“the amount of uncertainty or investment return volatility that an investor is willing to accept when making a financial decision”* (Hallahan et al., 2004). For a retail investor who is willing to decide on whether to invest, their risk tolerance is what will ultimately help their selection of asset classes to which they seek exposure to. Risk tolerance helps define individuals' investment strategies, investment goals, and diversification plans, and helps with facilitating a rational evaluation of asset classes to inform investment decisions and the allocation of funds. However, due to its subjective nature and its inherent variability from one individual to another, it is challenging to measure on a broader scale (Thanki & Baser, 2021).

When the range of risks which investors may take are considered, various asset classes that significantly differ in terms of volatility and the factors that drive such fluctuations become apparent. Government and corporate bonds are typically regarded as low-risk and secure investments, whereas equities, commodities, and real estate tend to be subject to higher levels of volatility, consequently carrying a greater inherent risk of losing value in the short or long term. Moreover, options and digital currencies often display the highest levels of volatility, which makes them suitable for high-risk, high-reward investment strategies but not necessarily appropriate for a broader retail investor base. Ultimately, it is an individual's risk tolerance that shapes their comfort level when selecting a specific asset class, and this risk tolerance is, in turn, influenced by a combination of key determinants, as is elaborated upon in the subsequent parts.



## 2.2 Risk Perception

The first of the key determinants impacting risk tolerance for Dutch retail investors is risk perception. Risk perception, not to be confused with risk tolerance, is the determinant that explains how investors view financial risk based on their personal expert knowledge and experience (Bairagi & Chakraborty, 2021). In other words, it is the belief of the investor in market performance, and this belief can be either rational or irrational. According to Bairagi & Chakraborty (2021), studies consistently show that the analysis of investment risk varies for each retail investor who performs an analysis using their personal level of perception towards the risks involved.

Furthermore, the perception of risks associated with a specific investment or market can significantly impact risk tolerance. In a study from Bairagi & Chakraborty (2021), findings show that retail investors are very financially conservative and their investment behaviour is reflected by emotions, which are caused by the volatile markets and stock price movement. Risk perception of the markets can in this case increase market volatility, by amplification due to a herding mentality and overconfidence (Abideen, Ahmed, Qiu, & Zhao, 2023). The changing of risk perception during market volatility is also backed by Hoffmann et al. (2013), who concluded that risk perception increases during a crisis. This heightened risk perception, in turn, correlates with diminished risk tolerance and lower return expectations, which in previous research has been shown to decrease investments and increase portfolio de-risking. On the contrary, Hoffmann et al. (2013) found in their study that retail investors continued trading as usual even as risk perception increased, thereby raising questions regarding the current relevance of risk perception for retail investors.

## 2.3 Financial Knowledge

Financial knowledge is another determinant that significantly influences the risk tolerance of investors. Earlier explained to be of importance for determining risk perception for retail investors (Bairagi & Chakraborty, 2021), studies have shown that individuals with higher financial knowledge are more likely to make sound investment choices (Fernando, 2023). Financial knowledge, according to Fernando (2023) is *“the ability to understand and effectively use various financial skills, including personal financial management, budgeting and investing”*. For this thesis, financial knowledge will be understood as both financial literacy and investing experience. For retail investors, financial knowledge can be essential for risk tolerance. Furthermore, financial knowledge can directly strengthen the influence of education and investment experience on investment decisions (Ediningsih, Satoto, & Subagio, 2020). This interplay underscores the complex nature of the relationships between financial knowledge, education level and investment experience.

As the paper from Hermansson & Jonsson (2021) shows, higher financial literacy is associated with higher risk tolerance. This would make sense as more knowledgeable individuals invest in more sophisticated assets, generating higher expected returns on assets with lower non-systematic risks. In essence, financial literacy helps the individual understand their investment options, as well as their assessment of risks and returns associated with said assets. For this paper, the definition from Hermansson & Jonsson (2021) is taken, which is *“knowledge of financial concepts, that is inflation and risk diversification”*. It is to be expected that financial literacy helps with resilience against negative behavioural impacts on investing, as retail investors with higher financial literacy are more resilient in the face of economic shocks (Lusardi & Mitchell, 2017).

Financial knowledge also depends on the investing experience of retail investors, as retail investors with more investing experience will, on average, have a better understanding of market dynamics, investment products, and the associated risks (Ediningsih, Satoto, & Subagio, 2020). Furthermore,

experienced investors have a better understanding of the risks associated with different investment opportunities as opposed to investors with less experience. Thus, investors with more experience can better assess the value of potential returns of potential new investments using their past investment experiences. Ultimately, these successful past investment experiences can lead to a higher risk tolerance, which can help generate higher returns (Ediningsih et al., 2020). Investment experience has also been highlighted as a crucial part of determining risk perception for retail investors. The confidence that is built by previous experiences can help investors take more risks (Ediningsih et al., 2020). In summary, it is evident that investor experience tends to positively influence risk perception, whereas behavioural biases typically exert a negative impact.

## **2.4 Demographic Factors**

Demographic factors also play a role in the shaping of risk tolerance of investors. Age, gender, income level, and education level are associated with investment preferences and risk tolerance (Charles & Kasilingam, 2013). For instance, older investors generally have a lower risk tolerance and are more inclined to make conservative investment decisions compared to younger retail investors (Charles & Kasilingam, 2013; Yao & Curl, 2011). Older people tend to make more sound investment decisions, mimicking those of institutional investors. Investor experience once again seems to be a substantial benefactor to this, as these older investors were shown to be more prone to market shocks. However, it is unclear how the impact of age on risk tolerance has changed over the past decade as the elderly are to some extent exposed to changes such as greater ease of investing and an array of new, easily accessible information sources.

Previous research indicates that a key determinant influencing risk tolerance among different demographics is the income level of investors. A recent study by Bui et al. (2022) found that investors with higher incomes tend to have higher risk tolerance, leading them to invest in riskier assets and trade more frequently than those with lower incomes. As a result, higher-income investors often enjoy higher returns on their investments. Furthermore, it appears that higher income has a positive impact on investors' perception of risk, as shown by the research of Lokhande and Saivasan (2022). However, Yao & Curl (2011) found that individuals who do not have a steady income from a job also had a higher risk tolerance. This may be because they possibly prefer to take more risks since they have less to lose and more to gain from financial gains, meaning that a higher risk-reward ratio is more appealing. It is important to note that a higher age has a positive impact on income: the older the individual is, the more likely it is that they have gotten more salary raises, a more important job, or have achieved more in life (Barucca, Kitov, & Ozhamaratli, 2022).

According to Gupta & Kallan (2021), a higher education level tends to have a positive effect on investment skills and knowledge of the individual, which consequently is causally related to financial knowledge. Not only does this, on average, improve financial knowledge, it also leads to more risk-taking from said higher-educated investors (Baihaqqy et al., 2020). Furthermore, a higher education level tends to be correlated with higher social and human capital (Yao & Curl, 2011). Thus, individuals with higher education levels tend to have a greater financial cushion from a social safety net should losses occur, making it more reasonable for individuals with higher education levels to be more risk-tolerant. Overall, it appears that higher education tends to affect financial knowledge, consequently affecting investment decision-making in the same way.

Furthermore, gender has been identified as one of the impactful demographic factors. It has been proven that there is, on average, a difference between the approach of men and women in investing (Charness & Gneezy, 2012). In a study from Charness & Gneezy (2012), it was found that women tend

to invest a lot less, especially in more risky assets compared to men, and are thus more risk averse than men. Yao & Curl (2011) support this finding in their research, which shows that from 1992 to 2006, men have a higher risk tolerance than women. However, it appears that when there is a higher financial knowledge for individuals, the difference in risk tolerance for genders is declining rapidly (Dwyer et al., 2002). This might be a cause for more risk tolerance in both demographic groups, especially in women.

Lastly, wealth has also been identified as an important factor for determining risk tolerance. Studies from Yao & Curl (2011) and Cahyono et al. (2020) indicate that wealth can have a positive impact on the risk tolerance of the individual when investing. However, findings indicate that the positive impact comes in two groups; in those that initially accumulated more wealth on average than others, and in those that excel others in wealth by an extreme margin such as the superrich. The latter tend to have a much higher risk tolerance than those that are above average, and those that are above average tend to only have a minor positive impact in comparison to average wealth levels (Yao & Curl, 2011). It was also found that women have less wealth on average than men, which may somewhat impact the gender differences in risk tolerance further. For wealth, age also has a positive impact as it has with income. This is because of years of potential wealth accumulation as the individual gets older (Vandenbroucke & Zhu, 2017).

## **2.5 Psychological Biases**

Psychological biases, such as loss aversion and overconfidence, have been identified as additional determinants which influence investor decision-making of retail investors and are thus worthy of note (Baker & Ricciardi, 2021). Many psychological biases influence retail investors' risk tolerance. Some of the most influential investment biases that are known are overconfidence bias, regret aversion bias, trend-chasing bias, confirmation bias, loss aversion bias, herd mentality bias, anchoring bias, and hindsight bias. Said biases can be a cause for fear, greed, anxiety, happiness, and many other emotions which can impact investing behaviour, and thus risk tolerance of retail investors (Adeel et al., 2023). Many of these biases affect risk perception during volatility in the markets as previously explained in the risk perception chapter. The biases triggered by market volatility can greatly impact risk tolerance due to individuals becoming more irrational and causing more illogical thoughts (Dervishaj, 2021). Psychological biases do tend to have less impact on financially knowledgeable individuals, as these individuals on average have more experience with separating emotions from investing (Adeel et al., 2023).

## **2.6 External Influences on Determinants**

The determinants mentioned above have different effects on risk tolerance depending on the year in which these effects are observed. Macroeconomic factors can lead to specific behaviours or biases that alter investors' risk tolerance. Therefore, the findings of determinants in one year may not accurately represent their overall significance. In addition to evaluating the importance of these determinants, it is valuable to assess if they change over time. The Netherlands is evolving into an information-intensive society, with increasing reliance on instant access to digital information sources. These sources provide real-time financial information that can influence the investor climate (Wyckoff, 2012). The ease of accessing investment platforms and information, along with the speed of market reactions, may impact investors' risk tolerance. Furthermore, investing has become easier with numerous brokers advertising to retail investors, with low barriers for usage. In the study from Yao & Curl (2011), it was found that risk tolerance changed over time, especially in times of market volatility

as individuals try to react to market movements. As stated earlier, Brooks & Williams (2023) emphasized that cultural differences are a reason for different risk tolerance levels for different nationalities of investors. As a result, the determinants mentioned above may vary for Dutch retail investors compared to the findings of previous studies that did not specifically focus on this demographic. Nonetheless, Brooks & Williams (2023) found that factors such as gender, income, wealth, and financial knowledge had a significantly greater impact on investor behaviour than the nationality of the respondents.

As shown previously with the determinants, market volatility has a significant impact on investor risk tolerance. When the market is highly volatile, retail investors tend to focus more on short-term trends. This can lead to biases and affect future market movements. Investor behaviour can be influenced positively or negatively depending on the direction of market volatility. Additionally, market volatility itself can increase significantly as a result of irrational behaviour induced by market volatility in the first place (Indro et al., 2002). These induced biases and irrational thoughts triggered by market volatility will likely have varying effects on the determinants of risk tolerance. For example, risk perception is negatively affected by a market downturn (Hoffmann et al., 2013). This may be because retail investors' fears and unwanted scenarios then become a reality, while those fears were previously suppressed during positive market times. Moreover, a higher level of financial knowledge has been shown to counteract impulsive emotional thoughts (Lusardi & Mitchell, 2017). The higher the level of financial knowledge, the more prepared one is for economic shocks. This is likely due to a better understanding of market behaviour and previous experiences with similar events. Additionally, it has been shown that older retail investors are more resilient to market volatility, which can be partly attributed to their greater investor experience (Charles & Kasilingam, 2013). Individuals with higher incomes may also have access to more resources and expertise to navigate market volatility, suggesting that income differences among retail investors may play a role in market movements. Furthermore, investors with higher levels of education tend to have greater financial knowledge and social capital, resulting in higher risk tolerance during economic shocks (Gupta & Kallan, 2021). Overall, it is important to take into account how a single economic shock or a different underlying investor market can impact an investor's mindset and behaviour.

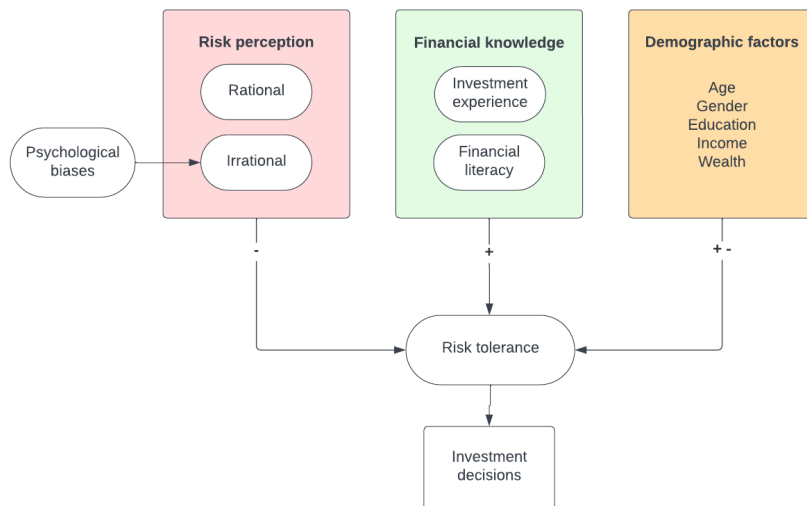
## **2.7 Research Hypotheses**

From the findings above, the following hypothesis is formed:

*The determinants will have the following effects on risk tolerance: Increasing risk perception will have a negative effect, increasing financial knowledge will have a positive effect, increasing age will have a negative effect, being a man in comparison to being a woman will have a positive effect, increasing wealth and income will have a positive effect, and increasing education level will have a positive effect.*

As mentioned in the literature review, various determinants have interconnected effects on one another. However, this thesis does not thoroughly investigate these interrelated effects. However, in combination with the hypotheses from above, an overview of the relationships of determinants with risk tolerance over time would be useful. Figure 1 below provides an overview of the conceptual model illustrating the relationships between these determinants and risk tolerance and their respective impacts based on the literature review.

**Figure 1: Conceptual model**



The conceptual model (Figure 1) shows how the risk tolerance of an investor is formed by its determinants. The influence of determinants is different, as one determinant has a positive influence and another a negative influence on risk tolerance. This is shown in the conceptual model by having financial knowledge depicted with a “ + ” shown in the linkage and green colouration of the determinant box as it is expected to positively affect risk tolerance, whilst risk perception is shown with a “ - ” linkage and red colouration of the determinant box as it has a negative expected effect on risk tolerance. As for the various other demographic factors, their effects are mixed and the box is thus orange with a “ + - ” linkage to risk tolerance.

Furthermore, as both rational and irrational feelings of risk perception are at stake, psychological biases can affect irrational thoughts in risk perception. Financial knowledge in this thesis is seen as a combination of financial knowledge and experience in investing. Demographic factors are mixed determinants and have been grouped accordingly. Overall risk tolerance affects investment decisions, as is shown at the bottom of the conceptual model.

### 3. Data & Method

This chapter outlines the methodology employed to investigate the main research question: "*What are the most influential determinants shaping the risk tolerance of Dutch retail investors?*" The research design and data source will be described, as well as the statistical analysis techniques used to identify the determinants that exert the most significant influence on risk tolerance.

#### 3.1 Research Design

The study adopts a quantitative research design, as it seeks to establish a causal relationship between the various determinants and the risk tolerance of Dutch retail investors. The key research method employed is OLS regression analysis, which allows for the examination of the combined effects of multiple independent variables on the dependent variable, i.e., risk tolerance. In this case, risk tolerance will be measured by a construct of various questions accountable for the risk tolerance of the respondent in that year. By finding out the significance and effect sizes of the determinants as variables, conclusions regarding the most heavily weighted determinants for risk tolerance can be drawn. Including control years in the regression analysis helps to mitigate any data bias caused by external events. This, in turn, allows for a more accurate understanding of how the determinants affect risk tolerance among Dutch retail investors.

#### 3.2 Data Collection

The main data source for this research will be the Dutch Household Survey (DHS) from De Nederlandsche Bank (DNB). This is a survey with over 2,000 independent representative households from the country. These surveys have been conducted for over 30 years. They are reliable for representing the Dutch population, being completed by all selected household members above the age of 16 for most of the queries which usually brings in around 5,000 respondents from all household members. These queries usually yield around 2,000 responses that fill in the entirety of the survey. As the data source is already reliable there will be no need for further sampling. With questions regarding multiple topics, this survey is useful for retrieving many demographic characteristics. Important to note is that the survey responses were collected from March to September for each year in which the survey was conducted.

The survey is set up as follows. The respondent receives questions comprising six categories:

1. General Information on the Household (HHI)	5,077 responses
2. Household and Work (WRK)	2,603 responses
3. Accommodation and Mortgages (HSE)	1,819 responses
4. Health and Income (INC)	2,478 responses
5. Assets and Liabilities (WTH)	2,543 responses
6. Economic and Psychological Concepts (PSY)	2,717 responses

Each of these categories has numerous questions regarding the topics at hand. The respondents are free to decide which questions they are willing to answer, and because of this not every category or question has an even amount of responses.

### 3.3 Data Analysis

For this study, an analysis needs to be conducted for multiple years to negate the possibility that the year researched differentiates greatly from the average due to external events. To achieve this, OLS regression analysis will be conducted to find out the significance of each determinant over multiple years. For this study, the primary focus will be 2022 as this contains the most recent data, but 2021, 2020, and 2019 as prior years are used as dummy years to help confirm there are no true anomalies as various extremities or external influences can influence one specific year. Thus, 2021, 2020, and 2019 will serve as control years to gain the most accurate conclusion. By finding out the effect sizes of the determinants in combination with significance, the importance of the determinants regarding risk tolerance can be concluded for overall retail investors but also real estate investors specifically.

#### 3.3.1 Dependent Variable

The dependent variable in this study is the "risk tolerance". Using the construct for risk tolerance created by Hermansson & Jonsson (2021) risk tolerance is defined.

The questions used by Hermansson & Jonsson (2021) are on a Likert scale like the DNB household survey questions regarding this topic, both being on a score scale of 1 – 7 from totally disagree (scored 1) to totally agree (scored 7). The questions from Hermansson & Jonsson for risk tolerance are:

- Q1. I can accept losing part of my saving if the chance of getting a good return is great
- Q2. I think one has to take risks to gain something
- Q3. I would like to increase risk because the return is too low

For which Q1 will be replaced by the following survey question: *I am prepared to take the risk to lose money, when there is also a chance to gain money.* Q2 will be replaced by the survey question: *If I want to improve my financial position, I should take financial risks.* Q3 will be replaced by the survey question: *If I think an investment will be profitable, I am prepared to borrow money to make this investment.* Although this last question does not correspond completely with Q3 created by Hermansson & Jonsson (2021), it does in essence mean the same thing; to borrow for investing is to increase risk for investing. It has to be acknowledged however that increasing risk can be done in multiple ways such as investing in riskier assets, not only using leverage as the to be used question describes.

To operationalize risk tolerance, a composite variable needs to be created out of all risk tolerance questions. To do this, firstly Cronbach's alpha score is tested. This will show the internal consistency reliability of the indicators tested for risk tolerance. Cronbach's alpha is widely used in research to evaluate the reliability of scales and questionnaires used to measure constructs such as attitudes, personality traits, and psychological states, thus it would be useful to test the consistency of the indicators for risk tolerance in this thesis. As seen in Table 1, an alpha score of 0.6919 is achieved using all three risk tolerance questions in 2022. This suggests a moderate level of internal consistency, indicating that the items in the scale are correlated and fit to be a composite variable to a certain extent. Although leaving Q1 out of the composite variable would lead to a higher Cronbach's alpha score and thus higher consistency as seen in Table 1, this question remains crucial for defining risk tolerance as a whole. For this reason, Q1 will remain in the composite variable. The Cronbach's alpha for 2021 is 0.7001, for 2020 it is 0.6691, and for 2019 it is 0.6628, indicating that alpha scores for risk tolerance in control years are of acceptable levels.

**Table 1:** Cronbach's Alpha test on risk tolerance defining questions (2022).

Risk tolerance	Observations	Mean	Correlation	Covariance	Alpha
Q1	1822	1.95	0.6758	1.817407	0.7460
Q2	1822	3.33	0.8368	.89094	0.5291
Q3	1822	2.71	0.8386	.8443938	0.4675
Test Scale				1.179671	0.6919

After testing for Cronbach's alpha for 2022 and the control years, standard deviations for all observations in the three variables are taken and divided by the total amount of questions used. This leads to the risk tolerance variable, which for all years has most observations measured within a range of -1 to +1, leading to higher than average and lower than average risk tolerance measurements for respondents.

### 3.3.2 Independent Variables

The independent variables will be based on the determinants that have been described in the literature review, for which some constructs and specific questions will be used. The following determinants will be translated into independent variables:

Risk perception, or the feeling of risk based upon an individuals' own experiences and knowledge in investing, will be determined based on the feelings of risk that the respondent has for the stock market in that specific year. Because the stock market will be used for volatility indication, the survey statement question "I do not invest in shares, because I find this too risky" will be used to show how much risk the respondent is perceiving for that year. It must be acknowledged that risk perception is not representative of all asset classes nor is it very elaborate compared to a construct for risk perception as in the study from Bairagi & Chakraborty (2021), who used various indirect questions to measure the psychological construct more thoroughly.

Financial knowledge will be measured with the survey question "How knowledgeable do you consider yourself with respect to financial matters?", which was answered in a four-way scoring from: not knowledgeable (1), more or less knowledgeable (2), knowledgeable (3) and very knowledgeable (4). Unlike the construct from Hermansson & Jonsson (2021) who measured financial literacy by asking financial questions to get a more objective view of financial literacy, this study lacks an elaborated construct and thus uses subjective questioning to measure financial knowledge. Despite not being the most accurate of ways to learn about the respondent's financial knowledge as this may be answered with bias and/or overconfidence and being unsure whether this is caused by higher financial literacy or experience, it should be a decent indicator regarding the financial knowledge of the respondent.

Age is quantified by the survey question asking for the year of birth, which is translated into the respondent's age (2022 being 0 years old for the 2022 household survey, 2021 being 1 year old, etc.), which will have a maximum spread of < 1 year.

Education level will be measured with the survey question that asks for the highest level of education that is completed by the respondent. Levels of education and their corresponding number regarding scoring are shown in the appendix.



Gender will be based upon the question of which gender the respondent is, in which 1 will equal men and 2 will be the indicator for women.

Income will be answered by the net income total aggregated data from the DNB survey, which accounts for the net income from all sources for the respondent after taxes. The net income will be integrated into the analysis using the euro currency. Due to the findings explained before by Yao & Curl (2011) regarding non-working respondents having a higher risk tolerance, people with negative income are dropped out of the respondent list to prevent false conclusions. Due to the responses of net income being highly skewed, the log function will be taken for more accurate findings. In the appendix, the distribution of net income and the log of net income can be found. Furthermore, the top and bottom 1% of remaining responses are dropped to negate the impact of outliers. This also helps reduce the effect of potential risk-taking for non-income respondents, as earlier explained by Yao & Curl (2011).

Wealth will be a construct of checking, savings and deposit accounts, mutual funds, and stock portfolio values of the respondent, which is the same construct that Hermansson & Jonsson (2021) used. By adding up the values respondents gave on these questions, an estimate of the wealth of the individual is created. Home values have been deliberately left out, as this is not liquid wealth and is thus not investable, so it should not have much effect on respondents' investment risk tolerance. Wealth is also shown in euros. Due to wealth being highly skewed in the responses, the log function will be taken for more accurate findings (see appendix for distribution of wealth and the log of wealth). For wealth, the top and bottom 1% of responses are dropped to negate the impact of outliers.

Biases induced by market volatility will be left out of the regression due to the inability to measure said biases, as well as the direct effect on determinants. For this paper, these biases are seen as one of the direct reasons for volatility-induced determinant significance changes.

The following Table 2 shows a list of the determinants and their abbreviations as variable names.

**Table 2:** determinants used and their variable abbreviations.

RP	Risk perception of the respondent (perceived risk perception level 1 to 7)
FK	Financial knowledge of respondent (perceived knowledge level 1 to 4)
AG	Age of respondent in years
GE	Gender of respondent
EL	Education level of respondent (by highest achieved, level 1 to 7)
LOGNI	Log of net income of the respondent
LOGWE	Log of the wealth of respondents

### 3.3.3 Regression Assumptions

In regression analysis, several key assumptions are of importance for the validity and reliability of the results. These assumptions will be addressed for the trustworthiness of regression analysis. The main assumptions include linearity, independence of errors, homoscedasticity (constant variance of errors), normality of errors, and absence of perfect multicollinearity.

Firstly, linearity is not of importance for nominal variables such as risk perception, financial knowledge, gender, and education. However, for age, wealth and net income which are continuous variables, linearity can be measured. All three variables do not show true linearity in scatterplots against the dependent variable risk tolerance (see appendix), but including these non-linear variables is justified for several reasons. Firstly, the real-world relationships between these socio-economic determinants and risk tolerance are often complex, and they inherently defy strict linearity. By using these variables in their raw form, the findings on the effects of these determinants on the respondent's attitudes towards risk can still be constructed. Furthermore, the impact of age, wealth, and net income on risk tolerance may not follow a linear trajectory logically speaking. For example, as individuals age, their risk attitudes may evolve nonlinearly due to changes in life circumstances, financial responsibilities, and retirement planning. The relationship between wealth or net income and risk tolerance may also show diminishing returns or non-linear effects as individuals reach certain thresholds of financial security, as explained by Yao & Curl (2011). Leaving out these determinants would also impact the results of other determinants, thus the decision is made to leave them in the regression.

In this analysis, it is assumed that errors in our data are independent because of its source. This is because in the DNB Dutch Household Survey each household's information is collected separately without any clustering.

To assess the assumption of homoscedasticity, the variance of errors was examined to ensure its consistency across different levels of the independent variables. Visual inspection of a scatterplot depicting the residuals against the dependent variable was conducted, aiming to detect any systematic patterns in the spread of residuals. The scatterplot shows that there is no issue of heteroscedasticity, as can be seen in the appendix. Furthermore, to evaluate the assumption of normality of residuals, a visual examination of a histogram of residuals was conducted which revealed a distribution that closely resembled a normal curve. This supports the assumption of normality of errors in the regression model, supporting the reliability of the results. The histogram of the residuals can be found below the scatterplot of residuals in the appendix.

A correlation matrix of data from 2022 is included to see whether certain independent variables are highly correlated to risk tolerance (RT). If this were the case, this would be a sign of multicollinearity, as well as an indication of a less efficient output of the regression. As seen in the correlation matrix shown in Table 3, none of the correlations are too high to be of concern. With risk perception (RP) correlation to risk tolerance being the highest at -0.38, there is only a moderate correlation at best. Cross-independent variable correlations are not high enough to be of concern either, showing little interference between one another. The correlation matrices for the control years can be found in the appendix. For these years, the correlation scores are also not high enough to be a cause for concern. The same findings apply to the real estate investors correlation matrix, which can be found in the appendix.

**Table 3:** Correlation matrix of risk tolerance and determinants for retail investors

	rt	rp	fk	age	gender	educat-n	logni	logwe
rt	1.0000							
rp	-0.4009	1.0000						
fk	0.1646	-0.1902	1.0000					
age	-0.2572	0.1635	-0.1035	1.0000				
gender	-0.2109	0.1535	-0.0940	-0.1711	1.0000			
education	0.2104	-0.1846	0.1418	-0.3076	-0.0317	1.0000		
logni	0.1722	-0.1704	0.1626	-0.0933	-0.2564	0.2818	1.0000	
logwe	0.1572	-0.1905	0.1138	0.1639	-0.1795	0.1887	0.2396	1.0000

In Table 4 below, the descriptive statistics of the 5003 remaining retail investors after data cleaning are shown for 2022 and control years. These show some interesting statistics, such as the RT scoring well out of bounds of the -1 to +1 range. This is due to a few outliers that were created by extremities in answers by a handful of respondents. In the year 2022, risk perception is shown to be leaning toward higher risk perception rather than low-risk perception. Respondents also answered to have on average higher financial knowledge than having lower financial knowledge. The average age of respondents is found to be around 59 years old, more men are respondents than women, and education level is on average around pre-university education, or senior vocational training or training through an apprentice system (see appendix). There are no major differences for control years, other than risk perception continuously dropping, and education level, wealth and net income continuously rising.

**Table 4:** Descriptive statistics of all variables for retail investors

	2022		2021		2020		2019			
Var	Mean	Std. dev	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Min	Max
RT	0	.7685969	0.03	.7964674	-0.01	.7524316	-0.02	.7698189	-0.989133	2.695558
RP	4.53	2.229755	4.65	2.21278	4.74	2.171567	4.80	2.166943	1	7
FK	2.42	.7352257	2.39	.7438497	2.31	.7310647	2.40	.7534327	1	4
AG	58.99	15.99381	57.96195	16.26031	58.04	15.83436	58.01	15.8437	20	96
GE	1.41	.4925876	1.42	.4932585	1.42	.4943538	1.41	.4915088	1	2
EL	5.07	1.436937	5.04	1.443799	4.98	1.43368	4.95	1.439575	1	7
NI	29616.15	16184.88	28924.07	15503.03	28805.74	15409.21	27112.45	14634.28	852	103510
WE	48305.06	69096.81	42182.91	61559.17	39696.88	62442.67	36243.59	59078.3	100	491200
LOGNI	10.09	.7707569	10.08	.7229012	10.08304	.7117132	10.02046	.7043046	6.747587	11.54742
LOGWE	9.887907	1.544046	9.7585	1.528162	9.609992	1.594016	9.434927	1.669584	4.60517	13.10461

For real estate investors, the dataset of all 202 respondents combined from 2022 and control years after data cleaning is shown below in Table 5. As can be seen, there are some differences between the overall retail investors and real estate investors in their determinants. Most notable are the higher average age of real estate investors, real estate investors being more likely to be male on average, and wealth and income are substantially higher. Most of these findings may be explainable by the greater capital needed to invest in real estate.

**Table 5:** Descriptive statistics of all variables for real estate investors

Var	Mean	Std. dev	Min	Max
RT	0	0.780491	-1.206171	2.148036
RP	3.950495	2.178028	1	7
FK	2.569307	.7036851	1	4
AG	61.01485	13.54281	24	84
GE	1.232673	.4235855	1	2
EL	5.391089	1.414396	1	7
NI	33332.5	20380.34	223	144695
WE	97617.75	228111.7	2	2130500
LOGNI	10.17377	.8297649	5.407172	11.88238
LOGWE	10.45297	1.684069	.6931472	14.57187

### 3.4 Methodology

To obtain the most representative findings for the importance of the determinants, multiple types of regression can be used. For a change in one variable, another variable will also likely be impacted as was explained in the literature review. For this reason, individual regressions that are running on each variable separately would deal with an omitted variable problem, showing false results. To create a more realistic model, an OLS regression analysis will be conducted. The purpose of this analysis is to identify the determinants that have the greatest impact on risk-taking in investment. This test will be conducted all at once in which the means, correlations, coefficients, and significance of both the dependent variable and the independent variables will be examined. This will provide valuable information about the effects of these factors. Additionally, effect sizes based on the results of the regression analysis will be measured. While significance tests (p-values) indicate whether an effect exists, effect size quantifies the magnitude or size of the effect giving a sense of the practical importance or real-world significance of the relationship between variables. Thus, integrating effect sizes into the results will give valuable insights into the importance of the determinants.

In the regression, The risk tolerance construct (=RT) will be used as the dependent variable and the investor determinants (risk perception (=RP), financial knowledge (=FK), the log of wealth (=WE), the log of net income(=NI), age (=AG), education level, (=EL) and gender (=GE)) as independent variables. The regression will be conducted for the years 2019, 2020, 2021, and 2022, in which 2022 will be the most interesting specifically, but prior years will be used as control years to see if there are no major differences in determinants R-squared to improve the accuracy of the study.

The model for the regression will be:

$$RT_t = \beta_0 + \beta_1 RP_t + \beta_2 FK_t + \beta_3 AG_t + \beta_5 GE_t + \beta_6 EL_t + \beta_7 LOGNI_t + \beta_8 LOGWE_t + \varepsilon_t$$

In this regression model,  $t$  will be the year from which the variable is retrieved,  $\beta$  its coefficient,  $\beta_0$  its constant, and  $\varepsilon$  its error term. Using this regression, a conclusion will be drawn on which determinant exerts the most influence on risk tolerance in a group setting giving information about the effect size and practical significance of each independent variable. In the following chapter, the results and discussion of this model will be shown. Firstly, the OLS regression analysis will be conducted and discussed, after which the effect sizes of each variable within this regression are shown and discussed for both retail investors and the sub-category real estate investors.

## 4. Results and Discussion

In this chapter, the empirical analysis examining the effects of determinants of risk tolerance on risk tolerance is shown for the year 2022, including 2021, 2020 and 2019 as dummy years. To find out what the linear relationship of determinants with RT is, an OLS regression is conducted on the retrieved data. After this, the Eta-squared of the determinants is calculated to find out which determinant has the most impact on risk tolerance. This approach will be used firstly for retail investors, after which the same analysis is used on real estate investors.

### 4.1 Retail Investor Results and Discussion

**Table 6:** OLS regression results for predicting Risk Tolerance for retail investors

Dependent variable Risk Tolerance test scores						
	Coef.	Std. Err.	t.	P> t	[95% Conf. Interval]	
RP	-.107***	.004	-23.04	.000	-.116	-.098
FK	.032*	.013	2.36	.018	.005	.058
AG	-.010***	.001	-15.13	.000	-.011	-.009
GE	-.269***	.021	-12.79	.000	-.311	-.228
EL	.030***	.008	4.00	.000	.015	.045
LOGNI	.002	.015	.13	.897	-.027	.031
LOGWE	.031***	.007	4.60	.000	.018	.044
2021	.039	.028	1.40	.161	-.015	.093
2020	.023	.028	.83	.409	-.032	.078
2019	.021	.028	.75	.451	-.034	.076
Constant	.912***	.169	5.40	.000	.581	1.243

Note: Adjusted R-Squared: 0.227, F-Statistic: 148.21,  $p < 0.001$ ,  $N = 5003$

Standard errors in parentheses: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

In this study, the impact of determinants risk perception (RP), financial knowledge (FK), age (AG) and gender (GE) of respondents, education level (EL), log scale of net income (LOGNI), and log scale of wealth (LOGWE) on risk tolerance (RT) is investigated. In the regression results shown in Table 6, an OLS regression was conducted on all determinants against risk tolerance in a singular model primarily on 2022 with 2021, 2020 and 2019 data integrated as dummy years. This table shows all regression results for each determinant and control year, with their coefficients, standard deviations, constants, observations, and R-squared score.

As can be seen in the results in Table 6, coefficients of determinants for risk tolerance are both positively and negatively impacting risk tolerance. Firstly, there is a negative relationship between risk perception and risk tolerance. Specifically, for every point increase in risk perception, risk tolerance changes by an average of  $-.107$ . The financial knowledge coefficient is moderately positive, indicating that a higher financial knowledge should be a cause for a higher risk tolerance. These findings may imply a negative correlation between risk perception and financial knowledge. This is supported by findings in the literature which have shown that risk perception and financial knowledge are negatively correlated as a higher financial knowledge may cause a decrease in risk perception, which is demonstrated in the results (Ediningsih et al., 2020). Furthermore, age shows a negative coefficient, bringing risk tolerance down the older the respondent is. This corresponds with findings from Charles & Kasilingam (2013) and Yao & Curl (2011), who found that the elderly tend to be more risk-averse than younger demographics. Gender is also shown to be negatively impacting risk tolerance, indicating that being a woman harms the average risk tolerance of the individual, supporting previous findings in the literature review from Charness & Gneezy (2012), whose research showed that women tend to take less risk than men. However, the findings of this thesis do not show whether gender differences have become less influential over a longer timeframe, as was claimed by Dwyer et al. (2002). The level of education has a positive influence on risk tolerance, suggesting that individuals with higher education are more likely to have a higher risk tolerance. This finding aligns with the results of a study by Baihaqqy et al. (2020). Additionally, the positive impact of both higher education and financial knowledge supports previous research that indicated this to be the case (Gupta & Kallan, 2021). While this thesis is not able to establish a causal relationship between these two determinants, their positive effects suggest that such a relationship is possible. Net income and wealth also impact the risk tolerance of the individual positively which corresponds with the findings from Bui et al. (2022) on income impacts and the findings from Yao & Curl (2011) and Cahyono et al. (2020) on wealth. However, it was expected that the income of the respondent would be a lot more impactful to risk tolerance; it is nearly neglectable in the findings of this regression. Overall, the effects found from all determinants are in line with the hypothesis that was created from the literature review.

As explained in the literature, external influences such as market volatility may impact the rationality of the respondents and thus the decision-making process (Dervishaj, 2021). For this reason, control years are included in the regression as dummy variables to negate the possibility that the year tested is impacted by external influences, as explained by Hoffmann et al. (2013). The positive coefficients on these dummy years in the results show that the overall risk tolerance in the control years 2021, 2020 and 2019 was higher than in year 2022. Furthermore, all dummy years were insignificant meaning that there was no major difference between the control years and 2022. This indicates that the year 2022 is representative for all control years, and shows that it is not heavily impacted by external influences.

The determinants of risk perception, age, gender, education level and wealth are shown to be significant to risk tolerance, although financial knowledge was less significant and net income is not significant. However, significance only shows the importance of the determinant to a certain extent and does not give concise conclusions as most significant determinants have P scores of 0.00. Thus, another tool of measuring determinant impact on risk tolerance is used. To find out the actual weighted impact of the determinants, the Eta-Squared (effect sizes) of the determinants on risk tolerance is measured, as seen in Table 7. A larger Eta-squared value suggests that a greater proportion of the variability in risk tolerance is attributable to the independent determinants included in the model. This highlights the strength of the relationship between the determinants and provides insight into the extent to which the determinants contribute to explaining the variability observed in the risk tolerance of the respondents. Thus, it serves as an important metric for evaluating the practical significance or importance of the determinants that are part of this research.

**Table 7:** Effect sizes of determinants on risk tolerance for retail investors

	<b>Eta-squared</b>	<b>[95% Conf. Interval]</b>	
Model total	.229	.208	.247
RP	.096	.008	.112
FK	.001	.000	.004
AG	.044	.033	.055
GE	.032	.023	.042
EL	.003	.001	.007
LOGNI	.000	.000	.001
LOGWE	.004	.001	.009
2021	.000	.000	.002
2020	.000	.000	.002
2019	.000	.000	.001

The effect sizes in Table 7 give a more clear indication about the overall importance of the independent variable on the dependent variable risk tolerance. Overall, the total model Eta-squared score for the determinants on the risk tolerance regression model was calculated to be 0.229. This indicates that approximately 22.9% of the variance in risk tolerance was explained by the predictors included in the model. A higher Eta-squared value suggests that the model has greater explanatory power and is more effective at predicting risk tolerance based on the specified determinants. Risk perception is shown to have the most impact out of all independent variables, with a small but significantly higher scoring than its peer determinants. The financial knowledge effect size was considerably lower, almost negligible in comparison to the risk perception effect size. Then, the age determinant was the most important independent variable of risk tolerance after the risk perception in this study by effect size. Although Charles & Kasilingam (2013) and Yao & Curl (2011) show that financial knowledge increases with age, this study cannot uncover whether the same is true here. Gender effect size is also fairly high in comparison to other determinants with an Eta-squared of 0.032, meaning that 3,2% of the variance in risk tolerance is explained by the gender of the respondent. The education determinant is only accountable for explaining 0.3% of the variance of risk tolerance, whilst net income has an Eta-squared of .000 meaning net income was almost completely negligible in this analysis. The wealth effect size was found to be at .004, which is also low for explaining the variance of the risk tolerance of the respondents. The control years are also more or less negligible from which we can conclude that they did not impact the results for the other determinants.

Overall it can be stated that risk perception has the largest effect size by a large margin, after which age and gender follow. Other determinants however appear to be of a lot less importance to risk tolerance in this analysis.



## 4.2 Real Estate Investor Results and Discussion

**Table 8:** OLS regression results for predicting Risk Tolerance for real estate investors

Dependent variable Risk Tolerance test scores real estate investors						
	Coef.	Std. Err.	t.	P> t	[95% Conf. Interval]	
RP	-.082**	.024	-3.39	.001	-.130	-.034
FK	.084	.074	1.14	.258	-.062	.229
AG	-.022***	.004	-5.44	.000	-.029	-.014
GE	-.484***	.127	-3.80	.000	-.735	-.233
EL	.054	.036	1.48	.142	-.018	.125
LOGNI	.075	.067	-1.13	.262	-.207	.0566
LOGWE	.038	.031	1.24	.218	-.023	.100
2021	-.007	.141	0.83	.410	-.284	.271
2020	-.002	.145	-0.01	.991	-.288	.285
2019	.116	.140	-0.05	.963	-.161	.393
Constant	2.07**	.934	2.22	.028	.228	3.91

Note: Adjusted R-Squared: 0.2234, F-Statistic: 6.78,  $p < 0.001$ ,  $N = 202$

Standard errors in parentheses: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

For real estate investors, regression results are noticeably different in comparison to overall retail investors as can be seen in table 8. Whilst coefficients of determinants are both positively and negatively impacting risk tolerance in the same way as they do overall with retail investors as was predicted in the hypothesis based on the literature review, various determinants have different effects for this investor group. Firstly, the risk perception effect is negative on a 1% significance basis to risk tolerance. Financial knowledge is not significant to risk tolerance, whilst age and gender are significant. Furthermore, education level, net income and wealth are all not of significance to risk tolerance. Dummy years appear to have higher scorings in coefficients but are not significant, indicating that although there are differences in determinant impacts between 2022 and control years, said differences are not significant. The constant is a lot higher than in the overall investor regression, indicating that real estate investors have a higher risk tolerance in comparison to the average investor as the base risk tolerance is higher in the regression.

One of the most noticeable differences in said coefficients between real estate investors and overall retail investors is the impact of gender and income. This indicates that women who invest in real estate are overall a lot less risk tolerant than men investing in this asset class. The increased risk tolerance due to a higher income for real estate investors may be impacted by the increased possibilities of leveraging against underlying assets using larger mortgages.

**Table 9:** Effect sizes of determinants on risk tolerance for real estate investors

	<b>Eta-squared</b>	<b>[95% Conf. Interval]</b>	
Model total	.262	.127	.325
RP	.057	.001	.130
FK	.007	.000	.047
AG	.134	.056	.224
GE	.070	.016	.148
EL	.011	.000	.058
LOGNI	.007	.000	.047
LOGWE	.008	.000	.050
2021	.000	.000	.039
2020	.000	.000	.000
2019	.003	.000	.004

Table 9 shows the effect sizes of determinants on real estate investors' risk tolerance. As can be seen, age has the highest effect size of all determinants for real estate investors, with gender and risk perception following. These results are somewhat different from the overall retail investor results, as risk perception had the highest effect size indicating it contributed most to explaining the variability observed in the risk tolerance. A reason that age may be more influential for real estate investors in comparison to retail investors overall, is that real estate is a capital-intensive asset class in comparison to most others. As age is correlated with wealth (Vandenbroucke & Zhu, 2017), real estate investors' average age is higher in comparison to the average investor in any asset class (see Tables 4 and 5 for the comparison in this thesis).

Overall, it appears that in both the average retail investor and the real estate investor the three main determinants of influence are risk perception, age, and gender. For real estate investors, age is the most influential determinant in their risk tolerance, whilst risk perception is the most influential determinant of risk tolerance for the overall retail investor.

## 5. Conclusion

This study focused on the determinants of risk tolerance for Dutch retail investors and Dutch real estate investors, namely their impacts and importance for the risk tolerance of the individual. The research question for this research was as follows: *What are the most influential determinants shaping the risk tolerance of Dutch retail investors?* To answer this question, both a literature review and an analysis was conducted. Existing literature initially showed the importance of multiple determinants, such as risk perception and financial knowledge, as well as age, gender, education, net income, and wealth of the individual. It also explained how multiple determinants are intertwined and (negatively) correlated with one another, adding to the complexity of risk tolerance determinant research. For one, research has shown that financial knowledge and risk perception have negatively correlating effects on one another. The results of the findings of this thesis support these findings. Furthermore, literature has shown that financial knowledge is an important determinant in the United States. However, the opposite is true in this study. This may indicate differences between the demographics which support the uniqueness of the Dutch investor, but it can also be because of differences in measurements due to questions asked and/or timing of the survey and the effects of external influences.

The primary goal of this research was to gain insight into the impact of various determinants on the risk tolerance of Dutch retail investors. Using multiple known determinants of risk tolerance over multiple years, as well as taking into account induced behavioural biases caused by external influences, fitting results are sought. The significance of the relationship between the determinants and risk tolerance was assessed using statistical tests, delving into both the strength and direction of these connections. The findings from this research add to the understanding of risk tolerance for Dutch retail investors and real estate investors, bringing knowledge as to what determinants are most important for determining risk tolerance and how they influence investor behaviour.

The findings of this thesis show that a higher risk perception negatively impacts risk tolerance, and a higher financial knowledge and higher education level positively impact retail investors. Furthermore, findings on gender, age, income, and wealth were in line with previous research, although the importance of various variables such as financial knowledge and income was expected to be more substantial. Overall, the analysis provided a comprehensive view of the determinants of risk tolerance among Dutch retail investors, with significant insights into how these determinants interact with risk tolerance and some insights into determinant interplay. Said interplay between different determinants, such as the combined effect of risk perception and financial knowledge, as well as the demographic factors, illustrates the complexity of how risk tolerance among retail investors is determined and shows that interaction between determinants is still a field that requires more research. Findings were similar for real estate investors, although from the three most influential determinants of risk tolerance, the overall most influencing determinant hierarchy was different.

Concludingly, to answer the research question, the results show that risk perception in this thesis is the most influential determinant for the risk tolerance of Dutch retail investors. Other determinants, such as financial knowledge, education, age, and gender form a valuable influence on risk tolerance as well. Although wealth appeared to be somewhat influential, the income of respondents was mostly negligible. For real estate investors, the most important determinant for determining risk tolerance was the age of the investor, after which risk perception and gender ensued. Other determinants had similar findings in comparison to the overall retail investor findings. The results of this thesis add to the growing literature on heterogeneity in risk tolerance and contribute to the fields of risk perception, financial knowledge and other determinants. Overall, it shows the importance of determinants and thought processes of Dutch retail investors and more specifically real estate investors, showing that one can look best at their risk perception to change investment behaviour.

These findings are particularly relevant for understanding the evolving risk tolerance profiles of Dutch retail investors and real estate investors, informing investment strategies and financial planning. Whilst this study offers valuable insights, it is limited by its scope and the available data. The survey questions used may not have fully captured the various determining factors that contribute to measuring risk tolerance, just risk tolerance itself, on their respectable underlying determining factors. Specifically regarding risk perception, the questioning was surrounded by risk tolerance questions which may have influenced the thought process of the respondent. The same goes for financial knowledge, which is based on a question which can be highly vulnerable to biased answers. This is likely to have influenced the outcome of specific determinants, and thus the findings of this thesis as a whole. Furthermore, the data from the DNB is collected over the summer months, which was shown to be potentially impactful on respondent feelings and thus potentially induce different behaviours of respondents (Hirshleifer & Shumway, 2003; Bos & Zwinkels, 2015). The conducted research may also have missed out on numerous other impactful determinants of risk tolerance, which this study was unable to identify and/or integrate into the research. This may have impacted the results of the thesis. Furthermore, the findings of this thesis are based on the average age of respondents which was found to be 59. This is fairly high and conclusions may thus not be very representative for younger generations. For the findings on real estate investors, the sample size after data cleaning was somewhat small. Because of this, findings may be less accurate than the overall Dutch retail investor sample.

Future research can improve this thesis by creating better constructs to measure risk tolerance, but also determinants such as risk perception and financial knowledge more accurately. One can also focus on exploring the effects of additional determinants on risk perception that may have been missed in this study. More avenues of research on this topic can be on determinant correlations, for instance, the effect of financial literacy on risk perception and vice versa to better understand the impact of determinant correlations on risk tolerance forming. Furthermore, the changing determinant impact of risk tolerance over longer periods is also a topic that can be researched further, as this study shows differences in determinant impacts between the years tested. The same study can also be conducted on different or more specific investor demographics further to enrich the understanding of investors' risk tolerance, as this thesis did for real estate investors.

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## 7. Appendix

### Survey questions

KUNDE

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

- 1 not knowledgeable ..... ADVIES
- 2 more or less knowledgeable ..... ADVIES
- 3 knowledgeable ..... ADVIES
- 4 very knowledgeable ..... ADVIES

The following statements concern saving and taking risks. Please indicate for each statement to what extent you agree or disagree.

Please indicate on a scale from 1 to 7 to what extent you agree with the statement.

1 means **'totally disagree'**

7 means **'totally agree'**

totally disagree								totally agree
1	2	3	4	5	6	7		

SPAAR2

I do not invest in shares, because I find this too risky..... SPAAR3

SPAAR3

If I think an investment will be profitable, I am prepared to borrow money to make this investment..... SPAAR4

SPAAR5

If I want to improve my financial position, I should take financial risks..... SPAAR6

SPAAR6

I am prepared to take the risk to lose money, when there is also a chance to gain money ..... BESCHRYF

GEBJAAR

Year of birth of the respondent

any answer ..... GESLACHT

GESLACHT

Sex of the respondent

1 male ..... POSITIE

2 female ..... POSITIE



## OPLMET

Highest level of education completed

1 (Voortgezet) speciaal onderwijs / (continued) special education .....	BEZIGHEI
2 Kleuter-, lager- of basisonderwijs / kindergarten/primary education.....	BEZIGHEI
3 Voorbereidend middelbaar beroepsonderwijs (VMBO) / pre-vocational education.	BEZIGHEI
4 HAVO/VWO / pre-university education .....	BEZIGHEI
5 MBO of het leerlingwezen / senior vocational training or training through apprentice system.....	BEZIGHEI
6 HBO (eerste of tweede fase) / vocational colleges .....	BEZIGHEI
7 Wetenschappelijk onderwijs WO / university education.....	BEZIGHEI
8 Did not have education (yet) .....	BEZIGHEI
9 other sort of education/training.....	BEZIGHEI

$$ntot = btot - ib + alik + beurs + studlen + otoel + ftoel + erf + hs + hg + \min(0, winst) + \min(alim, 0) + rente + og.$$

Note that for the calculation of the net income, a negative profit (loss) and negative alimony (paid alimony) are added to the gross income (a negative number is added). Furthermore, looking at the equations mentioned above, we see that the total gross income is not necessarily greater or equal to the total net income. For example, a student who receives only a scholarship or parental support has a gross income equal to zero, while his net income is greater than zero.

### *Main asset, debt, and mortgage components*

From the questionnaire 'Assets and liabilities' we obtain in total twenty-five main asset components (B1-B4, B6-B8, B11-B25, B28-B30), eight debt components (S1 through S8), and one mortgage component (B19Hy). From the questionnaire 'Accommodation and mortgages' we obtain two main asset components (B26OG and B27OG) and two mortgage components (B26HY and B27HY).

*Table 4. Overview of all main asset, debt and mortgage components*

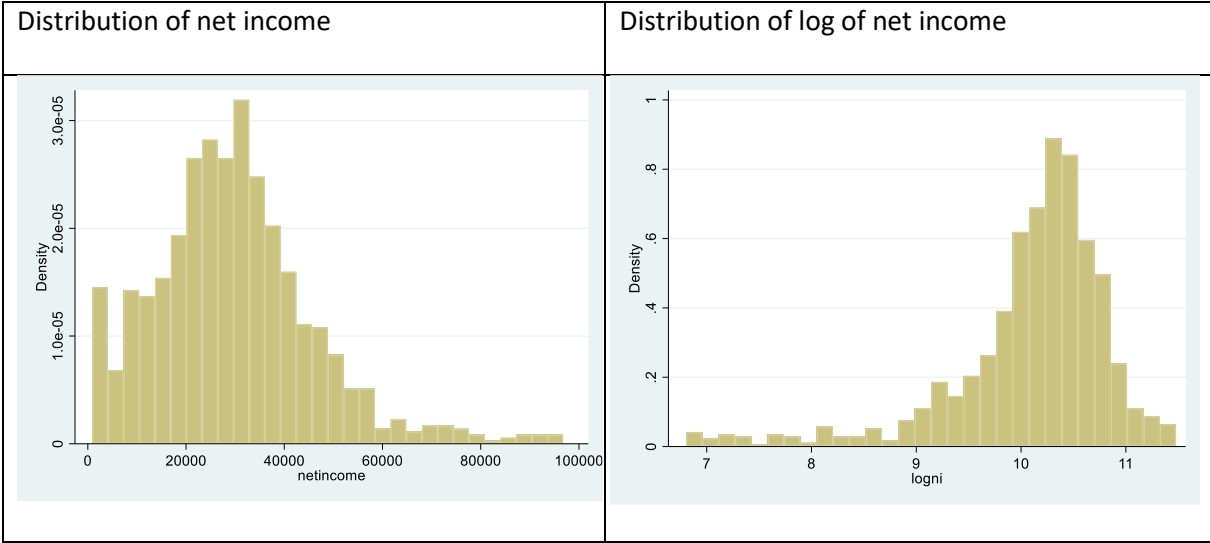
#### *Questionnaire Assets and Liabilities*

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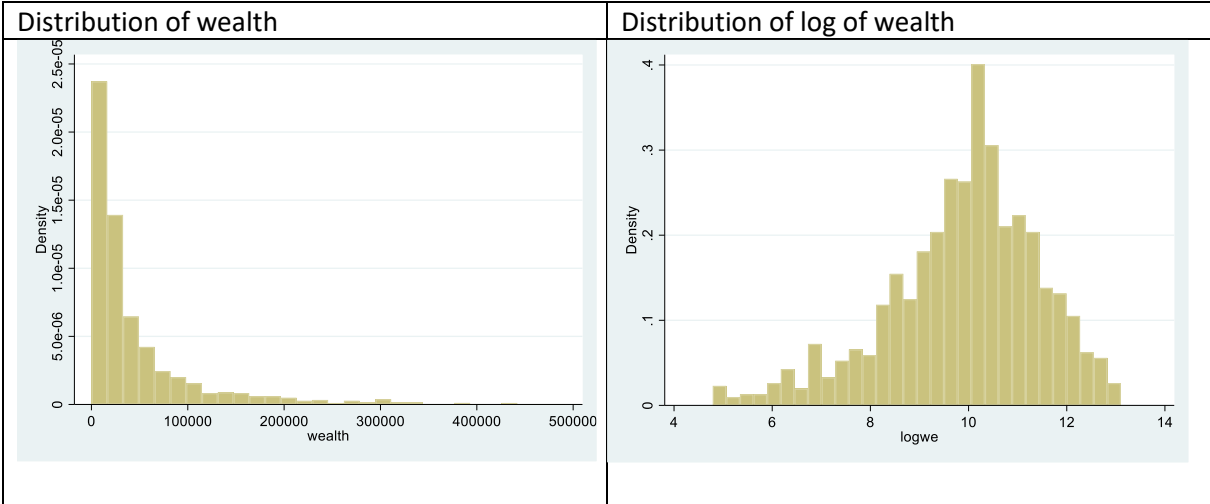
B1	checking accounts
B2	employer-sponsored savings plans (1=yes, 0=no)
B3	savings or deposit accounts
B4	deposit books
B6	savings certificates
B7	single-premium annuity insurance policies
B8	savings or endowment insurance policies
B11	growth funds
B12	mutual funds and/or mutual fund accounts
B13	bonds and/or mortgage bonds
B14	stocks and shares
B15	put-options bought (1=yes, 0=no)
B16	put-options written (1=yes, 0=no)
B17	call-options bought (1=yes, 0=no)
B18	call-options written (1=yes, 0=no)
B19Og	pieces of real estate, not being used for own accommodation
B19Hy	mortgages on pieces of real estate, not being used for own accommodation
B19Vz	value life insurance mortgage real estate
B20	cars

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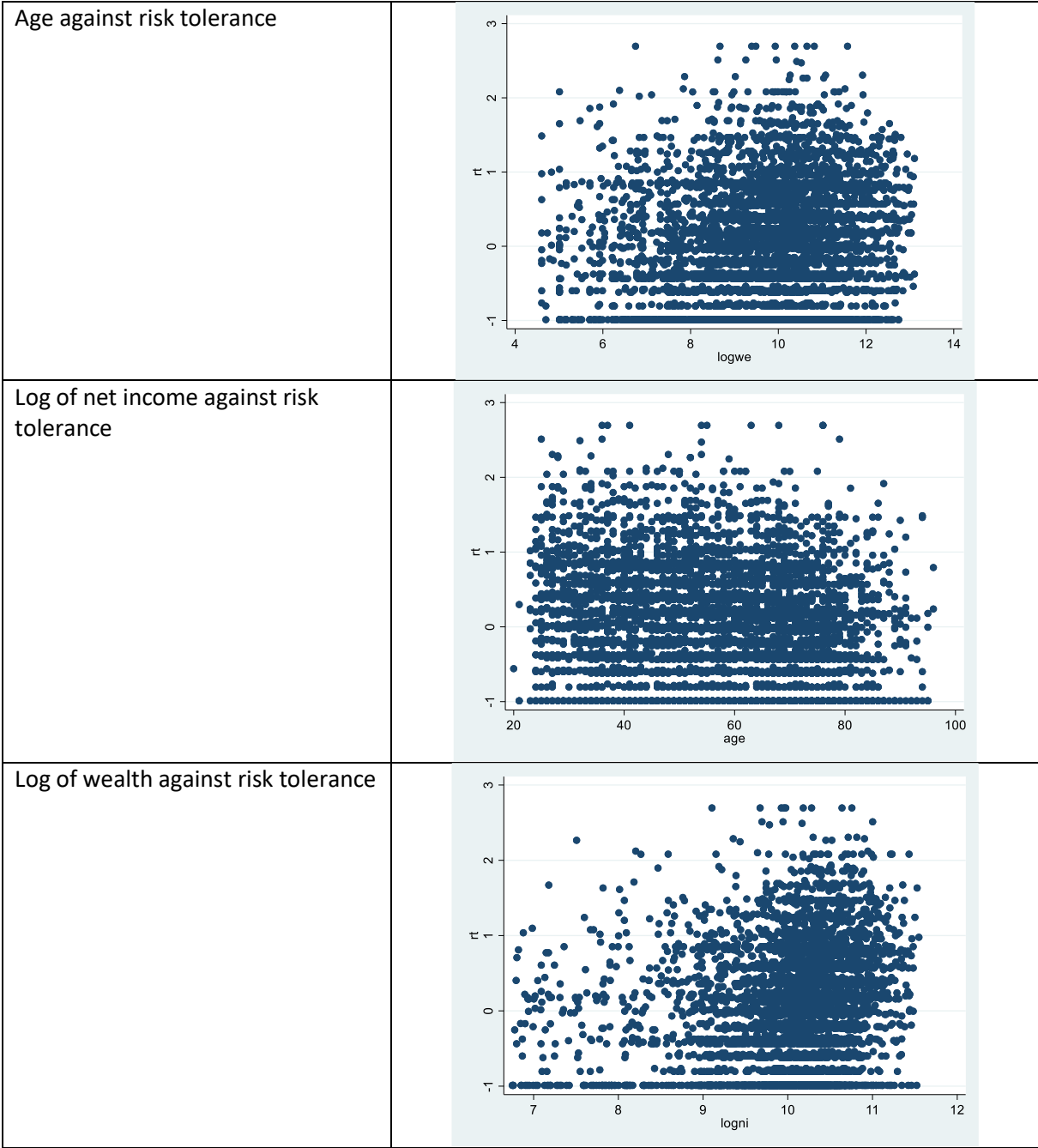
**Distribution of (log of) net income in 2022**



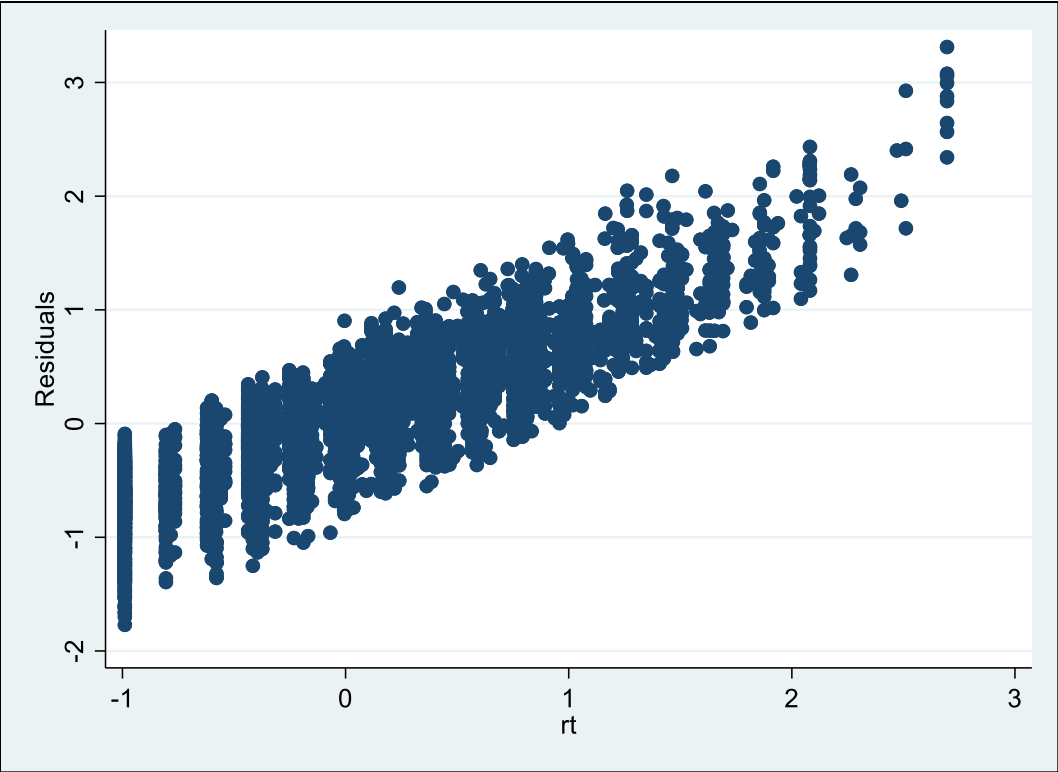
**Distribution of (log of) wealth in 2022**



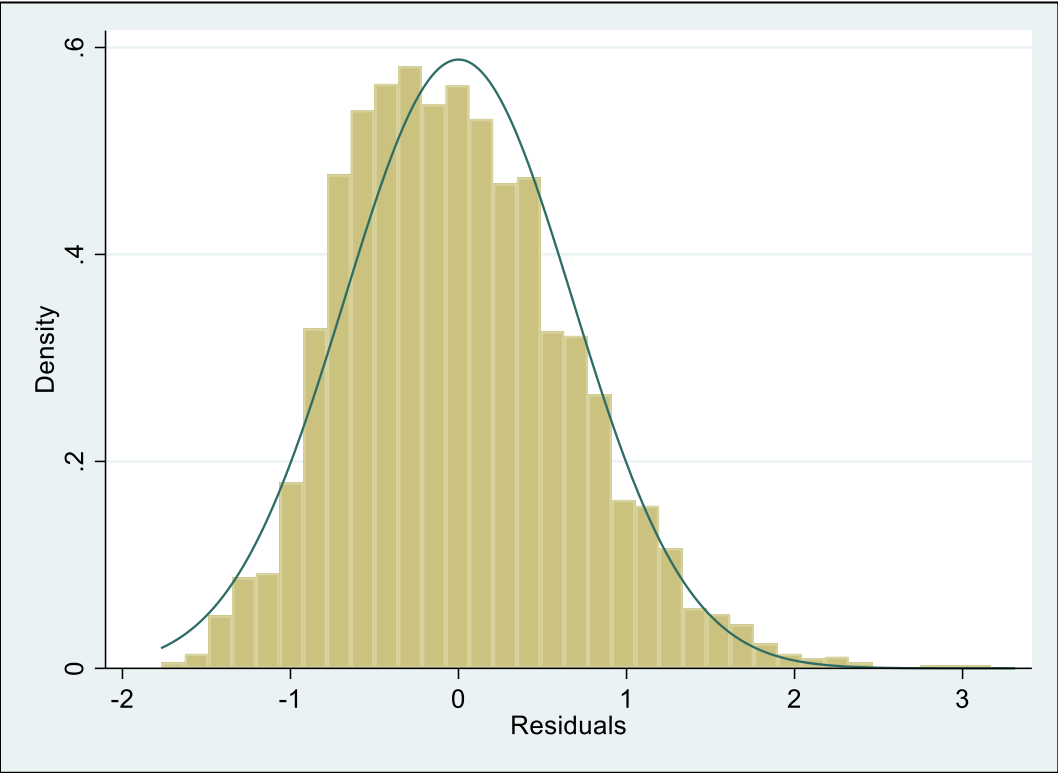
Scatterplots of age, net income and wealth against risk tolerance



Scatterplot of residuals against risk tolerance



Histogram of residuals



## Correlation matrices 2021, 2020, 2019, real estate investors

Correlation matrix 2021

	rt	rp	fk	age	gender	educat~n	logni	logwe
rt	1.0000							
rp	-0.4065	1.0000						
fk	0.1080	-0.1692	1.0000					
age	-0.2556	0.1710	-0.0845	1.0000				
gender	-0.1788	0.1771	-0.1194	-0.1690	1.0000			
education	0.2356	-0.2403	0.1462	-0.3217	-0.0506	1.0000		
logni	0.1624	-0.1705	0.1537	-0.0358	-0.2745	0.2806	1.0000	
logwe	0.1147	-0.2314	0.1717	0.1387	-0.1817	0.2134	0.2668	1.0000

Correlation matrix 2020

	rt	rp	fk	age	gender	educat~n	logni	logwe
rt	1.0000							
rp	-0.3789	1.0000						
fk	0.1838	-0.1309	1.0000					
age	-0.2000	0.1067	-0.0645	1.0000				
gender	-0.2117	0.1459	-0.1458	-0.1842	1.0000			
education	0.2066	-0.1660	0.1388	-0.3575	-0.0324	1.0000		
logni	0.1516	-0.1526	0.1609	-0.0564	-0.3061	0.2893	1.0000	
logwe	0.1820	-0.1672	0.2074	0.1694	-0.1867	0.1590	0.2862	1.0000

Correlation matrix 2019

	rt	rp	fk	age	gender	educat~n	logni	logwe
rt	1.0000							
rp	-0.3758	1.0000						
fk	0.1100	-0.1779	1.0000					
age	-0.2223	0.0981	-0.0579	1.0000				
gender	-0.2291	0.1880	-0.1804	-0.1369	1.0000			
education	0.1841	-0.2048	0.1420	-0.3162	-0.0603	1.0000		
logni	0.1399	-0.2035	0.2004	-0.1075	-0.2931	0.2908	1.0000	
logwe	0.1094	-0.2172	0.1725	0.1701	-0.2127	0.1696	0.2557	1.0000

Correlation matrix real estate investors

	rt	rp	fk	age	gender	educat~n	logni	logwe
rt	1.0000							
rp	-0.2529	1.0000						
fk	0.2097	-0.2087	1.0000					
age	-0.3121	-0.0632	-0.1330	1.0000				
gender	-0.2061	0.0934	-0.1128	-0.2070	1.0000			
education	0.2082	-0.1568	0.1251	-0.2115	-0.0447	1.0000		
logni	0.1522	-0.2212	0.2248	-0.1327	-0.3177	0.2166	1.0000	
logwe	0.0715	-0.2035	0.1037	0.2379	-0.1719	-0.0443	0.0684	1.0000