Justus-Liebig-Universität Gießen

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Masterthesis

# An empirical analysis of private investor characteristics and their impact on asset allocation

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**List of abbreviation**

AMEX ..... *American Stock Exchange*
ECB ..... *European Central Bank*
FKP ..... *Financially knowledgeable person*
HHID ..... *Household identifier number*
NASDAQ ..... *US-Tech stock exchange*
NYSE ..... *New York Stock Exchange*
Pers id ..... *Personal identifier number*
PHF ..... *Panel on Household Finances*
Pid ..... *Person identifier number at the household level*
SCF ..... *Survey of Consumer Finances*
T-bills ..... *Treasury Bills*
T-bonds ..... *Treasury Bonds*

## 1. Introduction

It is widely acknowledged that Germany faces challenges with its pension system due to demographic changes, as the number of retirees in Germany is increasing at a faster rate than that of contributors. According to figures by *Deutsche Rentenversicherung*, published by *Statista*, over the past three decades, the number of contributors has grown by 21 percent, whereas the number of retirees has increased by 56 percent (Janson, 2023). This implies that there are increasingly fewer funds in the pension fund available for future pensions of retirees. Börsch-Supan (2000) already concluded that, in light of the demographic changes anticipated for Germany, a substantial reinforcement of private retirement provisions is "a straightforward necessity" (Börsch-Supan, 2000).

Moreover, even though investing in stocks yielded positive high single digit average yearly returns over the last 50 years (Deutsches Aktien Institut, 2023) - and thus might embody a suitable asset class for private retirement provision - Germans hold a relatively low number of stockholdings in relation to total financial assets (OECD, 2023). A survey of Verband der Privaten Bausparkassen (2023) has further shown that, despite earning low interest rates over almost the entire last decade, the most widespread asset classes in Germany have been the checking account and the savings account (38% and 33% participation rates). Only 20% of survey participants invested in stocks, up from 17% in 2021. Therefore, the question arises why people do not invest their money more wisely.

This paper aims to offer a contemporary analysis on how chosen personal and socio-demographic characteristics impact private portfolio allocation in Germany. Most of the studies already conducted are based on datasets from the USA and mostly used the Federal Reserves' Survey of Consumer Finances (SCF), e.g., Campbell (2006), Bertaut and Starr-McCluer (2000), Chang, Hong and Karabarbounis (2018), Wachter and Yogo (2010), Poterba and Samwick (2001). In addition, Davis and Kim (2017) studied a dataset of the Eurosystem Household Finance and Consumption survey to shed light on portfolio allocation decisions across fifteen European countries. Research on personal characteristics that influence portfolio allocation in Germany goes back to the studies conducted by Börsch-Supan and Eymann (2002) who used the *Income and Expenditure Survey,* and Barasinka et al. (2008) who used the *German Socioenomic Panel*. The majority of the papers identify age, marital status, gender, income, wealth and financial education as

important factors. Furthermore, geographical background and economic expectations are also found to impact asset allocation (Berlemann & Luik, 2014; Sung & Hanna, 1996).

In contrast, this paper uses the newest available dataset of the Panel on Household Finances (PHF) provided by Deutsche Bundesbank, which is a representative dataset for the German population, to study the impact of age, gender, income, wealth, financial education, marital status, the geographical background and different economic expectations on portfolio allocation. It aims to answer the research question "which of the chosen personal and socio-demographic characteristics impact asset allocation?". Therefore, the study focuses on five investigations juxtaposing the relationships between the personal characteristics and 1) the likelihood to invest in financial assets at all, 2) the share of risky assets in private portfolios, 3) the share of stocks in the latter, 4) the likelihood to invest in bonds and 5) the share of deposits in the portfolio.

Both positive and negative significant effects the majority of the independent variables on the dependent variables have been found. More precisely, age, gender, income, wealth, financial education, marital status, the geographical background, and economic expectations all affect asset allocation. The effect of expectations regarding deposit interest was found to be insignificant.

Section two lays the theoretical foundation of this paper and first summarizes rational reasons to invest one's money in financial assets compared to holding non-investment grade assets such as cash. In addition, it gives an overview of prior research on the impact of personal characteristics and asset allocation based on which the importance and the effect of the different variables can be hypothesized. This sub-chapter is further structured according to the independent variables. In the following methodology and data section, the dataset and the calculation steps of the variables, as well as the empirical models are further explained. It is attempted to provide a suitable foundation for the replicability of the investigation in order for the results to be validated by other authors. After the analysis section, a prior dataset is studied and interpreted, to generalize the empirical results of this paper.

## 2. Literature review and hypothesis formation

### 2.1 Determinants of asset allocation

Investing in financial markets instead of holding cash can be rationalized through several key arguments, supported by academic literature. First, there is the potential to earn higher returns through investments in financial assets such as stocks or bonds (Bodie et al., 2017). For example, between 1926 and 2015, the average returns for US stocks (all stocks listed on the NYSE, AMEX, and NASDAQ) were 11.77% per year, and for US T-bonds 6.00% annually, while the returns for US T-bills averaged only 3.47% (ibid.). Furthermore, according to calculations by Damodaran (2024), an initial investment of 100 US dollars in the stock index S&P 500 in 1928, accounting for reinvested dividends, would have grown to over $785,000 by 2023. Meanwhile, the same amount invested in 3-month T-Bills as a proxy for cash would have become approximately $2,250, and if placed in US Treasury Bonds, the investment would have reached around $7,300. This demonstrates the significant differences in long-term returns across asset classes, highlighting the substantial growth potential of equity investments in contrast to the more modest returns of cash equivalents and government bonds.

Furthermore, between 2012 and 2022, Eurozone interest rates ranged between zero and 0.5 percent due to the quantitative easing program introduced by the ECB to counteract the recession triggered by the global financial crisis (ECB, n.d.). As a result, banks adjusted their interest rates on deposits, wherefore this asset class did not yield any returns at all. According to these facts, one might argue that a rational German investor would allocate at least some of their funds towards asset classes offering potential for higher returns in order to counteract to the addressed problems concerning the pension system.

Secondly, larger asset returns simultaneously offer the possibility to hedge against inflation, thus countering the devaluation of cash. In their study, Fama and Schwert (1977) examine which asset classes are well-suited to hedge against inflation. They consider a period between 1953 and 1971 and concluded that U.S. government bonds and bills provide a complete hedge against expected inflation. To their surprise, stocks did not seem to offer a hedge against inflation. However, Ely and Robinson (1997) have shown that stocks may indeed provide a hedge against price increases in the long run. Kim and Ryoo (2009) confirmed the findings observing the long-run relationship between

goods prices and stock prices using century-long US data. A later study by Salisu et al. (2020) also demonstrated that US stocks can actually be utilized as an inflation hedge when one chooses price level data over index level data for stock returns. Other studies revealed that investing in metals can also act as an inflation hedge. Ghosh et al. (2004) also concluded that gold may be an inflation hedge in the long run. Bahram et al. (2003) findings indicated that gold and silver may be a suitable hedge against inflation for both the short- and long-run. Beckmann et al. (2012) used data from for the USA, UK, Japan and the Euro Area for the period 1970 to 2011 and uncovered that gold can partially serve as an inflation hedge in the long term. The effect was found to be stronger for the USA and the UK as compared to Japan and the Euro Area. Therefore, investing in financial assets may offer the advantage of countering the inflation rate.

Thirdly, besides offering higher returns as compared to holding cash, the inclined risk one is facing through investing can be reduced by diversifying investments across various asset classes. By allocating capital to a broad range of securities with low or non-correlated returns, the portfolio's expected return theoretically converges towards a risk-free rate of return as the number of assets approaches infinity (Werner, 1997). This concept is commonly associated with the principle of diversification described in modern portfolio theory (Markowitz, 1952).

The question why the reality is quite different when it comes to investing can be explained by behavioral finance theory. Behavioral finance theory has its foundations in the research conducted by Kahnemann and Tversky (1974), who were among the first researchers to discover different factors and heuristics which explain people's irrational behavior in decision making. A well-known theory is the so-called *Prospect Theory*, developed by Kahnemann and Tversky (1979). It explains anomalies in individuals' risk taking in decisions under risk and it further explains that individuals face a phenomenon known as loss aversion, which describes that financial losses are typically perceived as more impactful than equivalent gains (Shiller, 1997). According to this, individuals tend to be risk averse in terms of potential gains, wherefore they would rather opt for a certain but smaller gain over a risky but potentially higher gain (Kahnemann & Tversky, 1979). This phenomenon could explain why individuals rather invest in less-risky assets.

Later studies confirm the existence of the biases. Kaustia et al. (2008) found that people tend to anchor their future return expectations on the stock markets to past performance and this effect was reduced if the individual is financial literate. This effect is referred to as *anchoring* which explains that individuals' estimations and forecasts tend to adhere excessively to baseline data (Kahnemann & Tversky, 1974).

Besides the psychological factors, research finds that financial decision making is influenced by socio-demographic as well as personal characteristics, wherefore these factors may further explain the irrational behavior in context of asset allocation. Empirical evidence indicates that factors such as education, age, gender, income, and marital status affect an individual's investment behavior (Riley & Chow, 1992; Schooley & Worden, 1999; and Love, 2010). Lan et al. (2018) used different statistical approaches as well as data mining techniques to show that the investors' decisions behavior can be predicted by demographic characteristics. They concluded the personal and demographical variables gender, age, occupation, education, knowledge, experience and income as significant predictors. Campbell (2006) researched the influence of investor wealth, income, age, race and education on public equity participation and discovered significant coefficients for all variables except wealth underlining the importance of personal characteristics in portfolio choice. A comprehensive review of the existing research and literature covering the selected personal characteristics is presented in the following section.

## 2.2 Socio-demographic characteristics and asset allocation

### 2.2.1 Impact of age on asset allocation

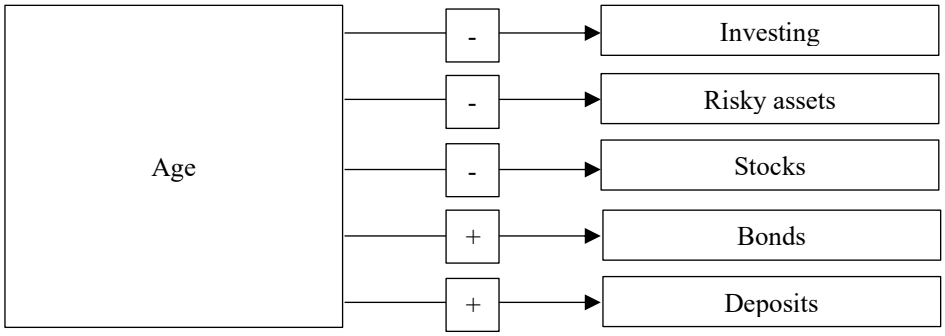
Theory covering the relationship of age and asset allocation has its foundations in the so-called *life cycle hypothesis*, which was developed by Modigliani and Brumberg (1954). According to this theory, which seeks to elucidate the savings behavior within an economy, individuals save money during their active working years, and subsequently make use of the accumulated funds during their retirement. Therefore, wealth accumulation in general follows a "hump-shaped" pattern (ibid.). Based on this, research has shown that portfolios increase in risk during the years of employment and become less risky, i.e., investors hold less risky assets with retirement approaching (Banks & Smith, 2002; Andersson, 2001, Cobb-Clark & Hildebrand, 2009).

Further research conducted on the relationship between age and risk showed, that with increasing age one is less tolerant to take on financial risk, i.e., to allocate less money towards risky assets. Wallach and Jogan (1961) were among the first to study the relationship between age and risk tolerance. The results of their study give a first indication that younger individuals tend to be more risk tolerant than older persons. Morin and Suarez (1983) studied household demand for risky assets using a dataset of the Canadian Survey of Consumer Finances and determined that risk tolerance consistently diminishes with increasing age. Yao et al. (2011) studied a sample of 21,167 respondents for the period 1989 to 2007 and further found a negative relationship between age and risk tolerance. Bashir et al. (2014) concluded similar results in their paper studying the impact of demographic characteristics and risk tolerance on investors' risk perception and portfolio management. The authors summarized that older respondents are more risk-averse than younger respondents. Confirming the findings, Zhang et al. (2015) found that older investors rather hold more cash and less property and stocks.

Several additional studies verified that financial risk tolerance decreases with age. The investigation by Gibson et al. (2013) correspondingly demonstrates that the average risk tolerance of older study participants significantly diminishes. The reason for these results could lie in the fact that younger investors have a longer duration to recover from potential losses as compared to their older counterparts (Hallahan et. al., 2004; Arano et. al., 2010).

Conversely, there exist some studies which unveiled that age has a positive relationship to risk tolerance. According to a study conducted by Grable (2000), older participants are more risk-tolerant than younger ones. Studying factors that are related to the bond and stock holdings of households using the 1989 SCF dataset, Zhong and Xiao (1995) came to the conclusion that the dollar value of the stock holdings exhibited a positive correlation with age, underlining these findings. However, the majority of the literature came to the conclusion, that age and asset allocation towards risky asset classes are negatively linked. Figure 1 displays the hypotheses for the relationship between age and the dependent variables. The positive and negative signs portray the direction of the hypothesized relationships.

**Figure 1**




*Impact of age on the dependent variables. Source: Own creation.*

In accordance with the majority of papers already reviewed, it is posited that as age increases, the risk profile of one's portfolio decreases, leading older individuals to allocate their money towards less risky investments. This is, as discussed before, due to older individuals being not as capable of enduring potential losses as younger people and that they, furthermore, might make use of the funds during retirement as they lack labor income. This would imply holding funds in liquid and less-risky assets. Consequently, the hypotheses are formulated as follows:

*Hypothesis 1a)* With increasing age, the likelihood of investing in financial assets decreases.

*Hypothesis 1b)* With increasing age, the proportion of risky assets in the portfolio diminishes.

*Hypothesis 1c)* With increasing age, the proportion of stocks in the portfolio decreases.

*Hypothesis 1d)* With increasing age, the likelihood to invest in bonds increases.

*Hypothesis 1e)* With increasing age, the allocation towards deposits increases.

### 2.2.2 Impact of gender on asset allocation

Next, the impact of gender in investment decisions is broadly discussed by theory and by previous literature. Women are said to be more risk averse than men (Dohmen et. al., 2011; Jianakoplos & Bernasek, 1996) and less overconfident when trading in the stock market (Barber & Odean, 2001). In their paper, Bogan et. al. (2013) surveyed the relationship between gender diversity and investment decisions by investigating the gender composition of a fund management. The authors found that team composition influences

financial decisions regarding the assessment of risk and loss. Their results indicate that the likelihood of opting for a riskier investment by the fund management is elevated in the presence of male individuals.

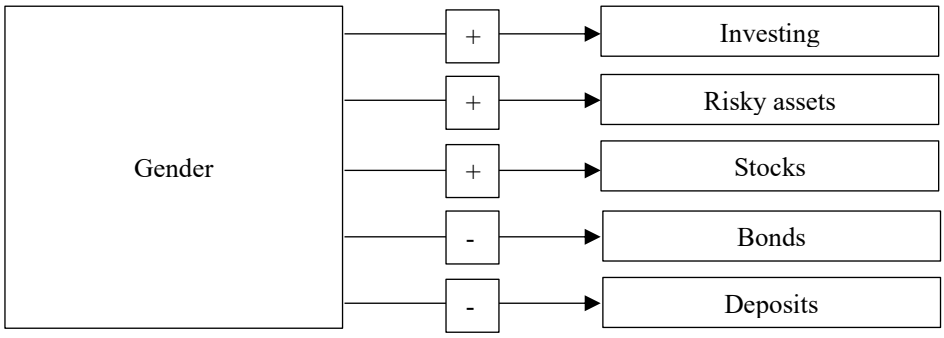
In a large meta-study, which comprises the analysis of 150 studies, Byrnes et. al. (1999) discovered that women were systematically more risk-averse than men. Later research confirmed the profound findings. Jacobsen et al. (2014) studied an international dataset and showed that women take a more conservative approach when investing. They argued that this might be due to women, as compared to men, seeing stock markets as rather being risky or due to women being less optimistic. Faff et al. (2011), having investigated a sample of adult Australians, as well as Bashir et al. (2014) all discoved that men were more likely to invest in risky assets than females, indicating robust findings over different continents. These results are supported by the findings of Zhang et al. (2015), who showed that female investors were overweighted in bonds and cash compared to males. Lyons et al. (2007) revealed that the individual retirement account of a household has a greater allocation to mostly stocks when the husband is the financially knowledgeable person.

Halko et al. (2011) argued that gender disparities in portfolio holdings might be artifacts of imperfect controls for risk aversion and financial literacy, as women score lower in financial literacy tests. According to them, the outcomes may thus vary between samples of different financial sophistication. Therefore, the authors examined the relationship between gender and portfolio holdings using a sample from Finland, a country which - according to them - ranks number three in the world in gender equality. However, the results indicated that, even in a gender-equal country, men tend to allocate more money towards stocks than women.

Furthermore, Bayyurt et al. (2013) claimed that the majority of the studies were conducted in developed countries, wherefore they considered investigating gender differences in investment decisions using a dataset of an emerging country. They examined how investment preferences between men and women in Turkey differ concerning six investment tools, namely, gold, foreign currency, funds, common stocks, real estate, and time deposits. They revealed that men rather invest in common stocks and real estate, while women, being more risk averse, tend to invest in funds, time deposits and gold.

These results are consistent with the findings of the papers already discussed. Consequently, the overall discoveries of prior literature propose that women are more risk averse, thus investing less in "risky assets".

**Figure 2**




*Impact of gender on the dependent variables. Source: Own creation.*

Figure 2 portrays the hypotheses for the relationship between gender and the dependent variables. As the findings reveal that females tend to be more risk-averse than males even across gender-equal countries like Finland, as shown by Halko et al. (2011), it is assumed that this similarly holds for Germany, wherefore the hypotheses are as follows:

*Hypothesis 2a)* Males have a higher probability to invest in financial assets compared to females.
*Hypothesis 2b)* Males allocate more funds towards risky assets than females.
*Hypothesis 2c)* Males allocate more funds towards stocks than females.
*Hypothesis 2d)* Males are less likely to invest in bonds as compared to females.
*Hypothesis 2e)* Males have less funds allocated in deposits compared to females.

### 2.2.3 Impact of income and wealth on asset allocation

In the existing literature, several papers indicated that income and wealth both have an impact on the investment behavior of individuals. Grable (2000) demonstrated in his study on risk tolerance that participants with a higher income exhibit greater risk tolerance compared to those with a lower income. Also, Gibson et al. (2013) provided in their study with American participants evidence of a significant, positive correlation between risk tolerance and income. Furthermore, Zhang et al. (2015) used the average tax

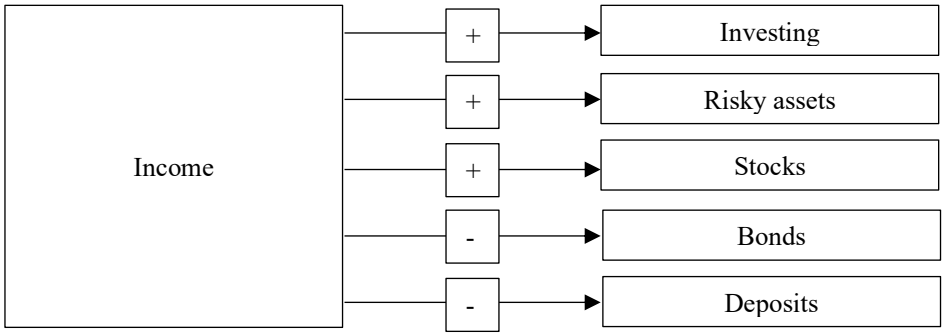
rate as a proxy for income and found that larger households with a lower percentage of female household members and higher average tax rates tend to hold more stocks, i.e., more risky assets.

Additional other studies concluded that an increase in income has a positive effect on stock market participation. Sulaiman (2012) studied the relationship between financial risk tolerance and demographic features of individual investors and revealed a significant positive relation between income and financial risk tolerance. Apergis and Bouras' (2020) outcomes indicated similar effects. Furthermore, investigating explanations for not participating in the stock market and for heterogeneity in portfolio allocation within a group of stock market participants, Vissing-Jorgensen (2002) uncovered a positive impact of the average nonfinancial income on both the likelihood of engaging in the stock market and the percentage of wealth allocated to stocks.

The findings for the impact of wealth on asset allocation show similar relationships. Examining the impact of different determinants of financial risk-taking, Calvet and Sodini (2010) documented that financial wealth is the dominant factor of asset allocation. Wachter and Yogo (2010) showed that wealthier households hold a larger fraction of their financial assets in "risky assets". Zhang et al (2015) used the logarithm of funds under management (FUM) as a proxy for wealth and document an increase of 4.52 percentage points in stockholdings for a one-percent increase in FUM. Riley and Chow (1992) analyzed individual risk aversion and documented that the share in risky assets consistently increases with income and wealth.

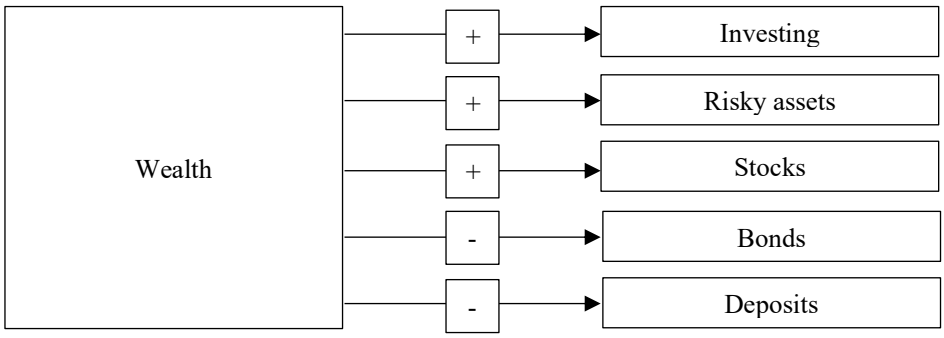
The higher proportion of risk tolerance of the affluent and, consequently, a greater allocation of financial assets to risky assets can be attributed to an increased ability to endure losses with diminished impact and recover from them more efficiently (Hallahan et al., 2004). Davis and Kim (2017) found similar results analyzing data of the Eurosystem Household Finance and Consumption survey. The authors concluded that the wealthier a household is, the larger share of their financial portfolio they allocate to riskier asset classes. Figure 3 and Figure 4 picture the relationship of income and wealth with the dependent variables.

**Figure 3**




*Impact of income on the dependent variables: Source: Own creation.*

**Figure 4**




*Impact of wealth on the dependent variables. Source: Own creation.*

The findings on the relationship between income and portfolio allocation as well as wealth and asset allocation all align in the same direction, indicating that both higher income and larger wealth lead to a greater allocation towards riskier assets. As Hallahan et al. (2004) already suggested, it is assumed that individuals with higher income and wealth are more liquid and thus have more funds available for investment and in addition to that can afford to engage in riskier investments, as they can recover from potential losses more efficiently due to being more affluent. Therefore, they should participate in financial markets and may prefer investments in risky assets and stocks over bonds and deposits. Consequently, the hypotheses are as follows:

*Hypothesis 3a)* A higher income increases the likelihood to invest.

*Hypothesis 3b)* A higher income leads to a higher allocation towards risky assets.

*Hypothesis 3c)* A higher income leads to a higher allocation towards stocks.

*Hypothesis 3d)* A higher income decreases the likelihood to invest in bonds.

*Hypothesis 3e)* A higher income leads to a smaller allocation towards deposits.

*Hypothesis 4a)* A larger wealth increases the likelihood to invest.

*Hypothesis 4b)* A larger wealth increases the allocation of funds towards risky assets.

*Hypothesis 4c)* A larger wealth increases the allocation of funds towards stocks.

*Hypothesis 4d)* A larger wealth decreases the likelihood to invest in bonds.

*Hypothesis 4e)* A larger wealth decreases the allocation of funds towards deposits.

### 2.2.4 Impact of financial education on asset allocation

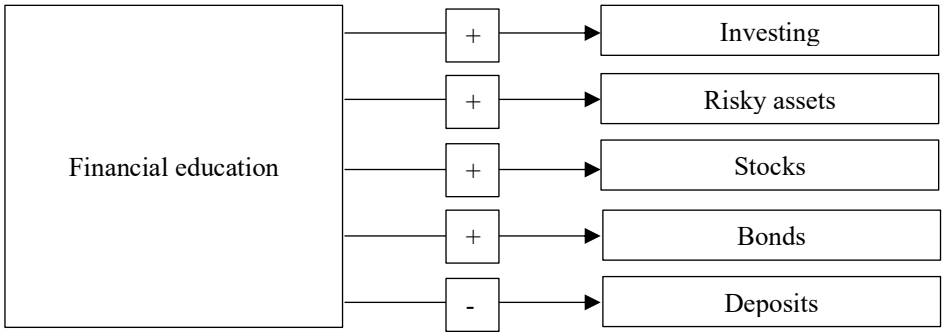
Referring to financial education, recent figures from the German Federal Statistical Office for the year 2022 revealed diverse educational attainment levels in Germany. Approximately 42 percent of individuals completed vocational training, while around 18 percent obtained a university degree. Less than two percent pursued a doctoral degree. Ten percent completed advanced technical training, while slightly over eight percent are engaged in school or vocational training, and nearly 20 percent are currently pursuing neither school nor vocational education (Statistisches Bundesamt, 2023). From the diverse educational landscape in Germany, one may suggest a relationship between personal education and asset allocation, especially as it is well acknowledged that personal finance is not taught in German high schools (Dpa, 2019).

Literature has shown that the educational level has a direct impact on portfolio and asset choices. Agnew and Szykman (2005) have outlined that financial education is related to education and income, and these factors influence asset allocation. Exploring the influence of personal characteristics, risk perception, and financial knowledge on investment preferences, Aren and Zengin (2016) revealed that, contrary to the limited impact of personal characteristics, risk perception and financial education significantly shape investment preferences. Using data from household surveys in the United Kingdom, Belgium, France, Germany, Japan, the Netherlands, Sweden, Norway, Denmark, Italy, Switzerland, Australia, New Zealand, Canada, and the United States, from 2009 to 2018, Apergis and Bouras (2020) found that education has a strong negative effect on the riskiness of the households' portfolio. In line with this finding, Naudon and Tapia (2004) as well as Tracy and Schneider (2001) likewise advocated for a negative correlation between risky investments and education.

Other studies presented contradictory results. Grable (2000) found that participants of his study with a higher educational level are more risk tolerant, compared to the ones with a low educational level. The author discovered the same result testing the relationship between financial knowledge and risk tolerance. Studying data from the 2001 Survey of Consumer Finances, Campbell (2006) used three measures for education: high school diploma, college diploma and graduate school. All variables were positively and significantly linked with whether an individual is invested in public equity. Moreover, the results showed that, the higher the educational level, the larger was the coefficient. In line with this, Hibbert et al. (2013) found similar results surveying 3,361 households and 1,147 finance professors. They showed that less-educated investors are much more risk averse. Dwyer et al. (2002) as well as Gibson et al. (2013) concluded analogous outcomes. The former authors found that wealthy, well-educated investors were more likely to take on risks and the latter authors proved that the level of risk tolerance is much higher for college graduates as compared to people without a college degree. Sulaiman (2012) extended the existing findings and posited that elevated levels of formal education augment an individual's capacity to assess risks, thereby resulting in a higher level of financial risk tolerance.

Furthermore, financial education is said to increase profits in the stock market (Zhang et al., 2023). The authors argued that investors, due to financial education, may have better investment habits. They confirmed that individuals who acquire financial knowledge are 11.3% more likely to be profitable with their investments. Cole et al. (2014) discovered similar results. As to them, individuals with one year more of schooling have a 7.5 percent higher likelihood of a positive investment income. As summarized by previous literature, there is a meaningful relationship between education or financial education and asset allocation. Figure 5 displays the hypotheses for the relationship of financial education and the dependent variables.

**Figure 5**




*Impact of financial education on the dependent variables. Source: Own creation.*

While there are differing findings concerning a possible positive or negative impact of education in the literature discussed, it will be assumed that financial literate individuals know about the advantages of investing in financial assets as discussed in section 2.1. and may thus prefer investing in financial assets over holding funds in cash, deposits or less-risky assets. As a result, they might invest their funds across different financial asset classes, to yield investment returns, safe for retirement and hedge against inflation. Therefore, the hypotheses are as follows:

*Hypothesis 5a)* Financial education increases the likelihood to invest.

*Hypothesis 5b)* Financial education leads to a higher allocation towards risky assets.

*Hypothesis 5c)* Financial education leads to a higher allocation towards stocks.

*Hypothesis 5d)* Financial education increase the likelihood to invest in bonds.

*Hypothesis 5e)* Financial education leads to allocating less funds towards deposits.

### 2.2.5 Effect of marital status on asset allocation

Furthermore, the effect of marital status on portfolio allocation is another socio-economic factor which has been surveyed extensively by previous research. The results are not consistent on whether portfolio allocation is dependent or not on the marital status of the investor or whether singles are more or less risk tolerant than married couples. Cohn et al. (1975) found that individuals who were married allocate less of their financial wealth to risky assets. Further, Apergis and Bouras (2020) have shown that marital status induces a negative effect on the riskiness of the portfolio behavior. Chang et. al. (2018) discovered similar results. Studying the relationship of labor market uncertainty and

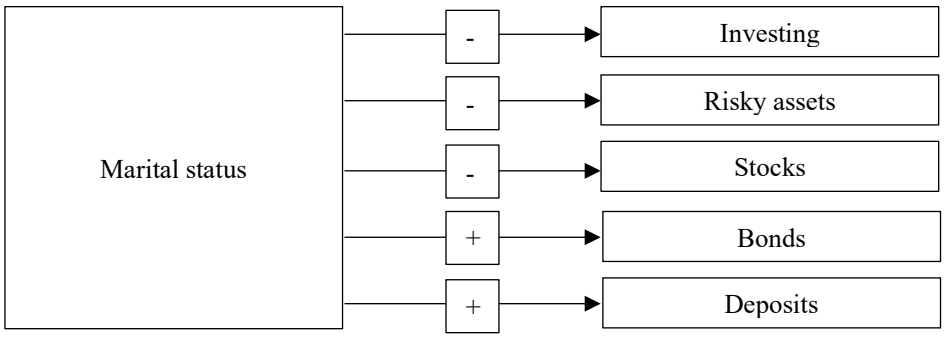
portfolio choice, the authors used marriage as a control variable and found that married individuals hold a smaller share of risky assets in their total financial assets. In addition, in the study by Hallahan et al. (2004), which has been introduced before, the authors confirmed that singles rather take on financial risks as compared to married individuals. According to their findings, the latter were less risk-tolerant, and the findings were not dependent on the individuals' gender. Hinz et al. (1997) conducted an examination of individuals' portfolio investment decisions within the federal government's *Thrift Savings Plan*. The study revealed that married individuals exhibited a less aggressive investment approach compared to their single counterparts, implying that the former were less risk tolerant. According to Gibson et al. (2013), a potential rationale for the observed distinctions could be attributed to the variance in responsibilities between singles and married individuals, leading singles to exhibit a greater inclination towards undertaking elevated levels of risk.

Bertocchi et al. (2011) studied the impact of gender and marital status on financial investments by conducting an empirical investigation on a dataset provided by the Bank of Italy Survey on Household Income and Wealth covering the period 1993 to 2006. In contrast to the findings previously discussed, the authors have shown that married individuals have a higher propensity to invest in risky assets than single ones. The study conducted by Grable (2000) revealed similar results, indicating that married participants of the study are more risk tolerant than singles.

Besides the contradicting literature, there is however evidence that it is not only marital status which has an impact on portfolio allocation or riskiness of a portfolio. Most papers argue that it is gender that mediates the effect of marital status on asset allocation. Yao and Hanna (2005) examined the impact of gender and marital status on the financial risk tolerance using a dataset of the SCF for the years 1983, 1989, 1992, 1995, 1998 and 2001 and showed that risk tolerance is highest for unmarried males followed by married males, unmarried females and then married females. The study conducted by Jianakoplos and Bernasek (1998) provides further evidence that gender might mediate the effect of the marital status. The authors uncovered that single women exhibited greater risk aversion compared to single men. However, notable age disparities are discerned. The authors have shown that single men display significantly higher risk tolerance in their early years than single women. As individuals enter middle age, these differences tend to converge

and in advanced age, married couples demonstrate a willingness to undertake the most substantial risks. Finding differing results, Sung and Hanna (1996) portrayed that single women are less risk tolerant than couples, and that couples are less risk tolerant than single men. Prior literature has revealed that there is a relationship between marital status and the dependent variables. Figure 6 displays the hypotheses for the association.

**Figure 6**




*Impact of marital status on the dependent variables. Source: Own creation.*

Looking at the conflicting findings in existing research, the influence of marital status on asset allocation remains ambiguous. However, since women are said to be more risk averse one might argue that in a marriage, the woman might influence financial choices of the household in a way that the members rather allocate funds towards less risky assets. Furthermore, as already addressed by Gibson et al. (2013), married households may face more responsibilities, wherefore they might opt for less risky and more liquid investment choices as compared to singles. Hence, the hypotheses are as follows:

*Hypothesis 6a)* Married individuals are less likely to invest compared to singles.

*Hypothesis 6b)* Married individuals allocate less funds towards risky assets compared to singles.

*Hypothesis 6c)* Married individuals allocate less funds towards stocks compared to singles.

*Hypothesis 6d)* Married individuals are more likely to invest in bonds compared to singles.

*Hypothesis 6e)* Married individuals hold a larger fraction of their financial assets in deposits compared to singles.

### 2.2.6 Impact of geographical background on asset allocation

The geographical background, i.e., the regional difference between East Germany and the other regions, is another characteristic surveyed in this paper. While the link between geographical background and asset allocation remains underexplored in the academic literature, it represents a significant factor potentially shaping individual investment decisions and preferences. Goetzmann et al. (2004) studied the effect of city agglomeration on portfolio diversification using survey data from Sweden for the period 1995 to 2000 and found that people living in rural areas do have more diversified portfolios as compared to people living in urban areas. Christelis et al. (2013) took a broader approach and examined the differences of portfolio holdings across different countries. The authors compared the US against different European countries and further analyzed different regions of the US and different countries within Europe to observe disparities in asset market involvement rates across Europe and the US, but also within Europe. They concluded that the variations stem from distinct economic environments encountered by households with similar characteristics. Furthermore, the authors noticed that European investors tend to have smaller shares of their assets allocated to stocks as compared to US households.

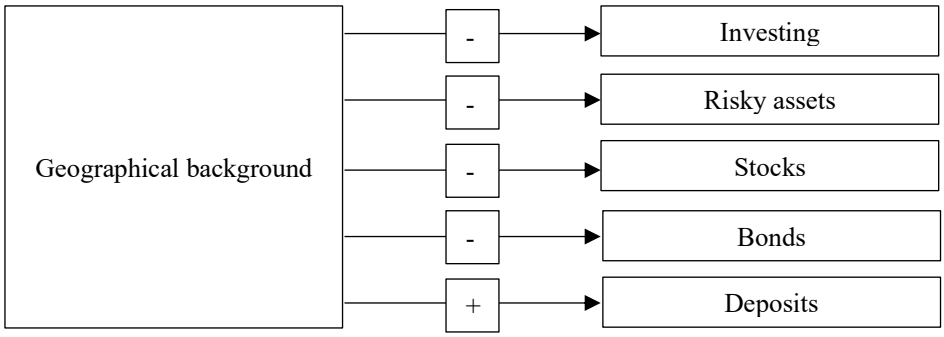
With regard to Germany, it is widely recognized that post-World War II the country was divided into two distinct states: The Federal Republic of Germany (FRG) in the West and the German Democratic Republic (GDR) in the East. These countries diverged significantly in their political, societal, and economic norms and principles (Würz, 2014). Under the leadership of Konrad Adenauer, the FRG politically, economically, and militarily integrated with the West, developed a market economy, and consequently, a majority of its population experienced increased prosperity. In contrast, the GDR was governed by a communist dictatorship that enforced a centrally planned economy, resulting in inadequate provision of goods and housing, as well as restricted civil liberties (ibid.).

Almost three decades later, there are still substantial economical regional disparities in Germany such as in per capita disposable income (Seils & Pusch, 2022). The authors identified a pronounced West-East divide in incomes. In 2019, the income in the so-called old federal states, which belonged to West Germany before reunification (excluding Berlin), amounted to €24,350 per capita, whereas in the so-called new federal states, formerly part of the GDR, it was only €21,046. Additionally, the authors observed

a South-North gradient as the average disposable income in the southern states of Bavaria and Baden-Württemberg was more than 10% higher than the mean of the remaining old federal states. The differences in disposable income could thus imply that households with less income have less funds available to invest into the financial markets. These findings give a first suggestion that the geographical background could have an impact on portfolio choice in Germany.

Furthermore, Berlemann and Luik (2014) investigated whether institutional reforms have an impact on the decisions to hold risky assets. The authors studied a dataset from 2006 which consists of individual customer data from 11 German savings banks, of which eight banks operate in East Germany and the remaining three in West Germany. The authors revealed that individuals in West Germany displayed a slightly elevated probability of investing in risky assets compared to their counterparts in East Germany, even though the German unification had already taken place approximately 15 years prior to the dataset. They argued that the effect is due to East Germany having been an informal institution and state that while formal institutions can undergo rapid changes, informal institutions tend to exhibit remarkable persistence over time. The findings suggest that the geographical background might lead to substantial differences in portfolio allocation in Germany. Figure 7 summarizes the hypotheses for the relationship between the geographical background and the dependent variables.

**Figure 7**




*Impact of geographical background on the dependent variables. Source: Own creation.*

As discussed, research has revealed significant inequalities between formerly Eastern and Western Germany to this day, which come due to the fact that the country was divided into two distinct states with highly differing government systems. As there is evidence that the regional disparities in asset allocation still last until today, as further shown by

Berlemann and Luik (2014), it is assumed that people who are situated in East Germany will be less inclined towards participating in financial markets. The effect might be pronounced by the regional differences in income as displayed by Seils and Pusch (2022), implying that people in East Germany might have less funds available to invest. Therefore, the hypotheses are as follows:

*Hypothesis 7a)* Living in East Germany leads to a lower likelihood to invest.
*Hypothesis 7b)* Being situated in East Germany leads to allocating less funds towards risky assets.
*Hypothesis 7c)* Being situated in East Germany leads to allocating less funds towards stocks.
*Hypothesis 7d)* Being situated in East Germany leads to a smaller probability to invest in bonds.
*Hypothesis 7e)* Being situated in East Germany leads to a higher fraction of deposits in total financial assets.

### 2.2.7 Impact of economic expectations on asset allocation

Economic expectations are the last independent variables surveyed in this paper. As discussed in section 2.1, assets with the potential for higher returns can serve as a hedge against the devaluing effect of inflation. Therefore, one might argue that individuals who anticipate higher inflation rates in the future may allocate funds towards asset classes that offer the possibility of yielding higher returns. In addition, if someone has positive expectations of the stock market, then, from a rational perspective, one could argue that they should allocate their money to stocks in order to make use of the advantages priorly discussed.

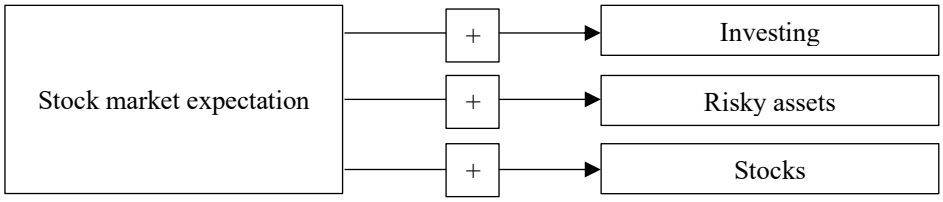
The economist Irving Fisher (1930) was the first who addressed the relationship between economic expectations and returns. He identified the correlation between anticipated inflation and nominal interest rates, stating that the nominal return on an investment is the aggregate of the real return and the anticipated inflation. Thus, an increase in expected inflation is typically accompanied by a proportional rise in the nominal return of an asset. This indicates that investors will expect higher nominal returns. Additional researchers such as Grable and Joo (1997), Grable and Lytton (1997), as well as Sung and Hanna (1996), have suggested that a person's knowledge of economic expectations

as well as of personal finance may play a role in shaping risk preferences and thus asset allocation.

Anoruo et al. (2003) studied the effect of consumer expectations regarding interest rates and inflation on individual investors' portfolio asset allocation using U.S. survey data covering the period 1988 to 1999. The authors observed that higher expectations regarding inflation and interest rates exerted a substantial downward influence on stock allocations while concurrently leading to increased allocations to bonds and cash. Furthermore, Yang (2022) examined a dataset from De Nederlandsche Bank Household Survey and documented opposing results. He revealed that Dutch households with higher inflation expectations had a higher probability to invest in equity markets, changing from safe assets to risky ones. In addition, Agarwal et al. (2021) leveraged a natural experiment in India, the "Inflation Targeting Policy," to assert that reduced inflation expectations were inversely associated with households' engagement in risky investments. Further, Friedman (1978), illustrated in his study on the importance of portfolio behavior of lenders on the relationship between nominal interest rates and expected price inflation, that the majority of investors reduced their demands for bonds if expected inflation increases.

The fact that future expectations play a role in stock market participation has moreover been addressed by previous literature. It has been demonstrated that a general inclination towards optimism correlates with optimism regarding positive stock returns, subsequently implying higher stock ownership (Kezdi & Willis, 2009). In her study, Vissing-Jørgensen (2003) established a correlation between the diverse beliefs of American investors and investment decisions. Those anticipating greater stock returns maintained higher allocations of equity in their portfolios. Lee et al. (2015) examined the link between stock market return expectations and individuals' risk aversion utilizing Dutch National Bank Household Survey data. They have shown that low stock market expectations are associated with higher risk aversion. Figure 8, Figure 9 and Figure 10 illustrate the hypotheses for the relationships of stock market expectations, inflation expectations and expectations regarding deposit interest with the respective dependent variables.

**Figure 8**




*Impact of stock market expectations on the dependent variables. Source: Own creation.*

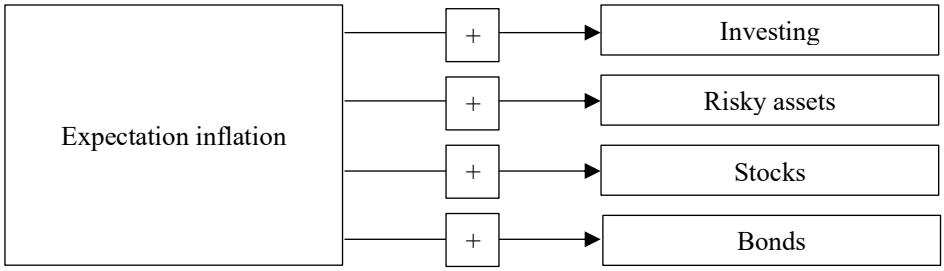
In general, positive beliefs regarding future returns of the stock market are assumed to lead to an allocation towards stocks, as also shown by literature. Thus, from a rational perspective, an individual who expects that the stock market will rise in the future may invest in stocks, what also implies that this individual participates in financial markets as well as in risky assets. Therefore, the hypotheses are as follows:

*Hypothesis 8a)* Positive expectations of the stock market increase the likelihood to invest.

*Hypothesis 8b)* Positive expectations of the stock market increase the share of risky assets.

*Hypothesis 8c)* Positive expectations of the stock market increase the share of stocks.

**Figure 9**




*Impact of inflation expectations on the dependent variables. Source: Own creation.*

As discussed before, expecting higher consumer prices for the future should, from a rational perspective, lead individuals to allocate funds towards asset classes that can compensate for the devaluing effect of inflation through yielding returns in excess of the inflation rate. As the historic figures and the literature discussed in chapter 2.1 have revealed, these asset classes may comprise financial assets such as stocks, bonds, and

metals. Consequently, the hypotheses for the relationship between expected inflation and the dependent variables are as follows:

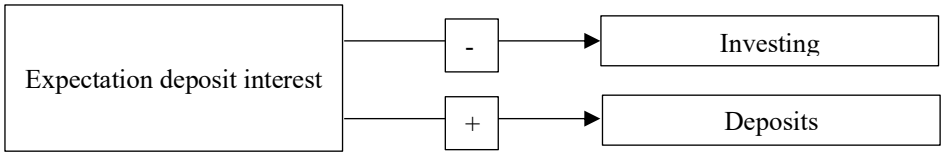
*Hypothesis 9a)* Expecting increasing future inflation increases the likelihood to invest.

*Hypothesis 9b)* Expecting increasing future inflation increases the allocation towards risky assets.

*Hypothesis 9c)* Expecting increasing future inflation increases the allocation towards stocks.

*Hypothesis 9d)* Expecting increasing future inflation increases the likelihood to allocate funds towards bonds.

**Figure 10**




*Impact of deposit interest expectations on the dependent variables. Source: Own creation.*

If one expects deposit interest rates to increase in the future, then a rational investor would allocate money to this almost risk-free asset class in order to benefit from the higher secure interest rates. This in return would imply that the probability to invest in assets offering insecure returns, such as asset classes trading on the financial markets, would suffer from increasing deposit interests, as the individual should prefer the less-risky alternative. Therefore, the hypotheses are as follows:

*Hypothesis 10a)* Higher expected deposit interest decreases the likelihood to invest.

*Hypothesis 10b)* Higher expected deposit interest increases the allocation towards deposits.

## 3. Data and methodology

### 3.1 Household portfolio data in the PHF

The main data source utilized in this paper is the dataset of the German Panel on Household Finances provided by Deutsche Bundesbank. The PHF constitutes a panel survey focusing on the financial landscape and wealth of German households. It is conducted by the Research Center of Deutsche Bundesbank in cooperation with *infas Institut für angewandte Sozialwissenschaften*. It is a representative survey of private households domiciled in Germany and it encompasses the examination of balance sheets, pensions, income sources, work life, and various demographic characteristics (Schmidt et al., 2023).

Within the survey, wealthy households are oversampled based on micro-geographic indicators. This is done to align more closely with the wealth distribution among households and to provide insights into the composition of wealth in Germany. Moreover, it increases the statistical power for the analysis on rare assets which are typically held by wealthy households. The dataset consists of four waves of panel survey data, which has been collected in 2010/2011, 2014, 2017 and 2021, respectively (ibid.).

The majority of the questions of the panel are targeted at the household level, where the respective questions are answered by the so called financially knowledgeable person of the household (FKP). In addition, the survey contains questions relating to occupation, income situation and old age provision of each household member older than 16 years. Questions relating to one of the three topics are answered by each household member individually. The questionnaire covers the modules *demographics*, *consumption*, *real assets and their financing*, *other abilities/credit constraints*, *private businesses and financial assets*, *intergeneration transfers and gifts*, *employment*, *pensions and insurance policies*, *income*, *savings behavior*, *financial literacy* as well as *price expectations* (ibid.)

In order to remain a high validity of the survey data, missing variables due to non-response have been imputed by the PHF-team through multiple imputation according to Donald B. Rubin (1987), wherefore each variable is represented five times in the dataset. In the present sample, the individual imputation value is simulated by drawing repeatedly

from an estimate of the conditional distribution of the data in order to generate an efficient estimate (ibid.).[1]

The sample of this dataset consists of 4,119 different households with a total number of 8876 individuals. Each household can be identified by a household identifier number (*hhid*) and each individual can be identified by a person identifier number (*persid*). This identifier is time-consistent and thus would enable tracking of specific persons over waves. Within each household, every member is identified by an additional identification number (*pid*), starting from one and going up to the total number of household members. The household member who is the most familiar with the household's financial situation, the FKP, is always assigned the number one. The FKP may change over waves, wherefore the *pid* is not consistent over the four different waves of the surveys (Schmidt et al., 2023).

### 3.2 Extracting household financial data

The financial assets surveyed in this paper which form the total financial assets of a given household encompass: *Deposits, bonds, the value of non-self-employment private business, stocks, managed accounts, money owed to households, mutual funds* (including hedge funds, real estate funds, money market mutual funds, equity funds, fixed-income funds and other investment funds), *voluntary pensions/whole life insurance*, and *other financial assets*.

To conduct a more detailed analysis, the variable *mutual funds* has been disaggregated into different categories and partially reconciled. Consequently, the variable *stocks* comprises the variables publicly traded shares, and mutual funds investing in public equity, which is in line with the classification of Börsch-Supan and Eymann (2002), Love (2010) and Anderrson (2001). The asset class *bonds* includes the Euro value of the total bond holdings plus the value of all mutual funds investing in fixed-income securities. A detailed description of the financial assets is provided in Appendix 1.

Regarding the calculation of a households' total financial assets, it is crucial to note that the provided value from the dataset obtained through questions posed to the

[1] For further information on the methodology of the survey see: https://www.bundesbank.de/en/bundesbank/research/panel-on-household-finances/methodology

interviewees, was not used. Instead, a new variable was computed as the sum of the financial assets published in Appendix 1. The reason for this lies in the existence of two distinct questions related to mutual funds. One question addresses the total amount invested in mutual funds, regardless of category, while the second question pertains to the allocation of funds to specific mutual fund categories. Upon review, discrepancies were observed between the value from the first question and the sum of values from the second question. Calculations were consequently performed using the values of individual allocations to different mutual fund categories, resulting in a divergent figure for the *total financial assets* in the PHF dataset.

In order to determine whether an individual participates in the financial markets, assets were classified as such that an investment in them implies participation in the financial market. The following assets were defined as investment assets: *hedge funds, stocks, bonds, other investment funds, real estate funds, managed accounts,* and *other financial assets*. The latter was included because this asset class also encompasses options, futures, commodities, as well as certificates (Schmidt et al., 2023). If the sum of the assets mentioned before is greater than zero, the individual is participating in the financial market and is thus investing. The variable named *Investing* is binary-coded and takes on one if the former is the case and zero if the sum is zero.

The classification of financial assets in risky and less risky is conducted in accordance with the frameworks proposed by Apergis and Bouras (2020), Davis and Kim (2017) and Chang et al. (2018). The authors define risky assets as the aggregate of stocks, stock options, mortgage-backed bonds, corporate bonds, mutual funds invested in stock and trusts, annuities invested in stocks, investment accounts managed by a third party, and private non-ownership stakes in firms. In contrast, less-risky assets, as outlined by the authors, encompass cash, deposits, owed debts, private pension or life insurance assets, money market funds, and domestic government savings bonds. In this research paper, however, it is not possible to distinguish between different bond classes. While the PHF-survey did inquire about the issuers of the bonds held by the households, it did not inquire about the value allocated to a specific bond class. Only the total value of the bond position was collected. Therefore, it will be assumed that households mainly hold bonds of issuers with a high credibility, such as government bonds. Consequently, *bonds*, which, as mentioned, also comprises investment funds invested in fixed-income securities will be

attributed to less risky assets. Other assets defined as less risky include *deposits*, as they are basically risk free, *money owed to households*, *voluntary pensions / whole life insurance* having basically no volatility, and *money market funds*. The latter is regarded as a cash equivalent, being a liquid asset class and thus less risky. *Money owed to households* is categorized as less risky as it includes loans to household individuals' friends or acquaintances, rental deposits, or other private loans (Schmidt et al., 2023) which are assumed to be paid back accordingly.

Regarding risky assets, *managed accounts* may include volatile asset classes such as stocks or equity funds or alternative investments, mostly attributed to illiquid, wherefore they are attributed to risky assets. The *value of non-self-employed business* and *other financial assets* are likewise defined as risky. The former is seen as an asset which is rather illiquid and thus bears the risk of one not being able to sell it and the latter includes, as mentioned, options, futures and certificates, which are derivatives. *Real estate funds* were found to have an increased likelihood of halting redemptions following economic disturbances as compared to other mutual fund categories (Grill et al., 2022), wherefor they are categorized as risky. An overview of all assets in this paper defined as risky and less risky is portrayed in Appendix 2.

To determine how the personal characteristics have an impact on the proportion of risky assets in the total financial assets, the absolute values were divided by the absolute value of *total financial assets*. This is a common method used in previous research (Chang et al., 2018, Davis & Kim, 2017). Referring to the third investigation on the factors influencing the allocation of funds towards stocks, the share of stocks in total financial wealth, namely *share of stocks*, is utilized as the dependent variable. This is likewise a common method used by previous research as shown by the papers previously mentioned as well as in the papers by Love (2010), Zhang et al. (2015) and Andersson (2001). For investments in bonds, logistic regressions will be applied, as these variables might rather be rare in this dataset. Therefore, a dummy variable, namely *bonds,* which takes one if the person allocated funds into this asset class and zero if not, is defined.

### 3.3 Defining socio-demographic and personal characteristics

Socio-demographic and personal characteristics were combined from different datasets of the PHF and have been utilized from the FKP, following Davis and Kim (2017).

The FKP was identified by its pid, where, as previously mentioned, the FKP is always assigned the pid number one. The combined dataset comprises the variables *age*, *married*, whether the person participated in financial education (*fin_edu*), the geographical background (*East*), *income*, *wealth* and expectations regarding the stock market, inflation and deposit interest rates (*Exp_stock_market*, *Exp_inflation*, *Exp_deposit_interest*). Questions regarding economic expectations were consistently directed to the FKP by the interviewers, facilitating seamless linkage to the other variables. *Income* refers to the household income and was calculated manually. It includes the total gross value of a household's income from employment, self-employment, pensions, and other regular social transfers, as well as income from regular private transfers. Income from financial assets was not considered, as this implies that the individual is investing what leads to distorted results. Wealth is defined as the sum of all real assets and financial assets, excluding public and occupational pension plans (Schmidt et al., 2023). The table below provides an overview of the coding of the different variables.

**Table 1**

| Variables | Values |
|---|---|
| Male | 0 = female<br>1 = male |
| Age | age in years (19-90) |
| R_Age | 0 = age < 65<br>1 = if age > = 65 |
| Married | 0 = single<br>1 = married |
| Fin_edu | 0 = no<br>1 = participated in financial courses |
| East | 0 = north, south, west<br>1 = east |
| Income | hh income as defined; amount in Euros |
| Wealth | total hh assets (real assets plus financial assets) in Euros. Positive value |
| Exp_stock_market | 1 = decreases significantly |
| Exp_inflation | 2 = decreases slightly |
| Exp_deposit_interest | 3 = same level<br>4 = increase slightly<br>5 = increase significantly |

*Definition of independent variables. Source: Own creation.*

The gender variable *Male* has been recoded and reduced from three specifications (diverse, male and female) to the latter two specifications, since it will only be differentiated between male and female. As it is not possible to add “diverse” to one of the remaining specifications and since this category comprises only one household, it cannot

be included in any calculations. Therefore, it has been deleted from the dataset. *Age* is the age of the FKP in years. *R_Age* is a dummy variable already implemented by Riley and Chow (1992), which might help explaining whether the riskiness of a portfolio decreases with retirement approaching, as supposed by Modigliani and Brumberg (1954) and by the findings of Davis and Kim (2017), Andersson (2001) and Chang et al. (2018).

Further, *Married* has been recoded from previously eight categories which included single, single and living with partner, divorced, widowed, married and living with spouse, married and separated, registered, same-sex partnership and living together and registered, same-sex partnership and separated, to two categories: married and single. *Fin_edu* is a binary variable and addresses whether the person attended any courses covering finances or money management during his educational time. *East* represents the geographical background variable. It has been recoded from previously four to two categories and takes on number one, if the person is located in eastern Germany (Brandenburg, Mecklenburg-Western Pomerania, Saxony-Anhalt, Saxony, Thuringia and Berlin, as defined by the PHF) and zero otherwise.

### 3.4 Model descriptions

#### 3.4.1 Impact on Investing

To investigate the relationship of the socio-demographic and personal characteristics with asset allocation, different multiple regressions were applied. As the dataset is multiply imputed five times, it is necessary to first conduct the respective regression on each imputed dataset. The regression results saved as R-objects are then saved into a list and finally combined applying Rubin's (1987) rules. This will give a combined regression result across the five imputations.

Shedding light on the first examination, which of the characteristics influence the likelihood to invest one's money, i.e., to participate in financial markets, a logistic regression is applied, as the dependent variable *Investing* is binary. This is in line with the methodology of Campbell (2006), who used logistic regressions to investigate public equity participation. The investing estimation is as follows:

$$P(Investing = 1) \quad (1)$$
$$= \frac{1}{1 + e^{-(\beta_0 + \beta_1 Age_i + \beta_2 Male_i + \beta_3 Married_i + \beta_4 East_i + \beta_5 Fin\_Edu_i + \beta_6 Income_i + \beta_7 Wealth_i + \beta_8 Exp\_inflation_i + \beta_9 Exp\_stock\_market_i + \beta_{10} Exp\_deposit\_interest_i)}}$$

where Investing is, as previously mentioned, the indicator whether a person *i* is investing in financial markets. Its likelihood of occurrence is predicted by the independent variables. The latter are as defined in Section 3.2.1. The variable *R_Age* is not included in this model, as the dependent variable *Investing* comprises both risky and less-risky assets, wherefore older individuals might also invest in financial markets.

Before conducting the logistic regression, the regression assumptions are initially verified. The results of the test for this regression and all following regressions can be reviewed in the Appendix. It is tested for outliners by counting the standardized residuals which are above or below the thresholds and calculating the percentage of these outliers in relation to the sample. Moreover, the fit of the model will be assessed using the Hosmer-Lemeshow test. To further assess the linearity of log odds of the variables, interaction terms for the interaction between the continuous variables age, income and wealth, and their respective logarithms (*Age* * log(*Age*); *Income* * log(*Income*) and *Wealth* * log(*Wealth*) are integrated following the Box-Tidwell-approach (Tabachnick & Fidell, 2014). Since some households have a value of zero for *Income* and *Wealth*, it was manually modified to 1.01 in order to calculate the logarithm. The manually modified values will be further used for the other investigations. Furthermore, the Variance Inflation Factor (VIF) is utilized to test for multicollinearity (ibid.).

The results of the Hosmer-Lemeshow test reveal significantly low p-values, suggesting that for each of the five models the logistic regression model's predicted probabilities do not align well with the actual distributions of the binary outcome variable. The results of the test for linearity of log odds further reveal that the relationship between the interaction terms of income and wealth with the dependent variable are significant indicating a non-linearity of the log odds and thus violating the assumption (ibid.). Therefore, the regression equation has been modified.

To better account for the non-linearity in the log-odds, *Income* and *Wealth* are replaced by their logarithm, following Campbell (2006). The coefficient for the interaction term of age is insignificant, wherefore no transformation is necessary. Applying the Hosmer-Lemeshow test to the modified model shows an improved fit of the model across all imputations.

To further compare the two models, the so-called "Pseudo $R^2$" (Tabachnick & Fidell, 2014) was calculated. The results indicate that the model without the transformation of *Income* and *Wealth* has lower $R^2$ values ($M = 0.260$ vs. $M = 0.298$), as compared to the modified one, underlining the better fit of the modified model. Therefore, the adjusted estimation equation is as follows:

$$P(Investing = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 Age_i + \beta_2 Male_i + \beta_3 Married_i + \beta_4 East_i + \beta_5 Fin\_Edu_i + \beta_6 log(Income)_i + \beta_7 log(Wealth)_i + \beta_8 Exp\_Inflation_i + \beta_9 Exp\_stock\_markets_i + \beta_{10} Exp\_deposit\_interest_i)}} \quad (2)$$

The test for multicollinearity of the adjusted model reveals results which are close to one across all imputations, being well below the critical threshold of ten (Tabachnick & Fidell, 2014), thus, rejecting the existence of multicollinearity. The results of the tests for the outliers across the imputations indicated no extreme values above or below the critical thresholds.

### 3.4.2 Impact on share of risky and less risky assets

Regarding the second investigation, the approach followed by Campbell (2006), Davis & Kim (2017) and Zhang et al. (2015), who applied OLS regressions on a relative share of asset classes, is used. The estimations will however only be performed on the risky share of the total financial assets, as the sum of the risky and less risky asset share equals one. The variables are thus complementary, wherefore every coefficient which indicates an increase (decrease) in the risky asset share implies a decrease (increase) in the less risky share (Anderrson, 2001). As a result, the outcomes of the regression can be interpreted for both the share of risky assets as well as for the less risky assets. The regression equation is as follows:

$$Share\_of\_risky\_assets_{\,i} = \beta_1 Age_i + \beta_2 R\_Age_i + \beta_3 Male_i + \beta_4 Married_i + \beta_5 East_i + \beta_6 Fin\_Edu_i + \beta_7 \log(Income)_i + \beta_8 \log(Wealth)_i + \beta_9 Exp\_inflation_i + \beta_{10} Exp\_stock\_markets_i \quad (3)$$

where the dependent variable *Share_of_risky_assets i* is the percentage of risky assets in total financial assets for person *i*. The independent variables used to predict the risky share are as explained in Section 3.2.1 where expectations regarding inflation might influence the decisions to invest in risky assets, in order to compensate for the devaluing effect of inflation, as previously mentioned. For *Income* and *Wealth*, the logarithms are used similar to Campbell (2006). The dummy variable *R_Age* will be introduced to the model in order to reveal whether individuals who approach retirement allocate less funds towards risky assets, as suggested by the life-cycle theory and literature priorly discussed.

Before conducting the regression, the assumptions for linear regressions are verified. First it is tested for the normal distribution of residuals using a histogram plot and a Q-Q plot as well as the Shapiro-Wilk test. Further, it is tested for linearity using the Rainbow-test, multicollinearity using the *Variance Inflation Factor* (VIF) and heteroscedasticity using the Breusch-Pagan test (Tabachnick & Fidell, 2014). Lastly outliers, that could possibly lead to distorted results, is tested for using Influence plots (Fox & Weisberg, 2019).

The results reveal that the residuals of the sample mimic a normal distribution but are to some extend positively skewed. The Shapiro-Wilk test confirms that the residuals are not normally distributed. However, according to Tabachnick and Fidell (2014) and Waternaux (1976), in large samples, the underestimates of variance associated with positive kurtosis disappear with samples of more than 100 cases and with negative kurtosis underestimations of variance disappears with samples of 200 or more, respectively. As the sample size in this paper exceeds the suggestions by far, it is suggested that there should be no problem with non-normality.

The test for linearity of the model uncovers a significant value for four of the five imputed datasets, indicating non-linearity. However, the final explanatory power of the

model will be judged on the *F*-statistics. The test for multicollinearity indicates no presence of multicollinearity and the test for autocorrelation rejects the presence of the former. The Breusch-Pagan test reveals existence of heteroscedasticity across all imputations, which might result in distorted standard errors, *t*-values and *p*-values. In order to receive robust *t*-values and *p*-values, robust standard errors will be introduced to the model (Hayes & Cai, 2007).

With regard to outliers, *Income* and *Wealth* were identified as variables having significant extreme values. Nonetheless, the values are suggested to be valid, as the larger values for *Income* and *Wealth* could be subject to oversampling of wealthy households by the PHF. Finally, the coefficients are standardized to counteract scale differences, given that the variables exhibit different ranges and distributions (Bortz & Schuster, 2010). The values are displayed in Appendix 37. Both standardized coefficients and robust standard errors are aggregated manually in R according to Rubin's (1987) rules.

### 3.4.3 Impact on stocks, bonds and deposits

Shedding light on the factors which influence investing in selected asset classes (*stocks*, *bonds* and *deposits*), three different regression analyses will be applied. For *share of stocks* and -*deposits*, OLS regressions are applied following Zhang et al. (2015) and Campbell (2006), whereas for *Bonds* a logistic regression will be used, as investigations of the distribution of the share of bonds in total financial assets revealed that the 90% percentile shows values of 0%, indicating that the majority of individuals hold 0% of their assets in bonds. This suggests that the variable is uneven distributed, wherefore a logistic regression will be used. The independent variables may vary according to the context of the dependent variable. Regarding the investigation of the *share of stocks* in total financial assets, the regression model for the estimation of the share of stocks is as follows:

$$\begin{aligned} Share\_of\_stocks_i & \\ &= \beta_1 Age_i + \beta_2 R\_Age_i + \beta_3 Male_i + \beta_4 Married_i \\ &+ \beta_5 East_i + \beta_6 Fin\_Edu_i + \beta_7 \log(Income)_i + \beta_8 \log(Wealth)_i \\ &+ \beta_9 Exp\_inflation_i + \beta_{10} Exp\_stock\_markets_i \end{aligned} \quad (4)$$

where *Share_of_stocks i* is the relative share of stock holdings in relation to total financial assets of person i. The other variables are similar to the investigation in Section 3.4.2, as stocks are categorized as risky assets and thus regularly used as a proxy for risky asset holdings in a given portfolio.

Before running the regression, the assumptions already addressed in Section 3.4.2 are verified. The model for the share of stocks shows a distribution of residuals that is to some extend leptokurtic and positively skewed. Again, there is no proof of linearity and the VIF values are close to the ones discussed in Section 3.4.2, indicating no multicollinearity. The tests for homoskedasticity show that heteroskedasticity is present, wherefor robust standard errors will be implemented. The Durbin-Watson test reveals no presence of autocorrelation. Again, certain extreme values are identified for Income and Wealth which will be kept due to being valid.

To continue with the next investigation, which personal factors influence the likelihood to invest in bonds, the regression model is as follows:

$$P(Bonds = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 Age_i + \beta_2 R\_Age_i + \beta_3 Male_i + \beta_4 Married_i + \beta_5 East_i + \beta_6 Fin\_Edu_i + \beta_7 \log(Income)_i + \beta_8 \log(Wealth)_i + \beta_9 Exp\_inflation_i)}} \quad (5)$$

where *Bonds* is the indicator that individual *i* is invested in bonds. The other variables are as defined in section 3.2.

Applying the Hoslem-Lemeshow goodness of fit test to the model for bonds reveals large *p*-values, well above the significance level, indicating a good fit of the model. Testing for linearity of the log-odds following the Box-Tidwell-approach, as performed in Section 3.4.2, shows significance for the interaction term between the unadjusted variable *Income* and log(*Income*) indicating no linearity of the logits for *Income*, and thus underlining the already undertaken transformation of *Income* and *Wealth* to the respective logarithm. The test for multicollinearity shows values close to one, indicating no presence of the former. Notable outliers are again accepted as they are suggested to be valid values.

Regarding the last investigation, which of the personal characteristics impact the decision to hold a larger share of funds in cash, the regression estimation is as follows:

$$\begin{aligned} Share\_of\_deposits_i &= \beta_1 Age_i + \beta_2 R\_Age_i + \beta_3 Male_i + \beta_4 Married_i \\ &+ \beta_5 East_i + \beta_6 Fin\_Edu_i + \beta_7 \log(Income)_i + \beta_8 \log(Wealth)_i \\ &+ \beta_9 Exp\_deposit\_interest_i \end{aligned} \quad (6)$$

where *Share_of_deposits i* is the relative share of deposit holdings in relation to total financial assets of person *i*. The other variables are as defined before. The variable *Exp_deposit_interest* is introduced to capture the effect of interest expectations on deposit holdings.

The model for the share of deposits shows a distribution of residuals that almost matches the normal distribution, as indicated by the Q-Q plots as well as by the value of the Shapiro-Wilk test which is very close to one. Testing for linearity reveals linearity between the dependent and independent variables. VIF values remain below the critical threshold indicating no multicollinearity. The tests for homoskedasticity show that heteroskedasticity is present, wherefore robust standard will be implemented as already undertaken in some of the other investigations. The Durbin-Watson test reveals no presence of autocorrelation. Testing for outliers shows signs of extreme values for income and wealth. However, these deviations are less extreme as for the other investigations.

## 4. Analysis and results

### 4.1 Descriptive statistics

After cleaning and recalculating the sample as described in Section 3.2, one ends up with a sample of 4,118 German households including personal and socio-demographic characteristics of 4,118 FKP's. The values of the summary statistics are pooled across all imputations, where the *mean* and *standard deviations*, if applicable, are calculated according to the rules of Rubin (1987). For *median*, *min*, *max*, and the *25%* and *75% quantiles* the respective values were first calculated for each of the imputed datasets and then aggregated using the *mean*. Descriptive statistics for all financial assets of the dataset are published in Appendix 36.

**Table 2**

| Variable | *Mean* | *SD* | *Median* | *Min* | *Max* | *X0.25* | *X0.75* |
|---|---|---|---|---|---|---|---|
| Financial assets | 139,160.8 | 356,644.9 | 55,100 | 0 | 15,030,000 | 15,592.5 | 150,942.5 |
| Risky assets | 48,052.2 | 274,196 | 0 | 0 | 14,000,000 | 0 | 20,000 |
| Stocks | 38,938.7 | 263,489.4 | 0 | 0 | 14,000,000 | 0 | 10,745 |
| Less risky assets | 91,108.6 | 169,478.9 | 42,020 | 0 | 3,907,560 | 12,120 | 108,625 |
| Deposits | 54,847.3 | 106,933.9 | 23,000.1 | 0 | 2,700,000 | 6,994 | 61,055 |
| Bonds | 6,193.3 | 45,563.5 | 0 | 0 | 1,200,000 | 0 | 0 |
| Income | 76,047.6 | 78,506.3 | 57,172 | 0 | 1,477,620 | 33,403.5 | 93,525 |
| Wealth | 624,541.1 | 1,151,710 | 339,700 | 0 | 19,940,700 | 55,213 | 743,085 |
| Age | 59.2 | 16.4 | 60 | 19 | 90 | 48 | 72 |
| Stock market | 3.8 | 0.86 | 4 | 1 | 5 | 3 | 4 |
| Inflation | 4.5 | 0.60 | 5 | 1 | 5 | 4 | 5 |
| Deposit interest | 2.8 | 0.65 | 3 | 1 | 5 | 3 | 3 |
| Investing Dummy | 0.48 | - | - | - | - | - | - |
| Bonds Dummy | 0.10 | - | - | - | - | - | - |
| Male Dummy | 0.58 | - | - | - | - | - | - |
| Married Dummy | 0.61 | - | - | - | - | - | - |
| Fin_edu Dummy | 0.25 | - | - | - | - | - | - |
| East Dummy | 0.20 | - | - | - | - | - | - |
| R_Age Dummy | 0.42 | - | - | - | - | - | - |

*Descriptive statistics of variables used. Note: N =4,118. "Stock market" = Exp_stock_market. "Deposit interest" = Exp_deposit_interest. "Inflation" = Exp_inflation. Source: Own creation.*

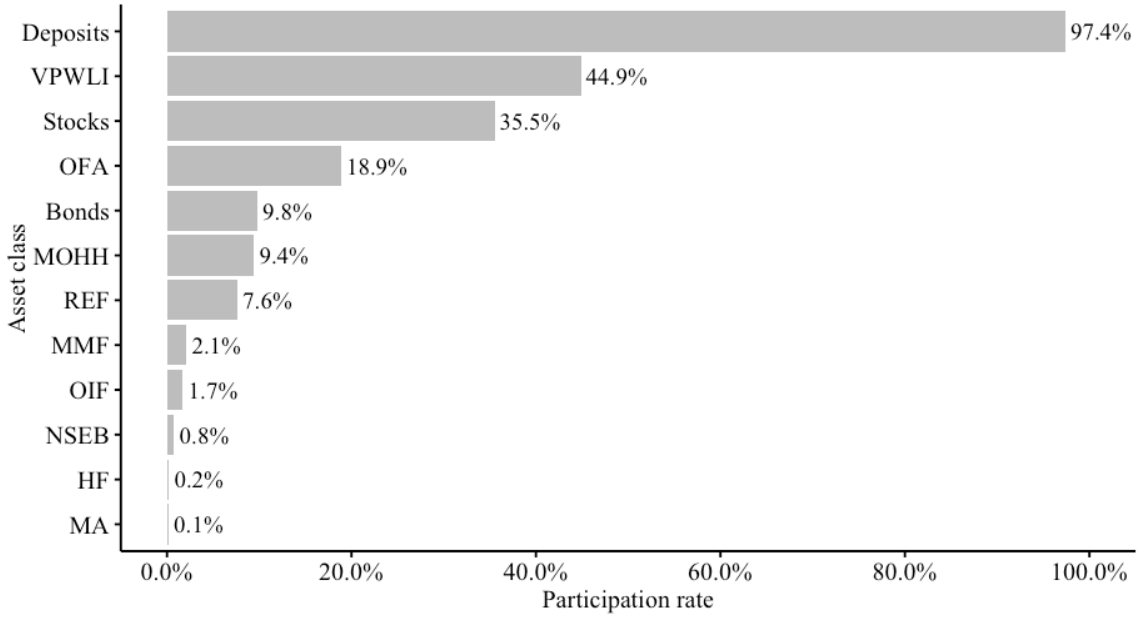
The table reveals that 48% of the individuals in the sample engage in investments in financial assets, as represented by the *Investing* dummy, with an average financial wealth (Financial assets) amounting to €139,160.8 (*SD* = €356,644.9) and a total range reaching €15,030,000. Among these, *less risky assets* (*M* = €91,108.6; *SD* = €169,478.9) constitute a larger portion of portfolios compared to *risky assets* (*M* = €48,052.2; *SD* = €274,196.0). Among the asset classes examined, deposits stand out as the most substantially allocated (*M* = €54,847.3; *SD* = €106,933.9), followed by stocks (*M* = €38,938.6; *SD* = €263,489.4) and bonds (*M* = €6,193.3; *SD* = €45,563.3), highlighting the individuals' preference for safer and more liquid assets.

The observed high standard deviations, especially for financial assets, predominantly stem from the considerable variation between the minimum and maximum values within each asset class. Furthermore, the disparity between the median and the 75th percentile against the maximum values underscores the existence of exceptionally affluent households within the sample. Conversely, the presence of less affluent households is demonstrated by the financial assets' minimum value of €0 and the 25th percentile of €15,592.5. As already addressed in section 3.3, the decision against excluding these outliers is justified by their validation as genuine values. The disproportionally high mean for wealth, valued at €624,541.1 (*SD* = €1,151,710), suggests the existence of other non-financial assets not explored in this paper but constituting the majority of all assets. The median household income amounts to €57,172 (*M* = €76,047.6; *SD* = €78,506.3), with the mean and standard deviation extending this value, underlining the presence of high-income households within the dataset.

Demographically, the sample's average age is 59.2 years (*SD* = 16.4), ranging from 19 to 90 years, indicating a predominance of older individuals, with 75% being older than 48 years and 42% being 65 years old or older. The gender distribution shows a majority of males (*M* = 0.58), and the majority of the sample are married (*M* = 0.61). Approximately a quarter of the sample has possessed financial education in school, and 20% are situated in East Germany. Economic expectations reveal a general anticipation of slight stock market increases (*M* = 3.8; *SD* = 0.86), significant inflation rate rises (*M* = 4.5; *SD* = 0.60), and an almost steady level of deposit interest rates (*M* = 2.8; *SD* = 0.65).

In addition, Figure 11 portrays participation rates across all financial asset classes. The visualization shows that nearly every individual in the sample possesses *deposits*, which is in line with the widely recognized fact that Germans hold the majority of their financial assets as sight deposits and time deposits, as mentioned in Section 1. Approximately 45% hold life insurance (VPWLI), and more than one-third are invested in *stocks*. This latter figure represents a significant increase from the 17% in 2021 reported by Verband der Privaten Bausparkassen (see Section 1).

**Figure 11**




*Participation rates in financial asset classes. Note: VPWLI = Voluntary pensions/ whole life insurance; OFA = Other financial assets; MOHH = Money owed to HH; REF = Real estate funds; MMF = Money market funds; OIF = Other investment funds; NSEB = Non self-employed business; HF = Hedge funds; MA = Managed account. Source: Own creation.*

*Other financial assets* constitute the fourth most common asset class representing approximately 19%. Roughly 10% invest in *bonds* and 9.4% lend money to private persons or relatives. Conversely, *managed accounts* and *hedge funds* are utilized by a very small fraction of the sample, possibly due to certain entry barriers associated with these investment classes, which may require minimum amounts of investments.

### 4.2 Impact of socio-demographic and personal characteristics

#### 4.2.1 Impact on likelihood to invest

The outcomes of the logistic regression analysis, which examines the relationship between the probability of investing and selected independent variables, are presented in

Table 3. The McFadden's Pseudo-$R^2$ is used in this regression to mimic the $R^2$ of the linear regression (Tabachnick & Fidell, 2014). In this paper the value represents the mean of the five McFadden's $R^2$ from each regression for every imputed dataset.

**Table 3**

**Regression output Investing**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Investing Dummy | | | |
| *Variable* | *Beta* | *OR* | *CI-LL* | *CI-UL* |
| Intercept | -6.332*** | 0.002 | 0.0006 | 0.005 |
| | (0.555) | | | |
| Age | -0.006*** | 0.993 | 0.988 | 0.998 |
| | (0.002) | | | |
| Male | 0.230*** | 1.259 | 1.074 | 1.476 |
| | (0.081) | | | |
| log(Income) | 0.041 | 1.042 | 0.981 | 1.107 |
| | (0.030) | | | |
| log(Wealth) | 0.451*** | 1.570 | 1.488 | 1.656 |
| | (0.027) | | | |
| Fin_edu | 0.474*** | 1.606 | 1.350 | 1.910 |
| | (0.088) | | | |
| Married | -0.361*** | 0.696 | 0.582 | 0.833 |
| | (0.091) | | | |
| East | -0.187* | 0.829 | 0.677 | 1.014 |
| | (0.102) | | | |
| Exp_stock_market | 0.181*** | 1.200 | 1.097 | 1.310 |
| | (0.045) | | | |
| Exp_inflation | 0.017 | 1.020 | 0.895 | 1.160 |
| | (0.065) | | | |
| Exp_deposit_interest | 0.045 | 1.050 | 0.933 | 1.173 |
| | (0.058) | | | |
| N | 3,332 | | | |
| McFaddens $R^2$ | 0.298 | | | |

*Regression output – Investing. Note: * p< 0.1; ** p<0.05; *** p<0.01. OR = Odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval of odds ratio.*
Source: Own creation.

To demonstrate the quantitative importance of each effect, the table also reports the participation probability. The so-called Odds ratios are calculated on the pooled estimates. In total the model can thus explain roughly 30% of the total variance, as indicated by the McFadden's $R^2$ and the sample is adequately large ($N$ = 3,332), indicating a robust sample size and a satisfactory fit of the model (Hensher & Johnson, 1981). The results reveal that some variables appear to be insignificant. The reason for this could lie in the fact that there is no relationship between the latter and the dependent variable. Another reason could be that the effect is fully explained by other variables that might mediate the effect of the insignificant variables. For all investigations, only significant relationships will thus be analyzed and interpreted.

Based on the regression results, a significant weak negative relationship between *Age* and the likelihood of investing is observed, with the odds of investing decreasing by approximately 0.7% with each additional year of age of the FKP ($OR = 0.993$, $p < 0.01$). Thus, *hypothesis 1a* stating that with increasing age the likelihood of investing in financial assets decreases, is accepted. This pattern may be attributed to the tendency of older individuals to allocate their funds into more liquid and less risky assets, such as cash or deposits, as previously discussed. This finding aligns with the results of studies such as Zhang et al. (2015), which identified a preference among older individuals for holding less in stocks but more in cash holdings. The weak negative effect may also come due to the regression controlling for income and wealth, which are more likely to be higher for middle-aged individuals (Campbell, 2006).

*Hypothesis 2a* posits that males have a higher probability to invest in financial assets compared to females. The hypothesis can be accepted as gender appears to play a significant role, wherefor being *Male* increases the odds of investing by 25.9% compared to females ($OR = 1.259$, $p < 0.01$). This could be due to a higher risk aversion of women in investment decisions, wherefore women might rather keep their funds in deposits or life insurances. The assumption is robust across various levels of development of countries and is consistent across nations with high gender equality rankings, as highlighted by Bayyurt et al. (2013) and Halko et al. (2011).

*Hypothesis 4a* suggests that a larger wealth increases the likelihood to invest. The regression uncovers that a higher level of the log-transformation of *Wealth* is associated with an increased likelihood of investing in financial assets, wherefore, *hypothesis 4* can be accepted. In particular, for a one percent increase in *Wealth*, the probability of investing increases by 57% ($OR = 1.570$, $p < 0.01$). The explanation could lie in the fact that wealthier individuals do have more financial flexibility, thus diversifying their funds across different investment grade asset classes. Moreover, they can endure losses more efficiently due to being affluent.

*Hypothesis 5a* states that individuals who gathered financial education during school time, are more likely to invest. Referring to the results of the investigation, it becomes obvious that this hypothesis can be accepted, as financial education (*Fin_edu*) demonstrates a strong positive effect on investment propensity, with a notable increase in

the odds of investing by 60.6% among those with financial education ($OR$ = 1.606, $p$ < 0.01). A possible reason for this lies in the fact that financially literate individuals may know about the benefits of investing in financial assets, such as the potential of yielding higher returns as compared to non-investment grade asset classes and thus the possibility to efficiently safe for retirement, as discussed in Section 2.1.

Regarding the relationship between marital status and investing *hypothesis 6a* postulates that married individuals are less likely to invest compared to singles. By taking into account the estimate of *Married* it becomes evident that marital status indeed influences investment decisions, where being married is linked to a decrease in the odds of investing by approximately 30.4% ($OR$ = 0.696, $p$ < 0.01). Thus, the hypothesis can be accepted. The cause of the outcome might be due to married individuals facing more responsibilities and thus rather hold liquid and non-investment grade assets.

The results, moreover, reveal that geographic location impacts the decision to invest in financial assets. Residing in East Germany, represented by *East*, is associated with a 17.1% lower likelihood of investing ($OR$ = 0.829, $p$ < 0.1), indicating potential regional disparities in investment preferences. The results add to the findings by Seils and Pusch (2022) as well as Berlemann and Luik (2014) who documented ongoing regional economic differences between East Germany and other parts of the country. It can thus be suggested that there might be a lingering influence of East Germany's former communist regime that continues to impact economic behaviors and investment decisions of individuals to this day. Therefore, *hypothesis 7a* which postulates that individuals who are situated in East Germany are less likely to invest, can be accepted.

*Hypothesis 8a* postulates that positive expectations of the stock market (*Exp_stock_market*) increase the probability to invest in financial assets. The results reveal that a one-point increase in the variable is associated with an increase in the likelihood to invest by approximately 20% ($OR$ = 1.200, $p$ < 0.01), wherefore the hypothesis is accepted. The outcome may be attributed to stocks which, as depicted in Figure 1, is the financial asset class with the highest number of participants and thus constituting a significant proportion of the investing variable.

### 4.2.2 Impact on share of risky assets

Table 4 portrays the regression outcomes of the multiple linear regression which investigates the impact of selected personal and socio-demographic characteristics on the portfolio share of risky assets. Taking into account the significant *F*-statistics ($F(10;3296)$; $p < 0.01$) as well as the sample size ($N = 3{,}307$) it is concludable that the model has profound explanatory power. The model can explain approximately 9.3% of the total variance ($R^2 = 0.093$).

**Table 4**

**Regression output risky share**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_Risky_assets | |
| Variable | *Beta* | *t-value* |
| Intercept | -0.230*** | -3.901 |
| | (0.054) | |
| Age | 0.00002 | 0.051 |
| | (0.0004) | |
| R_Age | 0.064*** | 4.195 |
| | (0.015) | |
| Male | 0.035*** | 3.680 |
| | (0.009) | |
| log(Income) | -0.003 | -0.747 |
| | (0.004) | |
| log(Wealth) | 0.035*** | 13.798 |
| | (0.002) | |
| Fin_edu | 0.040*** | 3.771 |
| | (0.010) | |
| Married | -0.048*** | -4.505 |
| | (0.010) | |
| East | -0.018 | -1.597 |
| | (0.011) | |
| Exp_stock_market | 0.011** | 2.055 |
| | (0.005) | |
| Exp_inflation | -0.012 | -1.552 |
| | (0.007) | |
| N | 3,307 | |
| Pooled $R^2$ | 0.093 | |
| Pooled adjusted $R^2$ | 0.090 | |
| Residual SE | 0.259 (df = 3296) | |
| Pooled F Statistic | 33.822*** (df = 10; 3296) | |

*Regression output – Share of risky assets.*
*Note:* *p<0.1; **p<0.05; ***p<0.01. Source: Own creation.

*Hypothesis 1b* states that with increasing age, the share of risky assets in the portfolio declines. The outcomes reveal opposing results. While effect of *Age* is insignificant, the dummy variable *R_Age* has a significant positive impact on the share of risky assets ($B = 0.064$; $SE = 0.015$; $p < 0.01$), indicating that individuals who approach retirement or who are already retired hold a larger fraction of their portfolio in risky assets. This finding is in line with the results of Aspergis and Bouras (2020), who found a positive relation between age and the risky asset share. As a result, *hypothesis 1b* is rejected.

The reason for this outcome could lie in the fact that the mean age in the sample is 59.2 and that 42% of the sample are older than 65. Moreover, *Wealth* could also impact this outcome, as the probability of being wealthy rises with age, due to the accumulation of funds over a longer lifetime as compared to younger individuals. Furthermore, as previously mentioned, the sample is oversampled in wealthy households, in order to provide insights into rare asset classes which are typically held by wealthy individuals, indicating that wealth might mediate the commonly assumption that older individuals hold less risky assets. In a second regression, published in Appendix 38, *R_Age* was replaced by $Age^2$ to further investigate the relationship between age and the risky share.

The results reveal a non-linear relationship between the two variables, as *Age* is significantly negatively related with risky share ($B = -0.009$; $SE = 0.002$; $p < 0.01$) but $Age^2$ slightly positively impacting the latter ($B = 0.00001$; $SE = 0.00002$; $p < 0.01$). Thus, individuals, as they age, first reduce their risky share of assets until a certain point. Then, after a certain age, the effect somehow seems to reverse, leading to an increase in the portfolio share, suggesting a somewhat u-shaped relationship. Applying the vertex formula of a parabola (Larson, 2013) to the coefficients of *Age* and $Age^2$ reveals a turning point at approximately age 48 and a half.

The results contrast the findings of Anderrson (2001) and Davis and Kim (2017), who found a hump-shaped relationship between *Age* and the *share of risky assets*. However, the further findings underline the suggestion that wealth might influence the allocation towards risky assets. Another explanation might be that older individuals have acquired more information on variance and yield of risky assets than younger individuals and thus hold a larger share (King & Leape, 1987).

In line with the findings of Aspergis and Bouras (2020), the result for the impact of the gender variable *Male* indicates a positive coefficient, with males having a 3.5 percentage points larger share of risky assets in total financial assets ($B = 0.035$; $SE = 0.009$; $p < 0.01$). As *hypothesis 2b* postulates that males allocate more funds towards risky assets compared to females, the hypothesis is accepted. The reason for this can be associated with the tendency of males being less risk averse than females, as found by Byrnes et. al. (1999) and further research, wherefore they might allocate more funds into risky assets as compared to their counterparts.

*Hypothesis 4b* assumes that a larger wealth leads to allocating more funds towards risky assets. The results support this hypothesis showing that a one percent increase in *Wealth* is associated with a 3.5 percentage point increase in the *share of risky assets* ($B = 0.035$; $SE = 0.002$; $p < 0.01$). Again, the reason for this could be that wealthier individuals are more affluent and can afford investing in riskier asset classes, as they have the economic possibility to endure losses with less impact and to recover from them more efficiently, as compared to less wealthy individuals (Hallahan et al., 2004). The results support the findings of Wachter and Yogo (2010), Riley and Chow (1992) and Davis and Kim (2017).

Further, *hypothesis 5b* suggests that financially educated individuals allocate more money into risky assets. This relationship can be supported, as *Fin_edu* has a significant positive impact on the *share of risky assets* ($B = 0.040$; $SE = 0.010$; $p < 0.01$), indicating that individuals who attended courses regarding finance and economics in school have a share of risky assets which is four percentage points larger as compared to individuals who did not attend such courses. The results support the findings by Grable (2000), who found that individuals with higher levels of financial knowledge are more risk tolerant than their counterparts. One might again suggest that financial literate individuals know about the benefits of investing in risky assets, such as historically yielding higher returns compared to less risky assets, and thus bearing the opportunity to more efficiently safe for retirement and counteract the devaluing effect of inflation.

According to *hypothesis 6b* married individuals allocate less funds towards risky assets compared to singles. This hypothesis is accepted, as the results reveal a negative effect of *Married* on the risky asset share ($B = -0.048$; $SE = 0.010$; $p < 0.01$), indicating

that unmarried individuals have 4.8 percentage points less of their financial assets allocated in risky assets as compared to married persons. As outlined in Section 2.2.5, the effect can be explained highlighting that married individuals may face more responsibilities than single, wherefore they should rather hold less risky and liquid assets in favor of assets that undergo certain price volatility, such as stocks and hedge funds.

Furthermore, the regression outcomes picture a negative relationship between stock market expectations ($B = 0.011$; $SE = 0.005$; $p < 0.01$), which is in line with *hypothesis 8b* stating that positive expectations regarding the stock market increase the allocation in risky assets. More precisely, for a one-point increase on the expectation scale of *Exp_stock_market*, there is a 1.1 percentage point increase in the share of risky assets held. This outcome underlines the relationship between individual's investment behavior and economic expectations, as covered in Section 2.2.7. A reason for the negative impact on the risky share can be explained by the fact that stocks form the largest asset of risky assets by mean allocated value (Appendix 36).

Juxtaposing the z-standardized coefficients of the significant variables to estimate the explanatory power of the latter shows that log(*Wealth*) exemplifies the largest impact on the risky share of the portfolio, with a one standard deviation increase in wealth leading to a 0.322 standard deviation increase in *share of risky assets* (z-standardized coefficient = 0.322), followed by *R_Age* (z-standardized coefficient = 0.123). The smallest significant effect is attributed to *Exp_stock_market* (z-standardized coefficient = 0.035). The results which are displayed in Appendix 37 highlight the importance of wealth in determining the share of risky assets, as suggested before.

### 4.2.3 Impact on share of stocks

Table 5 portrays the regression outcomes of the multiple linear regression which investigates the impact of selected personal and socio-demographic characteristics on the portfolio share of stocks. Taking into account the significant f-statistics ($F(10;3338)$; $p < 0.01$) as well as the sample size ($N = 3,349$) it is concludable that the model has profound explanatory power. The model can explain approximately 8.5% of the total variance ($R^2 = 0.085$).

**Table 5**

**Regression output share of stocks**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_stocks | |
| Variable | *Beta* | *t-value* |
| Intercept | -0.208*** | -4.400 |
| | (0.047) | |
| Age | -0.00005 | -0.124 |
| | (0.0004) | |
| R_Age | 0.035*** | 2.679 |
| | (0.013) | |
| Male | 0.032*** | 3.887 |
| | (0.008) | |
| log(Income) | 0.001 | 0.435 |
| | (0.003) | |
| log(Wealth) | 0.026*** | 13.732 |
| | (0.002) | |
| Fin_edu | 0.036*** | 3.773 |
| | (0.009) | |
| Married | -0.033*** | -3.523 |
| | (0.009) | |
| East | -0.015 | -1.510 |
| | (0.010) | |
| Exp_stock_market | 0.012*** | 2.804 |
| | (0.004) | |
| Exp_inflation | -0.013** | -2.043 |
| | (0.007) | |
| N | 3,349 | |
| Pooled $R^2$ | 0.085 | |
| Pooled adjusted $R^2$ | 0.083 | |
| Residual SE | 0.224 (df = 3338) | |
| Pooled F Statistic | 31.34*** (df = 10; 3338) | |

*Regression output - Share of stocks.*
*Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.* Source: Own creation.

The results mostly align with the findings for the *share of risky assets*. As previously mentioned, and as can be seen in Appendix 36 and Figure 11, stocks embody the largest asset class of risky assets and moreover form the asset class with the third largest participation rate. Referring to *hypothesis 1c*, which states that with increasing *Age* the proportion of stocks in the portfolio decreases, a positive and highly significant coefficient for *R_Age* is likewise found. More precisely, being similar as older than 65 years old leads to a 3.5 percentage points larger share of stocks in total financial assets, contradicting the finding by Riley and Chow (1992) who found that individuals older than 65

are more risk averse. Therefore, the hypothesis is rejected. Similar to Section 4.2.2, the relationship is further studied by replacing the variable *R_Age* by $Age^2$.

The results, which are displayed in Appendix 39, show opposing results as compared to the findings by Zhang et al. (2015) and Anderrson (2001). Again, it seems that individuals, as they age, first reduce their share of stocks until a certain point ($B$ = -0.006; $SE$ = 0.002; $p < 0.01$) and, after a certain age, tend to slightly hold more stocks ($B$ = 0.00006; $SE$ = 0.00002; $p < 0.01$), suggesting a somewhat u-shaped relationship. Applying the vertex formula of a parabola (Larson, 2013) again, uncovers a turning point of holding stocks at age 50 and four months.

The outcomes contradict the typical life-cycle theory on investing covered in Section 2.2.1, where investors hold less risky assets, e.g., stocks, with approaching retirement. As already addressed in the previous section, this outcome may be caused by the fact that older individuals in this sample are likely to be wealthy, wherefore they can afford to invest in volatile assets such as stocks.

Next, in line with Halko et al (2011), a significant positive relationship between *Male* and the share of stocks ($B$ = 0.032; $SE$ = 0.008; $p < 0.01$) is found. Correspondingly, being male is associated with a 3.2 percentage point increase in the share of stocks, supporting the overall assumption that men being less risk averse then women hold more risky assets and stocks, as already addressed in Section 4.2.1. As a result, *hypothesis 2c* which states that men allocate more funds towards stocks is accepted.

*Hypothesis 4c* postulates that a larger wealth leads to allocating more funds towards stocks. In line with the findings of Zhang et al (2015), this statement is accepted as a positive and highly significant impact of *Wealth* on the share of stocks is found ($B$ = 0.026; $SE$ = 0.002; $p < 0.01$). A one percent increase in *Wealth* causes the individual to allocate 2.6 percentage points more funds towards stocks. Similar to the findings for the risky share of assets an explanation might be that wealthy households may endure possible volatility of stock prices more efficiently, as they are more affluent and thus might feel financially secure to take on risk (Guiso et al, 2003). Moreover, the finding is somewhat contradicting to the conclusions of Campbell (2006) who observed a quadratic

relationship between the two variables, where the share of stocks first declines with increasing wealth but in the upper percentiles of the wealth distribution sharply increases.

Regarding the effect of financial education, again a significant positive coefficient for *Fin_edu* is found indicating that individuals who acquired financial knowledge hold more stocks than persons who did not have financial education ($B = 0.036$; $SE = 0.009$; $p < 0.01$). *Hypothesis 5c* which claims that financial education leads to a higher allocation towards stocks is thus accepted. Again, financially educated individuals may know about the benefits that come with investments in stocks. As already addressed in Section 2.1, stocks have higher average historic returns compared to bonds and cash and thus, provide the possibility to efficiently safe for retirement and counteract the pension problems in Germany caused by the demographic change.

Similar to Aspergis and Bouras (2020) and Anderrson (2001) who studied the impact of certain demographic variables on the *share of risky assets*, a negative effect of *Married* on the share of stock is found. Married individuals have a share of stocks which is 3.3 percentage points smaller as compared to singles ($B = 0.033$; $SE = 0.009$; $p < 0.01$). Consequently, *hypothesis 6c* which states that married individuals allocate less funds into stocks is accepted. Again, as posited by Gibson et al. (2013), married households may face more responsibilities, such as taking care of children, wherefore they might opt for less risky investments instead of allocating funds in volatile asset classes such as stocks.

*Hypothesis 8c* states that individuals with positive expectations towards the stock market have larger shares of stocks. The results reveal a positive relationship between *Exp_stock_market* and *share of stocks* with an increase in the share of stocks by 1.2 percentage points for every increase in the expectations for the stock market ($B = 0.012$; $SE = 0.004$; $p < 0.01$), wherefore the hypothesis is accepted. This finding is in line with the rational suggestion that individuals who expect positive returns of the stock market should adjust their portfolio in favor of stocks, as already outlined by the findings of Vissing-Jørgensen (2003).

Surprisingly, a significant negative impact of inflation expectations (*Exp_inflation*) is found ($B = -0.013$; $SE = 0.007$; $p < 0.05$), as already uncovered by Anoruo et al. (2003). Expecting higher inflation for the future is thus associated with a decrease in the

share of stocks. As a result, *hypothesis 9c* which suggests that individuals allocate more funds towards stocks when expecting higher inflation rates is rejected. The outcome thus contradicts the suggestion that individuals may make use of stock, yielding returns in excess of inflation, to compensate for the devaluing effect of price inflation. An explanation for this on the one hand could be that individuals do not regard stock as an adequate inflation hedge, as already proposed by Fama and Schwert (1977). On the other hand, expecting higher inflation rates might compel individuals to reduce their financial asset holdings like stocks, reallocating resources to cover day-to-day living expenses as these costs potentially surge.

Taking into account the z-standardized coefficients shows that log(*Wealth*) again exemplifies the largest impact on the share of stocks of the portfolio, with an increase of one standard deviation in the variable resulting in an increase of 0.282 standard deviations in the share of stocks (z-standardized coefficient = 0.282), followed by *R_Age* (z-standardized coefficient = 0.078). The smallest significant effect is attributed to *Exp_inflation* (z-standardized coefficient = -0.036). The results once more highlight the importance of wealth in determining portfolio allocation.

### 4.2.4 Impact on likelihood to invest in bonds

Table 6 portrays the regression outcomes of the logistic regression which investigates the impact of selected personal and socio-demographic characteristics on the likelihood to invest in *bonds*. Again, odds ratios are calculated on the pooled coefficient estimates, to demonstrate the quantitative importance of each effect. In total the model can thus explain roughly 8 percent of the total variance, as indicated by the McFadden's $R^2$ and the sample is adequately large ($N$ = 4,097), indicating a robust sample size and a satisfactory fit of the model (Hensher & Johnson, 1981).

**Table 6**

**Regression output Bonds**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Bonds dummy | | | |
| *Variable* | *Beta* | *OR* | *LL* | *UL* |
| Intercept | -8.373*** | 0.000 | 0.000 | 0.001 |
| | (0.764) | | | |
| Age | -0.001 | 0.999 | 0.987 | 1.012 |
| | (0.006) | | | |
| R_Age | 0.314* | 1.369 | 0.941 | 1.990 |
| | (0.191) | | | |
| Male | 0.071 | 1.073 | 0.854 | 1.348 |
| | (0.116) | | | |
| log(Income) | 0.045 | 1.046 | 0.945 | 1.158 |
| | (0.052) | | | |
| log(Wealth) | 0.441*** | 1.554 | 1.423 | 1.698 |
| | (0.045) | | | |
| Fin_edu | 0.307** | 1.359 | 1.071 | 1.724 |
| | (0.121) | | | |
| Married | -0.259** | 0.772 | 0.602 | 0.991 |
| | (0.127) | | | |
| East | -0.010 | 0.990 | 0.730 | 1.343 |
| | (0.156) | | | |
| Exp_inflation | -0.012 | 0.988 | 0.816 | 1.197 |
| | (0.098) | | | |
| N | 4,097 | | | |
| McFaddens $R^2$ | 0.078 | | | |

*Regression output – Bonds dummy. Note: * p< 0.1; ** p<0.05; *** p<0.01; OR = odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval.* Source: Own creation.

Referring to *hypothesis 1d* which states that with increasing age, the likelihood to invest in bonds increases, it is concludable that this assumption is accepted. Even though *Age* does not reveal a significant relationship with the dependent variable, *R_Age* shows a slightly significant impact on the likelihood to invest in bonds, indicating that individuals who approach retirement or are retired have a 36.9 percent larger probability to invest in *bonds* (*OR* = 1.369, $p < 0.1$). This is in line with the suggestion of older individuals holding less risky assets, as concluded by Riley and Chow (1992). The variable *bonds*, which, as explained before, also includes funds invested in fixed income securities embodies this characteristic.

Referring to Appendix 40, which displays a robustness check replacing *R_Age* by $Age^2$, supports this outcome. Again, the coefficient of *Age* is insignificant, but the squared term shows a slight but significant positive relationship with *Investing* (*OR* = 1.0004, $p < 0.1$), indicating that older individuals do have a higher probability to invest in bonds.

Furthermore, *hypothesis 4d* posits that individuals with greater wealth may demonstrate a reduced propensity for bond investment, potentially preferring riskier asset classes that offer higher returns. The regression, however, reveals opposing results, with the wealth variable having a large positive impact on the likelihood to hold bonds ($OR$ = 1.552, $p < 0.01$). According to the outcome, a one percent increase in *Wealth* results in a 55.2 percentage points larger probability to invest in *bonds*, wherefore the hypothesis is rejected. An explanation for this might be that wealthier individuals may make use of diversifying wealth across different asset classes. While they may hold a significant share in risky assets in order to yield higher returns, as outlined by the previous chapters, they could also hold bonds, as a proxy for a risk-free asset, in order to reduce the overall risk of the portfolio, as outlined in Section 2.1.

Regarding the relationship between financial education (*Fin_edu*) and the likelihood of investing in bonds, again a positive relationship is found ($OR$ = 1.359, $p < 0.05$). Hence, individuals who are financially literate are almost 36 percentage points more likely to invest in bonds. *Hypothesis 5d* stating that financial education increases the likelihood to invest in bonds is thus accepted. Once more it can be suggested that financially literate individuals know about the benefits of investing in bonds, such as yielding higher returns as compared to cash investments as well as diversification advantages, as already suggested by the findings in Section 4.2.1.

*Hypothesis 6d* postulates that married individuals are more likely to invest in bonds compared to singles, as they might prefer less risky investment options, due to facing more responsibilities, as already outlined before. This postulation is rejected, as a significant negative relationship between these *Married* and the dependent variable is found ($OR$ = 0.772, $p < 0.05$). Married individuals appear to have a 22.8 percentage points smaller likelihood to be invested in bonds. This outcome, while initially counterintuitive, aligns with the prior finding indicating that married individuals are substantially less likely to invest in financial assets at all, as detailed in Section 4.2.1, and hence would naturally invest less in bonds, which are categorized under financial assets.

### 4.2.5 Impact on the share of deposits

Table 7 portrays the regression outcomes of the multiple linear regression which investigates the impact of selected personal and socio-demographic characteristics on the

portfolio share of deposits. Taking into account the significant *F*-statistics ($F(9;4028)$; $p < 0.01$) as well as the sample size ($N = 4{,}028$), it is concludable that the model has profound explanatory power. The value of the $R^2$ shows that the model can thus explain 10% of the total variance ($R^2 = 0.010$).

**Table 7**

**Regression output share of deposits**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_deposits | |
| Variable | *Beta* | *t-value* |
| Intercept | 0.996*** | 15.095 |
| | (0.066) | |
| Age | -0.002*** | -3.975 |
| | (0.001) | |
| R_Age | 0.235*** | 11.844 |
| | (0.020) | |
| Male | -0.037*** | -3.218 |
| | (0.012) | |
| log(Income) | -0.010** | -2.048 |
| | (0.005) | |
| log(Wealth) | -0.018*** | -4.461 |
| | (0.004) | |
| Fin_edu | -0.051*** | -4.137 |
| | (0.012) | |
| Married | -0.003 | -0.266 |
| | (0.013) | |
| East | 0.055*** | 3.677 |
| | (0.015) | |
| Exp_deposit_interest | -0.005 | 0.625 |
| | (0.009) | |
| N | 4038 | |
| Pooled $R^2$ | 0.10 | |
| Pooled adjusted $R^2$ | 0.098 | |
| Residual SE | 0.34 (df = 4028) | |
| Pooled F Statistic | 50.10*** (df = 9; 4028) | |

*Regression output - Share of deposits.*
Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. Source: Own creation.

Regarding *hypothesis 1e* which states that with rising age, the allocation towards deposits increases, mixed results are found. The variable *Age*, though having a small coefficient, is significantly negatively related with *share of deposits* ($B = -0.002$; $SE = 0.001$; $p < 0.01$), while *R_Age* is significantly positively related with deposits, and further having a considerably larger coefficient ($B = 0.235$; $SE = 0.020$; $p < 0.01$). It is observable that

individuals similar as or older than 65 hold 23.5 percentage points more deposits than individuals younger than 65.

Thus, even though there is a strong positive relationship for certain age levels, the overall relationship does not conform to the relationship hypothesized, wherefore *hypothesis 1e* is rejected. The outcome again indicates a typical u-shaped relationship between the variables, as already found by Anderrson (2001), where individuals who approach retirement hold significantly larger shares of deposits. A rational explanation of this might be that older individuals tend to reduce the risk of the portfolio as they do not have as much time to recover from potential investment losses as younger individuals. A cross check replacing *R_Age* by $Age^2$ is not necessary, as both age coefficients are significant, and the relationship is thus interpretable.

The negative coefficient of *Male* reveals that males allocate less funds into deposits compared to females, which is in accordance with *hypothesis 2e*, wherefore the hypothesis is accepted. More precisely, being male is associated with a 3.7 percentage points smaller share of deposits as compared to females ($B$ = -0.037; $SE$ = 0.012; $p < 0.01$). The outcome corroborates the findings from the previous sections indicating that males, exhibiting lower risk aversion, are more likely to invest and are also more inclined towards investing in risky investments and stocks compared to females. An explanation for this might be that women are more risk averse then men (Grable, 2000), thus investing more funds in deposits, as already found by Bayyurt et al. (2013) and Zhang et al. (2015).

In line with *hypotheses 3e* and *4e*, it is found that a higher income and a larger wealth both lead to a smaller allocation towards deposits (($B$ = -0.010; $SE$ = 0.005; $p < 0.05$); ($B$ = -0.018; $SE$ = 0.004; $p < 0.01$)). A one-percent rise in *Income* is associated with a reduction of the deposit share by one percentage point, while a similar increase in *Wealth* corresponds to a decline of 1.8 percentage points, respectively. These findings support the hypotheses, wherefore they are accepted. It appears that individuals with higher wealth and income levels prefer to channel additional financial resources towards investments in riskier assets, stocks or bonds. The outcome aligns with the patterns observed in the previous sections.

*Hypothesis 5e* suggests that financial educated individuals allocate less funds towards deposits. The findings support the postulation, as it is reported that financial education results in a 5.1 percentage points smaller share of deposits compared to individuals who are not financially literate ($B$ = -0.051; $SE$ = 0.012; $p < 0.01$). The positive association between *Fin_edu* and the likelihood of investing, as well as the proportion of assets held in risky assets, stocks and bonds found in the previous sections, reaffirms the notion that financially educated individuals are familiar with the advantages of investing in financial assets over retaining cash and deposits. Given that deposit interest rates have remained around zero for the past decade, as previously mentioned, it is reasonable to surmise that those with financial literacy are more inclined to divert resources from low-yielding deposits into more lucrative assets.

Referring to the geographical background, represented by the variable *East*, a significantly positive relationship is found. Individuals who live in East Germany hold a 5.5 percentage points larger share of deposits as compared to people who live in other regions in Germany ($B$ = 0.055; $SE$ = 0.015; $p < 0.01$). *Hypothesis 7e* which states that being situated in East Germany leads to a higher fraction of deposits in total financial assets, is thus accepted. The finding is in accordance with the outcome found in Section 4.2.1, where individuals who live in East Germany are significantly less likely to invest in financial markets at all. These results underscore the suspicion that there continue to be economic differences in investment behavior between East Germans and Germans from other regions, due to the fact that East Germany formerly was part of a communist dictatorship system. The results confirm the findings of Berlemann and Luik (2014), who examined a dataset from 2006 and prove that the differences can also be found in a more recent dataset.

Taking into account the z-standardized coefficients shows that *R_Age* exemplifies the largest impact on the share of deposits of the portfolio. The value indicates that people who are similar as or are older than 65 years old have a 0.314 standard deviation larger *share of deposits*, underlining the fact that people who reach retirement hold more deposits. The second largest coefficient is attributed to log(*Wealth*) (z-standardized coefficient = -0.121) and the smallest significant effect is attributed to *Male* (z-standardized coefficient = -0.013).

### 4.3 Comparison with prior dataset

This section extends the analysis by providing a robustness check of the empirical findings by applying the same methodology on the PHF dataset from the third wave, collected in 2017. The sample size in this analysis ($N = 4{,}942$) is substantially larger than that of the fourth wave utilized in this paper. Due to the differences in sample size and composition, it is not possible to derive causal inferences or direct comparisons of changes in portfolio allocation. The purpose of this comparison is to verify whether similar or congruent results can be achieved using a different, albeit characteristically comparable, German sample. Detailed descriptive statistics of the sample and regression results are provided in Appendix 41 ff.

In line with the findings in this paper, the data indicates that the most popular asset class is deposits, with a participation rate of 95.8%, followed by voluntary pensions/whole life insurance at 46.4%, and stocks at 27.7%. The engagement in stock investments is observed to be eight percentage points less than in the 2021 sample.

When examining personal characteristics, the results align closely with those found in this paper. Though *Age* does not impact *Investing*, *Age* and *R_Age* both display a significant positive impact on asset allocation. Both variables positively impact the share of risky assets and the share of stocks. The results between *Age* and the *share of deposits* are almost similar to the prior findings, indicating that individuals first reduce their deposit holdings and with retirement significantly increase the position. The inclusion of the $Age^2$ variable again reveals a u-shaped relationship with the *share of risky assets* and *stocks* (turning point at age 43 and five months and at age 43 and a half) reinforcing the insights of this paper. Similarly, the small likelihood for older individuals to invest in bonds is observed.

Similar to the prior findings, male participants show a considerably higher likelihood of engaging in financial markets, with significant inclinations towards risky assets and stocks, and a reduced preference for deposits as compared to female participants. This is corroborated by the corresponding coefficients and significance levels (see Appendix).

Furthermore, the influence of the geographic location (*East*) does not present a significant effect on any of the dependent variables. This could be attributed to the sample's lesser representation from East Germany compared to the dataset of the survey wave four.

In addition, marital status appears to influence investment behaviors, with married individuals showing a lower propensity to invest at all and similarly allocating fewer funds towards riskier assets, stocks, and bonds, likewise supporting the prior findings.

Financial education is again found to be another predictor of asset allocation, with financially knowledgeable individuals being more likely to invest and allocate a higher portion of their portfolio to riskier assets, stocks, as well as a higher likelihood to invest in bonds, while allocating less to deposits. Similar yet stronger effects are likewise observed for the relationship of the dependent variables with *Wealth*.

Moreover, income is observed to positively affect the likelihood of investing, a finding that diverges slightly from the prior investigation, where no significant association was noted. Consistent with the paper's findings, however, is the negative correlation between *Income* and the *share of deposits*.

In terms of economic expectations, positive expectations regarding the stock market enhance the likelihood of investing, aligning with the paper's observations. While a positive correlation with the share of stocks is confirmed, no relationship like this is detected with the share of risky assets. The negative impact of high inflation expectations on the share of stocks priorly discovered could not be found. Furthermore, to the authors surprise, a negative association between expectations of deposit interest rates and the share of deposits is found, suggesting that higher expected interest rates correlate with a decreased allocation to deposits. Again, this effect may be mediated by *Wealth*, as it has been shown that wealthy individuals allocate less funds towards deposits.

Thus, in this section it has been demonstrated that the results are almost identical, which significantly underscores and confirms the robustness and generalizability of the findings in this paper, meaning that the outcomes can also be replicated in a different sample within Germany.

## 5. Conclusion

This paper investigated the impact of chosen socio-demographic and personal characteristics on asset allocation utilizing the Panel on Household Finance dataset. To determine whether these characteristics influence asset allocation, the study examined how these characteristics affect the likelihood of investing, the allocation towards risky assets in the portfolio, towards stocks in the portfolio, the likelihood of investing in bonds, and the allocation towards deposits in the portfolio.

Through different regressions, it was possible to answer the main research question, namely, which of the chosen personal and socio-demographic characteristics impact asset allocation. Significant correlations were found across all examinations, with age, gender, income, wealth, financial education, marital status, the geographical background, and economic expectations all effecting asset allocation. The effect of expectations regarding deposit interest was found to be insignificant.

First, it was discovered that deposits are the asset class held by the majority of the sample, followed by life insurances and stocks. The finding has been validated by the robustness check in chapter 4.2.5. Compared to other studies and datasets, it was found that stocks in this paper have a significantly higher participation rate as compared to wave three and as found by the study of the Verband Deutscher Bausparkassen (2023).

Regarding age, even though a significantly small and negative influence of age on the likelihood of investing was found, a significant u-shaped relationship between age and the share of risky assets, share of stocks, share of deposits, and the likelihood of investing in bonds was reported, contradicting previous research. Thus, the share and the probability of being invested in these assets were found to increase with advancing age, contrasting the assumption that older people reduce their risky investments to remove volatility from their portfolios. The divergent findings may be attributed to the fact that, in this dataset, *Wealth* plays a major role and older people are likely to be wealthy wherefore they can afford to take on more risk and thus to be invested in risky assets and stocks.

Males were found to have a significantly higher likelihood of investing in general, investing more in risky assets and stocks, and less in deposits compared to women, as expected and reported by prior literature. This can be attributed to the already addressed

greater willingness in men to take on risks compared to women, or because of the assumption that women naturally are more risk-averse than men.

Income only had a significantly negative influence on the share of deposits. An explanation for the finding could be that wealth was included in every regression, which could have absorbed the effect of income. The result, however, supports the assumption that more affluent people continue to prefer riskier investments, as also found in the literature.

Wealth was attributed the greatest influence, affecting the likelihood of investing significantly positive and influencing the share of risky assets and stocks, and the likelihood to invest in bonds strongly positive. Also, wealth affected the share of deposits slightly negative. The variable almost consistently constituted the highest odds ratios and z-standardized coefficients, proving its strong explanatory power. Wealthy people seem to continue to invest additional funds in financial assets as their wealth increases. The result reflects the majority of the literature examined and was also found during the robustness check.

As expected, financial education has a highly significant positive influence on the likelihood of investing, the share of risky assets and stocks, and on the likelihood of investing in bonds, and a significant negative influence on the share of deposits was reported. This result is confirmed by the robustness check of wave three and supports the assumption that financially literate individuals are aware of the discussed advantages of investing in financial assets and prefer to allocate their funds to these rather than holding deposits or cash, especially in the context of low-interest rates.

As assumed by the majority of the literature, married individuals seem to be more risk-averse, as they were found to invest significantly less, have a lower share of risky assets and share of stocks, and a lower probability of holding bonds than singles. Again, this may come due to married individuals may having more responsibilities compared to singles.

Regarding individuals living in East Germany, a significantly strong negative correlation between *East* and the likelihood of investing was found. Moreover, it was found

that these individuals hold more deposits, which supports the assumption that the history of East Germany, which used to be a communist dictatorship, still has an impact today. The result confirms the findings of the literature. No significant correlation was found in the robustness check with wave three, which, however, does not contradict the assumption.

As expected, positive expectations regarding the stock market imply a higher likelihood of investing, a higher share of risky assets, and stocks. Contrary to expectations, inflation expectations had a significant negative influence on stockholdings, possibly because people use their money for daily life, which becomes more expensive. No correlation was found for the other dependent variables. For expectations regarding deposit interest rates, no significant correlations were found.

Overall, partially highly significant influences on asset allocation were found, providing insights into how the asset allocation of Germans is influenced. Mostly all effects could also be replicated applying the same methodology as a robustness check on the dataset of wave three and further mostly align with the literature discussed, underlining the validity of the results. The goal of further research could be to investigate psychological factors for Germany and, thus, gain further insights into why, for example, stocks still seem less popular in Germany in international comparison.

Moreover, the impact of *Wealth*, which predominantly was the variable with the greatest influence on the investigations, should be examined more closely. As initially described, the dataset is oversampled in wealthy households in order to better investigate rare asset classes that are more likely to be held by these social classes. To obtain a representative result for Germany, future research should consider the oversampling effect. Moreover, stock ownership could be investigated in relation to non-deposit financial wealth, to study the wealth effect of older individuals in context of investment grade assets more closely. To be able to make temporally consistent results and thus causal statements of portfolio shifts of individuals' over multiple points in time, the datasets of the different points of measurement could also be combined based on the personal identifier numbers (pers id). Although this could significantly reduce the sample size, it would allow for the examination of changes in assets. However, these suggestions are beyond the scope of this paper and therefore serve as inspirations for future research.

**Reference list**

**Articles:**

Agarwal, S., Chua, Y. H., Ghosh, P., & Song, C. (2022). Inflation Expectations of Households and Portfolio Rebalancing: Evidence from Inflation Targeting in India. SSRN. https://ssrn.com/abstract=4069564 or http://dx.doi.org/10.2139/ssrn.4069564

Agnew, J., & Szykman, L. (2005). Asset allocation and information overload: The influence of information display, asset choice, and investor experience. Journal of Behavioral Finance, 6(2), 57-70.

Anoruo, E., Bajtelsmit, V. L., Ramchander, S., & Simpson, M. W. (2003). The effect of consumer expectations on portfolio asset allocation. Journal of Financial Planning, 16(9), 64-70.

Apergis, N., & Bouras, C. (2023). Household choices on investing in financial risky assets: Do national institutional factors have their own merit? International Journal of Finance & Economics, 28, 405–420. https://doi.org/10.1002/ijfe.2427

Arano, K., Parker, C., & Terry, R. (2010). Gender-based risk aversion and retirement asset allocation. Economic Inquiry, 48(1), 147-155.

Aren, S., & Zengin, A. N. (2016). Influence of Financial Literacy and Risk Perception on Choice of Investment. Procedia - Social and Behavioral Sciences, 235, 656-663.

Arrondel, L., Padro, H. C., & Oliver, X. (2010). Temperance in stock market participants: Evidence from France. Economica, 77(2), 314–333.

Bajtelsmit, V. L., Bernasek, A., & Jianakoplos, N. A. (1996). Gender effects in pension investment allocation decisions. Center for Pension and Retirement Research, 145-156.

Banks, J., & Smith, S. (2002). UK household portfolios. In L. Guiso, M. Haliassos, & T. Jappelli (Eds.), Household Portfolios. MIT Press.

Barasinska, N., Schäfer, D., & Stephan, A. (2008). Financial risk aversion and household asset diversification. SOEP Papers on Multidisciplinary Panel Data Research (No. 117). Retrieved from http://www.diw.de/soeppapers

Barber, B. M., & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. Quarterly Journal of Economics, 116, 261–292.

Bashir, T., Shaheen, S., Batool, Z., Butt, M. H., & Javed, A. (2014). The impact of demographic characteristics and risk tolerance on investors' risk perception and portfolio management. The Lahore Journal of Business, 2(2), 33-48.

Bayyurt, N., Karışık, V., & Coşkun, A. (2013). Gender Differences in Investment Preferences. European Journal of Economic & Political Studies, 6(1).

Beckmann, J., & Czudaj, R. (2012). Gold as an inflation hedge in a time-varying coefficient framework (Ruhr Economic Paper No. 362). SSRN. https://ssrn.com/abstract=2144781 or http://dx.doi.org/10.2139/ssrn.2144781

Bertocchi, G., Brunetti, M., & Torricelli, C. (2011). Marriage and other risky assets: A portfolio approach. Journal of Banking & Finance, 35(11), 2902-2915. https://doi.org/10.1016/j.jbankfin.2011.03.019

Bogan, V. L., Just, D. R., & Dev, C. S. (2013). Team gender diversity and investment decision-making behavior. Review of Behavioral Finance, 5(2), 134-152.

Börsch-Supan, A. (2000). Perspektiven der privaten Vorsorge. In E. Mezger (Ed.), Zukunft der Alterssicherung. Edition der Hans-Böckler-Stiftung.

Börsch-Supan, A., & Eymann, A. (2002). Household Portfolios in Germany. Sonderforschungsbereich 504 Publications (00-15), Universität Mannheim; Sonderforschungsbereich 504, University of Mannheim.

Byrnes, J. P., Miller, D. C., & Schafer, W. D. (1999). Gender differences in risk taking: A meta-analysis. Psychological Bulletin, 125(2), 367–383.

Campbell, J. (2006). Household finance. Journal of Finance, 61(4), 1553–1604.

Cardak, B. A., & Wilkins, R. K. (2009). The determinants of household risky asset holdings: Australian evidence on background risk and other factors. Journal of Banking and Finance, 33(5), 850–860.

Chang, Y., Hong, J. H., & Karabarbounis, M. (2018). Labor Market Uncertainty and Portfolio Choice Puzzles. American Economic Journal: Macroeconomics, 10(2), 222-62.

Christelis, D., Georgarakos, D., & Haliassos, M. (2013). Differences in portfolios across countries: Economic environment versus household characteristics. The Review of Economics and Statistics, 95(1), 220–236. Retrieved from http://www.jstor.org/stable/23355661

Cobb-Clark, D. A., & Hildebrand, V. A. (2009). The asset portfolio of native-born and foreign-born Australian households. Economic Record, 85(268), 46-59.

Cohn, R. A., Lewellen, W. G., Lease, R. C., & Schlarbaum, G. G. (1975). Individual investor risk aversion and investment portfolio composition. Journal of Finance, 30(2), 605-620.

Cole, S. A., Paulson, A., & Shastry, G. K. (2014). Smart money? The effect of education on financial outcomes. Review of Financial Studies, 27(7), 2022–2051.

Davis, A., & Kim, J. (2017). Household Portfolio Allocation in the EU. https://www.cerp.carloalberto.org/wp-content/uploads/2017/10/Paper-Davis.pdf

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. Journal of the European Economic Association, 9(3), 522-550.

Dwyer, P., Gilkeson, J., & List, J. (2002). Gender Differences in Revealed Risk Taking: Evidence from Mutual Fund Investors. Economics Letters, 76, 151-158. https://doi.org/10.1016/S0165-1765(02)00045-9

Ely, D. P., & Robinson, K. J. (1997). Are stocks a hedge against inflation? International evidence using a long-run approach. Journal of International Money and Finance, 16(1), 141–167. https://doi.org/10.1016/s0261-5606(96)00039-3

Faff, R., Hallahan, T., & McKenzie, M. (2011). Women and risk tolerance in a changing world. International Journal of Accounting and Information Management, 19(2), 100-117.

Fama, E. F., & Schwert, G. W. (1977). Asset returns and inflation. Journal of Financial Economics, 5, 115-146.

Fisher, I. (1930). The Theory of Interest: As Determined by Impatience to Spend Income and Opportunity to Invest It. MacMillan Company.

Friedman, B. M. (1980). Price Inflation, Portfolio Choice, and Nominal Interest Rates. The American Economic Review, 70(1), 32–48. Retrieved from http://www.jstor.org/stable/1814736

Ghosh, D., Levin, E. J., Macmillan, P., & Wright, R. E. (2004). Gold as an inflation hedge? Studies in Economics and Finance, 22, 1–25.

Gibson, R., Michayluk, D., & Van de Venter, G. (2013). Financial risk tolerance: An analysis of unexplored factors. Financial Services Review, 22, 23-50.

Grable, J. (2000). Financial Risk Tolerance and additional Factors that affect risk taking in everyday money matters. Journal of Business and Psychology, 14(4), 625-630.

Grable, J. E., & Joo, S. H. (1997). Determinants of risk preference: Implications for family and consumer science professionals. Family Economics and Resource Management Biennial, 2, 19–24.

Grable, J. E., & Lytton, R. H. (1997). Determinants of retirement savings plan participation: A discriminant analysis. Personal Finances and Worker Productivity, 1(1), 184–189.

Grill, M., Molestina Vivar, L., & Wedow, M. (2022). Mutual fund suspensions during the COVID-19 market turmoil – asset liquidity, liquidity management tools and spillover effects. Finance Research Letters, 50, Article 103249.

Guiso, L., Haliassos, M., & Jappelli, T. (2003). Household stockholding in Europe: where do we stand and where do we go? Economic Policy, 18(36), 123–170. https://doi.org/10.1111/1468-0327.00104

Haliassos, M., & Bertaut, C. C. (1995). Why do so few hold stocks? The Economic Journal, 105(431), 1110–1129.

Halko, M.-L., Kaustia, M., & Alanko, E. (2012). The gender effect in risky asset holdings. Journal of Economic Behavior and Organization, 83, 66–81.

Hallahan, T., Faff, R., & McKenzie, M. (2004). An empirical investigation of personal financial risk tolerance. Financial Services Review, 13, 57-78.

Hayes, A. F., & Cai, L. (2007). Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. Behavior Research Methods, 39(4), 709-722.

Hibbert, A. M., Lawrence, E. R., & Prakash, A. J. (2013). Does knowledge of finance mitigate the gender difference in financial risk-aversion? Global Finance Journal, 24(2), 140-152.

Jacobsen, B., Lee, J. B., Marquering, W., & Zhang, C. Y. (2014). Gender differences in optimism and asset allocation. Journal of Economic Behavior & Organization, 107(Part B), 630–651. https://doi.org/10.1016/j.jebo.2014.03.007

Jianakoplos, N. A., & Bernasek, A. (1998). Are Women More Risk Averse? Economic Inquiry, 36, 620-630. https://doi.org/10.1111/j.1465-7295.1998.tb01740.x

Kahneman, D., & Tversky, A. (1974). Judgment under uncertainty: Heuristics and biases. Science (New York, N.Y.), 185(4157), 1124–1131. https://doi.org/10.1126/science.185.4157.1124

Kahnemann, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. Econometrica, 47(2), 263-291.

Kaustia, M., Alho, E., & Puttonen, V. (2008). How much does expertise reduce behavioral biases? The case of anchoring effects in stock return estimates. Financial

Management, 37(3), 391–412. https://doi.org/10.1111/j.1755-053X.2008.00018.x

Kezdi, G., & Willis, R. J. (2008). Stock market expectations and portfolio choice of American households. Mimeo, University of Michigan.

Kim, J. H., & Ryoo, H. (2009). Common stocks as a hedge against inflation: Evidence from century-long US data. Finance and Corporate Governance Conference 2010 Paper. SSRN. https://ssrn.com/abstract=1526243 or http://dx.doi.org/10.2139/ssrn.1526243

Lamont, O. A., & Thaler, R. H. (2003). Can the market add and subtract? Mispricing in tech stock carve-outs. The Journal of Political Economy, 111(2), 227–268. https://doi.org/10.1086/367683

Lan, Q., Xiong, Q., He, L., & Ma, C. (2018). Individual investment decision behaviors based on demographic characteristics: Case from China. PLoS ONE, 13(8), e0201916. https://doi.org/10.1371/journal.pone.0201916

Lee, B., Rosenthal, L., Veld, C., & Veld-Merkoulova, Y. (2015). Stock market expectations and risk aversion of individual investors. International Review of Financial Analysis, 40, 122-131. https://doi.org/10.1016/j.irfa.2015.05.011

Love, D. A. (2010). The effects of marital status and children on savings and portfolio choice. Review of Financial Studies, 23(1), 385–432. https://doi.org/10.1093/rfs/hhp074

Markowitz, H. (1952). Portfolio selection. Journal of Finance, 7, 77–92.

Modigliani, F., & Brumberg, R. H. (1954). Utility analysis and the Consumption Function: An Interpretation of Cross-Section Data. In K. K. Kurihara (Ed.), Post-Keynesian Economics (pp. 388–436). Rutgers University Press.

Morin, R. A., & Suarez, A. E. (1983). Risk aversion revisited. The Journal of Finance, 38, 1201–1216.

Naudon, A., & Tapia, M. (2004). Ignorance, fixed costs, and the stock-market participation puzzle. Econometric Society 2004 Latin American meetings (Paper No. 252). Econometric Society.

Pinjisakikool, T. (2018). The Influence of Personality Traits on Households' Financial Risk Tolerance and Financial Behaviour. Journal of Interdisciplinary Economics, 30(1), 32-54. https://doi.org/10.1177/0260107917731034

Poterba, J. M., & Samwick, A. (2001). Household portfolio allocation over the life cycle. In Aging Issues in the United States and Japan (pp. 65-104). University of Chicago Press.

Riley, W. B., & Chow, K. V. (1992). Asset Allocation and Individuals' Risk Aversion. Financial Analysts Journal, 48(3), 32-39.

Salisu, A. A., Ndako, U. B., & Akanni, L. O. (2019). New evidence for the inflation hedging potential of US stock returns. Finance Research Letters, 101384. https://doi.org/10.1016/j.frl.2019.101384

Schmidt, T., Kocharkov, G., Paule-Paludkiewicz, H., Tzamourani, P., & Wehrhöfer, N., et al. (2023). Panel on Household Finances 4th Wave. Deutsche Bundesbank. https://doi.org/10.12757/Bbk.PHF.04.01.01

Schooley, D. K., & Worden, D. D. (2003). Generation X: Understanding Their Risk Tolerance and Investment Behavior. Journal of Financial Planning, 16(9), 45-56.

Sulaiman, E. (2012). An empirical analysis of financial risk tolerance and demographic features of individual investors. Procedia Economics and Finance, 2, 109–115. https://doi.org/10.1016/S2212-5671(12)00070-6

Sung, J., & Hanna, S. D. (1996). Factors Related to Risk Tolerance. Financial Counseling and Planning, 7. Available at SSRN: https://ssrn.com/abstract=2234 or http://dx.doi.org/10.2139/ssrn.2234

Thaler, R. (1985). Mental accounting and consumer choice. Marketing Science, 4, 199–215.

Tracy, J., & Schneider, H. (2001). Stocks in the household portfolio: A look back at the 1990s. Current Issues in Economics and Finance, 7(1), 1–6.

Vissing-Jorgensen, A. (2003). Perspectives on Behavioral Finance: Does 'Irrationality' Disappear with Wealth? Evidence from Expectations and Actions. SSRN. http://dx.doi.org/10.2139/ssrn.417421

Wachter, J. A., & Yogo, M. (2010). Why do household portfolio shares rise in wealth? Review of Financial Studies, 23(11), 3929–3965.

Wachter, J. A., & Yogo, M. (2010). Why do household portfolio shares rise in wealth? Review of Financial Studies, 23(11), 3929–3965.

Wallach, M. A., & Kogan, N. (1961). Aspects of Judgment and Decision Making: Interrelationships and Changes with Age. Behavioral Science, 6, 23-26.

Wang, H., & Hanna, S. D. (1997). Does risk tolerance decrease with age? Financial Counseling and Planning, 8(2). Available at SSRN: https://ssrn.com/abstract=95489 or http://dx.doi.org/10.2139/ssrn.95489

Waternaux, C. M. (1976). Asymptotic distribution of the sample roots for a nonnormal population. Biometrika, 63(3), 639–645.

Werner, J. (1997). Diversification and Equilibrium in Securities Markets. Journal of Economic Theory, 75, 89-103. https://doi.org/10.1006/jeth.1997.2271

Yang, Q. (2022). Inflation Expectations and Households Portfolio Choice. SSRN. https://ssrn.com/abstract=4137431

Yao, R., & Hanna, S. (2005). The effect of gender and marital status on financial risk tolerance. Journal of Personal Finance, 4, 66-85.

Yao, R., Sharpe, D. L., & Wang, F. (2011). Decomposing the age effect on risk tolerance. Journal of Socio-Economics, 40, 879-887.

Yuan, H., Puah, C., & Yau, J. T. (2022). How Does Population Aging Impact Household Financial Asset Investment? Sustainability.

Zhang, A., Jacobsen, B., & Marshall, B. R. (2015). Peer effects, personal characteristics and asset allocation. SSRN. https://ssrn.com/abstract=2448535 or http://dx.doi.org/10.2139/ssrn.2448535

Zhang, Y., Lu, X., & Xiao, J. J. (2023). Does financial education help to improve the return on stock investment? Evidence from China. Pacific-Basin Finance Journal, 78, 101940. https://doi.org/10.1016/j.pacfin.2023.101940

Zhong, L. X., & Xiao, J. J. (1995). Determinants of family bond and stock holdings. Financial Counseling and Planning, 6, 107-114. Retrieved from https://my.afcpe.org/system/journals/vol612.pdf

**Books:**

Bodie, Z., Kane, A., & Marcus, A. J. (2021). *Investments*. McGraw-Hill Education.

Bortz, J., & Schuster, C. (2001). *Statistik für Human- und Sozialwissenschaftler* (7th ed.). Springer.

Fox, J., & Weisberg, S. (2019). *An R Companion to Applied Regression* (3rd ed.). Sage.

Hensher, D., & Johnson, L. W. (1981). *Applied discrete choice modelling*. Croom Helm.

Larson, R. (2013). *Precalculus: A concise course (3rd ed.)*. Cengage Learning.

Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. John Wiley & Sons.

Tabachnick, B., & Fidell, L. (2014). *Using Multivariate Statistics* (6th ed.). Pearson.

**Online references:**

Damodaran, A. (2024). Historical returns on stocks, bonds and bills: 1928-2023. Retrieved from https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html

Deutsches Aktien Institut (DAI). (2023). 50 Jahre Aktien-Renditen. Retrieved from https://www.dai.de/fileadmin/user_upload/231231_DAX-Rendite-Dreieck_50_Jahre_Web.pdf

Dpa. (2019, December 17). Experten sehen Defizite bei der Finanzbildung von Schülern. Süddeutsche Zeitung. Retrieved from https://www.sueddeutsche.de/bildung/bildung-experten-sehen-defizite-bei-der-finanzbildung-von-schuelern-dpa.urn-newsml-dpa-com-20090101-191217-99-170140

European Central Bank (ECB). (2024). Key ECB interest rates. Retrieved from https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

Janson, M. (2013). Deutschlands Rentenproblem (Data of Deutsche Rentenversicherung). In Statista. Retrieved from https://de.statista.com/infografik/25751/alters-rentner-und-beitragszahler-in-der-rentenversicherung-in-deutschland/

OECD. (2024). Household financial assets (indicator). https://doi.org/10.1787/7519b9dc-en

Statistisches Bundesamt. (2023). Verteilung der Bevölkerung in Deutschland nach beruflichem Bildungsabschluss im Jahr 2022 [Graph]. In Statista. Retrieved from https://de-statista-com.ezproxy.uni-giessen.de/statistik/daten/studie/3276/umfrage/bevoelkerung-nach-beruflichem-bildungsabschluss/

Verband der Privaten Bausparkassen. (2023, April 11). Welche Möglichkeiten der Geldanlage nutzen Sie aktuell? [Graph]. In Statista. Retrieved from https://de-statista-com.ezproxy.uni-giessen.de/statistik/daten/studie/13314/umfrage/aktuell-genutzte-geldanlagen-der-deutschen/

Würz, M. (2014). Geteiltes Deutschland. Lebendiges Museum Online, Stiftung Haus der Geschichte der Bundesrepublik Deutschland. Retrieved from http://www.hdg.de/lemo/kapitel/geteiltes-deutschland.html

**Working papers:**

Anderrson, B. (2001). Portfolio allocation over the life cycle: Evidence from Swedish household data (Uppsala University Department of Economics Working Paper No. 4). Retrieved from http://www.nek.uu.se/pdf/2001wp4.pdf

Berlemann, M., & Luik, M. A. (2014). Institutional reforms and depositors' portfolio choice: Evidence from censored quantile regressions (Working Paper No. 4782). Center for Economic Studies, Ifo Institution.

Calvet, L. E., & Sodini, P. (2010). Twin picks: Disentangling the determinants of risk-taking in household portfolios (Working Paper No. 15859). National Bureau of Economic Research.

Goetzmann, W. N., Massa, M., & Simonov, A. (2004). Portfolio diversification and city agglomeration (NBER Working Paper Series No. 10343). https://doi.org/10.3386/w10343

King, M. A., & Leape, J. I. (1987). Asset accumulation, information, and the life cycle (NBER Working Paper No. 2392).

Lyons, A., Neelakantan, U., Fava, A., & Scherpf, E. (2007). For better or worse: Financial decision-making behavior of married couples (NFI Working Paper No. 2007-WP-14). https://ssrn.com/abstract=985894 or http://dx.doi.org/10.2139/ssrn.985894

Seils, E., & Pusch, T. (2022). Ungleichheit, Umverteilung und Preise im regionalen Vergleich (WSI Policy Brief No. 70). Wirtschafts- und Sozialwissenschaftliches Institut (WSI), Hans-Böckler-Stiftung.

Shiller, R. J. (1997). Human behavior and the efficiency of the financial system (Working Paper). Yale University.

Vissing-Jorgensen, A. (2002). Towards an explanation of household portfolio choice heterogeneity: Nonfinancial income and participation cost structures (NBER Working Paper Series No. 8884). https://doi.org/10.3386/w8884 or http://www.nber.org/papers/w8884

**Editorial Contributions**

Bertaut, C., & Starr-McCluer, M. (2002). Household portfolios in the United States. In L. Guiso, M. Haliassos, & T. Jappelli (Eds.), Household Portfolios. MIT Press.

Hinz, R. P., McCarthy, D. D., & Turner, J. A. (1997). Are women conservative investors? Gender differences in participant-directed pension investments. In M. S. Gordon, O. S. Mitchell, & M. M. Twinney (Eds.), Positioning Pensions for the Twenty-First Century (pp. 91-103). University of Pennsylvania Press.

# Appendix

## Appendix 1

*Definition of financial assets*

| Variable | Description |
|---|---|
| Deposits | Total balance of checking accounts, savings accounts, credit card accounts, accounts in home loan savings agreements and contracts of a given household |
| Stocks | Sum of stock and shares in mutual funds investing in public equity |
| Bonds | Sum of bonds and shares in mutual funds investing in fixed income securities |
| Other financial assets | Total value of shares in cooperatives, precious metals, options, futures, effective pieces of securities not held in a securities account, claims arising from legal proceedings or from an estate, extraction rights (e.g., for oil and gas), claims arising from patents and licenses, other securities in the securities account and the market value of certificates |
| Voluntary pension/whole life insurance | Voluntary pensions and whole life insurance (including, for example, "Riester pension", "Rürup pension", "basic pension", as well as non-government-subsidized private retirement pensions), excluding occupational pension plans |
| Value of non-self-employment private business | value of shares in silent partnerships |
| Managed accounts | Assets managed by a wealth manager |
| Money owed to households | Any funds owed to a household member by at least one person outside the household, such as loans to acquaintances, private loans, and rental deposits |
| Money market funds | Funds that predominantly invest in money market securities |
| Real estate funds | Funds that predominantly invest in real estate |
| Hedge funds | Funds that invest in high-risk asset classes |
| Other investment funds | Funds that invest in other assets |

*Source: Schmidt et. al. (2023), own definition.* Own creation.

## Appendix 2

*Definition of risky and less risky assets*

| Variable | Description |
|---|---|
| Risky assets | Sum of stocks, managed accounts, value of non-self-employed business, real estate funds, hedge funds, other investment funds and other financial assets |
| Less risky assets | Sum of deposits, bonds, money owed to households, money market funds, and voluntary pensions / whole life insurance |

*Note: Definitions mainly in accordance with Apergis and Bouras (2020), Davis and Kim (2017) and Chang et al. (2018).* Source: Own creation.

## Appendix 3

*Hosmer and Lemeshow GOF test before modification – Investing*

| Regression | X-squared | df | p-value |
|---|---|---|---|
| Imputation 1 | 55.082 | 8 | 4.255e-09 |
| Imputation 2 | 56.332 | 8 | 2.43e-09 |
| Imputation 3 | 63.761 | 8 | 8.478e-11 |
| Imputation 4 | 66.505 | 8 | 2.431e-11 |
| Imputation 5 | 48.861 | 8 | 6.76e-08 |

Source: Own creation.

## Appendix 4

*Linearity of Log-odds test before modification – Investing*

| Variable | *Beta_Imp1* | *Beta_Imp2* | *Beta_Imp3* | *Beta_Imp4* | *Beta_Imp5* |
|---|---|---|---|---|---|
| Age:log(Age) | -0.072 | -0.045 | -0.080 | -0.057 | -0.060 |
| Income:log(Income) | -0.000002** | -0.000002** | -0.000002*** | -0.000002*** | -0.000001* |
| Wealth:log(Wealth) | -0.0000001** | -0.0000001** | 0.0000008** | -0.0000001** | -0.0000001** |

Source: Own creation. *Note: For simplification only the coefficients of the variables that might be transformed are reported. The regression has been done with all variables of the investigation.*

## Appendix 5

*Hosmer and Lemeshow GOF test after modification – Investing*

| Regression | X-squared | df | p-value |
|---|---|---|---|
| Imputation 1 | 10.066 | 8 | 0.2610 |
| Imputation 2 | 10.592 | 8 | 0.2259 |
| Imputation 3 | 13.721 | 8 | 0.08933 |
| Imputation 4 | 7.5339 | 8 | 0.4803 |
| Imputation 5 | 17.282 | 8 | 0.0273 |

*Note: Retesting of goodness of fit after transforming Income and Wealth.* Source: Own creation.

## Appendix 6

*Test for multicollinearity after modification – Investing*

| Regression | VIF Imp1 | VIF Imp2 | VIF Imp3 | VIF Imp4 | VIF Imp5 |
|---|---|---|---|---|---|
| Age | 1.114436 | 1.115257 | 1.116364 | 1.114031 | 1.116563 |
| Male | 1.057576 | 1.056687 | 1.057326 | 1.057865 | 1.056857 |
| log(Income) | 1.148457 | 1.161175 | 1.152501 | 1.154034 | 1.162822 |
| log(Wealth) | 1.297876 | 1.299827 | 1.299273 | 1.297205 | 1.300595 |
| Fin_edu | 1.021978 | 1.021137 | 1.022006 | 1.022047 | 1.021355 |
| Married | 1.259590 | 1.259265 | 1.258629 | 1.261396 | 1.260728 |
| East | 1.040369 | 1.040081 | 1.041553 | 1.040366 | 1.039736 |
| Exp_stock_market | 1.016889 | 1.016687 | 1.016472 | 1.016628 | 1.016787 |
| Exp_inflation | 1.017700 | 1.017924 | 1.017303 | 1.018005 | 1.018009 |
| Exp_deposit_interest | 1.016581 | 1.017049 | 1.016535 | 1.016859 | 1.016697 |

Source: Own creation.

## Appendix 7

*Test for outliers after modification – Investing*

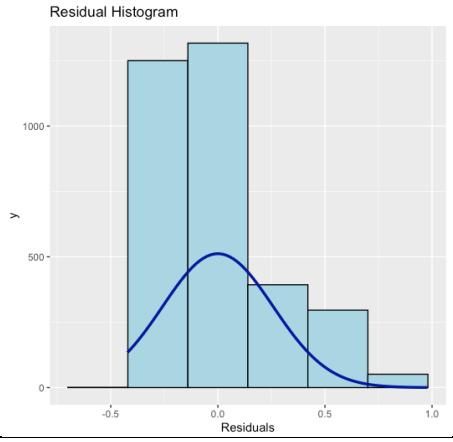
| Regression | Strong outliers | Soft outliers | % soft outliers |
|---|---|---|---|
| Imp1 | 0 | 17 | 0.51% |
| Imp2 | 0 | 17 | 0.51% |
| Imp3 | 0 | 17 | 0.51% |
| Imp4 | 0 | 17 | 0.51% |
| Iimp5 | 0 | 17 | 0.51% |

*Note: Values below critical threshold.* Source: Own creation.

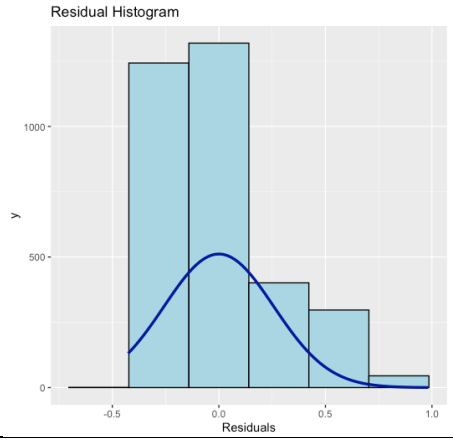
## Appendix 8

*Histogram as test of normal distribution of residuals - Risky share*

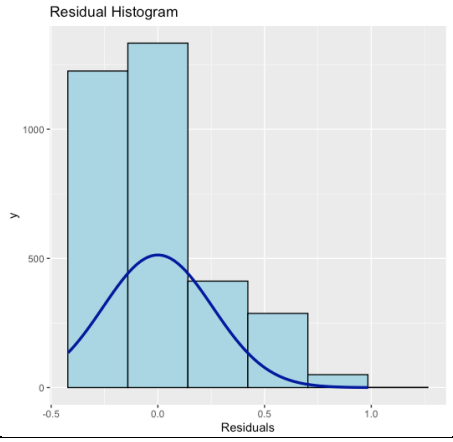
Imputation 1



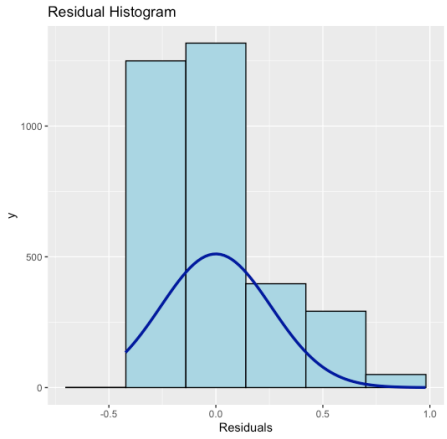

Imputation 2



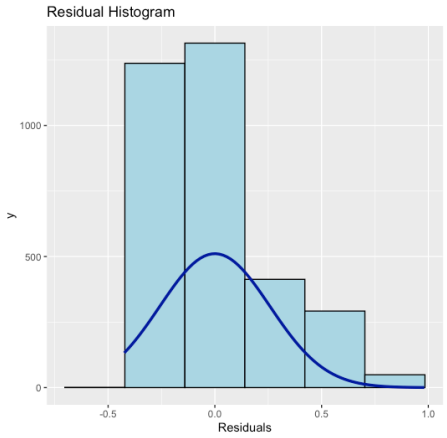

Imputation 3




Imputation 4




Imputation 5

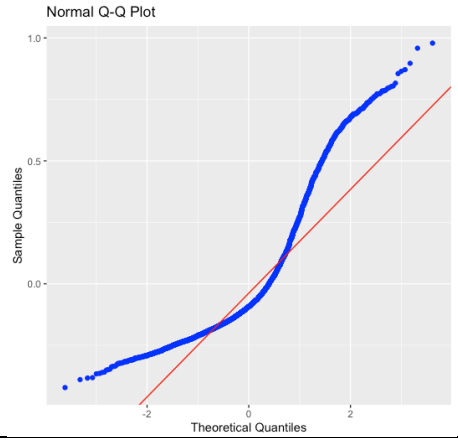



Source: Own creation.

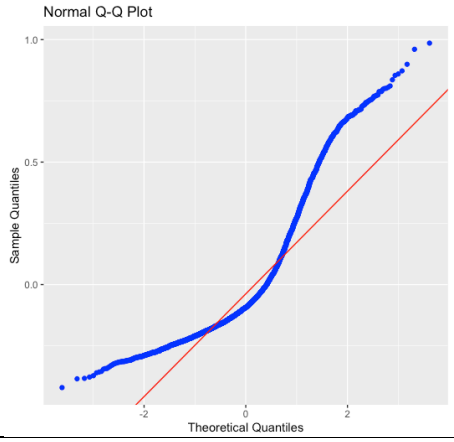
## Appendix 9

*Q-Q-Plot as test of normal distribution of residuals - Risky share*

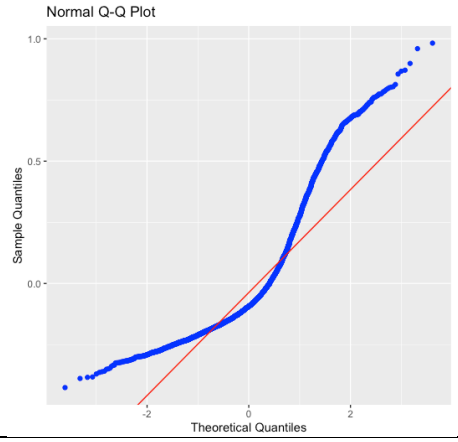
Imputation 1



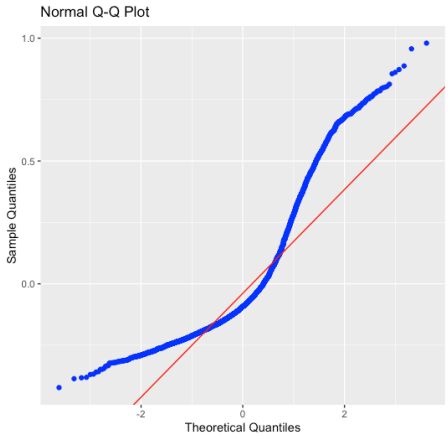

Imputation 2



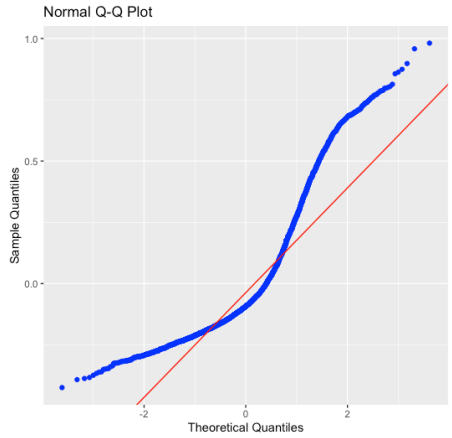

Imputation 3




Imputation 4




Imputation 5




Source: Own creation.

## Appendix 10

*Shapiro-Wilk Test of normal distribution of residuals - Risky share*

| Regression | W | P-value |
|---|---|---|
| Imputation 1 | 0.85629 | < 2.2e-16 |
| Imputation 2 | 0.85546 | < 2.2e-16 |
| Imputation 3 | 0.85565 | < 2.2e-16 |
| Imputation 4 | 0.85616 | < 2.2e-16 |
| Imputation 5 | 0.85742 | < 2.2e-16 |

Source: Own creation.

## Appendix 11

*Breusch-Pagan Test of Heteroskedasticity - Risky share*

| Regression | Df | Chi2 | Prob > Chi2 |
|---|---|---|---|
| Imputation 1 | 1 | 213.9536 | 1.885098e-48 |
| Imputation 2 | 1 | 202.8261 | 5.048189e-46 |
| Imputation 3 | 1 | 216.2929 | 5.821406e-49 |
| Imputation 4 | 1 | 207.9760 | 3.797191e-47 |
| Imputation 5 | 1 | 208.1877 | 3.414094e-47 |

Source: Own creation.

## Appendix 12

*Rainbow Test of linearity - Risky share*

| Regression | Rain | Df1 | Df2 | P-value |
|---|---|---|---|---|
| Imputation 1 | 1.1096 | 1654 | 1643 | 0.0174 |
| Imputation 2 | 1.1421 | 1654 | 1643 | 0.003507 |
| Imputation 3 | 1.1393 | 1653 | 1642 | 0.004092 |
| Imputation 4 | 1.1535 | 1653 | 1642 | 0.001884 |
| Imputation 5 | 1.1319 | 1653 | 1642 | 0.005975 |

Source: Own creation.

## Appendix 13

*VIF Test for multicollinearity - Risky share*

| Regression | VIF Imp1 | VIF Imp2 | VIF Imp3 | VIF Imp4 | VIF Imp5 |
|---|---|---|---|---|---|
| Age | 3.025981 | 3.026736 | 3.024847 | 3.020267 | 3.023351 |
| R_Age | 2.902199 | 2.909613 | 2.906891 | 2.899257 | 2.906040 |
| Male | 1.061579 | 1.061392 | 1.061578 | 1.062511 | 1.061145 |
| log(income) | 1.190570 | 1.207720 | 1.197767 | 1.053984 | 1.053400 |
| log(Wealth) | 1.357615 | 1.362987 | 1.356838 | 1.254489 | 1.257300 |
| Fin_edu | 1.044611 | 1.043723 | 1.044161 | 1.044425 | 1.043634 |
| Married | 1.254958 | 1.255700 | 1.251650 | 1.198932 | 1.210383 |
| East | 1.054573 | 1.054811 | 1.054899 | 1.356357 | 1.362089 |
| Exp_stock_market | 1.033180 | 1.032298 | 1.032664 | 1.032698 | 1.032952 |
| Exp_inflation | 1.019247 | 1.019628 | 1.019321 | 1.019573 | 1.019599 |

Source: Own creation.

## Appendix 14

*Durbin-Watson Test for autocorrelation - Risky share*

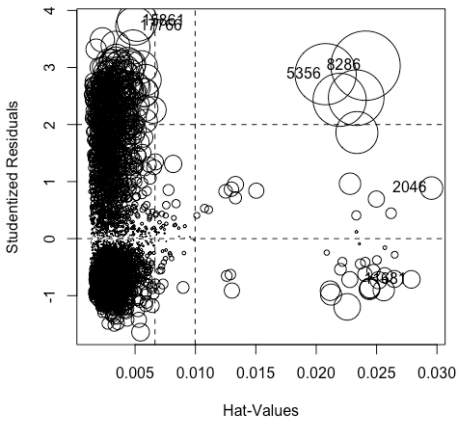
| Regression | DW | P-value |
|---|---|---|
| Imputation 1 | 2.0315 | 0.8169 |
| Imputation 2 | 2.0298 | 0.804 |
| Imputation 3 | 2.026 | 0.7721 |
| Imputation 4 | 2.0145 | 0.6614 |
| Imputation 5 | 2.0207 | 0.724 |

Source: Own creation.

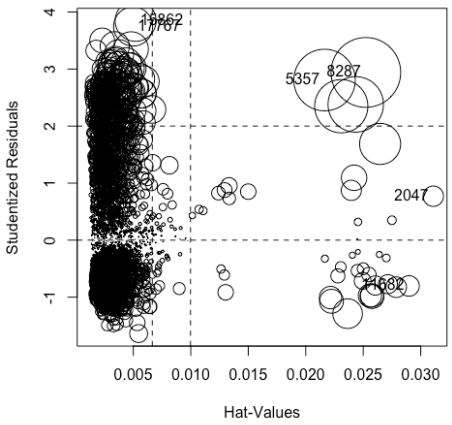
## Appendix 15

*Influence plots to detect outliers - Risky share*

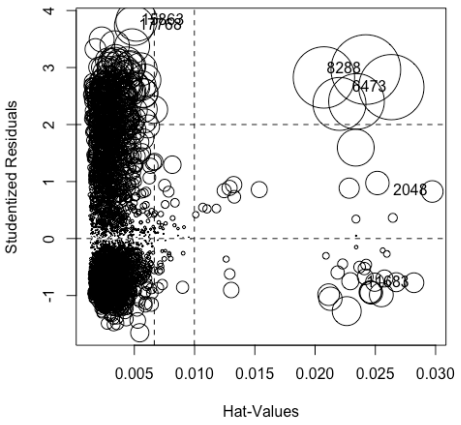
Imputation 1



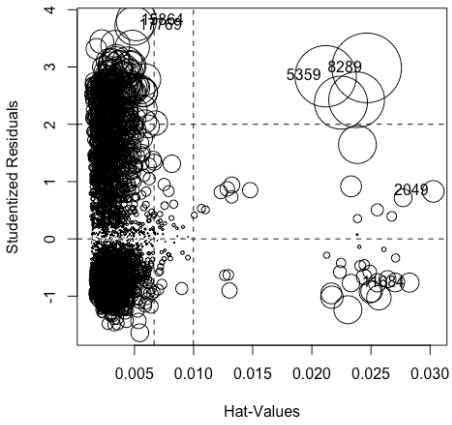

Imputation 2



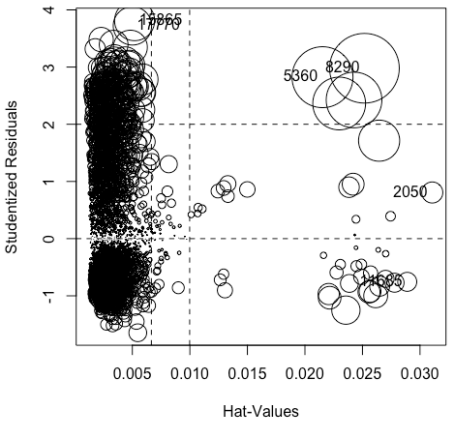

Imputation 3




Imputation 4




Imputation 5

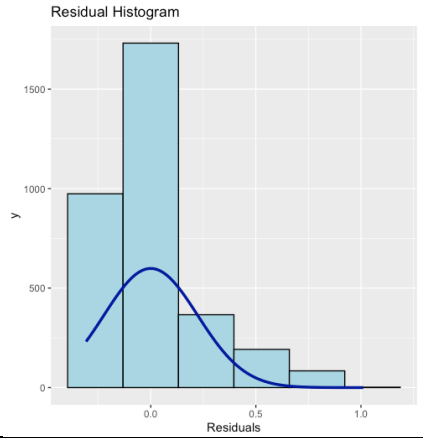



Source: Own creation.

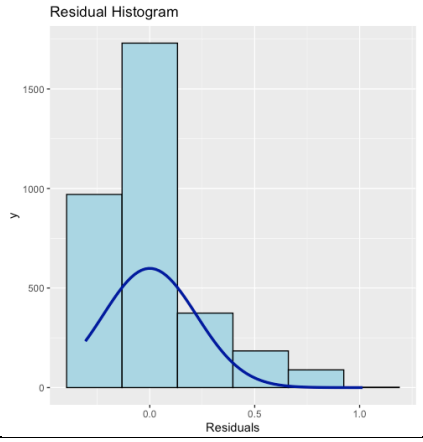
## Appendix 16

*Histogram test of normal distribution of residuals – Share of stocks*

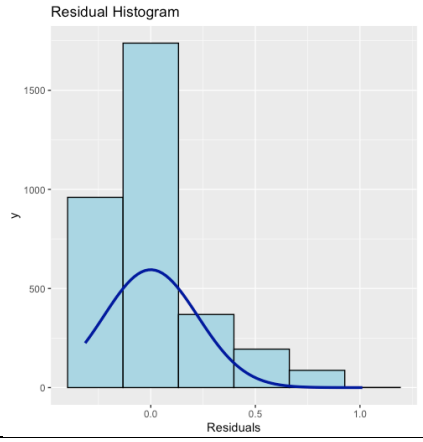
Imputation 1



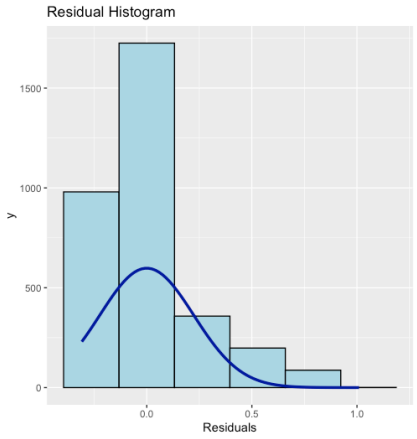

Imputation 2



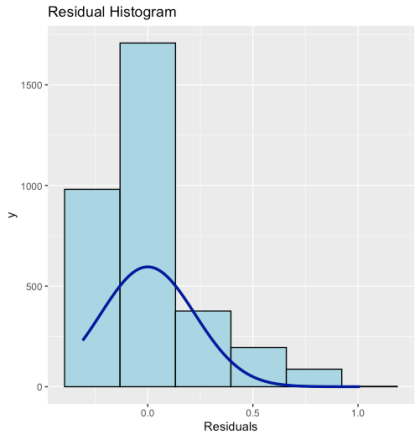

Imputation 3




Imputation 4




Imputation 5

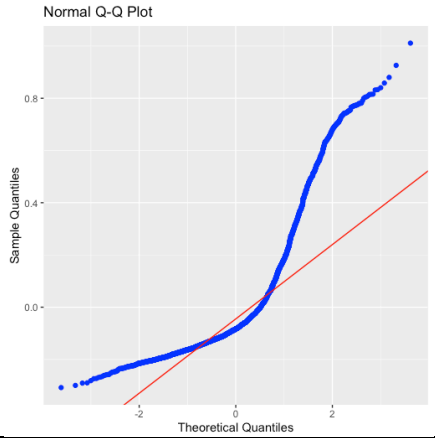



Source: Own creation.

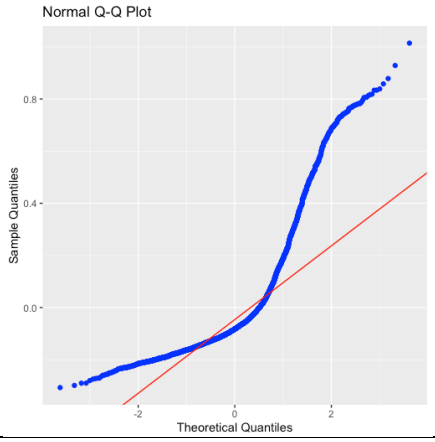
## Appendix 17

*Q-Q-Plot test of normal distribution of residuals – Share of stocks*

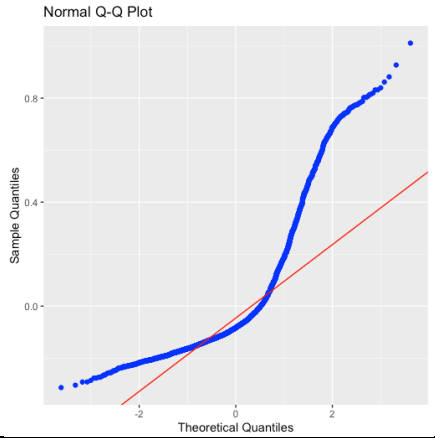
Imputation 1



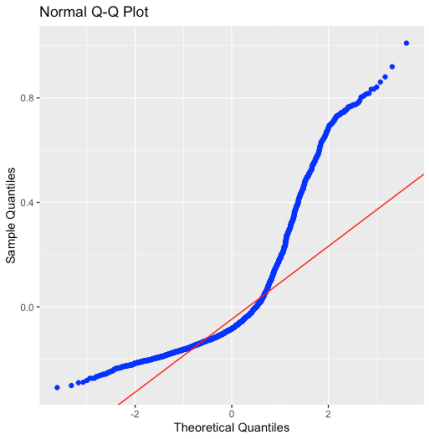

Imputation 2



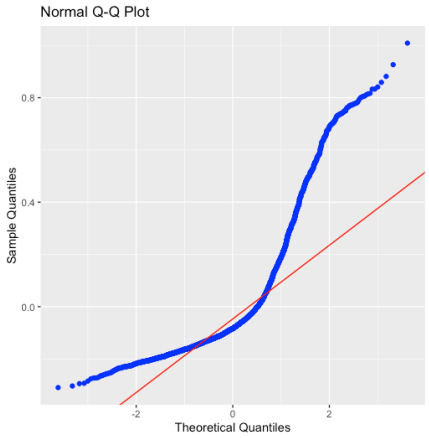

Imputation 3




Imputation 4




Imputation 5




Source: Own creation.

## Appendix 18

*Shapiro-Wilk test of normal distribution of residuals - Share of stocks*

| Regression | W | P-value |
|---|---|---|
| Imputation 1 | 0.78604 | < 2.2e-16 |
| Imputation 2 | 0.78559 | < 2.2e-16 |
| Imputation 3 | 0.78521 | < 2.2e-16 |
| Imputation 4 | 0.78648 | < 2.2e-16 |
| Imputation 5 | 0.7879 | < 2.2e-16 |

*Source: Own creation.*

## Appendix 19

*Breusch-Pagan Test of Heteroskedasticity – Share of stocks*

| Regression | Df | Chi2 | Prob > Chi2 |
|---|---|---|---|
| Imputation 1 | 1 | 288.1703 | 1.245171e-64 |
| Imputation 2 | 1 | 287.4813 | 1.759392e-64 |
| Imputation 3 | 1 | 297.9477 | 9.223795e-67 |
| Imputation 4 | 1 | 294.1419 | 6.224526e-66 |
| Imputation 5 | 1 | 291.6016 | 2.226341e-65 |

*Source: Own creation.*

## Appendix 20

*Rainbow Test of linearity - Share of stocks*

| Regression | Rain | Df1 | Df2 | P-value |
|---|---|---|---|---|
| Imputation 1 | 1.0978 | 1675 | 1663 | 0.02841 |
| Imputation 2 | 1.1133 | 1675 | 1663 | 0.01421 |
| Imputation 3 | 1.1099 | 1675 | 1663 | 0.01664 |
| Imputation 4 | 1.1262 | 1675 | 1663 | 0.007608 |
| Imputation 5 | 1.0959 | 1675 | 1663 | 0.03082 |

*Source: Own creation.*

## Appendix 21

*VIF Test for multicollinearity - Share of stocks*

| Regression | VIF Imp1 | VIF Imp2 | VIF Imp3 | VIF Imp4 | VIF Imp5 |
|---|---|---|---|---|---|
| Age | 2.971274 | 2.972373 | 2.970043 | 2.969349 | 2.971678 |
| R_Age | 2.872596 | 2.880127 | 2.876656 | 2.873344 | 2.879103 |
| Male | 1.058571 | 1.058175 | 1.058148 | 1.059042 | 1.057823 |
| log(Income) | 1.193328 | 1.210081 | 1.043272 | 1.042924 | 1.042451 |
| log(Wealth) | 1.310624 | 1.317053 | 1.243735 | 1.246207 | 1.249040 |
| Fin_edu | 1.045217 | 1.044482 | 1.044931 | 1.045184 | 1.044445 |
| Married | 1.245971 | 1.248127 | 1.199754 | 1.201192 | 1.212294 |
| East | 1.042957 | 1.043141 | 1.310998 | 1.310535 | 1.316025 |
| Exp_stock_market | 1.033012 | 1.032720 | 1.032572 | 1.032602 | 1.032804 |
| Exp_inflation | 1.018837 | 1.018976 | 1.018759 | 1.018970 | 1.019034 |

Source: Own creation.

## Appendix 22

*Durbin-Watson Test for autocorrelation - Share of stocks*

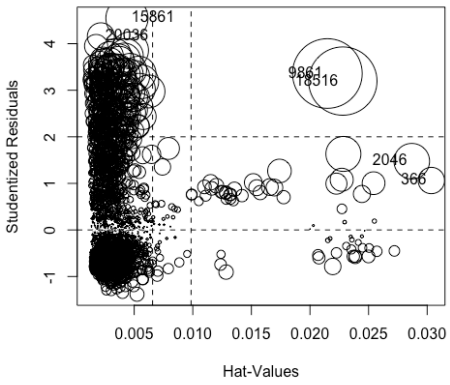
| Regression | W | p-value |
|---|---|---|
| Imputation 1 | 2.0226 | 0.7426 |
| Imputation 2 | 2.0298 | 0.805 |
| Imputation 3 | 2.0114 | 0.629 |
| Imputation 4 | 2.0121 | 0.6359 |
| Imputation 5 | 2.013 | 0.6461 |

Source: Own creation.

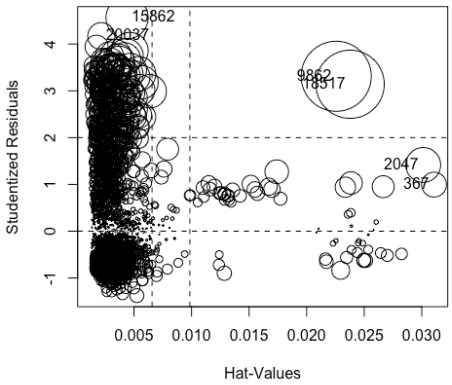
## Appendix 23

*Influence plots to detect outliers – Share of stocks*

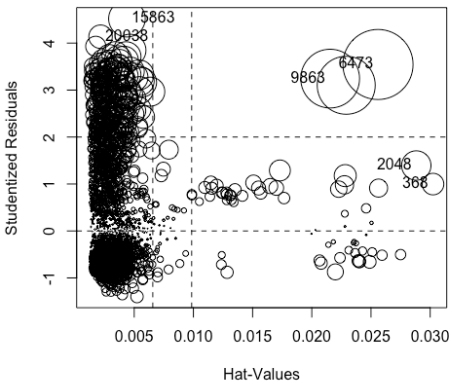
Imputation 1



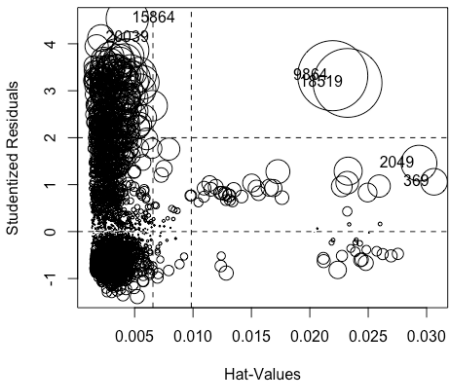

Imputation 2



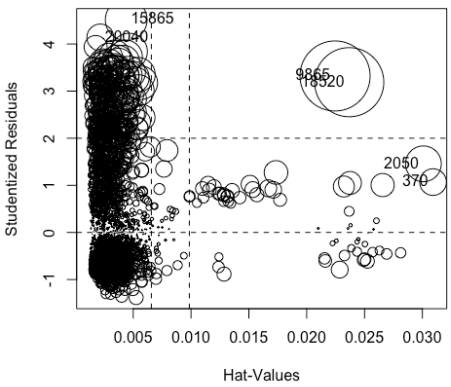

Imputation 3




Imputation 4




Imputation 5




Source: Own creation.

## Appendix 24

*Hosmer and Lemeshow GOF test modification – Bonds Dummy*

| Regression | X-squared | df | p-value |
|---|---|---|---|
| Imputation 1 | 5.1018 | 8 | 0.7466 |
| Imputation 2 | 6.4136 | 8 | 0.601 |
| Imputation 3 | 8.5949 | 8 | 0.3776 |
| Imputation 4 | 3.7508 | 8 | 0.8789 |
| Imputation 5 | 5.6459 | 8 | 0.6868 |

Source: Own creation.

## Appendix 25

*Linearity of Log-odds test before modification – Bonds Dummy*

| Variable | *Beta_Imp1* | *Beta_Imp2* | *Beta_Imp3* | *Beta_Imp4* | *Beta_Imp5* |
|---|---|---|---|---|---|
| Age:log(Age) | -0.169 | -0.182 | -0.223 | -0.154 | -0.154 |
| Income:log(Income) | -0.000005** | -0.000003* | -0.000005*** | -0.000005** | -0.000005** |
| Wealth:log(Wealth) | -0.00000004 | -0.00000003 | -0.00000003 | -0.00000005 | -0.00000005 |

Source: Own creation. *Note: For simplification only the coefficients of the variables that might be transformed are reported. The regression has been done with all variables of the investigation.*

## Appendix 26

*Test for multicollinearity after modification – Bonds Dummy*

| Regression | VIF Imp1 | VIF Imp2 | VIF Imp3 | VIF Imp4 | VIF Imp5 |
|---|---|---|---|---|---|
| Age | 3.134463 | 3.122724 | 3.117870 | 3.123615 | 3.119727 |
| R_Age | 3.094012 | 3.086358 | 3.083742 | 3.088594 | 3.086499 |
| Male | 1.054524 | 1.054110 | 1.054884 | 1.055213 | 1.055222 |
| log(Income) | 1.201049 | 1.195946 | 1.210195 | 1.203403 | 1.202585 |
| log(Wealth) | 1.233942 | 1.227613 | 1.237597 | 1.227864 | 1.230054 |
| Fin_edu | 1.041373 | 1.040343 | 1.041492 | 1.040950 | 1.041150 |
| Married | 1.180614 | 1.179873 | 1.180829 | 1.183206 | 1.182260 |
| East | 1.052642 | 1.052281 | 1.056019 | 1.053189 | 1.054329 |
| Exp_inflation | 1.011065 | 1.011458 | 1.011111 | 1.011147 | 1.011500 |

Source: Own creation.

## Appendix 27

*Test for outliers after modification – Bonds Dummy*

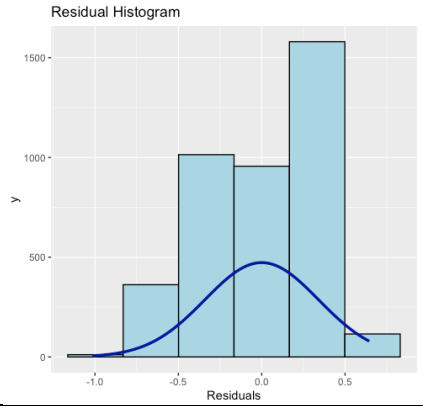
| Regression | Strong outliers | Soft outliers | % soft outliers |
|---|---|---|---|
| Imp1 | 6621; 1320 | 212 | 5.17% |
| Imp2 | 6621; 1320 | 207 | 5.05% |
| Imp3 | 0 | 216 | 5.27% |
| Imp4 | 6624; 1320 | 208 | 5.07% |
| Iimp5 | 0 | 205 | 5.00% |

*Note: Values below critical threshold.* Source: Own creation.

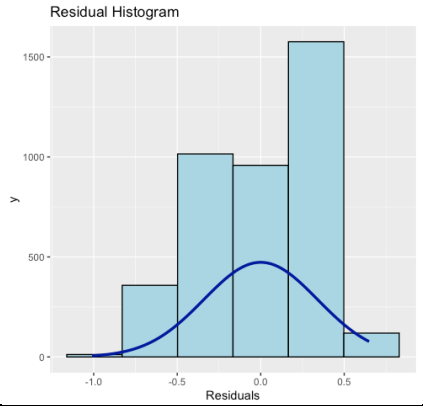
## Appendix 28

*Histogram test of normal distribution of residuals – Share of deposits*

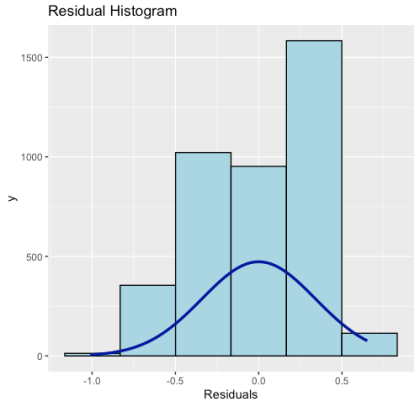
Imputation 1



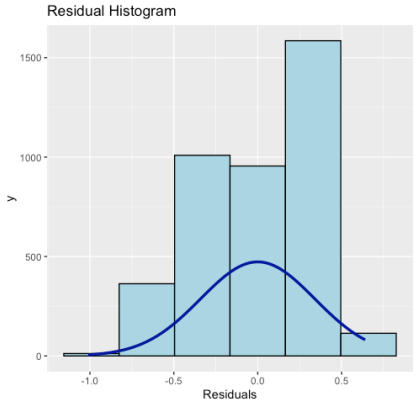

Imputation 2



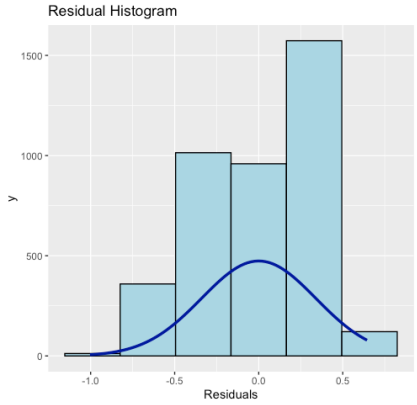

Imputation 3




Imputation 4




Imputation 5

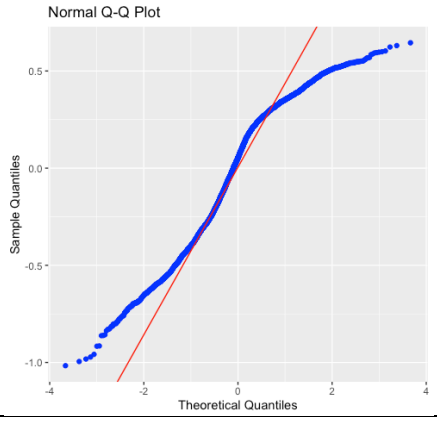



Source: Own creation.

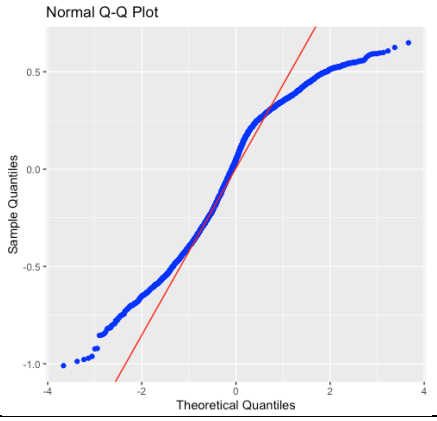
## Appendix 29

*Q-Q-Plot test of normal distribution of residuals – Share of deposits*

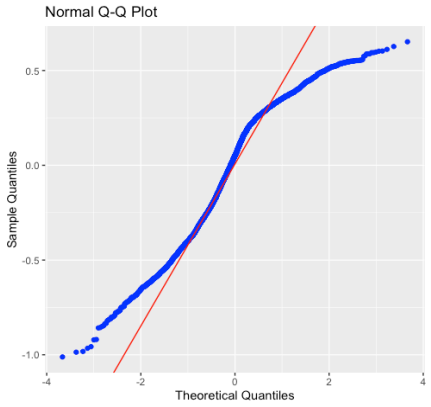
Imputation 1



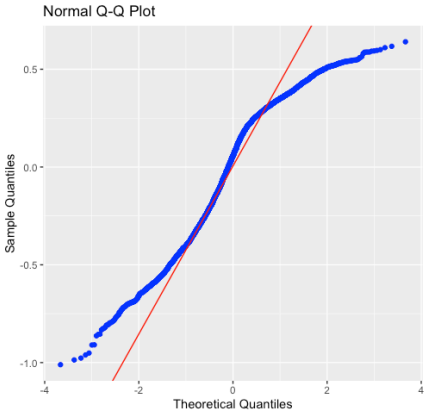

Imputation 2



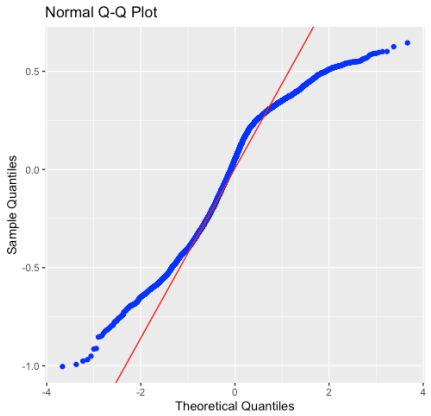

Imputation 3




Imputation 4




Imputation 5




Source: Own creation.

## Appendix 30

*Shapiro-Wilk test of normal distribution of residuals - Share of deposits*

| Regression | W | P-value |
|---|---|---|
| Imputation 1 | 0.95161 | < 2.2e-16 |
| Imputation 2 | 0.95282 | < 2.2e-16 |
| Imputation 3 | 0.95252 | < 2.2e-16 |
| Imputation 4 | 0.95063 | < 2.2e-16 |
| Imputation 5 | 0.9514 | < 2.2e-16 |

Source: Own creation.

## Appendix 31

*Breusch-Pagan Test for Heteroskedasticity – Share of deposits*

| Regression | Df | Chi2 | Prob > Chi2 |
|---|---|---|---|
| Imputation 1 | 1 | 35.7072 | 2.293148e-09 |
| Imputation 2 | 1 | 33.0886 | 8.805336e-09 |
| Imputation 3 | 1 | 43.48287 | 4.276873e-11 |
| Imputation 4 | 1 | 37.29255 | 1.016724e-09 |
| Imputation 5 | 1 | 37.52833 | 9.009471e-10 |

Source: Own creation.

## Appendix 32

*Rainbow Test of linearity - Share of deposits*

| Regression | Rain | Df1 | Df2 | P-value |
|---|---|---|---|---|
| Imputation 1 | 1.0143 | 2019 | 2009 | 0.3747 |
| Imputation 2 | 1.023 | 2019 | 2009 | 0.3048 |
| Imputation 3 | 1.0271 | 2019 | 2009 | 0.2742 |
| Imputation 4 | 1.0168 | 2019 | 2009 | 0.354 |
| Imputation 5 | 1.0345 | 2019 | 2009 | 0.2232 |

Source: Own creation.

## Appendix 33

*VIF Test for multicollinearity - Share of deposits*

| Regression | VIF Imp1 | VIF Imp2 | VIF Imp3 | VIF Imp4 | VIF Imp5 |
|---|---|---|---|---|---|
| Age | 2.958480 | 2.958900 | 2.956792 | 2.957194 | 2.958879 |
| R_Age | 2.889670 | 2.895467 | 2.892104 | 2.889977 | 2.894706 |
| Male | 1.065122 | 1.064697 | 1.064616 | 1.065543 | 1.064131 |
| log(Income) | 1.204202 | 1.219036 | 1.208409 | 1.211656 | 1.221437 |
| log(Wealth) | 1.309961 | 1.314984 | 1.308032 | 1.310692 | 1.316488 |
| Fin_edu | 1.045695 | 1.044976 | 1.045594 | 1.045527 | 1.045207 |
| Married | 1.249234 | 1.251259 | 1.247448 | 1.249796 | 1.252642 |
| East | 1.043699 | 1.044198 | 1.044308 | 1.044092 | 1.044186 |
| Exp_deposit_interest | 1.012169 | 1.012303 | 1.012169 | 1.012128 | 1.012240 |

Source: Own creation.

## Appendix 34

*Durbin-Watson Test for autocorrelation - Share of deposits*

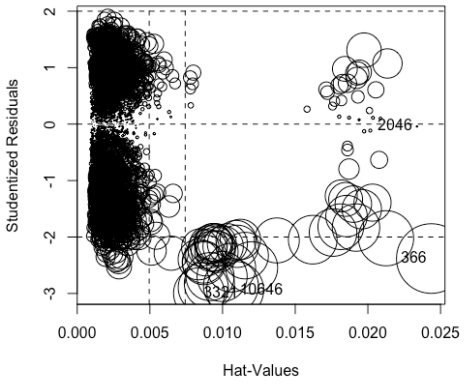
| Regression | DW | p-value |
|---|---|---|
| Imputation 1 | 2.0024 | 0.5292 |
| Imputation 2 | 1.9872 | 0.3411 |
| Imputation 3 | 1.9851 | 0.3173 |
| Imputation 4 | 1.9842 | 0.3074 |
| Imputation 5 | 1.9873 | 0.3428 |

Source: Own creation.

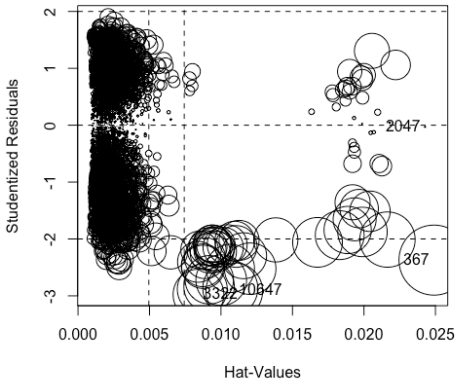
**Appendix 35**

*Influence plots to detect outliers – Share of deposits*

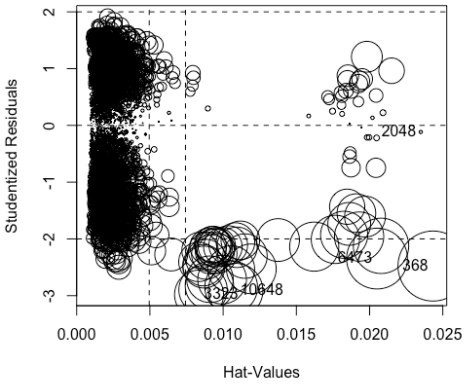
Imputation 1



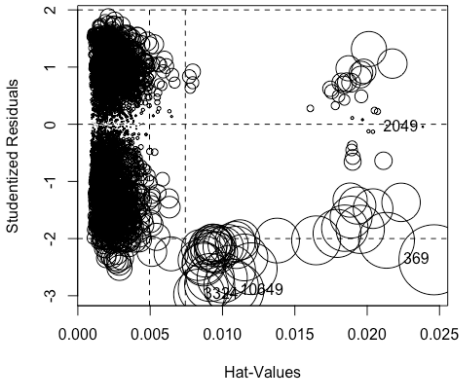

Imputation 2



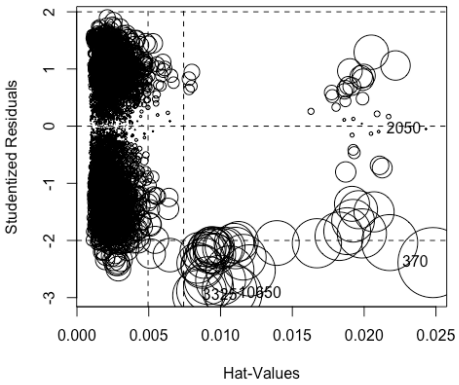

Imputation 3




Imputation 4




Imputation 5




Source: Own creation.

## Appendix 36

*Descriptive statistics of all financial assets*

| Variable | *Mean* | *SD* | *Median* | *Min* | *Max* | *X0.25* | *X0.75* |
|---|---|---|---|---|---|---|---|
| Financial assets | 139,160.8 | 356,644.9 | 55,100 | 0 | 15,030,000 | 15,592.5 | 150,942.5 |
| Stocks | 38,938.65 | 263,489.4 | 0 | 0 | 14,000,000 | 0 | 10,745 |
| Managed accounts | 123.85 | 4,234.93 | 0 | 0 | 200,000 | 0 | 0 |
| Non-self employed business | 591.23 | 12,975.82 | 0 | 0 | 500,000 | 0 | 0 |
| Real estate funds | 3,505.46 | 23,184.43 | 0 | 0 | 500,000 | 0 | 0 |
| Hedge-funds | 4.05 | 136.35 | 0 | 0 | 6,000 | 0 | 0 |
| Other investment funds | 836.95 | 15,991.67 | 0 | 0 | 750,000 | 0 | 0 |
| Other financial assets | 4,052.04 | 26,095.51 | 0 | 0 | 700,000 | 0 | 0 |
| Money owed to HH | 2,364.9 | 60,281.4 | 0 | 0 | 3,800,000 | 0 | 0 |
| Voluntary pensions/ whole life insurance | 26,907.6 | 74,001.4 | 0 | 0 | 1,393,580 | 0 | 24,942.5 |
| Money market funds | 795.5 | 9,687.4 | 0 | 0 | 350,000 | 0 | 0 |
| Bonds | 6,193.3 | 45,563.5 | 0 | 0 | 1,200,000 | 0 | 0 |
| Deposits | 54,847.3 | 106,933.9 | 23,000.1 | 0 | 2,700,000 | 6,994 | 61,055 |

Source: Own creation.

## Appendix 37

*Z-standardized coefficients*

| Z-standardized coefficients | | | |
|---|---|---|---|
| | Risky share | Share of stocks | Share of deposits |
| Intercept | 0.045 | 0.060 | -0.002 |
| Age | 0.002 | -0.004 | -0.114 |
| R_Age | 0.123 | 0.078 | 0.314 |
| Male | 0.067 | 0.071 | -0.051 |
| log(Income) | -0.017 | 0.009 | -0.067 |
| log(Wealth) | 0.322 | 0.282 | -0.121 |
| Fin_edu | 0.067 | 0.070 | -0.061 |
| Married | -0.092 | -0.073 | -0.013 |
| East | -0.028 | -0.026 | 0.063 |
| Exp_stock_market | 0.035 | 0.048 | - |
| Exp_inflation | -0.027 | -0.036 | - |
| Exp_deposit_interest | - | - | 0.005 |

Source: Own creation.

## Appendix 38

Robustness check Risky share – Age squared

**Regression output Risky share**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_Risky_assets | |
| Variable | *Beta* | *t-value* |
| Intercept | -0.053 | -0.772 |
| | (0.069) | |
| Age | -0.009*** | -4.714 |
| | (0.002) | |
| $Age^2$ | 0.00001*** | 5.456 |
| | (0.00002) | |
| Male | 0.034*** | 3.567 |
| | (0.010) | |
| log(Income) | -0.003 | -0.647 |
| | (0.004) | |
| log(Wealth) | 0.037*** | 14.237 |
| | (0.003) | |
| Fin_edu | 0.041*** | 3.837 |
| | (0.011) | |
| Married | -0.041*** | -3.726 |
| | (0.011) | |
| East | -0.015 | -1.345 |
| | (0.011) | |
| Exp_stock_market | 0.010* | 1.914 |
| | (0.005) | |
| Exp_inflation | -0.008 | -1.087 |
| | (0.008) | |
| N | 3,307 | |
| Pooled $R^2$ | 0.098 | |
| Pooled adjusted $R^2$ | 0.095 | |
| Residual SE | 0.257 (df = 3296) | |
| Pooled F Statistic | 35.677*** (df = 10; 3296) | |

*Note:* $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. Source: own creation.

## Appendix 39

*Robustness check share of stocks– Age squared*

**Regression output share of stocks**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_stocks | |
| Variable | *Beta* | *t-value* |
| Intercept | -0.087 | -1.519 |
| | (0.057) | |
| Age | -0.006*** | -3.685 |
| | (0.002) | |
| $Age^2$ | 0.00006*** | 4.100 |
| | (0.00002) | |
| Male | 0.031*** | 3.829 |
| | (0.008) | |
| log(Income) | 0.002 | 0.606 |
| | (0.002) | |
| log(Wealth) | 0.027*** | 13.750 |
| | (0.002) | |
| Fin_edu | 0.036*** | 3.824 |
| | (0.009) | |
| Married | -0.028*** | -2.928 |
| | (0.009) | |
| East | -0.013 | -1.366 |
| | (0.010) | |
| Exp_stock_market | 0.012*** | 2.671 |
| | (0.004) | |
| Exp_inflation | -0.011 | -1.642 |
| | (0.007) | |
| N | 3,349 | |
| Pooled $R^2$ | 0.089 | |
| Pooled adjusted $R^2$ | 0.087 | |
| Residual SE | 0.224 (df = 3338) | |
| Pooled F Statistic | 32.71*** (df = 10; 3338) | |

*Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.* Source: own creation.

## Appendix 40

*Robustness check bonds - Age squared*

**Regression output Bonds**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Bonds Dummy | | | |
| *Variable* | *Beta* | *OR* | *CI-LL* | *CI-UL* |
| Intercept | -7.694*** | 0.000 | 0.000 | 0.003 |
| | (0.981) | | | |
| Age | -0.038 | 0.962 | 0.916 | 1.011 |
| | (0.025) | | | |
| $Age^2$ | 0.0004* | 1.0004 | 1.000 | 1.001 |
| | (0.0002) | | | |
| Male | 0.064 | 1.066 | 0.848 | 1.340 |
| | (0.117) | | | |
| log(Income) | 0.042 | 1.043 | 0.944 | 1.153 |
| | (0.051) | | | |
| log(Wealth) | 0.448*** | 1.565 | 1.432 | 1.712 |
| | (0.046) | | | |
| Fin_edu | 0.313** | 1.367 | 1.078 | 1.734 |
| | (0.121) | | | |
| Married | -0.225* | 0.798 | 0.620 | 1.028 |
| | (0.129) | | | |
| East | 0.00004 | 1.0000 | 0.737 | 1.356 |
| | (0.155) | | | |
| Exp_inflation | 0.024 | 1.024 | 0.845 | 1.241 |
| | (0.098) | | | |
| N | 4,097 | | | |
| McFaddens $R^2$ | 0.078 | | | |

*Note: * p< 0.1; ** p<0.05; *** p<0.01. OR = Odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval of OR.* Source: own creation.

## Appendix 41

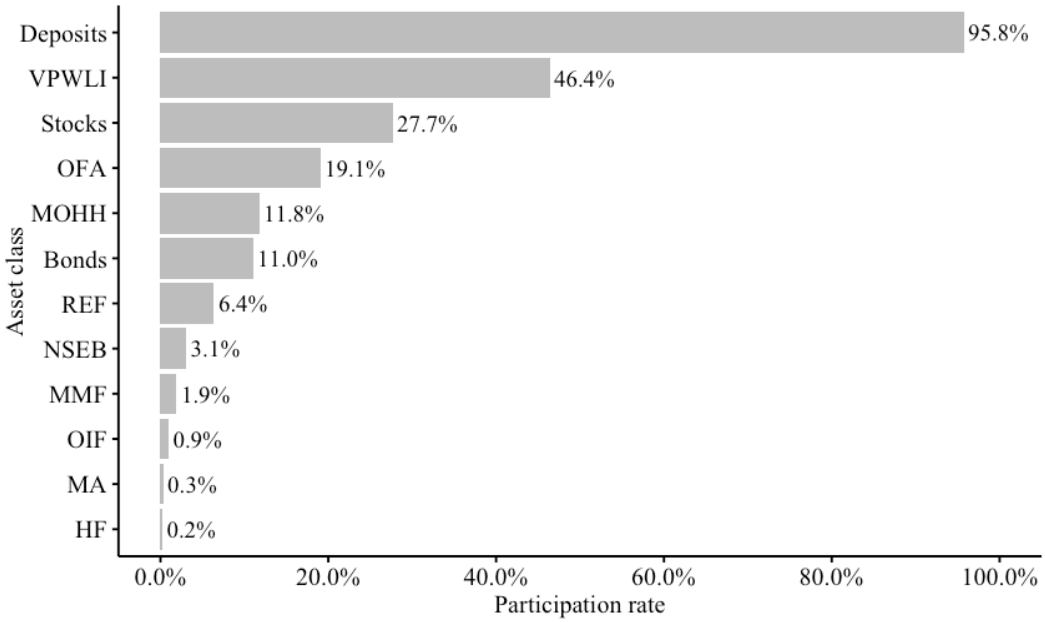
*Robustness check - Descriptive statistics of wave 3*

| Variable | *Mean* | *SD* | *Median* | *Min* | *Max* | *X0.25* | *X0.75* |
|---|---|---|---|---|---|---|---|
| Financial assets | 112,885.8 | 301,562.4 | 40,835 | 0 | 10,550,000.0 | 9,440 | 116,190 |
| Stocks | 25,359.1 | 179,592.0 | 0 | 0 | 6,500,000.0 | 0 | 1,995 |
| Managed accounts | 314.5 | 9,718.8 | 0 | 0 | 450,000.0 | 0 | 0 |
| Non-self employed business | 3,411.2 | 47,196.3 | 0 | 0 | 2,000,000 | 0 | 0 |
| Real estate funds | 2,167.3 | 13,776.4 | 0 | 0 | 240,000 | 0 | 0 |
| Hedge funds | 125.0 | 7,167.2 | 0 | 0 | 500,000 | 0 | 0 |
| Other investment funds | 141.1 | 2,098.3 | 0 | 0 | 60,000 | 0 | 0 |
| Other financial assets | 3,441.6 | 42,603.0 | 0 | 0 | 2,000,000 | 0 | 0 |
| Money owed to HH | 2,226.8 | 18,391.9 | 0 | 0 | 500,000 | 0 | 0 |
| Voluntary pensions/ whole life insurance | 20,942.9 | 47,691.2 | 0 | 0 | 714,480 | 0 | 20,700 |
| Money market funds | 664.0 | 9,776.2 | 0 | 0 | 400,000 | 0 | 0 |
| Bonds | 7,717.3 | 56,330.8 | 0 | 0 | 1,700,000 | 0 | 0 |
| Deposits | 46,375.0 | 108,037.6 | 16,820.0 | 0 | 4,050,000 | 4,000.0 | 49,990 |
| Income | 67,794.3 | 76,189.2 | 51,535.0 | 0 | 2,148,800 | 29,300.5 | 84,040 |
| Wealth | 528,019.5 | 1,635,510.7 | 268,260.3 | 0 | 92,691,570.4 | 45,704.5 | 597,809 |
| Age | 57.3 | 16.2 | 58 | 18 | 90 | 46 | 70 |
| Stock market | 3.58 | 0.85 | 4 | 1 | 5 | 3 | 4 |
| Inflation | 4.01 | 0.56 | 4 | 1 | 5 | 4 | 4 |
| Deposit interest | 2.98 | 0.62 | 3 | 1 | 5 | 3 | 3 |
| Investing Dummy | 0.42 | - | - | - | - | - | - |
| Bonds Dummy | 0.11 | - | - | - | - | - | - |
| Male Dummy | 0.58 | - | - | - | - | - | - |
| Married Dummy | 0.65 | - | - | - | - | - | - |
| Fin_edu Dummy | 0.26 | - | - | - | - | - | - |
| East Dummy | 0.18 | - | - | - | - | - | - |
| R_Age Dummy | 0.37 | - | - | - | - | - | - |

Source: Own creation.

## Appendix 42

*Robustness check – Participation rates wave 3*




Source: Own creation.

## Appendix 43

*Wave 3 regression output impact on investing*

**Impact of socio-demographic and personal characteristics on Investing**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Investing Dummy | | | |
| *Variable* | *Beta* | *OR* | *CI-LL* | *CI-UL* |
| Intercept | -7.830*** | 0.0004 | 0.0001 | 0.0012 |
| | (0.559) | | | |
| Age | 0.002 | 1.002 | 0.997 | 1.007 |
| | (0.003) | | | |
| Male | 0.231*** | 1.260 | 1.085 | 1.464 |
| | (0.076) | | | |
| log(Income) | 0.058** | 1.060 | 1.000 | 1.123 |
| | (0.030) | | | |
| log(Wealth) | 0.488*** | 1.629 | 1.546 | 1.717 |
| | (0.027) | | | |
| Fin_edu | 0.379*** | 1.461 | 1.250 | 1.708 |
| | (0.080) | | | |
| Married | -0.310*** | 0.733 | 0.620 | 0.867 |
| | (0.085) | | | |
| East | -0.143 | 0.867 | 0.711 | 1.57 |
| | (0.101) | | | |
| Exp_stock_market | 0.188*** | 1.200 | 1.110 | 1.312 |
| | (0.042) | | | |
| Exp_inflation | 0.045 | 1.050 | 0.914 | 1.200 |
| | (0.069) | | | |
| Exp_deposit_interest | 0.052 | 1.050 | 0.937 | 1.184 |
| | (0.060) | | | |
| N | | 3,833 | | |
| McFaddens $R^2$ | | 0.298 | | |

*Note: * p< 0.1; ** p<0.05; *** p<0.01. OR = odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval of OR.* Source: own creation.

## Appendix 44

*Wave 3 regression output share of risky assets*

**Regression output share of risky assets**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Share_of_risky_assets | | Share_of_risky_assets | |
| Variable | *Beta* | *t-value* | *Beta* | *t-value* |
| Intercept | -0.303*** | -6.206 | -0.153*** | -2.757 |
| | (0.005) | | (0.055) | |
| Age | 0.001** | 2.509 | -0.007*** | -4.478 |
| | (0.0004) | | (0.0016) | |
| R_Age | 0.046*** | 3.537 | - | - |
| | (0.013) | | - | |
| $Age^2$ | - | - | 0.00008*** | 5.543 |
| | - | | (0.00001) | |
| Male | 0.036*** | 4.862 | 0.035*** | 4.718 |
| | (0.007) | | (0.007) | |
| log(Income) | 0.0002 | 0.076 | 0.001 | 0.420 |
| | (0.003) | | (0.003) | |
| log(Wealth) | 0.027*** | 12.834 | 0.029*** | 13.213 |
| | (0.002) | | (0.002) | |
| Fin_edu | 0.022*** | 2.650 | 0.021** | 2.511 |
| | (0.008) | | (0.008) | |
| Married | -0.028*** | -3.200 | -0.021** | -2.400 |
| | (0.009) | | (0.009) | |
| East | -0.007 | -0.712 | -0.005 | -0.478 |
| | (0.010) | | (0.010) | |
| Exp_stock_market | 0.007 | 1.490 | 0.007** | 1.475 |
| | (0.005) | | (0.005) | |
| Exp_inflation | 0.001 | 0.136 | 0.003 | 0.486 |
| | (0.007) | | (0.007) | |
| N | 3,790 | | 3,790 | |
| Pooled $R^2$ | 0.094 | | 0.010 | |
| Pooled adj. $R^2$ | 0.091 | | 0.097 | |
| Residual SE | 0.227 (df = 3779) | | 0.227 (df = 3779) | |
| Pooled F Statistic | 39.12*** (df = 10; 3779) | | 41.69*** (df = 10;3779) | |

*Note: * p< 0.1; ** p<0.05; *** p<0.01. OR = odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval of OR.* Source: own creation.

## Appendix 45

*Wave 3 regression output share of stocks*

**Regression output share of stocks**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Share_of_stocks | | Share_of_stocks | |
| Variable | *Beta* | *t-value* | *Beta* | *t-value* |
| Intercept | -0.266*** | -6.989 | -0.132*** | -3.045 |
| | (0.038) | | (0.043) | |
| Age | 0.001*** | 3.538 | -0.006*** | -4.534 |
| | (0.0003) | | (0.001) | |
| R_Age | 0.027*** | 2.762 | - | - |
| | (0.010) | | - | |
| $Age^2$ | - | - | 0.00007*** | 5.460 |
| | - | | (0.00001) | |
| Male | 0.031*** | 5.265 | 0.029*** | 5.099 |
| | (0.006) | | (0.006) | |
| log(Income) | 0.003 | 1.056 | 0.004 | 1.585 |
| | (0.002) | | (0.002) | |
| log(Wealth) | 0.018*** | 13.110 | 0.019*** | 13.287 |
| | (0.001) | | (0.001) | |
| Fin_edu | 0.022*** | 3.079 | 0.021*** | 2.925 |
| | (0.007) | | (0.007) | |
| Married | -0.019*** | -2.648 | -0.013* | -1.798 |
| | (0.007) | | (0.007) | |
| East | -0.007 | -0.808 | -0.005 | -0.579 |
| | (0.008) | | (0.008) | |
| Exp_stock_market | 0.009** | 2.465 | 0.009** | 2.471 |
| | (0.004) | | (0.004) | |
| Exp_inflation | 0.001 | 0.106 | 0.003 | 0.477 |
| | (0.005) | | (0.005) | |
| N | 3851 | | 3851 | |
| Pooled $R^2$ | 0.091 | | 0.098 | |
| Pooled adj. $R^2$ | 0.088 | | 0.096 | |
| Residual SE | 0.184 (df = 3840) | | 0.183 (df = 3840) | |
| Pooled F Statistic | 38.21*** (df = 10; 3840) | | 41.80*** (df = 10;3840) | |

*Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$.* Source: own creation.

## Appendix 46

*Wave 3 regression output bonds*

**Regression output Bonds**

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | Bonds Dummy | | | |
| *Variable* | *Beta* | *OR* | *Beta* | *OR* |
| Intercept | -10.305*** | 0.000 | -9.509*** | 0.00007 |
| | (0.790) | | (0.910) | |
| Age | 0.008 | 1.008 | -0.031 | 0.970 |
| | (0.006) | | (0.023) | |
| R_Age | 0.072 | 1.074 | - | - |
| | (0.165) | | - | |
| $Age^2$ | - | - | 0.0003* | 1.0003 |
| | - | | (0.0002) | |
| Male | -0.020 | 0.980 | -0.028 | 0.972 |
| | (0.102) | | (0.102) | |
| log(Income) | 0.043 | 1.044 | 0.045 | 1.046 |
| | (0.044) | | (0.044) | |
| log(Wealth) | 0.550*** | 1.733 | 0.560*** | 1.751 |
| | (0.042) | | (0.042) | |
| Fin_edu | 0.226** | 1.254 | 0.223** | 1.250 |
| | (0.102) | | (0.102) | |
| Married | -0.218* | 0.805 | -0.185 | 0.831 |
| | (0.118) | | (0.120) | |
| East | -0.107 | 0.899 | -0.100 | 0.905 |
| | (0.153) | | (0.154) | |
| Exp_inflation | 0.119 | 1.126 | 0.127 | 1.135 |
| | (0.093) | | (0.093) | |
| N | 4,916 | | | |
| McFaddens $R^2$ | 0.11 | | | |

*Note: * p< 0.1; ** p<0.05; *** p<0.01. OR = odds ratio. CI-LL/UL = lower/upper bound of 95% confidence interval of OR.* Source: own creation.

## Appendix 47

*Wave 3 regression output share of deposits*

**Regression output share of deposits**

| | *Dependent variable:* | |
|---|---|---|
| | Share_of_deposits | |
| Variable | *Beta* | *t-value* |
| Intercept | 1.038*** | 18.633 |
| | (0.056) | |
| Age | -0.002*** | -2.927 |
| | (0.001) | |
| R_Age | 0.203*** | 11.325 |
| | (0.018) | |
| Male | -0.025** | -2.275 |
| | (0.011) | |
| log(Income) | -0.022*** | -5.568 |
| | (0.004) | |
| log(Wealth) | -0.010*** | -2.934 |
| | (0.003) | |
| Fin_edu | -0.044*** | -3.747 |
| | (0.012) | |
| Married | -0.006 | -0.511 |
| | (0.012) | |
| East | 0.022 | 1.536 |
| | (0.014) | |
| Exp_deposit_interest | -0.019** | -2.176 |
| | (0.009) | |
| N | 4,816 | |
| Pooled $R^2$ | 0.077 | |
| Pooled adjusted $R^2$ | 0.075 | |
| Residual SE | 0.351 (df = 4806) | |
| Pooled F Statistic | 44.430*** (df = 9; 4806) | |

*Note*: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$. Source: own creation.

**Affidavit**

I, [redacted] hereby declare in lieu of an oath that I have composed the enclosed Master's thesis entirely on my own and without any inadmissible help from outside. I have not used any outside sources without declaration in the text. Any concepts or quotations applicable to these sources are attributed to them. This Master's thesis has, to my best knowledge, not been submitted in the same or a substantially similar version, not even in part, to any other authority for grading.

[redacted]