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# Financial Risk Aversion and Household Asset Diversification

Nataliya Barasinska[1] (DIW Berlin)

Dorothea Schäfer (DIW Berlin)

Andreas Stephan
(JIBS Jönköping, DIW Berlin, CESIS Stockholm)

[1]Corresponding author. Postal address: Nataliya Barasinska, DIW Berlin, Mohrenstraße 58, 10117. Email: nbarasinska@diw.de

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Nataliya Barasinska[‡](DIW Berlin)
Dorothea Schäfer (DIW Berlin)
Andreas Stephan
(JIBS Jönköping, DIW Berlin, CESIS Stockholm)

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**Abstract**

This paper explores the relationship between self-declared risk aversion of private investors and their willingness to hold diversified portfolios of financial assets. The analysis is based on household survey data from the German Socioeconomic Panel (SOEP) that provides a reliable measure of individual attitude towards financial risk. Our empirical findings suggest that more risk averse investors tend to hold incomplete portfolios that consist mainly of a few safe assets. We also find that for private households the propensity to diversify is highly dependent on whether liquidity and safety needs are satisfied.

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[‡]Corresponding author. Postal address: Nataliya Barasinska, DIW Berlin, Mohrenstraße 58, 10117. Email: nbarasinska@diw.de

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***JEL Classification***: D14, G11

# 1 Introduction

The prevailing view, based on the predictions of the capital asset pricing model theory, is that investors should hold diversified portfolios of assets regardless of the degree of their individual risk aversion. However, empirical studies frequently find that a large portion of private households owns only a small subset of available assets (Börsch-Supan and Eymann (2000); Burton (2001); Campbell (2006); Hochguertel et al. (1997); King and Leape (1998)). Understanding the reasons behind the diversification behavior of private households is highly relevant for both policymakers and the financial services industry.

Our paper intends to shed new light on this issue. Using recent household survey data, we investigate how individual attitudes towards risk affect portfolio choices of private investors. Specifically, we consider the influence of self-declared risk aversion of private investors on their willingness to diversify among six broad classes of financial assets: saving deposits, mortgage savings plans, fixed-interest securities, shares of listed companies and equity of non-listed firms. It is noteworthy that most studies relying upon the CAPM framework use the Arrow-Pratt measure of relative risk aversion operationalized by Friend and Blume (1975). In contrast, we employ the self-declared attitudes towards financial risk as a measure of risk aversion. Previous research has demonstrated that such stated risk attitudes are good predictors of the actual investment behavior Kapteyn and Teppa (2002); Fellner and Maciejovsky (2007).

Two hypotheses regarding the relationship between risk attitude and portfolio diversification are formulated and tested. The first and main hypothesis is that *the probability of holding a diversified portfolio is positively related to an investor's degree of risk aversion*. This conjecture reflects the predictions of the mean-variance analysis of Markowitz (1952). The second and partly competing hypothesis states that *the willingness to diversify is positively related to holdings of safe assets*. This hypothesis is derived from the proposition that precautionary and transaction motives dominate financial activities of private households as was suggested by Keynes (1936).

Our empirical analysis is based on the German Socioeconomic Panel (SOEP). We use four subsequent survey waves – 2004 through 2007 – resulting in a panel including more than 5,000 households. The SOEP provides detailed information on socioeconomic characteristics of private households in Germany, their financial portfolios and attitude towards risk. In order to determine the level of portfolio diversification, we develop two

measures. The first measure is the number of distinct asset types held in a portfolio. Despite its simplicity, this measure is intended to reflect decisions of individuals who follow a "naive" diversification strategy according to the principle "don't put all your eggs in one basket". Such a strategy is frequently observed for nonprofessional investors who split their wealth evenly among available assets types hoping that this will reduce the risk of their portfolio Benartzi and Thaler (2001). Consequently, the more risk averse an investor, the more distinct types of assets should be included in her portfolio. The second measure of diversification is designed to capture more sophisticated investment strategies. Specifically, a sophisticated investor differentiates the assets according to their return and risk properties and thereby assigns them to different "return-risk" classes. Based on such a classification the investor then decides what combination of asset classes to hold in her portfolio given the expectation about returns. Again, we expect that risk-averse investors would avoid concentration of their wealth in one asset class; instead, they should prefer to diversify among the available asset classes in order to reduce the risk.

Surprisingly, the findings of our empirical analysis refute the first hypothesis. The results indicate that the number of different asset types held in a portfolio is negatively related to the investor's degree of risk aversion. Even for the sophisticated diversification measure, the findings suggest that the propensity to hold complete portfolios *decreases* with increasing risk aversion. The second hypothesis, however, is supported by the results. Thus, if a household already holds safe assets in the portfolio it is more likely to diversify its assets. This confirms our hypothesis regarding precautionary and transaction motives behind households' portfolio diversification decisions.

The remainder of the paper is organized as follows. In the next section, we review the existing literature on the role of risk aversion in portfolio diversification and present argumentation for our main hypothesis. The third section describes the data and provides more details on the measures of portfolio diversification. The fourth section presents the indicator of individual risk aversion. In the fifth section, we test the main hypothesis using regression analysis and discuss the results. In section six, we analyze the role of precautionary motives for diversification. The last section concludes.

# 2 Theoretical predictions regarding the impact of risk aversion on diversification

Scientific research into determinants of portfolio diversification can be traced back to the mean-variance analysis of Markowitz (1952). Markowitz derives how investors would select assets if they cared only about the mean and variance of portfolio returns. He theorizes that risk aversion plays a major role in determining investment decisions. The predictions with respect to portfolio diversification are twofold. Firstly, an investor, independently of her risk aversion, will not hold dominated portfolios. Portfolios are dominated if an alternative combination with the same risk content yields a higher return. Secondly, investors with high risk aversion will prefer diversified portfolios with moderate expected returns to undiversified portfolios with high expected returns because diversification allows reducing portfolio risk associated with variance of returns on individual assets.

Under the assumptions of capital assets pricing theory and based on Markowitz's mean-variance analysis, investors should always hold a portfolio of all available assets regardless of the degree of their risk aversion. Risk aversion determines only the amount of wealth allocated to individual assets. However, recent as well as previous empirical studies show that predictions of CAPM in this respect do not hold and majority of private investors hold incomplete portfolios Burton (2001); Henry et al. (1992); Guiso and Jappelli (2000)e.g.,.

Empirical research into private investor portfolio diversification started with a study by Blume and Friend (1975) who find that many private investors hold undiversified portfolios of risky financial assets despite the expectations from the capital asset pricing theory. Regarding the role of risk aversion, however, the study closely follows the CAPM framework: risk aversion is assumed to determine relative amount of wealth allocated across the assets, but not the diversification decision. The authors explanation of lacking diversification is (1) heterogeneity in investors' expectations regarding returns and risks and (2) investors' inability to correctly aggregate risks of individual assets and calculate the risk of an entire portfolio.

Later studies, however, revealed the importance of risk aversion for diversification. King and Leape (1998), for example, explicitly tests the effects of investors' risk aversion

on the probability of owning particular combinations of assets. The main finding is that risk-averse individuals generally choose to hold only a subset of available assets, usually a set of safe assets, such as saving accounts and government bonds. Respectively, risky assets are held less frequently. Thus, this study provide evidence of a negative relationship between risk aversion and diversification.

Campbell et al. (2003), however, theoretically predict that the relationship should not be always negative. The authors argue that demand for risky assets might be a hump-shaped function of risk aversion: strongly positive at intermediate levels of risk tolerance, but negative for extremely risk-averse and extremely risk-loving investors. They explain this idea by noting that stocks can be used to hedge against the fluctuations in their own future returns. This hedging feature should be attractive for investors with intermediate levels of risk aversion, forming the middle of the demand "hump". On either side of this hump are the very conservative investors, who tend to avoid any risk, and the extremely risk-tolerant investors, who have little interest in the intertemporal hedging. Therefore, very risk averse investors should choose to hold undiversified portfolios consisting mainly of safe assets; extremely risk-loving investors should hold undiversified portfolios too, however in their case, these portfolios will comprise few risky assets; finally, investors with moderate risk aversion are expected to hold the most diversified portfolios consisting of all available assets.

Gomes and Michaelides (2005) formulate a model describing decisions of private investors to diversify their wealth over the life-cycle between two asset types: a riskfree asset and a risky one. The results of the analysis imply that probability of owning the risky asset in addition to the safe one is an increasing function of risk aversion. The explanation of this relationship is that risk-aversion determines prudence in financial decisions. Respectively, more risk-averse investors manage to accumulate significantly more wealth than their risk-loving counterparts and have a greater incentive to participate in financial markets. Risk-prone investors, on contrast, accumulate very little wealth and, correspondingly, most of them do not have enough means to carry the fixed costs of market participation and, therefore, do not hold any risky assets.

In contrast to Campbell et al. (2003) but in line with Gomes and Michaelides (2005) we hypothesize that there should be a positive relationship between risk aversion and diversification for two reasons. First, according to predictions of the mean-variance analysis of Markowitz (1952), a completely diversified portfolio should be preferred to a single risky

asset or a portfolio of few risky assets because diversification eliminates idiosyncratic risk associated with individual assets and thus reduces the portfolio's total risk. Second, risk averse investors should not stick to undiversified portfolios consisting of one or few safe assets despite the fact that such a portfolios might have lower risk than a market portfolio. This should happen due to the positive relationship between risk aversion and prudence in financial behavior as predicted by Gomes and Michaelides (2005).

# 3 Evidence on household portfolios from the SOEP

## 3.1 Ownership of financial assets

Our analysis is based on a sample of households that participated in four subsequent waves, 2004 through 2007, in the the German Socioeconomic Panel (SOEP) survey. [1] Accordingly, our data set presents a balanced panel, with N = 5,056 observation units and T = 4 years.[2]

The SOEP survey contains information on whether a household owns any of the following six types of financial assets: bank saving deposits, mortgage savings plans[3], life insurance policies, fixed-interest securities (including federal savings bonds, saving bonds issued by banks and mortgage-backed bonds), security papers of listed companies (including stocks, bonds and equity warrants held directly or through mutual funds), and equity of non-listed firms.[4]

Figure 1 documents the fraction of households owning the specified asset types at the beginning and at the end of the observation period. Apparently, bank deposits, life insurances and mortgage savings plans are the three financial assets that are most frequently held by private households in Germany. The figures do not change very much over the four years, although a slight decline in the ownership of bank deposits and life insurances is observable.

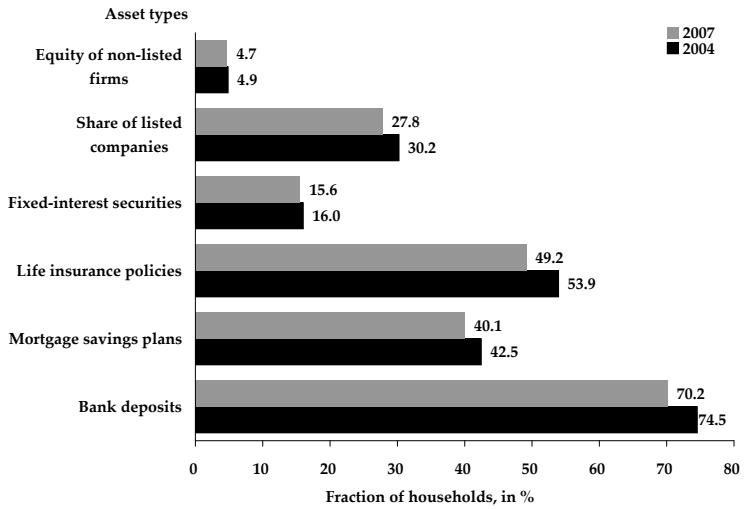
[1] Earlier survey waves do not provide information on individual risk preferences.

[2] The unit of observation is a household. For all socioeconomic characteristics that cannot be observed at a household level, e.g., age, sex, etc., we use the information given for the household head.

[3] The German term is "Bausparvertrag".

[4] In the survey it is not specified what individual securities are held within the given six asset types and what wealth amounts are allocated to them.

Figure 1: Ownership rates of different asset types in the sample




## 3.2 Measures of diversification

Despite the fact that analyzing portfolio diversification has a long history, there is no common approach for measuring the degree of diversification in household portfolios. Across the empirical literature one can find diverse approaches, mostly depending on the data at hand. Blume and Friend (1975) use the total number of securities constituting a portfolio as a measure of diversification. Goetzmann et al. (2005) correct the total number of financial instruments in a portfolio for the correlation among returns on these instruments in order to account for passive diversification.[5] These measures are well suited for an analysis in the framework of Markowitz's mean-variance approach. However, both methods require knowledge of what share of wealth is allocated to each individual asset – this information is rarely provided in household surveys.

Instead, most household surveys report indicators of wealth allocation across assets, a tendency reflecting actual practice, since most households prefer to build fairly simple portfolios. For example, Campbell (2006) shows that the majority of household financial portfolios in the United States are poorly diversified. Liquid assets (e.g., cash, demand funds) play the dominant role for the poor, while less liquid savings (e.g., savings

[5]Passive diversification means that correlation between individual assets included in a portfolio is not taken into account, only the number of assets matters.

accounts, life insurance contracts) dominate the portfolios of middle-class households. Risky assets have some importance for the middle class too, but account for the largest portfolio share in wealthier households. Carroll (1995) documents a similar pattern of portfolio composition among European households. Moreover, as shown by Benartzi and Thaler (2001), it is not rare for nonprofessional investors to follow some naive or heuristic diversification strategy, e.g., *1/n strategy*, according to which investors split their wealth evenly among *n* available assets.

Taking into account availability of data, the specific nature of household portfolios and the fact that some investors make decisions based on naive notions of diversification, we construct two alternative measures of portfolio diversification: "naive diversification" and "sophisticated diversification."

### 3.2.1 Naive diversification

Naive diversification takes into account only the number of distinct asset types held in a portfolio.[6] Accordingly, the more asset types are held, the more diversified a portfolio is. Investors who follow the naive strategy expect to reduce portfolio risk at the expense of portfolio return. As discussed above, the SOEP data allow identification of six distinct asset types.

Figure 2 documents the sample distribution of households by the number of asset types held in portfolios. Apparently, the largest fraction of households allocates wealth among two or three asset types.

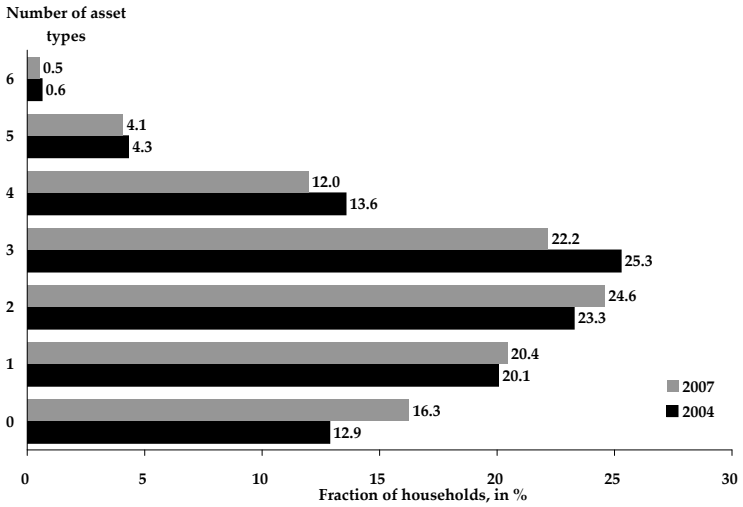
### 3.2.2 Sophisticated diversification

Our second measure of diversification is constructed to capture more sophisticated investment patterns. It accounts not only for the number of assets, but also for their degree of risk and combination in a portfolio. The measure is constructed as follows.

The six available asset types are grouped into three classes according to their riskiness: *low risk*, *moderate risk*, and *high risk* (see Table A.1). Because we do not know the

[6]The term "naive diversification" is often used to reflect the fact that an equal amount of wealth is attached to all assets available DeMiguel et al. (2007). We refer only to the number of asset types due to the data constraints of the SOEP.

Figure 2: Distribution of households by the number of asset types in portfolio




share of wealth allocated to each individual asset, defining riskiness according to the mean-variance approach is not possible. Instead, we use a more simple, but feasible, categorization drawing upon Blume and Friend (1975) and Börsch-Supan and Eymann (2000).[7]

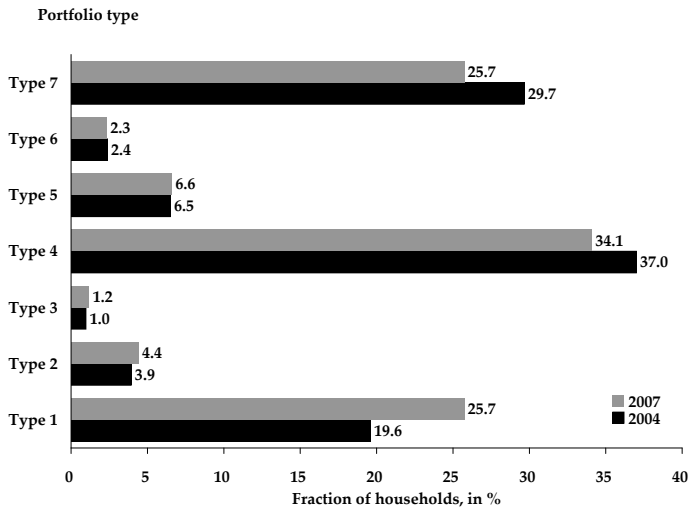
This categorization is justified as follows. Bank deposits are clearly safe because their returns do not exhibit any variation and are guaranteed by the financial institution. The returns on fixed-interest assets are also stable; however, the real payoff depends on the duration and on the issuer's rating. Holders of life insurance policies do not bear the risk of losing the entire investment, but the real return upon termination is uncertain and can be significantly lower than the expected return. Listed securities and equity of non-listed firms are the most risky, since stock prices and dividends as well as firms' value are volatile and uncertain. In accordance with the "no free lunch principle" the lowest expected return is assigned to assets in the *safe class*; *relatively risky assets* are assumed to have moderate expected returns; the highest expected return is assigned to assets in the *risky class*. We assume that the defined asset classes are not perfectly positively correlated.

Based on this classification rule, we define seven portfolio types (Table A.2). A portfolio that consists of assets from only one class, i.e., either safe, relatively risky, or risky, has

[7]This approach has also been applied by Alessie et al. (2000), Banks and Smith (2000), Bertaut and Starr-McCluer (2000), Guiso and Jappelli (2000).

the least degree of diversification and is referred to as *undiversified*. Depending on what asset type is held, an undiversified portfolio can have low risk (Type 1), moderate risk (Type 2), or high risk (Type 3). A portfolio that includes assets from at least two different classes is referred to as *quite diversified*. Different types of quite diversified portfolios are defined according to the degree of risk of the included individual asset types: Type 4 includes safe and relatively risky assets, Type 5 consists of safe and risky assets, and Type 6 contains relatively risky and risky assets. Finally, the *fully diversified* portfolio (Type 7) is one that includes assets from all three classes.

Figure 3: Distribution of households by portfolio types



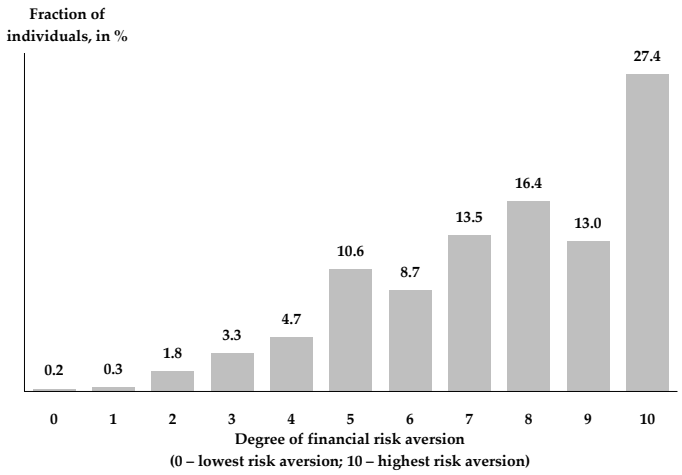

The sample distribution with respect to the seven portfolio types (Figure 3) indicates that households have a strong tendency towards safety: most of them hold incomplete portfolios that comprise either safe assets or a mix of safe and relatively risky assets. If the risk/return profiles assigned to six asset types are correct, we can argue that most of households choose to forgo higher returns in favor of safety of their investments.

# 4 Risk aversion

The SOEP data provide an experimentally validated indicator of individual attitude towards financial risk.[8] In the 2004 wave, respondents were asked to rate their willingness to take risks when investing money on a 11-point scale, with 0 indicating complete unwillingness and 10 indicating a very high willingness.

Two adjustments are made to the original indicator of risk attitude so as to make it better suited for the purposes of our analysis. First, we convert the indicator from being a measure of risk tolerance into a measure of risk aversion. This is accomplished by reversing the scale, so that "0" denotes the lowest risk aversion and "10" the highest risk aversion. The new discrete variable that emerges is called *FRA*, financial risk aversion. Figure 4 presents the sample distribution of household heads according to the level of risk aversion in 2004. Apparently, the majority of respondents perceive themselves as highly risk averse.

Figure 4: Distribution of individuals by degree of risk aversion




As we have only one year of data for the measure of financial risk aversion, a further adjustment is necessary to make the it applicable in the panel-data context. We treat the measure as a time-invariant variable assuming that attitude towards risk remains stable

[8] For details and discussion of the validity tests, see Dohmen et al. (2005).

over the four-year period, which appears to be a reasonable assumption for periods of normal economic conditions.[9]

# 5 Regression analysis

## 5.1 The model

Our main hypothesis is that risk aversion has a statistically and economically significant positive effect on diversification of financial portfolios by private households. To test this hypothesis, we model probability of observing a certain level of diversification as a function of risk aversion of a household head and a set of socioeconomic characteristics of the household and its members.[10] Table A.3 summarizes descriptive statistics of the control variables used in the regression analysis.

The two diversification measures are categorical variables with $J$ mutually exclusive and exhaustive alternatives. Specifically, the measure of naive diversification takes on 5 successive values, from 0 to 4, according to the number of asset types owned by a household; the measure of sophisticated diversification takes on eight values corresponding to the portfolio types defined earlier in Section 3.2.2 including the case when none of the specified asset types are held.

Because of the categorical nature of the dependent variable, we employ a pooled multinomial logistic regression model similar to Uhler and Cragg (1971).[11] For the case

[9] Barsky et al. (1997) provide evidence that risk preferences are in fact relatively stable over time.

[10] There is a wide agreement in the empirical literature that socioeconomic and demographic characteristics of investors have significant influence on portfolio decisions. In particular, Uhler and Cragg (1971) find that differences in income, age, and education explain a large portion of variation in number of different financial assets held by U.S. households; evidence from more recent studies supports this finding. See, e.g., King and Leape (1998), Hochguertel et al. (1997), Börsch-Supan and Eymann (2000), Burton (2001) and Campbell (2006).

[11] We also employed an ordered logit model. However, the results of a Brant test indicated that the parallel regression assumption is violated. Furthermore, the Hausman test for independence of irrelevant alternatives (IIA) supported that multinomial logit model is a more appropriate in our case.

of $J$ outcomes, the probability of observing a particular outcome, $P(Y_j)$, is:

$$P(Y_j) = \frac{exp(X'\beta_j)}{\sum_{n=1}^{J} exp(X'\beta_n)}, \quad (1)$$

$$n = 0, 1, 2, ..., J; \quad j = 0, 1, 2, ..., J; \quad j \neq n.$$

We estimate two specifications. First, we include naive diversification as dependent variable. The explanatory variables comprise the measure of financial risk aversion and other socioeconomic variables. Year dummies are also included in order to control for time-specific effects. The second specification uses sophisticated diversification as the dependent variable. Control variables are the same as in the first specification.

## 5.2 Impact of risk aversion on "naive" diversification

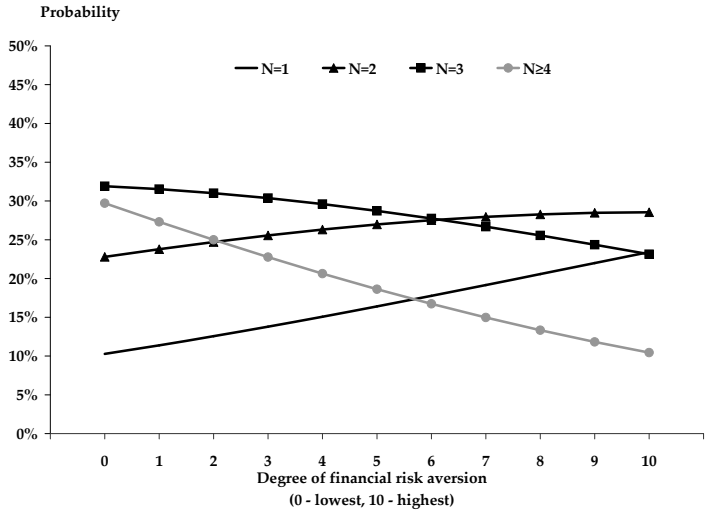
The estimation results with respect to the effects of risk aversion on propensity to diversify naively are documented in Table A.4. The predicted probabilities of the specified number of assets are calculated for the degree of risk aversion equal to the sample mean of 7.55. The marginal effects show how the estimated probabilities would change, if risk aversion rose by one unit. For example, a coefficient of 0.010 means that, anything else being equal, individuals with a risk aversion one unit higher than the sample average risk aversion are by 1% more likely to hold an one-asset portfolio.

Apparently, households with the average level of risk aversion are most likely to hold either a two- or a three-asset portfolio. Overall, the predicted probabilities are largely in line with the sample distribution of households with respect to the number of asset types held in a portfolio. The estimated marginal effects suggest that degree of financial risk aversion has a strong influence on the number of asset types held in a portfolio. Moreover, an important conclusion that can be driven from the figures, is that individuals with risk aversion slightly higher than the average tend to hold a smaller number of asset types in their portfolios.

To provide a more complete picture of the changing effects of risk attitudes on diversification, we estimate probabilities to hold a particular number of asset types for each

degree of risk aversion. Figure 5 demonstrates how these probabilities vary with the degrees of risk aversion.

Figure 5: Effect of financial risk aversion on the probability of holding particular number of asset types in portfolio




Note: The estimated probability of six assets is close to zero, and is not shown here; The probabilities do not add up to 1, because results for "0 assets" are not presented in the graph

The figures clearly show a positive relationship between risk aversion and the likelihood of holding only one asset. The most risk tolerant investors allocate their wealth in one single asset class with probability of 10%. Their very risk averse counterparts do the same with considerably higher probability of almost 24%. The likelihood of two assets also increases with rising levels of risk aversion. On contrast, the two curves describing the relationship between risk aversion and the probability of holding three asset types and clearly exhibit declining profiles.

In conclusion, the findings are not consistent with the naive diversification principle. According to this principle an investor should include as many types of assets as possible in her portfolio anticipating that this strategy would reduce the risk associated with a specific return, but the findings point to the opposite direction. One potential explanation is that households do *not* follow the naive diversification strategy, but instead employ more sophisticated rules when constructing their investment portfolios. This will be investigated in more detail in the next section.

## 5.3 Impact of risk aversion on "sophisticated" diversification

In this section we study whether the impact of individual risk aversion on portfolio structure becomes positive when assuming that households follow a more sophisticated diversification strategy. To this end, we proceed with estimating a model where the described measure of sophisticated diversification serves as dependent variable. The estimated effects of *financial* risk aversion on the probability of the specified portfolio types are reported in Table A.5.

Households with average risk aversion are most likely to hold portfolio "Type 4", that is a quite diversified portfolio comprising safe and relatively risky assets; the estimated probability is 37%. The respective marginal effect of 0.011 suggests that the likelihood of this portfolio type will rise by 1% if the level of risk aversion increases by one unit. The estimated probability of a fully diversified portfolio is considerably lower, 22%, and is decreasing in risk aversion.

Figure 6: Effect of financial risk aversion on the probability of holding a particular portfolio type according to the "sophisticated" diversification rule

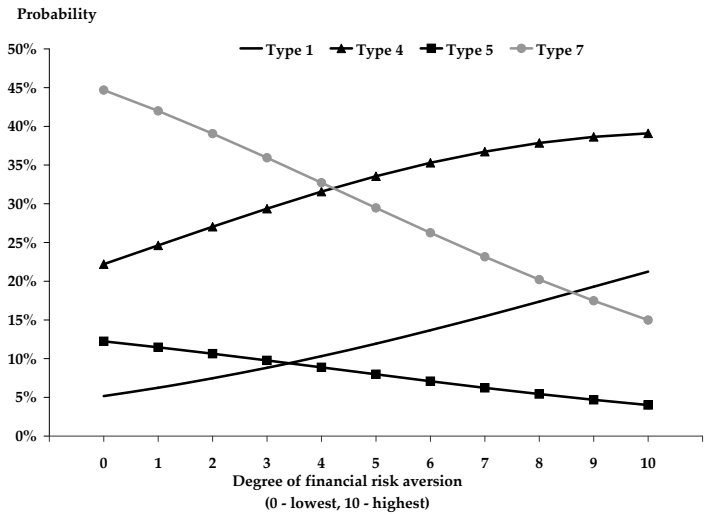



Figure 6 illustrates how the probabilities of holding the specified portfolio types change with levels of financial risk aversion. It is clear that likelihood of the undiversified portfolio "Type 1" rises at an increasing rate as risk aversion gets stronger. The relationship between the probability of the quite diversified portfolio "Type 4" and risk aversion is

also positive. However, the effect is especially strong for the lower than average levels of risk aversion and gets sufficiently weaker for the above average levels of risk aversion. For both portfolio types, the effect is quite plausible. As risk aversion gets stronger, individuals tend to invest in safe assets.

An opposite relationship emerges when we look at the relationship of risk aversion and the willingness to invest in the quite diversified portfolio "Type 5"; probability of this portfolio decreases almost linearly when risk aversion gets stronger. Since the portfolio "Type 5" is a mix of safe and risky assets, it is not surprising that more risk averse investors are less willing to hold this mix than their more risk tolerant counterparts.

Finally, the effect of risk aversion on the probability of holding the fully diversified portfolio "Type 7" is not easy to explain. Assuming that returns on different asset types are not perfectly positively correlated and there are no transaction or entry costs, we would expect that a fully diversified portfolio is more attractive to individuals with higher risk aversion than to their more risk tolerant counterparts. Instead we find a strong and an almost linear negative relationship.[12] Thus, our findings clearly reject the hypothesis that individuals with high risk aversion tend to invest in portfolios where risks are diversified over different asset classes.

# 6 Extension: safety and liquidity first

Our analysis reveals a negative relationship between the manifested individual risk aversion and the probability of holding a diversified portfolio. How can this finding be explained? An explanation can be found when one thinks about motives of saving by private households. Among the main motives, saving for precautionary reasons has long been considered as one of the main motives of personal saving. Already Keynes (1936) suggests that economic activity of private households is dominated by safety and liquidity needs. A number of more recent applied works – e.g. Skinner (1988), Zeldes (1989), Caballero (1991) and Ventura and Eisenhauer (2005) – confirm the relevance of the precautionary motive for saving.

[12] We also estimate the effects of risk aversion on the sophisticated diversification in a model where we additionally include ownership of commercial real estate and value of household total assets and liabilities as control variables. As the data on these variables are available for 2007 only, the model is estimated with a cross-sectional data set. Nevertheless, the results obtained for this specification once again confirm the negative relationship between risk aversion and probability of holding a diversified portfolio.

For any particular household, its individual safety needs should determine what mix of assets the household chooses to own. If this conjecture holds, then the most natural decision for a household would be first and foremost to invest in safe assets like cash and saving deposits. Only when the basic precautionary needs would be satisfied, a household would acquire other, more speculative types of assets, like bonds or stocks. Thus, it is reasonable to assume that if a household owns only one asset type, it will be a safe one. This assumption coincides with what we observe in our sample (see Figure 3). Therefore, we expect that a household's propensity to invest in risky assets is higher when its safety needs are satisfied.

To test this hypothesis, we estimate an additional multinomial logit model with the data of the 2007 survey wave. The dependent variable in this model represents the number of types of risky assets held in a portfolio. The explanatory variables include the main socioeconomic and wealth characteristics of households. In addition, we control for the number of safe assets held in a portfolio, $N_{Safe\ assets}$. The details on the estimation are reported in Table A.6.

As expected, the results confirm a positive relationship between the number of safe assets and the ownership of risky financial assets. Ceteris paribus, ownership of a unit increment in the number of safe assets reduces the probability that a household refrains from risky assets by 7%, while the likelihood of owning one risky asset increases by 6%. The probability of holding two and more risky assets is also positively associated with a unit increment in safe assets. Thus, we can conclude that propensity to diversify by including more risky assets into a portfolio is in fact highly dependent on whether safety needs are satisfied.

# 7 Conclusions

This paper explores the link between self-declared risk aversion and the level of diversification in financial portfolios of private households. Taking into account a wide range of socioeconomic and demographic characteristics of households, we find that diversification is negatively related to the level of risk aversion. This result is in odds with the mean-variance principle of Markowitz (1952). On the other hand, our findings are largely

in agreement with King and Leape (1998) who also find a negative influence of the degree of risk aversion on portfolio diversification by private households in the USA.

There are two basic explanations of this evidence. First, in line with predictions of Keynes (1936), private households are primarily concerned with replenishment of some safety buffer by allocating wealth in safe or liquid assets. Respectively, households prefer safety to higher returns on their investments. In effect, they choose to stay away from risky financial assets and limit their portfolios to a few safe assets.

Second, private households might not exploit the potential of diversification that would allow them to achieve minimal risk for a given return because they either are not aware of this potential, or do not possess the necessary knowledge for a proper selection of individual assets into a portfolio; finally, they might consider the task of managing complex portfolios too burdensome.

From the practical perspective, understanding the determinants of portfolio choices made by private investors is especially important in the light of rising necessity of private provisions for retirement. The distinct preference of private households for safe assets indicates what kind of pension plans will prevail once individuals have to provide for their own retirement. Another implication of results of the present study, is that promotion of financial education among ordinary people should be given a high priority on the political agenda.

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# Appendix

Table A.1: Categorization of asset types according to their riskiness

| **Low Risk** | **Moderate Risk** | **High Risk** |
|---|---|---|
| Bank deposits | Life insurance policies | Listed securities |
| Mortgage savings plans | Fixed-interest securities | Equity of non-listed firms |

Table A.2: Definition of portfolio types according to strategies of "sophisticated diversification".

| Portfolio type | Level of diversification | Asset classes included in portfolio | | |
|---|---|---|---|---|
| | | safe | relatively risky | risky |
| Type 1 | Undiversified | + | - | - |
| Type 2 | Undiversified | - | + | - |
| Type 3 | Undiversified | - | - | + |
| Type 4 | Quite diversified | + | + | - |
| Type 5 | Quite diversified | + | - | + |
| Type 6 | Quite diversified | - | + | + |
| Type 7 | Fully diversified | + | + | + |

" + " indicates that at least one asset of particular type is owned, "-" indicates that no assets of particular type are owned.

Table A.3: Summary statistics[a]

| Variable | Description | Mean | Std. Dev. |
|---|---|---|---|
| FRA | Degree of financial risk aversion, on a scale from 0 (very low) to 10 (very high) | 7.55 | 2.23 |
| Property | = 1 if household owns residential, 0 otherwise | 0.46 | 0.49 |
| InvestProperty | = 1 if household owns commercial property | 0.33 | 0.12 |
| Total Assets | Total value of financial and real assets[b], in Euro | 156343.90 | 311989 |
| Total Debt | Total value of consumer credits and mortgages[b], in Euro | 77388.88 | 92359.89 |
| Income | Net annual household income, in Euro[c] | 31171.60 | 19742.22 |
| Age | Age in years | 51.95 | 15.67 |
| Sex | = 1 if male, 0 if female | 0.58 | 0.49 |
| Education | = 1 if with university degree, 0 otherwise | 0.19 | 0.39 |
| Employment | = 1 if full-time employed, 0 otherwise | 0.55 | 0.49 |
| Self-Employed | = 1 if self-employed, 0 otherwise | 0.06 | 0.24 |
| Retirement | = 1 if retired, 0 otherwise | 0.29 | 0.45 |
| Adults | Number of adult household members, age 18 and older | 1.95 | 0.77 |
| $N_{children}$ | Number of children under 18 | 0.501 | 0.87 |
| Total number of households in the panel, N = 5056 | | | |

[a] For socioeconomic characteristics that cannot be observed at the household level, e.g., FRA, age, sex, etc., reported figures relate to the household head;
[b] Information available only for 2007;
[c] Income is calculated in real terms adjusted for inflation.

# Table A.4: The effects of the *financial* risk aversion on "naive" diversification

The table reports marginal effects after estimation of a multinomial logit model with maximum likelihood. Marginal effects are calculated at the mean values for continuous variables and at the value of 0 for the binary dummy variables and count variables. Dummy variables are marked with "(d)". Robust standard errors are in parentheses. Levels of significance: $^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$. *Probability of outcome* is the predicted probability of holding a given number of asset types.

The dependent variable is a categorical variable that takes seven successive values, according to the number of asset classes held in a portfolio. Variable *FRA* indicates financial risk aversion and takes on values from 0 (lowest risk aversion) to 10 (highest risk aversion). *Income20* through *Income80* are dummy variables indicating to which income group the household belongs: Income20 = the lowest 20-percentile, Income40 = 40-percentile – 20-percentile, etc. Income100 – the upper 20-percentile is the base category. Among dummy variables indicating age group, Age>75 is the base category.

| Outcome: | $N_{assets}=0$ | $N_{assets}=1$ | $N_{assets}=2$ | $N_{assets}=3$ | $N_{assets}\geq 4$ |
|---|---|---|---|---|---|
| | | | Effects of financial risk aversion | | |
| FRA | 0.010*** | 0.014*** | 0.003 | -0.011*** | -0.016*** |
| | (0.001) | (0.002) | (0.002) | (0.002) | (0.001) |
| | | | Effects of socioeconomic variables | | |
| Income20 (d) | 0.275*** | 0.190*** | -0.065*** | -0.230*** | -0.170*** |
| | (0.021) | (0.019) | (0.013) | (0.008) | (0.005) |
| Income40 (d) | 0.133*** | 0.152*** | 0.004 | -0.142*** | -0.146*** |
| | (0.016) | (0.016) | (0.014) | (0.009) | (0.005) |
| Income60 (d) | 0.074*** | 0.107*** | 0.021 | -0.097*** | -0.104*** |
| | (0.014) | (0.015) | (0.013) | (0.009) | (0.005) |
| Income80 (d) | 0.036** | 0.047*** | 0.014 | -0.036*** | -0.062*** |
| | (0.013) | (0.014) | (0.013) | (0.010) | (0.005) |
| Property (d) | -0.084*** | -0.081*** | -0.028*** | 0.092*** | 0.101*** |
| | (0.005) | (0.006) | (0.007) | (0.007) | (0.006) |
| Adults | 0.016*** | 0.008 | -0.004 | -0.013* | -0.007* |
| | (0.004) | (0.005) | (0.006) | (0.005) | (0.004) |
| $N_{children}$ | 0.025*** | 0.015** | -0.005 | -0.024*** | -0.012*** |
| | (0.003) | (0.005) | (0.005) | (0.004) | (0.003) |
| Sex (d) | 0.005 | 0.007 | 0.017* | -0.005 | -0.024*** |
| | (0.005) | (0.007) | (0.008) | (0.007) | (0.005) |
| Employment (d) | -0.079*** | -0.026** | 0.017 | 0.073*** | 0.015* |
| | (0.007) | (0.009) | (0.011) | (0.010) | (0.007) |
| Self-Employed (d) | 0.072*** | 0.012 | -0.026 | -0.064*** | 0.005 |
| | (0.016) | (0.016) | (0.015) | (0.012) | (0.009) |
| Retirement (d) | -0.028*** | -0.010 | 0.018 | 0.043** | -0.023* |
| | (0.008) | (0.012) | (0.014) | (0.015) | (0.011) |
| Education (d) | -0.067*** | -0.032*** | 0.003 | 0.041*** | 0.054*** |
| | (0.006) | (0.008) | (0.009) | (0.009) | (0.007) |
| Age <25 (d) | -0.057*** | -0.166*** | -0.126*** | 0.029 | 0.321*** |
| | (0.014) | (0.009) | (0.030) | (0.052) | (0.071) |
| Age 25-35 (d) | -0.044*** | -0.188*** | -0.103*** | 0.058* | 0.276*** |
| | (0.010) | (0.008) | (0.019) | (0.027) | (0.038) |
| Age 36-45 (d) | 0.007 | -0.196*** | -0.078*** | 0.076** | 0.190*** |
| | (0.013) | (0.010) | (0.019) | (0.024) | (0.031) |
| Age 46-55 (d) | 0.021 | -0.155*** | -0.066*** | 0.039 | 0.162*** |
| | (0.014) | (0.010) | (0.019) | (0.023) | (0.031) |
| Age 56-65 (d) | -0.005 | -0.138*** | -0.057*** | 0.021 | 0.179*** |
| | (0.011) | (0.009) | (0.017) | (0.021) | (0.031) |
| Age 66-75 (d) | -0.017 | -0.090*** | -0.009 | -0.012 | 0.128*** |
| | (0.009) | (0.009) | (0.017) | (0.019) | (0.029) |
| Probability of outcome | 0.12 | 0.20 | 0.28 | 0.26 | 0.14 |
| Probability($\chi^2$) | 0.000 | | | | |
| Log-Likelihood | -28098.00 | | | | |
| Pseudo-$R^2$ | 0.116 | | | | |
| $N_{obs}$ | 19948 | | | | |

## Table A.5: The effects of *financial* risk aversion on "sophisticated" diversification

The table reports marginal effects after estimation of a multinomial logit model with maximum likelihood. Marginal effects are calculated at the mean values for continuous variables and at the value of 0 for the binary dummy variables and count variables. Dummy variables are marked with "(d)". Robust standard errors are in parentheses. Levels of significance: $^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$. *Probability of outcome* is the predicted probability of a given portfolio type.

The dependent variable is a categorical variable that takes eight different values corresponding to the seven portfolio types defined in Section 3.2.2 plus the category "no investments". Variable *FRA* indicates financial risk aversion and takes on values from 0 (lowest risk aversion) to 10 (highest risk aversion). *Income20* through *Income80* are dummy-variables indicating to which income group the household belongs: Income20 = the lowest 20-percentile, Income40 = 40-percentile – 20-percentile, etc. Income100 – the upper 20-percentile is the base category.

| Outcome | no investments | undiversified portfolio | | | quite diversified portfolio | | | fully diversified portfolio |
|---|---|---|---|---|---|---|---|---|
| | | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 | Type 7 |
| | | | | Effects of financial risk aversion | | | | |
| FRA | 0.012*** | 0.019*** | 0.000 | -0.002*** | 0.011*** | -0.008*** | -0.003*** | -0.029*** |
| | (0.001) | (0.001) | (0.001) | (0.000) | (0.002) | (0.001) | (0.000) | (0.001) |
| | | | | Effects of socioeconomic variables | | | | |
| Income20 (d) | 0.290*** | 0.192*** | 0.013* | -0.004* | -0.166*** | -0.045*** | -0.020*** | -0.261*** |
| | (0.021) | (0.020) | (0.007) | (0.002) | (0.014) | (0.004) | (0.002) | (0.006) |
| Income40 (d) | 0.144*** | 0.176*** | 0.005 | -0.002 | -0.073*** | -0.018*** | -0.017*** | -0.215*** |
| | (0.017) | (0.018) | (0.006) | (0.002) | (0.014) | (0.005) | (0.002) | (0.006) |
| Income60 (d) | 0.083*** | 0.115*** | 0.012* | 0.001 | -0.022 | -0.020*** | -0.012*** | -0.156*** |
| | (0.015) | (0.016) | (0.006) | (0.002) | (0.014) | (0.005) | (0.002) | (0.007) |
| Income80 (d) | 0.039** | 0.060*** | 0.004 | -0.000 | 0.008 | -0.002 | -0.010*** | -0.100*** |
| | (0.013) | (0.015) | (0.006) | (0.002) | (0.014) | (0.006) | (0.002) | (0.007) |
| Property (d) | -0.087*** | -0.049*** | -0.028*** | 0.004** | 0.037*** | 0.017*** | 0.001 | 0.106*** |
| | (0.005) | (0.006) | (0.003) | (0.001) | (0.008) | (0.004) | (0.002) | (0.007) |
| Adults | 0.019*** | 0.013** | 0.004 | -0.003** | 0.024*** | -0.016*** | -0.006*** | -0.034*** |
| | (0.004) | (0.005) | (0.002) | (0.001) | (0.006) | (0.003) | (0.001) | (0.005) |
| $N_{children}$ | 0.028*** | 0.012* | 0.008*** | -0.003*** | -0.000 | -0.017*** | -0.006*** | -0.022*** |
| | (0.003) | (0.005) | (0.002) | (0.001) | (0.005) | (0.003) | (0.001) | (0.004) |
| Sex (d) | 0.007 | 0.005 | 0.000 | 0.004** | 0.019* | -0.008 | 0.001 | -0.028*** |
| | (0.005) | (0.006) | (0.003) | (0.001) | (0.008) | (0.004) | (0.002) | (0.007) |
| Employment (d) | -0.083*** | -0.023** | -0.000 | -0.003 | 0.086*** | 0.005 | -0.004 | 0.021* |
| | (0.007) | (0.009) | (0.004) | (0.002) | (0.011) | (0.006) | (0.003) | (0.010) |
| Self-Employed (d) | 0.074*** | -0.041** | 0.026** | 0.004 | -0.127*** | 0.018* | 0.018*** | 0.028* |
| | (0.016) | (0.014) | (0.008) | (0.003) | (0.014) | (0.009) | (0.004) | (0.013) |
| Retirement (d) | -0.030*** | -0.003 | -0.008 | -0.002 | 0.056*** | 0.005 | -0.005 | -0.013 |
| | (0.008) | (0.011) | (0.005) | (0.003) | (0.016) | (0.008) | (0.003) | (0.014) |
| Education (d) | -0.071*** | -0.027*** | -0.007* | 0.004* | -0.047*** | 0.028*** | 0.016*** | 0.104*** |
| | (0.006) | (0.008) | (0.004) | (0.002) | (0.010) | (0.005) | (0.003) | (0.009) |
| Age <25 (d) | -0.039* | -0.129*** | -0.010 | 0.024 | -0.082 | -0.019 | -0.001 | 0.257*** |
| | (0.018) | (0.009) | (0.014) | (0.020) | (0.046) | (0.015) | (0.012) | (0.060) |
| Age 25-35 (d) | -0.034** | -0.150*** | 0.002 | 0.002 | 0.017 | -0.010 | -0.002 | 0.175*** |
| | (0.012) | (0.008) | (0.011) | (0.004) | (0.026) | (0.009) | (0.005) | (0.030) |
| Age 36-45 (d) | 0.015 | -0.170*** | 0.013 | 0.002 | 0.053* | -0.021** | 0.001 | 0.108*** |
| | (0.014) | (0.009) | (0.012) | (0.004) | (0.025) | (0.008) | (0.005) | (0.026) |
| Age 46-55 (d) | 0.027 | -0.145*** | 0.040* | 0.002 | 0.042 | -0.032*** | 0.001 | 0.065** |
| | (0.014) | (0.009) | (0.016) | (0.004) | (0.024) | (0.007) | (0.006) | (0.025) |
| Age 56-65 (d) | 0.002 | -0.120*** | 0.046** | -0.004 | 0.032 | -0.018** | 0.003 | 0.058* |
| | (0.012) | (0.007) | (0.016) | (0.002) | (0.022) | (0.007) | (0.005) | (0.023) |
| Age 66-75 (d) | -0.010 | -0.069*** | 0.032* | 0.002 | -0.009 | 0.008 | -0.002 | 0.048* |
| | (0.010) | (0.008) | (0.014) | (0.003) | (0.020) | (0.008) | (0.004) | (0.022) |
| Probability | 0.13 | 0.17 | 0.04 | <0.01 | 0.36 | 0.06 | 0.02 | 0.22 |
| Probability($\chi^2$) | 0.000 | | | | | | | |
| Log-Likelihood | -28436.57 | | | | | | | |
| Pseudo-$R^2$ | 0.126 | | | | | | | |
| $N_{obs}$ | 19168 | | | | | | | |

## Table A.6: The effects of the number of safe assets on the number of risky assets held

The table reports marginal effects after estimation of a multinomial logit model with maximum likelihood. Marginal effects are calculated at the mean values for continuous and count variables and at 0 for binary dummy variables. Dummy variables are marked with "(d)". Robust standard errors are in parentheses. Levels of significance: $^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$. *Probability of outcome* is the predicted probability of a given number of risky assets.
The dependent variable is a categorical variable that takes four successive values from 0 to 3, according to the number risky assets in a portfolio. Variable *FRA* indicates financial risk aversion and takes on values from 0 (lowest risk aversion) to 10 (highest risk aversion). *Income20* through *Income80* are dummy variables indicating to which income group the household belongs: Income20 = the lowest 20-percentile, Income40 = 40-percentile – 20-percentile etc. Income100 – the upper 20-percentile is the base category.

| Outcome: | no risky assets | one risky asset | two risky assets |
|---|---|---|---|
| FRA | 0.039*** (0.005) | -0.033*** (0.005) | -0.006***(0.002) |
| $N_{Safe\ \ assets}$ | -0.074*** (0.014) | 0.058*** (0.013) | 0.016*** (0.005) |
| Property (d) | 0.013 (0.047) | -0.012 (0.044) | -0.001 (0.010) |
| InvestProperty (d) | -0.132** (0.041) | 0.122** (0.039) | 0.011 (0.010) |
| log(Total Assets) | -0.053*** (0.010) | 0.039*** (0.009) | 0.014*** (0.002) |
| log(Total Debt) | 0.021* (0.010) | -0.015 (0.009) | -0.006** (0.002) |
| Income20 (d) | 0.183*** (0.043) | -0.154*** (0.043) | -0.029** (0.010) |
| Income40 (d) | 0.194*** (0.035) | -0.160*** (0.034) | -0.034*** (0.010) |
| Income60 (d) | 0.155*** (0.032) | -0.132*** (0.031) | -0.023** (0.008) |
| Income80 (d) | 0.054 (0.031) | -0.043 (0.029) | -0.011 (0.007) |
| Adults | 0.043* (0.019) | -0.033 (0.018) | -0.010* (0.005) |
| $N_{children}$ | 0.043** (0.015) | -0.041** (0.014) | -0.002 (0.003) |
| Sex (d) | 0.062* (0.028) | -0.047 (0.027) | -0.015* (0.007) |
| Employment (d) | 0.003 (0.036) | -0.005 (0.035) | 0.002 (0.009) |
| Self-Employed (d) | -0.109* (0.052) | 0.053 (0.046) | 0.056* (0.024) |
| Education (d) | -0.106*** (0.032) | 0.084** (0.030) | 0.022* (0.009) |
| Retirement (d) | 0.087 (0.045) | -0.077 (0.044) | -0.010 (0.010) |
| Age <25 (d) | -0.065 (0.219) | 0.099 (0.219) | -0.034*** (0.009) |
| Age 25-35 (d) | 0.167 (0.101) | -0.148 (0.097) | -0.019 (0.018) |
| Age 36-45 (d) | 0.176 (0.120) | -0.160 (0.113) | -0.022 (0.024) |
| Age 46-55 (d) | 0.221* (0.110) | -0.208* (0.097) | -0.022 (0.021) |
| Age 56-65 (d) | 0.119 (0.524) | -0.203 (0.115) | -0.021 (0.019) |
| Age 66-75 (d) | -0.437 (1.283) | -0.266 (0.202) | -0.017 (0.072) |
| Probability of outcome | 0.68 | 0.29 | 0.03 |
| Probability($\chi^2$) | 0.000 | | |
| Log-Likelihood | -1380.78 | | |
| Pseudo-$R^2$ | 0.197 | | |
| $N_{obs}$ | 1833 | | |

$^{*}p < 0.05, ^{**}p < 0.01, ^{***}p < 0.001$