Housing valuation, wealth perception, and households' portfolio composition *

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Abstract

This paper empirically explores the relationship between wealth perception from homeownership and households' preference towards asset categories pooled by risk. We use household survey data from the Household Finance and Consumption Survey to obtain a measure of the rate of housing valuation to be used in regressions against shares of safe, medium risk, and risky assets from a single portfolio. Shares are treated as a fraction of total wealth and estimated with fractional multinomial logit models and fractional logit models. Data shows incomplete household portfolios along with housing capturing the largest share of households' wealth in accordance with the literature (e.g. Campbell, 2006). Our findings indicate robust empirical evidence that perceived wealth from the rate of housing valuation matters to portfolio choices. The estimations predict that an increase in the rate of housing valuation increases the demand for risky assets of mixed type, together with negative effects on the demand for safe deposits held within the strictly financial portfolio.

JEL Classification: C35; C58; D14; G11

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1 Introduction

Economic and financial instability from the last decade reaffirmed households' financial fragility, centring authors' attention on its determinants. Households' liabilities are the counterpart of assets acquisitions, with stylised empirical facts pointing to households having poorly diversified portfolios holding mostly deposits and a residential property that retains the largest share of their total wealth (Campbell, 2006). As a consequence, real estate market price shapes households' wealth perception and informs their investment decisions. Besides, by defining the price of housing, fluctuations in residential property price affect other assets choices and change households' welfare. Understanding these portfolio choices is essential to prevent episodes of financial instability and can only be appraised along with changes in housing wealth from their main asset valuation.

The scrutiny of households' investment behaviour claims to understand how and why households choose specific assets in detriment of another, what are the relative amounts in which they choose them, and how these choices connect with households' distinctive features such as their social-economic gradient, financial restrictions, or attitude towards risk. Extending to the household level subjects whose early roots go back to portfolio theory from Markowitz (1952), Tobin (1958), and Merton (1972), the household finance literature is destined to explain the empirical composition puzzles (Guiso, Haliassos and Jappelli, 2002), that is the predominance of under-diversified households portfolios and the fact that on average households own a low share of equity. Portfolio theory predicts that rational investors should distribute wealth across the largest possible number of alternative assets in an attempt to build a diversified portfolio and that this pool of assets ought to combine different yield, risk, return, and maturity, decreasing portfolio volatility by minimising the standard deviation of its total expected return. Applied to households' portfolio choices, empirical studies focus on trying to explain why households avoid owning risky assets like stocks, and how to conciliate the fact that this feature seems to be decreasing in wealth with that displaying richer households showing a higher appetite for riskier investments (e.g. Gollier, 2002, Campbell, 2006, Wachter and Yogo, 2010).

Several features can be moulding household's peculiar saving and investment choices, among them assets liquidity, yield differentials between assets, perceived risk, the economic environment, and even legislation on assets property. When the house renting market is poorly developed, households are shoved into homeownership. In this context, the residential property, an illiquid asset with high economic and physical transaction costs, tends to be

perceived as the most valuable asset by its owner, holding its largest wealth share. Homeownership rises individual welfare by providing housing services and backing up against fluctuations in housing rents. In tandem, housing is assumed as a lifetime investment bearing moderate risk and available for future financial uncertainty. Housing is thus both a durable consumption good and a capital good with return and risk, and, in the presence of a binding investment constraint, this consumption-investment duality shapes households' portfolio composition, determining rational overinvestment in housing (Brueckner, 1997). Further portfolio investment decisions typically take place if, once housing acquisition is done, there is still remaining liquidity to invest.

In this paper, we study empirically the relationship between portfolio composition and wealth perception from homeownership. According to the literature, households' investment decisions are informed by their total wealth. Wealth is a relative impression, assessed by feeling richer or poorer with respect to the past, where the initial price paid to buy owned assets exerts an anchoring effect as defined by (Kahneman, 2011), the more important the larger the share of personal wealth invested in its initial acquisition. Homeowners tend to recognise themselves richer when the real estate market signals housing appreciation and poorer otherwise. The analysis uses microdata from the recent Household Finance and Consumption Survey (HFCS)(HFCN, 2013) containing information on the acquisition price of the residential property and on its evaluation by the homeowner at the time the survey was taken, that we use to build a rate of housing valuation. We show that this subjective perception is relevant for the explanation of Portuguese households' portfolio composition at the same time that our aim is to acknowledge drivers of Portuguese investors' wealth allocation across categories of assets defined by risk. To achieve this goal we define shares of a mixed type portfolio including real and financial assets to build the dependent variable of the empirical model to be estimated against a set of covariates comprising usual socio-economic features, financial constraints, and households' self-assessed behaviours. We further estimate a model where the dependent variable is defined by similar shares of a pure financial portfolio.

We start by estimating a fractional multinomial logit model to grasp to what extent wealth allocation by categories of assets is jointly determined. The model predicts that one unit increase in the rate of housing valuation encourages households to transfer additional wealth to the share of mixed type risky assets but to increase safe deposits within the merely financial portfolio. We then assume that proportions are independent of one another and estimate a fractional logit model that confirms the influence of the rate

of housing valuation on the final composition of both mixed type and financial portfolios. Homeownership being a form of medium risk asset at once contributes to increasing households' exposure to risk by the amount involved in its acquisition and the associated loss of liquidity, while comforts their future return expectation given residential property prices are usually faced as being prone to perform an upward trend. A key issue in our analysis is the definition of housing appreciation. To test the reliability of our measure of wealth perception, the rate of housing valuation, we replace it by two additional measures - the absolute housing valuation and the number of years from housing acquisition - and estimate new models showing that estimation results are robust to these changes. Households owning high valued residential properties prefer a lower share of safe assets in their mixed type portfolios but are less prone to take additional strictly financial investment with higher risk. This paper contributes to the literature by empirically investigating portfolio composition of Portuguese households using the novel HFCS, by including real assets as part of the financial wealth allocation, and by assuming wealth perception from being a homeowner as a decisive determinant of portfolio investment choices. Moreover, the analysis departs from previous empirical analysis on portfolio composition by identifying perceived wealth with the average annual rate of growth of estimated house price with respect to the initial pecuniary value paid for its acquisition. The rest of the paper is organized as follows. In Section 2, we briefly review the empirical literature on households' portfolio composition. Section 3 presents the HFCS, the model's dependent and explanatory variables and descriptive statistics on these variables. Section 4 estimates fractional multinomial logit models and fractional generalised models of both mixed type and financial portfolios and discusses these estimations results. Section 5 presents robust checks for these models based on different measures of housing valuation, and Section 6 concludes.

2 Literature review

Modern portfolio theory, founded by Markowitz (1952) and further developed by Tobin (1958) and Merton (1972), investigates how given a certain amount of individual wealth private investors decide on which financial assets to include in the same portfolio among a group of alternatives that show diversification in return and risk. Investments would be undertaken by rational agents in efficient markets, intending to maximise expected return from the chosen combination of assets and ultimately aiming to increase total

wealth. Since assets with higher expected returns are also frequently those with higher risk when intending to increase the reward from investing agents should be willing to allocate a larger share of their personal wealth to riskier assets. Risk-averse agents ought to turn to an asset diversification strategy, avoiding isolated decisions on wealth allocation by comparing alternative assets and their price evolution with respect to each individual asset, evaluating their return and risk trade-off, and finally deciding on which assets to combine in the portfolio.

Many empirical studies addressed these and similar questions from the perspective of organized and institutional investors and more recently from the perspective of the household, the later trying to capture how much diversified is the typical household portfolio and what pushes households' diversification decisions. General findings from the household finance literature underline the existence of composition puzzles in the agents' portfolios (e.g. Guiso et al., 2002, Haliassos and Michaelides, 2002) with either households not participating in the equity market or participating but owning insignificant shares of equity, and avoiding risk. The majority of the households' portfolios are under-diversified with people tending to concentrate their wealth in a small number of assets (Campbell, 2006). The two central determinants of these decisions are the age of the household's reference individual and the level of the household's total wealth (Campbell, 2006, Carroll, 2002). Socio-economic factors such as income (e.g. Worthington, 2009), gender (e.g. Barasinska, 2011), education (e.g. Cooper and Zhu, 2013), civil status (e.g. Love, 2010), and employment status (e.g. M.Bremus and Kuzin, 2014) have also been found to play a decisive role for portfolio composition. Besides these features, the literature has recognized behavioural drivers of households' portfolio composition such as household preferences and tolerance to financial risk (Barasinska, Schäfer and Stephan, 2012), financial literacy (van Rooij, Lusardi and Alessie, 2012), health status (Fan and Zhao, 2009), and background risk (Jiang, Ma and An, 2013).

It is quite acknowledged in the literature that, on average, when compared to the poor, the richer hold more diversified portfolios, and keep higher equity shares. The connection between owning riskier assets and age is less consensual among authors, the empirical outcomes oscillating between being increasing with age to displaying a hump-shaped distribution (e.g. Guiso and Sodini, 2013). Campbell (2006)'s seminal paper on household finance settles wealth as a central determinant of the type of assets held in the portfolios, specifically poorer households hold mostly liquid assets and vehicles, whereas middle-class households own real estate, by large corresponding to owner-occupied housing. According to Campbell, limited participation in

equity markets even by richer households is one of the main stylised facts from household finance, yet richer households seem to be comparatively more willing to take higher risk in their portfolios. On average, households that participate in financial markets exhibit concentrated portfolios, do not hold many stocks, show a local market bias, and hold stocks from their employer, a set of features the author attributes to how they self-perceive their (low) skills to efficiently invest in a complex portfolio. King and Leape (1998) also pioneer in studying households' portfolio composition aiming at apprehending how net wealth is allocated across different assets. In line with Campbell their analysis of households' asset demands points out the presence of very incomplete portfolios while their empirical model estimates greater than unity wealth-elasticities for risky financial assets among U.S. households' portfolios, at once rejecting the presence of constant relative risk aversion in the portfolio composition data (that would imply a unit elasticity) and supporting the existence of portfolio composition puzzles. Carroll (2002) backs up both Campbell and King and Leape's analysis by describing the mean U.S. household portfolio as usually comprising deposits and a home with a mortgage, a clearly less complex combination than the typical portfolio of a rich household exhibiting on average a much higher proportion of the different type of risky assets. Risky investments of the US rich encompass either their own private businesses or real estate for investment purposes while holding a far smaller proportion of home equity. Additionally, the probability of these households owning risky assets is increasing with age even if the proportion of risky assets on older people's portfolio tends to be smaller, a result that, following King and Leape (1998), Carroll attributes to the accumulation of experience in dealing with financial investments that occur through life. Risk aversion and capital market imperfections are the two possible candidates to explain the composition puzzles of U.S. households. Arrondel, Bartiloro, Fessler, Lindner, Mathä, Rampazzi, Savignac, Schmidt, Schürz and Vermeulen (2014) after Campbell and Carroll compare the portfolios of households from different European countries covered by the HFCS. Their estimations point to heterogeneity throughout countries both across wealth and income distributions, though identifying certain regularities among them such as real assets being the largest category of assets held by European households, and the main residence playing a dominant role in total net wealth allocation. Dropping out real assets from the analysis, the authors describe European households as tending to prefer safer types of financial assets, especially deposits and savings accounts, and only a small minority of households owning risky financial assets. Asset ownership rates increase in wealth for all assets categories, but risky assets are more likely to

be held by wealthier households, single households, and households were the head of the household has higher educational attainment. A strand of the empirical literature on portfolio composition has explicitly scrutinized the impact of including real assets within the household portfolio, placing real estate (e.g. Hu, 2005, Cocco, 2004) and proprietary businesses (e.g. Heaton and Lucas, 2000, Jin, 2011, Veld-Merkoulova, 2011, Cardak and Wilkins, 2009) at the forefront. Hu (2005) concludes that the decision to purchase a house tends to bias financial portfolios towards safer assets, a preference that is partially the result of frictions associated with housing due to its physical nature and its transaction costs. Investing in housing impacts households' savings and all other financial assets that are chosen to be part of their portfolio investments. Homeowners with a higher share of wealth concentrated in housing hold fewer stocks among total liquid assets, a feature explained by the need to reduce their exposure to risk that housing and its associated mortgage debt represent. Cocco (2004) after Hu treats house price risk and the illiquid nature of the housing investment as main determinants of the insignificant presence of stocks in households' portfolios, particularly among households with low net-worth. The author assumes housing and portfolio decisions as being endogenous and shows that housing represents an important financial effort to homeowners, reducing net wealth especially of the youngest generations, and affecting their decisions to participate in the stock market. Evidence also suggests that proprietaries who own higher shares of housing in their portfolios tend to hold smaller shares of risky assets in a sort of crowding-out effect from housing to equity, an outcome shared with Yao and Zhang (2005).

Both housing and the planning horizon are present in Cardak and Wilkins (2009)'s analysis of drivers of Australian households' portfolio allocation decisions, combined with uncertainty in income and health. Contrary to Hu (2005) they conclude that homeownership tends to increase the holdings of risky assets by providing easy access to cheap credit for other investment purposes, operating as a sort of collateral. Furthermore, by estimating the share of risky financial assets held in total portfolios against households' background risk they find that Australian households will choose to hold smaller proportions of risky assets whenever labour income uncertainty increases or health deteriorates. Veld-Merkoulova (2011) classifies real estate investments in the category of risky assets even for owner-occupied housing, and models portfolio composition of Dutch individual investors explicitly taking into account age and the investment horizon in their portfolio decision. Age is shown to decrease the share of risky assets in the portfolio of private investors which discards the U-shape relationship frequently de-

scribed in the literature, whereas an increase in the planning horizon of an individual investor encourages the choice to hold risky assets among portfolio investments.

Heaton and Lucas (2000) focus on proprietary business income that they define as the value of households' own and other immediate family members' equity share in their businesses and test the impact of entrepreneurial income risk on both portfolio composition choice and asset prices. Examining the cross-sectional variation in portfolio holdings alongside with the variability in wage income and in proprietary income, they show the latter to be both more variable and more correlated to households' stock holdings. Households with high proprietary business are shown to participate more in the stock market but with less wealth, a fact the authors relate to the higher background income risk these households face. Additionally, while including real estate in the definition of financial net worth they found it to account for a significant proportion of the total financial wealth of low and moderate net worth household groups and of the youngster cohorts in their sample. Jin (2011) centres his work on empirically testing the existence of portfolio composition puzzles, starting by classifying stocks, real estate, and private businesses within the category of risky assets. Allowing for leverage effect in the analysis, his results indicate that both wealth and age effects on the households' portfolio composition describe a U-shape behaviour. Jin author argues that by comprising non-stock assets and leverage in the portfolios it is possible to eliminate the empirical puzzles given the findings then show poor and/or young households making risky investments such as, for example, buying a house through mortgage debt.

Other empirical papers have emphasised the role of preferences towards risk as helping to clarify households' low participation in equity markets (e.g. Frijns, Koellen and Thorsten Lehnert, 2008, Dimmock and Kouwenberg, 2010, Barasinska et al., 2012). Frijns et al. (2008) analyse behavioural determinants of portfolio allocations, regressing a multinomial logit model on data collected in an experimental setting replicating a simplified financial market with one risk-free asset and two risky assets. Besides testing hypothesis from the Markowitz (1952) portfolio model, the authors examine how the interactions between different behavioural elements guide the decision-making process related to the allocation of portfolio capital. Among the set of behavioural factors included in their analysis lies the proportion of the risk-free asset in total portfolio, the individual risk aversion, market sentiment, and self-assessed financial expertise. Market factors such as the risk-return relationship and individual features as the coefficient of constant relative risk aversion are established to be important drivers of portfolio

choices and compositions. (Dimmock and Kouwenberg, 2010) on their turn build behavioural measures of loss-aversion and test how they impact Dutch households' decisions to participate in the equity market and the amount of wealth they allocate to equity. Their findings reveal that non-standard preferences as loss-aversion explain the household's propensity to allocate smaller amounts of wealth to equity and to choose special types of equity, namely to prefer mutual funds in detriment of individual stocks. Households with higher reported loss-aversion are found to participate less in the equity market and to avoid to a greater extent holding stocks but rather hold mutual funds. Nevertheless, the authors are not able to establish a significant relationship between loss-aversion and households portfolio allocations to equity. Studying German private investors, Barasinska et al. (2012) examine their propensity to hold incomplete financial portfolios by the degree of risk aversion. They run a pooled multinominal logistic regression on SOEP microdata for two different types of asset portfolios, describing two different behaviours, viz. the naïve investment strategy if households choose as many asset types as possible without a clear perception of the involved risk-return profile, and the sophisticated investment strategy if the combination of risk and return is considered when choosing the assets to invest. Risk aversion is shown to be negatively related to the number of assets held by each household in its portfolio, while households are shown to display a strong propensity to choose safety while doing financial investments in a quest to meet precautionary and liquidity needs, even when this implies forgoing higher returns.

On top of choice theory, prospect theory (Kahneman and Tversky, 1979) questions expected utility theory ability to explain decision making under risk. Individuals establish a reference point and measure weights and losses with respect to that reference point. However, they do not react symmetrically to these gains and losses, tending to overweight losses with respect to gains, which implies being loss-averse. Individuals are also shown to prefer results obtained with certainty to results that are less probable. In terms of portfolio composition bringing these features to the analysis could explain the bias towards safe assets or at least the preference for assets whose expected return is easier to track and assets with less uncertain returns.

3 Data and model variables

3.1 The HFCS

The subsequent empirical analysis is based on a sample of 4404 Portuguese households who participated in the first wave of the Eurosystem Household Finance and Consumption Survey with 2010 as the reference year. The HFCS is a household survey run by the European Central Bank and is meant to be representative of each country population. It covers harmonised household data from 15 Eurozone countries. The Portuguese survey was fielded by personal interviews throughout 2010 but part of its data, as for instance household yearly income, reports to 2009. HFCS provides detailed information on household composition, socio-demographic features of the household representative, and a variety of economic and financial variables, including different sources of household income and household's wealth allocation. Comprehensive information on their balance sheets distinguishing financial and real assets and liabilities is also provided, along with a few facts on consumption expenditures and details on credit constraints. Financial instruments identified in the survey are: deposits; total mutual funds; bonds; the value of the non-self-employment private business; publicly traded shares; managed accounts; money owed to households; voluntary pension and whole life insurance; other assets. Real instruments correspond to the value of: household's main residence; other real estate property; household's vehicles; valuables; and, self-employment businesses. In the survey, the household is inquired about the event of adverse changes in a recent past that may have contributed to a deterioration of its economic situation, namely through a decrease in average income or wealth. Additionally, it is possible to find questions about the households' future expectations, either positive or negative, regarding the evolution of their income and/or wealth. Behavioural features concerning the personal propensity towards risk taking of both the head of the household and his spouse are also the subject of inquiry in the survey. The unit of observation of our empirical model is the household, however, a significant part of socio-economic data as for example the education degree, age, or civil status, is collected at the individual level by the HFCS and will be used in estimations reporting to the household representative. Due to homogeneity purposes and following, for instance, Costa and Farinha (2012), we chose to identify the reference person from the household with the adult male whenever possible, eliminating gender as an explanatory variable in the model. To capture if housing valuation may instigate a richness effect thus shaping the households' portfolio composition we distinguish

total population from the narrower population of homeowners according to their answer to one question in the survey that controls if the household is the proprietary of its main residence. We are then able to distinguish a sub-sample of 2986 households who report owning their residence, are richer on average, and are susceptible to accounting perceived wealth effects from housing valuation. When estimating the pure financial portfolio we found 129 households that do not possess financial assets and eliminated them from our sample for these particular estimations, reducing the observations to a number of 2857 households.

3.2 Dependent and explanatory variables

3.2.1 Dependent variable: portfolio categories

Since we want to study the impact of housing valuation on wealth reallocation across categories of assets within a single portfolio, our starting point is to define the dependent variable as shares of assets bearing similar risk and held by each household in its portfolio. After the literature (e.g. Guiso et al., 2002) we delineate three categories in the portfolios, specifically safe assets, intermediate risk assets, and risky assets, whose shares must sum up to one. Secondly, we classify household's total assets by risk and aggregate them in a single portfolio category. We assume that all assets are recognised as an investment implying that households allocate wealth today in the expectation of a future return even if it can merely resume to having access to a savings pool in the form of different assets that can be converted into liquidity. Moreover, we assume that households' investment decisions are broader than just financial allocations, and include both real and financial assets in their portfolios. To control for the arbitrariness in the assets classifications and its aggregations into risk categories we followed, whenever possible, suggested classifications from the main literature on the subject, nevertheless we also tried to integrate the effect that the recent financial crisis may have had on redefining these categories by exacerbating the average risk of different assets or instigating a more risk-averse behaviour. Financial and real assets included in the survey were enumerated in section 3.1. From the extended list, and in accordance to with existent literature (Carroll, 2002), deposits are the unique asset classified as safe and included in the category safe assets. Deposits also happen to be the only true liquid asset held by these households. Medium risk assets are defined as the value of the household main residence and of another real estate like secondary homes, the value of self-employment businesses, mutual funds, bonds, money owed

by other households, and voluntary pension and whole life insurance, while all other assets from our list are included in risky assets. Our first dependent variable is three shares of a mixed type portfolio obtained by calculating the proportions of these three assets categories on total wealth. Furthermore, we use the same classifications to build a set of similar categories for a pure financial portfolio, then calculate shares of financial classes over total financial wealth to distinguish safe financial assets, medium risk financial assets, and risky financial assets. These three shares sum up to one and correspond to a second dependent variable, the financial portfolio. Fractional generalised model estimations take each individual fraction as an independent variable in the estimations. Table 1 summarises our categorization of assets by intrinsic risk.

(Table 1 about here)

3.2.2 Explanatory variables: housing

The key explanatory variable in the model is housing. According to the HFCS, households can be proprietaries of the dwelling they inhabit because they bought it, they built it, they inherited it, or other less frequent possibilities. To control for those households who decided to allocate wealth to the acquisition of their main residence we define the dummy variable Homeownership that takes the value 1 when the head of the household declared having bought or built his residence, and 0 otherwise. In few cases, the dummy is also monitoring the households' ability to calculate its housing valuation rate meaning its initial price, its current market value, and/or the number of years since its acquisition. The Housing valuation rate is captured through the household insight on its main residence valuation. The respondents were asked both about the price at which they have acquired their residence and the price at which they would expect to hypothetically sell it if they could do it at the moment the survey was taken. The coefficient between the self-reported market price of the homeowner's residential property and its original acquisition value measures the dwelling valuation, corresponding to a gain perceived as certain with respect to a reference point. The respondents were also asked to answer for how many years the household is the proprietary of its main residence. To obtain the housing valuation rate we have calculated the nth root of the total house price appreciation replacing n by the number of years of homeownership. When using the number of years since homeownership we try to control for valuation from market conditions against valuation pertaining to accumulated inflation on this asset

price. Time is a decisive element in this type of analysis since it contributes to change people's perception on their relative wealth while seizures the inevitable decay of the dwelling features and defines its actual price. Also given risk aversion leads people to prefer immediate gains over future gains (Patak and Reynolds, 2007, Takahashi, Ikeda and Hasegawa, 2007) those that have bought their housing a long time ago may be less certain of feeling wealthy from its valuation since they are no longer able to recognize it or just face it as a sunk cost. Wealth perception by the household is also dependent of the liabilities related to the housing acquisition, in particular to its concomitant outstanding debt. The dummy variable Mortgage Debt aims to grab this effect, taking the value 1 when the household answered positively to having debt associated with the acquisition of a dwelling, and 0 otherwise.

3.2.3 Explanatory variables: socio-economic features

We follow conventional choices for control variables included in the model comprising the age of the household head (Age); dummies for marital status of the household representative (Married, Divorced); the number of dependents in the household (Dependents); dummies for educational attainment of household head (Secondary Education, Higher Education); the difference between household total real and financial wealth and household debt (Net Worth); and total income measured on a monthly basis (Monthly Income). To increase homogeneity in the model, the head of the household is identified with the man in the house, unless that is not possible. The marital status Married includes both married individuals and those that declared having a consensual union on a legal basis. The number of dependents follows a definition from the survey that identifies as a dependent any individual under 25 years old who is not the head of the household and does not cohabit with him/her in connubial terms. Educational attainment corresponds to the standard definitions where Secondary implies having successfully completed upper secondary, and Tertiary stands for households' representatives having at least completed a first stage tertiary degree. Household wealth comprises real and financial wealth measured as derived variables calculated according to the HFCS definitions. Real wealth corresponds to the category Total real assets 1 and includes the value of household's main residence, the value of other real estate proprieties, the value of household's vehicles, valuables, and the value of self-employment businesses. Financial wealth is denominated Total financial assets 1 in the list of HFCS derived variables and comprises deposits, mutual funds, bonds, the value of the non-self-

employment private business, publically traded shares, managed accounts, money owed to households, other assets, and voluntary pension or whole life insurance. To obtain household's Net Wealth we have subtracted the category Total outstanding balance of household's liabilities to the sum of their real and financial wealth. These liabilities cover two categories of outstanding debt, explicitly of mortgage debt, from household main residence (HMR) and from mortgages on other proprieties, and of other, non-mortgage debt. Since households may borrow money to invest in assets, we have chosen to keep negative net wealth values in the estimations. Finally, Monthly Income is calculated dividing by 12 the derived variable Total household gross income that encompasses employee income, self-employment income, income from public and private pensions, income from unemployment benefits and from regular social transfers.

3.2.4 Explanatory variables: financial environment

When investing in real and financial assets there are features of the household financial environment and attitude that are decisive (Christelis, Ehrmann and Georgarakos, 2015). The household financial background may impose limited access to credit markets inhibiting their participation in assets markets (e.g. Cocco, Gomes and Maenhout, 2005, Rampini and Viswanathan, 2013), but their willingness to take risky decisions, their economic future expectations, and recent changes in their economic positions, act together as important determinants of their investment decisions. To capture households' financial conduct, background, and settings, we include well-established additional covariates in the model. The dummy variable Credit Constraints captures the households' limited access to finance, assuming the value 1 when the household reports having applied for a loan in the last 3 years and either having been turned out or having received credit but in an amount inferior to the amount it had applied for. This dummy also takes the value 1 whenever for the same period the head of the household reports not having applied for a loan due to perceived credit constraints. To capture the households' appetite towards risk we use their declared risk-aversion and build two dummy variables, namely High Risk Taker, and Average Risk Taker. These dummies are based on the survey questions on investment attitudes to both financial respondent and spouse, namely what is the amount of financial risk he/she is willing to take when saving or making investments. A High Risk Taker is someone who answered to this question as being willing either to take substantial financial risks expecting to earn substantial returns or to take above average financial risks expecting to earn above average returns.

An Average Risk Taker corresponds to a financial respondent who answered that would take average financial risks expecting to earn average returns. The HFCS questions households on their future income expectations, explicitly if they expect the household total income to go up more, less or about the same as prices. We built a dummy variable for Optimistic Expectations being equal to 1 when the household indicated to expect its future income to increase more than prices. This dummy variable also takes the value 1 when the household reports expecting to receive a substantial gift or inheritance in the future. The dummy variable Pessimistic Expectations was built to capture the opposite sentiment, taking the value 1 when a household answered that perspectives on its future income are that it will increase less than prices. Past Adverse Changes is a dummy variable aiming to control for households' reported downturn of their financial conditions. It takes the value 1 when the household reports that at least one of its members had unfavourable job changes, a substantial reduction in their net worth in the three years that precede the interview, an unusual low income during the year reported in the interview (2009), or an increase in regular expenses in the same time span. The variable takes the value 0 if the household does not report having been affected by any of these negative events.

3.3 Evidence on Portuguese portfolios

Our analysis focuses on homeowners' portfolio shares distinguishing total portfolio from financial portfolio. Table 2 displays summary statistics for this group and for both portfolios. Similar calculations were performed for total population but the corresponding values are not presented herein. The evidence places the average homeowner exhibiting a riskier behaviour than the average household from the total population, a result mostly explained by the ownership of real assets, especially housing. In any case, the appetency for risky financial investments is very low for the two sample groups as can be confirmed by the fact that both medium risk and risky assets are almost absent from financial portfolios.

(Table 2 about here)

Homeowners' participation rates by asset together with the average share of total wealth allocated to each asset are reported in Table 3. The percentage from this group who report owning deposits is very high (96%) a choice normally explained by the absence of costs, or further obstacles associated with this asset, besides revealing Portuguese households' preference for liquidity. As expected, the household's main residence accounts on average for

73% of total wealth, while other real assets such as vehicles and other real estate property are among preferred assets. The most predominant financial investment, voluntary pension and whole life insurance, is being held by 16.6% of these households, but only capturing a modest share of about 0.98% of their total wealth. The generally low participation rates on further assets suggest a not very diversified portfolio, even among homeowners, and emphasize the insignificant role played by equity. On top of this, the significant gap that prevails between participation rates and wealth shares points to homeowners taking prudent steps towards investing high amounts on categories of assets displaying more uncertain return.

(Table 3 about here)

Table 4 shows descriptive statistics of the explanatory variables used in the econometric model. In comparison with total population, homeowners earn a 1.1 higher monthly income, and own a 1.3 fold higher net wealth. Since the average age of the head of the household is very similar for the two sample groups, a higher level of wealth accumulation by homeowners cannot be ascribed to longer lifetime savings. The housing valuation rate is clearly contributing to net wealth dissimilarities, differing by a factor of about 1.4 between samples. Among homeowners, net wealth is more unevenly distributed than income, and even higher than inequality measured through the housing valuation rate. Socio-economic factors do not indicate relevant disparities between the two samples. Worth noticing is the detail that, confronted with total population, homeowners have slightly fewer respondents with credit restrictions and marginally more respondents who find themselves high risk takers.

(Table 4 about here)

Portfolio allocation changes both across the wealth distribution and across the housing valuation rate distribution. Figures 1 and 2 present the investment shares on the three asset categories from real and financial assets by respectively quartiles of net wealth and quartiles of the housing valuation rate. Quartiles for the housing valuation rate were calculated after isolating all households who are not homeowners. Non-proprietaries concentrate 53% of their wealth in the form of deposits, a share decreasing in net wealth across the distribution. Homeowners invest comparatively less on safe assets and marginally increase the weight of deposits in their portfolios with the housing valuation rate. The initial significant financial effort and mobilization of safe assets that buying a residential property typically requires, works as a

barrier for the group of non-homeowners, the poorest fraction of households from the total population. In this context, the share of deposits behaves as an inferior good for total population, being held proportionally more by the fraction of poorest households, but becomes a luxury good among proprietaries, increasing in wealth and in the valuation rate, and even being preferred to risky assets.

(Figures 1 and 2 about here)

Age is shaping differently the portfolios distribution of both samples as can be found in Figures 3, 4, 5, and 6. The proportion of deposits held within the household portfolio increases across age classes for homeowners but describes a U-shaped distribution for total population, a feature verified for both portfolio types. This suggests that whenever possible households acquire their residential property when young, decreasing their liquidity and most likely even getting indebted as predicted by the lifecycle theory (e.g. Modigliani and Brumberg, 1954, Ando and Modigliani, 1963) . Homeowners maintain a preference for deposits, a bias that seems to strengthen with age.

(Figures 3, 4, 5, and 6 about here)

Besides wealth and age, homeownership may reveal behavioural motives towards holding riskier assets. As displayed in Figures 7, 8, 9 and 10 the group from the population that assumes being more prone to take risk also holds higher shares of risky assets, while those who assume being risk averse assemble the highest shares of safe deposits. These preferences are not shared by a very large fraction of homeowners, given that the groups of self-assessed high risk takers and average risk takers correspond to a modest 1.6% and 6% of total population as indicated in table 4.

(Figures 7, 8, 9 and 10 about here)

Overall, figures from Portuguese data confirm Campbell (2006)'s and Carroll (2002)'s results for the United States, namely liquid assets are the principal class of assets for the less rich, and portfolio diversification towards risky assets increases in wealth. The composition puzzles seem to be present when we do not take into account real investments made by these households which are typically riskier than their financial investments.

4 Empirical model results

The main hypothesis of this paper is that the appreciation of the residential property price captured by a positive rate of housing valuation produces a wealth effect on portfolio composition, at the same time that the household becomes relatively more exposed to risk by owning a valued medium risk asset. Additionally, we test if the wealth effect prevails when exerted over an exclusively financial portfolio. We focus on dependent variables defined in proportional terms, and regress them against the rate of housing valuation, and standard control variables as a set of socio-economic variables and a background of reported financial circumstances. As additional model covariates we also include reported adverse changes and both optimistic and pessimistic expectations. We apply estimation methods that are able to deal with fractional dependent variables, starting with an approach were the reallocation of wealth across assets categories is faced as being interdependent, and then assuming independence of these decisions. The models are estimated for two different types of portfolios, one of a mixed type, including financial and real assets, and one solely financial portfolio. In both models, the dependent variable is the proportion of each risk category of assets held in the household portfolio, the sum of the three categories adding up to 1. When the variable of interest is a fraction, it is bounded and can take any value between 0 and 1. Standard estimation methods such as OLS are not suited since they would produce non-linearity of the conditional expectation. To solve the problem, Papke and Wooldridge (1996) have proposed the use of a nonlinear link function, as for instance the logistic function, to impose constraints on the conditional mean and produce predicted values that lie between the boundary values. By applying a quasi-maximum likelihood estimator of the coefficients these will turn out to be consistent and asymptotically normal.

4.1 Fractional multinomial logit estimations

In this subsection we model the joint probability of holding a specific combination of assets bearing different risk and classified in similar categories each of them representing a fraction of a specific household's total wealth. Explicitly, we follow Buis (2008) and apply a multinomial logit model that corresponds to a multivariate generalization of the fractional logit model by Papke and Wooldridge (1996). The fractional multinomial logit model measures the simultaneous changes in proportions of multiple variables as a result of a group of covariates. The technique uses one of the shares as a piv-

otal variable. Since in this type of regressions the estimated coefficients and their standard errors are not particularly informative, we opted to report marginal effects that are held at the sample mean for continuous variables and at zero for dummy variables. The marginal effects sum up to zero through equations since the covariates determine a reallocation across assets from the same portfolio. The effects of changes in different variables will result in different substitution patterns between portfolio shares. Additionally, when regressing the multinomial logit model for the joint probability of holding each specific portfolio share, the independence in these estimations is attested through robust standard errors. Table 6 shows the results of our fractional multinomial logit applied to the portfolio of the mixed type of Portuguese homeowners, and Table 7 displays similar estimations of the purely financial portfolio. A fair part of the estimated marginal effects are statistically significant, especially for the proportions of safe and intermediate assets categories and for the estimations referring to the mixed type portfolio.

(Tables 6 and 7 about here)

We interpret the rate of housing valuation as having a positive wealth effect on the portfolio composition if a unit increase in this rate increases wealth allocated to riskier assets while decreases the share of safe assets, given our set of control variables. The estimated marginal effects corroborate this assumption by suggesting that the rate of housing valuation impacts households' portfolio shares. The probability of holding risky assets is predicted to increase by 5 percentage points (pp) when the rate of housing valuation rises by one unit. The economic magnitude of this impact is not trivial, since initial descriptive statistics from Table 2 showed risky assets amounting to about 2% of homeowners' riches, our estimates pointing to housing valuation causing an average increase of about 3 fold of this category, implying an important decrease in liquidity and safeness. The estimated marginal effect is statistically significant for a level of significance of 10%. Estimation results for the narrower financial portfolio reveal that one unit increase in the rate of housing valuation imply a positive marginal effect on the proportion of safe financial assets, and a negative marginal effect on medium risk financial assets both of about 20 pp in absolute terms pointing to a transfer of financial wealth across the two categories. These findings suggest that owning a presumably valued residential property induces a risk aversion behaviour approach to assets acquisition which can be justified by the household feeling that too much risk is already being undertaken and/or expected returns from investing in different assets is presently taken as being satisfactory. Despite matching the evidence described in section 3.3 the

outcomes from these estimations are in accordance with Cocco (2004) who has shown that, besides decreasing financial net worth, choosing to invest in housing not only reduces liquid assets as reduces the benefits of equity market participation. In the same line of reasoning, Goetzmann (1993), and Flavin and Yamashita (2002)) sustain that since both a consumption and investment good, housing exerts a constraint on the portfolio decision that can compromise portfolio diversification.

By disclosing the effect of holding a liability related to the rate of housing valuation, the predicted change in portfolio shares from having a mortgage debt is considered complementary to the information on the rate of housing valuation. In our model this liability decreases in about 2.6 pp the share of deposits held within mixed type portfolios and raises by a similar magnitude the proportion of medium risk assets a raise that we attribute to housing, confirming that one major effect from home owing is losing liquidity.

Socio-economic variables included in the model seem to be affecting Portuguese households' investment behaviour in a standard way. Those with higher net wealth tend to invest more in risky assets from the mixed type portfolio, although displaying a marginal effect of small magnitude, i.e., of about 0.1 pp. This result validates the empirical regularity displaying richer households holding more diversified portfolios and with more equity. Comparing the marginal effect of the rate of housing valuation with the marginal effect of holding higher net wealth, the latter also amplifies the share of risky assets, reinforcing the flight to equity from having a valued housing. Age exerts a customary effect on mixed type portfolios since estimations predict that a one-year increase in the age of the head of the household raises the fraction of safe deposits in about 0.14 pp and mostly at the expense of the share of medium risk assets. Recent explanations (e.g. Spaenjers and Spira, 2015) refer the increase in life expectation as an important determinant of future uncertainty thus causing savings to increase by the end of the life-cycle, especially in the form of liquid assets. Avoiding risky investments for precautionary reasons may be related to the way the eldest perceive their health conditions, to their concern with bequests, and to preferring traditional real and financial applications for their lifetime savings, all factors that lie beyond this paper scope.

Demographic features as having a higher number of children or just being in charge of dependants contribute to increasing the share of medium risk assets by 1.1 pp at the cost of safe deposits. This result is not unexpected since larger families will typically tend to allocate capital to bigger and therefore more expensive housings. However, given richer people can afford more numerous families and buy more expensive houses it is hard to

detach the cause from the effect. The propensity of the higher educated to invest comparatively more in risky assets is well documented in the literature that relates it to higher financial literacy and with the ability to invest in more complex and frequently riskier financial assets (e.g. Campbell, 2006, Barasinska et al., 2012). In our model, the estimations of the coefficients for education are not statistically significant, an outcome that may be connected to the relationship between higher levels of education and income. A Portuguese household where its representative has higher education displays total earnings about two-fold greater than the average Alves, Centeno and Novo (2010). These households will have more contacts with a banking agency, more financial advice, and higher incentives to diversify their portfolio and buy risky financial assets as ways to maximise their expected return. The more educated tend to be located at the top quartile of the income distribution, are able to keep enough liquidity in their portfolios, and to regularly reinforce it, holding a higher share of deposits within portfolios. The results on education should, therefore, be interpreted in tandem with the estimations for marginal effects of a unit change in monthly income. Within mixed type portfolios a one unit increase in income tends to divert resources from the medium risk category together to safe and risky assets, while within financial portfolio it allocates additional wealth to the share of medium risk and risky assets, decreasing safe deposits. Safe deposits behave as a normal good within mixed type portfolios given their demand increases with income, but as an inferior good within financial portfolios.

As further drivers of households' investment decisions, we have included in the model people's positive and negative expectations along with their reported past adverse changes. Expectations affect household's perception about future income and also unveil behavioural individual features. The estimations for optimistic expectations reveal contradictions in marginal responses from mixed type and financial portfolio allocations. Households reporting to be optimistic about their future display positive marginal effects on deposits (of 2.2 pp) and negative marginal effects on medium risk assets (of 3.3 pp) held in their mixed portfolios. On the contrary, the predictions from financial portfolios indicate an increase in risk-taking by displaying favourable expectations causing a transfer of households' riches from deposits to medium risk assets. The combination of these findings on the two types of portfolios settles the investment on the residential property as a basic need for Portuguese households, while reinforces the central role liquidity has on their preferences and discloses behavioural aspects such as expectations being decisive for riskier investments. The opposite movements revealed by the set of marginal effects can be partially related to households'

relative participation in different types of assets, namely their low participation rate in financial assets with higher risk and the parsimonious amounts they invest in financial markets. Optimistic expectations estimations show that even when feeling confident about their future, thus more prone to take risks, households invest in a prudent way, allocating modest sums to riskier assets, an option that may only be possible to put into practice in financial markets.

Our first estimations confirm our main hypothesis at the same time that reaffirm standard covariates in the explanation of portfolio composition. However, as has been widely discussed in this paper, choosing to hold a specific category of assets in the portfolio, is not completely independent of the choice of a different asset category, furthermore when choosing between two alternative categories the household still considers the possibility of choosing the third category. For a certain level of accumulated net wealth, it is not possible to sustain that the proportion of safe deposits in the portfolio does not depend on, for instance, the housing acquisition price or on the total amount of wealth allocated to own businesses. Being aware that it is unrealistic to assume that human choices verify an independence property, we nevertheless choose to apply independent estimation methods to assure that we are catching a possible complete picture.

4.2 Fractional generalized model estimations

In this subsection, we report the results from estimating fractional response generalised linear models for each previously defined assets category and we compare these results with the fractional multinomial logit estimations. This type of model has been suggested by Williams (2016) in line with Papke and Wooldridge (1996) and allows to independently estimate the probability of holding a proportion such as our shares of wealth allocated to assets with approximate risk. Fractional estimations help to verify the coherence in households' preferences towards asset risk classes, testing if previous results on households' preferences do not change when each portfolio share is individually estimated against the set of explanatory variables. Since the results from the estimations are independent of one another, the marginal effects of different shares from the same portfolio do not sum up to one. Nevertheless, the estimated effects of different covariates may support or discard the direction and magnitude of wealth reallocation previously detected in the multinomial logit model estimations.

Tables 8 and 9 display marginal effects from fractional logit models, respectively for mixed type and financial portfolios. Results strongly confirm

previous multinomial logit estimations, reporting statistically significant estimators for covariates that were already statistically significant, similar mathematical signs and approximate magnitudes for estimated marginal effects. Contrariwise, these new estimations display statistically significant results for combinations of marginal effects and assets shares categories that were not captured by the multinomial logit model permitting to improve model's interpretation and to increase its scope.

(Tables 8 and 9 about here)

Fractional logit estimations confirm the positive relationship between the rate of housing valuation and the share of risky assets held in total portfolio, since displaying a marginal effect of about 7 pp. With respect to the financial portfolio, the marginal effects for the rate of housing valuation point to a preference for safe assets (the share rises by 22 pp) and a flight from medium risk category (the share declines 25 pp), reappraising the previously detected high amplitude effects of these coefficients. These results endorse households' cautious behaviour manifest in the movement of wealth to safer assets once the expected return on the largest share of their riches increase, and as such reinforces the portfolio composition puzzles stated by the empirical literature. By embracing real assets in the portfolios we can analyse the puzzles from a new angle, namely, we find that wealth perception acts to increase the fraction of riskier assets held in the portfolios, but households' preferences go to material assets. Several explanations can lie behind these outcomes. First, a perception of what are safe investments may bias preferences for real assets given these are usually the subject of lower leveraging and by a symmetric reasoning of lower deleveraging. Financial assets are faced as riskier since subject to higher return fluctuations. Second, an asset residual value is seen to be connected with its physical features, with real assets having intrinsic value that can be recovered once the original investment is done. On its turn, a financial asset is faced as a form of income redistribution that can materialise both ways, as an intake or as an outturn. Third, housing is often used as collateral for other investments, in particular, own businesses. An appreciated housing may facilitate the increased access to credit to finance the acquisition of real riskier assets.

The marginal effects of marital status, education, financial constraints, and attitude towards risk become statistically significant in the fractional logit estimations. Herein we report the most striking outcomes. Being married contributes to increasing the proportion of risky assets held in financial portfolios pointing to a sort of psychological comfort from being backed by each other decisions. Estimations for the marginal effects of education on mixed type portfolios predict that a head of the household with tertiary ed-

ucation will tend to increase the share of safe assets in about 3.1 pp, at the expense of medium risk assets, a result diverging from those reported in the literature supporting education as having strong positive effects on equity participation. The model estimations for financial portfolios are reconciled with the literature given both secondary and tertiary education coefficients display an increase in the shares of both risky and medium risk assets. The role of financial constraints is also highlighted by fractional logit estimations, decreasing by 4.2 pp the relative amount of wealth allocated to deposits in the mixed type portfolio, a result in line with the literature. Additionally, the estimations enhance the role of behavioural features in conditioning portfolio allocations. Assuming to be a high or average risk taker in financial issues is predicted to raise the share of risky assets by 2.6 pp within mixed portfolios, and to decrease the share devoted to housing in 6.1 pp. A high risk taker will positively impact the proportion of risky financial assets by 2.8 pp, but wealth is now allocated from safe deposits that decrease 6.2 pp. The perspective of a future economic downturn impels homeowners to transfer wealth from safe deposits to risky assets of the mixed type, the share decreasing 1.4 pp. This result defies the outcomes of economic theory that indicates uncertainty as tending to increase prudent savings (e.g. Carroll, 1997), however, it may be indicating that households who report themselves as expecting future difficulties are those who are already affected by financial drawbacks and in tandem are those who have exhausted their last available liquidity.

On short, these set of multinomial logit estimations and logit estimations place wealth as an important driver of Portuguese households' portfolio composition but its effect is expressed through channels that go further beyond the impact traditionally noticed. The rate of housing valuation, which captures the assessed return on the most important slice of households' real wealth, impacts positively the proportion of risky assets held within their mixed type portfolios. On top of this, demographic variables, income and other behavioural determinants such as future expectations or attitude towards risk seem to mould the poorly diversified portfolio of Portuguese households.

5 Robustness checks

Both types of previous estimations suggest that the rate of housing valuation is an important determinant of Portuguese households' portfolio composition. In this section, we investigate this relationship by addressing the

sensitivity of our previous estimations to alternative measures of housing appreciation. We now choose as explanatory variables housing appreciation and the number of years since housing acquisition, separating the rate of housing valuation into its two components. Housing appreciation measures the difference between estimated house price and its acquisition price, grasping perceived absolute wealth increase from housing valuation, and the number of years since housing acquisition captures for how long the household owns its housing. Estimations of the multinomial logit model are reported in Tables 10 and 11 respectively for total portfolios and financial portfolios, whereas fractional generalised estimations are reported for both portfolios respectively in Tables 12 and 13. The results of these new estimations are complementary to those from the original model. The marginal effects indicate that when housing appreciation increases one unit, households are more likely to decrease the share of safe assets held within mixed type portfolios. This outcome suggests an increase in risk from feeling wealthier thus confirming our previous key results. In contrast but in accordance to earlier estimations, as housing appreciation increases, households are less likely to hold risky financial assets. These results may imply that to these households buying a house involves too much risk bearing, triggering risk-averse behaviours with respect to other assets. Independent estimations of portfolio shares through fractional logit models corroborate fractional multinomial estimations using the new measures of housing valuation. The magnitude of financial portfolio marginal effects from housing appreciation deserves a final remark since it is now about 10 fold smaller than estimations for the rate of housing valuation. We assign these results to the very different scale of the two variables, the rate of housing valuation being significantly smaller than absolute housing appreciation.

6 Conclusion

In this paper, we have addressed drivers of Portuguese households' investment decisions taking as covariates explanatory variables that range from wealth perception, socio-economic gradient, self-assessed risk and future economic expectations, among other standard variables from the household finance empirical analysis. We distinguished three types of assets by risk category and estimated fractional logit models for both a mixed portfolio and a strictly financial portfolio of Portuguese households. We provide new evidence which points to, when deciding how much wealth to allocate to higher risk assets, households take into account wealth perception from the

valuation of their main asset, their residential property. Wealth is a relative concept that is attributed to the value estimated by households for the set of assets they own. In this context, how the household measures and notices wealth, namely how household's assets are monetarily prized by the survey respondent is an important determinant of their preferences and of their portfolio composition. Another important element to perceive wealth is the price paid for these assets in their acquisition process, a reference point to measure the household enrichment. In the case of Portuguese households, given the strong predominance of the residential property among their portfolios, total lifetime savings and wealth end up materialised in the form of a physical asset that while holds their money reserves can as well serve their housing needs. By settling perceptions on savings and wealth, households' insight on the housing valuation over time impacts their portfolio investment decisions. In our findings, an increase in these households' rate of housing valuation impels them to prefer riskier assets, a result pointing wealth effects from housing on portfolio composition in line with the literature. Our estimations also confirm the presence of composition puzzles for Portuguese households, although less evident when real assets that typically bear higher risk are included in the portfolio. Besides wealth perception, other factors that seem to contribute the most to increase the proportion of wealth allocated to risky assets are higher monthly income, expectations, and behavioural attitudes towards risk. As much as our results can be representative of all other countries where a housing renting market is not settled and households will be naturally induced to buy a residential property, we can affirm that the prospect of emergency of bubbles in the real estate market in these countries should be carefully monetarized since booms and busts in the housing market by changing households' wealth perception can cause significant and even devastating effects on their behaviours, investment decisions, and ultimately on their riches and welfare.

Tables and figures

A Tables

Table 1: Classification of assets by risk

Safe	Intermediate Risk	High Risk
Deposits	Mutual funds	Value of non-self-employment private business
	Bonds	Shares
	Money owed to households	Managed accounts
	Voluntary pension and whole life insurance	Other financial assets
	Value of household's main residence	Value of self-employment businesses
	Value of household's vehicles	
	Value of household's valuables	
	Value of other real estate property	

Table 2: Portfolio shares summary statistics (homeowners)

Total portfolio	Median	Mean	Sd	Min	Max
Safe	0.0296097	0.0806298	.1224059	0	0.9770585
Medium Risk	0.9615384	0.8982492	0.1458003	0.0229415	1
Risky	0	0.021121	0.0844014	0	0.9721181
Financial portfolio	Median	Mean	Sd	Min	Max
Safe	1	0.8670708	0.2675945	0	1
Medium Risk	0	0.1170716	0.2529099	0	1
Risky	0	0.0158576	0.0923181	0	0.99338

Table 3: Homeowners participation rates and shares of total wealth

Asset category	Participation rate (%)	Share (%)
Deposits	96.0	8.06
Mutual Funds	3.2	0.22
Bonds	0.4	0.03
Value of non-self-employment private business	0.2	0.02
Shares	5.4	0.2
Managed accounts	0.2	0.01
Money owed to household	8.4	1.0
Other financial assets	0.03	0.0
Voluntary pension/whole life insurance	16.6	0.98
Value of household's main residence	100.0	73.07
Value of other real estate property	33.3	9.90
Value of household's vehicles	77.7	4.70
Value of household's valuables	8.9	0.37
Value of self-employment businesses	9.4	1.80

Table 4: Explanatory variables summary statistics (homeowners)

Variable	Median	Mean	Sd	Min	Max
Home acquisition	1	.8640048	0.3427854	0	1
Rate of housing valuation	1.05	1.059048	0.0527365	.0003	7.716
Mortgage debt	0	0.3695159	0.4826763	0	1
Net wealth	1.063	1.954949	6.102005	-0.654	231.1225
Age	56	56.48692	14.98011	18	85
Married	1	0.7118003	0.452927	0	1
Divorced	0	0.0687811	0.2530828	0	1
Number of dependents	0	0.6186514	0.8638262	0	8
Secondary education	0	0.1235682	0.32909	0	1
Higher education	0	0.0888265	0.284496	0	1
Monthly income	1.288333	1.829673	2.09529	0.00875	50.38334
Past adverse expectations	1	0.5132915	0.499826	0	1
Pessimistic expectations	1	0.5620813	0.4961336	0	1
Optimistic expectations	1	0.528096	0.4992127	0	1
Credit constraints	0	0.0290145	0.167848	0	1
High risk taker	0	0.0184245	0.1344812	0	1
Average risk taker	0	0.0710504	0.2569103	0	1
Housing appreciation	0.0242	0.186567	0.527193	0	7.716
Years	20	22.34875	14.30494	1	81

Table 5: Variables description

Variable	Description
Home acquisition	Dummy for having expend money buying the house
Rate of housing valuation	(Price at which the house would be sold / House acquisition price)$^{1/Years}$
Mortgage debt	Dummy for having oustanding mortgage debt
Age	Age of the head of the household
Married	Dummy for married couple or having a legal and consensual union
Divorced	Dummy for divorced head of the household
Dependants	Number of dependants up to 25 years old in the household
Secondary education	Upper secondary education degree
Tertiary education	College degree
Net Worth	Real and financial wealth minus total outstanding liabilities in thousand euros
Monthly Income	Total household gross income /12 (hundred euros)
Credit Constraints	Dummy for household who had credit refused in a recent past
High Risk Taker	Dummy for financial respondents and spouses who are willing to take high or above average financial risk
Average Risk Taker	Dummy for financial respondents and spouses who are willing to take average financial risk
Optimistic Expectations	Dummy for households expecting an increase in future real income or an increase in wealth
Pessimistic Expectations	Dummy for households expecting a decrease in future real income
Past Adverse Changes	Dummy for households that went through a downturn in their financial conditions in the last three years
Housing appreciation	Price at which the house would be sold / House acquisition price
Years	Number of years since acquisition of residential property

Table 6: Fractional multinomial logit estimation, mixed type portfolio

	Safe	Medium risk	Risky
Home acquisition	-0,0033	0,00472	-0,0014
Rate of housing valuation	-0,00148	-0,05066	0,05212*
Mortgage debt	-0,0256*	0,02668*	-0,001062
Net wealth	-0,000856	0,0000488	0,000806***
Age	0,00136***	-0,001072***	-0,000272*
Number of dependents	-0,01172***	0,01144***	0,0002878
Married	-0,00233	-0,0004482	0,0028
Divorced	-0,02396	0,02482	-0,0008374
Secondary education	0,01096	-0,00928	-0,00172
Higher education	0,03244	-0,02952	-0,00296
Monthly income	0,00462***	-0,0057***	0,00104***
Pessimistic expectations	-0,01368*	0,01226	0,0014
Optimistic expectations	0,02166**	-0,03286**	0,0112
Past adverse changes	-0,00806	-0,00096266	0,009
Credit constraints	-0,03306	0,03798	-0,00492
High risk taker	0,03094	-0,06184	0,0309
Average risk taker	0,01628	-0,02432	0,00804

Table 7: Fractional multinomial logit estimation, financial portfolio

	Safe	Medium Risk	Risky
Home acquisition	0,01528	-0,00448	-0,01078
Rate of housing valuation	0,20936*	-0,2241**	0,01472
Mortgage debt	-0,02416	0,02266	0,00152
Net wealth	-0,001072	0,00099	0,0000642
Age	0,000504	-0,000666	0,000158
Number of dependents	0,00352	-0,00428	0,000768
Married	-0,02798	0,019	0,00896
Divorced	-0,02396	0,02022	0,00372
Secondary education	-0,05078	0,03878	0,01196
Higher education	-0,043	0,03008	0,01292
Monthly income	-0,00778**	0,00678**	0,000974*
Pessimistic expectations	0,0021	-0,00464	0,0025
Optimistic expectations	-0,04212*	0,03766*	0,00446
Past adverse changes	-0,0405*	0,037	0,0035
Credit constraints	-0,04952	0,05732	-0,00782
High risk taker	-0,06706	0,017164	0,04988
Average risk taker	-0,06088	0,04434	0,01652

Table 8: Fractional generalize linear model estimation, mixed type portfolio

	Safe	Medium risk	Risky
Home acquisition	-0,0030489	0,00672298	-0,00196068
Rate of housing valuation	-0,00340768	-0,09832028	0,07449402*
Mortgage debt	-0,0269357***	0,02567854***	-0,00141838
Net wealth	-0,0014164***	-0,00213728**	0,00116402***
Age	0,00138902***	-0,00108394***	-0,0003846*
Number of dependents	-0,01211224***	0,00802048*	0,00036006
Married	-0,00149622	0,00318434	0,0043145
Divorced	-0,02742214**	0,0342886**	-0,00134672
Secondary education	0,01151168	-0,00695622	-0,00236496
Higher education	0,0313057***	-0,02053466**	-0,00426312
Monthly income	0,00420998***	-0,00550666***	0,00134318***
Pessimistic expectations	-0,01364246**	0,01312414**	0,00214482
Optimistic expectations	0,02242772***	-0,033546***	0,01566414***
Past adverse changes	-0,00843766	-0,00228148	0,01280378***
Credit constraints	-0,0420762***	0,04885048***	-0,00893462
High risk taker	0,02333488	-0,06145402***	0,02358816***
Average risk taker	0,01603118**	-0,02320256***	0,00948882**

Table 9: Fractional generalized linear model estimation, financial portfolio

	Safe	Medium Risk	Risky
Home acquisition	0,01751542	-0,0037653	-0,0117215
Rate of housing valuation	0,2190403*	-0,24606242**	0,02244566
Mortgage debt	-0,02591874*	0,02417516*	0,00194416
Net wealth	-0,00115722	0,00062904	-0,00002954
Age	0,0005131	-0,00070142	0,0002539
Number of dependents	0,00325334	-0,00496496	0,00132588
Married	-0,03287988**	0,02232384	0,0159585***
Divorced	-0,02492058	0,02121484	0,00494652
Secondary education	-0,0490185***	0,0385569**	0,01304224**
Higher education	-0,04262892**	0,0328378*	0,0144535***
Monthly income	-0,00892644**	0,0056799**	0,00108834
Pessimistic expectations	0,0010865	-0,00526128	0,00394902
Optimistic expectations	-0,04558912***	0,0415134***	0,00668858
Past adverse changes	-0,04479186***	0,03943144***	0,00477698
Credit constraints	-0,04403504	0,05203292*	-0,02192186
High risk taker	-0,0620565**	0,00834562	0,0278116***
Average risk taker	-0,05793162***	0,0411606***	0,01555892***

Table 10: Fractional multinomial logit estimation, mixed type portfolio robust check

	Safe	Medium Risk	Risky
Home acquisition	-0,002392	0,00366	-0,00124
Housing appreciation	-0,01044*	0,00776	0,00266
Years since acquisition	0,000846***	-0,000666*	-0,000184
Mortgage debt	-0,02142**	0,02402**	-0,00264
Net wealth	-0,000776	-0,00004412	0,000816***
Age	0,000998***	-0,000804***	-0,000202
Number of dependents	-0,0112***	0,01116***	0,0000208
Married	-0,0017138	-0,000878	0,0026
Divorced	-0,0224**	0,02432*	-0,00193
Secondary education	0,0123	-0,01052	-0,0018
Higher education	0,03428***	-0,03106**	-0,00322
Monthly income	0,00466***	-0,00564***	0,000976***
Pessimistic expectations	-0,01284**	0,01128*	0,00156
Optimistic expectations	0,02122***	-0,03316***	0,01196
Past adverse changes	-0,00784	-0,0010222	0,00886
Credit constraints	-0,0315**	0,0365***	-0,005
High risk taker	0,03106	-0,06128**	0,03022
Average risk taker	0,01616	-0,02422*	0,00808

Table 11: Fractional multinomial logit estimation, financial portfolio robust check

	Safe	Medium Risk	Risky
Home acquisition	0,01652	-0,00638	-0,01016
Housing appreciation	0,0223	-0,01522	-0,00708*
Years since acquisition	0,00001152	-0,000154	0,000142
Mortgage debt	-0,02622*	0,02442*	0,00178
Net wealth	-0,000974	0,000928	0,0000636
Age	0,000442	-0,000578	0,000136
Number of dependents	0,00266	-0,0034	0,000736
Married	-0,02676	0,01816	0,00864
Divorced	-0,02418	0,02052	0,00368
Secondary education	-0,05052**	0,03864*	0,0119
Higher education	-0,0427*	0,03006	0,01264
Monthly income	-0,00778**	0,00686**	0,000922*
Pessimistic expectations	0,00268	-0,00528	0,00264
Optimistic expectations	-0,04078***	0,0366***	0,00418
Past adverse changes	-0,04058**	0,03732**	0,00326
Credit constraints	-0,04814	0,05556	-0,00744
High risk taker	-0,06802	0,017748	0,0503
Average risk taker	-0,06042**	0,04448**	0,01594

Table 12: Fractional generalized linear model estimation, mixed type portfolio, robust check

	Safe	Medium Risk	Risky
Home acquisition	-0,00222232	0,00511476	-0,00171238
Housing appreciation	-0,01071522*	0,00924032	0,00376494
Years since acquisition	0,00086438***	-0,00080922**	-0,00026318
Mortgage debt	-0,02247676***	0,02299866**	-0,00373168
Net wealth	-0,00138658***	-0,00221238**	0,0011718***
Age	0,00105382***	-0,00079164**	-0,00027752
Number of dependents	-0,01161906***	0,00819966*	-0,00001564
Married	-0,00085702	0,0025321	0,00394814
Divorced	-0,02555818**	0,0333079**	-0,00303474
Secondary education	0,01282306*	-0,00815918	-0,00244146
Higher education	0,03301922***	-0,02177698**	-0,0047056
Monthly income	0,00427174***	-0,00546618***	0,00122062**
Pessimistic expectations	-0,0129111**	0,01227802*	0,00234314
Optimistic expectations	0,02213848***	-0,03356986***	0,01652656***
Past adverse changes	-0,00826708	-0,00225042	0,01247578***
Credit constraints	-0,03996832***	0,04679052***	-0,00892744
High risk taker	0,02358632*	-0,06106824***	0,02315578***
Average risk taker	0,01609022**	-0,02302844**	0,00942634**

Table 13: Fractional generalized linear model estimation, financial portfolio, robust check

	Safe	Medium Risk	Risky
Home acquisition	0,0190711	-0,0057087	-0,01149802
Housing appreciation	0,0242337	-0,0168917	-0,01144356**
Years since acquisition	-0,000042048	-0,0002101	0,00021624
Mortgage debt	-0,02804716*	0,02579352*	0,00234332
Net wealth	-0,00107576	0,00056362	-0,000019726
Age	0,00046094	-0,00058916	0,00022734
Number of dependents	0,0023221	-0,00403004	0,00128936
Married	-0,03163136**	0,02116922	0,01582966***
Divorced	-0,02498578	0,02137086	0,004943
Secondary education	-0,0490746***	0,038249**	0,01323368**
Higher education	-0,04281756**	0,03244936*	0,01452478***
Monthly income	-0,00895538**	0,00574766**	0,00105224
Pessimistic expectations	0,00183318	-0,00602462	0,00425334
Optimistic expectations	-0,04407552***	0,04032276***	0,00644156
Past adverse changes	-0,04507692***	0,03975328***	0,00459182
Credit constraints	-0,04327676	0,05063486*	-0,02121192
High risk taker	-0,06219964**	0,00871254	0,0283084***
Average risk taker	-0,05776058***	0,04106276***	0,01550528***

B Figures

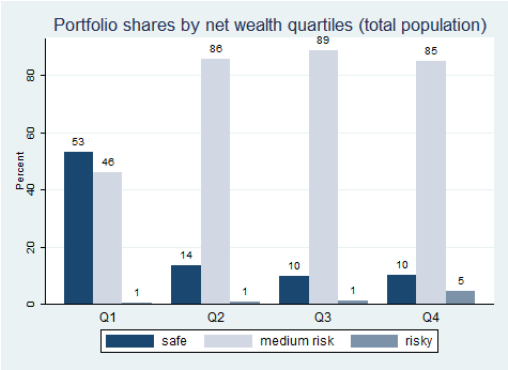

Figure 1: Portfolio shares by quartiles of net wealth (total population)

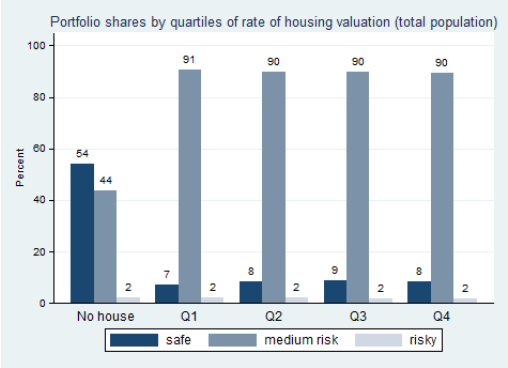

Figure 2: Portfolio shares by quartiles of the rate of housing valuation (total population)

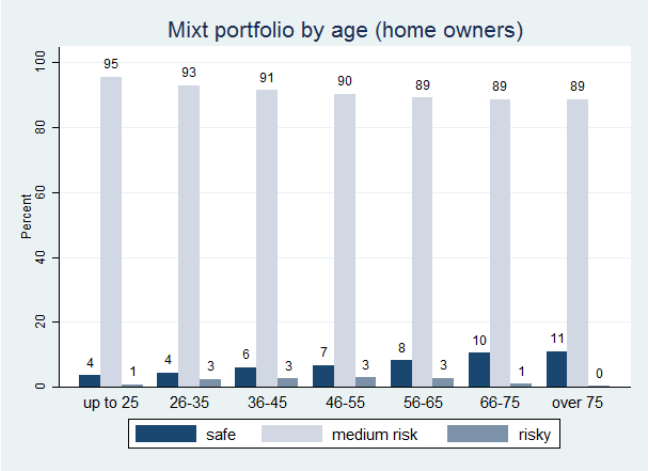

Figure 3: Mixt type portfolio by age (homeowners)

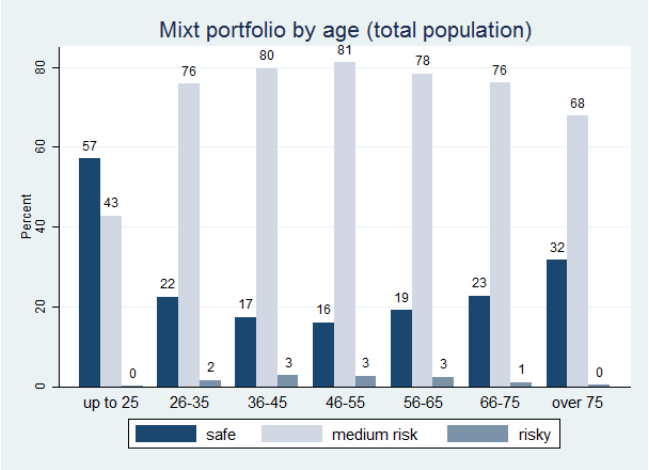

Figure 4: Mixt type portfolio by age (total population)

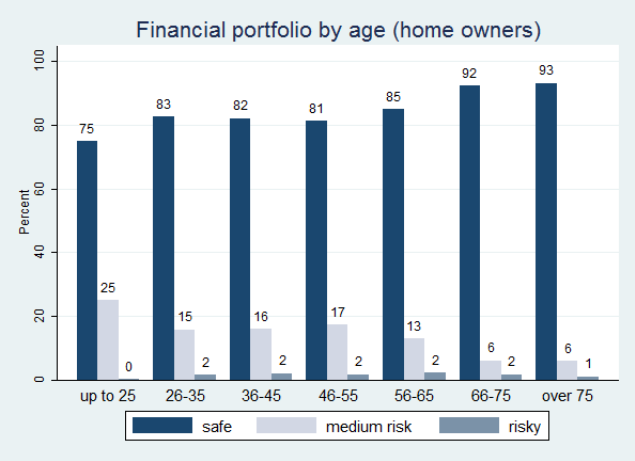

Figure 5: Financial portfolio by age (homeowners)

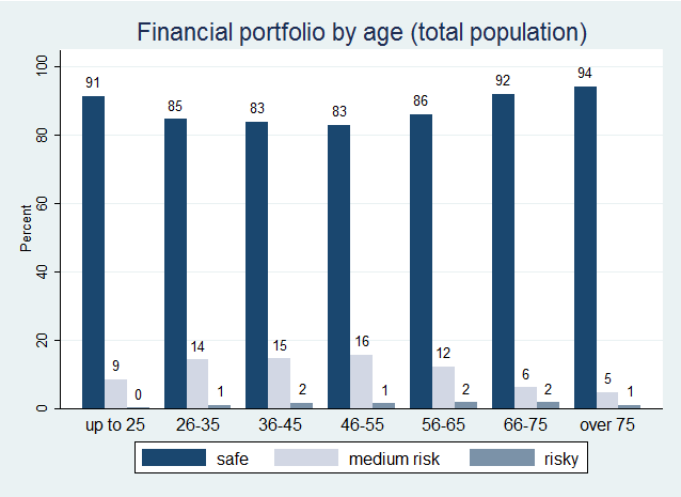

Figure 6: Financial portfolio by age (total population)

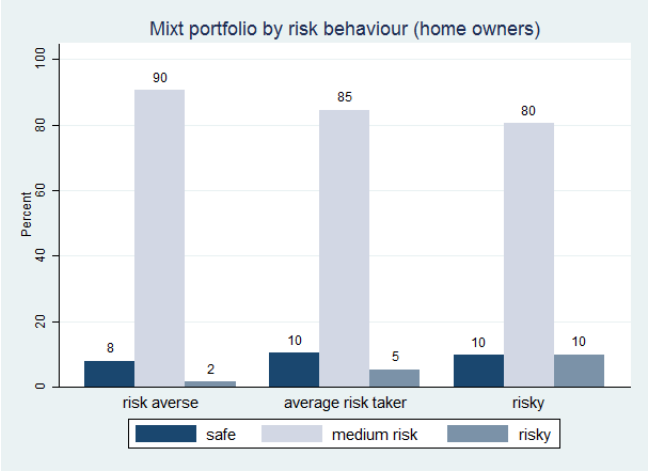

Figure 7: Mixt type portfolio by risk behaviour (homeowners)

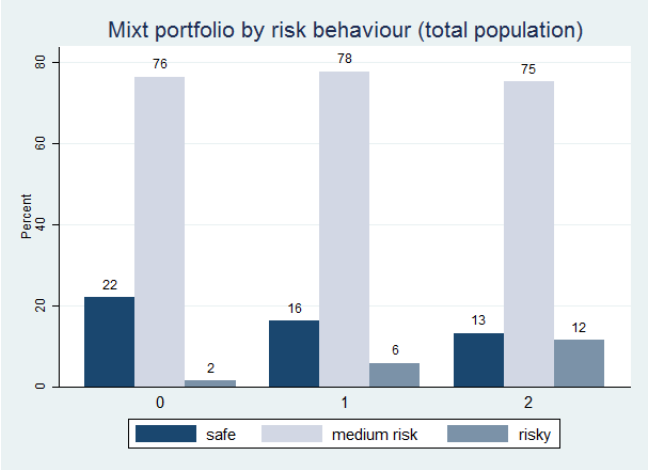

Figure 8: Mixt type portfolio by risk behaviour (total population)

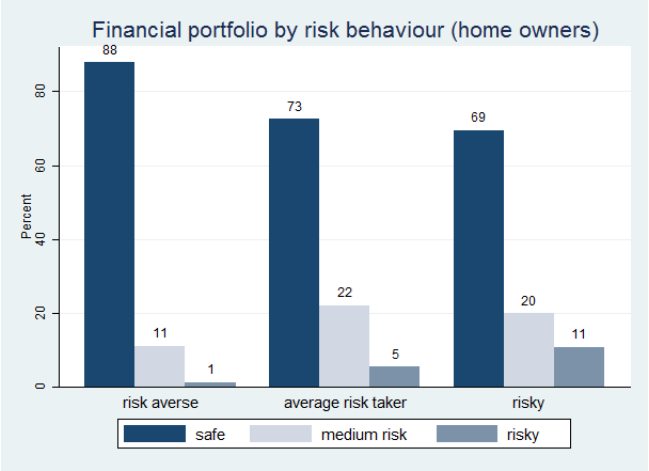

Figure 9: Financial portfolio by risk behaviour (homeowners)

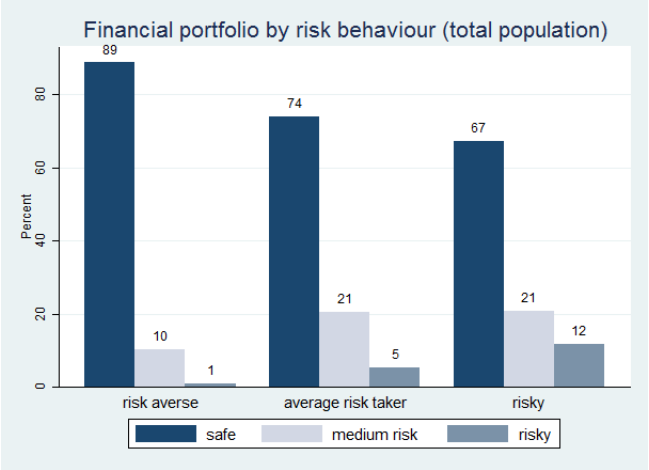

Figure 10: Financial portfolio by risk behaviour (total population)

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