Lisbon School of Economics & Management
Universidade de Lisboa

MASTER

MONETARY AND FINANCIAL ECONOMICS

MASTER´S FINAL WORK

DISSERTATION

HOW HOMEOWNERSHIP INFLUENCES PORTUGUESE HOUSEHOLDS' INVESTMENT CHOICES ACROSS DIFFERENT LEVELS OF RISK?

MARTA DE AZEVEDO TAVARES

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SUPERVISION:
PROFESSORA PAULA CRISTINA ALBUQUERQUE

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Aos meus pais, que me deram a oportunidade de estudar, e à minha família (pais e irmã) pelo amor incondicional e todo o apoio.

GLOSSARY

HFCS – Household Finance and Consumption Survey.

BdP – Banco de Portugal.

FKP – Financially Knowledgeable Person.

IV – Instrumental Variables.

OLS – Ordinary Least Squares.

EEV – Endogenous Explanatory Variable.

CF – Control Function.

ABSTRACT, KEYWORDS AND JEL CODES

This dissertation explores the effects of homeownership on financial investments decisions across three different levels of risk (high, moderate and low). For this purpose, pooled cross-section data for Portuguese households for the periods of 2013, 2017 and 2020 were used to estimate a two-part fractional Probit model. The results suggest a significant effect of homeownership on the proportion of high and low risk investments, suggesting that homeownership crowds out risky financial investments, while stimulating allocation towards lower risk assets. However, homeownership does not significantly affect the proportion of moderate risk investments.

KEYWORDS: homeownership; crowding-out; portfolio asset allocation; financial assets; risk investments; fractional regression model.

JEL CODES: C25; C26; G11; R21; D10.

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HOW HOMEOWNERSHIP INFLUENCES PORTUGUESE HOUSEHOLDS' INVESTMENT CHOICES ACROSS DIFFERENT LEVELS OF RISK?

By Marta de Azevedo Tavares

A two-part fractional model, using pooled cross-section data from 2013, 2017 and 2020, was estimated to study the effects of homeownership in Portuguese households' investment choices, across different levels of risk: high, moderate and low. The findings reveal both a crowding-out and a diversification effect of homeownership on the proportion of risky and safe investments, respectively. However, homeownership does not affect the proportion of moderate risk investments.

1. INTRODUCTION

Housing represents a significant financial asset in most households portfolios, mainly on account of its dual nature as both a durable consumption good and a financial asset, providing consumption utility and investment equity. Besides being a primary avenue to assure basic needs, providing stability, security and well-being, housing also has a capital component, as it generates wealth accumulation through price appreciation and hedges against rent risks and price variations. However, unlike other financial assets, such as stocks and bonds, housing can be an illiquid and highly leveraged investment, imposing financial constraints on investors (Flavin & Yamashita, 1998). As a vital long-term asset over the life course of households, housing can impact families financial decisions, acting as a financial constraint. During the course of life, individuals optimize their financial behavior regarding consumption and savings in order to have available resources for retirement. However, when facing constraints associated with homeownership, such as high levels of mortgage debt and therefore, limited available income, or illiquidity, they see these factors influencing their financial planning decisions, in particular, the allocation of their remaining wealth (Deaton, 2005). This interplay between wealth allocation and housing demand shows how homeownership substantially influences and helps shaping financial decisions.

Although theoretical work and empirical evidence confirm the significant relationship between homeownership and the portfolio asset allocation, they diverge on how it affects the latter, exposing two main effects. Crowding-out and diversification represent opposing effects of homeownership on investment decisions. The former posits that

homeowners are more likely to be more risk averse, mainly due to the financial constraints associated with homeownership, thus, investing less in risky assets, while the latter suggests that homeownership, by reflecting wealth accumulation or serving as a collateral, may encourage individuals to invest more and adopt a more risk-seeking behavior, particularly when expecting a low correlation between stock returns and house returns (Grossman & Laroque, 1990; Yao & Zhang, 2005). The literature highlights several factors impacting homeowners' financial decisions, concerning their propensity to invest. These factors include housing-related payments, financial constraints, housing price expectations and variations, risks perceptions and housing illiquidity.

Building upon these arguments, the purpose of this study is to understand the influence of homeownership on financial behavior by examining portfolio asset allocation and the resulting distribution of remaining wealth across different types of investments. Considering the significant weight of housing on households total wealth and the extremely increase of housing prices observed in Portugal, this study focuses on Portuguese households. For this reason, the following section delves into Portuguese households wealth allocation context, with focus on the real asset, the main residence.

Portuguese wealth allocation is mainly distributed between real assets, consisting of main residence, other real estate properties, self-employment business, vehicles and valuables, financial assets, which include sight accounts, saving accounts, tradable assets, voluntary pension schemes and others, and debt, such as main residence mortgage, other property mortgages, non-mortgage loans, credit lines overdrafts and credit cards and any debt (Banco de Portugal & Instituto Nacional de Estatística, 2022).

An analysis through this wealth composition reveals the significant role housing has on Portuguese households wealth. In fact, housing constitutes the largest share of Portuguese families real wealth in all distinct net wealth quintiles, with the exception of the wealthiest one. In this class, real assets allocation is more diversified, with the most significant asset being other real estate properties. This prominence of housing in households wealth allocation aligns with the strong preference among Portuguese households for owning their main residence. Only a residual percentage of homeowners would prefer to be renters (2.0% of 70.0% in 2020), whereas a large majority of renters seek homeownership (63.5% in 2020), however they are financially restricted (Banco de

Portugal & Instituto Nacional de Estatística, 2022). This preference towards homeownership is consistent with high homeownership rates, which exceed 90% in 2020, and with the overall higher median value of the main residence compared to other real assets, in all net wealth quintiles, with the exception of the wealthiest one, where the median value of self-employment businesses is slightly higher (Banco de Portugal & Instituto Nacional de Estatística, 2022).

Addressing the composition of financial assets, deposits constitute the dominant asset, accounting for a share of 80% of all net wealth quintiles, with the exception of the wealthiest, whose portfolios reflect once again diversified strategies. The prominent role of housing persists even in the context of debt, since the most common type of debt owned by Portuguese households is mortgages on the main residence (30.5% of households in 2020). This percentage relates to all net wealth quintile, except the bottom 20%. In the poorest quintile, homeownership was 8.3% and only 5.4% had a mortgage on the main residence (Banco de Portugal & Instituto Nacional de Estatística, 2022).

Considering the significant weight of the main residence on households total wealth, housing can significantly impact future financial behavior. As showed by the following evidence, housing accounted for a considerable impact on the evolution of Portuguese households net wealth. In particular, in 2020, alongside the increase of households deposits, the increase in house prices was one of the main contributors to the 19.9% growth on mean net wealth per household, compared to 2017 (Banco de Portugal & Instituto Nacional de Estatística, 2022)

To better understand the relationship between homeownership and wealth allocation among Portuguese households, this study uses data from a Household Finance and Consumption Survey (HFCS), conducted by Banco de Portugal (BdP) and Statistics Portugal. This survey collects detailed information on the wealth, debt and income of households living in Portugal, on the basis of a representative sample (Banco de Portugal, 2025). The present investigation covers Portuguese households financial decisions from 2013, 2017 and 2020.

This study estimates a two-part fractional regression model with Probit specification, which was justified by the nature of the variables of the model, to investigate the impact of homeownership on investment allocation. For a more detailed understanding of

housing's impact on portfolio allocation, the dependent variables, probability and proportion decisions were defined into three different levels of risk: high, moderate and low. The RESET test, used in both parts of the model, revealed misspecification in the first part of the model, while the second part was correctly specified. That being said, the results reveal a significant negative relationship between homeownership and the proportion of high risk investments and a significant positive relationship between homeownership and the proportion of low risk assets. Regarding moderate risk assets, there is no significant relationship with homeownership. Potential reverse causality and endogeneity were considered during the model estimation.

The remaining chapters are organized as follows: Section 2 is the literature review, providing the concepts, theoretical and empirical background on the topic and the hypotheses of this study; Section 3 presents the data, the variables and the methodology used; Section 4 reveals empirical findings; Section 5 is the conclusion.

2. LITERATURE REVIEW

2.1. Theoretical Background

Within the existing theoretical literature, a consensus exists that housing has a significant impact on the composition of financial portfolios. This is primarily due to its perception of a dual asset, providing utility as a durable consumption good and value as an investment asset (Cocco, 2005; Grossman & Laroque, 1990). But, beyond this dual nature, a house fundamental role in fulfilling basic needs justifies its position as the largest asset in families portfolio, which is consequently anticipated to significantly influence portfolio allocations.

Based on different approaches, theoretical models demonstrate how housing, whether through consumption or investment, affects individuals wealth allocation. These models include for example dynamic-life cycle models, which often employ stochastic dynamic behavior to account for consumption and investment decisions over lifetime, mean-variance estimations of several financial assets to balance risk and return (Flavin & Yamashita, 1998) or optimization problems to maximize utility (Cocco, 2005). Authors incorporate housing-related and external factors into their model, like taxes, fixed costs of equity market entry (Cocco, 2005), transaction costs, uncertainty in income or asset

prices (Grossman & Laroque, 1990), house price changes or expectations, mortgage defaults, among others, to demonstrate the various channels through which homeownership can influence financial behavior. For example, when taxes benefits are removed, households may choose to pay for their mortgage, therefore holding more housing equity instead of more diversified portfolios (Dietz & Haurin, 2003). Some of these factors were identified and further explored as mechanisms that have a substantial influence on financial decisions through homeownership, including housing-payments, financial constraints, housing illiquidity, house price risks and variations, hedging and diversification (Cocco, 2005; Flavin & Yamashita, 1998; Grossman & Laroque, 1990; Yao & Zhang, 2005).

Theoretical and empirical studies reveal two main opposite effects in particular on the allocation of risky assets, namely the crowding-out (Flavin & Yamashita, 1998; Grossman & Laroque, 1990; Vestman, 2012) and the diversification effects (Gu & Zhu, 2024; Summers et al., 2006; Yao & Zhang, 2005). While the crowding-out effect suggests that homeownership influences portfolio allocation by increasing risk aversion and shifting investments in risky assets towards safer assets, the diversification effect implies that housing can stimulate risky asset investments rather than discourage them.

The same mechanism can have divergent effects on homeowners financial choices, which will be analyzed in the following section.

Narrowing to the first effect, both liquidity and transaction costs influence households financial decision-making (Cocco, 2005). In situations where households hold an illiquid durable good (like a house) or encounter transaction costs, households are less likely to adjust portfolios frequently. This may happen because additional burdens when acquiring or selling assets derived from transaction costs and investments in illiquid assets lower the level of liquid wealth available. Therefore, smaller percentages of wealth are foreseen to be invested (Grossman & Laroque, 1990).

In line with this argument, financial constraints like mortgage debt may crowd out investments, since highly leveraged homeowners are more likely to adjust their investments by reducing risky financial asset holdings, as a strategy to mitigate the risks associated with high leverage and house price variations (Flavin & Yamashita, 1998; Vestman, 2012;). The perception of price variations directly influences investment

choices. When housing prices appreciate, homeowners benefit both from home equity increases and avoid rising rents. These changes can impact households asset allocation by increasing the perception of available resources. Consequently, the role of housing as a partial hedge against housing price risks can encourage individuals towards real estate as opposed to investments in risky assets, implying a substitution effect (Vestman, 2012). Considering house price expectations, it has been shown that homeowners expecting housing price increases are less likely to invest in stocks (Zhou et al., 2017).

House price variations are inherently associated with house price risks. Risk is a significant factor shaping financial decisions and portfolio allocation. When investors perceive higher overall asset risk in the market, they tend to limit their stockholdings and withdraw from risky investments (Cocco, 2005).

Empirical evidence supports the negative impact of mortgage debt on risky investments, since it represents a long-term committed expenditure, potentially reducing financial flexibility and increasing future uncertainty, potentially, resulting in more conservative financial decisions to mitigate risks (Michielsen et al., 2015). More findings on housing-related payments corroborate that stock market participation costs and liquidity constraints amplify homeowners aversion to stock asset investment, reflecting the crowding-out effect. In particular, households facing financial constraints or carrying mortgage debts are less inclined to reallocate their wealth, even in response to increases in home equity (Fratantoni, 1998). Also, doubling the average homeowner's mortgage payment-to-income ratio has been shown to decrease by 15% risky assets, shifting investments towards safer alternatives (He et al., 2019). A notice effect caused by housing-related payments is the evidence of postponement in homeownership for buyers, while prioritizing savings (Huang, 2010). In Sweden, nearly 20% of first-time homebuyers exit the stock market entirely upon purchasing a home (Vestman, 2012). These findings confirm that homeownership commitments, like down-payment requirements and mortgage obligations, limit stock market participation, reducing the availability of funds for risky investments. They converge with the conclusion that investment in real estate represents an alternative to investment in risky assets and may crowd it out, mainly due to liquidity constraints, precautionary motives and demand for financial security (Li et al., 2022; Pelletier & Tunc, 2019).

From a holistic perspective, more empirical evidence converges with the previous arguments. The trade-off between housing assets and stock assets is confirmed by empirical studies which revealed a negative effect of housing equity to net wealth on both the likelihood and extent of stock market participation, as a strategy to limit the exposure of the limited liquid wealth to higher risks, such as stock assets (Zhou et al., 2017). Also, data from the 1989 wave of the Panel Study of Income Dynamics, used in regression estimates, revealed a strong negative relationship between housing investment and stockholding, indicating that households with a high house-to-net-worth ratio hold lower stocks proportions (Flavin & Yamashita, 1998), confirming the crowding-out effect. A similar outcome was revealed for Japanese and Korean households, indicating that individuals owning a house have higher shares of riskless assets compared to households without homeownership (Iwaisako et al., 2016; Yuh, 2008) and for Chinese households. Independent research utilizing data from the China Family Panel Studies (2010 to 2018) and the China Household Finance Survey (2011, 2013 and 2019) reveal lower proneness for Chinese households to participate and to allocate wealth in the stock market (Li et al., 2022; Zhou et al., 2017). In particular, Chinese single-homeowners exhibit a negatively correlation with both the allocation and the proportion of risky financial allocation, with a marginal impact of – 0.2003 and – 0.0883, respectively (Wu & Yu, 2024) and single homeowners are 5.61% less likely to hold stocks (Zhou et al., 2017). Based on this line of studies, the following hypothesis is formulated:

H1: Homeownership has a crowding-out effect on financial assets.

Contrary to the crowding-out effect, some authors predict a positive effect of homeownership on financial investments, namely, the diversification effect. These authors demonstrate an opposite outcome and perspective through the diverse mechanisms previously mentioned, implying that homeownership can facilitate, rather than restrict, riskier asset markets participation.

Regarding high levels of mortgage debt, which can be perceived as a financial constraint to investments, it is also associated with individuals that own more expensive houses and borrow more. Assuming that they have higher labor income and more human capital and potentially higher future income expectations, they are more willing and able

to take on leverage and simultaneously participate in risky financial assets (Cocco, 2005). In turn, increases in home equity can be perceived as an indicator of overall wealth growth and financial stability, encouraging investors to increase risk-taking, reflecting the wealth or diversification effect, as mentioned before. Higher home equity increases borrowing capacity, providing access to more credit, which can be allocated into riskier assets like stocks (He et al., 2019). Findings confirm a positive correlation between home equity and the proportion of portfolio allocation to both deposits and equities, meaning that homeowners become more risk seeking as home equity grows (Gu & Zhu, 2024; Summers et al., 2006). Therefore, rising home equity can stimulate stock market activity. House price expectations have also been proven to positively impact stock investments when homeowners expect a decrease in housing prices (Zhou et al., 2017), as they tend to prefer stock investments.

Following a diversification strategy may lead homeowners to increase the demand for risky assets. In particular, a tangible asset ownership might encourage diversified portfolios, characterized by higher-risk and higher-returns assets, due to both financial security and wealth accumulation derived from homeownership (Gu & Zhu, 2024; Summers et al., 2006). Another reason corroborating this perspective is the expected low correlation between stock returns and housing returns. Under these circumstances, homeowners might be encouraged to invest in riskier assets to offset unexpected increases in portfolio costs, for instance transaction costs and diversify their portfolio (Huang, 2010; Yao & Zhang, 2005). In particular, a 10% increase in home equity leads to a 0.6% rise in the stock market participation and greater stock shareholding, among Chinese homeowners. This result verifies the stimulation role home equity and therefore housing has in the likelihood and proportion of risky assets holdings (He et al., 2019). This empirical evidence aligns with theoretical predictions, suggesting that financial security and equity accumulation derived from homeownership may encourage more diversified portfolios with higher risk but potentially higher returns (Gu & Zhu, 2024). Therefore, the subsequent hypothesis is formulated:

H2: Homeownership has a diversification effect on financial assets.

Despite these findings, Netherlands data between 2006 and 2012, revealed insignificant effects of either home equity or mortgage debt on stock market participation. This contrasting result is explained by low stock market participation rate and high pension contributions, along with strong tax incentives for homeownership and mandatory pension savings in the Netherlands (Michielsen et al., 2015).

Expanding beyond the scope of primary residence, the literature explores how owning multiple residences impacts household portfolio allocation, as opposed to owning a single residence. Unlike single-home ownership, multiple residences are often acquired as investments, that can provide stable rental income to support greater risk-taking (Wu & Yu, 2024). Consequently, owning multiple residences can enhance the likelihood of investing in risky assets due to the additional capital generated by rental income from multiple properties. This is further amplified by demographic and socioeconomic factors associated with multi-homeowners, specifically better access to and rationing credit by multi-homeowners, which improves assets liquidity (Zhou et al., 2017). Research demonstrates that owners of multiple homes are 4.53% ($p < 0.05$) more likely to hold stock assets than owners of one home (Zhou et al., 2017). Similarly, studies revealed a positive correlation between owning more than one house and the risky financial asset allocation, with marginal impacts of 0.0469 and 0.0310 in the probability and extent of risky financial asset allocation, respectively (Wu & Yu, 2024). Thus, owning multiple houses can result in an asset allocation effect, reflecting multi-real estate's influence on households' willingness and ability to invest in risky assets, whereas the primary effect of acquiring the first house is crowding-out risky investments. This contrast is evident from the statistical data, where owning only one house has a marginal effect of -0.2003 on the allocation of risky financial assets and -0.0883 on the proportion of risky financial asset allocation (Wu & Yu, 2024).

However, Chinese data from 2015 shows that households owning more than a house reduces by 4.74 percentage points the proportion of risky financial assets. This result refutes the prior argument, suggesting that real estate can instead function as a strong substitute asset to risky investments for multi-home owners, indicating the crowding-out effect. However, no significant crowding-out effect was found for the share of riskless financial assets of multi-home owners. This study also addresses households risk awareness regarding real estate, in a sense that increasing housing prices and house

market growth can weaken risk consciousness, leading to smaller substitution effects. Despite that, the observed results suggest that households maintain a strong risk perception of housing risks and are responsive to relative changes in the market conditions, indicating a significant substitution effect (Chen et al., 2021).

Literature focuses also on heterogeneous analyses to differentiate portfolio allocation decisions according to households' factors, such as income levels, age groups, geographic regions and the number of properties owned.

Age is a crucial determinant in financial decision-making. After investing in housing, younger and older agents are more likely to reduce the equity market participation, due to limited financial wealth, resulting in an inverted U-shape relationship with the probability and degree of stock investment (Cocco, 2005; Zhou et al., 2017). Further life cycle framework analysis provides additional age-related insights: younger homeowners tend to be more affected by reducing investments in risky financial assets, due to life stage factors and financial constraints, since their significant wealth concentrates on housing and associated mortgage debt. Consequently, they tend to prioritize mortgage repayment or investments in safer assets like bonds instead of stocks. In contrast, older households (age 70 and over), with greater wealth and a lower housing-to-net-worth ratio, find stock ownership more attractive, investing up to 60% of their net worth in stocks. This reflects the reduced exposure to housing constraints, therefore, more ability to allocate a higher portion of their wealth into risky assets. Furthermore, assuming a moderate level of relative risk aversion, household with a house to net worth ratio of 3.5 (typical of those in their twenties) hold an optimal portfolio which contains 8.5% stocks, while a mature household with a house to net worth ratio of 0.76 (typical of those in their sixties) should hold a portfolio share of 57.5% in stocks (Flavin & Yamashita, 1998).

Analyses of portfolio composition by net worth exhibit substantial differences on wealth allocation proportion across income levels, supporting that economic status is an important factor influencing the allocation of financial assets and participation in financial markets. Compared to wealthy investors, low financial net worth households participate less in equity markets and hold less stocks, mainly due to liquidity constraints, limited wealth and avoidance of fixed costs once entering into the market (Cocco, 2005). These limitations are reflected when accounting for housing, for example, for Chinese

urban households, owning only one house significantly negatively impacts the probability of risky asset allocation and the proportion of market value of risky financial assets to financial assets. Specifically, the crowding-out effect is more pronounced for middle-income households (−0.1710), than for low-income households (−0.1629) and higher-income households (−0.1444). Regarding owning multiple houses, there is a positive effect on risky financial asset allocation, both for low-income (0.0423) and middle-income households (0.0428), revealing that owning multiple housing will increase the probability of risky financial asset allocation of low-income and middle-income urban households, an asset allocation effect. However, for high-income households, the impact of multi-homeownership is statistically insignificant for the probability of risky financial assets, as individuals of this income level display of more funds available, other than income through rentals, bed and breakfast operations and appreciation realization, to allocate into risky financial assets. Therefore, due to higher availability of funds, the asset allocation effect demonstrated is not significant enough (Wu & Yu, 2024).

Another line of literature expands the research by differentiating between tenure types. Differences between homeowners and renters from the perspective of financial market participation reveal the risks considerations associated with home ownership. Homeowners appear to be more risk averse, consequently, less prone to participate in the stock market and to allocate stock assets in financial assets, compared to renters (Huang, 2010; Zhou et al., 2017). This is possibly due to the renters' flexibility in adjusting housing expenditures more readily, a feature owners lack. This is supported by the lower significance of rent-to-income ratio in determining renters' risky asset share, contrasting with the significantly negative influence of mortgage-payment-to-income ratio on homeowners' risky asset holdings (Fratantoni, 1998). Additionally, when comparing USA and Sweden participation rates, a life-cycle portfolio choice model revealed a significant gap of 30–40 percentage points between homeowners and renters market participation rate. This disparity is attributed to renters' lower net worth, which further limits their stock market engagement compared to homeowners. This model also demonstrates a U-shaped life-cycle pattern of stock market participation pattern among renters. As homeownership rate rises, the stock market participation among renters declines, with higher-income renters transitioning to homeownership. The remaining lower-income renters display reduced financial capacity to invest, therefore, stock market

participation declines. When homeownership reaches the peak, renters' financial stability improves, leading to a return in stock market participation (Vestman, 2012).

In essence, several factors are mentioned as important determinants of the type of influence homeownership has on financial assets. Those factors include mainly housing-related payments, housing illiquidity, which reduces allocation flexibility, financial constraints, like mortgage debt, which limit wealth availability, house prices variations and expectations, financial benefits (like taxes), risk strategies and home equity. Individuals characteristics, such as age and income, the number of properties owned and the tenure type also determine financial choices.

2.2. Empirical Approaches

This section addresses the different econometric methodologies employed in empirical studies to investigate the relationship between homeownership and investments in risky assets. In existing literature, homeownership is often represented as a binary variable (Zhou et al., 2017) or with housing-related variables, such as mortgage-debt or home equity. (He et al., 2019; Michielsen et al., 2015). To study the effect of these variables on portfolio shares, researchers commonly employ econometric regressions models like Tobit, Probit or Logit (Gu & Zhu, 2024; Li et al., 2022; Michielsen et al., 2015; Wu & Yu, 2024; Zhou et al., 2017). Other methodologies are also implemented like the Heckman selection models (Iwaisako et al., 2016; Michielsen et al., 2015; Yuh, 2008), as well as econometric regression like Ordinary Least Squares (OLS) (Wu & Yu, 2024) and Two-Stage Least Squares (Cho, 2014; He et al., 2019; Michielsen et al., 2015). A different approach adopts a life-cycle asset allocation model incorporating Epstein-Zin recursive preferences to address the effects of housing investment on the portfolio allocation of households, while distinguishing risk aversion from intertemporal substitution (Pelletier & Tunc, 2019).

Regarding this matter, a few econometric issues are identified when calculating the effect of housing on portfolios. First, there is a risk of endogeneity between investments in financial assets and homeownership: housing can affect financial decisions, but the decision of households to participate in the stock market may reversely affect their decision of housing asset allocation (Zhou et al., 2017). This problem is generally

addressed by researchers through the addition of some Instrumental Variables (IV) to the econometric regression studied, in order to capture possible effects of unobserved variables in the dependent variable. For example, house price indexes (Chetty et al., 2017; Michielsen et al., 2015), dummy variables for whether the households have experienced housing demolition in the past or whether the households inherited houses (Zhou et al., 2017), the number of rooms at home, the number of years since the household moved into the community, the number of years since the household moved into the house, dummy variables for the region of residence (Cho, 2014), the supply of land for commercial use in the city (Sun et al., 2022), housing supply elasticities (Chetty et al., 2017), regional policies and others.

Another econometric issue present in the literature is the sample selection problem. Authors highlight the importance of including non-participant observations in the model to have a more comprehensive view of the differences between those who participate and those who do not. This is a crucial point since households decision to participate in the market is not random conditional and might have significant effects on the results, therefore, observing only market participants might result in biased estimations (Felici & Fuerst, 2023; Michielsen et al., 2015). To account for the selection bias problem methodologies like the Heckman type selection model are employed (Michielsen et al., 2015).

3. DATA, VARIABLES AND METHODOLOGY

3.1. Data

The data source for this study is the Portuguese HFCS, conducted by BdP and Statistics Portugal, covering the years of 2010, 2013, 2017 and 2020. This survey collects detailed data on the wealth, debt, income, consumption and savings of households living in Portugal. This survey is relevant for this study since it provides information on the distribution of real and financial assets and liabilities of households, by characteristics such as age, education, labor status and income, enabling a more detailed analysis of Portuguese households financial behavior (Banco de Portugal & Instituto Nacional de Estatística, n.d.). The final sample of the survey consists of observations from 4 404

households, 6 207 households, 5 924 households, and 6 107 households in 2010, 2013, 2017 and 2020, respectively.

Given that the HFCS surveys different samples of families in each wave, the data used in this study constitutes a pooled cross-section, allowing for an analysis of the change in the relationship between homeownership and investment behavior at population-level over the years. A crucial point to consider regarding the HFCS is the use of the multiple imputation method to mitigate information loss (Banco de Portugal, 2025). The multiple imputation method replaces non-answered questions with estimated values, based on the collected information. By replacing them with estimated values, this method considers the possibility of uncertainty in the imputed results, while previous methods were limited to replacements by using the mean, median, interpolation or even linear regression (Nunes et al., 2009). There are five alternative estimations for each variable and individual (Banco de Portugal & Instituto Nacional de Estatística, n.d.). Consequently, Rubin's Rules were applied to analyze the imputed data facilitating the interpretation of the multiple coefficients and enabling inferences without compromising the models validity (Nunes et al., 2009). These rules combine results from the separate analysis of each imputed data estimation into a single combined valid estimate, by averaging the individual coefficients (Nunes et al., 2009). In this sense, each model in this study was estimated five times and, when applicable, the results were averaged to obtain a single model with the final coefficients. Even after applying the multiple imputation method, some observations remain unanswered due to "don't know" or "prefer not to answer" responses, but when estimating STATA automatically removed these observations.

3.2. Variables

Focusing on the purpose of the present investigation, the relationship between homeownership and investment allocation is studied through the analysis of household homeownership status and financial assets holdings in three risk categories: high risk, moderate risk and low risk assets. The value of high risk assets is defined as the household's total amount invested in stocks, the value of moderate risk assets is the sum of the total amount of a household's investment in funds and other financial assets, including options, futures, patents (Brown et al., 2021; Yuh, 2008) and the value of low

risk assets is the sum of the total amount of a household's deposits, current accounts, bonds and government bonds (Brown et al., 2021; Yuh, 2008). The dependent variables are the proportion of high risk assets in total financial assets (*prop_high*), the proportion of moderate risk assets in total financial assets (*prop_moderate*), the proportion of low risk assets in total financial assets (*prop_low*) and their respective participation dummy variable (*high_risk_participation*, *moderate_risk_participation*, *low_risk_participation*), indicating whether the household invests in each category (yes = 1, no = 0). The independent variable measuring homeownership status (*homeowner*) is 1 for individuals with full ownership and co-ownership[1] and is 0 for rental and free use.

To separate the effects of various factors on households' portfolio choices, several control variables are also included in the regressions. The control variables include family characteristics that are known to influence market participation and investment decisions, such as age, gender, education level, marital status, risk preferences and job status (Zhou et al., 2017). Higher education levels include higher professional technical courses, bachelor's and master's degrees and doctorates. Total monthly consumption (*hi0220_R*) (Gu & Zhu, 2024) was added as a proxy of households income as it provides more complete observations compared to income data. The value of the property in the year of acquisition and in the year of the survey (He et al., 2019) were also added.

These characteristics refer to the main respondent of the household's financial information, considered by the members of the household as the financially knowledgeable person (FKP). However, the FKP, identified as the household head, is only distinctly identified for the years 2020 and 2017. For the year 2013, the FKP was selected based on the reference person, who is identified according to Canberra criteria (HFCN, 2020). The empirical analysis comprises a pooled cross-section of the latest dataset from 2013, 2017 and 2020, covering 18 099 observations.

3.3. Methodology

The choice of the empirical methodology used in this investigation is based on the characteristics of the variables of interest. The dependent variables, the proportion of

[1] Co-ownership grants a property right over a property, shared with one or more individuals

financial assets in total assets and the participation decisions, are defined and observed only in the interval between 0 and 1. The bounded nature of these variables makes fractional regression models more appropriate, since it guarantees that the predicted values of the dependent variables are restricted to the unit interval [0, 1], by assuming a functional form for the dependent variable:

(1) $E\ (Y|X) = G(X\beta)$

where $G(.)$ is a nonlinear function satisfying $0 < G(.) < 1$ and β the vector of parameters to be estimated (Ramalho et al., 2011).

Additionally, it is important to recognize that boundary observations (at 0 or 1) reflect individual choices, not any type of censoring. This fundamental distinction further justifies the use of fractional regression models over alternative approaches, like Tobit models (Ramalho et al., 2011). Therefore, a two-part fractional regression model approach is more fitting. This approach analyzes separately the participation decision and the amount decision, providing a more detailed and complete analysis of households' investment choices. The first part consists of a standard binary choice model, which governs participation, that is, the probability of observing a positive outcome (Ramalho et al., 2011). Define

(2) $\text{y} * = \begin{cases} 0\ for\ \ Y = 0 \\ 1\ for\ Y\ \in\ (0,1) \end{cases}$

In this part, the dependent variables (represented in the system with $y*$) are the dummy variables indicating whether the household invests in high, moderate or low risk assets. The second part of the model estimates outcomes conditional to positive choices (Ramalho et al., 2011). Thus,

(3) $E(Y|X\ , Y \in (0,1)) = G(X\beta)$

As for fractional regression models, the function $G(X\beta)$ is estimated using the robust quasi-maximum likelihood (QML) method, which provides consistent estimates without requiring the assumption of its true distribution (Ramalho et al., 2011). Here, the dependent variables are the proportion of high, moderate and low risk assets. The Probit function form was employed to estimate both the impact of housing on the decision to participate and the decision on the proportion of the financial asset held conditional to the

households who hold investments. To assess the robustness of the model specification, a RESET test is implemented for both parts of the model (Ramalho et al., 2011). The RESET test is commonly applied in literature to test for misspecification, primarily in linear models. However, it can be extended to assess the functional form of generalized models. This regression error specification test evaluates the functional form of the model and potential non-linear relationships that are not captured by the model due to omitted variables (Sapra, 2005), by introducing to the original model its estimated error term.

Literature often highlights the endogeneity bias involving these variables. To address the potential reverse causality, we limit the sample to households that have lived in their current house for over 12 months, ensuring the housing asset allocation decision precedes the investment decisions (Zhou et al., 2017). Instrumental Variables were added to account for the potential endogeneity problem (Zhou et al., 2017). The variables whether the household has children, whether the household savings are to buy a house and the period of residence in accommodation (years) (Cho, 2014) are used as instruments for home ownership. To be a good instrument, an IV must be correlated with the endogenous explanatory variable (EEV), influence the dependent variable exclusively through the EEV and cannot be correlated with the error terms. Theoretically, the period of residence in accommodation is correlated with housing consumption demand, and not directly with shares of investments (Cho, 2014). It is expected that individuals saving to purchase a house influences their homeownership status and that its influence on the dependent variables is solely through the homeowner variable.

It is important to note some limitations regarding the IV used due to limited information availability. Therefore, omitted information and flaws in its foundations are risks that should be considered when interpreting the results. Nevertheless, the validity of these instruments is justified by their join F-statistics ($F > 10 = 70.48$) and statistical significance (p-value < 0.05, across five imputations).

Due to the potential endogeneity, the first part of the model was estimated using an IV Probit model. However, given that the second part focuses on the proportion of investments conditional on positive outcomes, the fractional Probit regression model was estimated with the Control Function (CF) approach. The CF method was applied to deal with the EEV in this part of the model (Wooldridge, 2015). This method consists of

estimating the EEV on all control variables and IV to obtain the residuals and then include the estimated residuals as an additional variable in the fractional regression model. The significance of these estimated residuals (which serve as the CF term) in the extended model acts as a test for endogeneity in the main model (Wooldridge, 2015). The residuals were estimated by OLS, which is appropriate for obtaining unbiased residuals from the reduced equation.

4. EMPIRICAL ANALYSIS

This analysis includes four different phases: starting with a baseline description of the sample, followed by an examination of the linear relationships through a correlation matrix to test the presence of multicollinearity; then, the analysis of the estimated results from the two parts of the model, focusing on the participation decision and proportion of investments.

Table I presents the descriptive analysis for the variables of the model of the first imputation. Around 84% of the Portuguese households have one house, revealing its importance on wealth allocation. It also demonstrates the Portuguese households preference for safer financial assets, with only 7% and 5% holding high and moderate risk assets, respectively, compared to 96% holding low risk assets. Portuguese families allocate, on average, 1.1%, 1.3% and 93% of their wealth in high risk, moderate risk and low risk assets, respectively. These findings are consistent with the high proportion of risk averse household heads (90%). The average age of the household head is 58 and 60% of them are male and married, 31% have no education and only 24% have higher levels of education. Half of the Portuguese households head are employed and only 6.3% are in fact unemployed. On average, Portuguese households spend 987 units of currency on total monthly consumption. Comparing households expected house values from the year of acquisition to the year of the survey, there was, on average, an increase of 85%.

The correlation matrix, presented in Table II, is employed to assess the multicollinearity of the coefficients estimated from the first imputation. Based on this linear relationship analysis, there are no high correlations among the variables, except the pair of dependent variables *prop_low* and *low_risk_participation*, which shows the strongest relationships in the matrix (0,8574). All other relationships are found to be

weak. For example, homeownership and all assets proportions and participation dummies have a weak and positive correlation. Risk aversion is negatively related to high and moderate risk proportions and participation dummies and positively related to low risk assets proportion. Meaning that, risk averse households invest less in risky assets, compared to safer assets. Also, older, uneducated and unemployed Portuguese households tend to invest less, as opposed to younger and higher educated employed households. Higher educated Portuguese households tend to participate and invest more in risky investments. A similar outcome is observed for employment status, with employed households being more likely to participate and invest more across all three levels of risk. These results reject the presence of significant multicollinearity and, for the dependent variables, they show a strong linear relationship for low risk assets, which is reasonable.

TABLE I

DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. dev.	Min	Max
high_risk_participation	18099	0.070391	0.2558113	0	1
moderate_risk_participation	18099	0.0481242	0.214035	0	1
low_risk_participation	18099	0.0481242	0.1913667	0	1
prop_high	18099	0.9619316	0.0723358	0	1
prop_moderate	18099	0.0135496	0.083481	0	1
prop_low	18099	0.9373454	0.2174064	0	1
homeowner	18099	0.843693	0.3631562	0	1
age	18099	58.29919	14.75471	18	90
male_dummy	18099	0.6069949	0.4884314	0	1
married_dummy	18099	0.6376595	0.4806897	0	1
risk_aversion	18085	0.9031794	0.2957215	0	1
higher_education_dummy	18099	0.2453174	0.4302871	0	1
no_education_dummy	18099	0.3176971	0.4655939	0	1
employed	18099	0.5095309	0.499923	0	1
unemployed	18099	0.0632632	0.2434424	0	1
hi0200_R	18099	987.9146	675.654	0	17500
value_house0	18099	72952.88	96501.66	0	5000000
value_house1	18099	135268.2	129784.6	0	2900000

Note: Std. de. is the standard deviation; Min and Max are the minimum and maximum value for each variable, respectively.

TABLE II

CORRELATION MATRIX

Variable	prop_h~	prop_m~	prop_low	high_r~n	moderate~n	low_ri~n	homeow~r	age	male~y	marrie~y	risk_a~n	higher~y	no_edu~y	employed	unempl~d	Hi0220
prop_high	1.000															
prop_mode~e	0.0435	1.000														
prop_low	-0.3227	-0.3706	1.000													
high_risk~n	0.5656	0.1409	-0.1947	1.000												
moderate_r~n	0.0733	0.7218	-0.2628	0.2431	1.000											
low_risk_p~n	0.0269	0.0219	0.8574	0.0536	0.0406	1.000										
homeowner	0.0246	0.0394	0.0897	0.0690	0.0540	0.1280	1.000									
age	-0.0080	-0.0074	-0.0447	-0.0051	-0.0242	-0.0567	0.0268	1.000								
male_dummy	0.0564	0.0264	0.0251	0.0963	0.0528	0.0622	0.0976	-0.0157	1.000							
married_du~y	0.0314	0.0040	0.0645	0.0699	0.0297	0.0873	0.1640	-0.0424	0.4331	1.000						
risk_aversion	-0.1829	-0.2343	0.1070	-0.2730	-0.3231	-0.0504	-0.0580	0.1142	-0.0808	-0.0453	1.000					
higher_edu~y	0.0836	0.1312	-0.0028	0.1860	0.2015	0.0857	0.0875	-0.1975	-0.0554	-0.0397	-0.2122	1.000				
no_educati~y	-0.0538	-0.0529	-0.0514	-0.0932	-0.0785	-0.1011	-0.0555	0.3618	-0.0113	-0.0231	0.1097	-0.2864	1.000			
employed	0.0274	0.0286	0.0542	0.0487	0.0551	0.0845	0.0602	-0.6734	0.0544	0.0690	-0.1237	0.2403	-0.3095	1.000		
unemployed	-0.0168	-0.0195	-0.0328	-0.0386	-0.0361	-0.0518	-0.0867	-0.1492	-0.0190	-0.0302	0.0320	-0.0678	-0.0264	-0.2648	1.000	
hi0200_R	0.0951	0.1141	0.0045	0.1772	0.1578	0.0891	0.1197	-0.0379	0.1072	0.1589	-0.1603	0.2947	-0.3199	0.1207	-0.0745	1.000
value_house0	0.0826	0.0919	0.0130	0.1605	0.1429	0.0847	0.3253	-0.2566	0.0776	0.1082	-0.1837	0.3306	-0.2322	0.2815	-0.0338	0.2523
value_house1	0.1002	0.1288	0.0132	0.2035	0.1762	0.1085	0.4486	-0.0418	0.0775	0.1361	-0.1808	0.3286	-0.1966	0.1366	-00683	0.3019

4.1. The Impact of Housing On Households' Financial Asset Participation

In the first part of the model, as previously mentioned, the probability of investing in financial assets is estimated for the three levels of risk, high, moderate and low, through an IV Probit model, to account for endogeneity with robust standard errors.

The Wald test of exogeneity for low risk assets participation does not indicate significant evidence of endogeneity consistently across the five imputations (p-values > 0.05), meaning that the statistical evidence supports the exogeneity of the homeowner regressor (Table III). Thus, the model can be estimated without IV. Without the instruments, the homeowner variable becomes significant, showing that homeowners are more likely to hold low risk assets in each imputation (p-values < 0.01). The rejection of significant endogeneity can be a consequence of weak instruments, despite their joint significance. Furthermore, the RESET test for this part of the model is rejected in every imputation, with significant p-values, suggesting that the Probit model for low risk participation is poorly specified (Table III). This implies that the Probit model is not correctly capturing the relationship between the independent variables and the low risk participation variable. Therefore, the estimated coefficients of this model may be inconsistent and biased, meaning that they may not reflect true effects. Consequently, the Rubin's Rules are not applied in this section, as the results would not be valid.

With a similar outcome, the Wald test of exogeneity for high risk asset participation revealed non-significant p-values (> 0.05) for all imputations (Table III). With no significant statistical evidence supporting that the homeowner variable is endogenous, the model is estimated without IV. However, the specification of the Probit model for high risk participation is rejected by the RESET test, justified by significant p-values (p-values < 0.01) (Table III). Consequently, the Rubin's Rules are not applied, as the results would not be valid.

In contrast to the findings for the high and low risk asset participation, the Wald test of exogeneity for the moderate risk participation indicates the presence of endogeneity across the five imputations, with significant p-values (p-values < 0.05) (Table III). This test indicates that the homeowner variable is an endogenous regressor, confirming that the IV Probit estimation is the proper approach to control for the presence of endogeneity.

However, the RESET test rejects this model specification in all five imputations. By including the linear prediction from the estimated residuals in the IV Probit, the model controls for unobserved variables correlated with the variable homeowner and the error term of the main equation, resolving the endogeneity issue, as confirmed by the Wald test of exogeneity (Table III). Due to misspecification, validated by the RESET test (significant p-values = 0.00), the Rubin's Rules are not applied (Table III).

Once the RESET test revealed misspecification in this part of the model across all three levels of risk, no inference can be made regarding the effects of homeownership in the participation in low, high and moderate asset risks investments.

TABLE III

ENDOGENEITY OF HOMEOWNERSHIP AND MODEL SPECIFICATION TEST RESULTS

FIRST PART

	Imputation				
First Part of the Model	1	2	3	4	5
Wald test of exogeneity (p-value)					
IV Probit					
low_risk_participation	0.5097	0.3101	0.3749	0.341	0.3661
high_risk_participation	0.7191	0.8997	0.9262	0.8995	0.9573
moderate_risk_participation	0.0142	0.0286	0.0263	0.0220	0.0191
RESET test (p-value)					
low_risk_participation (Probit)	0.00	0.00	0.00	0.00	0.00
high_risk_participation (Probit)	0.0001	0.0022	0.0037	0.0086	0.0095
moderate_risk_participation (IVProbit)	0.00	0.00	0.00	0.00	0.00

Note: Dependent variables: low_risk_participation, moderate_risk_participation, high_risk_participation. Independent variables: homeowner, age, male_dummy, married_dummy, risk_aversion, higher_education_dummy, no_education_dummy, employed, unemployed, hi0200_R, value_house0, value_house1, iYEAR (2017, 2020).

4.2. The Impact Of Housing On Households' Financial Asset Proportion

To estimate the impact of homeownership on the proportion of households financial assets, the second part of the model uses a fractional regression model with robust standard errors.

For low risk assets proportion, the p-value of the homeowner residuals variable is significant, across the five imputations, suggesting that, in this part of the model, homeowner is endogenous (Table IV). This statistical significance justifies the homeowner residuals variable inclusion in the final model. The RESET test verifies in every imputation the specification of the model, with high p-values (Table IV). When applying the Rubin's Rules (Table V), the variables homeowner, age, marital status, risk aversion, higher education, no education, unemployed, total monthly consumption and current house value become statistically significant for the proportion of low risk assets (with a p-values lower than 0.05), meaning that these variables influence the proportion of wealth allocated into low risk assets, like deposits, current accounts and bonds. Specifically, Portuguese homeowners tend to allocate higher proportions of wealth into low risk assets, suggesting that homeownership is associated with a shift towards safer investments. Age, marital status and higher education variables are associated with smaller proportions of low risk assets. This result is also observed for male households, suggesting that, compared to women, men tend to be more risk-seeking. Individuals with no education levels tend to invest more in safer assets, as opposed to higher educated individuals. As documented in literature, the results confirm that age is associated with smaller proportions invested in riskless financial assets, suggesting that older individuals tend to invest more in risky assets, since they are expected to be less financially constrained, compared to younger households (Flavin & Yamashita, 1998). Conversely, risk aversion reveals a positive impact on the proportion of low risk assets, meaning that risk averse households tend to allocate more wealth into safer assets. Additionally, compared to 2013, Portuguese households allocated higher proportions of wealth into safer assets in both 2017 and 2020. Notably, the current house value and the total monthly consumption indicate a significant negative relationship with the proportion invested in safer assets.

The estimations for the proportion of high risk assets revealed, firstly, no significant evidences of endogeneity in any imputation, explained by the high p-values of the homeowner residuals variable and, secondly, the RESET test validated the Probit model without the IV (Table IV). Applying the Rubin's Rules, the variables homeowner, marital status, risk aversion and higher education are significant, with a p-value lower than 0.05, while the others remain insignificant (Table VI). The findings reveal a significant

negative relationship between the proportion of high risk assets and the variables homeownership, marital status, risk preferences and education. The negative coefficient of the homeowner variable reveals that being a homeowner is associated with a smaller proportion of risky assets held in their portfolios. This outcome confirms that homeownership significantly crowds out the proportion invested in high risk investments, as indicated by literature. Furthermore, married, higher educated and risk averse Portuguese households tend to hold smaller proportions of high risk assets. Additionally, in 2020, Portuguese households held smaller percentages of high risk assets in their portfolios, compared to 2013.

Lastly, the CF approach applied to test the endogeneity in the second part of the fractional Probit regression model for the moderate risk proportion, reveals that the residuals homeowner variable is not significant, thus, there is no evidence of endogeneity between homeownership and moderate risk proportion (Table IV). The RESET test (p-values > 0.05 for all imputations) validates the functional form, with homeowner acting as an exogeneous regressor (Table IV). Consequently, it is reasonable to apply the Rubin's Rules (Table VII). The final combined model exhibit significance for marital status and the value of the house in the year of acquisition (p-value < 0.05), revealing a negative relationship between married Portuguese households and the proportions of moderate risk assets, meaning that, married Portuguese households tend to hold smaller proportions of moderate risk investments. Additionally, comparing to 2013, in 2017 and 2020, Portuguese households held smaller percentages of moderate risk assets. Regarding homeownership, the variable homeowner is not significant for the proportion of moderate risk assets (Table VII).

TABLE IV

ENDOGENEITY OF HOMEOWNERSHIP AND MODEL SPECIFICATION TEST RESULTS

SECOND PART

	Imputation				
Second Part of the Model	1	2	3	4	5
Test for endogeneity (residual homeowner p-value)					
IV Probit					
prop_low	0.006	0.001	0.003	0.001	0.001
prop_high	0.159	0.8997	0.133	0.0639	0.056
prop_moderate	0.121	0.056	0.098	0.050	0.046
RESET test (p-value)					
prop_low (IVProbit)	0.828	0.324	0.393	0.505	0.381
prop_high (Probit)	0.972	0.576	0.757	0.6214	0.6203
prop_moderate (Probit)	0.146	0.0953	0.616	0.469	0.274

Note: Dependent variables: proportion of low, high and moderate risk assets. Independent variables: homeowner, age, male_dummy, married_dummy, risk_aversion, higher_education_dummy, no_education_dummy, employed, unemployed, hi0200_R, value_house0, value_house1, iYEAR (2017, 2020).

TABLE V

EFFECT OF HOMEOWNERSHIP ON THE PROPORTION OF LOW RISK ASSETS (COMBINED IV PROBIT MODEL)

Dependent variable: prop_low			
Regressors	Coefficient	Robust std. err.	p-value
cons	0.8702***	0.2876	0.0034
homeowner	1.6096***	0.5164	0.0027
age	-0.00586**	0.00231	0.016
male_dummy	-0.1411***	0.0396	0.0004
married_dummy	-0.0675	0.0511	0.19
risk_aversion	0.7607***	0.0368	<0.0001
higher_education_dummy	-0.1924***	0.0397	<0.0001
no_education_dummy	0.1378***	0.0455	0.0035
employed	0.0205	0.049	0.677
unemployed	0.2722***	0.0955	0.0055
hi0200_R	-0.000071***	0.0000211	0.0013
value_house0	-3.26E-07	2.25E-07	0.146
value_house1	-2.62E-06***	5.81E-07	<0.0001
Year_2017	0.0883**	0.04	0.0292
Year_2020	0.1442***	0.0389	0.0002
residuals_homeowner	-1.6268***	0.5095	0.0023

Note: Rubin Rules applied by Artificial Intelligence.

*, ** and *** represent statistical significance at levels of 10%, 5% and 1%, respectively.

TABLE VI

EFFECT OF HOMEOWNERSHIP ON THE PROPORTION OF HIGH RISK ASSETS (COMBINED PROBIT MODEL)

Dependent variable: prop_high			
Regressors	Coefficient	Robust std. err.	p-value
cons	-0.3278	0.2162	0.1294
homeowner	-0.2993**	0.1175	0.0109
age	-0.0001	0.0025	0.9645
male_dummy	0.0014	0.0663	0.9827
married_dummy	-0.1231**	0.0625	0.0487
risk_aversion	-0.1903***	0.0542	0.0004
higher_education_dummy	-0.2156***	0.0582	0.0002
no_education_dummy	-0.0504	0.0787	0.5217
employed	-0.0022	0.0724	0.9761
unemployed	0.0616	0.1534	0.6879
hi0200_R	-0.0000034	0.000028	0.9023
value_house0	5.21E-08	0.00000026	0.8412
value_house1	1.56E-08	0.00000023	0.9461
Year_2017	-0.0069	0.0647	0.9146
Year_2020	-0.185***	0.0651	0.0045

Note: Rubin Rules applied by Artificial Intelligence.
*, ** and *** represent statistical significance at levels of 10%, 5% and 1%, respectively.

TABLE VII

EFFECT OF HOMEOWNERSHIP ON THE PROPORTION OF MODERATE RISK ASSETS (COMBINED PROBIT MODEL)

Dependent variable: prop_moderate			
Regressors	Coefficient	Robust std. err.	p-value
cons	-0.436**	0.2099	0.042
homeowner	0.0397	0.1026	0.699
age	0.004	0.0025	0.122
male_dummy	-0.0859	0.0646	0.184
married_dummy	-0.1544**	0.0634	0.017
risk_aversion	-0.0672	0.055	0.228
higher_education_dummy	-0.0679	0.0604	0.265
no_education_dummy	0.0256	0.0782	0.743
employed	-0.0125	0.0722	0.864
unemployed	0.0308	0.1882	0.875
hi0200_R	1.77E-05	2.83E-05	0.527
value_house0	-6.28E-07**	2.77E-07	0.027
value_house1	3.61E-07*	2.04E-07	0.085
Year_2017	-0.158**	0.0713	0.03
Year_2020	-0.3315***	0.0645	<0.001

Note: Rubin Rules applied by Artificial Intelligence.
*, ** and *** represent statistical significance at levels of 10%, 5% and 1%, respectively.

5. CONCLUSION

The relationship between homeownership and asset allocation decision-making is extensively covered in literature. However, empirical and theoretical studies provide mixed findings regarding the accurate impact of owning a house and investing in assets. Several studies argue that homeownership act as a financial constraint to risky investments (Zhou et al., 2017; Vestman, 2012), suggesting that homeowners allocate less of their wealth into risky investments, identifying some responsible factors like housing-related payments, like mortgage debt, financial benefits, risks and housing price risks. Alternatively, some authors find a different effect, where homeownership positively affects the allocation of risky investments by stimulating it (Gu & Zhu, 2024; Yao & Zhang, 2005).

Based on these two concepts, two hypotheses were formulated in the beginning of this paper. First, homeownership has a crowding-out effect on risky financial assets; and the second is homeownership has a diversification effect on risky financial assets.

Using a sample comprising 18 099 observations for the period of 2013, 2017 and 2020, the estimation results of two-part fractional Probit model revealed the following insights regarding Portuguese households, specially focusing on Portuguese homeowners.

First, homeownership does not significantly affect the proportion invested in moderate risk assets, for investors who participate in the moderate asset market. Other control variables also are insignificant.

Second, the homeowner variable is significant for the proportion of high and low risk assets. This means that having a house significantly affects the proportion invested in high risk assets and low risk assets. The negative relationship between homeownership and the proportion of high risk investments confirms the first hypothesis, indicating that homeownership crowds out financial investment, for high risk assets, such as stocks. This evidence aligns with previous empirical findings mentioned in the literature (Flavin & Yamashita, 1998; Grossman & Laroque, 1990; Vestman, 2012).

Complementarily, the positive relationship found for homeownership and the proportion of low risk assets supports the second hypothesis for safer assets, suggesting that homeownership stimulates lower risk investments. This finding is also consistent with the conclusions of existing research. Thus, Portuguese households, tend to adopt more risk averse investment strategies once they own a house, leading to a reallocation of wealth towards low risk assets. Risk aversion, gender, age, marital status and level of education significantly influence Portuguese households´ investment choices, for both safer and risky assets.

It is important to acknowledge the limitations of this research, as they narrowed the extent of its insights. Given the misspecifications of the first part of the model, justified by the RESET test, changes in future investigations are required, for example adding more explanatory variables or alternative IVs. Regarding the choice of IVs, it is important to acknowledge certain weaknesses in their foundation. However, due to limited data availability, these instruments were maintained in the model and used to detect endogeneity. Therefore, stronger IVs with solid theoretical foundations would be an improvement. Although the focus of this investigation was to test the significance of homeownership in allocation decision-making, it would be interesting for future investigation to add more housing-related variables, like having financial constraints or housing price expectations.

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