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Can a small leak sink a great ship? A comprehensive analysis of the Portuguese household savings

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GEE

Can a small leak sink a great ship?
A comprehensive analysis of the Portuguese household savings [1]

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Abstract:

The household saving rate is slowing down since the mid-1980s and in 2018 registered a record low. This article aims to contribute to the debate on the evolution of household savings in Portugal by considering both the microeconomic behaviour and the macroeconomic dynamics of household savings. First, we use microdata from the Household Finance and Consumption Survey (HFCS) to empirically assess the main microeconomic determinants of household savings, the heterogeneity across households regarding different ways of financing negative savings, and the main factors determining liquidity constrained agents. Second, we develop a time-series model for aggregate consumption to forecast the household saving rate in Portugal. We found household characteristics and heterogeneity regarding individual variables to be significant and economically important determinants of household saving decisions and credit constraints. Moreover, our out-of-sample forecast suggests there was no structural change in household savings decisions, indicating that the unexpected rise in the Portuguese household saving rate during the 2008 recession was led by temporary shocks to income and wealth.

JEL Classification Codes: C32; C8; D13; D14; D15; D91; E21; E27

Keywords: Household Savings, Survey Data, Microeconomic Behaviour, Time-series; Macroeconomic Forecasting

Note: This article is the sole responsibility of the authors and does not necessarily reflect the positions of GEE or the Portuguese Ministry of Economy.

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"*Beware of little expenses; a small leak will sink a great ship.*"
Benjamin Franklin - *Almanack (1732-1758)*

1. Introduction

For more than two decades, the Portuguese economy has been continuously expanding its level of debt, relying on international borrowing to finance its spending. Data from the Bank of Portugal shows that the current and capital account balance was only positive from 2012 onwards, meaning that during the period 1995-2011, capital and transactions out-flowing from Portugal fell behind the inflows from overseas (Figure 1). Thus, it is of utmost importance to understand how the different economic agents are performing with regards to their financial needs and, hence, further study their contribution to the economy's macroeconomic imbalances.

In absolute terms, since 2008, the public administration's budgetary balance has been deteriorating, i.e. the revenues generated by the state are falling short on covering its expenditures. In 2018, the accrued debt was more than twice the stock measured in 2008.[4] Relatively to GDP, some progress has been made following 2014's peak at 130.9%, with 2019 set to be the year with the lowest budget deficit of the last 40 years (estimated at 0.2%).[4] Yet, the public debt is still over 120%, placing Portugal on the podium of the most indebted European countries in 2018. Contrarily, the total debt accumulated by firms and households has not been increasing. Private businesses' debt reached its maximum in 2012 and has, since then, been steadily decreasing.[4] Indeed, the amount of newly raised debt has been out-weighted by the settled amounts, though the pre-crisis levels are yet to be reached.

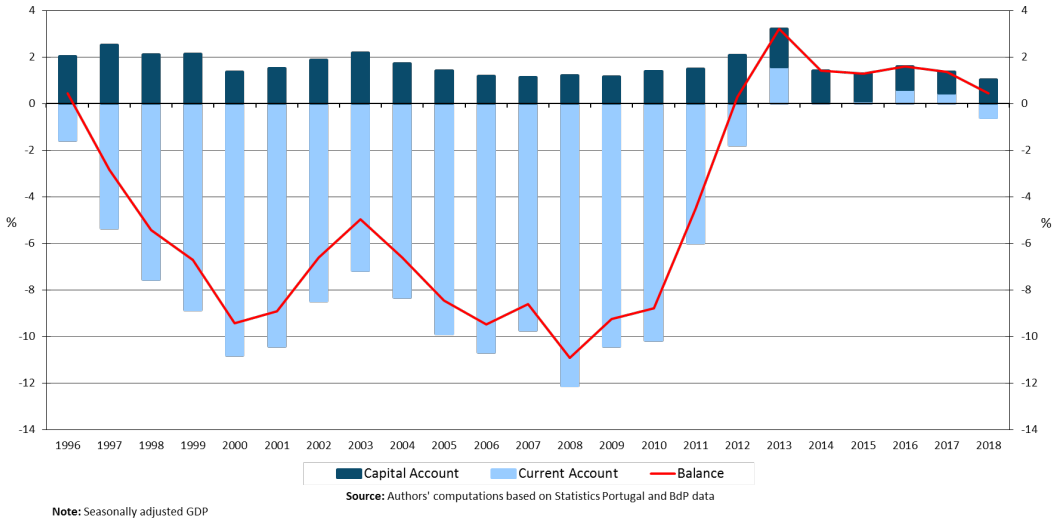


Figure 1: **Current and capital accounts (% GDP)**

Households', however, tell a different story. In 2010, in the aftermath of the crisis, the debt levels rose to their largest absolute value.[4] Also, as a share of gross income, the highest registered level of household debt as a share of total income was reported in 2009 (127.56%).[4] However, the European sovereign debt crisis restricted the Portuguese banks' capacity to obtain international financing, which resulted in stricter criteria for households to borrow from the financial market. Simultaneously, the macroeconomic conditions deteriorated, leading the Portuguese families to be more cautious with regards to their expenditures and, consequently, to a fall on their debt levels. Indeed, household debt levels have been on a diminishing trend from thenceforth, reaching the lowest observed value in 2018.[4] This extra level of precaution adopted by Portuguese households following the onset of the financial crisis led to a momentary rise of the personal savings rate in Portugal as individuals fear the imposition of additional financial restrictions. Yet, this pick up was neither substantial nor long-lasting (Figure 2).

[4]All data was retrieved from the Bank of Portugal

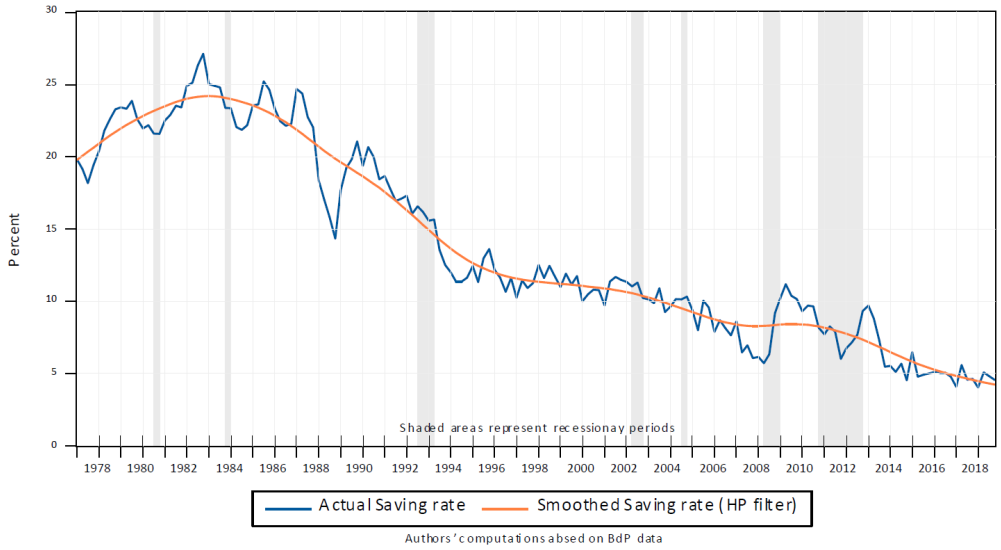


Figure 2: **Net lending/borrowing by institutional sector**

We thus reach the trigger of the present study. Though household debt levels are diminishing and the personal saving rate abruptly increased during the last two recessionary periods, the latter has been on a ceaselessly downward path since the end of the previous recessionary period.

Our microeconomic analysis allows for a better comprehension of the population and enables the identification of households who are more vulnerable to credit default, with regards to their socioeconomic characteristics. Take the example of a leaking boat. When the crew of a great ship discovers it is leaking, fixing the boat becomes their number one priority. They then need to precisely detect all the sources of leakage and cover them up, as even "a small leak will sink a great ship" (Benjamin Franklin). Similarly, when our economy displays increasingly lower levels of household savings, it is vital to understand who are the families mostly contributing to these phenomena, bearing in mind overall characteristics they are likely to share. As well, after covering up the leaks, the crew would try to map the areas of the ship that are more vulnerable to new leaks to prevent future incidents. Our insights are intended to better inform policymakers and enable the design of more accurate preventive policies targeting families more prone to have expenses higher than their income, henceforth being unable to save.

An economy where private savings are down is particularly worrisome since it may negatively impact the country's growth in several ways. Firstly, choosing consumption today in detriment of future expenditures means individuals might be overspending their budget, leaving little room for banks to lend money, which might stagnate productivity levels and consequently, economic growth. Besides, not only low savings hinder investment, but they also prevent families from accumulating wealth, an important instrument to increase their resilience to future financial restrictions. In the 2008-09 financial crisis, Portuguese households were highly indebted and had few liquid assets to meet their financial commitments. In a future recession, the problem may be further aggravated as the focus of policymakers' concern might not be the liquidity of the held assets but rather their nonexistence.

One novelty of the paper is the joint presentation of micro and macroeconomic evidence. The two measurements are complementary since household decisions are not always consistent with the macro effects at the aggregate level. An example of these puzzling effects is present by Keynes as the "paradox of thrift", where households decide to increase savings but, given the contractionary impact of these decisions on demand and disposable income, overall savings ends up declining. Accordingly, this paper presents two complementary dimensions of the household saving rate: microeconomic and macroeconomic evidence.

2. *The Small Leaks* - A Micro Perspective of Household Saving Behaviour

Households react to economic stimulus such as movements in the interest rate. Yet, their reactions and subsequent decisions differ as well across households with distinct socioeconomic characteristics. Hence, it is essential to understand which households are more able to save. This analysis enables a better understanding of how these changes in the population's composition might impact savings stocks in the future. For instance, the dependency ratio (i.e. the percentage of individuals aged 65 or more over those adults in a working age) is estimated to more than double in the next fifty years, reaching 67% by 2070, as Portugal is expected to suffer one of the most severe ageing processes within the Euro Area (European Commission, 2018). Likewise, Alves and Cardoso (2010) show that Portuguese individuals over 64 tend to diminish their saving levels. Hence, the changes in the age pyramid might lead to a further reduction of the aggregate savings, which needs to be further studied and addressed.

2.1. Data description and methodological issues

The first part of the paper is based on the microdata from the second wave of the Eurosystem Household Finance and Consumption Survey (HFCS). The HFCS produces important information in areas related to saving and consumption decisions, portfolio allocations, employment, income and liquidity constraints, demographic and socioeconomic measures as well as qualitative information about households' expectations.[5] Though the survey pools information in a single micro dataset per country, it aims to provide country-representative data across all Euro Area countries, which allows for in-depth scientific analysis and consistent comparisons across different countries.[6]

In Portugal, the survey has been managed by the Bank of Portugal and by Statistics Portugal. The first wave was conducted in 2010 (data collection from April 2010 to July 2010) and the second wave in 2013 (data collection from March 2013 to July 2013). The third wave of the HFCS was conducted in 2017, and its results are expected to be released at the end of 2019. We build on the second wave, which represents the last dataset available to date. The final net sample includes 6.207 households, compared with 4.404 households in the first wave, and registered a response rate of 84.8%, corresponding to an eligibility rate of 91.5%.[7]

The sample is intended to represent households living in Portugal and includes a strategy that over-samples wealthy households, aimed to obtain more accurate estimates on the right tail of the wealth distribution (Kennickell, 2008).[8] Individual answers were subject to logical consistency checks leading to queries and data edits on non-response item. The multiple imputation strategy is based on an interactive Bayesian stochastic model with chained equations, resulting in five different implicates for each variable set to adjust for imputation uncertainty accurately.[9] We followed some extracts of code for Stata provided by the ECB and executed all multiple imputations and weighted regressions using standard estimation procedures with *mi svyset* structure, which provides robust estimates and standard errors. To compute medians and quantiles, we use the Stata package *medianize*. The survey uses the rescaling bootstrap according to Rao and Wu (1988), as further specified by Rao and Wu (1988) and Rao (1996), since it constitutes a robust and flexible way to estimate variance, even in the case of complex survey designs.

[5] Differences in purchasing power parities (PPP) are taken into account by the use of monetary control variables included as weighted quintile dummies, and so we did not apply inflation and PPP adjustments since they have minimal impacts (Network, 2016).
[6] The methodological features of HFCS can be accessed in more detail in Costa et al. (2016) and Network (2016).
[7] Interestingly, the incentives provided to respondents are quite disparate across countries, which might have an impact on the reported results (for example, Portugal provided no financial incentives, but Luxembourg gave a coin set in the value of 30$).
[8] The strategy included 50% of the sample drawn for dwellings with a floor space (m2) above a predefined threshold, located in the metropolitan areas of Lisbon and Porto, regions where there was evidence for a higher probability of having wealthy households.
[9] The aim of dealing with the missing values is to impute in such a way that the associations between all variables are preserved in terms of maintaining the correlation structure of the dataset. This approach to impute missing data has been made in similar surveys such as the U.S. Survey of Consumer Finances and the Spanish Survey of Household Finances. We combine the results for each of the five implicates according to Rubin (2004) and follow the multivariate procedure according to (Royston, 2008) using the Stata software.

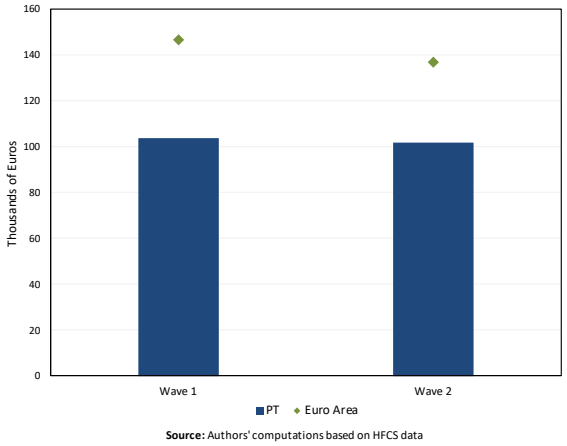
2.2. Descriptive statistics

This chapter summarises key stylised facts from the second wave of the HFCS regarding assets, liabilities and net wealth along with income, consumption and credit constraints. Section 2.2.1 discusses the composition of both the assets and liabilities side of euro area households' balance sheets and describes the distribution of net wealth, the difference between total assets and total liabilities. Section 2.2.2 looks in more detail into the total household gross income, defined as the sum of all pre-tax income sources at the household level (excluding mandatory contributions for retirement plans), as well as summarises the leading indicators of household consumption and savings.

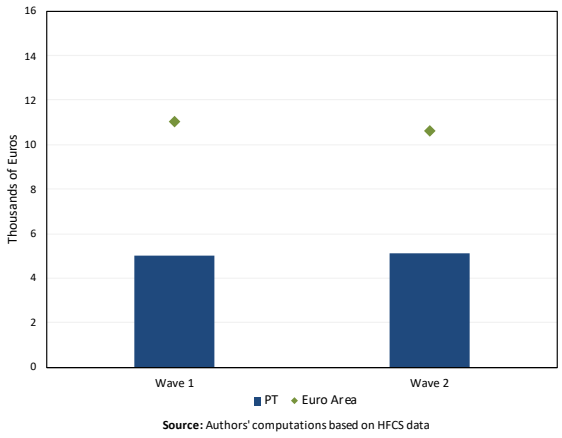
2.2.1. Assets, liabilities, net wealth and inequality

We summarise the leading stylised facts about real and financial assets and their components. In general, real assets are composed of the household main residence (HMR), other real estate properties, vehicles (such as boats, planes or motorbikes), valuables (such as jewellery, works of art, antiques), and others (mostly self-employment businesses). On the other hand, financial assets are mainly composed of sight accounts (deposits that can be withdrawn from a bank either without notice, or after a short notice period), savings accounts, voluntary pensions schemes and whole life insurance, tradable assets (bonds, investments in private businesses, and stocks), and others (such as options, futures, index certificates, royalties).[10]

Figure 3 shows the average portfolio structure held by households in Portugal and the Euro-Area, comparing the results between the two waves. In Portugal, the average household real assets portfolio decreased from 103.8 to 101.9 thousand euros, respectively, between the first and second wave. Similar developments have taken place in the Euro-Area (it decreased from 146.3 to 136.6 thousand euros). In Portugal, the average household financial assets portfolio increased from 5.0 to 5.1 thousand euros, respectively, while in the Euro-Area it decreased from 11.0 to 10.6 thousand euros.[11]



(a) **Real assets**



(b) **Financial assets**

Figure 3: **Total assets**

[10] The HFCS asset definition does not contain the value of accumulated pension rights in public defined benefit plans. Their absence is in line with existing practice in other wealth surveys, such as the Survey of Consumer Finances conducted by the US Federal Reserve.

[11] Portfolio theory suggests that household portfolios should optimally be well-diversified Markowitz (1952). It is useful to analyse the portfolio allocation for different portfolio sizes (i.e. the total value of real assets or financial assets), as both the participation rates and the portfolio shares of the different asset types generally vary quite substantially with portfolio size.

Figures 4 and 5 displays the distribution of real and financial assets (as well as the average distribution for the sample) held in each quintile of net wealth. The HMR is the component weighting the most out of all real assets, and its relative importance increases until the 3rd quintile (84%), decreasing afterwards. Indeed, for the wealthiest 20%, HMR represents just around 41% of all real assets, while other real estate properties represent 37% and self-employed business accounts for 18%. Overall, the HMR accounts for 71.7% of the Portuguese households' real assets, with other real estate properties occupying the second place with remaining 15.5%. Vehicles represent 5.5% of total assets, and the remaining 7.3% is allocated to valuables and others. Considering the financial assets portfolio, sight accounts are particularly important for the first quintile of net wealth. However, they represent a quarter of the total financial assets of all households solely since its importance decreases as net wealth increases (while the share of saving accounts increases). For the highest quintile of net wealth, saving accounts and voluntary pension schemes represent 55.0% and 14.0% of total financial assets (27.6% and 10.2% for the first quintile, respectively).

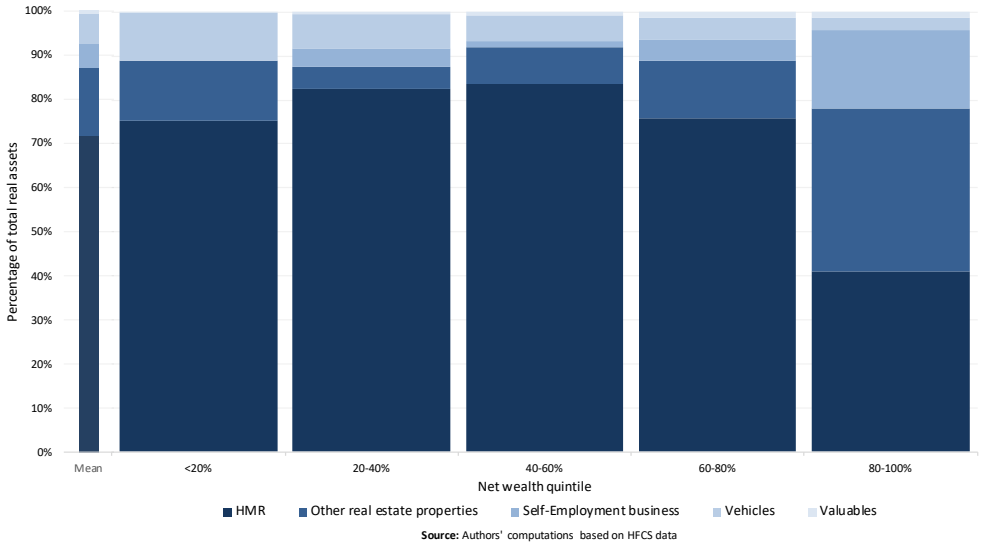


Figure 4: **Decomposition of real assets by quintile of net wealth**

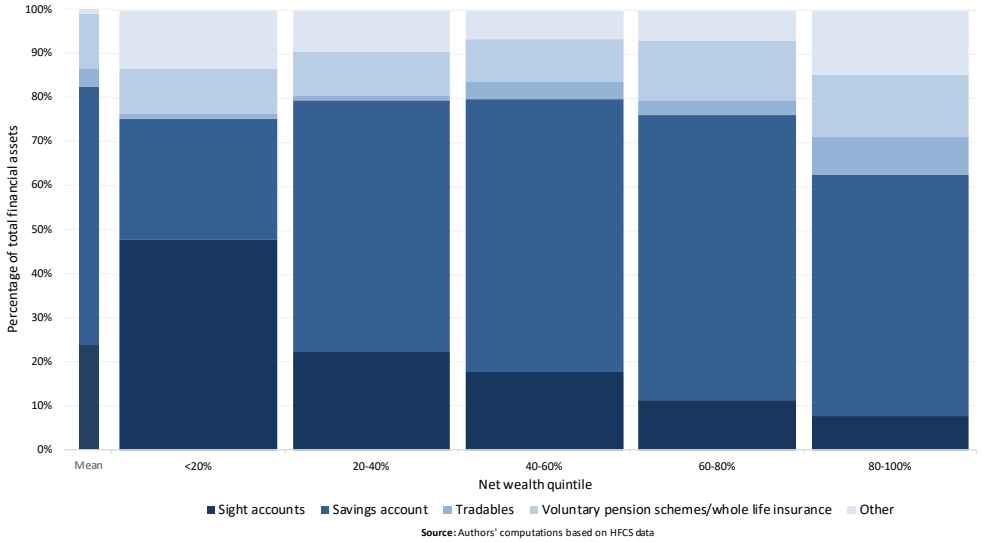


Figure 5: **Decomposition of financial assets by quintile of net wealth**

After summarizing the key information concerning real and financial assets, we discuss the liabilities side of households' balance sheets. The household liabilities can be divided into mortgage debt (mortgages for the HMR and other real estate properties) and non-mortgage debt (credit line/overdraft debt, credit card debt and other non-mortgage loans). Figure 19 in the Appendix shows the structure of the liabilities held by households in Portugal. About 93% of the total liabilities held by households consists of mortgage debt (82.4% on their HMR and 10.6% related to other real estate proprieties), and only 7% is non-mortgage debt (0.7% credit card or credit line and 6.3% composed by non-mortgage loans). Figure 6 displays the distribution of liabilities held in each quintile of net wealth. Non-mortgage loans are particularly relevant for the poorest quintile (14.8%). The share of HMR mortgages in total liabilities is 75.1% in the first quintile and 81.4% in the 4th quintile. On average, debt is 82.3% composed by HMR mortgages, 10.2% by other properties mortgages, 6.7% by non-mortgage loans and 0.7% by credit lines and credit card debt.

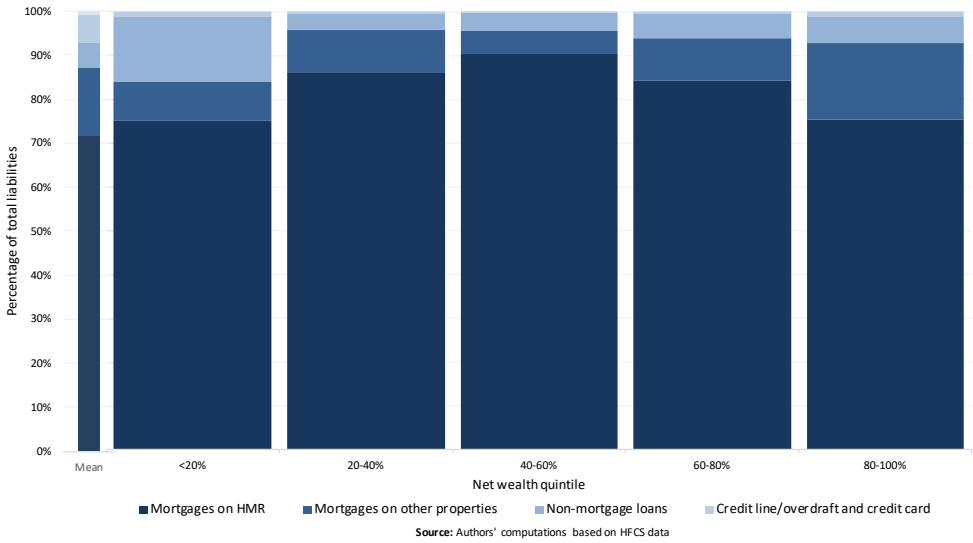


Figure 6: **Decomposition of debt by quintile of net wealth**

Based on HFCS data, figure 7 presents a set of micro-measures (for the two waves) to assess households' debt burden and financial vulnerabilities.[12] The debt-to-asset ratio reflects the household's ultimate capacity to pay its debts. A value above 100% for this ratio is an indicator of high insolvency risk. For Portugal, the median ratio of debt to total assets is increasing (34.0% in the first wave, and 37.8% in the second wave) and it is above the median Euro Area average (22.2% in the first wave and 25.7% in the second wave). Considering the average value of the last income decile, the debt-to-asset ratio was 27.4% in Portugal and 19.2% the Euro Area (25.1% and 15.8% in the first wave, respectively). The debt-to-income ratio provides information on the extent to which a household can service its debt based on its income-generating capability, i.e., it is a commonly used measure of debt sustainability in the medium to long-run. The median debt-to-income ratio for Portugal is decreasing (224.5% to 198.5%) which is substantially higher than the median Euro Area average, pointing out to lower debt sustainability of Portuguese household's. The mean values for the last decile of the income distribution are, however, significantly lower, having yet increased between the two waves, from 118.3% to 132.9%. A third indicator, the median debt-service-to-income ratio, provides information regarding the drain that debt payments impose on the current income flow, and thus reflects the burden of short-term commitments. For Portugal, the median debt service-income ratio for indebted households with debt payments was 19.8% in the first wave and 16.2% in the second wave.

[12]In all cases, the indicators are calculated for indebted households only.

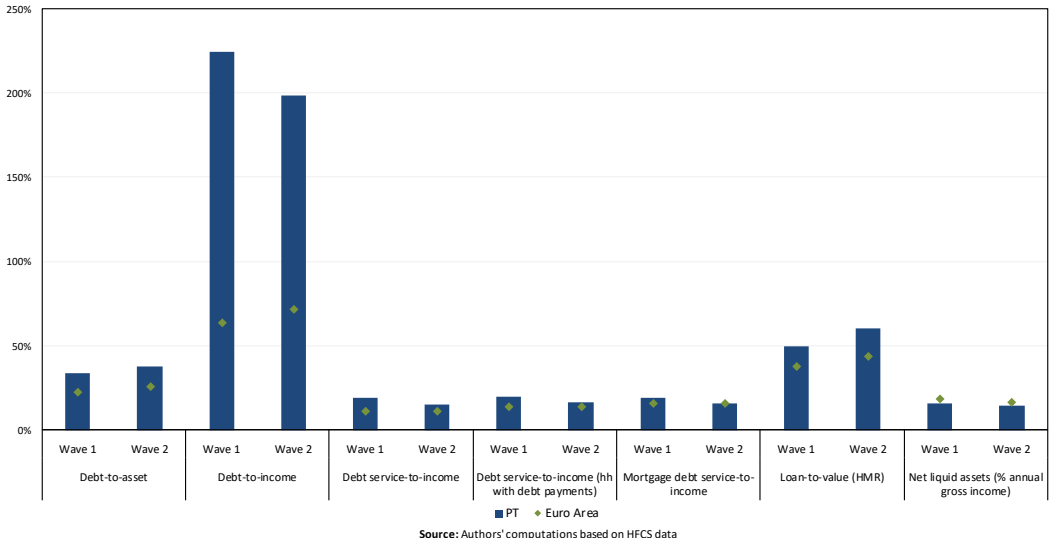


Figure 7: **Financial vulnerability**

Figure 8 shows the distribution of net wealth, i.e. the difference between total assets and total liabilities, across different age and educational groups. Net wealth increases with the level of education, and the difference between the mean and the upper educated households becomes substantially larger as age increases. For the mean and lower educated, the average accumulated wealth increases until 64 years old and then decreased as people retire. In contrast, wealth increases even after retirement (despite at a lower speed) for the upper educated households.

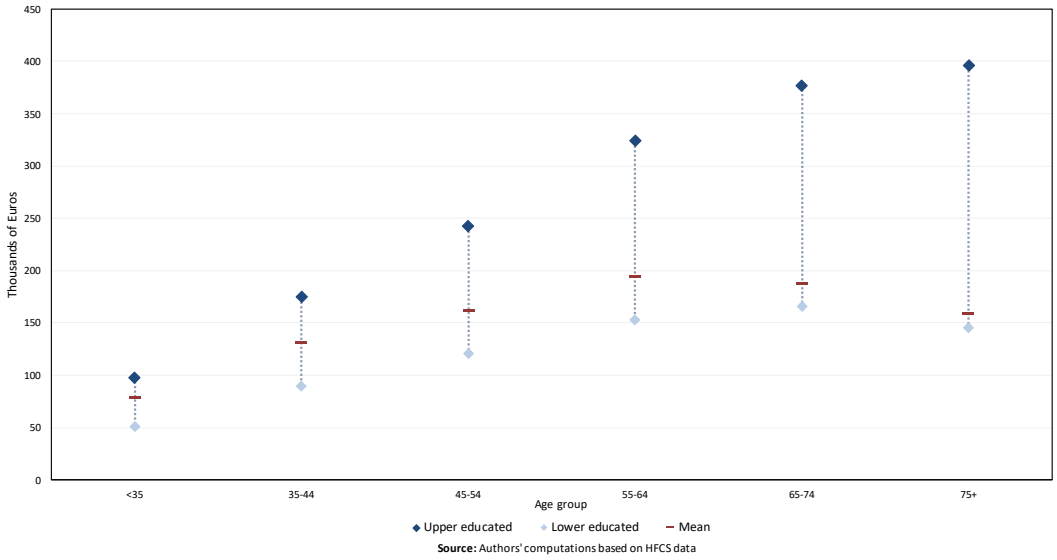
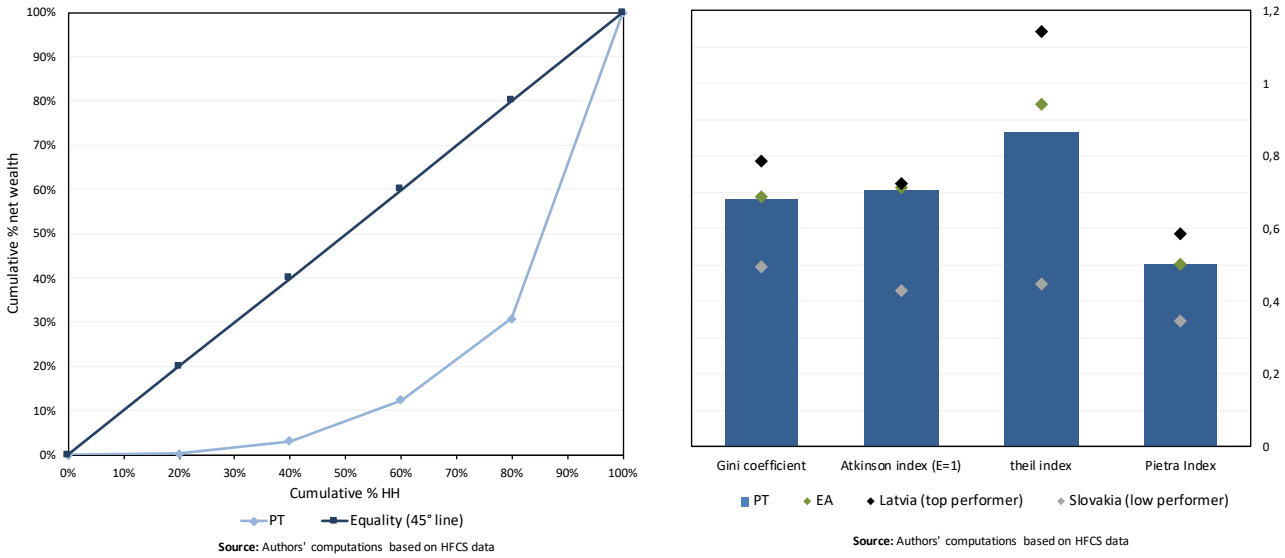


Figure 8: **Net wealth by age and educational groups**

Figure 9 illustrates the net wealth distribution per household in Portugal, alongside with a set of inequality measures to better assess how net wealth is distributed, compared with the Euro Area average. In Portugal, the poorest 40% have only 3.1% of national wealth, while the wealthiest 20% have around 70% of total Portuguese wealth. Indeed, figure 9a enables visual analysis of whether a country's wealth is more or less equally distributed since the 45º line corresponds to a situation where an economy's wealth is equally distributed between its individuals.

Portugal's Lorenz Curve is far from being a straight 45° line. The Gini coefficient for Portugal is similar to the Euro Area average and went slightly up compared to the first wave (from 0.66 to 0.68). Though all the displayed inequality measures for Portugal are below the Euro Area mean, this difference is only marginal. It is also relevant to highlight that Portugal's inequality measures figures are always closer to the top performer's results (Latvia) than the lowest (Slovakia).



(a) **Net wealth distribution** (b) **Inequality indexes**

Figure 9: **Inequality measures**

2.2.2. Income, consumption, savings and credit constraints

In the wake of the recent economic crisis, many households have lost financial ground and have to cope with higher financial vulnerabilities. Household income is a crucial input to assess savings and credit restrictions, and also enters broader metrics used to measure economic well-being at the country level. This section focuses on total household gross income, defined as the sum of all pre-tax income sources at the household level and excluding mandatory contributions for retirement plans. It includes labour/pension income, rental from real estate property, income from financial assets, regular social and private transfers, and income from other sources.

Figure 10 shows the distribution of household income by age and educational groups. As expected, income increases with education, though this difference tends to be more accentuated as age increases. Mean and lower educated individuals' income increases until 54 years old, while for the upper educated ones, the peak is reached at 64 years old. More educated people can smooth inter-temporal consumption through income, illustrated by median and lowest' educated households income reaching its minimum value after 75 years old.

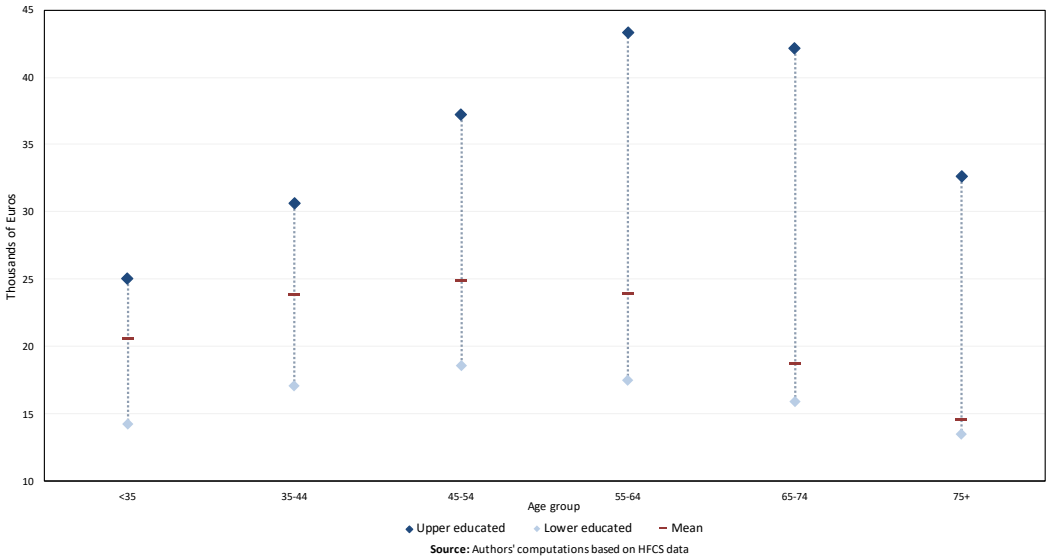


Figure 10: **Income by age and educational groups**

Consumption is a direct and widespread measure of households' living standards. The HFCS records data on food consumption (at home and outside) and spending on utilities, as well as the total expenditure on consumer goods and services. To study household savings, i.e. the part of income not spent on current consumption, we considered the average propensity to consume, a key parameter in the microeconomic theory of household consumption, corresponding to the percentage of gross household income that is spent on goods and services. Figure 11 displays the average consumption-to-income ratio, by quintile of net wealth. On average, the first quintile of net wealth's expenses is 47.3% higher than income. For the second quintile onwards, the savings rate is positive and increases at a growing speed (30,1%, 40,2%, 51,6% and 64,9%, respectively).

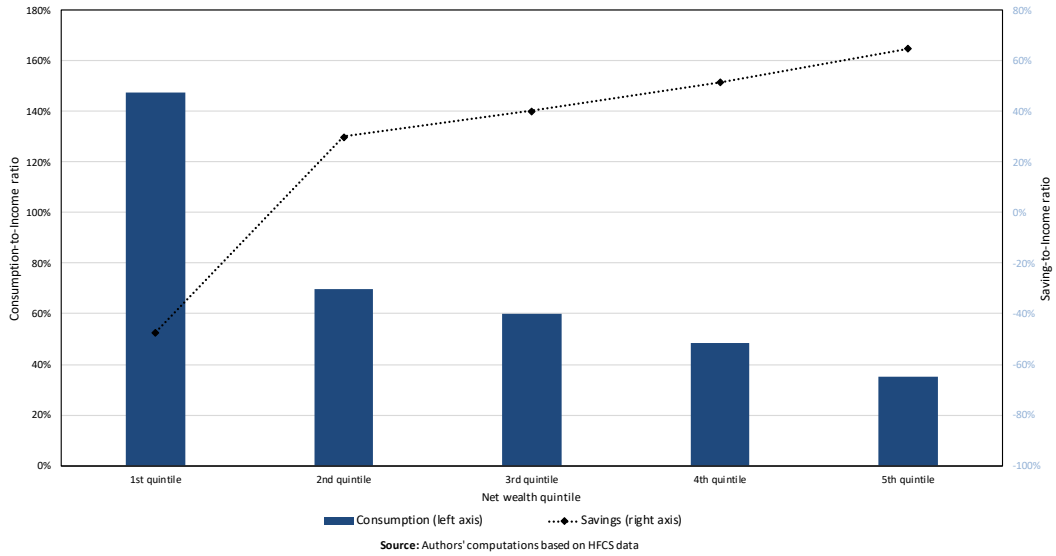


Figure 11: **Consumption and savings by quintile of net wealth**

Figure 12 shows the share of credit-constrained agents, decomposing a set of indicators related to liquidity constraints and self-assessed measures of financing ability. According to the second wave of the HFCS, 14.4% of households applied for credit within the last three years with 15.3% of these being at least partially refused. Additionally, 4.9% declare not having applied for credit due to a perceived credit constraint. Considering the previous information, around 7.1% of households were considered to be credit constrained.

Out of those credit constrained, we observe that the perception of credit constraint decreases until the 4th quintile of net wealth. Contrarily, the percentage of households that were (at least, partially) credit refused increases until the 4th quintile of net wealth. As the individuals' grow their awareness of their financial constraints hence deterring them from requesting credit, less is the number of financial institutions to refuse it. Around 70% of credit-constrained households consider having the ability to get informal financial assistance, although the share for the 3rd quintile is substantially lower. In Portugal, 38% of agents in the first quintile of net wealth were credit-constrained. This share decreases until the 3rd quintile of net wealth (22,6% and 10,1% in the second and third quintiles, respectively) and then increases in the 4th quintile of net wealth (15,8%). Additionally, around 13,5% of the wealthiest 20% were credit constrained.

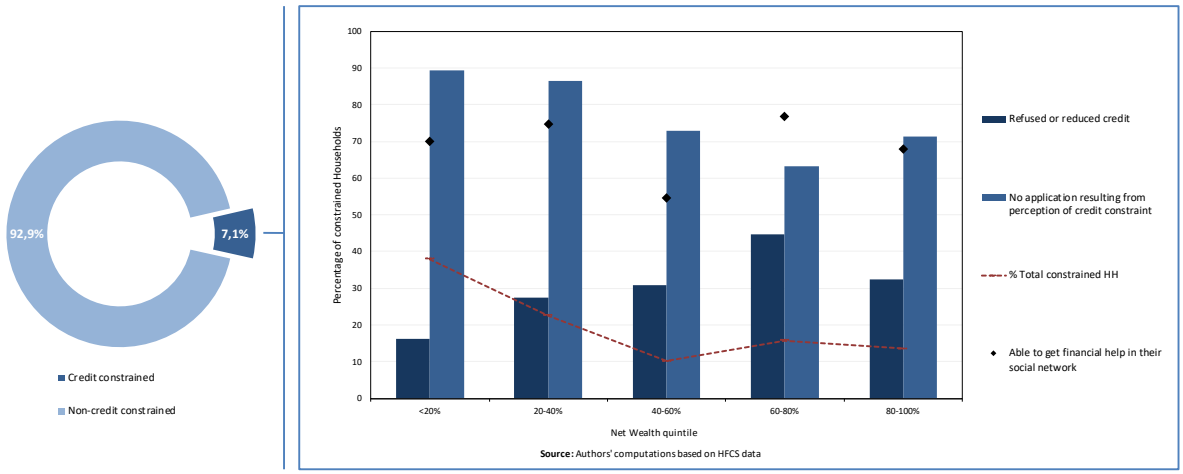


Figure 12: **Credit constraints by quintile of net wealth**

Summing up, Portuguese households saw both their real and financial assets decreased between the two waves. The first are mainly related to the HMR (close to 70%), though for high-income families this asset is relatively less relevant. Regarding the latter, the weight of sight accounts on the families' balance sheets seems to be inversely related to the household's wealth. Yet, savings accounts' relative importance is increasing with the families' wealth. On the liabilities side, the HMR mortgage debt is the main component and, interestingly, non-mortgage loans have a higher weight for those in the bottom wealth quintile. Concerning the families' financial vulnerability, Portugal is, in general, performing worse than the Euro Area but has slightly improved its position between the two waves (except for two measures). As well, Portugal is close to the Euro Area figures in terms of wealth inequality. Furthermore, both income and wealth seem to vary profoundly with the level of education and age of the FKP. Also, as individuals grow older, the effect of education on both wealth and income seems to be more substantial, i.e. highly educated individuals display average levels of wealth (or income) increasingly higher than lower educated ones as time passes by. Moreover, the savings rate seems to increases with income, though for those in the bottom quintile, consumption surpasses their income. Lastly, data on credit constraints show that less than 10% of the households are credit constrained, with the majority not requesting a credit as they perceive they would be refused.

2.3. Empirical approach

After summarising the main descriptive statistics of the HFCS, this section shed further light on the main microeconomic determinants of Portuguese household savings as well as their link to a set of credit constraints indicators. First, section 2.3.1 focuses on how households perceive their saving behaviour at a micro-level. Then, section 2.3.2 evaluates how those who were unable to save, financed their negative levels of saving and the factors associated with each instrument. Finally, section 2.3.3 analyses the household characteristics and heterogeneity regarding different liquidity constraints indicators.

2.3.1. Negative saving

With regards to the microeconomic determinants of household savings, we follow Le Blanc et al. (2014) 's approach, though solely targeting Portugal. This strategy allows us to exclude potential country-specific effects impacting the results founded by the authors. As we compare individuals from the same country, we obtain more accurate results than if we simply ran the same regression for the EU members allowing for a fixed-effects dummy variable for each country. Indeed, countries with specific effects could be skewing the results with regards to the Portuguese reality.

Hence, we first build on an indicator directly derived from respondents' answers given to HFCS, according to the following question: **Aside from any purchases of assets, over the last 12 months would you say that your (household's) regular expenses were higher than your (household's) income, just about the same as your (household's) income or that (you/your household) spent less than (your/its) income?**[13]

Using the answers given to this question, along with a set of socio-demographic variables from the HFCS, we perform a probit analysis to better understand which household characteristics may influence the probability of having a negative ability to save, that is, to study the relationship between expenses and income among different households. Thus, considering $Expenses \geq Income$ as a dummy variable that equals 1 if the FKP i stated that the household's regular expenses in the last 12 months exceeded the household's income and 0 otherwise, and where X denotes all the explanatory variables as presented in Table 2. Our model can be expressed as:

$$Expenses \geq Income_i = \beta_0 + \sum_{i=1}^{n} \beta_n X_i + \varepsilon_i \tag{1}$$

Around 50% of Portuguese households state that during the previous 12 months their income was about the same as average household expenses. About 35% claim that expenses were lower and the remaining 15% affirm they were higher than average expenses. The results for our probit estimation are available in table 2 as they represent the average marginal effects over the five different implicates and t-statistics.

Households whose head is male and younger than 25 years old are 81.8% less likely to have had expenses above income, ceteris paribus. As well, the higher the FKP's income quintile, the lower the probability of that households' expenses surpassing the income (the marginal effects of the 2^{nd}, 3^{rd}, 4^{th} and 5^{th} income quintiles are, respectively, -28.7 percentage points (pp), -28.9pp, -66.7pp and -98.9pp). Le Blanc et al. (2014) found a similar relation to income, though the marginal effects obtained in their model were of a much smaller magnitude.

The main labour status of household reference person was proven not to have a significant impact on savings, except for "others". This indicates that households where the FKP are not employed, self-employed, unemployed or retired are 62.6% more likely to have had negative savings in the last 12 months, all else equal. Also, as expected,

[13]For further details see the HFCS core variables catalogue: HI0600.

the probability of having expenses higher than income increases with the household size, a result consistent with Le Blanc et al. (2014). Other variables expected to increase the probability of a household having self-perceived negative savings are the existence of interest payments (33pp), having credit card debt (51.3pp), having been credit refused (47pp) or perceiving a credit constraint (39.5pp). Surprisingly, households whose FKP's parents completed tertiary levels of education, have a significant positive probability of having expenses higher than income. As well and contrarily to Le Blanc et al. (2014), different levels of net wealth do not turn out to be statistically significant to households' saving levels

2.3.2. Financing negative saving

The fact that at a certain point in time, for some households, expenses are higher than income is not a per se indicator of financial vulnerability, as it can evidence wealthy credit market dynamics. Bearing in mind the previous findings, we consider additional information present in the HFCS, particularly on how households finance their negative savings, once again following the model constructed in Le Blanc et al. (2014). Households that self-assessed a negative level of savings were then asked the following: **You have told me that your expenses in the last 12 months have been above your income. What did you do to meet expenses?**[14]

Based on the answers to this question, we can identify four different groups of households, given the instrument used to finance the negative savings: out of net wealth (either through assets selling or out of existing savings), out of formal loans (by a credit card/overdraft facility or other loans), out of informal loans (asked for help from their relatives or friends) and out of default (unpaid bills). From those who reported expenses higher than income, the majority finance their negative savings through their own wealth (approximately one half). The second source of financing is through informal loans (around 40%), while financing via formal loans and default are less representative.

To study the forces shaping the use of each financing source type to cover for negative savings, we resort to similar models where the dependent variables *Out of wealth, Out of formal loans, Out of informal loans and Unpaid bills* are dummies that take value 1 if that is the corresponding source of negative savings financing and 0 otherwise, and where X denotes all the explanatory variables as presented in Table 2. Our model can be expressed as:

$$Financing\ Sources_{_i} = \beta_0 + \sum_{i=1}^{n} \beta_n X_i + \varepsilon_i \tag{2}$$

We then perform four different probit regressions, to each one of the four sources of financing negative savings. The results are available in table 3. Considering the financing of negative savings out of net wealth, results indicate a significant effect of wealth with the expected sign, i.e. wealthier households are more likely to cover negative savings with their own wealth (either savings or assets). In contrast, wealthier households are less likely to finance their saving needs through informal loans or by default. Additionally, results show that there is an income effect. Households in higher quintiles of income are also expected to finance their need through wealth. All of these are quite consistent with what Le Blanc et al. found in their analysis.

Other variables (some of which the previous authors did not consider) turned out to be statistically significant with regards to using one of the four mentioned instruments to finance negative savings. Interestingly, we observe that larger households are less likely to get financing from unpaid bills, as they are more likely to finance negative savings via net wealth. Additionally, households who are able to get financing assistance from their friends and relatives are less expected to finance their negative savings through wealth, as they are significantly more prone to get financing from informal loans.

[14]For further details see the HFCS core variables catalogue: HI0700x.

2.3.3. Credit constraints

Finally, we analyze the factors driving individuals to be credit constrained either because they were wholly or partially denied credit or because they self-perceived an incapacity to obtain financing in the credit market. A fundamental condition for the proper functioning of the credit market is that agents can access financing and, therefore, are not constrained. To study the main characteristics associated with credit-constrained households, we consider two different types of constraints. First, those who were totally or partially denied credit, according to the following two questions:

In the last three years, has any lender or creditor turned down any request you [or someone in your household] made for credit, or not given you as much credit as you applied for?[15] and **(Were you/Was your household) later able to obtain the amount requested, by reapplying to the same institution or somewhere else?**[15]

Given that expectations matter in the decision to apply for a credit line, we decide to include a self-assessed measure of constraint, i.e. the perception of acceptance of financing by the household. In this case, we use the information in the HFCS questionnaire from the following question:

In the last three years, did you (or another member of your household) consider applying for a loan or credit but then decided not to, thinking that the application would be rejected?[15]

To capture the characteristics driving each of the two liquidity constraints, we estimate, as done in the previous sections, two probit models where the dependent variables *Refused credit, and Perceived constraint* are dummies that take value 1 if that is the corresponding type of liquidity constraint the FKP expressed and 0 otherwise, and where X denotes all the explanatory variables as presented in Table 4. Our model can be expressed as:

$$Credit\ constraints_{_i} = \beta_0 + \sum_{i=1}^{n} \beta_n X_i + \varepsilon_i \tag{3}$$

We observe that around 2% of the Portuguese sampled households report having been turned down the amount required in the loan, either partially or totally. In the case of the self-assessed perception of credit constraint, approximately 5% of Portuguese households did not apply for credit due to perceived constraints (see Table 1).

Table 4 shows that having negative savings (expenses higher than income) increases the probability of being refused credit by 37%, all else constant, and that having the perception that credit will be denied is associated with an increased probability of being partially or totally refused (58.4pp). In the case of the probit estimation for the perceived constraint, results corroborate the idea that singles are more likely to perceive a credit constraint (39.8pp) and that the household size has a significant positive effect on the probability of having a worse perception of credit acceptance (16.9pp). Another impressive result is that FKP who noticed a deterioration of job conditions during the past two years are more likely to perceive a credit constraint. Additionally, people in the third quintile of net wealth tend to be less pessimistic about their credit restrictions (-46.8pp). Finally, and not surprisingly, having negative savings (expenses higher than income) and being refused credit are positively associated with a higher probability of perceiving a constraint, with respectively, 37.3pp and 68.1pp of marginal effects.

[15] For further details see the HFCS core variables catalogue: HC1310x, HC1320 and HC1400.

3. *The Great Ship* - A Macro Perspective of Household Saving Dynamics

In the first part of the paper, we analyse the main microeconomic determinants of household savings, the heterogeneity across households regarding different ways of financing negative savings, and the key factors impacting liquidity constrained agents. To complement our previous findings, this part of the paper considers the inter-temporal long-run relationships between the household savings rate and a set of macroeconomic variables. Our main objective is to understand to what extent the recent financial crisis has produced a structural change in household savings. Section 3.1 starts by describing the data and discuss the main methodological issues associated with the time-series. Afterwards, section 3.2 presents our empirical approach that consists of a vector error-correcting (VEC) model designed to understand the main macroeconomic determinants of household savings in Portugal. Finally, section 3.3 presents our out-of-sample forecast for the household savings rate in Portugal, considering the Bank of Portugal (BdP) predictions for the main macroeconomic aggregates during the 2019Q1-2021Q4 period.

3.1. Data description and methodological issues

The primary data used in this chapter comes from Bank of Portugal's long time series, spanning 1990Q1 to 2018Q4, namely the household savings rate, real consumption, real disposable income, real net worth, and the 3-month Euribor rate. Four more variables were introduced to the model to capture short-run dynamics: unemployment rate, 10-year government bond yield, CBOE volatility index and one consumer sentiment index.[16] We conduct our exercise as follows. We develop a baseline model using only data until the onset of the financial crisis to predict the household saving rate after that period. If our model convincingly predicts the observed household saving rate, it produces satisfactory statistical evidence on the belief that the financial crisis did not produce a structural change in the household saving behaviour. Finally, we conduct an out-of-sample forecast exercise using the BdP's forecasts in our baseline model to trace short-run scenarios for the household saving rate.

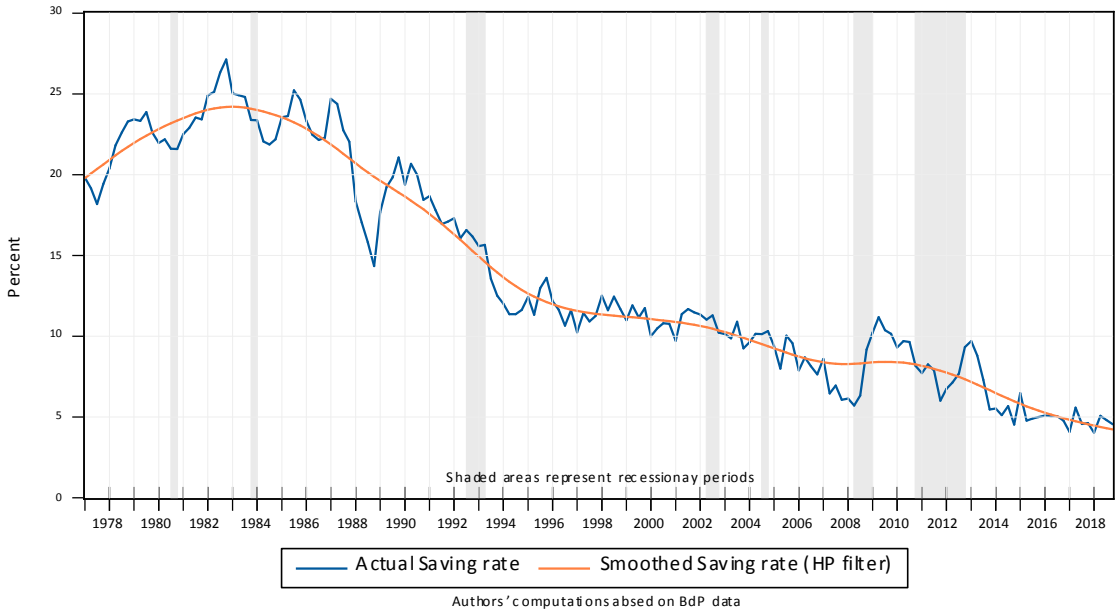
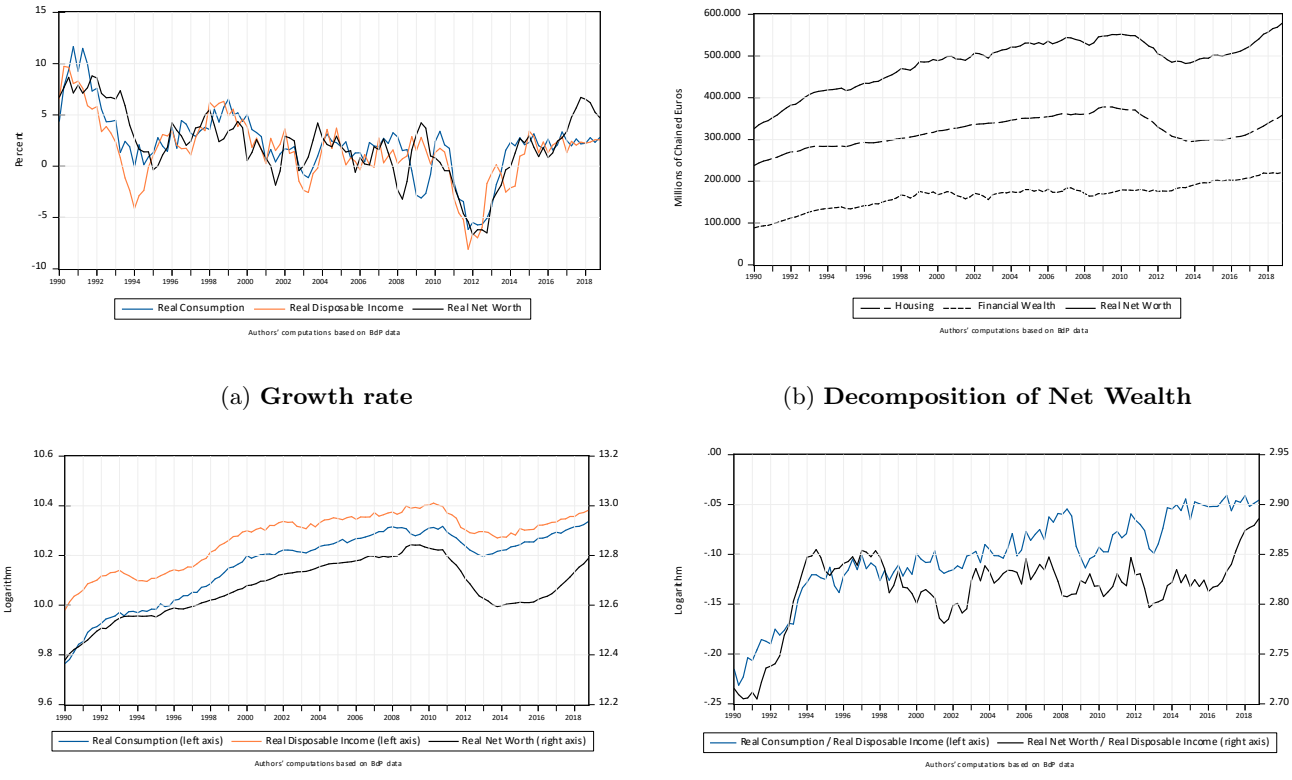


Figure 13: **Household saving rate**

[16]Table 5 details the data sources and the standard statistics.

There is a clear downward trend in the Portuguese household saving rate since the early 1980s (Figure 14). However, during the last two recessionary periods, household savings increased abruptly, generating a distinct absence of consensus on what have caused those fluctuations. Additionally, the fact that household savings are at historic lows may lead to macroprudential policies to achieve an economically sound allocation of savings (Rodriguez-Palenzuela and Dees, 2016). The mid-1980's financial liberalization enabled financial institutions to develop at a high pace, allowing households to decide on their consumption paths, which translated into broader access to credit. The downward trend in the Portuguese household savings can be associated with the entrance of Portugal in the European Union and the implementation of the Euro as a single currency. Those events drove the Portuguese economy away from a price instability regime to a fiscal framework of budgetary discipline that guarantees the maintenance of sound fiscal policies.

A decade after the financial crisis, interest rates are stuck close to zero and likely to remain so. Also, investment is the only key macroeconomic variable that did not recover from its pre-crisis levels. Understanding the household savings fundamentals contributes to a better assessment of the long-run link between saving and investment decisions. The economic theory identifies monetary policy, fiscal policy, financial market development, uncertainty, economic growth, and demographics as the main transmission channels of household savings. Empirical evidence suggests that household saving positively correlates with economic growth, inflation, interest rate, uncertainty, and financial sector development. In contrast, the literature suggests the government budget balance, unemployment rate, net wealth and the dependency ratio as negatively correlated with household saving rate.[17]



(a) **Growth rate**

(b) **Decomposition of Net Wealth**

(c) **Logarithm of RC, RDY and RNW**

(d) **Logarithm RC/RDY and RNW/RDY**

Figure 14: **Real consumption, real disposable income and real net worth**

[17]For a complete understanding of the primary household savings determinants see, for example, (Callen and Thimann, 1997).

Our analysis develops a multi-equation time-series model for aggregate consumption. Our assessment is built on Milton Friedman's Permanent Income Hypothesis (PIH) and recognizes real disposable income and real net wealth as the main long-run determinants of household consumption.[18] Additionally, the inclusion of the real interest rate is justified by the Intertemporal Substitution hypothesis (ISH).[19] Our long-run real consumption equation seeks to explore possible cointegration relations between real consumption, real disposable income, real net wealth and the real interest rate. To capture short-run dynamics, four more variables were introduced to the model using a multi-equation vector error-correcting (VEC) model. We then derived household savings using the standard SNA identity.[20]

Figure 14 illustrates the behaviour of real consumption, real disposable income and real net worth. All three variables show a very similar behaviour during the entire time-span, indicating a possible cointegration relationship between them. The financial crisis has produced a negative shock on the stock value of the real estate in Portugal, which in turn pressured total net wealth down. The real value of household net wealth in Portugal is increasing since 2015, and it already exceeded its pre-crisis levels, as a result of the rise in the real estate stock value. Despite a quick recovery since 2015, total household real estate wealth did not yet reach its pre-crisis values.

On average, total household net wealth corresponds to approximately 4.5 times the yearly real disposable income, and it has been increasing in recent years as a result of the rise in the stock value of the real estate and the decrease in households' liabilities (Figure 15).[21] Household financial health consists mainly of cash and deposits (around 45%), stocks and other securities (around 28%), insurance and pension schemes (around 17%), and others (around 10%). The relative importance of cash and deposits in total household financial wealth has been falling while the other components have increased its relevance, especially insurance pension schemes and others (Figure 20).

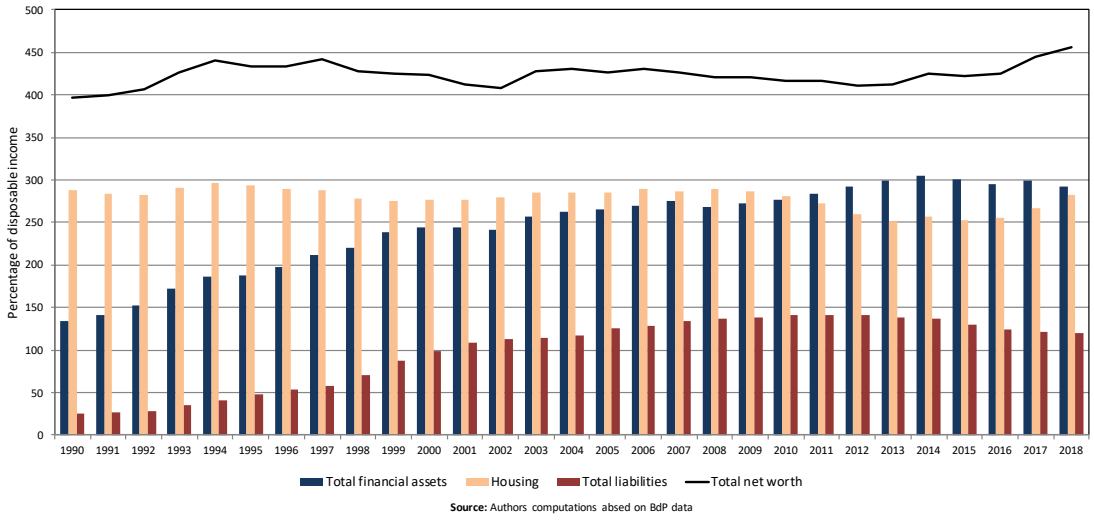


Figure 15: **Decomposition of financial wealth**

[18] The Permanent Income Hypothesis (PIH) model states that changes in permanent income, rather than changes in temporary income, are what drive the changes in consumption patterns and so the main drivers of consumption will depend on the lifetime expected income and wealth. Additionally, the PIH framework suggests that consumers tend to spread out the gains and losses from other short-run dynamics (such as a tax cut) over a long horizon, and so the stimulus effect tends to be null (Friedman, 1957).

[19] One of the crucial determinants of the response of saving and consumption to the real interest rate is the elasticity of intertemporal substitution. That elasticity can be measured by the response of the rate of change of consumption to changes in the expected real interest rate (Hall, 1988).

[20] According to the 2008 System of National Accounts (SNA), household saving is defined as household net disposable income plus the adjustment for the change in pension entitlements less household final consumption expenditure.

[21] Total net worth = Financial assets + Housing - Liabilities

3.2. Empirical approach

This section develops our empirical approach that consists of a vector error-correcting (VEC) model designed to understand the main macroeconomic determinants of household savings in Portugal. Section 3.2.1 starts by presenting our long-run baseline model for aggregate consumption afterwards linked with household savings using the standard identity equation. Section 3.2.2 evaluates the model, and section 3.2.3 presents our final multi-equation error-correction model constructed to embody short-run dynamics. Then, section 3.2.4 develops a forecast evaluation using both dynamic stochastic and static deterministic simulations. Finally, section 3.2.5 assesses the out-of-sample forecasting performance of the VEC model using the BdP's predictions as exogenous variables into our baseline model to trace different short-run scenarios for the Portuguese household saving rate.

3.2.1. Baseline Model

Our empirical approach is built on a multi-equation time-series model for real consumption. We used real disposable income (rdy), real net wealth (rnw) and real interest rate (euribor - proxied by the 3-month Euribor rate) as the main long-run explanatory variables for real aggregate consumption. The long-run real consumption equation can be expressed as follows:

$$ln(rc_t) = \beta_0 + \beta_1 ln(rdy_t) + \beta_2 ln(rnw_t) + \beta_3 euribor_t + \epsilon_t \tag{4}$$

We based our choice for the explanatory variables on the Permanent Income Hypothesis (PIH), which supports the use of real disposable income (rdy) and real net wealth (rnw) as long-run drivers of real consumption. According to previous studies, we expect both variables to have positive elasticities. Additionally, the inclusion of the Euribor rate is justified by the intertemporal substitution hypothesis. In this case, the expected relationship is somehow indeterminate. Equation 4 represents our long-run model for real consumption and does not account for any short-run dynamics. To deal with that, section 3.2.3 presents our final multi-equation VEC model, considering that all variables exhibit stochastic non-stationary behaviour and are co-integrated.

In a time-series setting, long-run cointegration means that two or more variables structurally co-move in a close manner - i.e. they are known to share the same long-run dynamics. Thus, cointegration does not reflect the direction in which variables move. Instead, it helps to identify whether the gap between the variables varies over time. In the short term, cointegration does not tell much. However, in the long term, the variables may share a close average distance between them. A vector error-correction (VEC) model is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. The VEC has cointegration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships while allows for short-run adjustment dynamics. In other words, the main difference between the VAR and the VEC models relies on the error correction term. In a VEC model, any deviations from the long-run equilibrium are corrected gradually through a series of partial short-run adjustments.[22]

Starting from our final VEC equation for real household consumption, we derive the household saving rate using the standard SNA identity, that can be represented as follows:[23]

$$Household\ saving\ rate = 100 \times \frac{(rdy - (rc - (adjustment\ pension\ funds/consumption\ deflator)))}{rdy} \tag{5}$$

[22] If two series are I(1), we could model their relationship by taking first differences of each series and including the differences in a VAR or a structural model (see Engle and Granger, 1987).

[23] Net household saving is defined as household net disposable income plus the adjustment for the change in pension entitlements less household final consumption expenditure. The adjustment item concerns (mandatory) saving of households, by building up funds in employment-related pension schemes. Bank of Portugal quarterly series for the Portuguese economy, 1977–2018.

3.2.2. Model evaluation

This subsection describes the construction and estimation of the baseline VAR model, according to Toda and Yamamoto (1995) procedure.[24] The first step to determine the core statistical properties of the time series is to analyse the stationarity of the variables. For that, we performed two different unit root tests, namely the Augmented Dickey-Fuller (ADF) and the Phillips Peron (PP) test.[25] We performed both tests in levels and first differences, and the results are available in table 6 in the Appendix. Unit root statistics for the period 1995Q1 2008Q2 suggest that all variables show a non-stationary behaviour, i.e. they have a unit root. Accordingly, all time-series in the long-run equation follow an I(1) process.

The next step involves the creation of a VAR model for the variables in levels.[26] After that, the information criteria (AIC[27] and SIC[28]) states that two lags are the optimal lag number for the model. Thus, caution tells us to analyse the residuals carefully and to check for the presence of serial correlation, normality and heteroskedasticity.[29] After testing the residuals, we found that the model is well specified using the selected information criteria. At this stage, knowing that the variables are I(1) and the model is well specified using two lags, one should analyse the presence of cointegration amongst the endogenous variables. To test the presence of cointegration in our long-run model, we applied the standard Johansen test based on the VAR(2) in levels.[30] The results are present in table 10.

The Johansen cointegration test suggests there is a cointegration relationship within our long-term model variables, which is expected in a sense that all time-series represent macroeconomic variables that are likely to co-move in the long-run. According to our preliminary assessment, we found two cointegration relationships in the long-run equation, namely: an equation explaining real consumption and one equation explaining real disposable income. The two long-run cointegration equations can be expressed as follows:

$$ln(rc_t) = -5.49 + 1.55ln(rnw_t) + 0.01ln(euribor_t) + \epsilon_t) \tag{6}$$

$$ln(rdy_t) = -6.46 + 1.63ln(rnw_t) - 0.01ln(euribor_t) + \epsilon_t) \tag{7}$$

In sum, we conclude that all five variables are not stationary when looking in levels. Still, there is strong evidence for those variables to follow an I(1) process, meaning that all variables are stationary in first differences. After performing the lag length criteria, serial correlation, normality and heteroskedasticity tests, one can conclude that the baseline VAR(2) model is well specified. After performing the Johansen cointegration test, the conclusion follows that there is evidence for the presence of two cointegration equations. The presence of cointegration in the long-run equation leads us to use the VEC specification model accounting for short-run dynamics.

[24] Stock and Watson (1988) concludes that two or more cointegrated variables share the same stochastic trends, which provides a valid option to study cointegration relationships. If two or more I(1) variables are shown to be cointegrated, they must follow a long-run equilibrium relationship, although they may diverge in the short-run.

[25] The ADF and PP test the null hypothesis that a unit root is present in a time series sample.

[26] For a complete guide of Vector Autoregression (VAR) models see, for example, Brooks (2019) and Sims (1980).

[27] The Akaike information criterion (AIC) is an estimator of the relative quality of statistical models for a given set of data. AIC tells nothing about the absolute quality of a model, only the quality relative to other models.

[28] The Schwarz criterion (SIC) or Bayesian information criterion is a criterion for model selection among a finite set of models. It is based on the likelihood function, and it is closely related to the AIC criteria.

[29] See tables 7, 8 and 9 in the Appendix.

[30] The Johansen (1988) test can be seen as a multivariate generalisation of the augmented Dickey-Fuller test. The generalisation is the examination of linear combinations of variables for unit roots. The estimation strategy (maximum likelihood) makes it possible to estimate all cointegrating vectors when there are more than two variables. The Johansen test provides estimates of all cointegrating vectors. Just as for the Dickey-Fuller test, the existence of unit roots implies that standard asymptotic distributions do not apply.

3.2.3. Final VEC model

After specifying the long-run equation for consumption, this subsection develops our final VEC model, designed to capture short-run fluctuations in real consumption around the long-run dynamics. In methodological terms, a VEC model is a VAR in the first-difference, constructed to account for any deviations from the long-run equilibrium that are corrected gradually through a series of partial short-run adjustments.

Beyond the endogenous variables used in the long-run equation - real disposable income (rdy), real net wealth (rnw), and the Euribor rate (euribor) - we decide to include four additional exogenous variables to model the short-run evolution of consumption: household confidence index (ci), the CBOE Volatility Index (VIX), unemployment rate (unemployment), and the 10-year Portuguese bond yield (10yield). As previously mentioned, we based our long-run model according to general accepted economic theories, i.e., the Permanent Income Hypothesis and the Intertemporal Substitution Hypothesis. In addition to those long-run determinants of consumption (and therefore savings), economic theory suggests a relatively broad set of transmission channels influencing consumption in the short-run. Our short-term analysis has focused on measuring the economic sentiment of economic agents towards financial markets, government, consumption and the general economic situation. According to the available data, we decided to include the consumer confidence (proxied by a consumer sentiment index), financial vulnerability (proxied by the change in the CBOE Volatility Index), uncertainty (proxied by the change in the unemployment rate), and government sustainability (proxied by the 10-year Portuguese bond yield).

Our final VEC model incorporates dynamics arising from movements in the long-run endogenous variables as well as short-run movements in the exogenous variables. Accordingly, the final VEC model can be expressed as:

$$\begin{aligned}\Delta ln(rc_t) = \ & \Psi + \sum_{i=0}^{k} \omega_i \Delta ln(rdy_{t-i}) + \sum_{j=0}^{p} \psi_j \Delta ln(rnw_{t-j}) + \sum_{l=0}^{h} \phi_l \Delta ln(eur_{t-l}) + \sum_{m=0}^{y} \kappa_m (10yield_{t-m}) \\ & + \sum_{n=0}^{z} \varphi_n (\Delta unemp_{t-n}) + \sum_{f=0}^{g} \theta_f (vix_{t-f}) + \sum_{w=0}^{z} \delta_w (ci_{t-w}) + \lambda ECT_{t-1} + \mu_t \end{aligned} \tag{8}$$

Where ECT_{t-1} represents the lagged OLS residual obtained from the long-run cointegration equations. The error-correcting term explains the previous period's deviation from the long-run equilibrium (which is the error) and influences short-run movement in the dependent variable at a given speed of adjustment λ, that measures the speed at which $ln(rc_t)$ returns to the long-run equilibrium after changes in the exogenous variables.

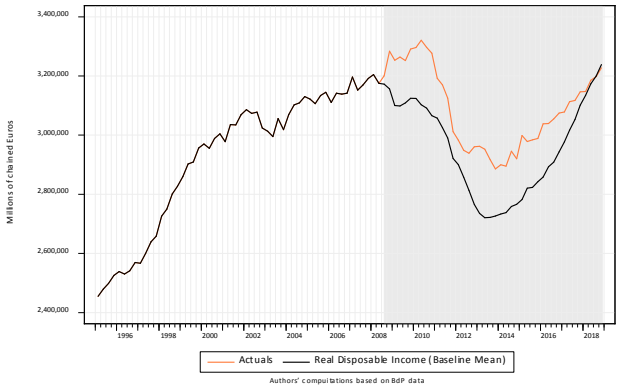
Considering the final VEC model (see table 11 in the Appendixes), for $ln(rc_t)$ the coefficient on its own error-correcting term is significant and negative (consistent with economic priors) and implies that it takes around 4 quarters for a shock in real consumption to return to its long-run path (i.e., to break up). The same applies to the equation for $ln(rdy_t)$, while the coefficient on its own error-correcting term is small, suggesting relatively weak responses of real disposable income to economic shocks. Regarding short-run exogenous variables, $10yield$ and VIX have negative and significant effects on real net wealth, which is consistent with economic theory. The change in *unemployment* has a negative (and significant) effect on real consumption, real net wealth and real disposable income. Finally, the $confidence\ \ index$ has a positive effect on all endogenous variables, especially in real disposable income. We decided not to impose any restriction in the cointegration relationships.[31]

[31] Although we have based the model on economic theory, our approach consists of a pure empirical data-driven time-series exercise. So, despite that both robustness and statistical inference tests were performed, the main objective was to forecast the short-run trajectory for the Portuguese household saving rate regardless of theoretical judgments.

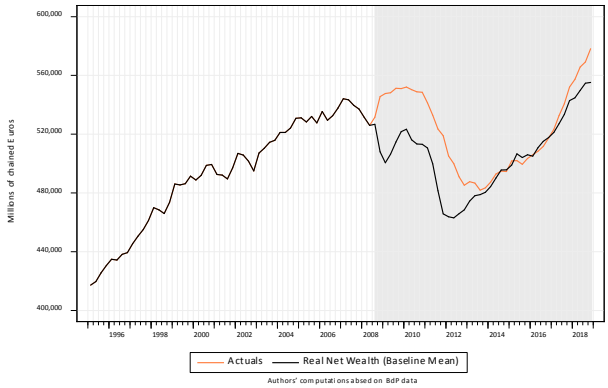
3.2.4. Forecast evaluation - dynamic stochastic and static deterministic simulations

After constructing the VEC model, this section presents our forecast exercise during the 2008Q2-2018Q4 period using both static deterministic and dynamic stochastic simulations. We solve the four equations in the VEC model simultaneously to generate the forecast path of real consumption, afterwards linked with the household saving rate using equation 5. Our forecast exercise is conducted on the following idea. We solve the VEC model using only data until the onset of the financial crisis to predict the household saving rate after that period. If our model convincingly predicts the observed household saving rate, it suggests that the financial crisis did not produce a structural change in the household saving behaviour.[32]

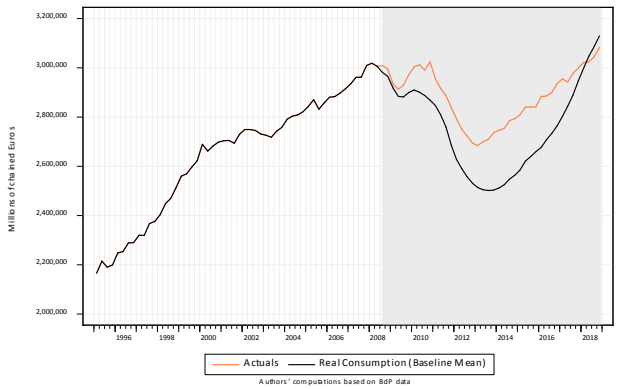
We first run a dynamic simulation that is calculated under the assumption that all short-run exogenous variables assume their actual values during the 2008Q2-2018Q4 period, allowing the prediction errors to "build on themselves". Figure 16 displays the estimated projections for the underlying endogenous variables, comparing the baseline model forecast predictions with actual values. The dynamic simulation slightly under predicts real disposable income and real net wealth (especially until 2014Q1), and therefore real consumption. However, our empirical model used for the dynamic simulation does a feasible job of predicting the household saving rate.



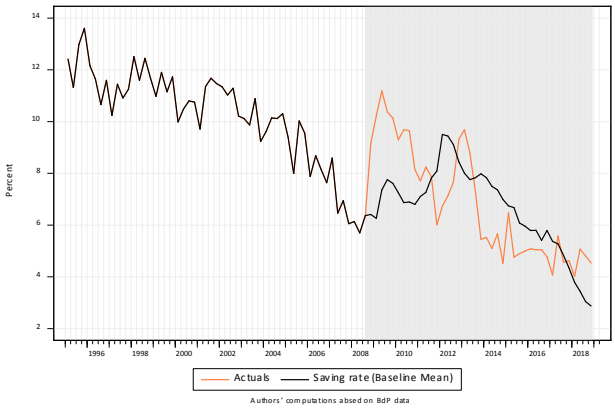
(a) **Real Disposable Income**



(b) **Real Net Wealth**



(c) **Real Consumption**



(d) **Saving Rate**

Figure 16: **Dynamic stochastic predictions for the endogenous variables**

[32]Our approach is based on Ouliaris and Rochon (2018), that develops a similar exercise for the U.S. personal saving rate.

The dynamic stochastic simulation arising from our final VEC model makes it possible to generate a fan chart for the predicted saving rate (see figure 17).[33] Thus, the fan chart mimics the dynamic stochastic predictions for the household saving rate. We assumed that all exogenous variables are equal to their 2008Q2 values. To produce the simulations, we run 100.000 dynamic simulations using bootstrapped shocks to the endogenous variables allowing for coefficient uncertainty.[34] We used ten shades of green to represent different confidence intervals for the predicted saving rate. The lightest green band represent the 90 per cent confidence interval, and the darkest line shows the central estimate or most likely value for the future household saving rate outcomes. Although the baseline model under predicts the household saving rate until 2010, the dynamic fan chart encompasses the actual outcomes of the saving rate during 2008Q2-2018Q4, providing statistical evidence that the underlying model is useful for predicting the actual saving rate. Moreover, one can infer that there has not been a structural break in consumption behaviour arising from the 2008 financial crisis.

We also conduct a static deterministic simulation (see figure 21 in the appendices). The static deterministic forecast resets the endogenous explanatory variables in the model to their lagged actual values before forecasting the next period. The static forecast is more accurate than the dynamic simulation, as the forecast errors of the endogenous variables do not accumulate throughout the prediction horizon. It provides further evidence on the nonexistence of the financial crisis structural break since it does not produce persistent forecast errors.

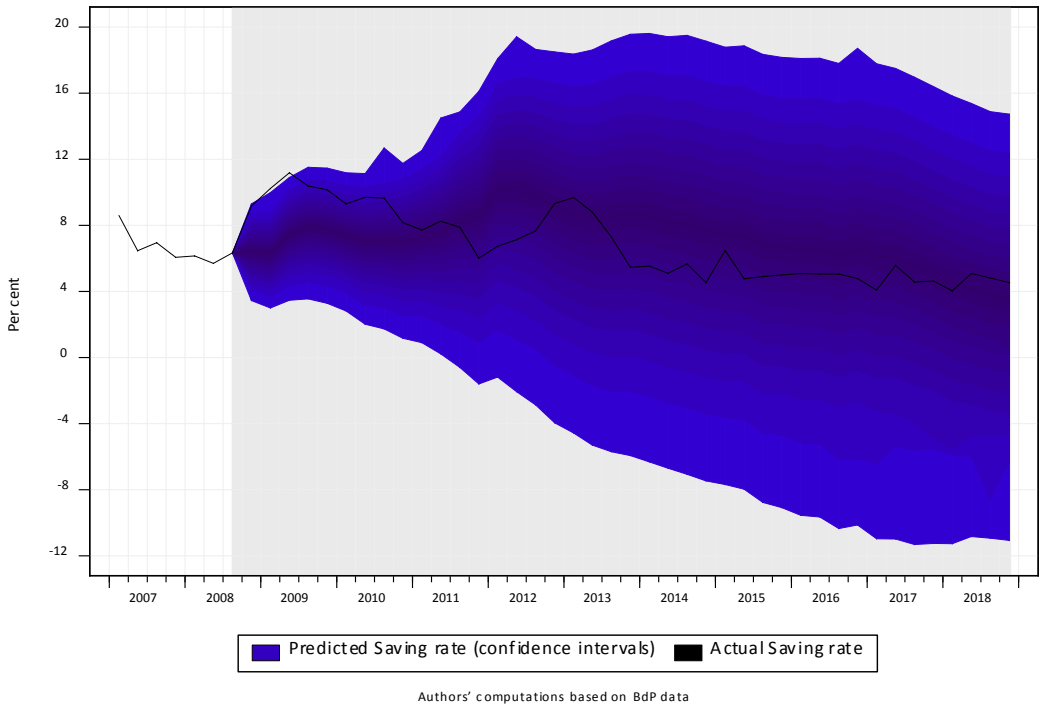


Figure 17: **Saving rate fan chart**

[33] The term "fan chart" was first introduced by the Bank of England in its "Inflation Report 1997". A fan chart is a chart that joins a simple line chart for observed past data, by showing ranges for possible values of future data together with a line showing a central estimate or most likely value for the future outcomes.

[34] We used the Broyden algorithm to solve the stochastic simulations. Contrarily to Newton's method, that requires evaluating each function 72 times and takes 48 minutes on average to solve, in the Broyden's method, the function is evaluated eight times, and it takes around five minutes to solve (see Broyden (1965)).

3.2.5. Forecasting household saving rate (2019-2021)

We re-estimated the VEC model using all available data (i.e., 1995Q1-2018Q4) to project the household saving rate during the period 2019Q1-2021Q4. In other words, all variables take their actual values until 2018Q4, and afterwards, we project a short-run path for all endogenous variables. From 2018Q4 onward, the unemployment rate is set to the Bank of Portugal projections, VIX is based on IMF WEO forecasts, and both consumer sentiment and 10-year bond yield are assumed to be constant.[35]

The projection starts in 2019Q1 where the actual saving rate is in line with its long-term value (i.e., the actual saving rate (blue line) is near the smoothed value (orange line) which is a good starting point given the mean-reverting nature of VAR models).

To produce the simulations, we run 100.000 dynamic simulations using bootstrapped shocks to the endogenous variables and allowing for coefficient uncertainty. Our dynamic stochastic forecast suggests that the saving rate will continue falling until 2020Q4 (2.3%) and then it increases up to 3.7% in the third quarter of 2021. We allow the prediction errors to "build on themselves" instead of assuming the Bank of Portugal forecast for our endogenous variables (real consumption, real disposable income and real net wealth). Our out-of-sample forecast suggests reasonable values, indicating a proper model specification. However, it is crucial to notice that since we decide not to introduce the Bank of Portugal forecast values for the endogenous variables, its accuracy tend to be worse as time goes on. Accordingly, our model should be re-estimated each quarter, as new data comes available.

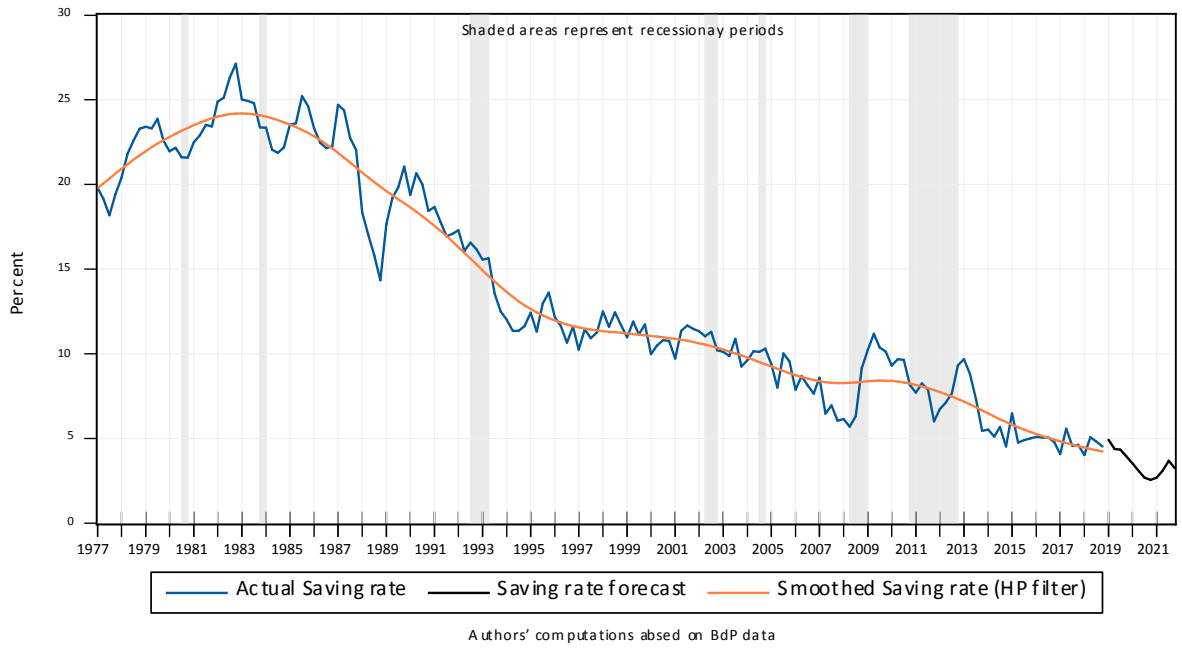


Figure 18: **Household saving rate forecast (2019-2022)**

[35] We used the Bank of Portugal projections for the Portuguese economy: 2019-2021, available in the economic bulletin, March 2019. Additionally, we used the IMF forecasts, present in the World Economic Outlook, April 2019.

4. Conclusions and future work

Household savings are slowing down since the mid-1980s and in 2018 registered a record low. The presence of Portugal in the Euro Zone provided broader access to credit by households and has put a premium on fiscal sustainability, which requires strict control over government budget balance and national current accounts. A decade after the financial crisis, interest rates are stuck close to zero and likely to remain so. Understanding the household savings fundamentals contributes to a better assessment of the long-run link between saving and investment decisions. This article sheds light on the debate about the evolution and determinants of household savings in Portugal by considering both the behaviour of households saving decisions at a microeconomic level and the dynamics of the household saving rate at an aggregate level.

Disequilibrium between savings and investment can only be adjusted by integrated demand and supply-side structural, fiscal and macroprudential policies. First, a positive regulatory environment can be made more favourable to household saving, investment and economic growth. Economic activity would take advantage of an improvement in framework conditions, stronger competition in product markets and better use of the available labour supply (Rodriguez-Palenzuela and Dees, 2016). Second, there is a strong need to develop non-bank optimal financing mix structures for companies and households such as equity and bond markets, venture capital and crowdfunding. Third, macroprudential policies can also play an essential role in achieving an economically sound allocation of savings. Finally, since agents are more prone to invest when there are confidence and certainty about the medium-term fiscal path, fiscal policies are advised to act under the legal framework for ensuring ongoing sound budgetary policies, by lower tax burden and reducing current unproductive expenditures.

The contribution of this paper is fivefold. First, we use the Household Finance and Consumption (HFCS) microdata to describe and compare the recent behaviour of household savings in Portugal at a micro-level. Second, we empirically assess the main microeconomic determinants of household savings, the heterogeneity across households regarding different ways of financing negative savings, and the main factors determining liquidity constrained agents. Third, we estimated a time-series model for aggregate consumption to forecast the household saving rate in Portugal. Fourth, we investigate whether the international financial crisis has had a structural effect on the household saving rate in Portugal. Finally, we evaluate the out-of-sample forecasting performance of our model using the BdP's predictions to trace different short-run scenarios for the Portuguese household saving rate. Based on our *micro* and *macro* empirical analysis, we outline the following set of conclusions:

- **The Small Leaks - A Micro Perspective of Household Saving Behaviour:** Around 50% of Portuguese households state that during the previous 12 months, their income was about the same as average household expenses; about 35% claim that expenses were lower; and the remaining 15% state they were higher than average expenses. The probability of households having expenses higher than income decreases with the households' income and is lower if the head of the family is a male under 25 years old. Yet, households are more prone to incur in negative savings if the family's head is not retired, and neither employed nor unemployed, as well as if the household has regular interest payments and credit card debt. Moreover, households who were refused credit or those who perceived credit constraint are significantly more likely not to save. Out of those who reported negative savings in the last year, the wealthiest are more likely to cover negative savings with their wealth and less probable to resort to informal loans or default. Higher-income households are also expected to finance their need through wealth instead of informal loans. Interestingly, larger households are less likely to get financing from unpaid bills vis-à-vis net wealth. Households who perceived a credit constraint are less expected to finance their negative savings through net wealth, and those who can get financing assistance from their friends and relatives are less expected to finance their negative savings through

wealth, as they are significantly more likely to get financing from informal loans. Other factors such as having credit card debt, regular interest payments, and being a house owner with a mortgage are more propense to be associated with financing through formal loans. Additionally, unemployed households are more likely to finance their negative saving with informal loans. Having negative savings increases the probability of being refused, and having a refused credit perception is associated with an increased probability of being partially or totally refused. Likewise, results corroborate the idea that single people and larger household are more likely to perceive a credit constraint. Another interesting result is that people who noticed a worsening in their job conditions during the past two years are more likely to perceive a credit constraint. Additionally, people in the higher quintile of net wealth tend to be less pessimistic about their credit restrictions. Finally and not surprisingly, having negative savings and being refused for credit are both positively associated with a higher probability of perceiving a constraint. With this, rather than advising policymakers and key stakeholders on a path to follow with specific policies recommendations, we seek to provide a detailed picture of a Portuguese representative sample, understanding who are the individuals incurring in each specific behaviour. Hence, after defining what they consider to be an undesirable behaviour (the leaks), our analysis will be useful in better informing where are these leaks place in the great ship.

- **The Great Ship - A Macro Perspective of Household Saving Dynamics:** Statistical evidence suggests there was no structural change in household saving decisions, indicating that the unexpected rise in the Portuguese household saving rate during the 2008 recession was led by temporary shocks to income and wealth. The real value of household net wealth in Portugal is increasing since 2015, and it already exceeded its pre-crisis levels, as a result of the rise in the real estate market. On average, total household net wealth corresponds to approximately 4.5 times the yearly real disposable income, and it has been increasing in recent years. A shock in consumption takes around four quarters to dissipate. The same applies to disposable income, while the coefficient on its own error-correcting term is small, suggesting relatively weak responses of real disposable income to economic shocks. Regarding short-run exogenous variables, 10yield and VIX show negative and significant effects on real net wealth, which is consistent with economic theory. The change in unemployment harms real consumption, real net wealth and real disposable income. Finally, the confidence index has a positive effect on all endogenous variables, especially in real disposable income. After solving our VEC model using both static deterministic and dynamic stochastic simulations based on our model estimated only with data until 2008Q2, one can conclude that it convincingly predicts the observed household saving rate, suggesting the financial crisis did not produce a structural change in the household saving behaviour. This conclusion implies that the abrupt rise in the Portuguese saving rate after 2008Q2 mirrors the recession shocks to real disposable income, real net wealth and unemployment rather than a primary change in household savings fundamentals.

The evolution of the household saving rate in Portugal has raised growing interest in the debate of the Portuguese economy. This study contributes to the discussion by combining microeconomic and macroeconomic evidence. Future developments in household savings will be determined by cultural, demographic and psychological individual characteristics, as well as by the macro environment in which families live. Understanding the main determinants of household savings and how do they influence each other is the first step in the elaboration of proper policy reforms aiming at increasing the ability of households to save. In this context, we intend to pursue future research in this field, by shaping our macroeconometric forecasting model with newly published data and by using the new wave of Household Financial and Consumption Survey (HFCS) microdata.

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A. Appendix

A.1. Tables and graphs - Micro

	Mean	Std.Dev.	Min.	Max.	N.Obs
Gender - dummies					
Female (Ref. Group)	0.4022877	0.4903673	0	1	31,035
Male	0.5977123	0.4903673	0	1	31,035
Age Classes - dummies					
Age $\geq$ 25 (Ref. Group)	0.9697116	0.1713825	0	1	31,035
Age $\leq$ 25	0.0302884	0.1713825	0	1	31,035
Marital Status - dummies					
Couple (Ref. Group)	0.6575157	0.4745483	0	1	31,035
Single	0.1308845	0.3372794	0	1	31,035
Divorced	0.1154825	0.3196085	0	1	31,035
Widowed	0.0961173	0.2947568	0	1	31,035
Education level - dummies					
Low Education (Ref. Group)	0.6192686	0.4855745	0	1	31,035
Mid Education	0.1488964	0.3559921	0	1	31,035
High Education	0.231835	0.422011	0	1	31,035
Parents education - dummies					
Low Education (Ref. Group)	0.8796887	0.3253307	0	1	29,299
Mid Education	0.0533807	0.2247952	0	1	29,299
High Education	0.0669306	0.2499061	0	1	29,299
Employment status - dummies					
Employee (Ref. Group)	0.4515225	0.4976524	0	1	31,035
Self-employed	0.1392943	0.346259	0	1	31,035
Unemployed	0.0661511	0.2485501	0	1	31,035
Retired	0.3062993	0.460963	0	1	31,035
Other	0.0367327	0.1881079	0	1	31,035
Housing status - dummies					
Owner - outright (Ref. Group)	0.4570324	0.4981584	0	1	31,035
Owner - with mortgage	0.3570485	0.479137	0	1	31,035
Renter/Other	0.1859191	0.3890477	0	1	31,035
Job worsening - dummies					
No worsening (Ref. Group)	0.7760861	0.4168706	0	1	37,242
Less hours or other	0.1524354	0.3594473	0	1	37,242
Lost job	0.0714784	0.2576258	0	1	37,242
Financial Sector	0.0178562	0.1324304	0	1	37,242
Public Sector	0.1089093	0.3115296	0	1	37,242
Temporary Contract	0.334837	0.4719398	0	1	37,242
Household gross income	25596.17	27074.52	0	760500	31,035
Household net wealth	222579.6	605646.5	-207500	3.09e+07	31,035
Household Size	2.660383	1.212309	0	10	31,035
Assistance from friends	0.6937347	0.4609475	0	1	36,870
Interest payments	0.3708179	0.4830303	0	1	37,242
Credit card debt	0.0774932	0.2673766	0	1	31,035
Expenses$\geq$ *Income*	0.1476045	0.3547132	0	1	30,995
Refused credit	0.0192793	0.1375068	0	1	37,242
Perceived constraint	0.0497825	0.2174982	0	1	37,242

Table 1. **Summary statistics - HFCS data**

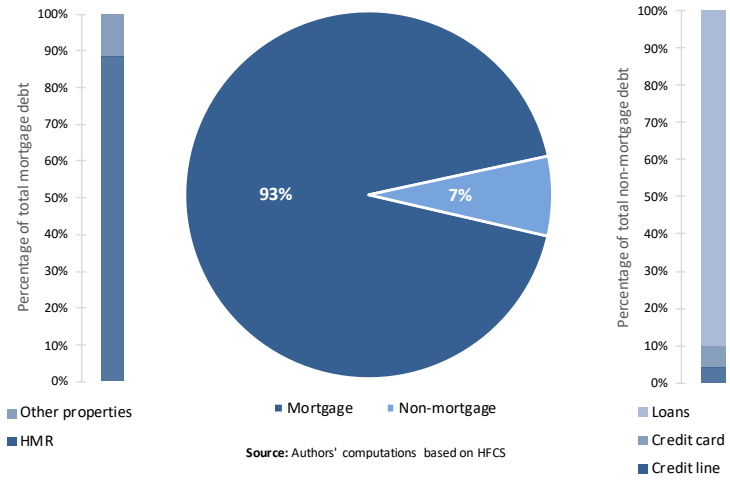


Figure 19: **Total debt**

	Expenses $\geq$ *Income*	
Female Age $\leq$ 25	-0.00539	(-0.02)
Male Age $\geq$ 25	0.108	(1.37)
Male Age $\leq$ 25	-0.818*	(-2.57)
Single	0.164	(1.53)
Divorced	0.143	(1.12)
Widowed	0.142	(1.24)
Mid Education	0.134	(1.27)
High Education	-0.0353	(-0.31)
Mid Education (Parents)	0.0340	(0.20)
High Education (Parents)	0.312*	(2.16)
Self-employed	0.229	(1.31)
Unemployed	0.154	(0.87)
Retired	0.0224	(0.13)
Other	0.626**	(2.84)
House owner - with mortgage	-0.0681	(-0.53)
Renter/Other	0.109	(0.97)
Less hours or other	0.157	(1.61)
Lost job	0.116	(0.82)
Financial sector	0.0958	(0.35)
Public sector	-0.110	(-0.89)
Temporary contract	-0.0904	(-0.60)
Household income - 2nd quintile	-0.287**	(-2.61)
Household income - 3rd quintile	-0.289*	(-2.50)
Household income - 4th quintile	-0.667***	(-5.35)
Household income - 5th quintile	-0.989***	(-7.25)
Household net wealth - 2nd quintile	0.0166	(0.14)
Household net wealth - 3rd quintile	-0.0944	(-0.72)
Household net wealth - 4th quintile	-0.146	(-1.13)
Household net wealth - 5th quintile	-0.0270	(-0.20)
Household size	0.103**	(3.05)
Assistance from friends	0.0817	(1.15)
Interest payments	0.330**	(2.81)
Credit card debt	0.513***	(4.38)
Refused credit	0.470*	(2.26)
Perceived constraint	0.395**	(3.16)
N.Obs.	5,799	
Imputations	5	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2. **Probit estimates - Negative saving**

Variable	(1)		(2)		(3)		(4)	
	Out of wealth		Out of formal loans		Out of informal loans		Out of unpaid	
Female Age $\leq$ 25	-0.135	(-0.18)	0.376	(0.87)	0.412	(0.54)	-0.0751	(-0.14)
Male Age $\geq$ 25	-0.295	(-1.68)	0.287	(1.14)	-0.149	(-0.81)	0.303	(1.24)
Male Age $\leq$ 25	0.428	(0.57)	0.0368	(0.04)	0.506	(0.71)	0	(.)
Single	-0.401	(-1.53)	-0.0877	(-0.28)	-0.106	(-0.35)	0.297	(0.91)
Divorced	-0.823**	(-2.73)	0.317	(0.62)	0.320	(1.00)	0.521	(1.32)
Widowed	-0.541	(-1.93)	0.161	(0.46)	0.483	(1.80)	0.430	(1.37)
Mid Education	-0.259	(-1.09)	-0.00962	(-0.03)	0.155	(0.64)	-0.0627	(-0.20)
High Education	0.0788	(0.25)	-0.491	(-1.45)	0.222	(0.68)	-0.696	(-1.36)
Mid Education (Parents)	0.289	(0.77)	0.125	(0.24)	0.365	(0.98)	0.0156	(0.02)
High Education (Parents)	0.0984	(0.27)	0.0858	(0.17)	0.344	(0.83)	-0.159	(-0.22)
Self-employed	-0.824	(-1.95)	0.635	(1.25)	0.665	(1.44)	-0.194	(-0.33)
Unemployed	-0.493	(-1.17)	0.759	(1.20)	0.868	(1.92)	0.111	(0.23)
Retired	-0.346	(-0.94)	0.152	(0.28)	0.316	(0.72)	0.456	(0.80)
Other	-0.597	(-1.29)	-0.122	(-0.20)	0.697	(1.40)	0.549	(0.86)
House owner - with mortgage	-0.0588	(-0.19)	-0.921*	(-2.46)	0.178	(0.54)	0.518	(1.38)
Renter/Other	-0.152	(-0.63)	-0.699	(-1.36)	0.220	(0.79)	0.235	(0.67)
Less hours or other	-0.195	(-0.78)	0.593*	(2.37)	0.179	(0.70)	0.433	(1.40)
Lost job	-0.377	(-1.35)	0.468	(1.39)	0.206	(0.60)	0.575	(1.62)
Financial sector	0.519	(0.67)	-0.468	(-0.76)	0.102	(0.12)	-1.117	(-1.51)
Public sector	0.430	(1.15)	-0.251	(-0.64)	-0.812*	(-2.46)	-0.0520	(-0.13)
Temporary contract	-0.515	(-1.50)	1.053*	(2.20)	0.558	(1.26)	-0.408	(-0.82)
Household income - 2nd quintile	0.380	(1.51)	0.249	(0.60)	-0.526*	(-1.98)	-0.0853	(-0.30)
Household income - 3rd quintile	0.546*	(2.07)	0.201	(0.48)	-1.008***	(-3.30)	-0.128	(-0.37)
Household income - 4th quintile	0.615*	(2.06)	0.695	(1.44)	-0.474	(-1.51)	-0.331	(-0.84)
Household income - 5th quintile	0.776*	(2.26)	0.521	(1.04)	-1.242**	(-3.28)	0.116	(0.28)
Household net wealth - 2nd quintile	0.396	(1.46)	-0.372	(-0.83)	-0.321	(-1.15)	-0.386	(-1.10)
Household net wealth - 3rd quintile	0.538	(1.69)	-0.988*	(-2.02)	-0.497	(-1.43)	-0.337	(-0.87)
Household net wealth - 4th quintile	1.042***	(3.48)	-0.478	(-0.98)	-0.904*	(-2.57)	-0.777*	(-2.04)
Household net wealth - 5th quintile	1.410***	(3.92)	-0.566	(-1.36)	-0.855*	(-2.36)	-0.944	(-1.85)
household size	-0.194**	(-2.95)	-0.0838	(-0.92)	0.0885	(1.09)	0.199*	(2.36)
Assistance from friends	-0.383*	(-2.11)	-0.185	(-0.78)	1.158***	(5.86)	-0.110	(-0.51)
Interest Payments	-0.294	(-1.11)	0.958**	(2.62)	-0.0164	(-0.06)	0.656*	(2.03)
Credit card debt	-0.358	(-1.28)	1.570***	(5.53)	-0.201	(-0.79)	0.392	(1.16)
Refused credit	-0.509	(-1.25)	0.0840	(0.17)	0.283	(0.63)	0.401	(0.95)
Perceived constraint	-0.495	(-1.86)	0.0266	(0.07)	0.449	(1.54)	0.189	(0.61)
N.Obs.	855		855		855		855	
Imputations	5		5		5		5	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3. **Probit estimates - Financing negative saving**

Variable	(1)		(2)	
	Refused credit		Perceived constraint	
Female Age ≤ 25	0.149	(0.36)	0.307	(0.71)
Male Age ≥ 25	0.102	(0.65)	-0.0979	(-0.98)
Male Age ≤ 25	0.386	(0.87)	0.227	(0.78)
Single	0.0612	(0.29)	0.398**	(2.62)
Divorced	0.260	(0.90)	0.295	(1.42)
Widowed	-0.0256	(-0.09)	0.227	(1.37)
Mid Education	-0.0386	(-0.21)	-0.0560	(-0.37)
High Education	0.186	(0.80)	-0.133	(-0.85)
Mid Education (Parents)	-0.0266	(-0.10)	-0.254	(-1.41)
High Education (Parents)	-0.233	(-0.86)	-0.214	(-1.05)
Self-employed	0.150	(0.44)	0.0977	(0.43)
Unemployed	-0.0512	(-0.14)	-0.236	(-1.09)
Retired	-0.145	(-0.38)	-0.465	(-1.68)
Other	-0.653	(-1.68)	-0.762	(-1.00)
House owner - with mortgage	0.0672	(0.31)	-0.292	(-1.68)
Renter/Other	0.174	(0.66)	0.169	(1.10)
Less hours or other	0.114	(0.75)	0.282*	(2.31)
Lost job	0.0910	(0.24)	0.525**	(3.20)
Financial sector	0.112	(0.34)	-0.136	(-0.45)
Public sector	-0.115	(-0.53)	0.0299	(0.21)
Temporary contract	0.0759	(0.25)	0.0726	(0.35)
Household income - 2nd quintile	0.0435	(0.16)	-0.0340	(-0.23)
Household income - 3rd quintile	0.255	(1.00)	-0.156	(-0.89)
Household income - 4th quintile	0.118	(0.44)	-0.0793	(-0.41)
Household income - 5th quintile	-0.0812	(-0.29)	-0.236	(-1.05)
Household net wealth - 2nd quintile	0.00151	(0.01)	-0.0782	(-0.54)
Household net wealth - 3rd quintile	-0.0964	(-0.31)	-0.468*	(-2.52)
Household net wealth - 4th quintile	0.277	(1.03)	-0.269	(-1.37)
Household net wealth - 5th quintile	0.00919	(0.03)	-0.358	(-1.77)
Household size	-0.00515	(-0.08)	0.169***	(4.06)
Assistance from friends	-0.0892	(-0.66)	-0.0907	(-0.91)
Interest payments	0.170	(0.86)	0.270	(1.74)
Credit card debt	0.388	(1.76)	0.210	(1.46)
Expenses $\geq$ *Income*	0.371*	(2.45)	0.373***	(3.51)
Refused credit			0.681***	(3.47)
Perceived constraint	0.584***	(3.31)		
N.Obs.	5,799		5,799	
Imputations	5		5	

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4. **Probit estimates - Credit constraints**

A.2. Tables and graphs - Macro

	RC	RDY	RNW	EURIBOR	10YIELD	U	VIX	CI
Mean	2752127.	3000630.	506352.9	2.387284	5.306001	9.327083	19.81022	−17.24306
Median	2793078.	3036766.	506449.1	2.156600	4.549056	8.600000	18.40944	−15.03333
Maximum	3083086.	3320855.	578137.0	7.136700	13.22314	17.30000	58.59594	0.166667
Minimum	2165950.	2454868.	417210.9	−0.329900	1.790000	4.800000	10.30794	−44.66667
Std. Dev.	231345.0	211379.1	35910.78	2.033260	2.572138	3.210295	7.557309	11.32837
Skewness	−0.994038	−0.995873	−0.537015	0.265059	1.348819	0.736025	1.932180	−0.777503
Kurtosis	3.184351	3.380540	2.853848	2.044194	4.320153	2.714128	9.526314	2.924366
Jarque-Bera	15.94572	16.44746	4.699601	4.778358	36.08020	8.994624	230.1042	9.695060
Probability	0.000345	0.000268	0.095388	0.091705	0.000000	0.011139	0.000000	0.007848
Sum	$2.64E+08$	$2.88E+08$	48609881	229.1793	509.3761	895.4000	1901.781	−1655.333
Sum Sq. Dev.	$5.08E+12$	$4.24E+12$	$1.23E+11$	392.7440	628.5101	979.0696	5425.727	12191.54
Observations	96	96	96	96	96	96	96	96
Source	BdP	BdP	BdP	ECB	OECD	Eurostat	Chicago Echange	EC

Table 5. **Summary statistics - Time-series data**

Additional information

RC – Household Real Consumption: Private Consumption (residents), Chain-linked volume (reference year 2011). In Economic Bulletin May 2019, Quarterly Series for the Portuguese Economy, 1977 – 2018, Banco de Portugal.

RDY – Household Real Disposable Income: Current prices in EUR millions. Private consumption (residents) deflator (2011=100). In Economic Bulletin May 2019, Quarterly Series for the Portuguese Economy, 1977 – 2018, Banco de Portugal.

RNW – Household Real Net Worth (Total net Wealth). Total net Wealth = Financial Wealth (1) + Non-financial Wealth (2). Stage 1: Quarterly Estimates for Current Prices. (1) Financial Wealth quarterly estimates. Total Financial Assets and Total Financial Liabilities (Current prices in EUR millions), annual estimates. In Economic Bulletin May 2019, Annual Series for Household Wealth (1980 – 2018, Banco de Portugal). Quarterly estimates based on Segmented Linear Interpolation of the corresponding annual time series (See Levy and Chen (1994) and Boyer and Merzbach (2011)). (2) Non-Financial Wealth quarterly estimates. Housing assets annual estimates (Current prices in EUR millions). Total Housing Assets (Current prices in EUR millions), annual estimates. In Economic Bulletin May 2019, Annual Series for Household Wealth (1980 – 2018, Banco de Portugal). Quarterly estimates based on Segmented Linear Interpolation of the corresponding annual time series (See Levy and Chen (1994) and Boyer and Merzbach (2011)). Stage 2: Quarterly Estimates for Volume (B2011). (1) Financial Wealth quarterly estimates. Share of Net Financial Wealth in total Household Disposable Income (current prices) applied to Real Disposable income. (2) Non-Financial Wealth quarterly estimates. Share of Net non-financial Wealth in total Household Disposable Income (current prices) applied to Real Disposable income.

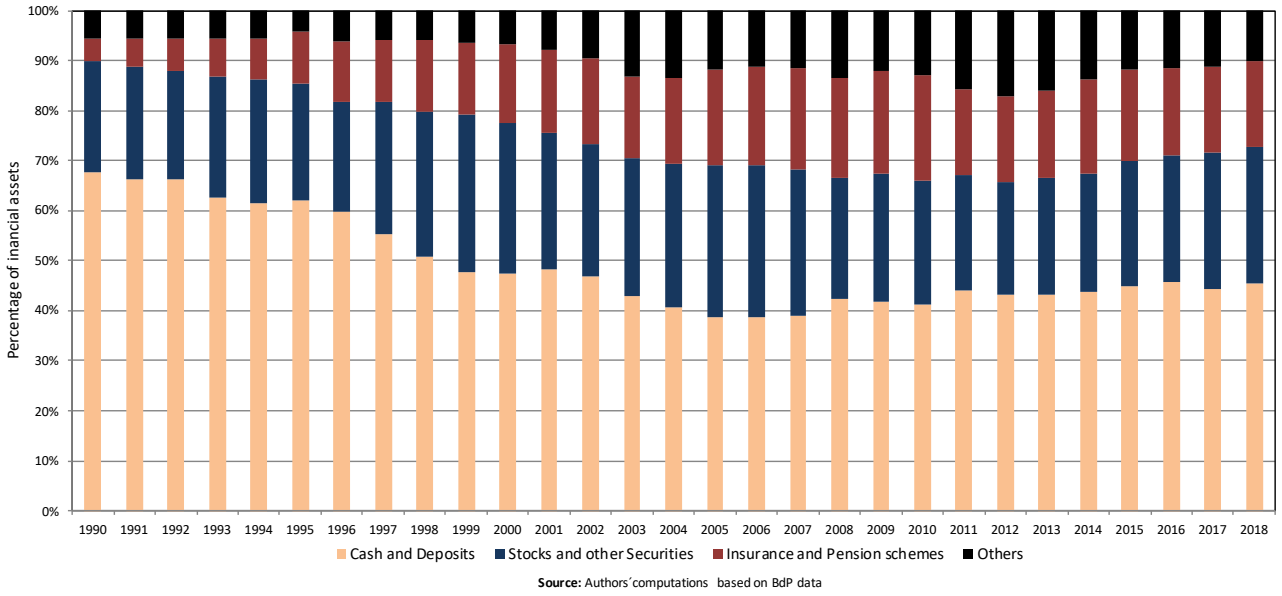


Figure 20: **Decomposition of net wealth**

	RC	RDY	RNW	EURIBOR	10YIELD	U	VIX	CI
Levels (P-values)								
ADF (intercept)	0.179000	0.047600	0.062900	0.046000	0.000200	0.639100	0.121500	0.826500
ADF (intercept+constant)	0.803500	0.950500	0.923300	0.657700	0.038800	0.844900	0.286000	0.156700
PP (intercept)	0.119700	0.077300	0.000900	0.160000	0.001500	0.772200	0.131800	0.677900
PP(intercept+constant)	0.829000	0.930000	0.986300	0.904800	0.401800	0.814300	0.326700	0.432800
1st differences (P-values)								
ADF (intercept)	0.000000	0.164500	0.000000	0.005000	0.002600	0.000000	0.000000	0.000300
ADF (intercept+constant)	0.000000	0.000000	0.000000	0.002900	0.000500	0.000100	0.000000	0.000100
PP (intercept)	0.000000	0.000000	0.000000	0.003400	0.002000	0.000000	0.000000	0.000300
PP(intercept+constant)	0.000000	0.000000	0.000000	0.001900	0.000400	0.000200	0.000000	0.000100

Sample (adjusted): 1995Q3 2008Q2

Table 6. **Unit root tests**

Orthogonalization: Cholesky (Lutkepohl)				
Component	Skewness	Chi-sq	df	Prob.
1	0.416198	1.501247	1	0.2205
2	0.126544	0.138783	1	0.7095
3	−0.181504	0.285513	1	0.5931
4	0.175315	0.266372	1	0.6058
Joint		2.191916	4	0.7005
Component	Kurtosis	Chi-sq	df	Prob.
1	3.087614	0.016632	1	0.8974
2	2.236774	1.262112	1	0.2613
3	2.474648	0.597988	1	0.4393
4	2.917482	0.014753	1	0.9033
Joint		1.891485	4	0.7557
Component	Jarque-Bera	df	Prob.	
1	1.517879	2	0.4682	
2	1.400895	2	0.4964	
3	0.883500	2	0.6429	
4	0.281126	2	0.8689	
Joint	4.083400	8	0.8495	

Sample (adjusted): 1995Q3 2008Q2

Table 7. **VEC residual normality test**

Lags	LM-Stat	Prob
1	18.36148	0.3032
2	9.585583	0.8874
3	14.59624	0.5544
4	29.63881	0.0200
5	9.850283	0.8743
6	11.84314	0.7547
7	17.05106	0.3823
8	2.929171	0.9999
9	20.35124	0.2048
10	22.61421	0.1244

Probs from chi-square with 16 df.
Sample (adjusted): 1995Q3 2008Q2

Table 8. **VEC residual serial correlation LM test**

Joint test:					
Chi-sq	df	Prob.			
211.0495	200	0.2824			
Individual components:					
Dependent	R-squared	F(20,31)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.392722	1.002375	0.4860	20.42157	0.4319
res2*res2	0.240451	0.490685	0.9505	12.50347	0.8977
res3*res3	0.469059	1.369346	0.2108	24.39107	0.2257
res4*res4	0.447557	1.255721	0.2779	23.27298	0.2756
res2*res1	0.389209	0.987693	0.5004	20.23886	0.4431
res3*res1	0.394990	1.011940	0.4767	20.53947	0.4247
res3*res2	0.401779	1.041017	0.4492	20.89252	0.4035
res4*res1	0.361530	0.877678	0.6132	18.79955	0.5349
res4*res2	0.468239	1.364841	0.2131	24.34841	0.2275
res4*res3	0.391191	0.995956	0.4922	20.34195	0.4367

Sample (adjusted): 1995Q3 2008Q2

Table 9. **VEC residual heteroskedasticity test - no cross terms**

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.521841	74.67886	47.85613	0.0000
At most 1 *	0.433476	36.31266	29.79707	0.0077
At most 2	0.104668	6.764409	15.49471	0.6052
At most 3	0.019334	1.015232	3.841466	0.3137

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.521841	38.36620	27.58434	0.0014
At most 1 *	0.433476	29.54825	21.13162	0.0026
At most 2	0.104668	5.749176	14.26460	0.6456
At most 3	0.019334	1.015232	3.841466	0.3137

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Cointegrating Equation(s):	Log likelihood	584.2331

Normalized cointegrating coefficients (standard error in parentheses)

LOG(RC)	LOG(RDY)	LOG(RNW)	EURIBOR
1.000000	0.000000	−1.545039	−0.006905
		(0.07977)	(0.00368)
0.000000	1.000000	−1.630257	0.005430
		(0.10770)	(0.00496)

Adjustment coefficients (standard error in parentheses)

D(LOG(RC))	−0.296235	0.153813
	(0.13992)	(0.09688)
D(LOG(RDY))	0.174167	−0.108139
	(0.16719)	(0.11576)
D(LOG(RNW))	0.282477	0.134585
	(0.16524)	(0.11442)
D(EURIBOR)	21.24382	−17.68058
	(4.74609)	(3.28622)

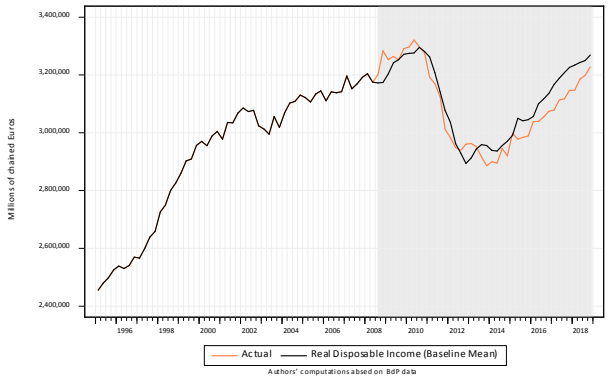
Sample (adjusted): 1995Q3 2008Q2
Trend assumption: Linear deterministic trend
Series: LOG(RC) LOG(RDY) LOG(RNW) EURIBOR
Exogenous series: 10YIELD D(U) VIX CI

Table 10. **Johansen cointegration test**

Error Correction:	D(LOG(RC))	D(LOG(RDY))	D(LOG(RNW))	D(EURIBOR)
CointEq1	−0.296235	0.174167	0.282477	21.24382
	(0.13992)	(0.16719)	(0.16524)	(4.74609)
	[-2.11719]	[1.04174]	[1.70946]	[4.47607]
CointEq2	0.153813	−0.108139	0.134585	−17.68058
	(0.09688)	(0.11576)	(0.11442)	(3.28622)
	[1.58766]	[-0.93415]	[1.17628]	[-5.38022]
D(LOG(RC(-1)))	−0.265779	−0.198726	−0.140015	−9.763758
	(0.13687)	(0.16355)	(0.16165)	(4.64278)
	[-1.94180]	[-1.21508]	[-0.86618]	[-2.10300]
D(LOG(RDY(-1)))	0.062955	−0.428731	−0.248791	5.756580
	(0.12478)	(0.14910)	(0.14736)	(4.23248)
	[0.50454]	[-2.87552]	[-1.68831]	[1.36010]
D(LOG(RNW(-1)))	−0.039010	0.197376	0.211387	−1.386714
	(0.12229)	(0.14613)	(0.14443)	(4.14823)
	[-0.31899]	[1.35070]	[1.46362]	[-0.33429]
D(EURIBOR(-1))	−0.000819	−0.000865	0.001846	0.269338
	(0.00331)	(0.00396)	(0.00391)	(0.11239)
	[-0.24705]	[-0.21857]	[0.47175]	[2.39639]
C	0.023523	0.016438	0.060272	−0.497382
	(0.01097)	(0.01310)	(0.01295)	(0.37196)
	[2.14511]	[1.25450]	[4.65405]	[-1.33718]
10YIELD	−0.001684	0.000774	−0.005145	0.161127
	(0.00146)	(0.00174)	(0.00172)	(0.04942)
	[-1.15594]	[0.44478]	[-2.99029]	[3.26021]
D(U)	−0.006729	−0.009162	−0.008244	0.007846
	(0.00335)	(0.00401)	(0.00396)	(0.11375)
	[-2.00651]	[-2.28644]	[-2.08148]	[0.06898]
VIX	−0.000121	$-5.71E-05$	−0.001161	0.003518
	(0.00023)	(0.00028)	(0.00028)	(0.00792)
	[-0.51930]	[-0.20459]	[-4.21309]	[0.44444]
CI	0.000374	0.000942	0.000315	0.032394
	(0.00023)	(0.00027)	(0.00027)	(0.00780)
	[1.62695]	[3.43107]	[1.16169]	[4.15461]
R-squared	0.492433	0.454415	0.510451	0.650173
Adj. R-squared	0.368636	0.321345	0.391049	0.564849
Sum sq. resids	0.001748	0.002496	0.002439	2.011695
S.E. equation	0.006530	0.007803	0.007712	0.221508
F-statistic	3.977747	3.414866	4.275060	7.620065
Log likelihood	194.0229	184.7635	185.3723	10.77412
Akaike AIC	−7.039342	−6.683211	−6.706627	0.008688
Schwarz SC	−6.626579	−6.270448	−6.293864	0.421451
Mean dependent	0.005877	0.004754	0.004342	−0.043773
S.D. dependent	0.008218	0.009472	0.009883	0.335791
Determinant resid covariance (dof adj.)		$5.30E-15$		
Determinant resid covariance		$2.05E-15$		
Log likelihood		584.2331		
Akaike information criterion		−20.47050		
Schwarz criterion		−18.51926		

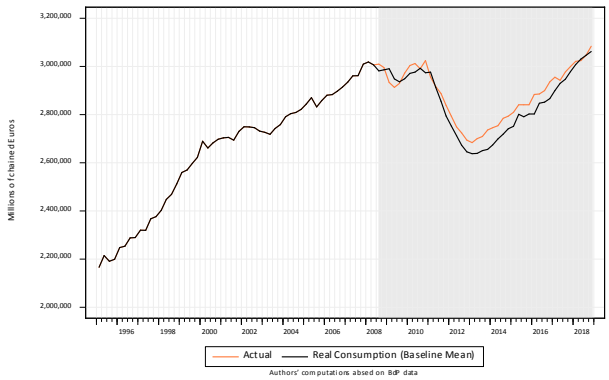
Sample (adjusted): 1995Q3 2008Q2
Standard errors in ( ) & t-statistics in [ ]

Table 11. **Final VEC model**

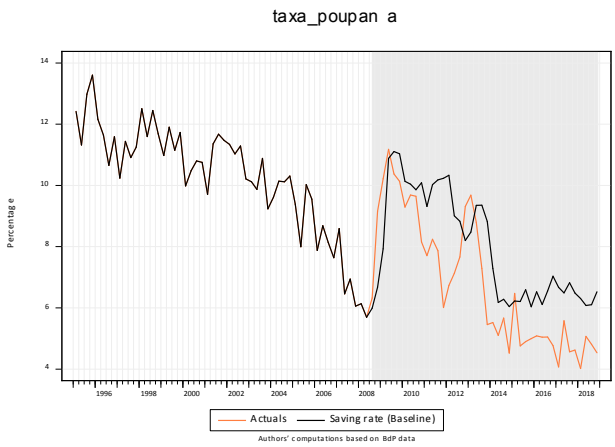


(a) **Real Disposable Income**

(b) **Real Net Wealth**



(c) **Real Consumption**



(d) **Saving Rate**

Figure 21: **Static deterministic predictions for the endogenous variables**

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