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THE EFFECTS OF MONETARY POLICY SHOCKS ON CONSUMPTION

A decomposition of the transmission channels for Portuguese households

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Abstract

In this study I use a combination of household level data from the 2nd wave of the HFCS with high-frequency data regarding changes in asset prices during events of monetary policy communication to evaluate the effects of monetary shocks on households' consumption expenditures in Portugal. I find that wealthy Hand-to-Mouth, i.e., households that are financially constrained but possess a significant amount of illiquid wealth, are the group with the most significant reaction to a negative monetary shock. In addition, Portugal displays a high home ownership rate, a fact that correlates with housing being the strongest transmission channel.

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1 Introduction

Monetary Policy is defined as the set of instruments, tools and decisions central banks take regarding money supply in order to achieve certain goals within the macroeconomic scenario. Nevertheless, the ramifications of monetary policy do not affect all households by the same token, and it is relevant to study and quantify the effects of these decisions on heterogeneous households. According to Slacalek et al. (2020), in recent years there has been a development in macroeconomics' literature regarding monetary policy transmission mechanism with heterogeneous economic agents. This is called the Heterogeneous Agent New Keynesian (HANK) literature. Instead of the traditional approach, the Representative Agent New Keynesian (RANK), these type of models consider different agents based on several characteristics. For example, households with different liquidity levels react differently to monetary policy shocks. Also, these HANK models consider several channels for monetary policy transmission. Besides direct effects, there is the presence of indirect effects when monetary policy is put into place, a characteristic RANK models do not take into consideration. With this being said, Slacalek et al. (2020) developed a model which contains several simple equations, in which each one corresponds to one channel through which monetary transmission is made to households. Their goal is to examine the effects of monetary policy on households' consumption expenditures in the biggest four countries of the Euro Area: France, Germany, Italy and Spain. Their bold point is that the magnitude of the monetary transmission depends essentially on three households' characteristics: balance sheets, debt exposure and marginal propensities to consume. Following this trend in macroeconomics' literature, I intend to replicate the results developed by Slacalek et al. (2020) to Portugal, i.e., I want to investigate the effects of a negative 100 bp shock on Portuguesese households' consumption expenditures. Being a recent topic in Europe, few are the countries where this analysis is performed. Altavilla et al. (2019) investigate the effects of monetary policy shocks in the Euro Area members and find significant heterogeneity levels in consumption related variables, labor and house markets. Slacalek et al. (2020) find significant differences in consumption responses between and within countries following a monetary shock. In the light of the existing literature, my analysis investigates the different channels of transmission through which monetary policy is made into Portuguese households,

using the same decomposition procedure from Slacalek et al. (2020). For this decomposition, I use Portuguese households micro data from the second wave of the Household Finance and Consumption Survey (HFCS) from the European Central Bank. To identify monetary surprises I adopt the approach of Corsetti et al. (2018) and use a dynamic factor model to construct a variable that represents the current policy surprise using the high frequency database developed by Altavilla et al. (2019). Then, I construct a Vector Autorregressive Model using this monetary surprise and a set of other macroeconomic variables to compute the Impulse Response Functions of this variable (the surprise) on other macroeconomic variables, as the decomposition proposed requires values for the reaction of those variables to a shock of monetary policy.

In line with Slacalek et al. (2020) conclusions for Spain and Italy, I find the presence of heterogeneity within Portuguese households after the shock. I estimate that wealthy Hand-to-Mouth households (which have illiquid wealth but no liquid one) increase their consumption by almost 8% following a monetary easing of 100 bp. As with Spain, the majority of this effect is made through capital gains on housing. Furthermore, both non Hand-to-Mouth (not constrained families) and poor Hand-to-Mouth (families with no liquid nor illiquid wealth), increase their consumption by less than 2%. However, the channels through which monetary transmission is made are distinct. For the former, the most relevant channel is the Fisher effect through long-term debt while for the latter is interest rate exposure. Also, I find that the monetary surprise generates positive effects on consumer, house and stock prices and on non-durable consumption. All in all, the bold picture brought by this study is that, while Wealthy Hand-to-Mouth households seem to represent only a fraction of the total households (around 15%), they seem to be very relevant to the aggregate effect of monetary policy. In addition, these findings corroborate with one of the conclusions from Corsetti et al. (2018): that the magnitude of the housing transmission channel is correlated with the home ownership rate, as Portugal displays housing as the strongest transmission channel with a home ownership rate of 74.5%.

The rest of this study goes in the following way: section 2 presents the existing literature on this field; section 3 sets up the theoretical model explaining the decomposition; section 4 explains the empirical implementation; section 5 reports the main findings; section 6 concludes.

2 Literature Review

Kaplan and Violante (2018) express the idea that the presence of heterogeneity among economic agents is a source of different reactions following a monetary shock and advocate for the usage of heterogeneous agent models rather than representative agent models using micro data. Therefore, as the goal here is to study household heterogeneity, I follow the steps of Kaplan et al. (2014) and divide the households according to their possessions of liquid and illiquid wealth, building on the concept of *Hand-to-Mouth* households, i.e., agents that have virtually no liquid wealth. In this latter study, the authors indicate that using this kind of measurement is consistent with the framework established for HANK models, but it is insufficient to separate agents only based on their liquid assets, and introduce the division based on illiquid assets as well with *Poor Hand-to-Mouth* and *Wealthy Hand-to-Mouth* households. Jappelli and Pistaferri (2014) reinforce the view for the usage of HANK models, as they find that the marginal propensities to consume in Italy demonstrate a significant level of heterogeneity.

Slacalek et al. (2020) follow the a similar approach to Kaplan et al. (2014) when dividing households according to their wealth possessions and evaluate the effects of a 100 bp decrease in interest rates on their consumption expenditures through several transmission channels. Their main conclusion is that Hand-to-Mouth households, i.e. financially constrained households are the ones that adjust their consumption the most following a monetary shock. Also, they show that the magnitude of each transmission channel within the total change in consumption expenditures is quite different across each type of household. The idea in my study is to perform the same analysis in Portugal. As the authors express, there is a large literature on the American monetary policy and its effects on financial markets, from periods when there was a clear lack of action by the Federal Reserve (such as in the Great Depression in 1929 in one of the largest downturns of the American history (Romer and Romer, 2013)) to the large intervention made in the first half of 2020 due to the Covid-19 outbreak with a broad range of measures such as interest rate cuts, forward guidance to keep expectations clear about the future path of monetary policy, massive securities' purchases, among others (Cheng et al., 2020). Nevertheless, in the Euro Area it is yet to be developed a complete insight on the effects of the European Central Bank policy and its significance. Altavilla et al. (2019) argue that this occurs due to the

nonexistence of a database that covers intraday information on a broad set of assets. For this reason they create the Euro Area policy event-study database (EA-MPD) that considers changes in several European asset prices and maturities during monetary policy press conferences and releases made by the ECB. This database is not only useful to measure and account for the effects of monetary policy but also a tool that can be used for a broad range of other purposes. Such useful data will be used in this study, in order to perform an identification of a monetary surprise. As they are able to separate conventional from unconventional policy due to the nature of ECB's communication, they find that during press releases, the setting of new policy rates is the relevant factor, while during press conferences, information about the medium-run and long-run on the state of monetary decisions are the relevant factors.

Corsetti et al. (2018) use a dynamic factor model to study heterogeneity within the Euro Area regarding the transmission of monetary policy. They build an instrument using the database previously mentioned to identify a monetary shock. They show that monetary transmission does not affect all Euro members by the same token, particularly in variables related to prices, housing and labor markets. Following this last result, they state that the depth of the housing transmission channel is correlated with the home ownership rates, a source of heterogeneity within the Euro Area.

Regarding the decomposition of the consumption expenditures' effects following a monetary policy shock, Auclert (2019) argues that there are three sources of redistribution after the shock that affect economic agents in distinct ways: first there is an effect in aggregate earnings (labor and profits), where there is a high level of heterogeneity as some agents win and others lose, the *earning heterogeneity channel*. Then, following changes in inflation, creditors and debtors are affected in different ways, a channel described as the *Fisher channel*. Lastly, changes in real interest rates affect financial asset prices, but the author states that one needs to consider the holdings of liabilities as well before naming who gains and loses. He defines this as the *interest rate exposure channel*.

Combining the mentioned tools with the existing knowledge on this topic, I intend to use all of them to the best of my knowledge to perform the decomposition. The grounds for the decomposition are explained in the next section.

3 Theoretical Framework

In order to perform a decomposition of the consumption expenditures' effects that occur after a shift in monetary policy, it is first necessary to define the channels through which monetary transmission occurs. Hence, I borrow the equations derived in Slacalek et al. (2020), where each equation corresponds to one channel of transmission. In the former study, to arrive to each equation, the authors start with a utility maximization from the households' perspective. For simplicity purposes I take them as given and execute my analysis.

There are five equations representing the five channels analysed. They are divided into direct effects, where each one is affected proportionally by the change in the policy interest rate, and indirect effects, in which each channel is affected proportionally to changes in macroeconomic variables (that occurred due to the swing in the policy interest rate). In addition, the main interest is to investigate the differences in consumption expenditures adjustment between groups of households that have different wealth levels. Therefore, each group has a different set of parameters (that will be approached later in the empirical implementation) and in two cases, even a different equation for the same channel, as each group has different characteristics.

With regards to assumptions, the equations derived bellow are seen as the reaction to an unannounced, unexpected change in the policy interest rate, an impossible *ex-ante*. Elasticity of intertemporal substitution and elasticity of individual income to aggregate income are seen as constant (where each group has its own value for each parameter). *Consumption* is defined as consumption expenditures of non-durable goods and services. Also, marginal propensitites to consume out of transitory income or wealth do not change after the policy shock i.e., households do not incur into precautionary savings and thus there is no change between hand-to-mouth status due to the effect. While the latter assumption is rather strong, the primal objective is to have a baseline scenario that allows for an evaluation of the change in consumption expenditures behavior for typical non, wealthy and poor hand-to-mouth households.

3.1 Direct effects

3.1.1 Intertemporal Substitution Effect

An increase in interest rates leads to households increasing their savings in the current period and deffer consumption the future. The higher the interest rate, the greater is the opportunity cost of buying goods and services today. Thus, there is a negative relationship between interest rate changes and this channel of monetary transmission. Slacalek et al. (2020) use the following equation:

$$IES = -\frac{1}{\gamma}(1-\mu)c \cdot dr, \tag{1}$$

where $\frac{1}{\gamma}$ is the elasticity of intertemporal substitution, $(1-\mu)$ the marginal propensity to save, (being μ the marginal propensity to consume), consumption expenditures c and a change in the real policy rate dr.

3.1.2 Net Interest Rate Exposure

Interest rate changes lead to gains if the economic agents are net savers and to losses if they are net debtors. Auclert (2019) defines unhedged interest rate exposure (URE) as a measure that captures the difference between all household's maturing assets and liabilities at one period in time, which reflects the gains and losses following an interest rate change. This gain/loss depends whether the household is a net saver or borrower. Accordingly, for non Hand-to-Motuh households, the quantification of the net interest rate channel is defined as:

$$NIE = \mu[(b+y-c)+\delta^B B - \delta^l l] \cdot dr \tag{2}$$

In this context, b is a short-term liquid asset and y household income. This formula also includes the difference between the portions δ^B and δ^l of long-term assets B and long-term liabilities l that mature every year.

However, Hand-to-Mouth households, i.e. families for which borrowing constraints do bind, are not on the Euler equation as they spend the totality of their income to make meets end. This

type of households cannot deffer consumption, which is given by:

$$c = y - \underline{b}r - \frac{\delta^m m}{p} \tag{3}$$

$\underline{b}$ is the value of the household's unsecured credit limit, δ^m is the proportion of nominal debt that is maturing and p is the price level. Taking the derivative of (3) with respect to r, one gets:

$$NIE = -\underline{b} \cdot dr \tag{4}$$

which is the net interest rate exposure channel for Hand-to-Mouth households.

3.2 Indirect effects

3.2.1 Labor Income Effects

According to New Keynesian thought, which is heavily based on the stickiness of prices, money and monetary policy can influence the real economy. Equation (5) is a representation of this statement. A decrease in the current policy interest rate will diminish the opportunity cost of consumption of households today, making them increase their consumption expenditures. This initial raise in expenditures leads to higher labor demand and earnings. In the short-run (and conceivably in the long-run), nominal rigidities are present as (most) prices do not respond immediately to shocks in macroeconomic variables and so, there is a real gain from consumers' perspective as they are able to purchase more goods and services. This gain is evaluated by:

$$INC = \mu \varepsilon_{y,Y} \left(\frac{y}{Y} \right) \cdot dY \tag{5}$$

$\varepsilon_{y,Y}$ is the elasticity of individual income to aggregate income, $\left(\frac{y}{Y}\right)$ is the share of each household group (non, poor and wealthy Hand-to-Mouth) relative to aggregate income and dY is the change in the latter following a change in the interest rate. Essentially, this channel captures the idea that aggregate shocks on macroeconomic variables affect households differently according to their characteristics.

3.2.2 Fisher Effects

Alterations to the policy rate also affect the real value of debt, namely long-term debt. In equation 2 the focus was on the interest rate exposure. Now the goal is to put the effect of inflation on the spotlight. As stated in Auclert (2019), a cut in r generates inflation, the value of debt deteriorates and debtors gain. For non Hand-to-Mouth households, the magnitude of the consumption increase due to changes in the value of long-term debt is measured by:

$$NOM = \mu m \cdot dp \tag{6}$$

m is a stock of nominal debt and dp the inflation change following an interest rate adjustment. Once again, the preposition for Hand-to-Mouth households is different due to the nature of the budget constraint from equation (3). Differentiating it with respect to p and setting p to 1, one gets:

$$NOM = \delta^m m \cdot dp \tag{7}$$

Meaning that the so called Fisher Effect only applies to the proportion of maturing debt.

3.2.3 Capital Gains on Real Assets

Lastly, there is an evaluation of the monetary shock through capital gains on real assets that are not so liquid. For instance, stock prices are very sensitive to changes in economic conditions, and adjustments to the interest rates are no exceptions. On the other hand, housing is an important channel for monetary transmission in Portugal (Corsetti et al., 2018). This way, the wealth effects occurring through changes in real long-term assets generated following a monetary easing/contraction are given by:

$$CAP^{sto} = \lambda \mu k \cdot dq^{sto} \tag{8}$$

$$CAP^{hou} = \lambda \mu k \cdot dq^{hou} \tag{9}$$

Assuming that only a proportion λ of people will accommodate the gain, the change in consumption expenditures following dr is directly proportional to MPC out of a capital gain $\lambda\mu$, to

the value of the underlying asset and to the change in stock market prices dq^{sto} or house prices dq^{hou}. In this derivation, I prepare these equations (8) and (9) to identify and separate the effects through housing and stock prices. While the equations are similar, it is relevant to analyse both effects separately as the conclusions retrieved from the analysis might serve public policy differently. Table 1 in the appendix summarizes the decomposition. For further details consult section 2 of Slacalek et al. (2020). The total change in consumption expenditures is given by the sum of all components for each kind of household:

$$dc = IES + NIE + INC + NOM + CAP \tag{10}$$

Notice that there is no value for the intertemporal substitution channel for Hand-to-Mouth households as, by definition, they spend all their income and thus, do not have the option to adjust consumption given their time preferences and so, monetary policy yields no effect through this channel for Hand-to-Mouth families. By the same token, poor Hand-to-Mouth do not have an equation for capital gains on real assets as, by definition, they do not possess such assets. This concludes the theoretical model for the decomposition. In the next section I explain under which circumstances I perform this analysis.

4 Empirical Implementation

The decomposition described previously requires several steps. First, using data from the second wave of the Household Finance and Consumption Survey, I divide Portuguese households into three categories according to their liquid and illiquid wealth. Then, I need a variable that I can use as a monetary policy to shock to evaluate the reactions of some macroeconomic variables (as several equations from table 1 require values for changes in aggregate income, inflation, etc.). In order to get this monetary shock instrument I use the dynamic factor model using changes in the Euro Overnight Index Average (EONIA) swap rate for several maturities from the high-frequency database developed in Altavilla et al. (2019). In this model, the interest lies in the first factor, which will be used to build a variable that represents the current monetary policy surprise. I use this variable then in a vector autoregressive model to compute impulse response functions for the required macroeconomic variables. Finally, I perform the decomposition by deriving the equations from the previous section. For this last part I borrow some estimates from the existing literature such as the marginal propensities to consume, the elasticity of intertemporal substitution and the is the elasticity of individual income to aggregate income. The list of HFCS variables used in both the household classification and the expenditure decomposition can be found in the appendix in section 7.2. Also, as HFCS does not include a variable for net income, I use the marginal tax rates for Portugal from OECD (see table 2). The present section describes the implementation for all these procedures.

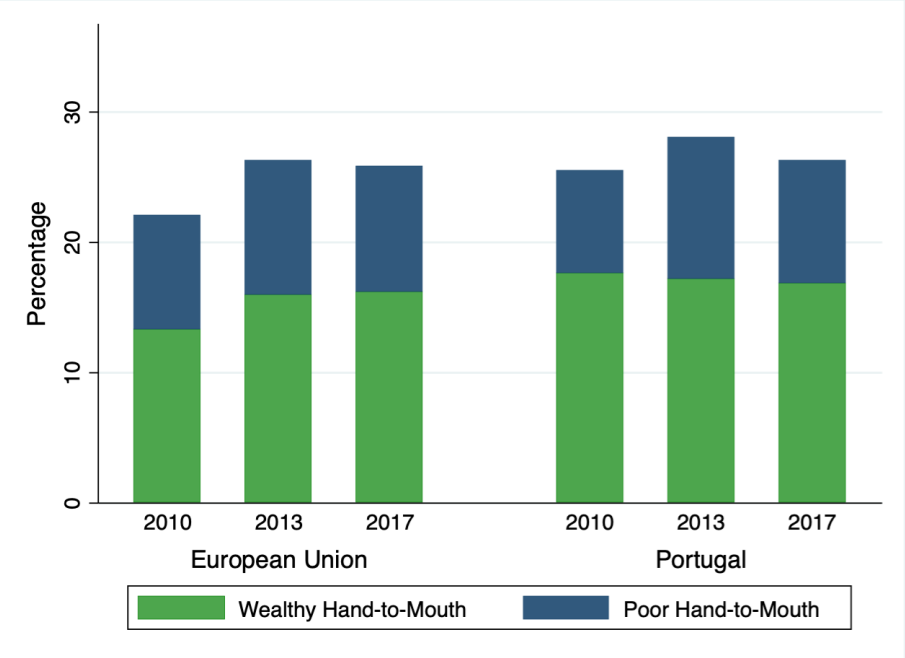
4.1 Household classification

Following the lines of Kaplan and Violante (2014), I make a subdivision of households into three categories: non-hand-to-mouth, poor hand-to-mouth and wealthy hand-to-mouth.

To be defined as a hand-to-mouth, a household needs to have basically no net liquid wealth. I define it as liquid assets net of liquid liabilities (see section 7.2 for the specific variables). Then, while poor hand-to-mouth households will have zero or negative net illiquid wealth (essentially the value real estate property, being it or not the household's main residence, discounted on the amount still owed on those or other properties), wealthy hand-to-mouth households have a positive position of net illiquid wealth. The remaining share of households, non-hand-to-mouth,

are grouped together and have positive net liquid wealth. For further information, see Slacalek et al. (2020) appendix.

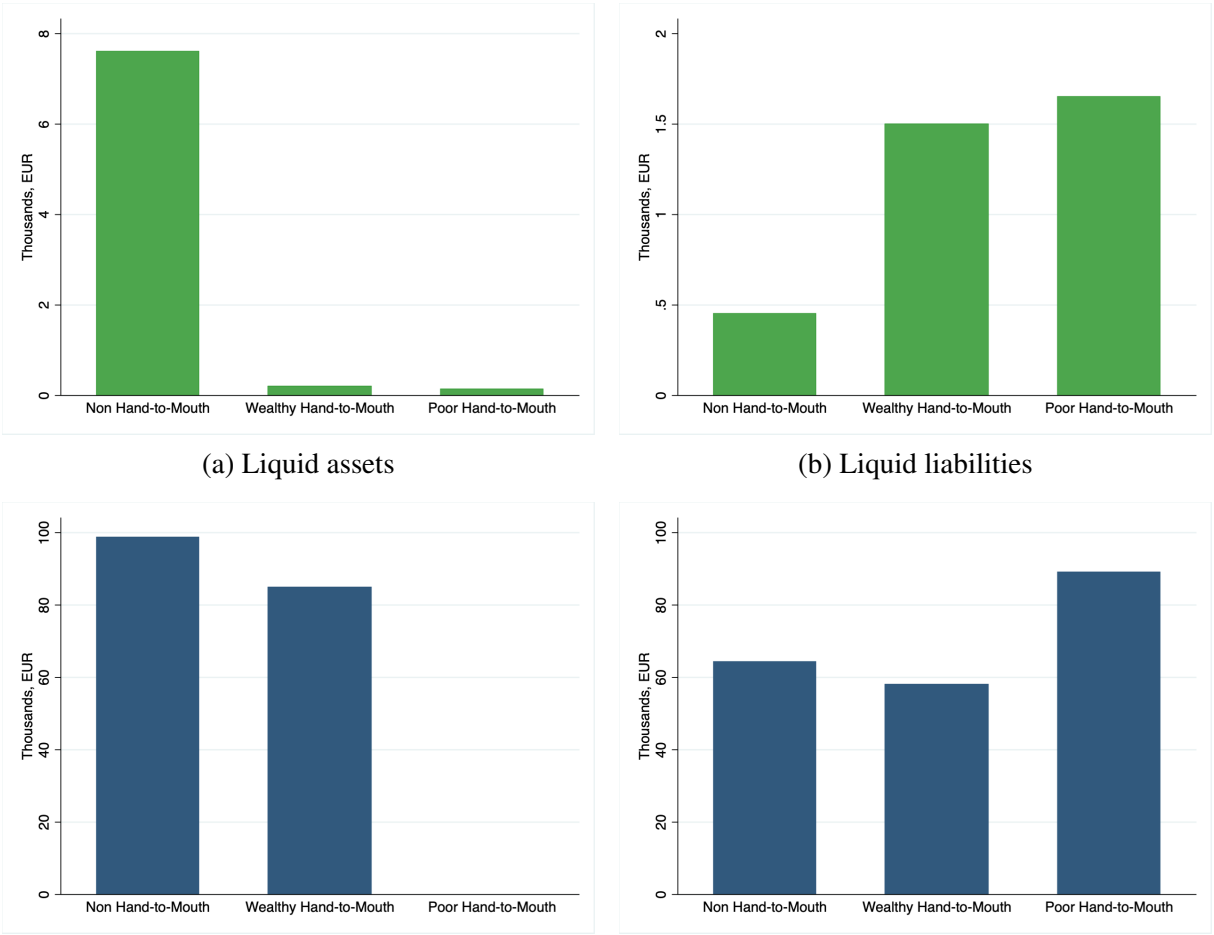
Figure 1: Share of HtM households in the European Union and in Portugal



Source: Household Finance and Consumption Survey 1st, 2nd and 3rd waves

Figure 1 displays the evolution of the share of hand-to-mouth households in the European Union (EU) and in Portugal throughout the last decade. Portugal exhibits a similar behavior to the average of the European Union, having the total percentage of hand-to-mouth families slightly above the EU in the three years analysed. While the number of wealthy hand-to-mouth families has stayed stable during this period (around 17% of total households), the amount of Portuguese poor hand-to-mouth households rose by almost 3 percentage points (from 7.86% to 10.9%) from 2010 to 2013. Then, from 2013 this value decreased again, but to 9.39%, a value still higher than the one from 2010. While the left side of this figure is relevant as a benchmark, Slacalek et al. (2020) perform similar calculations for the four biggest countries in the Euro Area, unraveling significant heterogeneity at the country level regarding the amount of Hand-to-Mouth families in these countries. Figure 2 shows the median values for liquid and illiquid assets and liabilities for Portuguese households. It gives the visual perception that allow for the distinction between the three groups considered. The criteria that allows for the differentiation from non Hand-to-Mouth to Hand-to-Mouth is the possession of positive net liquid wealth. Panel (a) and (b) from

Figure 2: Assets and liabilities in Portugal by HtM status, median values



(a) Liquid assets

(b) Liquid liabilities

(c) Illiquid assets

(d) Illiquid liabilities

Source: Household Finance and Consumption Survey 2nd wave

figure 2 yield the visual representation of this criteria. There is a clear discrepancy between non Hand-to-Mouth and Hand-to-Mouth households. While the former possess a median value of EUR 7,800, the latter have a value close to EUR 0 and no significant difference between the two Hand-to-Mouth groups. For liquid liabilities, while non Hand-to-Mouth households have a median value lower than Hand-to-Mouth households, the difference is not so sharp, being it approximately EUR 1,000. As expected, Hand-to-Mouth households have a higher challenge to ”make meets end”. It is no surprise that they have more short-term liabilities and become more indebted. The main objective here is to illustrate the value of net liquid wealth: non Hand-to-Mouth households have positive holdings of net liquid wealth while Hand-to-Mouth households have negative or zero net liquid wealth. The second dimension of this classification is the separation between poor and wealthy Hand-to-Mouth households where the former group

possesses positive net illiquid wealth, while the latter does not. Panels (c) and (d) from figure 2 illustrate this scenario. It is interesting to observe that the median values for non Hand-to-Mouth and Wealthy Hand-to-Mouth households do not differ that much, both in terms of illiquid assets (EUR 80,000-100,000) and liabilities (around EUR 60,000). Nevertheless, the situation for the Poor Hand-to-Mouth is rather different. Not only is the median average of assets EUR 0, but also the value of the median illiquid liabilities is greater than the other two groups (EUR 90,000).

4.2 Household parameters

In order to implement equations of table 1, some parameters are needed, and thus I borrow them from the existing literature, namely the values for the marginal propensities to consume, the elasticity of intertemporal substitution and the elasticity of individual income to aggregate income. According to Kaplan et al. (2014), the most effective way to measure changes in consumption is to have a considerable amount of Hand-to-Mouth households, (which the HFCS has) as this kind of consumers spend all their their available resources in each period (and thus, fulfilling the requirement for being considered Hand-to-Mouth by having zero or negative liquid wealth). Hand-to-Mouth will therefore have much higher marginal propensities to consume (MPCs) than households that are not constrained, i.e. have savings and/or accessible credit. Looking at empirical evidence on differences in marginal propensities to consume, the previous result is confirmed, as consumers with little economic means have higher MPCs in general (as examples we have Jappelli and Pistaferri (2010), Parker et al. (2013), Jappelli and Pistaferri (2014) and Kaplan and Violante (2014)). For this reason, it makes sense to perform this subdivision of households when evaluating the several channels of transmission of monetary policy on consumers.

Furthermore, there is a distinction between the marginal propensity to consume out of transitory income and out of wealth as not everyone reacts to the capital gain as described in (8) and (9). Drescher et al. (2020) derive MPC's for several European countries based on the third wave of the Household Finance and Consumption Survey and reach to a value of 0.3 for the MPC out of an unexpected and one time increase in income for Portugal. De Castro (2007) estimate an

MPC of 0.03 out of wealth gains in Portugal. Neither of these two studies presents a household separation regarding its wealth status, but these values seem to be close to intermediate values between the estimates for non Hand-to-Mouth and Hand-to-Mouth households in Slacalek et al. (2020). Henceforth, I use the MPCs from this study, which are presented in table 3.

Table 3: Marginal Propensities to Consume

	Transitory Income	Real Estate Wealth	Stock Market Wealth
Non Hand-to-Mouth	0.05	0.01	0.01
Wealthy Hand-to-Mouth	0.5	0.07	0.07
Poor Hand-to-Mouth	0.5	-	-

Source: Slacalek et al. (2020)

Two other parameters are necessary for the derivation: the elasticity of intertemporal substitution and the elasticity of individual to aggregate income. While estimates for the former have been around for the last two decades, Havránek (2015) finds that these values are positively biased. While the range for the values of this parameter is rather large, I follow Slacalek et al. (2020) and set it to 0.5. With regards to the elasticity of individual aggregate income, Lenza and Slacalek (2018) concludes that monetary expansion affects much more incomes at the bottom of the income distribution. Slacalek et al. (2020) goes in line with these findings and so, it the reference for this study, I use an weighted average for their values of Spain and Italy, as these two countries have more similarities with Portugal than France or Germany regarding reactions to monetary policy shocks (for example see the reaction of GDP or housing prices to a contractionary monetary shock in Corsetti et al. (2018)). Table 4 summarizes these elasticities.

Table 4: Elasticities

	Elasticity of individual to aggregate income	Elasticity of intertemporal substitution
Non Hand-to-Mouth	0.8	
Wealthy Hand-to-Mouth	1.6	0.5
Poor Hand-to-Mouth	2.4	

Source: Slacalek et al. (2020)

4.3 Modeling monetary policy communication

To identify the monetary policy shocks, I use the policy event-study database (EA-MPD) developed in Altavilla et al. (2019) that reports changes in assets prices and maturities following monetary policy announcements made by the Governing Council of the European Central Bank. Before explaining the scenario under which the model is developed, it is relevant to clarify the functioning of the communication of the policy announcements.

Since the ECB creation in 1999, the frequency for monetary policy meetings and announcements has changed several times. It started with two policy meetings a month, to one a month after November 2001. Later, since January 2015 these gatherings occurred every 6 weeks.

After these meetings, the communication of the monetary decisions goes in the following way: at 13:45 (Central European Time) there is a publication of a list with all the decisions that were taken following the meeting, without any explanations for those decisions. It is just a statement with the new measures. Later, at 14:30 the president of the ECB goes on a press release to explain the reasoning behind each one of the decisions. After this speech there is a 45-minute session for questions and answers with journalists. During this whole period of the president's speech, market participants might identify the future monetary policy scenario and react according to their perceptions. Altavilla et al. (2019) report the changes of several asset prices and yields during the press release, the press conference and the whole monetary event, and register all this information in a database that is routinely updated. To create an instrument for monetary policy shocks, I select the changes in the Euro Area Overnight Indexed Swap (OIS) rates for 1 week, 1, 3, 6 months, 1 and 2 year maturities during policy communication from their database. Corsetti et al. (2018) and Slacalek et al. (2020) use changes in this rate for measuring monetary surprises in the Euro Area, and thus I follow the same approach.

The type of communication of monetary policy is also relevant in the development of this model. For instance, as shown in Altavilla et al. (2019), during the press release, the surprise perceived by economic agents is relative to policy rates targeting. Later, during the press conference, the surprises are more related to medium and long-term information regarding monetary policy, namely forward guidance and Quantitative Easing (QE). Gürkaynak et al. (2004) find that two monetary policy factors affect asset prices in the United States. They interpret the first factor as

a target for the federal funds rate and the second as a description of the future path of monetary policy, similar to what is described as forward guidance in the Euro Area. Based on this analysis, I do a similar one and form an hypothesis where there are two factors representing surprises that affect assets prices in the Euro Area: changes in policy rates and forward guidance. A third factor that influences asset prices could be QE as it refers to a more distant horizon for monetary policy than forward guidance. Nevertheless, I abstract from this hypothesis as it is a relatively recent form of unconventional monetary policy in the Euro Area and the amount of available data is rather small. The important aspect for the analysis is the first factor that corresponds to what Slacalek et al. (2020) calls the current policy surprise.

Assuming that changes in OIS rates that occur within the monetary event window for each day, that is, from 13.25 to 15.50, are caused only by the monetary policy announcements, I estimate a Dynamic Factor Model (DFM) using those changes. Corsetti et al. (2018) elaborate on the motivation of using a DFM for the Euro Area. They argue that this type of model has several advantages as it does not require for explanatory variables to be observable, it gets statistically robust results and it goes accordingly with economic theory. Using their framework to identify monetary policy shocks, the model is laid down the following way:

$$X_t = \Lambda F_t + e_t \tag{11}$$

Where, X_t and e_t are n x 1 matrices corresponding to a series of macroeconomic observable variables and disturbance errors, respectively, Λ is a n x m matrix of factor loadings and F_t is a m x 1 matrix of unobserved factors. Applying the general model in (11) to the specific case of our study yields:

$$\begin{bmatrix} OIS\ 1W_t \\ OIS\ 1M_t \\ OIS\ 3M_t \\ OIS\ 6M_t \\ OIS\ 1Y_t \\ OIS\ 2Y_t \end{bmatrix} = \begin{bmatrix} \lambda_{11} & 0 \\ \lambda_{12} & 0 \\ \lambda_{13} & \lambda_{23} \\ \lambda_{14} & \lambda_{24} \\ \lambda_{15} & \lambda_{25} \\ \lambda_{16} & \lambda_{26} \end{bmatrix} \begin{bmatrix} f_{1t} \\ f_{2t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \tag{12}$$

To dissociate the effects of forward guidance on the short-sighted OIS, I force λ_{21} and λ_{22} to be zero so that all fluctuations during the monetary window occur due to changes in policy rates. I follow Stock and Watson (2016) for the estimation of the parameters. For a principal components estimation, one needs to solve the following least-squares minimization:

$$\underset{F_1,\ldots,F_T,\Lambda}{\text{minimize}} \quad \frac{1}{NT}\sum_{t=1}^{T}(X_t - \Lambda F_t)'(X_t - \Lambda F_t) \tag{13}$$

In the EAMPD data set, for the period and variables chosen, there are no missing data, which means that it is possible to get estimators both for F_t and Λ as follows:

$$\hat{F}_t = N^{-1}\hat{\Lambda}' X_t \tag{14}$$

$$\hat{\Lambda} = T^{-1}\sum_{t=1}^{T} X_t X_t' \tag{15}$$

Equation (15) corresponds to the matrix of eigenvectors of the sample variance matrix of the observed variables, X_t.

After the estimation, we are left with a number of series for each factor equal to the number of policy announcements for 2000 to 2019. Now the effects of policy rate changes and forward guidance are isolated. As the main interest of this study is to investigate the effects of surprises in policy rates, I focus on the first factor to build a quarterly instrument of communication shocks, z_t. As the data from the used database does not have a regular frequency, I sum the values of the first factor for each quarter and get a regular quarterly time series for z_t. This

new variable will be used in a Vector Autoregressive Model (VAR) that is presented in the next subsection. In the end, I end up with a time-series for 80 quarters, that goes from the first quarter of 2000 to the fourth quarter of 2019.

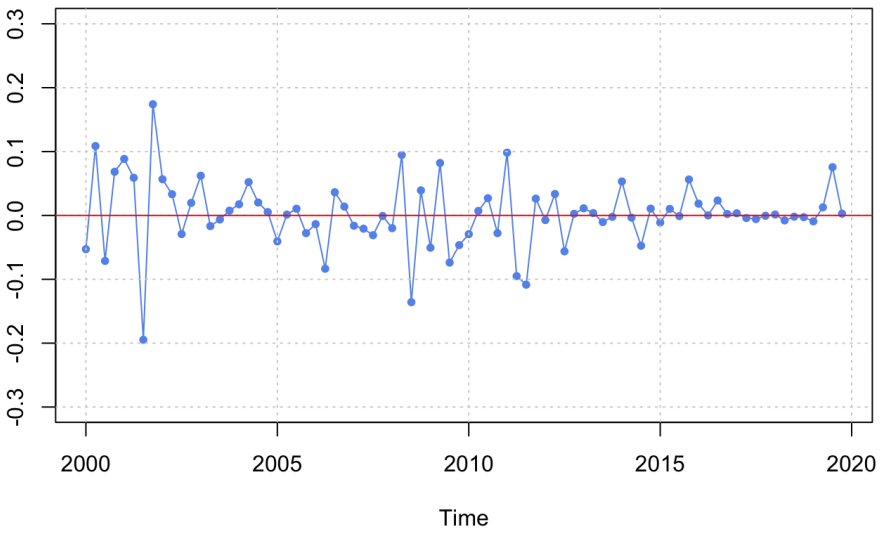
4.4 Vector Autoregressive Model for Monetary Shocks

To estimate the impulse response functions (IRFs) of a negative monetary policy shock on several macroeconomic variables, I construct a 2-lagged (according to the Akaike information criterion) VAR with the following components: the constructed indicator z_t, the Euro Area 3-month interest rate, a house price index, a consumer price index, real GDP, non-durable consumption and an index for non-financial bank volume lending. All variables enter in the VAR in log-levels except for the surprise z_t and the nominal interest rate. The VAR is estimated using standard OLS techniques. After assuring no autocorrelation in the residuals of the VAR (see section 7.4 in the appendix for the Portmanteau test and for several statistics regarding the VAR), I estimate the respective IRFs to examine the response of all the variables to a negative shock of 100 bp on the monetary surprise z_t. Then, when performing the decomposition described in section 3, in order to abstract from measurement error, I focus on the mean values for horizons 1-3, a similar step done also in Slacalek et al. (2020). Here I end the empirical implementation and present my findings in the next section.

5 Results

Figure 3 the series of the estimated instrument for monetary policy shocks, z_t. It is possible to observe that the magnitude of these shocks has not always been the same since the beginning of the millennium. While in the first years, volatility was higher in the sense that a negative shock was followed by a positive one (and vice versa), between 2003 and 2008 it decreased significantly. Later, during the period characterized by the great recession and the European sovereign debt crisis, volatility increased once again. Finally, in 2015 when the ECB's rates became closer to the zero lower bound, the magnitude of these shocks is essentially zero.

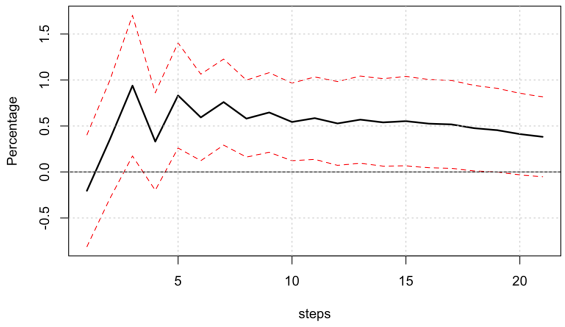
Figure 3: Monetary Surprise z_t



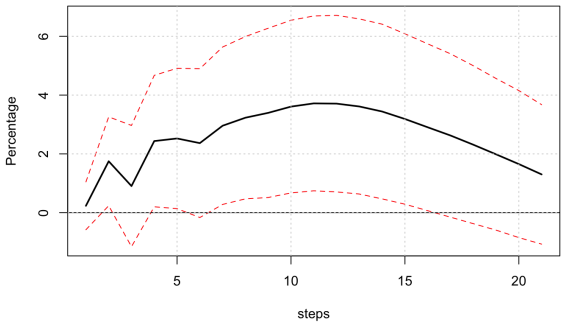
Source: Altavilla et al. (2019)

This scenario gives strength and robustness to the policy surprise z_t as it matches the macroeconomic narrative of the Euro Area during this 20-year period. Furthermore, as it represents a monetary surprise, it should have an expected value of zero, which it does. Next we have the VAR from section 4.4. As I am not interested in the coefficients of the VAR, I skip that part of the analysis since the IRFs are what is needed for the main goal of the consumption decomposition (see section 4.4 in the appendix for more information on the VAR).

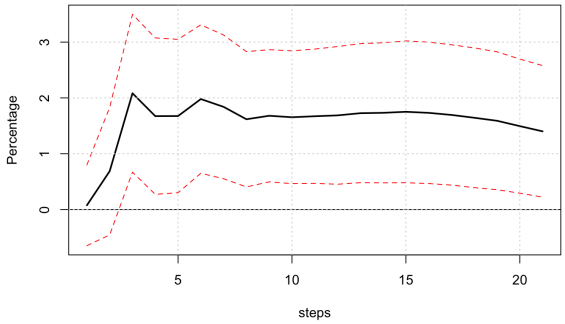
Figure 4: Impulse Response Functions following a 100 bp decrease



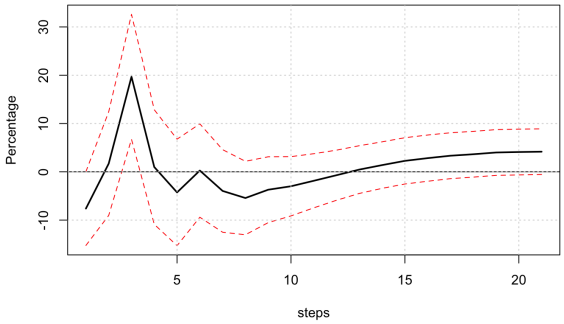
(a) Consumer Price Index



(b) House Price Index



(c) Non Durable consumption



(d) PSI 20

Source: see section 7.5

Figure 4 displays the impulse response functions of the most relevant variables following a shock of -100 basis points in the estimated variable z_t. The black line represents the median value, while the two red lines denote the percentiles 16 to 84. While on one hand, there is still a lack of a common agreement regarding the effects of monetary policy surprises in the European countries (as it is a relatively recent topic and there is still a small amount of literature, particularly for Portugal), on the other hand, the results obtained seem to be not only relevant from a theoretical point of view, but also statistically significant. There might exist some measurement error, as the responses at impact of the Consumer Price and PSI 20 indexes are negative which seems odd not only from an economic theory point of view, but also from the existing empirical evidence (Corsetti et al. (2018), Alessi and Kerssenfischer (2019) or Rigobon and Sack (2004)). For this reason, and as it was done in my main reference Slacalek et al. (2020), I ignore the responses at impact on the remaining of the analysis.

Non-durable consumption displays a positive reaction following the monetary easing, showing

that consumption is a strong channel for monetary policy transmission, a conclusion that goes in line with Lenza and Slacalek (2018). Not only does it display a positive response following the shock, but this effect remains persistent throughout time. While the confidence band is rather large, with values ranging sensibly between 0.5 and 4 percent, the effect is definitely positive. This result seems considerably consistent with the findings of Corsetti et al. (2018) that estimate a negative and persistent effect on private consumption after a contraction of 25 bp in interest rates. Accordingly, consumer prices go up following the shock as well, and this effect also appears to persist in a more distant horizon. House prices also seem pretty responsive to monetary policy. As in Spain (Slacalek et al., 2020), in Portugal house prices also tend to go up following a monetary easing. In addition, as of 2018, Portugal home ownership rate was around 74.5% while Spain was some places above with 76.3% according to the Eurostat. These two facts combined prepare the tale for the role of the housing channel in household consumption expenditures following a monetary surprise. In Slacalek et al. (2020), the authors find that the capital gains through housing is the largest effect on consumption expenditures in Spain, particularly for wealthy Hand-to-Mouth households. Portugal seems to display a similar narrative as it will be seen in figure 5. Finally, the Portuguese stock market index, PSI 20 appears to have the strongest reaction of all variables. If on one hand, it displays a maximum increase of 19.7%, on the other hand this effect dissipates over a longer horizon. Both Corsetti et al. (2018) and Altavilla et al. (2019) conclude that the stock market responses following a monetary shock are fairly homogeneous and my results go accordingly as well. Table 5 summarizes the values used for the consumption decomposition. As mentioned previously, I use the average of the median values of the impulse responses for horizons 1 to 3.

Table 5: IRFs summary estimates

	Step 1	Step 2	Step 3	Step 4	Average 1-3	Average 2-4
PSI 20	1.69	19.68	0.98	-4.27	7.45	5.46
Consumption	0.68	2.08	1.67	1.68	1.48	1.81
House prices	1.75	0.91	2.44	2.52	1.70	1.96
CPI	0.35	0.94	0.33	0.83	0.54	0.7
GDP	1.55	1.81	1.01	1.55	1.46	1.46

Source: see section 7.5

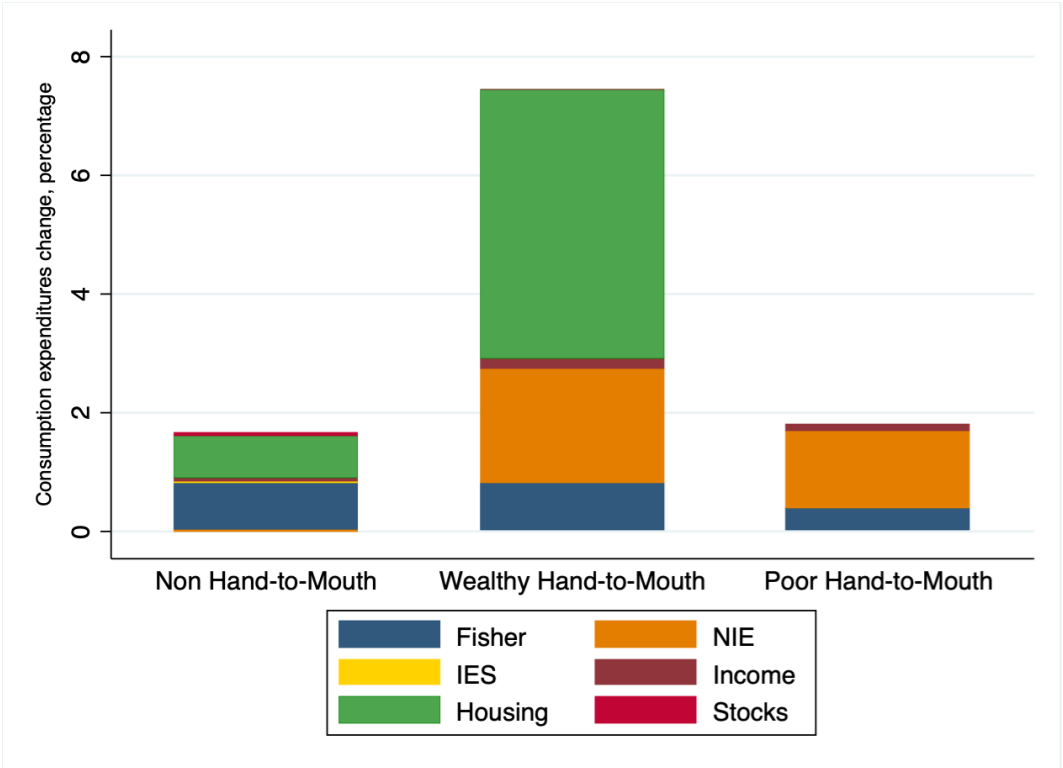
Finally, I arrive at the final results regarding the the consumption expenditures decomposition. Figure 5 displays this the magnitude of each channel in the consumption response for each one of the household types (with the respective confidence intervals in table 6 in the appendix). I start by analysing the effects on the Wealthy Hand-to-Mouth households, as they are the ones where the change in consumption expenditures as a whole is greater with an increase of 7.5% on average. The majority of this change is made through the housing channels that accounts for more than half of the increment. After, we have the direct effect of net interest rate exposures. Being net debtors as shown in panels (a) and (b) from figure 2, wealthy Hand-to-Mouth families benefit vastly from an interest rate drop as the value of their short-term debt decreases. Next we have the Fisher effect accounting only for 0.8 percentage points mostly due to the rather small effect on inflation. The income effect is the smallest with only 0.18 percentage points of the total change in consumption expenditures.

While the monetary surprise affects the three different groups differently, the response of poor Hand-to-Mouth households is similar to wealthy Hand-to-Mouth except for one aspect: the housing channel. This is no surprise as the difference between the two groups is precisely the amount of net wealth one possesses and the other not. Once again, the stronger effect in this group is made through the interest rate exposure channel as a typical poor Hand-to-Mouth household is also a net debtor.

Lastly, non Hand-to-Mouth households are the ones display the smallest change in consumption. In fact, as on average they are net creditors, they are subject to a negative effect through the interest rate exposure channel (though the effect is almost zero). Once again the housing channel is strong, being only surpassed by the Fisher channel. Regarding the capital effects through stocks, one must take into consideration that this analysis considers only holdings of Portuguese stocks and so capital gains based on international stocks are ignored. Still, this channel is rather small. This occurs because the distribution of Portuguese shares is very uneven and it only affects a very small portion of households (see figure 6 in the appendix). Comparing these findings with the results from Slacalek et al. (2020), there is a similarity of Portuguese and Spanish households reaction. In both countries the group that is largely better off is wealthy Hand-to-Mouth and the greatest effect is through the housing channel. Portu-

gal and Spain have a higher home ownership than other European countries (like France and Germany for example), and thus, this dominance of the housing channel goes in line with that fact. The great difference between Slacalek et al. (2020) and this study is the intertemporal substitution effect which is almost non-existent for non Hand-to-Mouth households with 0.05 percentage points (and it is zero for the remaining by definition, as Hand-to-Mouth households are not on the Euler equation). This result suggests that, despite having positive net liquid assets (figure 2), on average, non Hand-to-Mouth Portuguese households do not have much leverage to adjust consumption expenditures as they might be closer to borrowing limits than other European households. The overall response to a monetary surprise is an increase of 2.7% as the majority of households are non Hand-to-Mouth, and thus this group has a greater weight.

Figure 5: Consumption response decomposition



Source: Household Finance and Consumption Survey 2nd wave

6 Conclusion

In the execution of this study, I followed existing literature to perform a decomposition of the change in Portuguese households' consumption expenditures following a -100 bp monetary shock in the current policy rate. Combining high-frequency data to identify monetary shocks with household level data and estimates from a VAR model including a multitude of macroeconomic variables allowed me to perform this decomposition.

My results show that Portugal demonstrates a reaction similar to Spain, and thus, quite different from France or Germany, which gives strength to premise that there is heterogeneity among Eurozone members. Wealthy Hand-to-Mouth households are the ones where the increase in consumption is the most significant, followed by poor Hand-to-Mouth and then non Hand-to-Mouth households. As a country with a high-level of home ownership rate, the channel that has the greatest relevance is housing, followed by the net interest rate exposure one, where net debtors benefit the most. In line with Slacalek et al. (2020), households that are constrained are the ones where monetary policy shocks impact the most. On the other hand, the intertemporal substitution effect is quite small in non Hand-to-Mouth households (which are the only ones where it applies). While in Spain this channel has a small significance, in Portugal it seems to be almost non-existent. Regarding macroeconomic variables, this sort of monetary shock appears to generate positive and permanent impacts on consumption, consumer prices and house prices, while it galvanizes a very strong positive impact on the stock market that appears to vanish. Some limitations are present. For instance, the total change in consumption according to the developed HANK model is greater than on the estimated impulse responses from the VAR. Another relevant constraint is the assumption that households do not change their marginal propensity to consume (and to save) following monetary shocks which might be unrealistic. With this being said, further improvements can be made. For instance, adding more complexity to the classification of households allowing for the existence of more than three categories or analysing the effect of QE under these HANK models brings a richer analysis. Slacalek et al. (2020) also suggests the development of DSGE models to bring robustness to this sort of literature.

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7 Appendix

7.1 Consumption Decomposition

Table 1: Consumption decomposition

	Effects	Equation
Non Hand-to-Mouth	IES	$-\frac{1}{\gamma}$ (1-μ)$c \cdot dr$
	NIE	$\mu[(b+y-c)+\delta^B B-\delta^l l]\cdot dr$
	INC	$\mu\varepsilon_{y,Y}\left(\frac{y}{Y}\right)\cdot dY$
	NOM	$\mu m \cdot dp$
	CAP	$\lambda\mu k \cdot dq^i$
Wealthy Hand-to-mouth	IES	-
	NIE	$-\underline{b}\cdot dr$
	INC	$\mu\varepsilon_{y,Y}\left(\frac{y}{Y}\right)\cdot dY$
	NOM	$\delta^m m \cdot dp$
	CAP	$\lambda\mu k \cdot dq^i$
Poor Hand-to-Mouth	IES	-
	NIE	$-\underline{b}\cdot dr$
	INC	$\mu\varepsilon_{y,Y}\left(\frac{y}{Y}\right)\cdot dY$
	NOM	$\delta^m m \cdot dp$
	CAP	-

7.2 HFCS 2nd wave variables

Consumption

hi0220 - monthly expenses on consumer goods and services

Income

di1300 - rental income from real estate property

di1400 - income from financial assets

di1412 - interest payments

di1500 - income from pensions

di1420 - income from private business other than self-employment

di1600 - Regular social transfers (except pensions)

di1700 - income from regular private transfers

di1800 - income from other sources

di2000 - total household gross income

Liquid assets

da2101 - deposits

da2102 - mutual funds

da2103 - bonds

da2105 - shares, publicly traded

Liquid liabilities

dl1210 - outstanding balance of credit line/overdraft

dl1220 - outstanding balance of credit card debt

dl1230 - outstanding balance of other non-mortgage loans

Illiquid assets

da1110 - value of household's main residence

da1120 - value of other real estate property

da1140 - value of self-employment businesses

da2109 - voluntary pension/whole life insurance

pf0710 - current value of all occupational pension plans that have an account

Illiquid liabilities

hb170$ - household main sesidence mortgage $x: amount still owed

hb370$ - other property mortgage $x: amount still owed

Stocks

hd1510 - value of publicly traded shares

hd1520 - any shares issued by foreign companies? (1 - Yes, 2 - No)

7.3 Marginal tax rates

Table 2: Tax rates for Portugal, 2014

Taxable Income (€)	Tax Rate (%)
$<$ 7,000	14.5
7,000 - 20,000	28.5
20,000 - 40,000	37
40,000 - 80,000	45
$>$ 80,000	48

Source: OECD

7.4 VAR

Portmanteau Test (asymptotic)

H0: no autocorrelation in the residuals

Hα: autocorrelation in the residuals

data: Residuals of VAR object var_model_2

Chi-squared = 903.29, df = 896, p-value = 0.4257

VAR Summary statistics

```
## VAR Estimation Results:
## ========================
## Endogenous variables: Surprise.zt, X3.month.interest.rate, PSI.20.Index, Non.durable.consumption, House.price.
index, CPI, Bank.Volume.Lending.Index, GDP
## Deterministic variables: const
## Sample size: 78
## Log Likelihood: -248.747
## Roots of the characteristic polynomial:
## 0.9817 0.9817 0.9691 0.8365 0.8365 0.7512 0.7512 0.6947 0.6513 0.6513 0.5349 0.5349 0.5149 0.5149 0.1763 0.112
2
## Call:
## VAR(y = var_variables, p = 2, type = "const")
##
##
## Estimation results for equation Surprise.zt:
## ============================================
## Surprise.zt = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumption.l1 + Hous
e.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest.rate.l2 +
PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Index.l2 + GDP
.l2 + const
##
##                                Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -4.895e-01  1.245e-01  -3.931 0.000218 ***
## X3.month.interest.rate.l1      1.474e-03  3.058e-02   0.048 0.961714
## PSI.20.Index.l1                2.746e-04  1.664e-03   0.165 0.869433
## Non.durable.consumption.l1     6.896e-03  1.910e-02   0.361 0.719342
## House.price.index.l1           1.128e-03  1.535e-02   0.074 0.941632
## CPI.l1                         1.977e-02  2.002e-02   0.988 0.327140
## Bank.Volume.Lending.Index.l1 -1.474e-03  2.746e-03  -0.537 0.593465
## GDP.l1                        -2.990e-03  2.580e-02  -0.116 0.908120
## Surprise.zt.l2                -2.500e-01  1.232e-01  -2.029 0.046848 *
## X3.month.interest.rate.l2      4.598e-04  2.548e-02   0.018 0.985658
## PSI.20.Index.l2               -1.403e-03  1.609e-03  -0.872 0.386731
## Non.durable.consumption.l2    -9.425e-03  1.642e-02  -0.574 0.568082
## House.price.index.l2          -6.397e-03  1.568e-02  -0.408 0.684690
## CPI.l2                        -2.332e-02  1.868e-02  -1.248 0.216774
## Bank.Volume.Lending.Index.l2  9.475e-05  3.136e-03   0.030 0.975998
## GDP.l2                         1.745e-02  2.769e-02   0.630 0.530847
## const                         -3.141e+00  6.666e+00  -0.471 0.639208
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.05022 on 61 degrees of freedom
## Multiple R-Squared: 0.2853,  Adjusted R-squared: 0.09781
## F-statistic: 1.522 on 16 and 61 DF,  p-value: 0.1214
##
##
## Estimation results for equation X3.month.interest.rate:
## =======================================================
## X3.month.interest.rate = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumptio
n.l1 + House.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest
.rate.l2 + PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Ind
ex.l2 + GDP.l2 + const
##
##                                Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -0.081768   0.545611  -0.150  0.88137
## X3.month.interest.rate.l1      1.077137   0.134003   8.038 3.78e-11 ***
## PSI.20.Index.l1                0.018633   0.007290   2.556  0.01310 *
## Non.durable.consumption.l1     0.131466   0.083717   1.570  0.12150
## House.price.index.l1          -0.043982   0.067252  -0.654  0.51558
## CPI.l1                         0.074526   0.087723   0.850  0.39890
## Bank.Volume.Lending.Index.l1   0.034516   0.012033   2.868  0.00566 **
## GDP.l1                        -0.085021   0.113061  -0.752  0.45495
## Surprise.zt.l2                -1.651547   0.540109  -3.058  0.00331 **
## X3.month.interest.rate.l2     -0.294604   0.111645  -2.639  0.01055 *
## PSI.20.Index.l2                0.005493   0.007051   0.779  0.43895
## Non.durable.consumption.l2    -0.060581   0.071957  -0.842  0.40313
## House.price.index.l2           0.103817   0.068706   1.511  0.13594
## CPI.l2                        -0.077816   0.081869  -0.950  0.34561
## Bank.Volume.Lending.Index.l2 -0.042858   0.013745  -3.118  0.00278 **
## GDP.l2                        -0.154874   0.121357  -1.276  0.20673
```

```
## const                        62.000182  29.212456   2.122  0.03787 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.2201 on 61 degrees of freedom
## Multiple R-Squared: 0.9872,  Adjusted R-squared: 0.9839
## F-statistic: 294.5 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
## Estimation results for equation PSI.20.Index:
## ============================================
## PSI.20.Index = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumption.l1 + Hou
se.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest.rate.l2 +
PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Index.l2 + GDP
.l2 + const
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1               -10.85744    9.73891  -1.115 0.269287
## X3.month.interest.rate.l1      7.61092    2.39190   3.182 0.002302 **
## PSI.20.Index.l1                0.72820    0.13012   5.596 5.51e-07 ***
## Non.durable.consumption.l1    -1.10365    1.49431  -0.739 0.463001
## House.price.index.l1           4.21579    1.20042   3.512 0.000844 ***
## CPI.l1                        -0.79245    1.56582  -0.506 0.614615
## Bank.Volume.Lending.Index.l1   0.04713    0.21478   0.219 0.827053
## GDP.l1                         2.65923    2.01810   1.318 0.192534
## Surprise.zt.l2               -22.05710    9.64071  -2.288 0.025623 *
## X3.month.interest.rate.l2     -5.31092    1.99281  -2.665 0.009837 **
## PSI.20.Index.l2               -0.17535    0.12586  -1.393 0.168613
## Non.durable.consumption.l2     1.31905    1.28439   1.027 0.308483
## House.price.index.l2          -3.71553    1.22637  -3.030 0.003587 **
## CPI.l2                         0.28268    1.46133   0.193 0.847258
## Bank.Volume.Lending.Index.l2   0.24394    0.24534   0.994 0.323998
## GDP.l2                        -4.05228    2.16617  -1.871 0.066184 .
## const                        660.19276  521.42945   1.266 0.210284
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 3.928 on 61 degrees of freedom
## Multiple R-Squared: 0.9165,  Adjusted R-squared: 0.8946
## F-statistic: 41.84 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
## Estimation results for equation Non.durable.consumption:
## =======================================================
## Non.durable.consumption = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumpti
on.l1 + House.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interes
t.rate.l2 + PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.In
dex.l2 + GDP.l2 + const
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -0.454276   0.822710  -0.552   0.5828
## X3.month.interest.rate.l1      0.002828   0.202059   0.014   0.9889
## PSI.20.Index.l1                0.006203   0.010992   0.564   0.5746
## Non.durable.consumption.l1     0.824860   0.126234   6.534 1.45e-08 ***
## House.price.index.l1           0.023282   0.101408   0.230   0.8192
## CPI.l1                         0.038332   0.132275   0.290   0.7730
## Bank.Volume.Lending.Index.l1   0.039573   0.018144   2.181   0.0330 *
## GDP.l1                         0.725124   0.170482   4.253 7.36e-05 ***
## Surprise.zt.l2                -1.181391   0.814415  -1.451   0.1520
## X3.month.interest.rate.l2     -0.109815   0.168346  -0.652   0.5166
## PSI.20.Index.l2                0.003992   0.010632   0.375   0.7086
## Non.durable.consumption.l2    -0.021352   0.108501  -0.197   0.8446
## House.price.index.l2          -0.022664   0.103600  -0.219   0.8276
## CPI.l2                         0.124378   0.123448   1.008   0.3177
## Bank.Volume.Lending.Index.l2  -0.028176   0.020725  -1.360   0.1790
## GDP.l2                        -0.451941   0.182991  -2.470   0.0163 *
## const                        -80.589436  44.048593  -1.830   0.0722 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
```

```
##
## Residual standard error: 0.3318 on 61 degrees of freedom
## Multiple R-Squared: 0.9978,  Adjusted R-squared: 0.9973
## F-statistic:  1762 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
## Estimation results for equation House.price.index:
## ==================================================
## House.price.index = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumption.l1
+ House.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest.rate
.l2 + PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Index.l2
+ GDP.l2 + const
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -1.57240    1.05092  -1.496 0.139753
## X3.month.interest.rate.l1     -0.22936    0.25811  -0.889 0.377689
## PSI.20.Index.l1                0.04464    0.01404   3.180 0.002318 **
## Non.durable.consumption.l1    -0.00835    0.16125  -0.052 0.958871
## House.price.index.l1           1.26869    0.12954   9.794 3.93e-14 ***
## CPI.l1                        -0.39739    0.16897  -2.352 0.021923 *
## Bank.Volume.Lending.Index.l1  -0.07124    0.02318  -3.073 0.003162 **
## GDP.l1                         0.08872    0.21777   0.407 0.685135
## Surprise.zt.l2                 1.64450    1.04032   1.581 0.119103
## X3.month.interest.rate.l2      0.20626    0.21504   0.959 0.341256
## PSI.20.Index.l2               -0.04887    0.01358  -3.598 0.000643 ***
## Non.durable.consumption.l2     0.10630    0.13860   0.767 0.446080
## House.price.index.l2          -0.38919    0.13234  -2.941 0.004619 **
## CPI.l2                         0.20007    0.15769   1.269 0.209341
## Bank.Volume.Lending.Index.l2   0.02776    0.02647   1.049 0.298519
## GDP.l2                         0.12293    0.23375   0.526 0.600876
## const                        -65.88839   56.26703  -1.171 0.246155
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.4239 on 61 degrees of freedom
## Multiple R-Squared: 0.9952,  Adjusted R-squared: 0.9939
## F-statistic:   790 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
## Estimation results for equation CPI:
## ====================================
## CPI = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumption.l1 + House.price.
index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest.rate.l2 + PSI.20.I
ndex.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Index.l2 + GDP.l2 + co
nst
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -0.600166   0.745850  -0.805   0.4241
## X3.month.interest.rate.l1      0.049122   0.183182   0.268   0.7895
## PSI.20.Index.l1                0.008116   0.009965   0.814   0.4186
## Non.durable.consumption.l1     0.039570   0.114441   0.346   0.7307
## House.price.index.l1          -0.155128   0.091934  -1.687   0.0966 .
## CPI.l1                         0.310850   0.119918   2.592   0.0119 *
## Bank.Volume.Lending.Index.l1   0.001812   0.016449   0.110   0.9127
## GDP.l1                        -0.115747   0.154555  -0.749   0.4568
## Surprise.zt.l2                -1.643753   0.738329  -2.226   0.0297 *
## X3.month.interest.rate.l2     -0.203265   0.152619  -1.332   0.1879
## PSI.20.Index.l2                0.003613   0.009639   0.375   0.7091
## Non.durable.consumption.l2     0.017333   0.098365   0.176   0.8607
## House.price.index.l2           0.126949   0.093921   1.352   0.1815
## CPI.l2                         0.535762   0.111915   4.787 1.12e-05 ***
## Bank.Volume.Lending.Index.l2 -0.016556   0.018789  -0.881   0.3817
## GDP.l2                         0.149854   0.165895   0.903   0.3699
## const                         -5.161521  39.933409  -0.129   0.8976
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.3008 on 61 degrees of freedom
## Multiple R-Squared: 0.9958,  Adjusted R-squared: 0.9947
## F-statistic: 897.1 on 16 and 61 DF,  p-value: < 2.2e-16
```

```
## Estimation results for equation Bank.Volume.Lending.Index:
## ==========================================================
## Bank.Volume.Lending.Index = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consump
tion.l1 + House.price.index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.inter
est.rate.l2 + PSI.20.Index.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.
Index.l2 + GDP.l2 + const
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                 2.30043    5.29163   0.435  0.66529
## X3.month.interest.rate.l1      2.16707    1.29964   1.667  0.10055
## PSI.20.Index.l1                0.13930    0.07070   1.970  0.05336 .
## Non.durable.consumption.l1    -0.46932    0.81193  -0.578  0.56537
## House.price.index.l1           0.65169    0.65225   0.999  0.32167
## CPI.l1                         0.69199    0.85079   0.813  0.41918
## Bank.Volume.Lending.Index.l1   0.81994    0.11670   7.026 2.09e-09 ***
## GDP.l1                        -1.16356    1.09653  -1.061  0.29282
## Surprise.zt.l2                 8.80368    5.23828   1.681  0.09795 .
## X3.month.interest.rate.l2     -1.12227    1.08279  -1.036  0.30408
## PSI.20.Index.l2               -0.21613    0.06839  -3.160  0.00245 **
## Non.durable.consumption.l2     0.57170    0.69788   0.819  0.41586
## House.price.index.l2          -0.63017    0.66635  -0.946  0.34803
## CPI.l2                        -0.88550    0.79401  -1.115  0.26913
## Bank.Volume.Lending.Index.l2   0.17125    0.13330   1.285  0.20376
## GDP.l2                         1.33215    1.17699   1.132  0.26214
## const                        -58.24295  283.31856  -0.206  0.83781
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 2.134 on 61 degrees of freedom
## Multiple R-Squared: 0.9818,  Adjusted R-squared: 0.9771
## F-statistic: 206.1 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
## Estimation results for equation GDP:
## ====================================
## GDP = Surprise.zt.l1 + X3.month.interest.rate.l1 + PSI.20.Index.l1 + Non.durable.consumption.l1 + House.price.
index.l1 + CPI.l1 + Bank.Volume.Lending.Index.l1 + GDP.l1 + Surprise.zt.l2 + X3.month.interest.rate.l2 + PSI.20.I
ndex.l2 + Non.durable.consumption.l2 + House.price.index.l2 + CPI.l2 + Bank.Volume.Lending.Index.l2 + GDP.l2 + co
nst
##
##                               Estimate Std. Error t value Pr(>|t|)
## Surprise.zt.l1                -1.330865   0.815952  -1.631  0.10803
## X3.month.interest.rate.l1      0.201089   0.200399   1.003  0.31961
## PSI.20.Index.l1               -0.002026   0.010902  -0.186  0.85318
## Non.durable.consumption.l1     0.140828   0.125197   1.125  0.26506
## House.price.index.l1           0.305399   0.100575   3.037  0.00352 **
## CPI.l1                        -0.038323   0.131189  -0.292  0.77118
## Bank.Volume.Lending.Index.l1   0.027647   0.017995   1.536  0.12962
## GDP.l1                         1.015179   0.169081   6.004 1.15e-07 ***
## Surprise.zt.l2                -0.846168   0.807724  -1.048  0.29896
## X3.month.interest.rate.l2     -0.181533   0.166963  -1.087  0.28120
## PSI.20.Index.l2                0.002987   0.010545   0.283  0.77793
## Non.durable.consumption.l2    -0.079238   0.107610  -0.736  0.46435
## House.price.index.l2          -0.288759   0.102749  -2.810  0.00664 **
## CPI.l2                         0.000624   0.122434   0.005  0.99595
## Bank.Volume.Lending.Index.l2 -0.030750   0.020555  -1.496  0.13981
## GDP.l2                        -0.217710   0.181487  -1.200  0.23494
## const                         71.885578  43.686735   1.645  0.10501
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##
## Residual standard error: 0.3291 on 61 degrees of freedom
## Multiple R-Squared: 0.9655,  Adjusted R-squared: 0.9565
## F-statistic: 106.8 on 16 and 61 DF,  p-value: < 2.2e-16
##
##
##
## Covariance matrix of residuals:
##                          Surprise.zt X3.month.interest.rate PSI.20.Index
## Surprise.zt                0.0025217               0.001971      0.02127
```

```
## X3.month.interest.rate      0.0019710               0.048428      0.38064
## PSI.20.Index                0.0212729               0.380637     15.42933
## Non.durable.consumption    -0.0001626               0.006922      0.10496
## House.price.index          -0.0007076              -0.027623      0.07610
## CPI                         0.0005943               0.020773      0.10111
## Bank.Volume.Lending.Index   0.0086733               0.140791      2.80205
## GDP                        -0.0018277               0.013269      0.14515
##                          Non.durable.consumption House.price.index        CPI
## Surprise.zt                           -0.0001626        -0.0007076  0.0005943
## X3.month.interest.rate                 0.0069218        -0.0276228  0.0207734
## PSI.20.Index                           0.1049619         0.0761033  0.1011082
## Non.durable.consumption                0.1101083         0.0090710  0.0162118
## House.price.index                      0.0090710         0.1796652 -0.0651502
## CPI                                    0.0162118        -0.0651502  0.0904959
## Bank.Volume.Lending.Index              0.1091057        -0.0848846  0.0576407
## GDP                                    0.0115024         0.0064561  0.0043344
##                          Bank.Volume.Lending.Index       GDP
## Surprise.zt                               0.008673 -0.001828
## X3.month.interest.rate                    0.140791  0.013269
## PSI.20.Index                              2.802052  0.145152
## Non.durable.consumption                   0.109106  0.011502
## House.price.index                        -0.084885  0.006456
## CPI                                       0.057641  0.004334
## Bank.Volume.Lending.Index                 4.555186  0.101589
## GDP                                       0.101589  0.108307
##
## Correlation matrix of residuals:
##                          Surprise.zt X3.month.interest.rate PSI.20.Index
## Surprise.zt                 1.000000               0.17835      0.10785
## X3.month.interest.rate      0.178355               1.00000      0.44034
## PSI.20.Index                0.107847               0.44034      1.00000
## Non.durable.consumption    -0.009757               0.09479      0.08053
## House.price.index          -0.033244              -0.29613      0.04571
## CPI                         0.039343               0.31380      0.08557
## Bank.Volume.Lending.Index   0.080925               0.29976      0.33423
## GDP                        -0.110591               0.18321      0.11228
##                          Bank.Volume.Lending.Index      GDP
## Surprise.zt                               0.08093 -0.11059
## X3.month.interest.rate                    0.29976  0.18321
## PSI.20.Index                              0.33423  0.11228
## Non.durable.consumption                   0.15406  0.10533
## House.price.index                        -0.09383  0.04628
## CPI                                       0.08978  0.04378
## Bank.Volume.Lending.Index                 1.00000  0.14463
## GDP                                       0.14463  1.00000
```

7.5 Sources for macroeconomic variables

Banco de Portugal

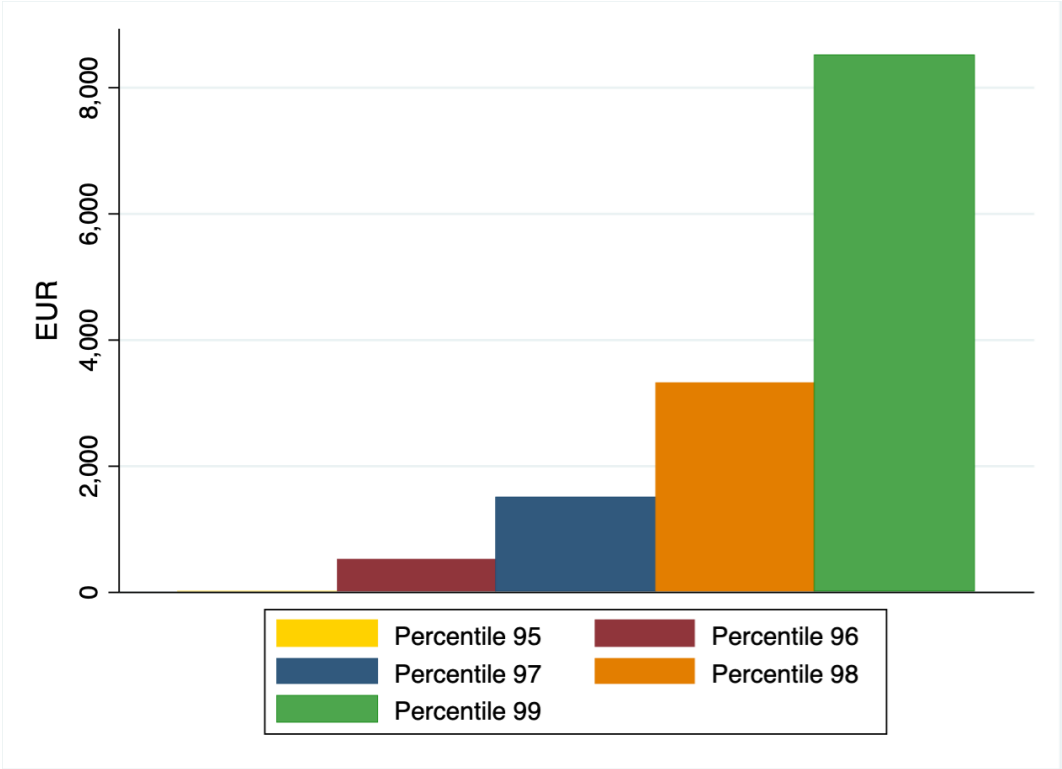
Eikon Reuters

Federal Reserve Bank of St. Louis

Instituito Nacional de Estatística

7.6 Portuguese stock market wealth

Figure 6: Distribution of Portuguese stock market wealth



Source: Household Finance and Consumption Survey 2nd wave

7.7 Consumption decomposition

Table 6: Decomposition means and confidence intervals

		Mean	Std. Err.	95% confidence interval
IES	Non Hand-to-Mouth	.0593206	.0000256	[.0592704, .0593708]
	Wealthy Hand-to-Mouth	0	(omitted)	
	Poor Hand-to-Mouth	0	(omitted)	
NIE	Non Hand-to-Mouth	-.0067956	.0000107	[-.0068164, -.0067747]
	Wealthy Hand-to-Mouth	1.910995	.0012349	[1.908574, 1.913415]
	Poor Hand-to-Mouth	1.298274	.0005385	[1.297219, 1.29933]
Fisher	Non Hand-to-Mouth	1.29181	.0011143	[1.289626, 1.293994]
	Wealthy Hand-to-Mouth	.811055	.0007401	[.8096045, .8125055]
	Poor Hand-to-Mouth	.3715693	.0007384	[.370122, .3730166]
Income	Non Hand-to-Mouth	.0455265	0	.
	Wealthy Hand-to-Mouth	.185436	0	.
	Poor Hand-to-Mouth	.1200507	0	.
Housing	Non Hand-to-Mouth	.7793418	.000435	[.7784892, .7801945]
	Wealthy Hand-to-Mouth	4.524574	.0020605	[4.520536, 4.528613]
	Poor Hand-to-Mouth	0	(omitted)	
Stocks	Non Hand-to-Mouth	.0162696	.0000786	[.0161154, .0164237]
	Wealthy Hand-to-Mouth	.0015309	.0000178	[.0014961, .0015656]
	Poor Hand-to-Mouth	0	(omitted)	