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MASTER'S FINAL WORK

DISSERTATION

INCOME AND WEALTH INEQUALITY: ANALYSES OF MONETARY POLICY CHANNELS ROLE

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Table of Contents

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ABSTRACT

This dissertation aims at analysing the relation between monetary policy and its transmission channels on both income and wealth inequality for the Euro Area. We analysed three different channels identified by the literature (Income, Portfolio and Earnings Heterogeneity) that might explain how monetary policy decisions may affect wealth and income distribution. In this empirical research we also set up a fourth regression combining all our selected explanatory variables with the goal of studying the impact of the aforementioned channels combined. For income inequality we analysed four different measures, namely Gini of disposable income (GDI), Gini of market income (GMI), share of income held by the top 1% and the share of income of the top 10% of society. In what regards to wealth inequality due to lack of data we had to create an alternative measure that can both translate the unequal savings rate of the Euro Area countries and evaluate the pace of capital accumulation in order to shed a light on the gap between high-income and low-income household's annual savings. So that our study could be conducted we developed an unbalanced panel data analysis for the Eurozone countries between 1999 and 2017. The results we reached led us to conclude that the increase in asset prices, mainly equity, seems to be relevant to explain an increase in income inequality. However, it seems that the positive impact that MP had on unemployment by reducing it, contributed to avoid a higher increase on income inequality in the Euro Area.

1. INTRODUCTION

The financial crisis, which started in 2007 triggered by the U.S.'s real estate market, rapidly reached a global scale. More than a decade after, its consequences are still being studied and policy makers, bankers and economists are still trying to understand all of its dimensions. After the beginning of the crisis, financial markets faced a long period of uncertainty and high volatility Moreover, almost all countries experienced significant declines in GDP, with world's GDP dropping by 1.7% according to the World Bank.

In order to reduce the negative impact of the crisis, Central Banks (CB) around the world cut interest rates at a fast pace. However, it was not enough and a new chapter started for most central bankers: the implementation of unconventional monetary policy (UMP). Interest rates in Europe and US got closer to 0% and new measures were needed. Before 2007 only Japan had had relevant experience with very low interest rates, but many thought it was a singular case. The Japanese economy was the first recorded to experience a long period of near 0% interest rates. The country was facing a long period of economic stagnation and according to the World Bank from 1992 to 2002 the Japanese economy grew by just 0.9%. Around the mid 90's, in order to try to stimulate the

economy, the Bank of Japan (BoJ) cut its interest rates to very low levels. for an extended period. This practice implemented by the Japanese authorities was seen as an exception.

In Europe the first measures of UMP were adopted in early 2008 while the US financial markets situation worsened. Since some European banks were exposed to US subprime market, the European Central Bank (ECB) had to act quickly to try to avoid the crisis from spreading to the whole continent. However, after the bankruptcy of Lehman Brothers in September 2008, the crisis gained a global magnitude with its effects felt in almost every segment of the market not just the real estate. Consequently, the ECB had to go deeper with the unconventional monetary policy in the following years. Under normal conditions, the CB operates monetary policy (MP) mainly through official interest rates movements followed by a proper communication to the public about its goals. Usually the CB provides the necessary amount of liquidity to the banking system by determining the interest rates. Financial institutions act as an intermediary to supply money to the general economy through granting credit and by providing other financial operations.

During a financial crisis, implementing MP is more challenging since its transmission mechanisms might have been affected by market disruptions. High volatility in the demand for reserves and challenges regarding their allocation between financial institutions might compromise the CB's ability to achieve its short-term interest rates goal. Besides that, when interest rates are already extremely low (near 0%) conventional monetary policy loses effectiveness and non-conventional measures are needed. According to Peersman (2011), UMP encompasses operations that change the CB's balance sheet composition and size as well as actions that aim at managing expectations regarding long-term interest rate mainly through active communication. For example, asset purchase programmes (APP) adopted by the ECB and the speech of Mario Draghi, where the former ECB president said that would do "whatever it takes" to save the euro. The ECB adopted a series of measures before Lehman Brothers bankruptcy, for example it started with extraordinary overnight operations, liquidity agreement with other CBs and additional Long-Term Refinancing Operations. However, the crisis was spreading faster and getting worse, so the ECB had to be more incisive to help boost the economy. In 2009, it launched the first APP, the Covered Bond Purchase Programme (CBPP). This

program had two more phases and was followed by new programs focusing in different asset classes including government and non-financial corporate bonds.

Central Banks and governments around the world were entering a new economic environment after 2008, they started doing everything they thought they could do to avoid a deep and long recession. Their measures aimed at saving corporations from bankruptcy in order to save jobs and avoid a total disruption of the financial system. Ordinary CB measures were no longer sufficient, there were rising concerns over the extent of the crisis and the monetary policy tools of the CB were increased. Under this context the full extent of the consequences of the previously untested policies is not known and undesirable side effects might have taken place in the following years. Many researchers studied the impact of those measures, mainly the different APP, and most of them agreed that unconventional measures were able to reduce long-term interest rates, avoid a major drop on GDP and a significant increase in unemployment. Besides that, UMP measures increased equity prices and inflation and stimulated credit grant. The main divergence between the authors were regarding the magnitude and duration of the positive impacts of UMP measures.

After more than a decade since the trigger of the financial crisis, some politicians and economists have begun to question the increase in inequality that happened afterwards. Among the possible culprits were the UMP measures adopted by several CBs around the world. Due to the significant increase in money supply from APP programs, some economists brought back the Cantillon Effect (Bagchi, Curran, and Fagerstrom, 2019), which says that since the wealthier have more access to credit and financial markets, they are the first to receive the "new money", allowing them to access more goods and services before the rest of the population. In this case, the purchasing power of high-income households would increase before the low-income households. It is possible to say that the Cantillon effect is somehow related to Thomas Piketty book *Capital in the Twenty-First Century*. Published in 2013, *Capital in the Twenty-First Century* relaunched the debate about inequality increase from wealth concentration. He has indeed showed an increasing trend in capital accumulation and rising in wealth and income inequality. Piketty concluded that an increase in financial assets bigger than an increase in GDP growth could lead to a significant rise in inequality in the long term.

Some years after the first non-conventional measures were adopted interest rates in Europe reached levels below 0% and some researchers decided to study whether UMP measures adopted by CBs all around the world, mainly APP, were responsible for the increase in wealth and income inequality. Since most countries have not had previous experience with said measures, few studies were available. Before that most studies tried to evaluate the relation between monetary policy channels and inequality however, before the crisis the focus of most studies was on conventional monetary policy and inflation. It is possible to state that the economic environment is different from the one before 2008. Inflation in most European countries is very close to 0%. In some of them, like Portugal, GDP is below pre-crisis levels and in others, like Spain and Greece, the unemployment rate is still above 10%, affecting mainly the younger sector of the population. Besides this context and associated with the popular belief that the high-income individuals are getting even richer through financial markets raises the question of whether unconventional monetary policy adopted by the ECB distorted wealth and income distribution is of the upmost relevance. Therefore, the question about the role of MP and its transmission channels' effects on inequality dynamics deserves a deeper analysis to better assess the undesired effects of expansionary MP.

In our work we will explore the impact that monetary policy transmission channels have in income and wealth distribution in some Euro Area countries. Therefore, our article analyses the connection between MP and income and wealth inequality by resorting to a new dataset and developing a data panel for all countries in the Eurozone. This dissertation is structured as follows. Section two discusses the literature about monetary policy and inequality, and presents the main findings of the authors. Section three describes the data and methodology employed in our analysis; Section four provides the main findings of our research regarding the impact of UMP measures on inequality. Section five presents the conclusions of this empirical research. We got mixed results regarding the impact of MP in the increase in wealth and income inequality for the Euro Area. However, it seems that since MP measures adopted by the ECB were able to eschew the increase in unemployment rates in the Euro Area, this effect may have carried a higher weight in decreasing wealth and income inequality than the weight that rising asset prices, mainly equity, caused by the same MP had on increasing wealth and income inequality.

2. LITERATURE REVIEW

On the recent past, some studies have analysed the effects of UMP on inequality using different approaches and methods. Most of those resort to US data, yet there are other important researches which aim at analysing the monetary policy's impact on income and wealth distribution for Japan, UK and Eurozone. The aforementioned countries and region have adopted UMP measures, namely large-scale asset purchase programmes and a significant cut in interest rates.

There are many ways monetary policy, conventional or otherwise, can affect inequality. We enumerate six channels that interact between them, following Colciago, Samarina and De Haan (2019). The first one is the *interest rate exposure channel,* which is associated with the impact that a change in interest rate may have on positions over assets and liabilities held by economic agents. Auclert (2019) says that if the CB cuts interest rates, it may benefit those who have negative saving requirements, which is the difference between maturing assets and liabilities, at the expense of those who have positive savings requirements. *Unexpected inflation channel*, the second channel, is the impact that inflation may have on households' fixed debts and cash positions. In this case, debtors are benefited and creditors harmed. The third one, the *earnings heterogeneity channel*, reflects the impact that MP may have on households' wages and employment status. This impact is different depending on income level and job characteristics. Except for civil servants, usually high-income households have a lower chance of losing its job than a low-income household, which means that low and mid-class people might benefit more than the rich if UMP measures were successful.

Moreover, income composition is different for each economic agent and the fourth channel arises from the impact that monetary policy may have regarding its composition. High-income households receive, proportionally, more income from financial assets than low and mid income households. Since UMP increases equity prices, wealthiest individuals may benefit more from the *income composition channel*. The *portfolio composition channel* is associated to the fact that a fall in interest rate affects the assets holdings of households. Proportionally, low-income households have more cash, in order to meet its daily obligations, than high-income households, that are able to save much more. In this case, UMP might increase inequality due to an increase in financial assets. Finally, *the savings redistribution channel* is the one that is related to the differences of

net financial positions among households´ balance sheets. The ECB reduces its interest rate to below 0% levels and tries to reduce long-term interest rate using UMP measures. In this scenario of low interest rates, net borrowers are benefited at the expense of net savers. If we assume that savers are richer than borrowers, those measures would reduce inequality.

Besides those six channels, Bernoth et al. (2015) also added a seventh one, the *financial fragmentation channel* that is associated with the benefits that economic agents may derive from being closely related to financial markets. For instance, usually rich individuals have more access to financial markets and consequently they have more chances to diversify their portfolio, protect themselves in some crisis and seize opportunities. It is important to highlight that some researchers may present slightly different versions of those channels or aggregate some of them in a single one. The authors usually find the earnings heterogeneity, income composition and portfolio compositions channels as the main drivers on whether unconventional monetary policy can affect income and wealth inequality. The savings redistribution and interest exposure channels gain more importance when dealing with conventional monetary policy. When analysing these channels, it is possible to see that the effects of unconventional monetary policy on wealth and income inequality are not clear, because it depends and is intensified by many factors. Besides that, sometimes is hard to quantify the indirect effects of UMP on inequality, which usually decline inequality through a reduction on unemployment and increase in GDP.

One of the main studies regarding the impacts of monetary policy on inequality was Coibion et al. (2017). They analysed the effects of MP since 1980 for the U.S. using local projections and, according to their model, contractionary monetary policy appears to increase income inequality in the long run. They identified the earnings composition channel and the interest rate exposure channel as being the most important on this dynamic. According to their study, contractionary monetary policy raises wages for the high-income households, which increases inequality. Besides that, since rich households are generally savers while low income are borrowers, an increase on interest rate will transfer wealth from borrowers to savers, increasing inequality. Coibion et al. (2017) also pointed to the fact that when interest rates hit the zero lower bound, the effects on inequality are similar to a prolonged period of contractionary monetary policy.

Davtyan (2016) also resorting to U.S. economy data found that contractionary monetary policy decrease inequality. Modelling time series through VECM and VAR, he found that contractionary monetary policy decreases the Gini coefficient of income inequality. One expatiation for differences between this analysis and the one made by Coibion et al. (2017) is the data source and the inequality measure, where this author does not include the top 1% of U.S. income distribution. An additional work on U.S. economy conducted by Bivens (2015) makes use of a counterfactual analysis. The author compared the impact of an expansionary monetary policy during the crisis with two different scenarios: (i) an equivalent fiscal stimulus and (ii) no stimulus at all. According to him, a fiscal policy can be more or less progressive than an expansionary monetary policy. For example, social transfers would reduce inequality while across-the-board tax cuts wouldn´t. In comparison with no stimulus, the expansionary monetary policy adopted, mainly with asset purchases, had a positive distributive impact. This perspective is more closely related with the one presented in Coibion et al. (2017), where both authors agree that contractionary monetary policy increase income inequality.

Regarding to the Japanese case, Saiki and Frost (2014) found that UMP increased income inequality in the country, especially through the portfolio channel. The authors did a VAR using household survey data. They used the Gini coefficient and the top 20% ratio as inequality measures and found that the increase in equity prices were the main driver for raise inequality in Japan, a result that contradicts the one found for the U.S. case (Coibion et al. 2017; Bivens, 2015). Moreover, Inui, Sudo and Yamada (2017) conducted another study for Japan and found that expansionary monetary policy increased income inequality mainly from 1981 to 1998. After that and until 2008, MP shocks appear to have no significant impact on inequality. They used micro-level data to analyse the impact on inequality by conventional and unconventional monetary policy. The authors constructed a DSGE model and identified labour market flexibility as the main driver on earnings inequality in the country. In comparison with Saiki and Frost (2014), this work used micro-level data instead of semi-aggregate data and evaluated inequality measures on six variables (earnings, pre-tax income, disposable income, consumption expenditure, financial positions and the dynamics between them) instead of only one (pre-tax income). Another study for Japan was made by Taghizadeh-Hesary, Naoyuki and Sayoko (2019). The authors found that expansionary monetary policy

adopted by BoJ, using extremely low and even negative interest rate associated with QE, increased income inequality on the country, mainly due to the increase of financial asset prices, a similar result to what found in Saiki & Frost (2014). Also for Japan, Israel and Latsos (2020) analysed the impact of UMP on the labour income distribution and found that measures by BoJ decreased the gender pay gap but increased education pay gap. Usually, wealthier individuals have more years of education than poorer households, which means that, according to their findings, UMP measures increases income inequality.

Looking for the studies on this topic and applied to the U.K. case, Mumtaz and Theophilopoulou (2017) analysed the impact of monetary policy on inequality from 1969 to 2012. They found that contractionary monetary policy increases income inequality, but also that the quantitative easing (QE) adopted in the country after the financial crisis contributed to raise inequality. They set up a Structural VAR model and used as inequality measure the Gini coefficient and the cross-sectional standard deviation of log levels to remove zeros and reduce sensitivity. Regarding the QE, the authors found that the increase in equity prices was the driver to the increase in inequality, similar to the result for Japan found by Saiki and Frost (2014). Furthermore, Bunn, Pugh and Yeates (2018) also verified the impact of UMP on inequality for the UK, but with a microsimulation approach. They found that, between 2008 and 2014, UMP had little impact on inequality and the Gini coefficient kept almost the same during this period. Their study showed that most of the households have gained from the UMP adopted by the Bank of England in comparison with a scenario without any stimulus. However, they highlight that in cash terms, high-income individuals receive much more than low-income individuals, which explain the fact that in percentage terms it doesn´t change. The authors also pointed that this might be important in terms of perception by the public about UMP measures.

Additionally, Casiraghi et al. (2018) adopted a macro model with scenario analysis to address the impact of expansionary monetary policy on inequality. They used data for Italy and focused on the measures adopted by the ECB in 2011 and 2012. They found that UMP did not increase inequality mainly due to the indirect effects on economy. These measures had a positive impact on job and wages, which benefits more low- and mid-income households. Their study also pointed to the fact that UMP was not a "bane

for savers", since the low remuneration of savings was partially compensated by the increase in asset prices.

Furthermore, studying Euro Area countries, Claeys et al. (2015) found that the increase in income and wealth inequality is a trend from the last decade, mainly due to structural changes. However, they agreed that UMP could amplify this inequality. According to their study, an increase in asset prices, primarily equity, enhance inequality between high-income and low-income households, young and old people and regions. However, UMP can reduce inequality due to an increase in housing prices, reduction in interest rates and stimulus to the economy. However, the authors think that the ECB should only monitor the side effects of its MP measures and keep on its main goal, which is the price stability. They think that fiscal policy should be used to face inequality problems. Moreover, another work for the Euro Area was Bernoth et al. (2015). They also affirm that the impacts of UMP on inequality were ambiguous and yet uncertain. On one hand, AAP can have a positive impact on real economy, reduce unemployment and increase GDP. On the other hand, UMP measures have a first impact on financial markets, which increases inequality in the short-term. The authors say that if AAP do not have a significant impact on activity in the next years, policy makers should rethink AAP.

An important research conducted for the Euro Area is Guerello (2018), where the author found that, for countries where its population is more involved in financial markets, income dispersion increases after UMP measures adoption. The panel VAR methodology employed in this study was built with monetary policy indicators, three different income inequality measures (Gini coefficient, Top-Bottom ratio and Theil coefficient) and some macroeconomic variables for each country. The author says that, during a long period of very low interest rates, UMP measures can have a positive impact on economic activity. However, in some countries it might increase income dispersion. Because of that, Guerello (2018) thinks that MP and fiscal policy should be coordinated, since MP alone cannot reduce inequality. This conclusion is somewhat similar with ideas proposed by Claeys et al. (2015). Also for the Euro Area, Hohberger, Priftis and Vogel (2020) analysed the distributional effects of monetary policy in a conventional regime, where CB uses the Taylor rule to define its short-term interest rates and an unconventional regime, where CB uses Quantitative Easing and increase its balance sheet. They estimated an open-economy DSGE model with two types of households (a group with and a group

without assets) and concluded that UMP not only does not increase income and wealth inequality, but it can also reduce it a little bit. The main reason for that was the positive impact on unemployment and on real wages.

After analysing some previous works and collecting some data for the Euro Area, Ampudia et al. (2018) argued that neither unconventional nor conventional expansionary monetary policy increases inequality, in fact it can reduce income and wealth inequality. Their conclusion was based on the indirect effects on the economy, which benefits more low- and mid-income households. Their conclusions are similar to what Bernoth et al. (2015) found for the Euro Zone with APP having a significant impact on economic activity. In addition, a multi-country VAR for the four biggest economies in the Euro Area (Germany, France, Italy and Spain) was estimated by Lenza and Slacalek (2018), where the authors pointed out that UMP adopted by the ECB decreased income inequality. The main channel for this reduction was the earnings composition channel. They found that low- and mid-income households benefit more than high-income households with the drop on unemployment rate promoted by UMP measures, whose results are in line with Ampudia et al. (2018)'s conclusions.

Going to a broader perspective, O'Farrel, Rawdanowicz and Inaba (2016) analysed the impact of MP on inequality in some advanced economies using microsimulation. They showed that the impacts of MP on inequality are uncertain and complex to estimate with precision. However, concluded that they are, in general, small. At the end, they indicate that inequality should be faced by fiscal policy and Central Bankers should focus on price stability and full employment, the same idea that Claeys et al. (2015) had. Yet, and by using microsimulations for some advanced economies, Domanski, Scatigna and Zabai (2016) consider that UMP increased inequality. They found that the positive impact on equity prices after the financial crisis increased inequality, while housing prices reduced inequality. However, the first effect is stronger. Besides that, they showed that higher bonds prices and lower interest rates did not have a big impact on inequality. For inequality measure, they used income quartiles and collect data from households' surveys for each country.

Colciago, Samarina and De Haan (2019) reviewed some papers that analysed the impact of MP on inequality in some advanced economies. They say that the study about UMP measures and its impact on inequality is still on early stages and consequently it is

hard to have a definitive conclusion. Some empirical studies were made using different methodologies and for several countries with ambiguous and uncertain results. However, most of them agreed that the increase in asset prices, as a consequence of UMP, had a negative impact on inequality while the indirect effects on the economic activity had a positive impact. The problem is that it's hard to measure quantitatively those impacts. In addition to this study, and by analysing some advanced economies and emerging countries, Furceri, Loungani and Zdzienicka (2018) indicate that expansionary MP reduces inequality in the medium term. However, they say that it can raise inequality in the short-term, mainly due the increase in some asset's prices. They used local projections via impulse response functions, data from the Standardized World Income Inequality Database for 32 countries and their main inequality measure was the Gini coefficient. They also highlighted that the effect depends on the business cycle and on the level of inequality of the country.

After examining those papers, it is possible to see that there are a significant number of authors studying the impact of conventional and unconventional monetary policy on inequality and that the outcome of each study can point to a different direction. Therefore, the goal of this work is to contribute to this debate and try to see the impact of the UMP adopted by the ECB after the financial crisis on wealth and income inequality in the Euro Area. Even though there are some approaches that can be used, most of the authors highlighted the scarcity of data as one of the main problems.

3. METHODOLOGY AND DATA

In our work, we have analysed how different monetary policy channels may influence inequality levels. In order to define those inequality levels, we resort to the Gini of disposable income (GDI) and the Gini of market income (GMI), all of them retrieved from The Standardized World Income Inequality Database (Solt, 2020). Besides that, we decided to evaluate the impact of monetary policy on two other variables which also signal inequalities, namely the pre-tax income held by the top 1% of society (TOPO) and for the top 10% (TOPT), from The World Inequality Database (Alvaredo et al. (2018). Regarding wealth inequality data, the existing data is very scarce. For instance, Household Finance and Consumption Survey (HFCS) collects only data for wealth inequality for only a subset of countries and only for few years. This lack of data leads to a need to resort to other methodology in order to examine wealth inequality trends and

how those trends are affected by monetary policy. Therefore, we build-up a measure of wealth inequality which results from the product of GDI, from (Solt, 2020) database, and the Household Savings as percentage of Disposable Income data from OECD. Although this indicator can be a rough indicator of wealth inequalities, we think that this option can translate wealth inequalities through time. In specific, while the GDI represents the income concentration post-tax policy effects, the average savings on percentage of disposable income translates the share of income-flow that it is became on stock of wealth at the end of each year. In addition, we are aware that the average of saving rates does not translate the distribution of saving rates across income gaps within an economy. In that sense, we have computed the correlation coefficient between our composite index for wealth inequalities and the Gini index for wealth inequalities from HFCS. Based on net wealth inequality data (see table J4 of HFCS, 2010, 2014, 2017), for the years of 2010, 2014 and 2017 of 0.510, 0.318 and 0.401, respectively. This shows that our index is positively correlated with the measures of wealth inequality of HFCS which despite all existing weaknesses that may arise with the use of this index we think to still be a suitable approach to study wealth distribution within an economy. Lastly, our analysis covers all Eurozone countries between 1999 and 2017.

Therefore, in order to study the impacts of monetary policy channels on inequalities proxies by the above-mentioned variables, we have decided to investigate three different channels that we considered to be the most relevant monetary channels, namely the income composition, the portfolio composition, and the earnings heterogeneity channels, which may affect inequality dynamics differently. Thereby, we test individually for the three channels effects on inequality, lastly we test the jointly effects of all channels on each measure of inequality.

The income composition channel was structured using an equity index, a measure for wages, both long and short nominal interest rate and the consumer price index. Most of households receive their income from their wages and some of them have other sources, mainly equity, bonds and savings accounts. As a proxy of wages (*wages*), we used the gross wages and salaries for households from the AMECO database. As an equity index (*eq*) we decided to use the annual change of the average monthly closing price of the Eurostoxx 600 for all countries. European markets are very integrated and most of its households have access to different asset markets. Therefore, we decided that a European

index to be a more representative of the household's portfolio when compared to each country's index. For long and short nominal interest rate (*long* and *short,* respectively), we resorted to AMECO. Under the present context, nominal long and short interest rate can be considered as a proxy for the income that households receive through the returns of both the bond markets and savings accounts. The last indicator used for this channel was the consumer price index (*cpi*), also extracted from the AMECO database.

In what regards to the portfolio composition channel, we used the same equity measure as before, constituted by the long and the short term nominal interest rates and by the consumer price index measures. Besides that, we resorted to a house price index (*reest*) from the Eurostat, which measures the changes in the transaction prices of dwellings purchased by households. This measure has some issues, as data for Greece is missing or is incomplete and the time periods are not homogeneous. For most countries, the data is only available from the 2000s onwards. However, most authors that we consulted/read previously highlighted that real estate is a significant variable in order to understand the interaction between monetary policy and inequality. For most households, real estate corresponds to a significant part of their portfolio, mainly for low-income households that own their house. For the third channel, earnings heterogeneity, we only considered the level of wages and the unemployment rate (*unemp*), all extracted from AMECO.

In addition, and in order to control for other unobserved effects that may have an impact on inequalities according to the vast literature on the subject, we have selected the natural logarithm of real GDP per capita (*lgdppc*) and the gross fixed capital formation growth rate (*vfbkf*) available at AMECO. Besides that, we used the current account balance as a percentage of GDP (*cab*) and liquid liabilities as a percentage of GDP (*llgdp*), as a proxy of M3 monetary aggregate, from the World Development Indicators database provided by the World Bank, lastly we got data from government spending in percentage of GDP (*pegdp*)[1] provided by the IMF. In table 1 we present the descriptive statistics of the variables employed in our study.

In sum, we tested the effects of monetary policy channels on five different measures of inequality, four of them representing income inequalities (*GDI*, *GMI*; *TOPO*

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[1] Some studies as Glomm and Ravikumar (1992), Li and Zou (1998), de Mello and Tiongson (2006), Basu and Guariglia (2007) and Bjornskov (2008) discuss important linkages between growth, investment and government spending on inequality dynamics.

and *TOPT*) and one of them representing the impacts of expansionary monetary policy on wealth distribution (*WII*). In order to do that, we employ equation (1) in a panel data framework:

$$(1) \quad Ineq_{i,t} = \beta_{0,i,t} + \beta_{m,i,t} x_{i,t}^m + \beta_{i,t} x_{i,t} + \eta_t + \nu_i + \varepsilon_{i,t}, \quad t = 1, \dots, T; i = 1, \dots, N,$$

where *Ineq* correspond to our above-mentioned inequality measures, $x_{i,t}^m$, m=1, 2, 3 is a vector of monetary policy variables belonging to each of the three refereed monetary policy channel, $x_{i,t}$ is the vector of control variables previously described, η_t and ν_i are respectively, the time effect and the country-specific effect; $\varepsilon_{i,t}$ is an unobserved zero mean white noise-type column vector satisfying the standard assumptions; $\beta_{0,i,t}$, $\beta_{m,i,t}$ and $\beta_{i,t}$ are unknown coefficients to be estimated. . Therefore, we have initially estimated the equation (1) using OLS approach and tested for fixed (FE) and random effects (RE). However, in a few cases, we identify some correlation among the residuals and then we decided to use FGLS regressions when T>N and applied a Panel Corrected Standard Errors (PCSE) using an Unconditional Robust covariance matrix estimator of Beck and Katz (Beck and Katz, 1995) when N>T, which suits better in these cases. A FE model controls for all time-invariant differences between the countries. In these cases, the coefficients are not biased because of omitted time-invariant characteristics. On the other hand, in RE models' countries effect or variations across them are assumed to be randomly correlated with our monetary policy variables. The main difference between those two models is the correlation between unobserved effects of the countries and the regressors existent in our model. In that sense we have performed Hausman's test for our FGLS and OLS regressions in order to identify whether the unique errors are correlated with the regressors, which helps us decide between fixed and random effects. Besides that, regarding cross-section dependence (CSD) issues, we employ Pesaran's CD test for both our LM and FGLS regressions. The CSD means that units in the same cross-section are correlated, which may happen due to unobserved common factors. If those factors are not considered in the model, the estimators are inconsistent and consequently they may mislead the underlying analysis. Besides that, we also did an unit root test on our data to validate it.

Table 1: Descriptive Statistics of our Database

Variable	Mean	Std. Dev.	Max.	Min.	Median	Skewness	Kurtosis	IQR	Coef.	Range	Obs.
gdi	29.449	3.392	35.500	23.300	29.400	0.112	-1.267	6.400	0.115	12.200	361
gmi	47.590	3.132	53.500	38.200	48.000	-0.698	0.292	3.250	0.066	15.300	361
topo	0.099	0.025	0.201	0.045	0.101	0.502	0.779	0.033	0.250	0.157	354
topt	0.332	0.038	0.456	0.229	0.330	0.092	0.186	0.055	0.114	0.227	354
wii	1.433	1.667	4.748	-5.031	1.564	-1.113	2.302	2.160	1.163	9.779	285
eq	0.032	0.163	0.215	-0.266	0.118	-0.625	-1.232	0.335	5.129	0.481	361
reest	100.712	16.529	162.810	58.430	100.000	0.635	1.685	16.795	0.164	104.380	213
unemp	9.142	4.595	27.500	2.300	8.200	1.393	2.277	5.300	0.503	25.200	361
wages	178.820	283.578	1394.041	1.885	57.606	2.151	4.109	196.433	1.586	1392.156	355
short	2.467	2.492	15.670	-0.330	2.190	1.490	3.836	4.040	1.010	16.000	361
long	4.249	2.425	22.500	0.090	4.260	2.008	11.044	1.885	0.571	22.410	345
cpi	88.206	11.658	104.662	53.571	90.436	-0.711	-0.227	19.427	0.132	51.092	361
lgdppc	1.379	0.252	1.977	0.744	1.372	-0.022	-0.074	0.347	0.183	1.234	361
vfbkf	0.047	0.127	0.633	-0.462	0.040	0.442	3.797	0.110	2.708	1.095	361
cab	-0.867	5.827	11.952	-21.088	-0.597	-0.389	0.235	7.152	-6.722	33.040	346
llgdp	120.562	152.622	938.722	4.161	86.428	3.896	14.967	48.191	1.266	934.561	348
pegdp	43.410	6.807	63.604	25.663	43.199	0.010	-0.491	10.543	0.157	37.941	361

4. EMPIRICAL ANALYSIS

4.1. MONETARY POLICY EFFECTS ON INCOME DISTRIBUTION

As described earlier, we have analysed the impacts of monetary policy channels on income distribution, resorting to four variables representing said distribution of income, namely *GDI*, *GMI*, *TOPO* and *TOPT*. Therefore, we have chosen to split the analysis of monetary policy channels' impact on income in two. We first reflect on the obtained results for *GDI* and *GMI*, and then we discuss the reached results for *TOPO* and *TOPT*.

Regarding the analysis for *GDI* and *GMI* we got quite similar results, varying in intensity on the variables that belongs to the channels (see the results on *GDI* and *GMI* in table 2). For most of our variables we got slightly higher values for *GMI* when compared to *GDI*, which is comprehensible in light of the fiscal policy effects. In specific, fiscal policy through taxation policy associated with progressive income tax rates acts as a counterbalance to monetary policy effects on the degree of income inequality. Our model identifies the portfolio channel as relevant to explain the Gini of market income through the real estate variable (see results of columns (2) for GDI and (6) for GMI). It seems that an increase on real estate prices can reduce GMI, similar to what Domanski, Scatigna and

Zabai (2016) found for some advanced countries. The main argument is that Real Estate is distributed more equally in society. When mid and low-income have their own home, real estate became the main asset class on their portfolio and if its prices increase more than other financial assets, it might reduce inequality. In the case of income channel, we found that an increase on equity prices leads to an increase in the Gini of disposable income (see results of columns (1) for GDI and (5) for GMI). Our results were similar to those of Mumtaz and Theophilopoulou (2017) for the UK and Saiki and Frost (2014) for Japan. They found that an increase in assets prices, mainly equity, leads to an increase in inequality for the underlying countries. This happened mainly because high-income households receive, in comparison with mid and low-income households, a greater share of their income from financial assets.

In both channels, we identified the impact that inflation can have on inequality. For both inequality measures, an increase in inflation may lead to an increase in inequality. In general, high-income households have more ways to protect themselves from a generalized increase in prices using several financial instruments. As it is shown in Claeys et al. (2015), members of the highest percentiles of the society have access to financial instruments other than deposits, for example mutual funds quotas, bonds and shares and so forth, constitute instruments that low-income households rarely have access to. Besides that, Carroll, Slacalek and Tokuoka (2014) showed that the marginal propensity to consume of high-income households are smaller than the low-income individuals, which means that the latter group usually are more affected by the increase in prices of consumables. Therefore, and on average, we may see an upward effect of 0.035 and 0.058 percentage points in income inequalities, measured by GDI and GMI, respectively, from a unit point increase on inflation.

Besides that, we identified that the Earnings Heterogeneity channel (see results of columns (3) and (7)) may have an impact on *GDI* and *GMI* due to the impact of monetary policy on unemployment and wages. From our data, we found that an increase in unemployment can increase both inequality measures with a higher influence on *GMI* (the increase of one percentage point in unemployment rate leads to an increase 0.152 and 0.259 in inequalities measured by GDI and GMI, respectively). This result is in accordance with Caliendo, Künn and Uhlendorff (2016) findings, which highlight the possibility that usually high-income individuals may have greater job stability and

consequently may have a lower chance of losing their jobs in a crisis. In this case, an expansionary monetary policy that can reduce unemployment would reduce income inequality. Most of the authors mentioned before identify that an increase in wages can also reduce inequality, however we do not reach that result, instead we found that an increase in wages might slightly increase GDI and GMI. A possible explanation for that is the fact that we only have data for gross wages. By this perspective, it makes sense that an increase in aggregate wages leads to a small increase in inequality, since it does not capture the redistributive impact of income taxes. Our findings reinforce the need of a progressive tax system in order to reduce income inequality and are in line with Joumard, Pisu and Bloch (2012). The authors showed that among all OECD countries, progressive income taxes are an important measure to reduce income inequality.

When we used all explanatory variables in a jointly regression, only *wages* and *unemp* were significant, which reinforces the importance of the Earnings Heterogeneity channel as a transmission channel of inequalities from expansionary monetary policies. However, the coefficient values were a little bit smaller than the ones we got when we used only those two variables in our third channel (see results of columns (4) and (8)). Furthermore, our results were somewhat similar to what Coibion et al. (2017) found for the US, where they identified the relative higher importance of Earnings Heterogeneity channel in comparison with the Portfolio and Income composition channels. For the Euro Area, some authors, such as Lenza and Slacalek (2018) and Hohberger, Priftis and Vogel (2020) also highlighted that an expansionary monetary policy via the Earning Heterogeneity channel can decrease income inequality. They pointed out that it was proportionally more intense than a possible decreased in inequality caused by an increase in asset prices that could be identified by the income or portfolio channel.

Regarding our control variables, it seems that *vfbkf, llgdp* and *pegdp* do not have a significant impact on *GDI* nor *GMI*. On the other hand, when we analysed the Earning Heterogeneity channel, it seems that cab might influence our inequality measures, -0.044 and -0.067 for GDI and GMI, respectively. An increase in Current Account Balance might be associate with a decrease in income inequality. Our findings are in line with Kumhof et al. (2012), where the authors found a link between increase in income inequality and current account deficits in developed economies. For the per capita GDP, lgdppc, we got mixed results. When we analysed the Income channel, we got that an increase in this

variable may decrease GDI and GMI. However, when we analysed just the Earnings Heterogeneity channel, we got the opposite result. One possible explanation is associated with Brueckner and Lederman (2018), the authors concluded that the impact of GDP per capita on income inequality might be related to the initial level of income inequality and because of that, there might be an increase or a decrease for given period of time depending on the country. Since we analysed several countries with different initial levels of income inequality in an aggregate way, those mixed results that we got are comprehensible given the nature of this variable.

Table 2: Results of Gini of Disposable Income and Gini of Market Income, 1999-2017.

	GDI				GMI			
	OLS - RE	OLS - RE	OLS - FE	OLS - RE	OLS - RE	OLS - RE	OLS - FE	OLS - RE
	1	2	3	4	5	6	7	8
eq	0.514*	0.004		-0.038	0.392	-0.188		-0.283
	0.246	0.275		0.261	0.363	0.386		0.352
reest		-0.006		-0.001		-0.012*		-0.001
		0.004		0.004		0.006		0.006
unemp			0.152***	0.092***			0.259***	0.174***
			0.016	0.024			0.025	0.033
wages	0.004***		0.006***	0.003***	0.006***		0.010***	0.004***
	0.001		0.001	0.001	0.001		0.001	0.001
short	0.041	-0.029		-0.009	0.018	-0.002		0.033
	0.030	0.034		0.033	0.044	0.048		0.044
long	-0.032	-0.005		-0.035	-0.024	-0.065		-0.129**
	0.025	0.032		0.032	0.037	0.044		0.042
cpi	0.038***	0.032**		0.008	0.069***	0.046**		0.005
	0.008	0.012		0.012	0.011	0.017		0.017
lgdppc	-3.179**	-4.292*	7.450***	-1.625	-5.896***	-3.273	10.546***	0.840
	1.185	2.000	0.732	2.000	1.586	2.215	1.125	2.273
vfbkf	-0.044	0.107	-0.503	-0.127	0.504	0.385	-0.414	-0.030
	0.385	0.343	0.306	0.330	0.568	0.480	0.470	0.444
cab	-0.005	-0.013	-0.044***	-0.022	-0.008	-0.010	-0.067***	-0.027
	0.010	0.014	0.010	0.014	0.015	0.020	0.015	0.019
llgdp	-0.001	-0.002	-0.002	-0.002	0.000	-0.002	-0.002	-0.003
	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.002
pegdp	-0.008	-0.016	-0.044**	-0.030*	0.036	0.036	-0.014	0.006
	0.016	0.015	0.014	0.014	0.022	0.020	0.021	0.019
R-squared	0.326	0.258	0.448	0.347	0.465	0.355	0.511	0.453
Obs.	315	206	329	206	315	206	329	206
Hausman-statistic	0.609	0.991	2E-16	0.116	0.964	0.915	0.001	0.998
Pesaran-CD statistic	0.947	0.076	0.302	0.451	0.271	0.624	0.073	0.110

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The Pesaran-CD statistic is the Pesaran cross-section dependence statistic.

Our results for *TOPO* and *TOPT* were not exactly similar to those found for *GDI* and *GMI* (see the results on *TOPO* and *TOPT* in table 3). For the Income channel, we identify that an increase on equity prices can lead to an increase on income inequality and income concentration (see results of columns (9) for *TOPO* and (13) for *TOPT)*. These results were similar to our what we found for *GDI* and several other authors. Once again, Earnings Heterogeneity seems to be an important channel to influence income inequality. However, the absolute values that we obtain here were smaller than the ones we found for *GDI* and *GMI,* in some cases below 0.001 (see results of columns (11) and (15)). For both *TOPO* and *TOPT*, it seems that an increase on equity prices leads to an increase in income concentration. Our results are in line with the findings of several other authors for different regions, including the Euro Area, for example, the ones presented by Bernoth et al. (2015).

However, for the jointly regression and the portfolio channel we did not reach similar conclusions for those obtained in the Gini indexes. Now we identify reest as a significant variable to increase income concentration in all cases, however with a small coefficient, below 0.001. Our results are different from those we got for GMI and from those found by Domanski, Scatigna and Zabai (2016), using data for some advanced economies. The authors argued that, since real estate is, in comparison with other assets, better distributed in society, house prices can reduce inequality, mainly if house prices increased more than equity and bond prices, which might be the case in some countries.

Regarding Real Estate in general, we would like to highlight that we think it should have a different treatment for policy makers when analysing the impact of this variable in inequality. Some authors showed that, contrary to what we observed for *TOPO* and *TOPT*, an increase in Real Estate prices might have a positive impact in reducing inequality mainly because low-income households have a significant part of their portfolio allocated on that (their own home). However, even if a rise in house prices as a wealth effect, it does not mean that low-income households can enjoy this increase in wealth, because a house has a different social function than equity, bonds and deposits. To enjoy this wealth, a household must sell or rent their property, but still needs to live somewhere. Buy a new house, in most of cases, would mean living in a less expensive neighbourhood, which might have its negative consequences (far from workplace, less access to services and other). Move to a smaller place or with a family member might be

an alternative, but it can also have a negative impact on the household wellbeing. Besides that, Real Estate is not an asset as liquid as most equities and bonds, which means that it should take more time to get the cash associated to an eventual sell. Those are the main reasons why we think real estate should have a different treatment when analysing household portfolio.

Regarding our control variables, it seems that *lgdppc, vfbkf* and *cab* do not have a significant impact on the share of income held by the top 1% and top 10% of society. However, we found that liquid liabilities as a percentage of GDP might increase income concentration while public expenditures as a percentage of GDP might decrease it. The impact that *pegdp* causes on our inequality measures might be associated with a redistributive public spending, for example education and human capital expenses and some types of social transfers that most Euro Area countries adopt. Afonso, Schuknecht and Tanzi (2010) found that those government expenses have an important role in decreasing income inequality. The influence that llgdp has on TOPO and TOPT is, despite being significant, we obtain a marginal effect of monetary supply on high-income individuals (below 0.001). The values we got for *TOPT* are, in module, higher than the ones found for *TOPO,* which makes sense since the top 10% includes a larger proportion of society than the top 1% from here the income distribution is surely more unequally distributed in the top 10% than the top 1% hence the effects from monetary policy and the remaining control variables are naturally stronger for the larger proportion of high-income individuals.

Table 3: Results of Share of Income held by the Top 1% and the Top 10% of society, 1999-2017.

	TOPO				TOPT			
	OLS - FE	OLS - RE	OLS - RE	OLS - FE	OLS - FE	OLS - RE	OLS - RE	OLS - RE
	9	10	11	12	13	14	15	16
eq	0.011*	0.008		0.009	0.014*	0.009		0.009
	0.005	0.007		0.006	0.006	0.009		0.008
reest		0.000*		0.000***		0.000**		0.000***
		0.000		0.000		0.000		0.000
unemp			0.001***	0.001			0.001**	0.002*
			0.000	0.001			0.000	0.001
wages	0.000		0.000**	0.000	0.000*		0.000**	0.000*
	0.000		0.000	0.000	0.000		0.000	0.000
short	0.000	-0.001		-0.001	0.001	-0.002.		-0.002
	0.001	0.001		0.001	0.001	0.001		0.001
long	0.000	0.001		0.001	-0.001*	0.002*		0.001
	0.000	0.001		0.001	0.001	0.001		0.001
cpi	0.000	0.000		0.000	0.000	0.000		0.000
	0.000	0.000		0.000	0.000	0.000		0.000
lgdppc	-0.042	-0.024	-0.001	-0.042	-0.048	-0.061*	-0.014	-0.053
	0.027	0.021	0.013	0.055	0.035	0.027	0.018	0.030
vfbkf	0.007	0.010	0.005	0.009	0.000	0.013	0.002	0.010
	0.007	0.008	0.006	0.008	0.009	0.011	0.009	0.010
cab	0.001***	0.001	0.000	0.001	0.001**	0.001	0.000	0.001
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
llgdp	0.000***	0.000***	0.000**	0.000***	0.000***	0.000***	0.000**	0.000***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
pegdp	-0.001***	-0.001***	-0.002***	-0.002***	-0.001***	-0.002***	-0.002***	-0.002***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.212	0.239	0.214	0.272	0.199	0.325	0.191	0.344
Obs.	314	205	328	205	314	205	328	205
Hausman-statistic	0.019	0.251	0.575	1E-08	9E-09	0.999	0.981	0.533
Pesaran-CD statistic	0.847	0.088	0.931	0.282	0.292	0.717	0.565	0.670

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The Pesaran-CD statistic is the Pesaran cross-section dependence statistic.

4.2. MONETARY POLICY EFFECTS ON WEALTH DISTRIBUTION

Unfortunately for the wealth inequality analysis, there is not as much data available as there is for the income inequality analysis. However, in order to overcome this scarcity of data, we proceeded our analysis by using only one variable, *WII*, which we described previously in our methodology section. It is important to highlight that the interpretation of this indicator is not as straightforward as it was for the four indicators we had for income inequality. Since we multiply the Gini of Disposable Income (*GDI*) for the Household Savings as percentage of Disposable Income we got an annually measure of unequal distributed savings, which gives, in our perspective, the amount of

wealth accumulated in a given year, from a monetary perspective. Moreover, since this composite measure translates the savings distributed within an economy, it shows/gives/represents, in our perspective, the wealth distribution accumulated in each period. Therefore, we are going to analyse the effect of our selected variables in our proposed wealth inequality measure. On one hand the increase of *WII* translates the increase of savings unequally distributed; on the other hand, when this composite measure decreases it translates a slower pace of wealth accumulation, although with a more equally trend, i.e., when *WII* diminishes we are saying that high-income families save less than poorer families and then, the accumulation of wealth, via saving decisions, becomes more equally distributed.

We identified the income and the portfolio channels as being relevant to explain our wealth inequalities measures, with a greater emphasis on the first (see the results on *WII* in table 4). Regarding the income channel, we found that an increase in the equity index might reduce our indicator, which means that it could reduce the disparities between the savings rate for high-income households and low-income households (see results of column (17)). As we showed before, low-income households consume proportionally more than high-income households, that in turn save more. Also for the income channel, we got similar results for inflation and the long run interest rate. An increase in both variables seems to reduce our indicator. For *cpi,* one possible explanation might be straightforward, an increase in inflation in the short term might reduce the savings rate so households can meet their short term obligations. Since high-income households save proportionally more than low-income, their reduction might be proportionally higher in a year, which explains the negative coefficient in our results.

In the case of *eq* and *long* for the income channel and *reest* for the portfolio channel (see results of column (17)), we concluded that their impact on *WII* might be stronger on its savings rate component, since we did not get similar results while analysing just the Gini of disposable income previously. Because of that, we focused our analysis on the savings rate side. Our results are in line with Berben, Bernoth and Mastrogiacomo (2006) findings, where the authors concluded that an increase in financial assets prices might have a negative effect on general households' savings rate. Their main explanation was the compensation idea that many investors have. When suffering significant losses on financial markets, many investors tend to invest (save) even more to

compensate previous losses in a strategy known as buy the pullbacks. Besides that, after a huge market pullback occur there are greater proportional increases on assets prices. These fluctuations constitute a significant opportunity for those who were able to save more right up until a drop on assets prices happens. This was the case after all market crashes on history, for example, in 2020 the Eurostoxx 600 fell more than 35% between February 19 and March 18. However, it roses more than 30% on the following three months. With our results we showed that the pace of capital accumulation for high-income households slow down when asset prices increases. However, the same is not true for mid and low-income households, since their income does not depend as much on assets as it does on their wages. Because of that, it is important to highlight that our results are not contrary to what Mumtaz and Theophilopoulou (2017) and Saiki and Frost (2014) found for the UK and Japan, respectively and those we got for the Gini of disposable income. With WII we are able to concluded that the gap between what high-income households save and what mid and low-income households save narrows when asset prices increase, but it does not mean that the mid and low-income classes are saving more than their richer countrymen.

On the other hand, our evidence suggests that an increase in the short term interest rate might increase our indicator, which means that it would increase the unequal distributed savings rate and consequently wealth inequalities. This might come from the association between short term interest rate and loans. Since low-income households have a higher level of indebtedness in comparison to high-income, it is comprehensible that our indicator increases when short-term interest rates (*short*) increase. Besides that, wealthier households can negotiate for low (high) interest rates when asking for a loan (or to borrow).

As it was the case for our income inequality measures, we also found the Earnings Heterogeneity channel relevant for *WII* (see results of column (19)). We found that an increase in *unemp* and *wages* reduces our indicator. The interpretation for the unemployment is straightforward, unemployed people do not save and in fact have to use their savings or borrow money to consume, which means that this reduction on our indicator might be related to a general decrease on the savings rate, which, and by taking account the heterogeneous behaviour of saving (remember that high- income families save proportionally more than low-income individuals) it may result in a decrease in

27

wealth disparities, when unemployment increases. Our results are similar to what Opoku (2020) found for OECD countries, where the author associated unemployment to uncertainty and a reduction in income that led to a reduction in household savings. For wages, its increases are associated with a reduction on the unequal distributed savings rate, meaning that low-income are saving proportionally more than high-income households of the wage increase. Therefore, high-income households are still saving more than low-income, however the gap might be slightly reduced due to the increase in wages. Wisman (2013) found that in an environment of wage stagnation wealth inequality tends to increase, mainly because low- and mid-income families cannot save and adjust their living standards in a scenario of wage stagnation. On the other hand, high-income households' savings rate is less dependent on wages and even in a scenario of wage stagnation they do not have to change a lot their behaviour. The author highlighted that there is a possibility that a decrease in the savings rate of wealthier people in a scenario of increasing asset prices. This argument is in accordance with our results for equity (*eq*), long-term rates (*long*) and real state (*reest*).

As for the jointly regression, real state (*reest*) was the only significant explanatory variable. The result was similar to the one we obtained for the portfolio channel, however it was less significant. Regarding our control variables, it seems that per capita GDP (*lgdppc*), change on gross fixed capital formation *(vfbkf)*, current account balance *(cab)* and liquid liabilities as a percentage of GDP (*llgdp)* are related to our wealth inequality measure. According to our model, an increase in the per capita income is associated with an increase in *WII*. Our results might be associated to the fact that in the Euro Area, countries with the highest GDP per capita have higher net savings than the others. For example, Luxemburg and Germany have around twice the GDP per capita of Slovakia and Slovenia and a higher net savings rate for the period we analysed. As for the change on the gross fixed capital formation, we got that an increase on it is associated with a decrease in our inequality measure. These results are in line with some authors such as Ampudia, et al. (2018), that argued that the MP impact in the real economy (for example via firms' and households' investments), reduces inequalities. The third variable is the current account balance. We identify that its increases are associated with an increase in WII. One possible explanation for our results is that following a period of current account deficit, one country tens to face a period of increasing savings rate to solve their

imbalance as it is suggested in Olivei (2000), consequently an increase in cab would be associated with an increase in the savings rate and WII. The last one is the liquid liabilities, which is associated with a marginal decrease on our wealth inequality measure. We use it as a proxy for M3 and can in a certain way show the impact of QE and the implicit increase in the ECB's balance sheet in the Eurozone. Our results are in line with Ampudia, et al. (2018) and Lenza and Slacalek (2018), among others, that found that unconventional monetary policy, mainly APP, did not increase inequality.

Table 4: Results of our Wealth Inequality Measure, 1999-2017.

	WII			
	FGLS - FE	PCSE - RE	OLS - FE	PCSE - RE
	17	18	19	20
eq	-0.499***	-0.53		-0.595
	0.0480	0.374		0.374
reest		-0.017**		-0.015*
		0.006		0.007
unemp			-0.175***	0.041
			0.027	0.029
wages	0.000		-0.003**	0.001
	0.000		0.001	0.000
short	0.072***	0.068		0.082
	0.009	0.065		0.063
long	-0.105***	-0.015		-0.027
	0.007	0.057		0.054
cpi	-0.080***	0.014		0.005
	0.002	0.019		0.020
lgdppc	14.736***	5.835***	0.631	7.016***
	0.408	1.380	1.847	1.652
vfbkf	-1.826***	-2.540**	-1.117	-2.545***
	0.103	0.757	0.612	0.747
cab	0.043***	0.001	0.079***	-0.007
	0.005	0.023	0.018	0.023
llgdp	-0.003***	-0.003*	-0.002	-0.004***
	0.000	0.001	0.001	0.001
pegdp	0.075***	0.020	0.042	0.018
	0.006	0.018	0.022	0.018
R-squared	0.828	0.319	0.235	0.327
Obs.	249	156	259	156
Hausman-statistic	2.E-16	0.176	0.007	0.778
Pesaran-CD statistic	0.286	n.a.	0.230	n.a.

Notes: *, ** and *** represent statistical significance at levels of 10%, 5% and 1% respectively. The robust standard errors are in brackets. The Pesaran-CD statistic is the Pesaran cross-section dependence statistic. For PSCE-RE econometric technique there are not available (n.a.) results for Pesaran-CD statistic.

5. CONCLUSIONS AND POLICY IMPLICATIONS

Income and wealth inequality have always been an important topic in economic and social sciences studies and one of the most discussed in politics. After the financial crisis in 2008, many researchers and politicians raised questions about how conventional and unconventional monetary policy measures adopted and decisions taken by Central Banks could have affected income and wealth distribution in society, mainly where CBs used several unconventional mechanisms to fight the crisis. On the last decade many authors analysed the impacts of MP on inequality, mainly for the regions that recently resort to unconventional tools, namely the US, Japan, the UK and some Euro Area countries. In accordance to this, in this empirical research we focused on the impact of MP in the Euro Area since the creation of the single currency in 1999, analysing the individual impact of three different monetary policy channels broadly recognized by the overall by the literature on monetary economics. Moreover, we also set up a jointly analysis using all our selected explanatory variables to study the impact of the channels combined.

Our model could identify that an increase in equity prices can increase income inequality, a relation that other authors, such as Mumtaz and Theophilopoulou (2017) and Saiki and Frost (2014) also found on their works for the UK and Japan, respectively. We highlight that a more detailed approach regarding the portfolio composition of households in the Eurozone might be necessary in order to deepen this analysis, doing this is beyond the scope of the present work. Besides that, it seems that the Earnings Heterogeneity channel have a more significant impact on both of our Gini index measures (disposable income and market income), similar to what Lenza and Slacalek (2018) and Ampudia, et al. (2018) found for the Euro Area, with wages and unemployment explaining part of the changes on them. However, contrary to those authors, we have identified a positive relation of gross wages and salaries and both of the Gini measures, which might be explained by the fact that we did not use net wages and salaries and, consequently, did not capture the redistributive impact that taxes might have on this variable. Our findings reinforce the importance of a progressive tax system to reduce income inequality on the Euro Area.

Regarding the share of income held by the top 1% and top 10%, we also got that equity prices increase income concentration. Besides that, we found that liquid liabilities and public expenditures as a percentage of GDP are the two control variables with higher significance in our model. As *llgdp* increases, both of our inequality measures increased marginally, while when *pegdp* increased, they decreased. This constitutes an important result for public policy, since it reinforces the redistributive aspect of public spending in the Euro Area countries and raises awareness about the increase in money supply (in our case we used a proxy for M3), mainly in a context of Asset Purchase Programs. We also identify the relevance of the Earnings Heterogeneity channel. The role of unemployment and gross wages and salaries was similar to what we found for both our Gini measures. Also for *topo* and *topt* we could notice that *reest* might have a role in increasing income concentration in the portfolio channel and the jointly regression. Mainly for *topt*, an increase in the Real Estate Index we used is associated with a marginal increase in the share of income held by the top percentiles of our society.

In the case of Real Estate, we would like to highlight that policy makers should analyse the impact of this variable in inequality in a different way. Some authors argued that an increase in Real Estate prices might reduce inequality, mainly because low-income households have proportionally a larger share of their portfolio allocated to it (their own home). However, a house has a different social function than equity, bonds and deposits and not the same liquidity, which means that even if a rise in its prices increases its wealth, it does not mean low-income households can enjoy this increase in wealth. To enjoy this wealth, a household could sell or rent his property, but he still needs to find a place to live. Buy a new house it is not that simple, it could be far from workplace or have less access to services for example. Move to a smaller place or with someone is possible, but it can also have a negative impact on the person´s wellbeing.

As we discussed before, there is not much data available for wealth inequality, that is why we restricted our analysis to one variable, *WII*, which we described previously in our methodology section. Besides that, we highlight, that the interpretation of this indicator is not straightforward, since it constitutes an annual measure of unequal distributed savings, which represents, in our perspective, the amount of wealth accumulated in a given year, although in a monetary way. We identify both the and income and the portfolio as being significant, with the first carrying a higher weight. For

the income channel, we found that asset prices (equity, bonds and deposits) influenced our indicator, while for the portfolio channel only Real Estate seems to be significant. As was the case for our income inequality measures, the Earnings Heterogeneity channel is significant, with both unemployment and wages being important to explain wealth inequality dynamics.

In sum, our work contributes to the debate about monetary policy and its impact on wealth and income inequality, bringing new data and methodology for Eurozone countries, mainly in what respects to wealth distribution. We highlight that wealth data is scarce for some countries and variables and that therefore, with our new approaches we think that our work can bring new and important insights to the existing literature that makes a linkage between monetary policy and its transmission channels and both income and wealth distribution. Moreover, with the new employed approach regarding wealth distribution data our paper is a valuable contribution for the discussion of how monetary policy affects wealth inequalities. We hope that we may have contributed to providing valuable intuitions about the causal linkage under analysis in this study, despite the possible criticism that may arise from the pioneering methodology applied to the study of the dynamics of wealth distribution.

REFERENCES

Abbasi, P., & Linzert, T. (2012). The Effectiveness of Monetary Policy in steering Money Market
    Rates during the Recent Financial Crisis. *Journal of Macroeconomics, 34*(4), 945 - 954.

Afonso, A., Schuknecht, L., & Tanzi, V. (2010). Income distribution determinants and public
    spending efficiency. *The Journal of Economic Inequality, 8*(3), 367 - 389.

Altavilla, C., Giannone, D., & Lenza, M. (2016). The Financial and Macroeconomic Effects of
    OMT Announcements. *International Journal of Central Banking, 12*(3), 29-57.

Altavilla, C., Motto, R., & Carboni, G. (2015). Asset Purchase Programmes and Financial
    Markets: Lessons from the Euro Area. *ECB Working Paper Series, 1864*, 1-54.

Alvaredo, F., Chancel, L., Piketty, T., Saez, E., & Zucman, G. (2018). *World Inequality Report.*
    World Inequality Lab.

Ampudia, M., Georgarakos, D., Slacalek, J., Tristani, O., Vermuelen, P., & Violante, G. (2018).
    Monetary policy and household inequality. *ECB Working Papers Series, 2170*, 1-38.

Andrade, P., Breckenfelder, J., De Fiori, F., Karadi, P., & Tristani, O. (2016). The ECB's Asset
    Purchase Programme: an Early Assessment. *ECB Working Paper Series, 1956*, 1-63.

Archarya, V., Eisert, T., Eufinger, C., & Hirsch, C. (2019). Whatever it takes: The Real Effects
    of Unconventional Monetary Policy. *The Review of Financial Studies, 32*(9), 3366–3411.

Areosa, W., & Areosa, M. (2016). The inequality channel of monetary transmission. *Journal of
    Macroeconomics, 48*(C), 214-230.

Auclert, A. (2019). Monetary Policy and the Redistribution Channel. *American Economic Review,
    109*(6), 2333-2367.

Aye, G., Clance, M., & Gupta, R. (2019). The effectiveness of monetary and fiscal policy shocks
    on th U.S. inequality: the role of uncertainty. *Quality & Quantity: International Journal
    of Methodology, 53*, 283-295.

Bagchi, S., Curran, M., & Fagerstrom, M. (2019). Monetary growth and wealth inequality.
    Economics Letters, 182, 23-25.

Balac, Z. (2008). Monetary Infaltion's Effect on Wealth Inequality: An Austrian Analysis. *The
    Quarterly Journal of Austrian Economics, 11*, 1-17.

Basu, P., & Guariglia, A. (2007). Foreign Direct Investment, inequality, and growth. *Journal of
    Macroeconomics, 29*(4), 824-839.

Beck, N., & Katz, J. (1995). What to Do (and Not to Do) with Time-Series Cross-Section Data. *The American Political Science Review, 89*(3), 634-647.

Beetsma, R., De Jong, F., Giuliodori, M., & Widijanto, D. (2014). The Impact of News and the SMP on Realized (Co)Variances in the Eurozone Sovereign Debt Markets. *ECB Working Paper Series, 1629*, 1-44.

Berben, R., Bernoth, K., & Mastrogiacomo, M. (2006). Households' Response to Wealth Changes: Do Gains or Losses make a Difference? *DNB Working Paper, 90*, 1 - 25.

Bernoth, K., Konig, P., Beckers, B., & Grazzini, C. (2015). Quantitative Easing - What Are the Side Effects on Income and Wealth Distribution In-Depth Analysis. *DIW Berlin: Politikberatung kompakt, 99*, 1-28.

Bivens, J. (2015). Gauging the impact of the FED on inequality during the great recession. *Hutchins Center on Fiscal and Monetary Policy Working Paper, 12*, 1-33.

Bjornskov, C. (2008). The growth-inequality association: Government ideology matters. *Journal of Development Economics, 87*(2), 300-308.

Brueckner, M., & Lederman, D. (2018). Inequality and GDP per capita: The Role of Initial Income. *Journal of Economic Growth, 23*(3), 341 - 366.

Bunn, P., Pugh, A., & Yeates, C. (2018). The distributional impact of monetary policy easing in the UK between 2008 and 2014. *Bank of England Staff Working Paper, 720*, 1-65.

Caliendo, M., Künn, S., & Uhlendorff, A. (2016). Earnings exemptions for unemployed workers: The relationship between marginal employment, unemployment duration and job quality. *Labour Economics, 42*, 177-193.

Carroll, C., Slacalek, J., & Tokuoka, K. (2014). The Distribution of wealth and the MPC: implications of new European data. *American Economic Review, 104*(5), 107-111.

Casiraghi, M., Gaiotti, E., Rodano, L., & Secchi, A. (2018). A "reverse Robin Hood"? The distributional implications of non-standard monetary policy for Italian households. *Journal of International Money and Finance, 85*(C), 215-235.

Cecione, M., Ferrero, G., & Secchi, A. (2018). Unconventional monetary policy in theory and in practice. In D. Evanoff, G. Kaufman, & M. A G, *Innovative Federal Reserve Policies During the Great Financial Crisis* (pp. 1-36). World Scientific Publishing Co. Pte. Ltd.

Claeys, G., Darvas, Z., Leandro, A., & Walsh, T. (2015). The effects of ultra-loose monetary policies on inequality. *Bruegel Policy Contribution, 885*, 1-23.

Coibion, O., Gorodnichenko, Y., Kueng, L., & Silvia, J. (2017). Innocent Bystanders? Monetary Policy and Inequality in the U.S. *Journal of Monetary Economics, 88*, 70-89.

Colciago, A., Samarina, A., & De Haan, J. (2019). Central Bank Policies and Income and Wealth Inequality: A Survey. *Journal of Economics Surveys, 33*(4), 1199-1231.

Davtyan, K. (2016). Income Inequality and Monetary Policy: An Analysis on the Long Run Relation. *IREA Universitat de Barcelona Working Paper, 2016/4*, 1-37.

de Mello, L., & Tiongson, E. (2006). Income Inequality and Redistributive Government Spending. *Public Finance Review, 34*(3), 282-305.

Domanski, D., Scatigna, M., & Zabai, A. (2016). Wealth inequality and monetary policy. *BIS Quarterly Review, March*, 1-20.

Feenstra, R., Inklaar, R., & Timmer, M. (2015). The Next Generation of the Penn World Table. *American Economic Review, 105*(10), 3150-3182.

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The Effects of Monetary Policy Shocks on Inequality. *Journal of International Money and Finance, 85*, 168-186.

Gambacorta, L., Hofmann, B., & Peersman, G. (2014). The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis. *Journal of Money, Credit and Banking, 46*(4), 615-642.

Glomm, G., & Ravikumar, B. (1992). Public versus Private Investment in Human Capital: Endogenous Growth and Income Inequality. *Journal of Political Economy, 100*(4), 818-834.

Guerello, C. (2018). Conventional and unconventional monetary policy vs. households income distribution: An empirical analysis for the Euro Area. *Journal of International Money and Finance, 85*, 187-214.

Hohberger, S., Priftis, R., & Vogel, L. (2020). The distributional effects of conventional monetary policy and quantitative easing: Evidence from an estimated DSGE model. *Journal of Banking & Finance, 113*(C).

Inui, M., Sudo, N., & Yamada, T. (2017). The effets of monetary policy shocks on inequality in Japan. *BIS Working Papers, 642*, 1-68.

Israel, K.-F., & Latsos, S. (2020). The impact of (un)conventional expansionary monetary policy on income inequality - lessons from Japan. *Applied Economics, Latest Articles*, 1-45.

Joumard, I., Pisu, M., & Bloch, D. (2012). Tackling Income Inequality. *OECD Journal: Economic Studies, 1*, 37-70.

Kumhof, M., Lebarz, C., Rancière, R., Richter, A., & Throckmorton, N. (2012). Income Ineqaulity and Current Account Imbalances. *IMF Working Paper*, 1 - 44.

Lenza, M., & Slacalek, J. (2018). How does monetary policy affect income and wealth inequality? Evidence from quantitative easing in the Euro Area. *ECB Working Paper Series, 2190*, 1-50.

Li, H., & Zou, H.-F. (1998). Income Inequality is not Harmful for Growth: Theory and Evidence. *Review of Development Economics, 2*(3), 318-334.

Mumtaz, H., & Theophilopoulou, A. (2017). The impact of monetary policy on inequality in the UK: An empirical analysis. *European Economic Review, 98*, 410-423.

O´Farrel, R., & Rawdanowicz, L. (2017). Monetary policy and inequality: Financial channels. *International Finance, 20*(2), 174-188.

O'Farrel, R., Rawdanowicz, L., & Inaba, K.-I. (2016). Monetary Policy and Inequality. *OECD Economics Department Working Papers, 1281*, 1-38.

Olivei, G. (2000). The role of savings rate and investment in balancing the current account: some empirical evidence from the United States. (F. R. Boston, Ed.) *New England Economic Review*(Jul), 3-14.

Opoku, P. (2020). The Short-Run and Long-Run Determinants of Household Savings: Evidence from OECD Economies. *Comparative Economic Studies*, 1 - 26.

Pattipeilohy, C., Van der End, J., Tabbae, M., Frost, J., & De Haan, J. (2013). Unconventional Monetary Policy of the ECB during the Financial Crisis: An Assessment and New Evidence. In M. Balling, & E. Gnan, *50 Years of Money and Finance: Lessons and Challenges* (Vol. 1, pp. 117-156). SUERF 50th Anniversary Volume.

Peersman, G. (2011). Macroeconomic effects of unconventional monetary policy in the Euro area. *ECB Working Paper Series, 1397*, 1-35.

Piketty, T. (2014). *Capital in the Twenty-First Century.* Harvard University Press.

Rogers, J., Scotti, C., & Wright, J. (2014). Evaluating Asset-Market Effects of Unconventional Monetary Policy: A Cross-Country Comparsion. *Economic Policy, 29*(80), 749-799.

Saiki, A., & Frost, J. (2014). Does unconventional monetary policy affect inequality? Evidence from Japan. *Applied Economics, 46:36*, 4445-4454.

Solt, F. (2020). Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database. *Social Science Inequality Database, 101*(3), 1183 - 1199.

Sterk, V., & Tenreyro, S. (2018). The transmission of monetary policy through redistributions and durable purchases. *Journal of Monetary Economics, 99*, 124-137.

Taghizadeh-Hesary, F., Naoyuki, Y., & Sayoko, S. (2019). The impact of monetary and tax policy on income inequality in Japan. *The World Economy, Early View*, 1-22.

Voinea, L., Lovin, H., & Cojocaru, A. (2018). The impact of inequality on the transmission of monetary policy. *Journal of International Money and Finance, 85*, 236-250.

Wisman, J. (2013). Wage stagnation, rising inequaliy and the financial crisis of 2008. *Cambridge Journal of Economics, 37*(4), 921-945.

Wu, J., & Xia, F. (2016). Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. *Journal of Money, Credit and Banking, 48*, 253-291.