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Investigating the Impacts of Monetary Policy on Income Inequality in Developed Nations: Case Study of the Euro Area, Japan and the United States

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Abstract

This paper tries to evaluate the effect that unconventional monetary policy has had on income inequality for the set of Eurozone countries, the United States and Japan using an unbalanced panel data model over the period from 1980 to 2021, first jointly and then individually, using different regressions for each case. Based on the regression model analyzed, the study attempts to analyze the relationship between money supply and income inequality as measured by the Gini index using fixed effects and random effects for our panel data model. The study reveals the importance of the money supply variable in reducing inequality when all countries are analyzed as a whole. For Eurozone countries, the common monetary policy created from 1999 onwards led to an increase in inequality, however the implementation of the unconventional monetary policy used from 2015 onwards had a beneficial effect on inequality reduction. The same result is found for the European Monetary Union countries. However, for the United States and Japan it is significantly concluded that the conventional monetary policies carried out since 1980 and, subsequently, the unconventional monetary policies have not only failed to reduce inequality, but have contributed to increase it for the aforementioned countries.

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1. Introduction

The latest report on global inequality by a leading group of economists from around the world shows that inequality over the last 40 years (1980-2020) has risen to early 20th century levels. The share of global income going to the top 10% of the world's income earners was 50% in 1820 and 55% in 2020, peaking at 60% in 2000, while the share going to the bottom 50% of income earners has fallen from 14% in 1820 to 7% in 2020. This 14% has never been exceeded since data has been available (Chancel and Piketty, 2021). Global inequality is as high today as it was at the beginning of the 20th century. In other words, and as quoted in the "World Inequality Report 2022", there is still a long way to go to correct the global economic imbalances left by the extremely unequal structure of world production during the mid-19th and mid-20th centuries.

This inequality of wealth and income in developed countries in the last three decades, and since the global financial crisis becomes particularly relevant not only because inequality does not have positive effects on society, but also because it has important consequences for economic and financial stability (OECD, 2013; Piketty, 2014). Because of this concern about inequality, numerous studies have documented the negative effects of inequality on macroeconomic outcomes (Ostry et al., 2014; Stiglitz, 2015; Rajan, 2011; Perugini et al. 2015). It is clear that current inequality can harm economic outcomes and social cohesion across social strata, indeed some studies point out that this relationship between inequality and financial instability may have been particularly significant in the debt-driven housing boom in the pre-crisis period in the United States (Rajan, 2011). Although as Ayako Saiki and Jon Frost point out the relationship of this link between inequality and credit booms depends largely on country-specific factors and institutions, however, Gu and Huang (2014) find the relationship exists for the case of economies with more market-based financial systems. Since the Great Financial Crisis (GFC) of 2008, central bank policies have been aimed at fighting low growth and inflation that appeared to turn into deflation if central banks did not act. They have done so by using aggressive and highly expansionary monetary policy and have even changed the way central banks dealt with these situations in the past from conventional to unconventional measures.

The intensive use of unconventional monetary policies (UMP) has led economists to question whether these policies have had a potential impact on inequality in recent years. Despite its importance, the distributional impact of monetary policy has been ignored in recent years by economists and top central bankers. It was not until 2014 that empirical studies analyzing the impact of unconventional monetary policies on income distribution began to be conducted (Ayako &Frost, 2014). The distributional impact of UMPs is starting to gain more importance in the public debate due to the long period of time in which they are being applied, even more so knowing that UMPs have been implemented for a long time.

The distributional impact of UMPs is starting to gain more prominence in the public debate due to the long period of time over which they are being implemented, even more so knowing that UMPs have been in place for a long time. This change in the way central banks act may be totally different from the impact of the monetary policy they used conventionally. To stabilize the economy, when central banks carry out conventional tools, they do their policy based on a variant of the Taylor rule or inflation targeting. That is, central banks should adopt a countercyclical policy in general. However, after the outbreak of the global financial crisis in 2008, the main objectives of central banks have changed, placing much more importance on financial stability and restoring the monetary transmission mechanism (Ayako &Frost, 2014). As a result, central banks conducted a wide variety of unconventional policies not conducted before, and that is why the economic analysis of these policies is still in its infancy to draw conclusions. Although each central bank may act differently, in fact the processes by which each country started to use unconventional tools vary, the objectives of stabilizing the financial market and ensuring monetary policy transmission mechanisms remain fundamental (Borio and Disyatat, 2009; De Haan et al., 2013). To achieve the objective of monetary transmission the buffers of commercial banks, which is determined by the value of assets, play a determining role. During this process, and this is where unconventional monetary policy takes place, central banks try to keep financial markets afloat by putting more liquidity into financial markets to support asset prices by directly buying private financial assets. As a result, asset prices may become overvalued while the PMU is in place (Ayako &Frost, 2014). The increase in asset prices when the overall economy is in a stagnation process will end up benefiting households with larger holdings of financial assets, which tend to have a high income, the most, which will see their incomes rise. On the other hand, lower-income households with fewer financial assets will not see an impact on wages and may even be negatively affected by lower interest rate gains on savings accounts. This disparity can lead to greater inequality (Ayako &Frost, 2014). If the use of these new monetary transmission mechanisms have a detrimental effect by increasing income and wealth inequality, this could cause future financial instability.

This study aims to show that central banks' monetary transmission changes to address inflation and growth objectives have had an effect on the increase in inequality in the sample of countries analyzed. Using macroeconomic variables, we analyze the impact of monetary policies of the European Central Bank, the Federal Reserve and the Bank of Japan on income inequality over the period from 1980 to 2021. Using an unbalanced panel data model we present evidence that monetary policy has increased inequality for the U.S. and Japanese countries but has succeeded in decreasing it when the countries are analyzed jointly and for the case of the Eurozone.

The rest of the paper is structured as follows. Section 2 reviews the existing literature on this issue, making an international comparison. Section 3 explains our data and our empirical model. Section 4 shows the results of this research work. Section 5 presents the policy implications and Section 6 presents the conclusions.

2. Literature Review

Due to the recent popularity of central bank monetary policies, many recent studies have been published on the impact of so-called "quantitative easing" on the economy, especially when negative interest rates have been introduced for the first time in many countries. However, the novelty of this research paper is the use of the econometric model and the selected data, as Eurozone countries, Japan and the United States have been considered together and analyzed separately, thus performing an international comparative analysis among the main developed economies.

On these effects in the Eurozone, Lenza and Slacalek (2018) investigate the effect that quantitative easing has had on Eurozone household wealth and income. To do so, they use aggregate time series data to assess the effects of quantitative easing on asset prices and the macroeconomy, they use the Bayesian VAR method that includes euro area variables as well as country-specific variables (for France, Germany, Italy and Spain). They argue that the choice of this approach is since it takes into account both the monetary policy of the euro area as a whole and the heterogeneity of the transmission mechanism across countries. The paper concludes that QE in the euro area has reduced income inequality, through a reduction in the unemployment rate for the poorest part of the population and, on the other hand, through wage increases for the employed. This result is demonstrated by the decline in the Gini coefficient of gross household income from 43.1 to 42.9, one year after the announcement of QE. They also show that the ECB's asset purchases have had a positive impact on reducing net wealth inequality, albeit almost insignificantly. The reason is that QE has a positive impact on real estate wealth, a component of net wealth, which is evenly distributed across the distribution.

Analyses also encompass studies comparing countries on both sides of the Atlantic. Domanski, Scatigna, and Zabai (2016) explore the recent evolution of household wealth inequality in the advanced economies of France, Germany, Italy, Spain, the United Kingdom, and the United States. To do so, they create a simulation based on survey data to construct household balances from the first to the fifth quintile of the wealth distribution in each country to then calculate the growth rate of assets and liabilities and, as a final step, calculate the measure of wealth inequality as the ratio of the fifth quintile of the wealth distribution to the second quintile. The results of the study show that wealth inequality has generally increased in a sample of countries since the GFC. This is because rising stock prices have been a key driver of inequality and rising house prices have only partially offset this effect. This suggests that monetary policy may have increased inequality to the extent that it has boosted stock prices.

For the OECD countries, opinions are mixed. Contrary to the belief that quantitative easing increases inequality, given its apparent strong effects on asset prices, O'Farrell and Rawdanowicz (2017) analyze using different financial channels. Using simulations based on surveys in different selected countries of the variation of different assets in different European and North American countries, the authors conclude that the impact of monetary policy on inequality across asset and interest rate channels is weak and uncertain. It is not only central banks and international agencies that are wondering about the effects of the unconventional monetary policies that have taken place in recent years. The McKinsey Global Institute (MGI) examines the distributional effects of these ultra-low rates from 2007 to 2012 by governments in the Eurozone, the United Kingdom and the United States. The authors use a counterfactual model to analyze the impact of monetary policy. In addition, they perform a microeconomic analysis considering the direct impact on specific sectors. The results are positive for tackling inequality as the authors find that household incomes have been jointly boosted by the increased consumption they have been able to enjoy. But there are studies that do not analyze the cause of low interest rates but the consequence of low interest rates that they may have over time. Greenwald et al (2021) argue that a persistent decline in real interest rates naturally leads to an increase in financial wealth inequality. To do so, they show how a standard Bewley incomplete markets model predicts that a decline in rates increases financial wealth inequality. They find that the model with falling interest rates explains all of the increase in financial wealth inequality.

In the United States, where the debate on inequality has gained prominence since inequality has continued to increase since 1980, numerous studies analyze whether monetary policy has been a driver of inequality. Albert, Peñalver and Pérez-Bernabeu (2020) evaluate the effects of monetary policy shocks on income and wealth inequality in the United States in recent years using two additional channels, the housing channel and the fiscal channel, by means of a Bayesian proxy structural vector autoregression (Bayesian proxy structural vector autoregression (Bayesian proxy SVAR). The results show that an expansionary monetary policy shock increases wealth inequality, which could be explained by the portfolio channel. Other academic studies take into account other variables, such as Coibion et al. (2012) who analyze the effect of monetary policy on consumption and income inequality in the United States since 1980.

They find that contractionary monetary policies lead to higher inequality in the US in the pre-crisis period, specifically before 1990. They point out that this is due to the different responses of labor incomes to monetary policy shocks for incomes in the high and low percentiles of society, in addition to the fact that savers gain and borrowers lose from the unexpected decline in inflation following a rise in interest rates. In the case of the United States, these effects prevail over the portfolio channel, defined as the larger impact of rising asset prices on high-income households, which own stocks. This study only takes into account the period prior to 1990, when the main focus of monetary policy was to respond to high levels of inflation, i.e., their study does not include the period of quantitative easing after 2008. Other more recent studies, such as the narrative paper by Watkins (2014), argue how income and wealth inequality has increased with the Fed's quantitative easing program.

It is pertinent to add to the empirical evidence studies with different perspectives, such as Vincent and Silvana (2018) who study the redistributive and aggregate effects of monetary policy in an economy where the government is a large net debtor as is the case in the U.S. economy. They conclude that an expansionary open market operation causes a downward revaluation of government debt and a negative wealth effect in the private sector, as household revaluation losses are not fully offset by tax cuts, this causes households to respond to the fall in wealth by increasing their saving rate. As the real interest rate naturally falls, this generates a substitution towards durable goods, leading to a boom in the durable goods sector. Countries such as the UK with central banks that have developed such policies due to concerns about the large increase in inequality following the great financial crisis has led authors Mumtaz and Theophilopoulou (2019) to study the effect that monetary policy has had on wealth inequality in the UK. As in previous work, the authors rely on wealth and asset surveys to build their database from 2005 to 2016.

They use this method as, they argue, it is the only data source that allows them to construct measures of wealth inequality in the UK at a frequency relevant to monetary policy. They employ a factor augmented vector autoregression (FAVAR) model as a benchmark model to observe the estimated impulse responses. The authors suggest that shocks to expansionary monetary policy led to an increase in wealth inequality and contribute significantly to its fluctuations. With different results but analyzing the same country, Bunn, Pugh, and Yeates (2018) conduct the first study in the United Kingdom to investigate the impact of monetary policy at a household-level detail that was not previously available. They conduct a panel with microdata from the UK National Survey of Wealth and Income over the years 2008 and 2014. They find that QE policy has small but positive effects on inequality reduction.

Although it does not have a separate monetary policy, Casiraghi et al (2017) analyzing for Italian households, consider that the main contribution of their work is precisely to analyze the asset price channel, the remuneration of savings and the income composition channel through which monetary policy affects inequality and compare them quantitatively perform for this purpose a quantitative empirical evaluation based on data from Italian household income and wealth surveys. The main finding is that the largest benefits accrue to households at the bottom of the income scale, as the effects through stimulating economic activity and employment outweigh those through financial markets, as for the net wealth response this has a moderate U shape: less wealthy households leverage their leveraged positions, wealthier ones their higher share of financial assets.

Studies such as Colciago, Samarina and de Haan (2019) conduct descriptive research analyzing the relationship between central bank monetary policies and income and wealth inequality in previous work. The authors clarify that to date the empirical evidence on the effect of conventional monetary policy on income and wealth inequality yields mixed results, this may be reflected in that these policies may reduce income inequality by stimulating economic activity but may increase income inequality by boosting financial asset prices. They also highlight the limitations faced in conducting this type of research. They point out that the main limitation of empirical studies on the distributional effects of monetary policy is that they cannot simultaneously identify all the distributional channels described in the theoretical literature. The authors conclude that future research should focus on estimating general equilibrium models with heterogeneous agents, as this would allow distinguishing between competing theories and provide a quantitative assessment of the effects of monetary policy on income and wealth inequality.

It is not only the United States and eurozone countries that have pursued unconventional monetary policies. The case of Japan may be less well known, as it has been using these techniques since 2001. In their analysis, Saiki and Frost (2014) conduct the first study that empirically analyzes the distributional impact of unconventional monetary policy on income inequality. To test how monetary policy affects income inequality more formally, they use a vector auto regression (VAR) framework. They find strong evidence that the Bank of Japan's PMU has increased income inequality during the sample period because asset prices rise disproportionately compared to economic fundamentals (especially wages and employment).

Rising asset prices mostly benefit high-income households, which have a higher amount and share of overall savings in securities, and thus benefit from higher capital inflows. The authors determine that, in addition to the relevance for Japan, the study also points to possible lessons for other countries undertaking a UMP. While avoiding deflation and repairing the monetary transmission mechanism at the zero lower bound is an inherently difficult undertaking, Japan's experience provides a cautionary tale about the side effects of the PMU. The portfolio channel is likely to be even larger in the United States, the United Kingdom, and many Eurozone economies, where households hold a higher proportion of their savings in stocks and bonds.

Another Asian country such as Korea, Park (2018) conducts the first paper on the effects of monetary policies on income inequality in Korea. The results show that after an expansionary monetary policy shock the Gini coefficient of market income decreases significantly after one year, peaking at 0.14%, while GDP and CPI decrease significantly by 0.48% and 0.15%, respectively.

Nhan et al (2019) in their paper have revealed the relationship between monetary policy and income inequality in Vietnam from 2001 to 2014 and found that monetary policy has a small and lagged effect on income inequality

Another place where research has been conducted and is worth noting is Africa. Due to the scarce literature on the effects of monetary policy on inequality on the African continent, Ahiadorme (2020) connects to research on monetary transmission in emerging economies by assessing the redistributive effects of monetary policy in sub-Saharan Africa (SSA). They identify the monetary policy shock in a sign-restricted VAR and investigate its propagation to income inequality using impulse response analysis. They find that the expansionary monetary policy shock (both standard and non-standard) exerts upward pressure on income inequality. They further conclude that monetary policy shocks can explain the long-run evolution of income inequality.Also for the case of Africa, Goodness et al (2020) examine the effects of monetary policy on wealth inequality in South Africa with newly available fiscal administrative panel data on wealthy individuals. This study uses fixed and random effects panel regression models to examine the effect of monetary policy on wealth inequality. The results show that monetary policy increases Gini wealth inequality and decreases the 90-10th percentile wealth differential.

3. Data and Methodology

The aim of this paper is to find out whether the unconventional monetary policies developed by the central banks of developed countries after the 2008 crisis served to alleviate the increase in inequality that was occurring or, on the contrary, had an impact and failed to reverse the trend of growing inequality. To do so, we use a base model in which we choose the Gini variable as the response variable, and we add different variables and techniques depending on the different situations we want to analyze.

3.1 Data

Data on the effect of monetary policy on income inequality are from the World Bank National Accounts Data and OECD National Accounts Data Files, Global Inequality Database, International Monetary Fund, World Economic Outlook Database, October 2021 and CEICdata.com database. The dataset contains annual data for GINI, CPI, M2, GDP and UNEM variables for 20 countries. The countries included are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, the Netherlands, Portugal, Slovakia, Slovenia, Spain and the United States. The observation period is from 1980 to 2021, collected on an annual basis.

Data on income inequality are from the World Inequality Database (WID). WID provides estimates of income distribution for at least four major income concepts: pre-tax factor income, after-tax income (which we will generally abbreviate as pre-tax income), after-tax disposable income and after-tax national income. It incorporates data from several sources (United Nations University's World Income Inequality Database, OECD Income Distribution Database, World Bank, Eurostat, Luxembourg Income Study) and standardizes them (see WIL 2020 for more details on the methodology).

The Gini coefficient has been used to measure income inequality. Gini coefficients are theoretically bounded between 0 (each reference unit receives an equal share of income) and 1 (a single reference unit receives all income). In our sample, they range between 0.36 and 0.54 for the mean measure and between 0.37 and 0.55 for the median measures (Table 1).

In this section we turn to an analysis of the provenance and nature of the data after a careful review of the literature reviewed. The data on the effect of monetary policy on income inequality come from the World Bank and OECD national accounts data files, the International Monetary Fund's World Inequality Database, the World Economic Outlook database, October 2021, and the CEICdata.com database. The dataset contains annual data for GINI, CPI, M2, GDP and UNEM variables for 20 countries. The countries included are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, the Netherlands, Portugal, Slovakia, Slovenia, Spain, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, the Netherlands and the United States. The observation period is from 1980 to 2021 and is collected annually. Cyprus is not included in the sample due to the lack of money supply data available for the country.

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In reference to the impact of monetary policy, we used the M2 variable that measures a country's money supply. It includes M1 (currency and coin held by the non-bank public, check and traveler's check deposits) plus savings deposits (including money market deposit accounts), small time deposits of less than $100,000, and retail money market mutual fund shares. It is important to describe the nature of the data for the different countries used, as a specific model has been chosen to treat the data. In the case of Austria, the Oesterreichische Nationalbank, Austria's central bank, provides data on M2 money supply growth from September 1980 to January 2022.

However, as I mentioned above, the data for the M2 variable were obtained from the CEICdata database, which is only available from 1998 onwards. This is because the Austrian central bank and the other central banks named below provide the money supply in euros, but there are no annual reports on the euro/dollar exchange rate, which is the currency we use for the other variables, until the European currency came into circulation in 1999. For Belgium, Belgian M2 money supply growth data are available from December 1997 to January 2022. For Estonia, CEIC calculates the monthly M2 growth rate from 1993 to 2021, for Greece from 2001 to 2021, for Ireland from January 2000 through January 2022 and for Latvia from 2004 through 2021. M2 money supply growth data are available for Lithuania from December 1994 through March 2021, for Luxembourg from January 2000 through February 2022, for Malta from January 1992 through January 2022 and for Slovakia from December 2001 through January 2022. At last, Money supply growth data for Slovenia are available from January 1994 through January 2022.

To measure the Consumer Price Index (CPI) we include a proxy for inflation in our model to observe its effect on inequality. We choose this variable because, as evidenced by the literature, high inflation can have a significant impact on income inequality (Galli et al 2001).
Another variable that makes sense to add to observe its relationship with inequality is Gross Domestic Product (GDP). Previous authors have evidenced that increases in inequality lead to reductions in GDP (Causa et al 2014). For our study the World Bank provides data from 1980 to 2020 for the countries used.

The last variable we incorporate into our model, and which is another large measure of inequality is the unemployment rate (UNEM). The inclusion of this variable in relation to income inequality has been amply demonstrated in other studies as unemployment causes a change in the shape of the income distribution and the effect of unemployment on the deterioration of the income distribution is very significant (Cysne, 2009). The data provided by the International Monetary Fund database show differences between countries. For Estonia and Slovakia, data are available from 1993. For Ireland, unemployment data are only available from 1985 onwards. For Latvia and Slovenia from 1992 onwards. For Lithuania, from 1999 onwards. Table 1 provides descriptive statistics.

3.2 Methodology

For the choice of the model, the characteristics of the data in the different variables selected have been considered. On the one hand, given that the different countries that make up the Euro Zone offered different dates for the first observation of the Money Supply variable and that the European Central Bank does not offer the data individually but in aggregate, the omission of data in this variable was significant, which made us rethink the econometric model that we had thought of in the first instance. On the other hand, due to the nature of the data collected, it was necessary to take the time samples in their annual series, since, for example, with the variable measuring income inequality GINI we could not find data on a quarterly or four-monthly basis. It is for these reasons, the omission of data and the different time samples of the variables, that we ended up opting for an unbalanced panel data regression model.

The variables we have decided to include in our model to explain the behavior of income inequality through the Gini index are the consumer price index (CPI) as a variable to measure inflation, the gross domestic product at current prices (GDP), the unemployment rate (UNEM) and the money supply (M2) which includes cash and current account deposits (M1) as well as near money. We apply fixed and random effects panel regression models to examine the effect of monetary policy on income inequality. The benchmark panel data model has been selected considering the methodology followed by Torres-Reyna (2007), Pavel (2012) and Goodness et al (2020).

The fixed-effects model is given as:

$$Y_{it} = \beta X_{it} + \varphi_1 Z_{it} \ldots . \varphi_k Zit + \alpha_i + u_{it}$$

where:

α_i is the unknown intercept for each individual (that is, fixed effects);

Y_{it} is the dependent variable (income Gini index) for each individual (at time, t);

X_{it} is the main independent variable of interest, monetary policy measured as M2;

Z_{it} are the control variables (GDP, unemployment rate and consumer prices index);

β and φ_1 to φ_k are the parameters to be estimated, and.

u_{it} is the stochastic term.

The random-effects model is given as:

$$Y_{it} = \beta X_{it} + \varphi_1 Z_{it} \ldots . \varphi_k Z_{it} + \alpha + u_{it} + \varepsilon_{it}$$

where:

u_{it} is the between-entity stochastic term; and

ε_{it} is the within-entity stochastic term.

After having mathematically demonstrated the models we are going to use, we will now describe the models applied with the variables previously explained and with the different extensions we have developed.

Model 1. Random effects model

$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)_{it} + \beta_2(lnCPI)_{it} + \beta_3(lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP){:}(lnM2)_{it} + u_{it} + \varepsilon_{it}$

Model 1.1. Fixed effects model

$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)_{it} + \beta_2(lnCPI)_{it} + \beta_3(lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP){:}(lnM2)_{it} + u_{it}$

Where the dependent variable $GINI_{it}$ denotes the measure of income inequality in country *i* and year *t* and is the most appropriate measure of income inequality. M2it describes the increase in the money supply which is expected to have a significant impact on the Gini index and which, depending on its sign, would mean that monetary policy has increased inequality if the sign is positive or reduced it if it is negative. The CPI_{it} measures the degree of inflation in the different countries, GDP_{it} as the increase in gross domestic product and $UNEM_{it}$ as a measure of the unemployment rate. These independent variables are expected to have a direct relationship with inequality for UNEM and CPI and an inverse relationship for GDP. In the following paragraphs we describe in detail these variables and the results obtained. We include the interaction term between the increase in money supply and gross domestic product to observe whether the effect of GDP on GINI varies for different values of M2. u_{it} is the within-entity stochastic term and ε_{it} is the between-entity stochastic term for the random effects model.

We extend model 1 by adding the dummy variable. To identify the unconventional monetary policy changes carried out by different central banks because of the Great Recession of 2008, we include a dummy variable, $Dummy_{UMP}$,which takes a value of 1 to observe central bank monetary policies that started after the 2008 crisis and 0 would denote the previous years in which central banks carried out conventional monetary policies. The new model 2.1 aims to observe how the onset of the financial crisis affected the change in direction of conventional monetary policies, moving to a long period of unconventional policies that seems to be coming to an end.

Model 2:

$$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)_{it} + \beta_2(lnCPI)_{it} + \beta_3(lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP):(lnM2)_{it} + Dummy_{UMP} + u_{it} + \varepsilon_{it}$$

With the two models above, all selected countries have been used (Eurozone countries, Japan, United States). Next, to enrich our work and our conclusions, we added extensions to the initial model with (I) the Eurozone block ONLY, (II) Japan ONLY, and (III) the United States, individually. With the addition of these extensions to our model, it may happen that the results are different if taken individually with respect to the sample as a group. This also influences when assessing the robustness of our results. The reason for adding the separate analysis of these three groups is that we could learn a lot from these results, as we will know whether these monetary policy impacts are the same in these developed economies when considered separately.

Model 2.1:

$$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)_{it} + \beta_2(lnCPI)_{it} + \beta_3(lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP):(lnM2)_{it} + Dummy_{UMP} + Dummy_{EUR} + u_{it} + \varepsilon_{it}$$

In model 2.1, we analyze how the introduction of the euro has affected the monetary policy of the euro area countries. For this purpose, we include the dummy variable of the year of the introduction of the currency, so that it would have a value of 1 for the date after 1999 and a value of 0 for the date before. In this model we are not only looking for the impact of the unconventional monetary policy, but also how the new monetary policy affected all the countries of the euro zone, since with this introduction the countries go from having an independent monetary policy to having a common monetary policy, and this could affect each country differently, since each country may need different measures depending on the situation in which it finds itself, but under the direction of the European Central Bank the measures would be the same for countries as different as Germany and Spain, for example. We also added the Dummyump variable to refer to the start of the unconventional monetary policies carried out by the European Central Bank from 2015 onwards.

Model 2.2

For the next model we take the U.S. country individually. The main difference of this new model with the previous one is the change in the regression type. To analyze in more detail the impact of monetary policy on inequality we use a linear regression model. The dependent variable remains the same (GINI) and the independent variables also remain the same (M2, CPI, GDP, UNEM). In this model we also add the interaction variable and the dummy variable but with the starting date when the Federal Reserve began to apply unconventional monetary policies, i.e., in 2009, in response to the 2008 financial crisis.

$$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)it + \beta 2(lnCPI)_{it} + \beta_3 (lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP):(lnM2)_{it} + Dummy_{UMP} + u_{it}$$

Model 2.3

For the last model in our analysis, we chose the country of Japan to analyze individually. In this model, as in the case of the United States, we use a linear regression model in which we can identify the direct relationship between the dependent variables and the independent variables. The dependent variable would remain the same (GINI) and the independent variables would also remain the same (M2, CPI, GDP, UNEM). We follow the same procedure of adding the interaction variable and the dummy variable. For this case the dummy variable starts in 2001 which is when the Central Bank of Japan starts the unconventional monetary policy.

$$(LnGINI)_{it} = \beta_0 + \beta_1(lnM2)_{it} + \beta_2(lnCPI)_{it} + \beta_3(lnGDP)_{it} + \beta_4(UNEM)_{it} + \beta_5(lnGDP):(lnM2)_{it} + Dummy_{UMP} + u_{it}$$

3.3 Data properties

For all the models used, I had to evaluate the properties of the panel data and the linear regressions. For this, the unit root test was performed to check the stationarity of my variables. The unit root test used for these data was the Im-Pesaran-Shin test. Unlike the commonly used Fisher Augmented Dickey-Fuller test for testing model stationarity, the Im-Pesaran-Shin test allows us to test for stationarity in unbalanced panel data models. For models 2.2 and 2.3 we have carried out the Fisher Augmented Dickey-Fuller test to test the stationarity of the models. The results of this unit root test for models 1 and 2 are summarized in Table 1. The test indicates that money supply M2, Gini (Gini coefficient as a measure of household income inequality), GDP are integrated of order one, I(1). For the CPI (as a proxy for inflation) and UNEM unemployment variables, it was not necessary to perform the first difference since at their original level they were already significant at 1%. Table 2 shows the same procedure performed for model 2.1 where the first difference is taken for the M2, GINI and GDP variables to get the significance of the model on the Eurozone countries.

Table 1: Unit root test for models 1 and 2		
Variables	Im–Pesaran–Shin Test	
	level	First Difference
GINI	4.4345	-2.0761**
M2	4.4345	-9.6245***
CPI	-24.457***	
GDP	5.3951	-16.795***
UNEM	7.553e-13***	

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

Table 2: Unit root test for model 2.1		
Variables	Im–Pesaran–Shin Test	
	level	First Difference
GINI	-1.1291	-18.449***
M2	4.4007	-9.6245***
CPI	-60.955***	
GDP	0.77613	-16.972***
UNEM	-7.6999***	

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

Table 3: Unit root test for model 2.2		
Variables	Augmented Dickey-Fuller Test	
	level	significant value
GINI	-1.2973	-4.4329**
M2	3.1957	-4.103**
CPI	-3.7147	0.03635**
GDP	-1.9266	-3.6447**
UNEM	-2.9515	-3.6995 **

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

For table 3 in reference to model 2.2, the following notes should be considered. For the GINI variable, two differences have been made to achieve the significant value required to achieve stationarity in our model. For the M2 variable we have made 5 differences. For the CPI variable it has not been necessary to take any difference. For the GDP and UNEM variables we have made 1 difference.

Because too many differences have been taken to make the series stationary, one might think that in this series we suffer from the problem that the errors are not normally distributed which would be a violation of our optimal estimator. To know if a variable is normally distributed it is necessary to perform the Shapiro-Wilk test. In the table 4 you can see the result of this test. As the P-value shows, the null hypothesis that my errors are normally distributed is accepted.

For the UNEM variable, we obtained the lowest significance value in the first difference (P-value=0.1993), so we cannot accept the alternative hypothesis of stationarity. We also performed the

Shapiro-Wilk normality test to check if the errors are normally distributed and this variable does not pass the normality test either (p-value = 0.0422). It is for this reason that the insignificance of this variable in the model can be explained. One of the reasons why this problem may exist is due to the size of the sample, which, not being too large, it is common to encounter these problems of non-stationarity and non-normality in the errors in time series models.

Table 4. Shapiro-Wilk normality test		
Variable	Level	P-value
M2	0.96827	0.3024

Table 5: Unit root test for model 2.3		
Variables	Augmented Dickey-Fuller Test	
	level	significant value
GINI	-2.3791	-4.1451**
M2	-2.2839	-4.5762**
CPI	-2.6104	-4.5911**
GDP	-1.4563	-4.7053**
UNEM	-1.8589	-4.1605**

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

For table 5 in reference to model 2.3, the following notes should be considered. For the GINI variable, two differences have been made to achieve the significant value required to achieve stationarity in our model. For the M2 variable we have made 2 differences. For the CPI variable we have made 2 differences. For the GDP variable we have also made 2 differences. For the variable UNEM we have made 3 differences.

To ensure that our models meet the necessary robustness conditions, the Wooldridge test was performed to check for autocorrelation in the panel data models. The null hypothesis of this test was that there was no first order serial autocorrelation in the error term. For model 2 and 2.1 we obtain that the values are significant, so we find signs of autocorrelation in our models. For models 2.2 and 2.3 we performed the Durbin-Watson test in which the null hypothesis is that there was no first order serial autocorrelation. We also found that the values are significant and that there is no autocorrelation in our models. Table 6 shows the results of these tests.

Table 6: Autocorrelation

Wooldridge Test		Durbin-Watson Test	
Models	Prob > F	Models	Level
Model 2	461.5***		
Model 2.1	338.4***		
		Model 2.2	0.99409***
		Model 2.3	1.0476***

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

In addition to performing the autocorrelation tests we must make sure that our model has no heteroscedasticity problems. For this we will use the Breusch-Pagan test for all models. For this test the null hypothesis indicates that there is homoscedasticity which is the result we are looking for. As shown in Table 7 the results of models 2.1 and 2.2 are significant so we must accept the alternative hypothesis of heteroscedasticity in our model. For models 2.2 and 2.3 there is no significance for us to reject the null hypothesis.

Table 7: Heteroskedasticity	
Breusch Pagan Test	
Models	Prob > F
Model 2	151.07***
Model 2.1	338.4***
Model 2.2	4.507
Model 2.3	5.0598

Note: ** indicates significant at 5% level and *** indicates significant at 1% level.

As we have observed with the tests performed previously, our model suffers from autocorrelation problems in all models and heteroscedasticity in two of them. To solve this problem, we use the Arellano-Bond estimator. With the Arellano-Bond estimator we convert the independent variable according to the differencing method. This produces the least amount of bias and variance in parameter estimation. With the help of this estimator, we make the standard error robust. The decision to use the Arellano bond is based on consideration of problems specific to panel data, such as heteroscedasticity (the standard errors of a controlled variable over a period are not constant) and serial correlation, which typically occurs in time series when a variable and its lagged version, i.e., Y_{it} and Y_{it-1}, are correlated with each other over periods of time.

This means that the level of a variable affects its future level as we have seen to exist in our model (Brătucu et al 2020). The above problems often arise in panel data analysis, and if not considered when choosing the appropriate estimation method, classical methods such as ordinary least squares (OLS) would lead to biased estimators. With the Arellano-Bond estimator, the independent variable is converted according to the method of differencing. This produces the least amount of bias and variance in the parameter estimation. With the help of this estimator, we make the standard error robust.

4. Results

Starting from the model developed by Torres-Reyna (2007) and Pavel (2012) we regress for the use of unbalanced panel data and its more specific extensions using linear regression models such as Ordinary Least Squares performing the necessary transformations so that the estimator is the best linear unbiased estimator. For panel data models we use fixed effects and random effects. The results can be seen in the tables below.

Table 10 shows the results of the panel data regression model with random effects for model 1. We observe that the M2 variables and the interaction variable M2 and GDP are significant in our model. This is consistent with our expectations of a strong relationship between monetary policy and inequality, but what is interesting about our results is the sign of the M2 variable, which in this model is negative, meaning that as the money supply has increased in recent years this has reduced inequality in the countries studied. Although this is not an expected result, it makes sense from an economic point of view since expansionary monetary policies have among their objectives to reduce the economic consequences of a recession and through the different tools used can help improve the economy and consequently reduce inequality.

In the case of the GDP*M2 interaction variable, we also observe that it is quite significant. This means that as the independent variable GDP increases, M2 increases on the dependent variable GINI. For the rest of the variables, we did not find significance with our dependent variable, in addition to the fact that for the CPI and UNEM variables the results do not make economic sense, i.e., the higher the levels of unemployment and inflation, the lower the inequality. On the other hand, for the GDP variable, although it is not significant either, it makes more sense economically speaking. The higher the level of GDP, the lower the inequality for the sample of selected countries.

Table 10. Model 1.				
Coefficients:	**Estimate**	**Std. Error**	**z-value**	**Pr(>|z|)**
C	-0.1651415	0.30529618	-0.5409	0.5886
log(m2)	-0.1424227	0.02277341	-6.2539	4.003e-10 ***
log(cpi)	-0.0027006	0.00210855	-1.2808	0.2003
log(nominal)	-0.0184192	0.01310759	-1.4052	0.16
Unem	-0.0008368	0.00066621	-1.2561	0.2091
log(m2)*log(nominal)	0.00510666	0.00076679	6.6598	2.743e-11 ***
p-value < 2.22e-16				
R-Squared: 0.35126				
Adj. R-Squared: 0.34616				
Chisq: 316.937 on 5 DF, p-value: < 2.22e-16				

Table 11 shows another variant of the base model (Model 1.1) of regression with panel data but in this case, we use fixed effects. This comparison serves to demonstrate that, regardless of the panel regression methods used, we obtain a comparable result. As can be seen, we obtain significance in the variables that are of special interest for our research, such as the M2 variable and the interaction variable between money supply and gross domestic product. As the rest of the variables are not sufficiently significant, we do not extend too much in describing them.

Table 11. Model 1.1				
Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
log(m2)	-0.1462845	0.02332448	-6.2717	6.725e-10 ***
log(cpi)	-0.0021508	0.00210994	-1.0194	0.3084
log(nominal)	-0.0110602	0.01449003	-0.7633	0.4456
unem	-0.0007378	0.00066448	-1.1103	0.2673
log(m2)*log(nominal)	0.00510435	0.00076577	6.6657	5.858e-11 ***
p-value < 2.22e-16				
R-Squared: 0.34671				
Adj. R-Squared: 0.31913				
F-statistic: 65.3829 on 5 and 616 DF, p-value: < 2.22e-16				

Table 12 shows the data for model 2, which is an extension of model 1 with the addition of the dummy variable "$Dummy_{UMP}$" in reference to the unconventional monetary policy implemented after the 2008 crisis. In this model we find similar results to those of model 1, but we also observe the high significance of the dummy variable in the model. In the results of this model the negative sign of the dummy variable indicates that the increases in the money supply applied after the 2008 crisis had a positive impact on the reduction of inequality as measured by the Gini index. More specifically, it can be said that a 1% increase in the money supply reduced inequality by 0.09% in the sample of countries used.

Table 12. Model 2.

Coefficients:	**Estimate**	**Std. Error**	**z-value**	**Pr(>|z|)**
C	-0.11827699	0.30350171	-0.3897	0.696753
log(m2)	-0.13592997	0.02275226	-5.9744	2.310e-09 ***
log(cpi)	-0.00354285	0.00211757	-1.6731	0.094313.
log(nominal)	-0.02501443	0.01316961	-1.8994	0.057511.
unem	-0.00043376	0.00067823	-0.6395	0.522469
$Dummy_{UMP}$	-0.00096632	0.00033583	-2.8774	0.004009 **
log(m2)*log(nominal)	0.00520758	0.00076406	6.8157	9.381e-12 ***
p-value < 2.22e-16				
R-Squared: 0.35992				
Adj. R-Squared: 0.35388				
Chisq: 327.643 on 6 DF, p-value: < 2.22e-16				

One of the reasons why we wanted to make extensions of model 2 to other more specific models is because in this way we could find differences between the models for the countries analyzed as a whole and the countries analyzed individually, as we have argued above. Table 13 shows the results of model 2.1 estimated for the Eurozone countries with the addition of the dummy variables which in this case are called "DummyEUR" in reference to the date of creation of the new monetary organization and the time when the countries started to have a common monetary policy and "DummyUMP" the year when the European Central Bank started its unconventional monetary policy. An unbalanced panel data model with random effects is used. For the choice of the type of panel data model, the Hausman test was performed. The results show a P-value greater than 0.05, which means that we accept the null hypothesis that the model is consistent with the use of random effects. The results of this test are shown in the appendix.

As can be seen, the money supply variable has a negative sign and is significant, which can be interpreted as meaning that the money supply carried out by the European countries before the creation of the common currency had a positive impact on the reduction of inequality, however when we look at the result of the dummy variable we see that it has a positive sign and is also highly significant, this means that the common monetary policy has had a negative impact on the inequality of the Eurozone countries as a whole after 1999. More specifically, it can be said that a 1% increase in the money supply increased inequality by 0.27%. One of the explanations for these results is that, when the monetary union was created, all countries were forced to follow the same monetary policies regardless of their economic situation.

This does not seem a very good idea if we take into account the great economic differences between the countries that make up the Euro Zone, for example between Germany and Spain, where if in Germany there is a punctual rise in inflation this forces the European Central Bank to raise interest rates and for countries such as Spain, Portugal, Italy or Greece a rise in these interest rates could cause a slowdown in the economy. However, before the creation of the monetary union, countries with an independent monetary policy could use the tools of each country's national central bank to deal with different economic situations.

Another significant result of the model is that unconventional monetary policy implemented from 2015 onwards has had a positive outcome on inequality. These results are consistent with previously reviewed literature as concluded by Michele & Slacalek (2018).

For our model the presence of the interaction variable indicates that the effect of the GDP variable on the GINI variable is different at different values of M2 is also significant, which is consistent with previously analyzed models.

Table 13. Model 2.1				
Coefficients:	**Estimate**	**Std. Error**	**z-value**	**Pr(>|z|)**
C	-0.55907863	0.29988418	-1.8643	0.06228.
log(m2)	-0.11557111	0.02229727	-5.1832	2.181e-07 ***
log(cpi)	-0.00113105	0.00204443	-0.5532	0.5801
log(nominal)	0.00396918	0.0130582	0.304	0.76116
unem	-0.00042733	0.0006447	-0.6628	0.50743
$Dummy_{EUR}$	0.00274215	0.00039203	6.9948	2.657e-12 ***
$Dummy_{UMP}$	-0.00084345	0.00041283	-2.0431	0.0410438 *
log(m2)*log(nominal)	0.00348048	0.00077474	4.4925	7.041e-06 ***
R-Squared: 0.39726				
Adj. R-Squared: 0.39157				
Chisq: 390.414 on 6 DF, p-value: < 2.22e-16				

Table 15 shows the result of model 2.2 for the case of the United States. For this case we have chosen to run a linear regression model to observe more precisely the behavior of the different variables when dealing with a single country over the selected time. The results of the model show that again, the money supply variable has a quite significant and positive result, which means that the monetary policies carried out by the Federal Reserve since 1980, which is the first year of the selected period, have had a negative impact on inequality. This is shown in accordance with the data provided by the World Bank for inequality measured by the Gini index for the United States since 1986 where the Gini index was 37.4% and went to 41.5% in 2019 (World Bank, GINI Index for the United States, 2022).

Another result that also appears as significant in the table is that of GDP growth, with a positive result. One explanation for this result is that although the US is the first country by GDP measurement, it is not among the most egalitarian countries in terms of income level since it has the same Gini index as countries like the Ivory Coast (41.5%) despite the large economic differences that exist between countries. Another significant variable in this model is the dummy variable that observes the behavior of monetary policy after 2008, "$Dummy_{UMP}$", which is when the Federal Reserve began its unconventional monetary policy. It is observed that it has a positive and significant result indicating that the monetary policies carried out have not managed to reduce income inequality. Finally, if we analyze the interaction variable between GDP and M2, we observe that if we take these two variables as an independent variable, the impact has been positive in reducing inequality.

Table 15. Model 2.2				
Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
C	-23.896090	3.788440	-6.308	3.91e-07 ***
log(m2)	22.730265	4.722597	4.813	3.20e-05 ***
log(cpi)	-0.001253	0.002462	-0.509	0.61414
log(nominal)	0.799823	0.122659	6.521	2.10e-07 ***
unem	-0.001048	0.001015	-1.033	0.30924
$Dummy_{UMP}$	0.010952	0.003170	3.455	0.00153 **
log(m2)*log(nominal)	-0.783590	0.150710	-5.199	1.02e-05 ***
Multiple R-squared: 0.9878				
Adjusted R-squared: 0.9856				
F-statistic: 446.6 on 6 and 33 DF, p-value: < 2.2e-16				

For our last model (model 2.3) we analyze the case of Japan. In Table 16, the results are similar to those of the U.S. case. The M2 variable has a significant and positive impact, which is consistent with the results analyzed above. In the case of the GDP variable, since it has a negative impact on inequality, the reasoning can be drawn that any increase that Japan has had in GDP has not had a positive transfer in the reduction of inequality. For the dummy variable, $Dummy_{UMP}$ for the unconventional monetary policy initiated in 2001, it is observed that it has had negative results that have affected inequality. Finally, the interaction variable has had positive effects on the reduction of inequality in Japan.

Table 16. Model 2.3

Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
C	-4.06E+01	1.04E+01	-3.926	0.000837 ***
log(m2)	2.31E+00	5.92E-01	3.905	0.000878 ***
log(cpi)	8.76E-05	4.58E-03	0.019	0.984912
log(nominal)	1.39E+00	3.77E-01	3.701	0.001415 **
unem	6.61E-03	8.47E-03	0.78	0.444693
$Dummy_{UMP}$	7.12E-03	3.29E-03	2.164	0.042737 *
log(m2)*log(nominal)	-8.07E-02	2.08E-02	-3.876	0.000941 ***
p-value: < 2.2e-16				
Multiple R-squared: 0.8991				
Adjusted R-squared: 0.8688				
F-statistic: 29.69 on 6 and 20 DF, p-value: 5.971e-09				

5. Policy Implications

As we have seen throughout the paper, monetary policy has a significant impact on inequality over the business cycle through changes in interest rates and asset prices. Although it is also true that the tools used by banks help stabilize the economy when recessions occur and there is high unemployment or when the economy undergoes periods of overheating that can turn into periods of high inflation rates. In the cases we have observed where monetary policy has helped to reduce inequality through ultra-expansionary central bank policies, it can help us to understand that these monetary policies can help the lower percentiles of society on the one hand by increasing consumption, since the marginal propensity to consume is higher in the lower strata of society, which in turn can lead to higher economic activity and thus higher job creation, which is the goal of central banks when they conduct these types of policies (Michele & Slacalek, 2018).

Even if the effect of monetary policy on inequality is negligible or positive, it should be monitored because it risks contributing to financial crises through the relative consumption effect. Another positive effect of this type of policy is that, due to low interest rates, the middle and lower classes benefit because this reduction in rates increases the wealth of these classes through the housing channel and makes it more accessible and incentivizes borrowing that individuals may need to deal with defaults. From a policy perspective, these results highlight the importance of the impact of monetary policy on financial and housing markets. On the other hand, we have observed through the literature review and our work that in some cases the excessive prolongation of this type of quantitative easing monetary policy may not achieve the initially desired effects by increasing inequality levels (Domanski, Scatigna, and Zabai, 2016).

This is because when interest rates are close to the zero lower bound, wealth inequality has a greater impact on the transmission channels of monetary policy than income inequality, as monetary policy can change asset prices to a greater extent than interest rates. Moreover, when central banks started to implement QE, with the purchase of assets and long-term bonds from banks and private entities, the money injected was not reflected in the real economy, but caused an artificial increase in stock prices and a bubble in the bond market, as the price of these bonds continued to rise. This situation causes an increase in the wealth and income of the highest percentiles, who have the most financial wealth due to the increase in the value of these assets, in turn causing inequality between social classes to become greater and greater (Ayako and Frost, 2014).

The complexity of the mechanisms linking monetary policy and inequality is evident, as there are several channels that work in opposite directions and lead to an uncertain net effect. The objective of central banks is to fulfill their mandate to achieve price stability, thus providing broad benefits to the economy. In addition, other types of policies seem to be more appropriate to address inequality problems more effectively, such as fiscal or incomes policy, progressive taxation, social welfare and equitable access to education Rawdanowicz, O'Farrell and Inaba, 2016). However, more recent research indicates that monetary policies can also have important distributional effects and should be taken into account when designing these policies appropriately (Auclert, 2018).

6. Conclusion

The results of this paper show that the effects of monetary policy conducted by central banks after the Great Financial Crisis on income inequality as measured by the Gini index through non-conventional tools have a significant impact on the sample of countries used. The differences between countries when analyzed jointly and separately yield different results. For the set of countries used in the panel data regression model with both fixed and random effects, the M2 variable and the interaction variable between GDP and M2 are significant. The M2 variable manages to reduce inequality, but the interaction variable tells us the opposite, having a negative effect on inequality. When we introduce the dummy variable to know how the change in monetary policy after 2008 affected the panel data model, we observe its significance and its positive result in the reduction of inequality.

In the case of Japan and the United States, we observe that the effects of these measures have not had the desired impact on inequality since the respective central banks initiated unconventional monetary policies, these results are consistent with the previously analyzed literature (Saiki &Frost, 2014). When we analyze the case of the Euro Zone countries, we observe that the monetary policy carried out after the creation of the monetary system also had negative effects on inequality, as explained throughout the paper. For the other models, when we estimate the impact of the money supply variable for all countries, it has a positive effect on inequality. As we can observe the results vary according to the conditions of each model, and this is due to the different channels through which monetary policy influences households.

Cross-country differences in the size and distribution of income and net wealth components explain the contrasting effects on income inequality. An increase in house prices typically reduces net wealth inequality, while the opposite is true for increases in stock and bond prices. The difference with the introduction of these new unconventional measures with those used by central banks in the past is that by buying bonds and assets from private entities the portfolio effect may be larger than the housing effect thus increasing total inequality. This is why one would expect greater effects on income inequality if the employment effects are taken into account. As a final note to this work, after previous research on the effect of monetary policy on the economy and on inequality and obtaining such different results, we note the complexity of this type of study and how the impact of a policy cannot be clearly concluded since there are many factors in an economy and a country that can lead to totally different results.

That is why I believe that the best way to conclude this paper is with a quote from Ben S. Bernanke, Former Chair of the Federal Reserve of the United States: "The degree of inequality we see today is primarily the result of deep structural changes in our economy that have taken place over many years, including globalization, technological progress, demographic trends, and institutional change in the labor market and elsewhere. By comparison to the influence of these long-term factors, the effects of monetary policy on inequality are almost certainly modest and transient." That is why these aspects on the interaction of variables beyond the economic ones are left for future research.

6. Appendix

Table 8. Arellano–Bond estimator for model 2.2				
Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
C	-1.07E+01	1.75E+00	-6.1003	6.385e-07 ***
log(m2)	6.59E-01	2.13E-01	3.0881	0.003995 **
log(cpi)	-3.14E-03	2.23E-03	-1.4091	0.167891
log(nominal)	3.33E-01	5.30E-02	6.2858	3.674e-07 ***
unem	2.95E-04	1.05E-03	0.2805	0.780813
log(m2)*log(nominal)	-2.18E-02	6.53E-03	-3.336	0.002065 **

Table 9 . Arellano–Bond estimator for model 2.3				
Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
C	-30.083958	12.1197813	-2.4822	0.02159 *
log(m2)	2.017568	0.7632601	2.6434	0.01520 *
log(cpi)	-0.0018693	0.0057272	-0.3264	0.74736
log(nominal)	0.9254066	0.4083756	2.2661	0.03414 *
unem	0.0132072	0.0084471	1.5635	0.13288
log(m2)*log(nominal)	-0.0646659	0.0257452	-2.5118	0.02026 *

Table 14 : Hausman Test	
p-value	0.0665

Table 17. GINI Descriptive Statistics Table

Descriptive Statistics: GINI								
GINI	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum	Sum	Count
Japan	0.51913085	0.00431349	0.52699364	0.02795463	0.47041072	0.55934935	21.8034955	42
United States	0.54569993	0.00534464	0.55038826	0.0346372	0.47001087	0.58865607	22.9193973	42
Austria	0.43678251	0.00201127	0.43511927	0.01303451	0.4097992	0.47433435	18.3448656	42
Belgium	0.44367003	0.00124756	0.44556214	0.00808509	0.42841098	0.4611162	18.6341414	42
Estonia	0.48060414	0.01048561	0.49629723	0.06795454	0.36680016	0.56928954	20.1853737	42
Finland	0.41512993	0.00410267	0.42534444	0.02658831	0.35916486	0.4465784	17.4354571	42
France	0.43696091	0.00148916	0.44078851	0.00965086	0.41524525	0.45255275	18.3523581	42
Germany	0.446718	0.00547678	0.43726076	0.03549361	0.39405633	0.49933907	18.7621561	42
Greece	0.48264618	0.00397847	0.48092357	0.0257834	0.4448973	0.54249257	20.2711394	42
Ireland	0.44473275	0.00312281	0.44525443	0.0202381	0.41080609	0.48061436	18.6787757	42
Italy	0.40900692	0.00506388	0.4247833	0.0328177	0.341435	0.44964448	17.1782907	42
Latvia	0.44575025	0.01070379	0.48158432	0.06936848	0.33881485	0.52768519	18.7215105	42
Lithuania	0.44727381	0.00794807	0.45915312	0.05150941	0.36532806	0.53043672	18.7855	42
Luxembourg	0.46409961	0.00254243	0.45770154	0.01647682	0.44134284	0.50566278	19.4921837	42
Malta	0.42517513	0.00249466	0.41450309	0.01616727	0.41450309	0.46169191	17.8573553	42
Netherlands	0.39116767	0.00288557	0.39034946	0.01870063	0.35431573	0.42345467	16.4290422	42
Portugal	0.47789685	0.00388877	0.48726919	0.02520213	0.41015937	0.51438295	20.0716677	42
Slovakia	0.36946572	0.00560009	0.37632724	0.03629275	0.30502392	0.41976	15.5175602	42
Slovenia	0.38154274	0.00614541	0.40387357	0.03982681	0.32342537	0.41968966	16.0247952	42
Spain	0.46287121	0.00144038	0.46041167	0.00933474	0.45067337	0.48903601	19.440591	42

Table 18. M2 Descriptive Statistics Table

Descriptive Statistics: M2								
M2	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum	Sum	Count
Japan	82961945.6	7803521.23	67698219.2	50572597.6	10606331.1	164894260	3484401714	42
United States	80117.8881	8712.48579	59964.2	56463.3612	18484.2	246839.2	3364951.3	42
Austria	3427497.22	270793.636	3919641.16	1326612.47	1397062.52	5750298.74	82259933.4	24
Belgium	453307.632	33317.9338	516381.13	166589.669	200688.157	737053.277	11332690.8	25
Estonia	107817.664	16502.8756	119922.513	88870.7047	4174.65252	330831.521	3126712.25	29
Finland	1116656.78	107837.114	815963.139	698864.376	235368.243	2680460.31	46899584.6	42
France	14355361.8	1524691.03	8721123.99	9881127.18	3673671.05	39609985.7	602925196	42
Germany	19639738.5	2211226.16	16202851	14330383.3	2131539.67	50119428	824869018	42
Greece	2642865.21	188653.303	2647195.04	864518.042	1046027.13	4273436.01	55500169.4	21
Ireland	2551644.16	199002.541	2753574.57	954382.661	918784.605	4398865.18	58687815.6	23
Italy	12287740.3	1264668.65	7854292.3	8195989.61	2863603.37	29830720.8	516085092	42
Latvia	151781.675	11380.1088	151582.581	48281.7128	55776.4588	256415.881	2732070.14	18
Lithuania	181501.143	28726.0857	194071.939	152004.158	10477.4622	576641.618	5082032.02	28
Luxembourg	3084651.61	200036.878	3250181.48	959343.166	1570536.9	5203478.6	70946987	23
Malta	139005.017	15843.4908	120304.958	86778.373	38327.7174	337581.085	4170150.51	30
Netherlands	6091180.56	686726.892	3950007.91	4397197.61	549354.127	13044122.2	249738403	41
Portugal	1448678.12	151458.788	1287296.8	981565.132	176778.244	3499680.6	60844481.2	42
Slovakia	596004.245	59821.9777	642109.422	274138.741	149014.932	1103150.04	12516089.1	21
Slovenia	270174.691	27953.129	323561.099	147914.055	51846.3759	562638.106	7564891.35	28
Spain	7875301.42	1020639.04	4381047.52	6614496.98	714400.713	19886222.1	330762660	42

Table 19. UNEM descriptive statistics table

Descriptive Statistics: UNEMPLOYMENT								
UN	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum	Sum	Count
Japan	3.82571429	0.17907169	3.715	1.16051722	0.9	6.23	160.68	42
United States	3.40811905	0.15988703	3.129	1.03618638	2.017	5.358	143.141	42
Austria	4.43980952	0.18881069	4.575	1.22363314	1.6	6.467	186.472	42
Belgium	8.2272381	0.22603116	8.3085	1.46484933	5.375	11.5	345.544	42
Estonia	8.93172414	0.58930556	8.628	3.17350758	4.448	16.707	259.02	29
Finland	8.48142857	0.49003337	8.1125	3.17577923	3.108	16.7	356.22	42
France	9.05971429	0.1638994	8.8835	1.06218948	6.349	10.892	380.508	42
Germany	6.96747619	0.32754704	7.6885	2.12274745	3.15	11.008	292.634	42
Greece	12.1006429	0.96417581	10	6.24857339	2.663	27.475	508.227	42
Ireland	10.8552432	0.87403211	9.925	5.31652978	4.175	19	401.644	37
Italy	9.41221429	0.25414012	9.204	1.6470162	6.208	12.808	395.313	42
Latvia	11.0435	0.78344086	10.4485	4.2910823	3.178	20.711	331.305	30
Lithuania	10.6018696	0.86231041	10.699	4.13549544	4.248	17.814	243.843	23
Luxembourg	3.51054762	0.29697518	3.149	1.92461915	0.723	7.07	147.443	42
Malta	6.45971795	0.36131686	6.2	2.25642307	3.6	12.5	251.929	39
Netherlands	5.39007143	0.21675739	5.063	1.40474845	3.137	8.254	226.383	42
Portugal	8.20411905	0.48316079	7.667	3.13123982	3.86	17.092	344.573	42
Slovakia	12.941	0.71901695	13.183	3.87202477	5.758	19.458	375.289	29
Slovenia	6.9218	0.28350669	6.817	1.55283008	4.392	10.175	207.654	30
Spain	17.2164048	0.73761967	17.2325	4.78032182	8.233	26.095	723.089	42

Table 20. GDP Descriptive Statistics table

Descriptive Statistics: GDP								
GDP	Mean	Standard Error	Median	Standard Deviation	Min	Max	Sum	Count
Japan	3.3894E+12	2.7103E+11	4.3747E+12	1.9355E+12	2.1261E+11	6.2724E+12	1.7286E+14	51
United States	9.0397E+12	8.7457E+11	7.6397E+12	6.2457E+12	1.0733E+12	2.1433E+13	4.6103E+14	51
Austria	2.1652E+11	2.0722E+10	1.9734E+11	1.4799E+11	1.5373E+10	4.5495E+11	1.1042E+13	51
Belgium	2.6549E+11	2.4361E+10	2.3654E+11	1.7397E+11	2.6706E+10	5.4301E+11	1.354E+13	51
Estonia	1.7237E+10	1837156811	1.9578E+10	9367698431	4502970889	3.1046E+10	4.4816E+11	26
Finland	1.3839E+11	1.276E+10	1.2777E+11	9.1128E+10	1.1358E+10	2.8455E+11	7.0578E+12	51
France	1.4786E+12	1.2877E+11	1.394E+12	9.1958E+11	1.4846E+11	2.9184E+12	7.5407E+13	51
Germany	2.0523E+12	1.7283E+11	2.0713E+12	1.2342E+12	2.1584E+11	3.9753E+12	1.0467E+14	51
Greece	1.3739E+11	1.3294E+10	1.3013E+11	9.4935E+10	1.314E+10	3.5446E+11	7.007E+12	51
Ireland	1.2309E+11	1.7103E+10	6.914E+10	1.2214E+11	4395995086	4.2589E+11	6.2776E+12	51
Italy	1.1826E+12	1.025E+11	1.1812E+12	7.3202E+11	1.134E+11	2.3989E+12	6.0311E+13	51
Latvia	2.1011E+10	2143097614	2.5184E+10	1.0928E+10	5789128637	3.5854E+10	5.4628E+11	26
Lithuania	3.1726E+10	3295864676	3.7258E+10	1.6806E+10	7867140395	5.6547E+10	8.2487E+11	26
Luxembourg	2.6738E+10	3424111800	1.9564E+10	2.4453E+10	1457768455	7.3353E+10	1.3637E+12	51
Malta	4844065479	621520081	3720400535	4438541174	250721822	1.5216E+10	2.4705E+11	51
Netherlands	4.5005E+11	4.2811E+10	4.1644E+11	3.0573E+11	3.8165E+10	9.48E+11	2.2953E+13	51
Portugal	1.177E+11	1.2149E+10	1.1702E+11	8.676E+10	8108235704	2.6234E+11	6.0025E+12	51
Slovakia	6.1383E+10	6271561364	6.2785E+10	3.4919E+10	1.2747E+10	1.0556E+11	1.9029E+12	31
Slovenia	3.883E+10	2582923525	4.3913E+10	1.317E+10	2.029E+10	5.5553E+10	1.0096E+12	26
Spain	6.8939E+11	7.188E+10	5.9688E+11	5.1333E+11	4.0993E+10	1.6252E+12	3.5159E+13	51

Table 21. CPI Descriptive Statistics table

Descriptive Statistics: CPI								
CPI	Mean	Standard Error	Median	Standard Deviation	Min	Max	Sum	Count
Japan	2.53931918	0.60524477	0.79527963	4.32231219	-1.3341367	23.2115842	129.505278	51
United States	3.94374513	0.40542281	3.15684157	2.89529795	-0.3555463	13.549202	201.131002	51
Austria	3.20213863	0.29961015	2.48567562	2.13964445	0.50630883	9.5217882	163.30907	51
Belgium	3.56366595	0.40996964	2.46925823	2.92776885	-0.0531457	12.7681986	181.746963	51
Estonia	9.90745364	3.54201782	3.75265629	18.7425966	-0.492326	89.811949	277.408702	28
Finland	4.44529639	0.62993356	2.80833623	4.49862543	-0.2079288	17.8113972	226.710116	51
France	4.11733503	0.56245513	2.11159795	4.01673305	0.03751438	13.6493175	209.984087	51
Germany	2.60946836	0.26198146	2.00849092	1.87092185	-0.1294128	7.03202572	133.082887	51
Greece	9.1376833	1.15864144	4.76622186	8.27435491	-1.7360368	26.5608344	466.021848	51
Ireland	5.50779128	0.84331516	3.3173213	6.02247484	-4.4781034	20.8758503	280.897355	51
Italy	6.09709209	0.82750949	4.05184218	5.9095998	-0.1377076	21.0641683	310.951696	51
Latvia	42.3492279	32.7038842	2.94264753	176.115807	-1.084636	951.696195	1228.12761	29
Lithuania	56.2799029	37.2391359	2.69792779	200.538884	-1.1343085	1020.62057	1632.11719	29
Luxembourg	3.43905845	0.38339105	2.66382111	2.73795971	-0.0566629	10.7176711	175.391981	51
Malta	3.15198077	0.44278683	2.36959288	3.16213049	-0.8809976	15.7472541	160.751019	51
Netherlands	3.17931194	0.35827671	2.45408986	2.55860751	-0.6912031	10.2174805	162.144909	51
Portugal	8.82351459	1.20296987	4.36990331	8.59092324	-0.83553	31.0167491	449.999244	51
Slovakia	5.43922902	0.95081776	3.91928599	5.12031036	-0.5200102	23.2870277	157.737642	29
Slovenia	74.7704569	34.5523062	7.68597227	218.527972	-0.5255523	1281.44349	2990.81827	40
Spain	6.47453676	0.8327766	4.56907088	5.94721446	-0.5004613	24.5380634	330.201375	51

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