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## MONETARY POLICY AND INCOME DISTRIBUTION: EMPIRICAL EVIDENCE FOR THE EU-15

### *POLÍTICA MONETARIA Y DISTRIBUCIÓN DEL INGRESO: EVIDENCIA EMPÍRICA PARA LA UE-15*

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#### ABSTRACT

This paper presents an empirical research on how monetary policy can affect income distribution. After describing the channels through which monetary policy may have an impact on income distribution, we perform a panel analysis of 15 EU (European Union) countries covering the period 1995-2014. The results provide evidence of a significant positive relationship between real interest rates and income inequality measured as the Gini coefficient. However, this relationship only becomes significant in the medium term but not in the short term. Our findings call for greater attention by central bankers to the redistributive effects of monetary policy.

*Keywords:* Gini coefficient; income inequality; monetary policy; panel data analysis; policy effects; real interest rates.

## RESUMEN

Este artículo presenta una investigación empírica sobre cómo la política monetaria puede afectar a la distribución del ingreso. Tras describir los canales a través de los cuales la política monetaria puede tener un impacto en la distribución de la renta, se realiza un análisis para un panel de 15 países de la UE (Unión Europea) que abarca el período 1995-2014. Los resultados evidencian una relación positiva significativa entre los tipos de interés reales y la desigualdad de ingresos medida como el coeficiente de Gini. Sin embargo, esta relación sólo es significativa a medio plazo, pero no a corto plazo. Nuestros resultados plantean que los bancos centrales tengan en consideración los efectos redistributivos de la política monetaria.

*Palabras clave:* coeficiente de Gini; desigualdad de ingresos; política monetaria; análisis de datos panel; tipos de interés reales.

*Clasificación JEL / JEL classification:* D31; E58.



## 1. INTRODUCTION<sup>1</sup>

According to several reports from the Organization for Economic Cooperation and Development (OECD), the gap between the highest and lowest income groups in OECD member countries has been growing steadily for more than three decades, a trend that has accelerated since 2008, after the outbreak of the global financial crisis (OECD, 2009, 2012, 2013, 2014a, b, and c).

The worsening of this problem has converted it into one of the most debated issues in the economic literature of recent years, and it has been frequently associated with the increase in the “skill premium” that separates skilled and unskilled workers –a factor that, combined with other processes related to the economic and financial globalization, has led high-skilled workers to benefit from the opportunities derived from the global market, while low-skilled workers are forced to compete internationally for ever lower-paying jobs with less bargaining power.

Thus, most studies on the causes of increasing inequality have focused on the following factors: globalization (Wood, 1995; Feenstra and Hanson, 2001; Meschi and Vivarelli, 2009; Bergh and Nilsson, 2010; Jaumotte et al., 2013; Asteriou et al., 2014); technological change, giving special attention to the impact of information and communication technologies (ICTs), and its relation with the educational level of the population (Bound and Johnson, 1992; Katz and Murphy, 1992; Acemoglu, 1998; Krusell et al., 2000; Card and DiNardo, 2002); the change of social norms on wage inequality (Piketty and Saez, 2006; Atkinson, 2008; Bakija et al., 2012); the growth of the financial sector (Beck et al., 2007; Jaumotte et al., 2013; Lin and Tomaskovic-Devey, 2013; Van Arnum and Naples, 2013; Denk and Cournède, 2015); the loss of the political and social status of trade unions (DiNardo et al., 1996; Acemoglu et al., 2001; Card, 2001); and the effect of redistributive fiscal policies (Alesina and Perotti, 1996; Bastagli, 2012; Joumard et al., 2012).

Similarly, much research has been carried out in order to analyze the effects of inequality on economic growth (Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Barro, 2000; Forbes, 2000; Piketty and Saez, 2006), household debt levels (Lacovello, 2008; Barba and Pivetti, 2009; Rajan, 2011;

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Paz-Pardo and Sánchez-Santos, 2014), socio-political stability and social cohesion (Alesina and Perotti, 1996; Kawachi and Kennedy, 1997; Putnam, 2000; Stiglitz, 2012), crime and violence (Neapolitan, 1999; Daly et al., 2000; Fajnzylber et al., 2002), or life expectancy (Wilkinson, 1997; Kawachi and Kennedy, 1999; Lynch et al., 2000).

However, after the outbreak of the global financial crisis started in 2008, a factor that had traditionally stayed in the background began to attract researchers' attention: monetary policy. Although the channels through which this policy may affect income and wealth distribution may seem less intuitive at first glance than those of the factors mentioned above, their influence on the evolution of inequality cannot not be ignored.

Accordingly, some recent studies (Saiki and Frost, 2014; Bivens, 2015; Doepke et al., 2015; Cloyne and Hürtgen, 2016; Domanski et al., 2016; Auclert, 2017; Coibion et al., 2017; Mumtaz and Theophilopoulou, 2017; Furceri et al., 2018) and monetary policy-makers (Coeuré, 2012; Bullard, 2014; Yellen, 2014; Panetta, 2015; Draghi, 2016) have emphasized the importance of the effects that monetary policy can have on income and wealth distribution. All this highlights the undeniable interest of the study of this matter.

Nevertheless, before attempting to quantify the effects that monetary policy can have on inequality, it is necessary to examine the channels through which these effects can be transmitted. Coibion et al. (2017) suggest the following five channels. First, the *income composition channel*: the diverse composition of the incomes of the different groups of households according to their source will cause that, if the effects of monetary policy on labor and capital income are not the same, the monetary policies may impinge on income inequality. Second, the *financial segmentation channel*: if some agents trade in financial markets more frequently and are more rapidly affected by changes in the money supply, some monetary policies may redistribute wealth for their benefit. Therefore, these policies would not only have a clear impact on income inequality but also on consumption inequality. Third, the *portfolio channel*: it works in the same way as the income composition channel but for the portfolio of real and financial assets held by households. It may affect wealth distribution instead of income distribution. Fourth, the *savings redistribution channel*: an unexpected increase in interest rates or a drop in inflation will benefit savers and harm debtors. Considering that households with higher income levels tend to act as lenders for those at the other end of the distribution, monetary policies that could cause such consequences will increase the gap between both groups. Finally, we have the *earnings heterogeneity channel*: labor earnings are the main source of income for most households and this type of income will respond differently to monetary policies depending on the position of each household in the income distribution. The greater pro-cyclicality of employment and wages for low-income households –which are also the most dependent on wages as a source of income– will lead to an unequal transmission of the effects of monetary policy to the different income groups.

Hence, the fact that the same monetary policy can cause –through the aforementioned five channels– effects of different magnitude and opposite direction on income, wealth and consumption inequality makes the net impact on these variables uncertain a priori. For these reasons, the purpose of this paper is to assess empirically the link between monetary policy and income distribution for the EU-15 countries throughout the period 1995-2014. In so far as the aforementioned channels, from a theoretical perspective, do not provide any conclusive prediction, it is necessary to assess the relationship between monetary policy and inequality through data analysis.

One of the most controversial issues related to the unconventional monetary policies implemented by some of the world's main monetary authorities in response to the last financial crisis is their potential influence on income and wealth inequality. This proves how relevant is the topic we address in this paper. In fact, providing evidence about this influence becomes especially important, mainly due to the agreement of a number of democratic societies to delegate in non-elected central bankers the implementation of monetary policy and, particularly, the power of setting interest rates. Within such a framework, central banks must improve their understanding of how monetary policy can affect income distribution and particularly the association between monetary stability and inequality.

This paper is organized as follows. In section 2, we present the dependent and independent variables included in our model, the justification of their inclusion and their main descriptive statistics. In section 3, we present and justify the econometric methods used, and we also show the results of our analysis. In section 4, we discuss the main results derived from the econometric analysis and their implications. Finally, section 5 summarizes the conclusions of our paper.

## 2. VARIABLES

Starting from a survey of the literature, in this section we present the variables selected for studying the effects of monetary policy on income inequality. At the end of this section, we include a table with the main descriptive statistics, as well as the data sources.

As for the dependent variables, we use the following two: The Gini coefficient of equalized disposable income (GINI) and the Gini coefficient of equalized disposable income before social transfers (including pensions) (MARKETGINI) as a proxy of net income inequality and market income inequality, respectively.

Despite its limitations (Atkinson, 1970; De Maio, 2007; Palma, 2011; Martín-Legendre, 2018), the Gini coefficient is the most used measure to quantify inequality in a population, because it allows to summarize in a number between 0 and 100 the way a certain variable (income, wealth, consumption, etc.) is distributed among all the members of such population.

The measure of inequality is nonetheless a very complex task, which means there is no single indicator that can cover all the inequality dimensions. Consequently, in order to make the results as consistent as possible and to ensure more sensitivity to changes at the ends of the distribution, two additional dependent variables were included in the model: on the one hand, the Palma ratio (PALMA), which is defined as the ratio of the richest 10% of the population's share of gross national income, divided by the poorest 40% of the population's share; on the other hand, the S80/S20 ratio (S80S20), which is defined as the ratio of the richest 20% of the population's share of gross national income, divided by the poorest 20% of the population's share.

We decided to include these last two measures to correct the relative "insensitivity" of the Gini coefficients to changes at the ends of the distribution, which are the most volatile segments, although it is also worth mentioning that this second set of variables does not adequately measure income inequality—they measure income polarization—since they exclude 50% and 60% of the population in their calculation, respectively.

Regarding the independent variables, we considered appropriate to include the following ones, which are discussed below: monetary policy, growth of financial sector, trade openness, technological change, redistributive policies, tertiary education, sectoral structure of employment, trade union influence—and the lack of thereof—, aging of the population, and structural unemployment—these last three explanatory variables do not appear in previous models to explain the behavior of income inequality; the justification for their inclusion is detailed afterwards.

*Monetary policy:* To proxy this variable, we use the real interest rates calculated as the nominal interest rate of the interbank market at 12 months minus the domestic consumer price index (YRIR). However, considering that monetary policy impulses are transmitted with a certain delay to the real economy and, ultimately, the income distribution, we include both the level variable (YRIR) and its first lag (L1\_YRIR).

These variables have been widely used in the literature as a proxy for monetary policy (Fazzari, 1993; Passamani and Tamborini, 2007; Dickens, 2016). Real interest rates—which can be defined either *ex-ante* or *ex-post*—are a relevant indicator to assess the looseness of monetary conditions. On the one hand, the *ex-ante* interest rates try to measure the yield or the expected actual cost over the time-horizon of an active or passive transaction. On the other hand, the *ex-post* interest rates refer to the actual cost or yield finally obtained when the operations have expired. In terms of spending decisions, the main thing is the *ex-ante* rate, although usually it is not observable. For this reason, the most common approach is to subtract from the nominal interest rate an expected inflation measure over the time-horizon of the instrument, which can be approximated by means of different procedures—moving averages of observed inflation rates, statistical or econometric methods based on the analysis of time series or on multivariate behavioral relations, or analysts'

expectations, such as those published by *Consensus Economics* (Research Service of the Bank of Spain, 2005).

For short terms, the different approaches often produce similar results. For longer terms, however, there will be more uncertainty in determining the level and evolution of real interest rates. In this case, another alternative indicator used sometimes is the yield of inflation-indexed bonds. In the Eurozone, since 1999 a growing number of sovereign issuers are being financed by these instruments. Anyway, this last indicator is not without its problems. On the one hand, the possible existence of an illiquidity premium, given the low liquidity of these instruments, could bias the level of real interest rates upwards. On the other hand, the asymmetric compensation of inflation in these products will tend to introduce a downward bias.

As a final point, it should be noted that, after the introduction of the euro in 1999, twelve out of fifteen countries included in the sample transferred their sovereignty in monetary policy matters to the European Central Bank. But in spite of the common monetary policy implemented by the ECB, the real interest rates of each Eurozone country evolved differently as a result of the unequal inflation levels faced by every country in the sample.

*Growth of financial sector:* The growth of financial services could have had an impact on the income distribution through several channels. On the one hand, widespread access to financial services may have reduced inequality by favoring a better allocation of resources that allows individuals to plan for the long term, and better adapt to short-term shocks. However, most wealthy people own a high proportion of financial assets, which implies they become much more favored than the rest of the population by the growth of the financial sector (Van Arnum and Naples, 2013). In addition, this increase in income inequality could be amplified by the growth in size of the financial sector – an increasingly skill-intensive sector –, widening the gap between skilled and unskilled workers (Philippon and Reshef, 2007).

As a proxy for the access to financial services –or “financial deepening”– we use the domestic credit to the private sector measured as a share of gross domestic product: CREDIT (Dabla-Norris et al., 2014). It should be noted that in another context, if we were talking about developing or Third World countries, the appropriate variable would be, e.g., the percentage of adults with a bank account.

As a proxy for the behavior of the capital markets, we use share price indices, calculated from the prices of common shares of companies traded on national or foreign stock exchanges (SHAREPRICES).

Finally, the inclusion of two variables to measure the size of the financial sector were considered: value added by the financial sector as a share of gross domestic product, and net foreign assets as a share of gross domestic product. But both were finally excluded from the model due to their high correlation (> 80%) with TRADE (Trade Openness).

*Trade openness:* The increase in international trade over the last decades has allowed companies to incorporate technology more easily in order to save

time and labor, or to relocate their activity in regions where production costs are much lower (Dabla-Norris et al., 2014). This new scenario has contributed to the reduction of inequality between countries, but it has particularly punished the working classes of the industrialized countries, so globalization could be considered as one of the main causes of the increase of income inequality in these countries (Bergh and Nilsson, 2010). Despite this, the net effects of trade liberalization on income distribution are, a priori, unknown considering that the increase of this variable promotes the economic growth, and could contribute to the rise of real wages due to the cheapening of importations (Dabla-Norris et al., 2014).

As a proxy for this variable, we use the sum of exports and imports of goods and services measured as a share of gross domestic product (TRADE).

*Technological change:* Literature suggests that a skill-biased technological change may have contributed to increase the skill-premium in developed countries and, as a result, income inequality (Acemoglu, 1998). The incorporation of new technologies into production processes –accelerated by the progressive elimination of barriers to trade– is complemented by the specialized training acquired by skilled workers, aimed at the performance of non-routine tasks, while it destroys jobs of unskilled workers who carry out repetitive tasks. This process favors the widening of the wage gap between both groups of workers, and, ultimately, is another key factor for explaining the increase in income inequality (Acemoglu, 1998).

As a proxy for long-term technological change, we use total factor productivity (TFP).

*Tertiary education:* As a result of technological change and globalization, the demand of skilled workers have increased remarkably, raising the skill-premium and widening the wage gap between skilled and unskilled workers (Autor et al., 2006). Nevertheless, the fact that the relative size of both groups and the income distribution within them can change over time makes the net effects of changes that educational attainment has on inequality unknown a priori.

In order to approximate this variable, we took into account the UNESCO International Standard Classification of Education (ISCED), which decomposes the level of educational attainment into nine categories from 0: Pre-primary education, to 8: Doctorate or equivalent.

Following the aforementioned classification, we use as a proxy for this variable population aged 15–64 with tertiary educational attainment (levels 5-8) as a share of total population aged 15-64 (UNIV).

*Redistributive fiscal policies:* In recent years, the gradual abandonment of tax and expenditure redistributive policies aimed at correcting the market income distribution may have played a key role in the increase of the inequality experienced by the countries under analysis (Alesina and Perotti, 1996; Bastagli, 2012; Joumard et al., 2012).

As a proxy for this variable, we use total social expenditure as a share of gross domestic product (SOCX).



*Sectoral structure of employment:* This variable seeks to approximate the level of prevalence of the service sector over the industry sector in terms of employment, in order to measure the effect that the tertiarization of the European economy may have had on income inequality –considering the primary sector contribution to the economy of the countries under analysis is negligible.

As a proxy for this variable, we use the difference between employment in services and employment in industry, both expressed as a share of total employment (DIF\_SERIND).

The sectoral structure of employment is typically included as a control variable, but not presented in the same way we did.

*Influence of trade unions:* The loss of political influence by trade unions, which for decades helped to counteract the income accumulation of the higher-income groups, may have had a direct impact on inequality, contributing to its increase (DiNardo et al., 1996; Acemoglu et al., 2001; Card, 2001).

Two variables can be used as proxies for this process: the workers' level of union protection in a given country, and the lack of thereof. Respectively: trade union density (UNION), which corresponds to the ratio of wage and salary earners who are trade union members, regarding the total number of wage and salary earners, and (ii) self-employment as a percentage of total employment (SELFEMP). In relation to this, self-employed workers are those workers who, working on their own account or with one or a few partners or in cooperative, hold the type of jobs defined as "self-employment jobs", i.e. jobs where the remuneration directly depends on the profits derived from the goods and services produced. Self-employed workers include four sub-categories: employers, own-account workers, members of cooperatives, and contributing family workers.

*Ageing of the population:* In a region like the EU-15, where demographic ageing is becoming an increasingly important issue, it may be questioned whether the demographic structure has any significant effect on income distribution.

As a proxy for this variable, whose inclusion is unprecedented in the literature consulted, we use the third age population (age  $\geq 65$  years) as a percentage of the total population (POPOVER65).

*Structural unemployment:* The risk of exclusion from the labor market suffered by many citizens who have been unemployed for long periods could have had a clear impact on the increase of the variables used to measure inequality. In addition, it would be interesting to compare southern and northern countries, where long-term unemployment is a problem of varying magnitude.

As a proxy for this variable, which does not appear in the literature consulted as a factor that could explain the behavior of income inequality, we use the long-term unemployment rate as a share of total unemployment (LTUNEM\_U).

The sample consists of an unbalanced panel of annual data for the EU-15 countries throughout the period 1995-2014. The EU-15 is the group of member countries of the European Union prior to the accession of ten candidate countries on 1 May 2004, and is comprised the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

The countries and the period of analysis chosen are due to data availability for constructing a panel with the highest number of observations.

After discussing all the variables included in our model, we show their main descriptive statistics in Table 1.

TABLE 1. MAIN DESCRIPTIVE STATISTICS

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
GINI	Eurostat	271	29.1704	3.8483	20.0	38.1
MARKETGINI	Eurostat	168	49.1291	3.8555	43.2	61.6
PALMA	Eurostat	258	1.0833	.20739	.73076	1.6927
S80S20	Eurostat	272	4.6198	1.0221	2.9	7.4
YRIR	Eurostat/OECD	299	1.2052	1.8171	-3.3629	6.8648
TRADE	World Bank	300	96.9492	63.8998	37.1078	374.1478
CREDIT	World Bank	273	99.4304	37.8581	28.8760	202.1896
SHAREPRICES	OECD	296	102.2412	43.3882	27.4644	297.8090
TFP	AMECO	300	98.3432	4.9556	78.3942	111.8734
UNIV	Eurostat	291	22.0793	7.2097	6	39.6
SOCX	OECD	300	24.3623	4.0292	13.1300	31.9526
DIF_SERIND	World Bank	300	44.6246	10.6425	16.0000	74.8999
UNION	OECD	286	37.6110	20.9830	7.5476	83.1381
SELFEMP	World Bank	300	16.6103	8.0754	6.5	46.1
POPOVER65	World Bank	300	16.3512	2.2745	10.5193	22.0141
LTUNEM_U	World Bank	295	37.5993	13.5375	9.5	73.5

Source: Own elaboration.

### 3. MODEL AND RESULTS

The Blundell-Bond method is the approach that, in principle, would seem optimal for the purposes of our research, as it corresponds to a dynamic panel model and allows us to address the problem of endogeneity derived from three causes: omitted variables (fixed effects associated with individuals), simultaneity (possibility that not only the explanatory variables influence the dependent variable, but also, at the same time, the latter, in turn, has an impact on them) and dynamic endogeneity (derived from the inclusion of a lag of the dependent variable as a regressor).

However, this method is not applicable to our analysis of the EU-15, as it requires panels of the type “large N, small T”, when the EU panel is of the type “small N, small T” (N = number of subjects, in this case countries; T = number of periods; N is considered to be large if greater than 20, and T is large if greater than 30).

Taking into account the two previous points, in order to control the possible effects of factors not captured by the explanatory variables of our econometric model, and face possible endogeneity problems, in the case of the EU-15 analysis we chose to use then a two-way fixed effects model, which solves the first question. Once the estimate was made, we applied the Wooldridge (2010) exogeneity test, to make sure that the second problem we pointed out was not present and, in short, that the estimates of the two-way fixed effects model were valid.

Our model can be written as follows:

$$\ln\_gini\_dis_{it} \text{ [or, alternatively, } \ln\_gini\_mkt_{it}, \ln\_palma_{it}, \ln\_s80s20_{it}] =$$

$$\begin{aligned} & \beta_{0i} + \beta_{1t} + \beta_2 l1\_yrir_{it} + \beta_3 credit_{it} + \beta_4 \ln\_shareprices_{it} \\ & + \beta_5 trade_{it} + \beta_6 \ln\_tfp_{it} + \beta_7 d1\_univ_{it} + \beta_8 socx_{it} \\ & + \beta_9 dif\_serind_{it} + \beta_{10} union_{it} + \beta_{11} selfemp_{it} \\ & + \beta_{12} d1\_pop65_{it} + \beta_{13} ltunem\_u_{it} + e_{it} \end{aligned} \quad [1]$$

$$i = 1, 2, \dots, 15; t = 1, 2, \dots, 20.$$

In this model, we use a two-way fixed effects model, where country dummy variables ( $\beta_{0i}$ ) collect the implicit differences between economies, and time dummy variables ( $\beta_{1t}$ ) pick up the impact of shocks that are common to all the countries in the sample.

It should be noted that, since none of the dependent variables passed the normality test, we transformed them by taking natural logarithms. We also transformed SHAREPRICES and TFP by taking natural logarithms since both variables were originally indices numbers, hindering the interpretation of the results. Finally, UNIV and POPOVER65 turned out to have a problem of non-stationarity –individual unit roots and common unit root, respectively– that was corrected by taking first differences of the original variables.

The normality and stationarity of the data were verified by means of the tests of Shapiro-Wilk, and Levin, Lin & Chu, and ADF Fisher, respectively.

The data panel poses two problems that had to be corrected before estimating the model: autocorrelation and heteroskedasticity, detected by means of the Wooldridge test and the Breusch and Pagan Lagrangian multiplier test, respectively. We also applied the Pesaran, Friedman and Frees tests, resulting in contemporaneous correlation, i.e. cross-sectional dependence.

All these problems can be corrected simultaneously using the Panel-Corrected Standard Errors (PCSE), which is a more accurate method than Feasible Generalized Least Squares (FGLS) (Beck and Katz, 1995; for more

details on both methods, see e.g. Greene, 2012). This method is adequate for linear cross-sectional time series models where the parameters are estimated by either OLS or Prais–Winsten regression (Prais and Winsten, 1954), which was the approach used here. We assume that (i) there is first-order autocorrelation AR(1) within the panels, (ii) the coefficient of the AR(1) process is panel-specific, and (iii) the disturbances are panel-level heteroskedastic only, with no contemporaneous correlation across panels.

The Pearson correlation coefficient revealed that in no case the variable selected reached a correlation above 60 percent –except for LTUNEM\_U and SELFEMP, which have a correlation coefficient of 0.6180.

The estimates obtained are shown in Tables 2 and 3 (in brackets, standard errors). Country and time fixed effects were significant for all the cases.

TABLE 2. POOLED OLS ESTIMATION RESULTS

	LN_GINI	LN_MARKETGINI	LN_PALMA	LN_S80S20
YRIR	-.00570 (.00444)	-.00022 (.00430)	-.00720 (.00645)	-.00502 (.00647)
L1_YRIR	.00134 (.0042)	.00245 (.00433)	-.00243 (.00618)	-.00517 (.00614)
CREDIT	.00115*** (.00014)	.00054*** (.00014)	.00167*** (.00021)	.00198*** (.00021)
LN_SHAREPRICES	-.01957 (.01552)	.03042 (.02272)	-.05823** (.02334)	-.08524*** (.02250)
TRADE	-.00009 (.00011)	-.00042*** (.00009)	-.00009 (.00016)	-.00018 (.00016)
LN_TFP	.19762 (.12775)	-.57774** (.22933)	.35798* (.19537)	.51727*** (.18612)
D1_UNIV	.00235 (.00389)	.00616 (.00439)	.00484 (.00604)	.00083 (.00566)
SOCX	-.00725*** (.00172)	-	-.00915*** (.00256)	-.00897*** (.00250)
DIF_SERIND	-.00058 (.00066)	.00222*** (.00068)	-.00179* (.00097)	-.00114 (.00094)
UNION	-.0021*** (.00027)	.00029 (.00027)	-.00271*** (.00041)	-.00272*** (.00040)
SELFEMP	.00673*** (.00094)	-.00168* (.00087)	.01052*** (.00138)	.01422*** (.00137)
D1_POPOVER65	-.07870** (.03349)	.01790 (.03214)	-.16210*** (.05045)	-.15641*** (.04878)
LTUNEM_U	.00197*** (.00051)	.00361*** (.00053)	.00287*** (.00075)	.00283*** (.00074)
Obs.	203	149	191	204

Source: Own elaboration.

Note: \*\*\*, \*\*, \* indicate rejection of the null hypothesis at the 1, 5, and 10 percent levels of significance, respectively.

TABLE 3. TWO-WAY FIXED EFFECTS ESTIMATION RESULTS

	LN_GINI	LN_MARKETGINI	LN_PALMA	LN_S80S20
YRIR	.00065 (.00266)	.00308 (.00266)	-.00037 (.00419)	.00178 (.00414)
L1_YRIR	.00706*** (.00267)	.00810*** (.00281)	.01169*** (.00423)	.00511 (.00423)
CREDIT	.00045** (.00021)	.00032 (.00023)	-.00006 (.00039)	.00057* (.00033)
LN_SHAREPRICES	.04878*** (.01425)	.01746 (.02794)	.03351 (.02426)	.04876** (.02329)
TRADE	-.00111*** (.00028)	-.00100*** (.00033)	-.00202*** (.00048)	-.00139*** (.00046)
LN_TFP	-.16266 (.11332)	-.29068 (.22399)	-.37178** (.17567)	-.29152 (.17880)
D1_UNIV	-.00277* (.00154)	-.00120 (.00227)	-.00223 (.00217)	-.00362 (.00254)
SOCX	-.01631*** (.00270)	-	-.01883*** (.00436)	-.02629*** (.00415)
DIF_SERIND	.00366** (.00150)	.00481*** (.00180)	.00456* (.00244)	.00793*** (.00252)
UNION	.00023 (.00143)	-.01506*** (.00225)	-.00343 (.00251)	.00333 (.00231)
SELFEMP	.01117*** (.00305)	.00707* (.00406)	.01800*** (.00447)	.01223*** (.00456)
D1_POPOVER65	-.01842 (.03600)	-.01959 (.03196)	-.07136 (.05068)	.03418 (.05580)
LTUNEM_U	.00112 (.00066)	.00166** (.00074)	.00109 (.00106)	.00085 (.00104)
Obs.	203	149	191	204

Source: Own elaboration.

Note: \*\*\*, \*\*, \* indicate rejection of the null hypothesis at the 1, 5, and 10 percent levels of significance, respectively.

#### 4. DISCUSSION OF RESULTS

The results obtained reveal that, first, the variable used as a proxy for monetary policy –namely, the real interest (YRIR)– is not significant to explain any of the dependent variables selected. Nevertheless, it is extremely significant ( $p$ -value > 0.01) to explain three of the dependent variables when we include it with a one-year lag (L1\_YRIR). We can also note that it ceases to be significant if we incorporate lags longer than one year: L2\_YRIR, L3\_YRIR, etc.

The relationship between real interest rates and income inequality is significant regardless of the indicator used to measure inequality –with the exception of the S80/S20 ratio. In this latter case, the sign of the coefficient is also positive but not significant. In order to interpret this result, it should

be taken into account that this indicator is a quantile ratio measuring the gap between the rich and the poor, that is, it measures the distance between the ends of the distribution. Therefore, this indicator could suffer from a problem of lack of generality when measuring the evolution of inequality, given that only the income received by the top and bottom income quintiles is considered in its calculation. This evidence would be consistent with the idea that the effects of monetary policy may not manifest themselves in the difference between the first and last quintile, that display particular behaviours derived from their extreme position in the income distribution, but in other sections of income distribution.

To explain these results, we may infer that the macroeconomic effects caused by low interest rates –a stronger aggregate demand, a faster fall in unemployment and medium-term price stability– have positive distributional effects over the medium term, while the potential negative effects in short-term inequality (less than a year), caused by the noticeable effects of expansionary monetary policy on financial asset prices, are not significant to explain the evolution of any income inequality indicator. In the end, our results reinforce a recent speech delivered by Mario Draghi (2016, p. 8) where he pointed out that “*over the medium-term, it is unambiguous that monetary policy has positive distributional effects through macroeconomic channels*”.

Second, regarding the growth of the financial sector, both variables included to analyze the effects of such growth are significant to explain the increase of income inequality measured as LN\_GINI, while the other three dependent variables show a consistent sign but different levels of significance. In cases where these variables are significant, their sign is also consistent with the results presented in the literature consulted, and this could be explained as follows: on the one hand, financial deepening (CREDIT) contributes to increase income inequality, according to the most common explanation, which would be more suitable for developing countries where domestic credit is largely concentrated on big companies and rich households, while the rest of the population is financially excluded. However, for the countries analyzed (EU-15), it seems that there is not a clear explanation for these results. On the other hand, as regards the behavior of capital markets (LN\_SHAREPRICES), considering that most of financial wealth is concentrated on high income households, the substantial increases experienced by stock indices during the period of analysis have caused the stockholders to progressively separate from the rest of the population in terms of income and wealth.

Third, the trade openness variable (TRADE) is significant to explain all the selected dependent variables. Considering that the effect of the level of trade openness on income distribution is a priori unknown –in accordance with what was explained in section 2–, the fact that this variable has a negative sign does not contradict previous empirical evidence.

Regarding technological change, the variable LN\_TFP is not significant to explain the behavior of the two Gini indices, nor the S80/S20 ratio. This could mean that technological change affects households at the ends of the

income distribution, while it has no demonstrable impact on those at the center of it. Unlike previous literature, the effect of technological change on income inequality has a negative sign in our case of analysis. In order to explain this sign, it may be necessary to take into account that TFP can be disaggregated into “growth into technological progress” and “changes in technical efficiency”, so it is possible that technological progress contributes to increasing inequality, but this increase becomes neutralized by the changes in technical efficiency.

As for educational gap, the first difference of UNIV is only significant to explain the behavior of GINI –with a negative sign. Perhaps, this is due to the speed of the broadening of the gap between skilled and unskilled workers.

With regard to redistributive fiscal policies, the variable SOCX is –along with TRADE– the only variable significant at the 99% confidence level for all the dependent variables. Therefore, its contribution to reduce income inequality seems unquestionable.

As regards the sectoral structure of employment, the variable DIF\_SERIND is significant to explain the behavior of all the dependent variables, although with different significance levels. Its sign is positive in all cases, which would mean that a greater tertiarization of these economies contributes to the deterioration of their income distributions. The worse working conditions characteristic of the service sector (more temporary contracts, lower wages...) compared to the industrial sector may be behind this adverse effect.

In relation to the influence of trade unions, the variable UNION is not significant to explain the behavior of any of the dependent variables, except for LN\_MARKETGINI. In this case, its effect on income distribution has a negative sign, which fits perfectly with the literature consulted –a greater level of unionization implies lower income inequality. Accordingly, on the one hand, the sharp fall in the unionization rate experienced by thirteen of the fifteen countries in the sample –the only two where the unionization grew are Belgium and Spain– would be irrelevant to explain the generalized increase in net income inequality. On the other hand, the self-employment variable (SELFEMP) is significant to explain the behavior of LN\_GINI and the two ratios –although it cannot be used to explain LN\_MARKETGINI. In the cases where it is significant, it has a positive sign, which seems to confirm its usefulness to approximate the lack of trade union protection. If so, the interpretation would be consistent with that of UNION: lower levels of unionization reduce the bargaining power of workers, and ultimately lead to an increase in income inequality. It should be noted that the rate of self-employment fell in all countries over the analyzed period –except for Germany, the Netherlands and the United Kingdom.

In regard to the possible influence of demographic aging of the European population, the variable D1\_POPOVER65 is not significant to explain the behavior of any of the selected dependent variables.

The structural unemployment variable (LTUNEM\_U) is only significant to explain the behavior of the Gini coefficient before transfers. Although these

results are reasonable—a higher percentage of long-term unemployment implies greater market income inequality, but it does not have a significant impact on net income inequality because of the damping effect of the public transfers programs—, we cannot make comparisons about further interpretations, since in the literature there is no precedent of the inclusion of this variable in models used to explain income distribution.

Finally, it is important to note that in the results obtained for the pooled OLS estimation (Table 2), it can be observed that our monetary policy variable (L1\_YRIR) is not significant to explain the behavior of any of the selected dependent variables. But once we change to the two-way fixed effects method, they become extremely significant—it should also be noted that, according to the results of the F-test, we can reject the null hypothesis that all the dummy variables are jointly not significant, and therefore, we can conclude that it is preferable to use the two-way fixed effects estimation method instead of a pooled OLS regression.

The joint significance of the dummy variables indicates there may be country-specific idiosyncratic variables that have a significant impact on income distribution and were not selected as independent variable. These results suggest that there are country and year-specific omitted variables that make our monetary policy variable not significant in a pooled OLS estimation, and that once these omitted variables are collected in the dummies, our monetary policy variable becomes highly significant.

## 5. CONCLUSIONS

In this paper, we explore the relationship between monetary policy and income inequality for a sample of fifteen European countries. We have offered new evidence on the effects of monetary policy considering several inequality indicators (Gini, Palma ratio, S80/S20) and distinguishing short and medium term effects.

Our results suggest that monetary policy decisions adopted by the central banks of the countries analyzed have had a significant effect on income distribution. More specifically, the redistributive effects that an expansive monetary policy may have in the short term through financial channels are not significant, while its effects in the medium term (one-year lag) through macroeconomic channels are unequivocally positive, since drops in real interest rates contribute to reduce income inequality. Hence, our findings support the view of some central bankers arguing that over the medium term, it is unambiguous that monetary policy has positive distributional effects through macroeconomic channels (i.e. Draghi, 2016).

Conversely, the association between monetary policy and income polarization proxied by the S80/S20 ratio is not unambiguous. The sign of the coefficient is positive in line with the case of other indices (Gini and Palma) but not significant. It seems that monetary policy affects to a lesser extent to the distance between the richest and the poorest, the most volatile segments. So,



a reduction in income polarization should not necessarily be expected as a result of unconventional monetary policies.

As for the rest of explanatory variables, the results are generally consistent with the expected ones. For instance, trade openness and social expenditure have a clear positive effect in reducing inequality, while technological change also contributes to a reduction in income inequality, although our results are not conclusive in this regard. By contrast, the tertiarization of these economies has negative effects on income distribution, since a greater prevalence of the service sector over industry induces a greater level of income inequality. Other variables such as financialization, the loss of influence of trade unions, and structural unemployment also contribute to increasing income inequality, although the results are not so conclusive.

The empirical evidence provided by the present study provides an argument in favour of the idea that central bankers should not overlook the unintended redistributive consequences of their policies. Particularly, authors such as De Haan and Eijffinger (2017) argue that the assumption that monetary policy has little or no redistributive consequences is crucial for arguments in favour of central bank independence. In this sense, it worth to note that if apart from price stability, central banks assume further tasks such as financial stability and, on the other hand, the unconventional monetary policy measures adopted by the major central banks in the period since 2008 are far more redistributive than traditional monetary policy, the rationale of the independence of central banks should be revisited. However, a closer attention to inequality does not mean that monetary authorities should target income inequality more explicitly or eventually change their mandates. Indeed, admitting these consequences (most of them unintended) could improve the accountability, reputation, credibility, and, eventually, the legitimacy of independent central bankers in the eyes of the citizens.

Finally, it is worth to note that the empirical research on the relationship between monetary policy and inequality suffers from a serious problem of data limitations. Particularly, further research is needed in this area with a view to analyzing directly the effects of monetary policy on specific groups of population. Such a detailed and comprehensive study would require using disaggregated data at household level in order to build a microdata panel for a given country.

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