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Income Inequality and the Distributional Effects of Monetary Policy: The Role of Financial Heterogeneity

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Abstract

We study the effects of both standard and unconventional monetary policies (UMPs) of the European Central Bank (ECB) on income inequality in 19 Euro Area (EA) member states over the years 2008-2018. We distinguish two main groups of UMPs: quantitative easing (QE) and credit easing (CE) policies. We further investigate the role of financial heterogeneity among EA member states in affecting the distributional effects of these monetary policies. Using the pooled mean group (PMG) estimator we find that restrictive standard monetary policy and expansionary UMPs lead to higher income inequality. Furthermore, our results suggest that a higher level of financial development augments the distributional effects of monetary policies. We also find that the financial integration and the stage of the credit cycle affect the distributional effects of monetary policy, while the stage of real estate prices and stock prices cycles do not.

1. Introduction

The Global Financial Crisis of 2008-2009 (GFC) and slow post-crisis recovery have resulted in an unprecedented monetary expansion in most advanced economies. The subsequent slow and uneven recovery coupled with perceived income disparities has intensified the debate about the causes and consequences of income inequality. The effect of monetary policy on income inequality has also come under scrutiny. The understanding of the distributional effects of monetary policy is not only highly relevant for academicians, but also for policymakers, as the resulting income inequality may have significant consequences. For example, Casiraghi et al. (2018) hypothesized that higher income inequality could reduce public support for the central bank, while several studies have found empirical evidence that higher income inequality hinders the transmission of monetary policy (Guerello, 2018; Voinea et al., 2018; Domonkos et al., 2020). Other studies have concluded that lower income inequality is associated with faster and more sustainable growth (Berg et al., 2018), that higher inequality only limits growth at low and middle levels of financial development (Madsen et al., 2018), that higher inequality limits the provision of

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credit to low-income households (Coibion et al., 2014), and that higher inequality leads to higher private sector debt and hampers financial stability (Perugini et al., 2016). While the distributional effects of monetary policies had already been investigated by many empirical studies, these studies have so far examined short-term distributional effects of monetary policy. To date, however, the study of potential more long-term effects of monetary policy on inequality has been missing. Furthermore, the prior studies often come to conflicting conclusions about the distributional effects of monetary policy: Some studies finding positive effects on inequality, while others find a negative effect.

In this paper, we first aim to contribute to this debate by studying the long-term distributional effects of monetary policy on income inequality in the Euro Area (EA). Namely, the significant expansion of the scope of monetary policy that occurred in most advanced economies over the past decade may have had a more pronounced and persistent effect on income inequality. To study the relationship between income inequality and monetary policy, we first distinguish between standard and non-standard (or unconventional) monetary policies. Standard monetary policy is conducted by setting the policy interest rate. For non-standard or unconventional monetary policies (UMPs), we additionally distinguish two main groups of such policies: Quantitative Easing (QE) and Credit Easing (CE). Consequently, we aim to study the long-term distributional effects of each of these groups of monetary policy separately.

While the overall distributional effects of monetary policy are not certain, the characteristics of a country's financial system are likely to play an important role in determining these effects. In other words, the existing financial heterogeneity across countries could help to explain the different distributional effects of monetary policy observed across different countries. As a result, the second aim of this paper is to study how the distributional effects of monetary policy are conditioned on financial heterogeneity across the EA member states. The Euro Area represents an interesting case for study, as the EA countries share common monetary policy conducted by the European Central Bank (ECB) and at the same time the EA countries exhibit a significant degree of financial heterogeneity. This enables us to examine how the transmission of a single monetary policy into income inequality varies across countries depending on the characteristics of their financial systems. And indeed, the existence of financial heterogeneity across the EA members (Baele et al., 2004) and its role in the transmission of monetary policies has already been highlighted (Badarau and Levieuge, 2011). For the purpose of this analysis, we intend to use three different measures of the financial heterogeneity across the EA member states: financial development, financial cycle and financial market integration. All these measures represent an important characteristic of a financial system and they all enable us to capture the existing financial heterogeneity across the EA member states.

The contribution of this paper is threefold. First, while empirical studies usually concentrate on studying the short-term effects of monetary policy on inequality (Lenza and Slacalek, 2018; Guerello, 2018; Samarina and Nguyen, 2019), we use the Pooled Mean Group (PMG) estimator, which enables us to study the short-term and long-term distributional effects separately. Second, while most studies that investigate the distributional effects of monetary policy only use one measure of

monetary policy, we extend the approach of Horvath et al. (2018) and Guerello (2018) and distinguish three different groups of monetary policies: standard monetary policy, QE policies and CE policies. The third contribution of this paper is that we study the role of financial heterogeneity across the EA member states in affecting the distributional effects of both standard and non-standard monetary policies.

We do find empirical evidence that the monetary policy in the Euro Area does have a long-term effect on income inequality. Our results therefore imply that monetary policy shocks may affect the income distribution and that changes in the relative positions of different income groups may be rather long-lasting. Using the Gini coefficient as our main measure of inequality, we find evidence that restrictive standard monetary policy and expansionary non-standard monetary policies (i.e., both QE and CE policies) positively affect income inequality (i.e., lead to higher inequality) over the long term. Our findings further indicate that standard monetary policy exhibits a small long-term effect on income inequality, while the effects of QE and CE policies seem to be moderate and small, respectively. Apart from the Gini coefficient, using the approach of Domonkos et al. (2020), we also construct three alternative measures of income inequality, which are all expressed as the ratio of the population share of the poorest individuals to the population share of the richest individuals. These alternative measures of inequality, unlike the Gini coefficient, which places a large weight on middle class developments, focus on the tails of the income distribution. The findings obtained when using these alternative measures of inequality corroborate our baseline findings for the standard policies but not for non-standard policies, where we do not find a statistically significant effect on income inequality. We hypothesize that these divergent results for the UMPs could be caused by UMPs affecting mostly the inequality within the middle of the income distribution, which is captured by the Gini coefficient but not by our alternative measures of income inequality.

We also find that the existing financial heterogeneity across the EA countries strongly affects the transmission of monetary policy to income inequality. As a result, the financial heterogeneity might explain the conflicting findings of earlier studies that studied the distributional effects of monetary policy in different countries. This is particularly the case for financial development, as we find that the restrictive standard and expansionary non-standard policies increase inequality more in countries with higher levels of financial development. We also find that a higher level of financial market integration in the EA slightly enhances the distributional effects of standard policies but also limits the distributional effects of QE policies. Finally, we find that the expansionary stage of the credit cycle amplifies the distributional effects of non-standard monetary policies, but the stages of the stock- and real estate-market cycles do not seem to affect the distributional effects of monetary policies.

The rest of the paper is organized as follows: Section 2 discusses the relationship between financial heterogeneity and the distributional effects of monetary policy, while Section 3 outlines the related literature. Section 4 presents the empirical methodology, whereas Section 5 outlines our dataset. Section 6 contains our results and Section 7 concludes the paper. Additional results are available in the online Appendix.

2. Theoretical Framework

In the following section, we outline the theoretical framework for the distributional effects of monetary policy and for the role of financial heterogeneity in affecting these distributional effects. For the distributional effects of standard monetary policy, the restrictive standard policy, represented by increasing interest rates, could be expected to lead to higher debt servicing costs for borrowers (more likely low earners) and to higher earnings for lenders (more likely higher earners). That is, higher interest rates (and/or lower inflation), associated with restrictive monetary policy may contribute to higher inequality through the savings redistribution channel (Doepke and Schneider, 2006; Coibion et al., 2017). Additionally, the economic slowdown caused by such policy is likely to affect low earners more adversely than high earners. The model of Areosa and Areosa (2016) further indicates that higher interest rates reduce consumption, and as a result, firms cut their production and demand for labour, leading to a sharper reduction in income for low-income agents, who are more reliant on labour earnings, resulting in an increase in income inequality. Conversely, expansionary standard monetary policy could be expected to reduce income inequality.

For unconventional monetary policies, the theoretically expected effect on inequality is rather less clear-cut, as these policies may operate through several different channels and the final effect will depend on the relative importance of these respective channels. For example, the main unconventional monetary policy of the ECB in the post-GFC era has been the QE, and QE may affect income inequality through the following three main channels. First, QE alters the income composition (income composition channel): by increasing the rate of economic growth, QE (and monetary expansion in general) may lead to higher wages or to higher rental, business and capital income and thus contribute to higher inequality (as low-income households disproportionately rely on transfers). Second, QE may operate through the portfolio composition channel, as it leads to higher financial assets and real estate prices, which are disproportionally owned by high-income households. Third, through the earnings heterogeneity channel, QE can in fact lead to lower inequality, as the potentially higher employment caused by QE is likely to disproportionately benefit low-income households (Lenza and Slacalek, 2018). Therefore, the final effect of QE on inequality will be dependent on the strength of these respective channels, which is likely to be different across countries.

Another large group of UMPs used by the ECB are the CE policies, which represent the central bank's liquidity provision to the banking system (Jacome et al., 2018). To date, however, to the best of our knowledge, no study has focused specifically on studying the distributional effects of CE policies. Nevertheless, the primary aim of CE policies is to increase credit provision, and there is a vast empirical literature that studies the effect of credit provision on inequality. Generally, credit expansion is expected to alleviate the financing constraints of the poorest individuals; however, this effect is often assumed to be absent in advanced economies, as the distribution of credit is argued to be more unequal than the distribution of income. As a result, the benefits of increased credit provision are likely to disproportionally benefit richer or middle class households and lead to higher income inequality (Greenwood and Jovanovic, 1990; Maldonado, 2017).

Having discussed the theoretically expected distributional effects of the three groups of monetary policies included in our analysis, we further outline the framework for the possible role of our three main measures of financial heterogeneity in affecting these distributional effects. Each of the three selected financial heterogeneity measures had previously been linked to monetary policy transmission or income inequality by empirical papers or theoretical models. Several papers have investigated the relationship between income inequality and financial development. For example, Hasan et al. (2020) found that financial development does play an important role in determining wealth inequality, finding that countries with larger stock markets, worse access to finance and less efficient financial intermediaries have higher wealth inequality. Altunbas and Thornton (2019) also found evidence that a higher level of financial development in high-income economies is associated with higher income inequality. Furthermore, in a sample of EA countries, Samarina and Nguyen (2019) found that the expansionary monetary policies of the ECB reduced income inequality more significantly in peripheral EA countries (by improving the economic performance) than in the core EA countries. This effect was weaker in the core EA member states, as the financial channel (i.e., portfolio balance channel) was found to weaken the equalizing effect of the expansionary monetary policy, and the financial channel is more important in EA member states with more developed financial markets. However, this study differs from ours, as it did not cover all EA member states; it focused on short-term effects and only used the shadow rate as a measure of the monetary policy stance. The effects of both standard and non-standard monetary policies can thus be expected to be more pronounced in countries with a higher level of financial development; for standard monetary policies, this is because of a higher proportion of indebted households and households holding deposits, while for non-standard policies (especially the QE), it is because of a higher proportion of financial assets in overall household wealth.

Additionally, we argue that the distributional effects of monetary policy may be affected by the stage of the financial cycle. In defining the financial cycle, we primarily follow the standard approach, where the definition of financial cycle relies on standard estimates based on credit-to-GDP gap (Drehmann et al., 2012).[1] During the expansionary phase of the credit cycle, accommodative monetary policy may further exacerbate credit provision and lead to even higher growth in real estate or financial asset prices (or to the creation of market bubbles) and thus also lead to higher inequality, as the macroeconomic gains of expansionary monetary policy are likely to be rather modest, while the portfolio composition channel is likely to dominate. On the other hand, during the contractionary phase of the credit cycle, the distributional effects of monetary policy may operate more through the macroeconomic channel (i.e., earnings heterogeneity channel), leading to lower inequality. Furthermore, as in this research we focus on Euro Area countries, the fact that the credit cycles in the EA are not yet fully synchronized (Meller and Metiu, 2015) could help explain the different magnitudes of the distributional effects of monetary policy across the different EA members. Indeed, Furceri et al. (2018) previously found empirical evidence supporting the notion that the distributional effects of monetary policy may depend on the phase of the business cycle; they found

[1] However, we also treat the real estate and stock prices cycles as distinct features of the financial cycle.

that monetary policy shocks had a more pronounced effect on inequality during booms than during recessions. On the other hand, O'Farrell and Rawdanowicz (2017) concluded that during downturns, monetary expansion raises inequality, while monetary tightening during the expansionary phase of the business cycle reduces inequality. Aikman et al. (2020) found that during the contractionary phase of the credit cycle, monetary policy affects the U.S. economic performance as expected. However, monetary policy was found to be inefficient during the expansionary stage of the credit cycle – supporting the notion that during the expansionary stage of the credit cycle, the effect of monetary policy on inequality through the macroeconomic channel is likely to be rather small. In this paper, we extend this previous research by focusing on the credit cycle and its role in affecting the distributional effects of monetary policy.

Finally, we also investigate whether the distributional effects of monetary policy are conditional on the level of financial market integration within the Euro Area. The detrimental consequences of the lack of financial market integration (i.e., financial market fragmentation) in the EA have already been highlighted in several papers (Horvath, 2017; Horvath et al., 2018). The lack of financial market integration is argued to reduce the effectiveness of the transmission of standard monetary policy to market interest rates (Paries et al., 2014). Consequently, if higher financial market integration enhances the interest rate pass-through, it may also enhance the distributional effects of standard monetary policy. For UMPs (chiefly QE), the higher financial market integration may increase the effectiveness of financial markets and also enable the economic agents from member states with less developed financial markets to invest more easily in other EA member states – augmenting the distributional effects of QE through the portfolio composition channel. On the other hand, higher financial market integration may have positive effects on real economy through the real interest rate channel (Ruscher and Vasicek, 2015). As a result, increased financial integration in the EA, by creating improved funding and investment conditions, may improve the transmission of QE policies to real economy and thus influence the distributional effects of UMPs through the earnings heterogeneity channel (and contribute to lower inequality). To the best of our knowledge, no paper has yet empirically investigated how the distributional effects of monetary policy are conditioned on financial market integration. However, a related study by Kunieda et al. (2014) found that for more financially integrated countries, financial development led to higher inequality, whereas for countries that are less financially integrated, the effect of financial development was the opposite. Jamotte et al. (2013) further concluded that higher financial globalization has contributed to an increase in income inequality. Additionally, some papers (i.e., Georgiadis and Mehl, 2016) have found empirical evidence that increasing financial integration affects the transmission of monetary policy.

3. Related Literature

The interest of the academic literature in studying the relationship between monetary policy and inequality started to grow in the aftermath of the GFC, as the operations of monetary policy of (mainly) developed countries were greatly expanded to counter the unprecedented slump of the economy. While a significant

number of studies have been published in recent years, Easterly and Fischer (2001) represent an earlier (i.e., pre-GFC) example of such a study. These earlier studies mostly concentrated on the relationship between inflation and inequality, finding that higher inflation had a disproportionately negative effect on the poor. Galli and van der Hoeven (2001) furthermore found that the effect of monetary policy on inflation, and by extension on inequality, is in fact nonlinear and depends on the initial rate of inflation. Using data on a panel of developed countries, they concluded that restrictive monetary policy might reduce inequality (by decreasing inflation) in countries with an initially high rate of inflation, while it may lead to higher inequality in low-inflation countries.

While a great number of empirical studies have recently been dedicated to the study of the relationship between monetary policy and income inequality, the strength or direction of causality of this relationship remains a contentious issue. For example, Bernanke (2015) argues that income inequality is driven by long-term factors, while the effects of monetary policy on inequality are likely to be only modest and transitory. Other authors (such as Bunn et al.,2018) also support the notion of monetary policy neutrality over the long run, with Hohberger et al. (2019) finding some empirical support for this hypothesis in the case of the EA countries and Inui et al. (2017) finding that the Bank of Japan (BoJ)'s monetary policy did not affect inequality in Japan over the period of 1981-2008. On the other hand, Coibion et al. (2017) found that over the years 1980-2008, there existed a strong causal relationship between monetary policy and income inequality in the U.S. and that monetary policy shocks accounted for a significant portion of the historical cyclical variation in both income and consumption inequality. An earlier study by Romer and Romer (1999) concluded that monetary policy might also have a long-term effect on income inequality. Furthermore, since the GFC, researchers sometimes distinguish between standard or conventional monetary policies and non-standard or unconventional monetary policies. Consequently, Colciago et al. (2019) argue that while conventional monetary policies may be neutral with regards to inequalities over the business cycle, unconventional policies may not.

Nevertheless, there are still numerous studies that find that even standard monetary policies affect the income distribution (at least in the short term). Restrictive standard monetary policy, represented by increasing interest rates, was indeed found to lead to higher inequality by several studies. For example, Coibion et al. (2017) found such evidence for the United States, Guerello (2018) for the EA countries, Mumtaz and Theophilopoulou (2017) for the United Kingdom and Furceri et al. (2018) for a panel of 32 developed and developing countries. Consequently, the literature generally finds support for the presence of the theoretically expected effects of conventional monetary policies. Nonetheless, there are still few exceptions: for example, Davtyan (2017) concluded that contractionary standard policies contributed to lower income inequality in the U.S.

As already discussed above, the distributional effects of unconventional monetary policies are ambiguous, and thus, the empirical literature has so far arrived at diverse conclusions. The findings differ not only across the countries included in the analysis but also across different estimation methods or measures of inequality. Bivens (2015) uses a counterfactual analysis to study whether income inequality in the U.S. would have been lower without QE. He found that in the absence of the

Fed's asset purchases, inequality would have increased even more in the post-crisis era. Similarly, Lenza and Slacalek (2018) also found that the ECB's QE did reduce income inequality in the Euro Area, mainly through increasing employment of low-income earners but also through higher wages (due to decreasing unemployment). Additionally, they also found that QE policies had only a limited effect on wealth inequality. Casiraghi et al. (2018) used micro data on Italian households' income and wealth, and they also concluded that the ECB's unconventional policies did reduce income inequality. Likewise, Ampudia et al. (2018) also found that QE reduced income, wealth and consumption inequality in the EA.

Nonetheless, there are also numerous papers that have concluded that non-standard monetary policies increase income inequality. For Japan, Saiki and Frost (2014) found that the BoJ's unconventional policy after 2008 did lead to higher inequality, mainly through its effect on financial asset prices. Mumtaz and Theophilopoulou (2017) also concluded that the Bank of England (BoE)'s QE may have raised the income inequality in the UK; they argue that the upper-income households that hold financial assets have benefited more than poorer households with little access to financial markets. For the United States, Montecino and Epstein (2017) also found that Fed's QE operated mainly through the portfolio channel (the mortgage refinancing and employment channels had some equalizing effects, though) and thus did increase inequality. Similarly, Hafemann et al. (2018) found that for 6 advanced economies, an expansionary monetary policy shock did raise income inequality; however, the effect was substantially limited by redistributive fiscal policies.

4. Empirical Methodology

In the following section, we outline the empirical methodology of this paper, which we use to study the distributional effects of monetary policies, as well as the role of financial heterogeneity in affecting the distributional effects of monetary policy.

In order to better understand the heterogeneity of the distributional effects of monetary policy in the EA, we rely on panel data and include all EA member states into our analysis. Thus, in the first step of the empirical analysis, we use the pooled mean group (PMG) estimator to estimate an autoregressive distributed lag (ARDL) model based on the methodology proposed by Pesaran and Smith (1995) and Pesaran et al. (1999). This model is well suited for our purpose, as it allows for heterogeneity in panel estimations. Specifically, the PMG estimator enables us to assume that in the short-term, the distributional effects of monetary policy are heterogeneous among individual EA member states, while over the long-term, it assumes homogeneous relationship among the respective panels.[2] Therefore, we first estimate the following regression:

[2] That is, the PMG estimator assumes that there exists a stable long-term relationship between the variables (in our case the monetary policy and income inequality), which is similar across all the studied countries. In order to verify this hypothesis, we have conducted the Hausman test on our baseline regression specifications. Indeed, the results of the test indicated that the PMG estimator is the more efficient estimator than the MG estimator (which assumes heterogeneous relationship also in the long-term).

$$\Delta Ineq_{i,t} = \sum_{j=1}^{p-1} \Phi_{i,j} \Delta Ineq_{i,t-j} + \sum_{j=0}^{q-1} \Pi_{i,j} \Delta IR_{i,t-j} + \sum_{j=0}^{r-1} \Theta_{i,j} \Delta Z_{i,t-j} + \beta_{0,i}(Ineq_{i,t-1} - \beta_1 IR_{i,t} - \sum_{j=0}^{u} \beta_j Z_{i,t} - \mu) + \varepsilon_{i,t} \quad (1)$$

where $Ineq_{i,t}$ stands for a measure of income inequality in country i and time t, IR stands for central bank interest rate – as our main proxy for the standard monetary policy. Z represents a vector of control variables that we use to control for other factors that may have affected our dependent variable (income inequality) during the studied period. The more detailed description of variables used in our regression framework is discussed in the following section.

In equation (1), the main coefficient of interest is β_1, which denotes the long-term response of the income inequality to changes in central bank interest rates. Furthermore, β_0 is the coefficient of the error correction term (ECT), which denotes the speed of adjustment towards the long-term equilibrium. Finally, $\Pi_{i,j}$ is the coefficient, which denotes the short-term effects of standard monetary policy on income inequality.

In order to further study the role played by financial heterogeneity across the EA countries in the distributional effects of standard monetary policy, we follow the approach taken by Leroy and Lucotte (2016) and Fisera and Horvath (2020) and interact our main explanatory variable (i.e., monetary policy measure) with a measure of financial heterogeneity:

$$\Delta Ineq_{i,t} = \sum_{j=1}^{p-1} \Phi_{i,j} \Delta Ineq_{i,t-j} + \sum_{j=0}^{q-1} \Pi_{i,j} \Delta IR_{i,t-j} + \sum_{j=0}^{r-1} \Theta_{i,j} \Delta Z_{i,t-j} + \beta_{0,i}(Ineq_{i,t-1} - \beta_1 IR_{i,t} - \beta_2 FinHet_{i,t} - \beta_3 IR_{i,t} * FinHet_{i,t} - \sum_{j=0}^{u} \beta_j Z_{i,t} - \mu) + \varepsilon_{i,t} \quad (2)$$

where *FinHet* represents one of our measures of financial heterogeneity in the Euro Area. Thus, coefficient β_2 denotes the long-term effect of the measure of financial heterogeneity on income inequality, while the coefficient β_3 captures the role of financial heterogeneity in the distributional effects of monetary policy. That is, this coefficient is of particular interest for our research. We do not include the financial heterogeneity measure in the short-term equation for two reasons. First, all our measures of financial heterogeneity are relatively stable over time and thus we do not expect these variables to have a short-term effect on the relationship between the monetary policy and income inequality. Second, and more important, in this part of the analysis, we focus on the differences in our measures of financial heterogeneity across the cross-sections and not across time.[3]

[3] That is, we are interested in the differences in the levels of our financial heterogeneity measures between the respective cross-sections (i.e., EA countries), which should capture the financial heterogeneity across the EA countries, and not in the changes of the financial heterogeneity measures for respective member states over time.

Additionally, we not only study the distributional effects of standard monetary policy, but we also study the distributional effects of unconventional monetary policies. In order to do so, we augment the equation (2) with a measure of unconventional policy and interact this measure with a measure of financial heterogeneity:

$$\begin{aligned}\Delta Ineq_{i,t} = &\sum_{j=1}^{p-1}\Phi_{i,j}\Delta Ineq_{i,t-j} + \sum_{j=0}^{q-1}\Pi_{i,j}\Delta IR_{i,t-j} + \sum_{j=0}^{q-1}\Omega_{i,j}\Delta UMP_{i,t-j} \\ &+ \sum_{j=0}^{r-1}\Theta_{i,j}\Delta Z_{i,t-j} + \beta_{0,i}(Ineq_{i,t-1} - \beta_1 IR_{i,t} - \beta_2 FinHet_{i,t} \\ &- \beta_3 UMP_{i,t} - \beta_4 UMP_{i,t} * FinHet_{i,t} - \sum_{j=0}^{u}\beta_j Z_{i,t} - \mu) + \varepsilon_{i,t}\end{aligned} \tag{3}$$

where *UMP* stands for one of the measures of unconventional monetary policy. In the equation (3) β_3 and β_4 are the coefficients of particular interest. The former measures the long-term effect of unconventional monetary policy on inequality, while the latter shows, whether the financial heterogeneity affects the effect of unconventional policies on inequality.

The main advantage of the PMG estimator is that since it is based on the cointegration approach, it enables us to study both the long-term and short-term effects of monetary policy on inequality. We consider the long-term distributional effects of monetary policy to be of particular importance, as the rather stable and persistent development of income inequality over the short-term could limit the short-term distributional effects of monetary policy. Moreover, the coefficients provided by the PMG estimator are consistent despite the possible presence of endogeneity – since it includes lags of the dependent and independent variables (Samargandi et al., 2015). However, one drawback of this approach is that since it is a cointegration-based approach, the variables included in the regressions must be cointegrated, and obviously, including more regressors inevitably leads to the presence of more cointegrating vectors and thus the PMG estimator becomes unwarranted. Therefore, we do not saturate these regressions with all the control variables that could control for other factors affecting income inequality.

Before proceeding with the estimations, we have conducted unit root tests on the variables included in the regression framework, as well as the Kao test of cointegration (Kao, 1999) on the baseline regression specifications. The results of the unit root tests are reported in Tables A5, A6 and A7 in the online Appendix and the results of the cointegration tests are reported in the Tables A3 and A4 in the online Appendix. The reported coefficients do indicate the presence of a long-term, cointegrating relationship among the variables.

Additionally, the income inequality is rather persistent over time and the current level of income inequality could be caused by numerous factors that affected the income distribution a long time ago. In order to address these issues, as a robustness check, we also use the standard fixed effects (FE) estimator in the dynamic panel setting to estimate the distributional effects of monetary policy. By

estimating the regressions in a dynamic setting, we can better control for the persistent nature of income inequality. By introducing the fixed effects, we are additionally able to control for unobserved country-specific factors that may have affected the level of income inequality in respective EA member states. As is well-known, the estimates of the FE estimator are biased in the dynamic setting (Nickell, 1981). Therefore, we estimate the below regression with the bootstrap-based biased-corrected fixed effects (BCFE) estimator[4] that was introduced by Vos et al. (2015), based on the estimator initially proposed by Everaert and Pozi (2007):

$$\Delta Ineq_{i,t} = \beta_1 Ineq_{i,t-1} + \beta_2 IR_t + \beta_3 UMP_{i,t} + \sum_{j=0}^{u} \beta_j Z_{i,t} + \alpha_i + \varepsilon_{it} \qquad (4)$$

where α_i stands for the country-level fixed effects. The advantage of this approach is that it allows us to control for general heteroskedasticity patterns and error cross-sectional dependence. However, unlike the PMG estimator, the BCFE estimator does not enable us to distinguish among short-term and long-term effects of monetary policy. As a result, the coefficients obtained using the BCFE estimator are not directly comparable with the coefficients obtained from PMG estimator. Therefore, we use the BCFE estimator primarily as a robustness check – to probe if the findings obtained by the PMG estimator are broadly in line with the findings obtained by another estimator.

5. Data

We use quarterly data over the years 2008-2018 for a panel of 19 Euro Area (EA) countries. The year 2008 was selected as the starting point for our analysis, as the ECB has started with the implementation of the non-standard (or unconventional) monetary policy measures in that year. This approach enables us to have the same sample for the analysis of the effects of both standard and non-standard monetary policies. We follow the approach taken by most previous papers and use the Gini coefficient as our primary measure of income inequality. The main advantage of the Gini coefficient is that it aggregates the entire income distribution into a single coefficient and thus it reflects developments in the entire income distribution. We use the Gini coefficient of equalized disposable income calculated based on data from the European Union Statistics on Income and Living Conditions (EU-SILC). While several papers use the Gini coefficient of pre-tax, pre-transfer income (Lenza and Slacalek, 2018; Samarina and Nguyen, 2019) because this approach enables them to ignore the redistributive effects of fiscal policy, we instead use the Gini coefficient of disposable income as our primary measure of income inequality. Similarly, Davtyan (2017) and Furceri et al. (2018) also used the Gini coefficient of disposable income as their measure of inequality. This approach entails several advantages. First, it enables us to maximize the sample size. Second, it enables us to control for the redistributive effects of fiscal policy. Third, as evidenced by Figure A1 in the online Appendix, the average Euro Area Gini coefficients of both disposable income and gross income followed a broadly similar trend during the studied period.

[4] We could not use the alternative GMM estimator, as if T is relatively large when compared to N, as is our case, the GMM estimates could become biased (Roodman, 2009).

Additionally, as a supplementary measure of income inequality, we use the shares of population earning a particular portion of overall disposable income; such a measure of inequality was used by Domonkos et al. (2020). Here, we first divide the overall disposable income into deciles. Then, we sort the population from lowest to highest earners and afterwards we calculate the share of the population that earns each decile of overall income.[5] Finally, based on the shares of the population earning a particular decile of overall income, we express our alternative measure of inequality as the ratio of the population share of low earners earning a certain percentage of overall income to the population share of high earners earning a certain percentage of overall income. Using different percentages of overall income, we create three such alternative measures of inequality. The population shares are also calculated based on data from the EU-SILC. We use these alternative measures of inequality, so that we can address some of the drawbacks of the Gini coefficient. First, the Gini coefficient can take the same value for different income distributions. Second, income inequality remains rather stable over time, which is also reflected in the Gini coefficients of EA countries. This relative stability of the Gini coefficient could be due to its emphasis on middle class developments. Indeed, for example, Davtyan (2017) found that the variation in income inequality in the United States is driven by the top 1 % of households. Palma (2011) further argued that changes in inequality are driven by changes in the relative positions of the highest and lowest earners, while the position of the middle class remains broadly stable over time. Thus, an inequality measure that focuses on the relative position of the lowest and highest earners could enable us to better capture the variation in the Eurozone's income inequality. Nevertheless, these alternative measures of inequality face similar drawback to other measures that focus on the tails of the income distribution; namely, they ignore the developments in the middle of the income distribution. Consequently, these alternative measures of inequality just supplement the Gini coefficient, which places more emphasis on the middle of the income distribution.

While a measure of income inequality serves as the dependent variable in all our regressions, a measure of monetary policy serves as our main explanatory variable. In defining our measures of monetary policy, we follow the approach taken previously by Horvath et al. (2018), Fisera and Kotlebova (2020) and Domonkos et al. (2020). We distinguish between standard and non-standard (unconventional) monetary policies. As our measure of the standard monetary policy, we use the Eonia interbank interest rate, which serves as a proxy for the key interest rates. The Eonia is often used in the literature (Gambacorta et al., 2011; von Borstel et al., 2016) as a proxy for key interest rates, mainly due to its superior statistical properties. We distinguish two main types of unconventional monetary policies. The first are Quantitative Easing (QE) policies, which we proxy with the volume of public sector securities held by respective national central banks (NCBs). The second are the policies that we refer to as Credit Easing (CE) policies, which are proxied by the sum of the volume of outstanding loans provided by the respective NCBs to the Monetary Financial Institutions (MFIs) and the volume of securities issued by MFIs and held by the NCBs. The data on these measures are taken from the ECB's balance sheet

[5] For example, in 2016, on average 22.9 % of the lowest earners in the Euro Area earned one decile of overall income, while only 3.1 % of the highest earners earned one decile of overall income as well.

statistics for the respective NCBs, and they enter our regressions expressed in logarithms. Figures A12-A14 in the online Appendix plot the development of these measures of monetary policies for all the countries in our sample. Finally, apart from these main measures of both standard and non-standard monetary policies, in a robustness check we also use the shadow rate calculated based on the methodology of Wu and Xia (2016) as another measure of monetary policy. The shadow rate may serve as an overall measure of the monetary policy stance.[6] While the estimates of shadow rates are not constrained by the zero lower bound (ZLB), there are some uncertainties associated with their estimation.

To study the role of financial heterogeneity in the transmission of the ECB's monetary policy to income inequality, we also introduce several measures of financial heterogeneity across the EA member states into our regressions. As a measure of financial development, we use the International Monetary Fund's (IMF) broad-based index of financial development proposed by Svirydzenka (2016). As a robustness check, we use the credit-to-GDP ratio as an alternative measure of financial development, which is also often used as a measure of financial development (Cihak et al., 2013). We calculate the credit-to-GDP ratios for the countries from our sample as the ratio of credit provided by the MFIs to the private sector to GDP. The data are from the ECB's database. To control for the financial cycle, the standard definition of the financial cycle based on credit-to-GDP gap (Drehmann et al., 2012) is used. A broader approach also includes real estate and stock prices as two distinct features of a financial cycle (Claessens et al., 2011). In this paper, we differentiate among all three dimensions and work with them separately, extracting the cyclical components of the credit-to-GDP ratio, real estate prices and stock prices by standard Hodrick-Prescott filter (with λ=1,600), following the credit-to-GDP gap literature. The data on real estate prices are taken from the BIS database, while the data on stock prices are taken from the Thomson Reuters database. The real estate prices are the residential property prices represented by the pure prices for all dwellings and are indexed to 100 for the first period of our sample (i.e., Q1 2008). The stock prices are represented by main stock prices index for each country and indexed to 100 for the first period of our sample. We plot the estimated credit-to-GDP gap, real estate prices gap, and stock prices gap for all the countries in our sample in Figures A9-A11 in the online Appendix. As a measure of financial integration, we use the comprehensive financial integration index (FINTEC) developed by the ECB (Hoffmann et al., 2019).

Apart from the key variables of interest described above, we also saturate our regressions with several control variables, which enable us to control for other factors that may have affected income inequality. First, we control for the unemployment rate, which is generally associated with higher inequality (Deyshappriya, 2017). Additionally, we introduce real GDP into our framework in order to control for economic developments. The value of this variable is indexed to 100 for the first observation for each country from our sample. The variable is indexed, as this approach enables us to include the levels of real GDP in the long-run equation, while first differences of indexed real GDP (i.e., QoQ growth in real GDP) can be included

[6] The shadow rate accounts for both standard and non-standard monetary policies (including other unconventional policies, such as forward guidance).

in the short-run equation. While the exact effects of economic performance on income inequality estimated by different studies that cover different countries vary (from positive to negative effects)[7], the existence of some form of relationship is confirmed by many papers (Barro, 2000; Deyshappriya, 2017). We also include GDP (PPP) per capita in our regressions – to control for different stages of economic development of the countries included in our sample. As age also affects income inequality (Wang et al., 2017), we additionally control for the median age of the population of each EA member. Furthermore, we also control for overall tax rates, expressed as the ratio of overall tax income to GDP. Higher tax rates are likely to lead to increased redistribution and thus lower income inequality. This variable therefore controls for the effects of the redistributional policies conducted by the governments. The data on the control variables are taken from the Eurostat database except for GDP (PPP) per capita, which is taken from IMF's World Economic Outlook (WEO) database and is expressed in logarithms. If the data on some variables were not available at the quarterly frequency, we used linear interpolation to convert annual data to a quarterly frequency. A detailed description of all the variables included in our regressions, as well as their sources, is provided in Table A1 in the online Appendix, while the summary statistics are reported in Table 1. Table A2 in the online Appendix reports correlations between the variables.

Table 1 Summary Statistics

Variable	*Unit*	*Obs*	*Mean*	*St. Dev.*	*Min*	*Max*
Gini	Index	768	29.62	3.57	20.90	37.90
Bottom 10 % to Top 10 %	Ratio	593	7.80	2.07	4.53	17.48
Bottom 20 % to Top 20 %	Ratio	593	4.73	0.95	3.17	7.81
Bottom 40 % to Top 10 %	Ratio	593	20.73	4.95	12.83	47.65
Eonia	%	768	0.40	1.10	-0.36	4.25
QE	EUR bn	768	45.15	82.80	0.00	452.59
CE	EUR bn	768	101.96	176.78	0.182	1218.12
Unemployment	%	768	9.52	5.08	3.30	27.70
Real GDP	Index	768	101.38	12.90	72.43	167.03
Median age	Years	768	40.98	2.63	33.33	46.30
Tax rate	%	768	37.35	5.59	23.00	48.60
GDP (PPP) per capita	PPP, USD	768	40,454	16,312	22,539	106,372
Financial development	Index	692	0.63	0.16	0.26	0.90
Credit-to-GDP	Ratio	768	1.07	0.51	0.38	2.70
FINTEC	Index	768	0.41	0.15	0.16	0.69
Credit-to-GDP gap	Deviation	768	-0.00	0.04	-0.26	0.25
Real estate prices gap	Deviation	762	-0.11	2.27	-7.10	7.62
Stock prices gap	Deviation	768	0.09	9.44	-27.96	41.30

[7] For example, Barro (2000) argues that at initial stages of economic development, growth first increases inequality, while at the later development stage, the effect of growth on inequality turns negative. Generally, one could argue that economic growth could be assumed to lead to lower unemployment, which increases the earnings of especially poorer and low-skilled workers – with the result being lower inequality. On the other hand, if the growth is driven by increasing productivity of only some sectors of the economy, the result could be higher inequality.

The summary statistics indicate that the Gini coefficient for the EA member states varied between 20.9 p.p. and 37.9 p.p., with the average value standing at 29.6 p.p. The summary statistics also confirm that the Gini coefficient indeed exhibits lower variability when compared to the three alternative measures of income inequality – as evidenced by their comparatively higher standard deviation. Additionally, the QE policies were on average smaller in volume than the CE policies, owing to the fact that the QE policies were only introduced in 2015, that is, later than the CE policies. The EA member states also exhibited high heterogeneity with regards to their economic performance, as evidenced by significant variation in their unemployment rates and GDP per capita. On the other hand, the EA countries have relatively old population, with average median age exceeding 40, and mostly high rates of fiscal redistribution, with average ratio of tax income to GDP standing at almost 40 %. While EA countries exhibit high levels of financial development and their average credit-to-GDP ratio exceeds 1, large differences among member states persist. Finally, the credit-to-GDP, real estate and stock prices gaps do not seem to have been very large.

6. Results

In the following section, we report our results. First, we focus on the results of our baseline regressions, which examine the long-term and short-term distributional effects of both the standard and non-standard monetary policies of the ECB. Second, we investigate the role of financial heterogeneity across the EA member states in affecting the distributional effects of monetary policies. Third, we report the results of several robustness checks.

6.1 Distributional Effects of Standard and Non-Standard Monetary Policies

In Table 2, we report the results of our baseline regressions estimated with the PMG estimator. Our results for the standard monetary policies are in line with the results of most previous studies, as we find a positive and statistically significant coefficient on Eonia, our proxy for standard monetary policy, in the long-run equation. This finding indicates that an increase in interest rates (i.e., restrictive standard monetary policy) leads to a higher Gini coefficient (i.e., higher income inequality). Thus, based on our results, it seems that restrictive standard monetary policy (reflected by higher interest rates) does indeed have the expected negative effects on borrowers, who are more likely to be low earners. While the coefficients for the Eonia interest rate vary in size across the respective specifications, the coefficient estimated in the baseline specification, that is after controlling for the tax rate and GDP (PPP) per capita, indicates that an increase in the Eonia interest rate by 1 p.p. (which is slightly less than one standard deviation) is associated with an increase in the Gini coefficient of approximately 0.5 p.p. in the long term. This increase in the Gini coefficient is thus somewhat lower than the average standard deviation of the Gini coefficient time series for the respective EA member states, which equals 0.85 p.p. On the other hand, we do not find a statistically significant short-term effect of standard monetary policy on income inequality. This finding can probably be explained by the fact that income inequality as measured by the Gini

coefficient is rather stagnant in the short run, leading to insignificant estimates of the short-run effects of standard monetary policy on inequality.

Table 2 Effect of Standard and Non-Standard Monetary Policies on Income Inequality

	(1)	(2)	(3)	(4)	(5)
Variables			***Gini***		
Long-run equation					
Eonia	1.206***	0.489***	0.544***	0.655***	2.385***
	(0.181)	(0.100)	(0.092)	(0.122)	(0.754)
QE				0.908***	
				(0.085)	
CE					0.587*
					(0.353)
Unemployment	0.416***	0.551***	0.466***	0.435***	0.734***
	(0.028)	(0.030)	(0.024)	(0.048)	(0.176)
Real GDP	0.041***	0.057***	0.058***	0.136***	0.043
	(0.014)	(0.008)	(0.010)	(0.022)	(0.066)
Median age	0.155*	-0.456***	0.039	-0.783***	-1.654***
	(0.087)	(0.105)	(0.092)	(0.116)	(0.523)
Tax rate		-0.100***	-0.102***	0.066*	-0.227
		(0.020)	(0.024)	(0.038)	(0.149)
GDP (PPP) per capita			-1.466**	-13.387***	8.156
			(0.718)	(1.356)	(7.073)
Constant	14.375***	39.491***	35.336***	171.182***	1.051
	(4.253)	(3.595)	(8.331)	(13.453)	(56.039)
Short-run equation					
Error correction	-0.024**	-0.030**	-0.032**	-0.033**	-0.013***
	(0.011)	(0.015)	(0.015)	(0.014)	(0.005)
D.Eonia	0.028	0.029	0.026	0.122	-0.076
	(0.033)	(0.035)	(0.034)	(0.105)	(0.122)
D.QE				0.040	
				(0.100)	
D.CE					0.063
					(0.132)
D.Unemployment	0.018	0.018	0.023	-0.003	-0.038
	(0.031)	(0.035)	(0.034)	(0.029)	(0.035)
D.Real GDP	-0.017	-0.022	-0.024	-0.041	-0.017
	(0.016)	(0.014)	(0.018)	(0.025)	(0.017)
Observations	817	817	817	740	749

Notes: The income inequality is measured with the Gini coefficient. The coefficients were estimated using the PMG estimator. *D* stands for first difference. We did not include the variables *Median age*, *Tax rate* and *GDP (PPP) per capita* in the short-run equation, as these variables are linearly interpolated to quarterly frequency from annual frequency – thus differencing them would lead to 4 similar values in each year. Additionally, the former two mentioned variables are rather constant over time and thus are unlikely to have any short-run effects on income inequality. Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

For non-standard monetary policies (both QE and CE), we also find statistically significant positive coefficients in the long-run equation in specifications

(4) and (5).[8] This finding indicates that these policies also affect income inequality over the long-run, albeit for credit easing policies only at a 10% level of significance. Furthermore, the effect of CE policies on income inequality seems to be only half the size of the effect of QE policies. In other words, a one standard deviation increase in QE volume is associated with an increase in the Gini coefficient of 1.75 p.p., while an increase in CE volume of one standard deviation is associated with an increase in the Gini coefficient of approximately 1.15 p.p. Our baseline regressions thus offer some evidence that in the Euro Area as a whole, the portfolio effect prevailed over the macroeconomic effect of unconventional policies in the long run. This is especially the case for the QE policies, and much less so for the credit easing policies. This finding is in line with our prior expectations, as QE policies may contribute significantly to higher asset prices and thus disproportionately benefit the wealthier households. On the other hand, CE policies focus on providing liquidity to banks and thus enabling banks to extend more credit to households (and thus ease households' financing constraints), and therefore, we would expect the effect of CE policies on inequality to be rather less significant.[9] Once again, we fail to find a statistically significant short-run effect of non-standard policies on inequality.

Our baseline regressions also indicate that the higher unemployment rate in the EA countries does have a statistically significant effect on income inequality. As expected, higher unemployment leads to higher inequality. We also find that higher real GDP growth also seems to lead to higher inequality, while the negative coefficient on the GDP (PPP) per capita indicates that the richer the EA member states are, the more equal their societies are. The rather startling finding that the higher real GDP growth raises inequality could be explained by the reasoning put forward by Barro (2000): higher GDP growth may contribute to higher inequality if that growth is driven by the productivity growth in only some sectors of the economy – then, the economic growth may not lead to a substantial increase in employment and the associated increase in incomes of lowest earners. Similar finding was obtained by Rubin and Segal (2015) for the United States. The results for unemployment, real GDP and GDP (PPP) per capita are broadly stable across the different specifications. On the other hand, for the median age of the population and tax rates, our results are mixed. For median age, we find a statistically significant and negative coefficient in the baseline regressions (apart from the standard monetary policy regression), providing some weak evidence that the older the population of a country is, the more egalitarian its society is. For the overall tax rate, we find the expected negative coefficient only in the standard monetary policy regression. Once we introduce the measures of unconventional policies, the statistical significance of the coefficient either disappears (for CE regression), or it even turns positive, though it is only significant at the 10 % level. Therefore, we find very limited evidence that higher overall tax rates had lowered income inequality in the EA. This rather

[8] The inclusion of the measures of non-standard monetary policies reduces our sample size slightly – due to missing observations for the non-standard measures for some countries.

[9] Nevertheless, the increased credit provision is more likely to benefit the higher- and middle-class earners, which explains the small positive effect of CE policies on inequality found in our baseline regression. Furthermore, banks may also use some of the liquidity provided by the central bank to invest on financial markets, leading to higher financial asset prices.

puzzling finding could be explained by the fact that across the entire EA, the overall tax rates are rather high and differences among the member states are limited. Furthermore, the overall tax revenues to GDP remained relatively stagnant during the studied period. The error correction term is negative and statistically significant in all specifications, indicating the presence of error correction.

6.2 Distributional Effects of Monetary Policy and Financial Heterogeneity

In the next step of our analysis, we investigate the conditionality of distributional effects of monetary policy in the EA on the financial heterogeneity across the respective member states. Therefore, we include interaction terms that interact our measures of financial heterogeneity and our measures of both standard and non-standard monetary policies in our regression framework.[10]

We first focus on differences in the level of financial development among the respective EA member states and on the role of financial integration among the EA members. The results of these regressions are reported in Table 3. When using the IMF's Financial Development Index as our measure of financial development, we find that the higher the financial development, the higher the income inequality. Furthermore, we find that financial development as measured by the financial development index affects the transmission of standard, QE and CE policies to income inequality. For standard monetary policy, we find that in countries with higher levels of financial development, the restrictive standard monetary policy leads to a more significant increase in income inequality than that in countries with lower levels of financial development, as evidenced by the positive and statistically significant coefficient of the interaction term in specification (1) in Table 3. This finding could be explained by the fact that in countries with higher levels of financial development, there are relatively more lenders and borrowers, and developments in financial markets also play a more significant role in the economy. For QE policies, we find, interestingly, that once we control for the level of financial development and the interaction between QE and financial development, the coefficient on QE becomes negative, suggesting that after controlling for different levels of financial development, QE policies actually lead to lower income inequality. This finding is in line with our theoretical expectations. Namely, QE policies may affect inequality through two main channels, portfolio composition channel and the earnings heterogeneity channel. When operating through the earnings heterogeneity channel, QE may be expected to lead to lower inequality. By improving economic performance and lowering unemployment, QE is likely to especially benefit the poorest households (by lifting their income). This effect is likely to operate across all EA member states (that is, regardless of their level of financial development). When operating through the portfolio composition channel, QE is expected to contribute to higher inequality by increasing asset prices (which are more likely to be held by richer households). Therefore, this effect is likely to be more significant in EA member states with more developed financial markets. Our results seem to corroborate these assumptions, as the coefficient on QE not only turns negative when we control for financial development, but the coefficient on the interaction term is

[10] We have demeaned the variables that are included in the interaction term to deal with collinearity issues.

also positive and statistically significant. This finding suggests that the higher the level of financial development is, the more significant is the contribution of QE policies to the increase in income inequality. We also find that for countries with higher levels of financial development, the CE policies have a more significant effect on income inequality, albeit this effect is smaller than in the case of QE policies. To better illustrate the economic significance of our results, we have calculated the total marginal effects of the three types of monetary policies on income inequality – conditional on the minimum, mean minus the standard deviation, mean, mean plus the standard deviation and maximum values of the respective financial heterogeneity measures. We plot the estimated total marginal effects in Figure A3 in the online Appendix, where the 9 plots correspond to specifications 1-9 from Table 3. The total marginal effects indicate that the standard monetary policies' transmission to income inequality does not vary significantly with the level of financial development, with a difference in the effect of standard monetary policy of only approximately 1 p.p. of the Gini coefficient between the country with the highest observed level of financial development in the EA and the country with the lowest observed level of financial development. On the other hand, the difference in the effect of QE policies on the Gini coefficient between the countries with the highest and lowest observed values of the financial development index represents almost 6 p.p., while for the CE policies the difference represents approximately 3 p.p.

Furthermore, we also use another commonly used measure for the level of financial development: the credit-to-GDP ratio. These results are reported in specifications 4-6 in Table 3. Here, we once again find that higher levels of credit relative to GDP (i.e., more financially developed countries) lead to higher income inequality. Nevertheless, the coefficient for the interaction term with the Eonia is not statistically significant; that is, here we do not find that higher levels of credit relative to GDP magnify the effects of standard monetary policy on income inequality. On the other hand, for both measures of non-standard monetary policies, we once again find that their impact on income inequality is stronger in countries with higher levels of credit-to-GDP ratio. These results are thus similar to the results obtained when we used the financial development index as our measure of financial development. However, for the credit-to-GDP ratio, it seems that CE policies have stronger distributional effects in countries with higher credit-to-GDP ratios than QE policies have. This result could be explained by the fact that the CE policies were designed to directly affect bank lending; thus, CE policies could be expected to have stronger effects in countries with higher levels of credit relative to GDP.[11]

[11] Namely, CE policies (such as Targeted Longer-Term Refinancing Operations, TLTROs) were provided to banks that needed to raise funds, regardless of the country they are based in. Consequently, the largest amount of liquidity through the CE policies was provided to banks from southern EA member states (i.e., Italy and Spain), which are also among the countries with highest credit-to-GDP ratios and where the banking sectors are particularly fragile. Nevertheless, in these countries, the constrained banks did not increase their lending significantly, indicating either that the additional credit was extended rather to higher and middle earners or that the banks used the additional liquidity to invest in financial markets, thus contributing to higher income inequality.

Table 3 Distributional Effects of Monetary Policies: Role of Financial Development and Financial Market Integration

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
					Gini				
Long-run equation									
Eonia	0.355***	0.255*	0.769***	0.288	1.098***	0.387	0.062	0.495***	0.385***
	(0.104)	(0.146)	(0.146)	(0.261)	(0.212)	(0.322)	(0.120)	(0.084)	(0.092)
QE		-1.619***			-0.643**			1.005***	
		(0.362)			(0.281)			(0.056)	
CE			0.583***			0.212			0.239***
			(0.180)			(0.388)			(0.088)
Interact	1.705**	7.778***	4.429***	0.233	1.976***	3.398**	1.364***	-1.135***	-0.260
	(0.853)	(1.072)	(0.529)	(0.371)	(0.622)	(1.385)	(0.508)	(0.223)	(0.366)
Financial development	15.105***	29.638***	0.736						
	(0.929)	(5.290)	(2.170)						
Credit-to-GDP				1.900*	12.120***	4.669**			
				(0.991)	(1.837)	(1.862)			
FINTEC							0.279	0.405	0.386
							(0.430)	(0.453)	(0.416)
Unemployment	0.368***	0.319***	0.262***	0.298***	0.484***	0.015	0.195***	0.330***	0.400***
	(0.021)	(0.070)	(0.044)	(0.090)	(0.063)	(0.133)	(0.024)	(0.035)	(0.030)
Real GDP	0.042***	-0.154***	-0.006	-0.191**	0.191***	-0.412***	0.013	0.095***	0.060***
	(0.009)	(0.057)	(0.023)	(0.082)	(0.029)	(0.119)	(0.012)	(0.017)	(0.010)
Median age	0.404***	0.444***	0.240***	0.281	0.805***	-0.532	0.278***	-0.426***	0.011
	(0.045)	(0.149)	(0.064)	(0.380)	(0.257)	(0.649)	(0.053)	(0.087)	(0.094)
Tax rate	-0.141***	-0.277***	-0.323***	-1.214***	0.586***	-1.149***	-0.273***	-0.038	-0.112***
	(0.017)	(0.077)	(0.046)	(0.192)	(0.115)	(0.265)	(0.017)	(0.027)	(0.023)
GDP (PPP) per capita	-2.239***	4.925*	0.690	-9.832**	-3.510*	-11.737*	-4.358***	-11.435***	-3.190***
	(0.636)	(2.924)	(2.036)	(4.411)	(1.936)	(6.362)	(1.004)	(1.090)	(0.939)
Constant	24.191***	-21.596	16.545	174.494***	-21.851	243.586***	71.377***	144.640***	53.113***
	(6.750)	(27.314)	(18.105)	(47.862)	(21.402)	(72.183)	(10.908)	(10.748)	(10.530)
Short-run equation									
Error correction	-0.043**	-0.025*	-0.055**	-0.017***	-0.018**	-0.012**	-0.044**	-0.043**	-0.037**
	(0.019)	(0.014)	(0.022)	(0.007)	(0.008)	(0.005)	(0.018)	(0.020)	(0.017)
Observations	753	740	749	753	740	749	753	740	749

Notes: The income inequality is measured with the Gini coefficient. The coefficients were estimated using the PMG estimator. For brevity, apart from Error correction term, we do not report the coefficients from short-run equation here. However, they are available from authors upon request. Interact is defined as a product of either of our three measures of monetary policies (Eonia, QE, CE) and three measures of financial heterogeneity (Financial development, Credit-to-GDP, FINTEC). That is, for specifications 1-3 the interaction term contains Financial development, for specifications 4-6 Credit-to-GDP and for specifications 7-9 FINTEC. For specifications 1, 4, 7 the interaction term contains Eonia, for specifications 2,5,8 QE and for specifications 3, 6, 9 CE. *Financial development* is the financial development index from the IMF, *Credit-to-GDP* is measured as private credit to GDP, and *FINTEC* is ECB's measure of financial market integration in the Euro Area. Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

Additionally, in specifications 7-9 in Table 3 we also report the results of the regressions where we studied the role of financial market integration in the Euro Area in affecting the distributional effects of monetary policies. We use the ECB's composite FINTEC index as our measure of financial market integration in the EA. We fail to find evidence that the level of financial integration itself affected the level of income inequality in the EA. However, we do find evidence that higher levels of financial integration increase the positive effect of restrictive standard monetary policies on income inequality, while they reduce the positive effect of QE policies on inequality (that is, with higher levels of financial integration, QE policies increase income inequality less significantly). These findings are in line with our prior expectations. As the increased level of financial market integration is expected to improve the transmission of standard monetary policies to interest rates across the EA[12] (Paries et al., 2014), while for QE policies, our results indicate that the positive effect of higher financial market integration on funding and investment conditions prevailed, leading to stronger positive effect of QE on real economy, which contributes to lower income inequality. Nonetheless, as illustrated in Figure A3 in the online Appendix, the effect of financial market integration on distributional effects of monetary policy is rather small, with the difference between the distributional effects of monetary policies at the highest and the lowest observations of the FINTEC index being less than 1 p.p. of the Gini coefficient.

Second, we study the role of financial cycles in affecting the distributional effects of monetary policy. We focus on three distinct components of financial cycle: credit, real estate prices and stock prices. The results of these regressions are reported in Table 4. Here, we first use the standard Hodrick-Prescott (HP) filter to calculate the credit-to-GDP gap so that we can study the role of the credit cycle stage in affecting the distributional effects of the monetary policies. We do not find conclusive evidence that the stage of the credit cycle affects the level of income inequality. Nonetheless, we do find evidence that the stage of the credit cycle affects the distributional effects of both our measures of non-standard monetary policies. For both QE and CE policies, we find that the more positive the credit-to-GDP gap (i.e., being in the expansionary stage of the credit cycle), the more significantly do these policies increase income inequality. The effect seems to be moderate in size, and slightly larger for QE policies than CE policies, as illustrated in Figure A4 in the online Appendix.

[12] And by extension exert stronger distributional effects.

Table 4 Distributional Effects of Monetary Policies: Role of Financial Cycles

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
					Gini				
Long-run equation									
Eonia	0.472***	0.629***	0.557***	0.531***	0.316***	0.426***	0.975***	0.633***	0.654***
	(0.096)	(0.124)	(0.123)	(0.185)	(0.095)	(0.109)	(0.228)	(0.126)	(0.179)
QE		0.856***			0.126			0.877***	
		(0.086)			(0.179)			(0.089)	
CE			0.639***			0.691***			0.676***
			(0.094)			(0.107)			(0.132)
Interact	3.257	7.844***	4.131*	0.216**	-0.210***	0.223***	-0.019**	-0.017**	-0.027***
	(2.064)	(2.321)	(2.445)	(0.087)	(0.061)	(0.027)	(0.009)	(0.008)	(0.010)
Credit-to-GDP gap	1.955	2.508	10.663***						
	(1.932)	(3.910)	(3.784)						
Real estate prices gap				0.160***	0.072*	-0.281***			
				(0.044)	(0.040)	(0.052)			
Stock prices gap							-0.032**	0.022	0.031
							(0.013)	(0.017)	(0.020)
Unemployment	0.551***	0.438***	0.792***	0.354***	0.228***	0.347***	0.744***	0.438***	0.512***
	(0.027)	(0.051)	(0.058)	(0.050)	(0.041)	(0.034)	(0.048)	(0.051)	(0.062)
Real GDP	0.055***	0.139***	0.187***	-0.057	-0.027	0.123***	0.086***	0.132***	0.138***
	(0.010)	(0.024)	(0.029)	(0.046)	(0.030)	(0.026)	(0.033)	(0.024)	(0.031)
Median age	-0.465***	-0.806***	-1.352***	-0.759***	0.105	-0.643***	-1.495***	-0.823***	-0.949***
	(0.096)	(0.117)	(0.133)	(0.201)	(0.107)	(0.072)	(0.152)	(0.119)	(0.144)
Tax rate	-0.105***	0.085**	-0.187***	-0.099***	-0.312***	0.021	0.058	0.074*	0.110*
	(0.029)	(0.041)	(0.034)	(0.033)	(0.024)	(0.030)	(0.080)	(0.040)	(0.060)
GDP (PPP) per capita	0.190	-13.678***	-0.192	2.861	-0.709	-12.055***	1.109	-13.384***	-10.250***
	(0.897)	(1.478)	(0.818)	(3.462)	(1.414)	(1.656)	(3.257)	(1.442)	(2.158)
Constant	38.301***	174.495***	60.476***	36.798	44.040***	158.058***	59.518**	173.144***	144.186***
	(9.281)	(13.731)	(9.310)	(26.554)	(12.070)	(14.771)	(28.348)	(13.975)	(20.917)
Short-run equation									
Error correction	-0.033*	-0.031**	-0.035**	-0.022**	-0.026	-0.034**	-0.024**	-0.031**	-0.030***
	(0.018)	(0.014)	(0.014)	(0.009)	(0.017)	(0.016)	(0.011)	(0.014)	(0.011)
Observations	753	740	749	753	740	749	753	740	749

Notes: The income inequality is measured with the Gini coefficient. The coefficients were estimated using the PMG estimator. For brevity, apart from Error correction term, we do not report the coefficients from short-run equation here. However, they are available from authors upon request. Interact is defined as a product of either of our three measures of monetary policies (Eonia, QE, CE) and three measures of financial cycle (credit-to-GDP gap, real estate prices gap, stock prices gap). That is, for specifications 1-3 the interaction term contains credit-to-GDP gap, for specifications 4-6 real estate prices gap and for specifications 7-9 stock prices gap. For specifications 1, 4, 7 the interaction term contains Eonia, for specifications 2,5,8 QE and for specifications 3, 6, 9 CE. Credit-to-GDP gap is the deviation of private credit to GDP from its trend, Real estate prices gap is deviation of real estate prices from their trend, and Stock prices gap is measured as deviation of stock market index from its trend. All deviations from trend (i.e. gaps) were measured using the standard Hodrick-Prescott filter. Standard errors are in parentheses. * indicates significance at the 10% level, ** at the 5% level and *** at the 1% level.

We also use a similar approach to estimate the real estate prices gap, as it is often considered to be a distinctive feature of the financial cycle (Claessens et al., 2011). We find evidence that a more positive real estate prices gap has a small but statistically significant positive effect on income inequality. In other words, the expansionary stage of the real estate prices cycle is associated with a slightly higher level of income inequality. Similarly, we find a very weak but significant effect of the stage of the real estate prices cycle on the distributional effects of all three of our measures of monetary policies. We find that the expansionary stage of the property prices cycle slightly increases the positive effects of standard restrictive policy on inequality. On the other hand, for QE policies, the effect is slightly negative, while for CE policies, it is positive. In all cases, the economic significance of the coefficients is rather small. Consequently, as the statistical significance, sign and size of the coefficient on the interaction term varies somewhat, we are not able to draw firm conclusions regarding the effect of the stage of the real estate prices cycle on the distributional effects of monetary policy.

Finally, we also use the HP filter to estimate the stock prices gap for each of the 19 EA member states, so that we can study the role of the stage of the stock prices cycle. Here, we find that all three coefficients on the interaction terms are statistically significant and negative, albeit very small, suggesting that the expansionary stage of the stock prices cycle slightly reduces the distributional effects of monetary policies. Thus, it seems that the stock market cycle does not significantly impact the distributional effects of monetary policy.

6.3 Robustness checks

As a first robustness check, we re-estimate our baseline regressions with the BCFE estimator, which enables us to control for unobserved cross-sectional heterogeneity and for the lagged value of income inequality.[13] The results of these estimations are reported in Table A8 in the online Appendix. The obtained results also indicate that both the QE and CE policies had a statistically significant effect on income inequality in the Euro Area, and that these policies do seem to have contributed to higher income inequality. However, for the Eonia, while the coefficient still remains positive, it loses statistical significance in almost all specifications. Only once we introduce our measures of non-standard monetary policies does the coefficient on the Eonia regain its statistical significance. Using the BCFE estimator, we also once again find that higher unemployment contributes to higher inequality, while higher median age and overall tax rate reduce income inequality, similar to the results we obtained using the PMG estimator. On the other hand, using the BCFE estimator, we do not find evidence that real GDP or GDP (PPP) per capita had any statistically significant effect on inequality. Nonetheless, we do find that a higher GDP deflator (i.e., higher inflation) seem to have contributed to

[13] As this approach is not cointegration-based, we were able to include additional control variables in our regressions, too. These additional variables include share of the population in post-productive age and inflation (proxied by the year-on-year GDP deflator). Furthermore, using this approach, we are also able to include the year time effects in the regressions – to control for time-specific variability of income inequality developments during the studied period.

lower inequality, probably by reducing the debt servicing costs of debtors (who are more likely to be low earners).

In another robustness check, we focus on our somewhat inconclusive results from the baseline regressions regarding the role of the real estate prices gap in affecting the distributional effects of monetary policy by using another measure of real estate prices gap. As a result, we replaced the main measure of real estate prices gap, which was calculated separately for each EA member state, with a Euro Area-wide measure for real estate prices gap. These results are reported in Table A9 in the online Appendix. The reported results corroborate our findings for the standard monetary policies but not for the non-standard monetary policies, as the coefficient on the interaction term is insignificant for QE policies and significant and negative for CE policies. These divergent results could be driven by the rather desynchronized real estate prices cycles, as illustrated in Figure A10 in the online Appendix, and heterogeneous real estate markets across the EA. Nevertheless, once again, as the statistical significance, sign and size of the coefficient on the interaction term varies somewhat, we are not able to draw firm conclusions regarding the effect of the stage of the real estate prices cycle on the distributional effects of monetary policy.[14]

In our baseline regressions, we found that the stock market cycle plays only a very minor role in influencing the distributional effects of monetary policy. We hypothesize that these somewhat insignificant results could be driven by the fact that many (especially smaller) EA member states have rather underdeveloped stock markets, leading citizens of these states to invest in other EA countries with more developed stock markets. Therefore, for the stock market, EA-wide (or global) stock market developments could be more important than local stock market developments. Therefore, we use the pan-European Eurostoxx50 stock market index to estimate the EA-wide stock prices gap and use it as an alternative measure of stock price gap. We report the results in specifications 4-6 in Table A9 in the online Appendix. Here, we once again find a statistically significant coefficient on the interaction terms in the case of the non-standard monetary policies. However, the estimated coefficients are once again very small in size. Thus, our results for the role of the stock market cycle in the transmission of the distributional effects of monetary policy are also rather inconclusive, suggesting that the stage of the stock prices cycle does not play a significant role in determining the distributional effects of monetary policies.

As a further robustness check, we address some of the shortcomings of our main measure of income inequality: the Gini coefficient. Namely, the Gini coefficients for small and large countries may not be completely comparable, the Gini coefficient places too much emphasis on the middle-class developments (i.e., developments in the middle of the income distribution), and the same Gini coefficients may arise from different underlying income distributions. Therefore, we define alternative measures of income inequality – based on the data on the shares of the population earning a certain portion of overall disposable income when the population is ordered from the poorest to the richest individual. The first of our

[14] We have also re-estimated the regressions without the measure of the real estate prices gap (i.e., leaving only the interaction term in the regression). Once again, the significance and sign of the interaction term varies, suggesting that these results are not driven by correlation between the real estate prices gap measure and the interaction term.

alternative measures of income inequality is the ratio of the bottom 10 % to the top 10 %, where the bottom 10 % represents the population share of the poorest individuals earning 10 % of overall disposable income, and top 10 % is the population share of the richest individuals earning 10 % of overall disposable income. Additionally, we use two other measures of inequality: the ratio of bottom 20 % to top 20 % and the ratio of bottom 40 % to top 10 %.[15] For all of our alternative inequality measures, an increase in their value reflects an increase in income inequality.[16] As these alternative measures of inequality emphasize the tails of the income distribution, they may also better capture both the cross-sectional and time series heterogeneity in income inequality during the studied period than the Gini coefficient does. Figures A5-A8 in the online Appendix display the development of the Gini coefficient, as well as the first of our alternative measures of inequality (including its components – bottom 10 % and top 10 %) for the respective EA member states. Furthermore, Figure A2 in the online Appendix compares the changes in the Gini coefficient and the ratio of the bottom 10 % and top 10 % between 2008 and 2015 in all EA countries. The figure seems to indicate that the alternative measure of inequality exhibits somewhat greater cross-sectional and time series heterogeneity than the Gini coefficient.

The results of the regressions with the alternative measures of income inequality are reported in Table A10 in the online Appendix. Due to the lower number of observations in this case (as our data on alternative inequality measures only extend through 2016) and the resulting estimation issues with the cointegrating PMG estimator, we estimated these regressions using only the BCFE estimator. Our findings do support our conclusions for standard monetary policy; we once again find that restrictive standard monetary policy leads to higher inequality. Nevertheless, for the nonstandard policies, while the coefficients on both the QE and CE policies remain positive, they are no longer statistically significant. Thus, these results diverge from the baseline results obtained when we used the Gini coefficient as our measure of income inequality. This divergence could be caused by the use of different measures of income inequality, as the QE and CE policies may have had a more significant effect on the distribution of income among the middle classes; thus, their effects are captured by the Gini coefficient but not by the alternative measures

[15] Our approach is thus based on Palma (2011), who argued that the developments in the bottom and top of the income distribution are driving changes in income inequality. Consequently, we have defined all our alternative measures of inequality as ratios of the bottom and upper tails of the income distributions. We selected the three particular ratios as follows: we selected the first ratio (i.e., bottom 10 % to top 10 %) so that we can concentrate on the relative fortunes of the richest and poorest individuals earning the top and bottom 10 % of overall income. The second ratio was selected based on Kochhar (2017), who found that in most Western European countries, slightly less than 20 % of the population live in lower-income households, while slightly less than 10 % of the population live in upper-class households, while the third ratio was selected based on Palma (2011), even though these authors discuss the share of the population, whereas our measures are based on shares of overall disposable income.

[16] For example, for the bottom 10 % to top 10 % ratio, an increase in the value of bottom 10 % would mean that more poorest individuals are needed to earn 10 % of overall disposable income. That is, the larger the bottom 10 % (and the larger the numerator), the higher the inequality. On the other hand, the lower the value of top 10 %, the fewer richest individuals are needed to earn 10 % of overall disposable income. Therefore, the smaller the top 10 % (and the smaller the denominator), the higher the inequality. As a result, the higher the ratio of the bottom 10 % to top 10 %, the higher the income inequality.

of inequality. This hypothesis is based on the assumption that the non-standard policies could be expected to boost the income of both the highest earners (through portfolio composition channel) and the lowest earners (through the employment channel).[17] Assuming that both effects were approximately equal in size, the policy would not alter the relative positions of the lowest and highest earners.[18] However, the UMPs' employment effects on the lower middle class are likely to be small, while the upper middle class may benefit more from increased financial assets prices, thus leading to increased inequality within the middle class. The empirical results of Casiraghi et al. (2018) for Italy support this reasoning. Alternatively, the divergence in the results obtained for the Gini coefficient and for the alternative measures of inequality could also be partly explained by the different time spans of the analyses, as for the alternative measures of inequality, our data end in 2016 (i.e., only the first two years of QE implementation is captured in the analysis).

In another robustness check, we use another measure of monetary policy: the shadow rate. The shadow rate enhances the standard short-term interest rates when the zero lower bound had been reached. The shadow rate is thus a proxy for overall expansionary monetary policy (both standard and non-standard). It also measures the effects of other unconventional policies such as forward guidance. The results of the regressions with shadow rate (estimated using both the PMG and BCFE estimators) are reported in specifications 1-2 in Table A11 in the online Appendix. These results differ across the estimators. When using the PMG estimator, we find the coefficient on the shadow rate to be positive and statistically significant, suggesting that over the long-term, overall contractionary monetary policy leads to an increase in income inequality. This finding is in line with our baseline results. On the other hand, using the BCFE estimator, the coefficient on the shadow rate retains its positive sign but loses its statistical significance, suggesting that the shadow rate, as a measure of the overall stance of monetary policy, does not affect income inequality. Nevertheless, we argue that this finding is in fact in line with our results from the baseline regressions. Namely, the shadow rate controls for both standard and non-standard monetary policies, and the lower the value it attains, the more expansionary the monetary policy is. However, for our baseline regressions, an increase in the value of the Eonia represents restrictive monetary policy, while an increase in the value of the QE and CE measures indicates expansionary policies. Thus, the positive coefficients for both the standard and non-standard monetary policies indicate that both restrictive standard and expansionary non-standard policies increase income inequality. As for the shadow rate, a decrease in its value represents an overall expansionary policy (both standard and non-standard), we argue that the effects of these two main types of policies may cancel each other out, resulting in the inconclusive results obtained for the shadow rate using the BCFE estimator.

Finally, we also use another measure of QE policies: we proxy QE policies with the amount of sovereign bonds issued by respective EA member states and held

[17] Obviously, the overall effect on inequality would depend on which of these channels is stronger.

[18] For example, Coibion et al. (2017) found that a monetary policy shock increases the labour income of the richest 10 % of households, but the labour income of the poorest 10 % of households also increases, leading to a more skewed earnings distribution.

by the Eurosystem.[19] In comparison to our main measure of QE policies, this alternative measure could help us to control for the fact that the respective national central banks could have been purchasing sovereign bonds issued by other national governments from foreign banks; that is, these QE purchases may not have increased the liquidity of their respective national financial systems. However, the obvious drawback of this alternative measure of QE is that the sovereign bonds of some EA member states could have also been held by banks from other countries.[20] The results of the regressions using the alternative measure of QE policies are reported in specifications 3-4 in Table A11 in the online Appendix. Once again, the regressions were estimated using both the PMG and BCFE estimators. Here, our findings do support our baseline conclusions, as the coefficient for the alternative QE measure using both estimators is positive and statistically significant. These results therefore also indicate that the QE policies lead to higher income inequality.

7. Conclusions

We study the distributional effects of both the standard and non-standard monetary policies of the ECB over the years 2008-2018. Furthermore, we also study how the distributional effects of monetary policy are conditioned on the financial heterogeneity among the Euro Area member states. Our results contribute to the literature in several respects. First, using the PMG estimator of Pesaran et al. (1999) on a panel of all 19 EA countries, we find that there exists a long-term relationship between monetary policy and income inequality. To the best of our knowledge, this paper represents a first attempt to empirically investigate the long-term effects of both standard and non-standard monetary policies. Using the Gini coefficient as our main measure of income inequality, we find that restrictive standard monetary policy contributes to higher income inequality. Thus, our findings corroborate the theoretical assumptions. The second contribution of our paper is that we distinguish between standard and two types of non-standard monetary policies. For non-standard monetary policies, we also find a statistically significant positive long-term effect of both the QE and CE policies on income inequality. Therefore, our findings are in line with some previous studies (Saiki and Frost, 2014; Montecino and Epstein, 2017; Mumtaz and Theophilopoulou, 2017). In comparison to these earlier studies, our results indicate that the very accommodative monetary policy of the ECB, which has lasted for over a decade, may have more long-term and persistent effects on income

[19] That is, as opposed to our main measure of QE policies, this measure does not account for the amount of sovereign bonds held by the respective national central banks, such as the outstanding volume of sovereign bonds held by the German central bank in the case of Germany. Instead, this alternative measure of QE accounts for the overall amount of sovereign bonds issued by respective EA member states. For example, in the case of Germany, the measure would take the value of all outstanding German sovereign bonds held by the entire Eurosystem, regardless of whether these German sovereign bonds were held by the German central bank or any other national central bank.

[20] For example, German sovereign bonds could have been held by, say, a Latvian commercial bank, and these bonds could then be purchased by the Latvian central bank; thus, such a transaction would lead to a liquidity injection into the Latvian financial system. This transaction would be correctly assigned to Latvia by our main measure of QE policies, but not by our alternative measure of QE policies, which would assign this purchase to Germany.

inequality. As a result, the distributional effects of monetary policy may not be a just a transitory phenomenon – as it is often assumed.

Nonetheless, the theoretical models and previous empirical studies have so far only provided conflicting results with regards to the overall distributional effects of non-standard monetary policies (i.e., positive or negative). To address these conflicting findings, in the third contribution of our research, we do find evidence that financial heterogeneity across countries affects the distributional effects of monetary policy. Thus, the existing financial heterogeneity across countries may explain the conflicting findings of the prior studies. In particular, our results for the Euro Area seem to be driven by member states with higher financial development. In other words, both standard and non-standard monetary policies affect income inequality more strongly in countries with higher financial development. The effect of the level of financial development on the distributional effects of monetary policy was found to be particularly large in the case of QE. Our findings indicate that the QE reduces inequality in countries with lower levels of financial development, while it increases inequality in countries with higher financial development. Additionally, we also find that the increased level of financial market integration among the EA member states slightly enhances the effects of standard monetary policy on inequality, while it slightly reduces the distributional effects of QE policies. We also find robust evidence that the expansionary stage of the credit cycle moderately enhances the distributional effects of both QE and CE policies. On the other hand, we fail to find robust and conclusive evidence that stage of the stock prices and real estate prices cycles affects the distributional effects of either standard or non-standard monetary policies.

The final contribution of this study is the use of alternative measures of income inequality, which we have defined as the ratios of the population share of the poorest individuals to the population share of the richest individuals. Using these alternative measures of inequality, we confirm our findings for standard monetary policy, but not for either of the non-standard policies, for which we fail to find a statistically significant effect on the alternative measures of inequality. We hypothesize that these divergent results could be caused by the slightly different time spans of the analyses, and/or by the fact that since the Gini coefficient places a much stronger emphasis on middle-class developments, non-standard monetary policies could have had a more significant effect on the middle-class income distribution, which our alternative measures of inequality failed to fully capture. This notion certainly presents an interesting area for further research.

This paper contributes to the ongoing discussions on the consequences of ultra-loose monetary policy, on the relationship between the monetary policy and income inequality and on the heterogeneity of monetary policy transmission. While income inequality is not among the goals of monetary policy, we argue that our findings are also relevant for policymakers. Particularly, our findings may help the policymakers to better understand the distributional effects of various types of monetary policies across different countries. Namely, the increased inequality partially caused by monetary policies, may not only erode public support for central bank and its policies but may also hinder the effectiveness of monetary policy transmission itself or decrease the financial stability. On the top of that, our results also indicate that the distributional effects of monetary policies may have a more

long-term character and thus may not be just a transitory phenomenon. However, as the non-standard monetary policies in the Euro Area have only been introduced relatively recently, our results are, admittedly, somewhat constrained by the relative lack of available data. Consequently, this research can be further extended in the future when more data become available.

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