Income Inequality as Conditioning Factor of Monetary Transmission in EA Countries

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Abstract

Interaction between income inequality and monetary policy has become an important subject to both, researchers and policy makers, over the course of the last few years. While there exists a sound consensus that standard monetary policy might contribute to change in income inequality the literature on effects of unconventional measures has not yet reached consensus (Colciago et al. 2019). In this paper we investigate effect of income inequality on transmission of monetary policy shocks to the common set of monetary policy intermediate targets. These include interest rate on consumer and business loans, long-term interest rate, stock market and real estate prices. We hypothesize that the different levels of income inequality might affect transmission of monetary policy shocks across different markets. We use interacted panel error correction model (ECM) as in Leroy and Lucotte (2015) on the set of EA countries for the period of 2008-2016. Monetary policy

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shocks are triggered by both, the key interest rate manipulation as well as the use of unconventional monetary policy tools (as in Horvath et al. 2018) and are interacted with level of income inequality. Our results suggest that income inequality limits transmission of monetary policy shocks into consumer bank loan rates in case of credit easing policies. On top of that, income inequality affects stock price behaviour and may contribute to bank loan rates heterogeneity across EA in consumers' loans segment.

Keywords: monetary pass-through, interacted PMG, income inequality,
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1. Introduction

In the presence of prolonged period of zero-lower bound constraint in the Euro Area the possible distributional effects of unconventional monetary policy have raised serious concerns among many policy makers. The theoretical and empirical research responded quickly to the call and numerous contributions in this field have emerged delivering some tentative conclusions.

The general consensus has so far produced common belief that standard monetary policy is likely to lead to the changes in overall income inequality (Coibion et al. 2017). However, the most recent empirical literature still provides only vague guidance whether effects of unconventional monetary policies are transmitted into income inequality levels (Colciago et al. 2019).

Additionally, while redistributive effects of monetary policy should be acknowledged as they represent an integral part of monetary policy transmission mechanism, overall effects are likely to be modest (Ampudia et al. 2018). In contrast, persistent differences in income or wealth inequality might hinder transmission on monetary policy impulses into economy (Voinea et al. 2018), thus limit conduct of optimal monetary policy especially during times when they it is most needed.

As a point of interest, empirical data shows that average income inequality remains relatively persistent over time. Thus, short-term monetary shocks might introduce small disturbances into changing composition of income inequality and its dispersion but long-term trends and cross-country heterogeneity are likely to be driven by more fundamental factors (e.g. Tricido et al., 2018; Hasan et al. 2018).

Lastly, relevant literature has predominantly concerned itself with effect of

monetary policy on households' consumption behaviour (Voinea et al., 2018; Guerello, 2018), as the standard approach focusing on saving-investment channel postulates (Areaosa and Areosa, 2016). Yet, the possible connection between income inequality and set of benchmark intermediate categories targeted by monetary policy, such as bank loan rates or long-term yields, has been so far neglected.

In this paper we hypothesise that income inequality might affect transmission of monetary policy impulses into the intermediate targets even before the overall distribution is affected as a consequence. The income distribution itself might reflect embodied structural differences in the individual financial systems and as such affects demand side on this particular markets (Krueger and Perri, 2006). Higher share of low-income households characterized by the higher risk profile will translate into higher risk premium imposed on them by loan providers. Alternatively, higher share of middle-income households relying on standard, bank-created, sources of financing pushes the demand for loans upward effectively increasing the loan rates, if not accommodated by the supply-side reaction. On top of that, monetary policy impulse transmitted into the loan rates provided to the marginal low-income customer might encounter the firm lower bound if the associated risk profile of the customer has not been affected by improvement in overall economic conditions. On top of that, low-income and risky households may disproportionately suffer from credit rationing in particular during periods of severe economic downturns (Bazillier and Hericourt, 2014). And even if indirect effect of monetary transmission has materialized via better prospects in labour markets, the elasticity of response for lower-income customers might not be fully linear in compar-

ison to medium-income class. The hypotheses presented above build upon the discussion in Bazillier and Hericourt (2014) and reflect the demand-side oriented approach in credit markets driven by underlying persistent income inequalities.

To sum up, we address this missing link between the long-term effects of persistent inequalities and conduct of monetary policy in the following way. Firstly, we assess possible effect of income inequality on set of intermediate targets of monetary policy including bank loan rates, long-term yields and stock and real estate prices. All the above mentioned factors are standardly used when investigating effects of monetary policy on income and wealth inequality (e.g. Lenza and Slacalek, 2018). Secondly, we show how the initial income distribution might affect overall transmission of monetary impulses to the selected intermediate targets, even before affected households can respond and adjust their final consumption. Thirdly, we separately investigate effects of standard and unconventional monetary policy tools thus adding our piece of evidence to disentangle the differences between these distinct measures.

Using monthly data from 2008 to 2016 for panel of 12 Euro Area countries we employ interacted pooled mean group model to investigate effect of income inequality on set of monetary policy intermediate targets (bank loan rates, long-term yield, real estate prices, stock prices). The conditioning effect of income inequality is introduced via interaction term with EONIA (standard monetary policy) and three measures of unconventional monetary policy tools (in fashion of Horvath et al., 2018). As far as the modelling technique is concerned, we depart from the approach adopted in the interest rate pass-through literature (Leroy and Luccotte, 2015) and extend it to investigate

the completeness of transmission to other types of financial and real assets.

Our results suggest that income inequality plays a significant role in explaining cross-country heterogeneity in consumers' segment of bank loans. Additionally, stock price indices tend to respond positively to increasing income inequality once controlling for effects of quantitative easing policies. As hypothesised, transmission of monetary policy impulses into consumer bank loan rates has been adversely affected especially in the case of credit easing policies and to a lesser extent in the case of standard monetary policy tools. These findings therefore support Voinea et al. (2018) or Guerello (2018) who argue that higher inequality may hinder effectiveness of monetary pass-through,in particular in the presence of zero-lower bound.

The rest of the paper is organized as follows. Section 2 discusses the relevant literature. Section 3 presents the empirical model and section 4 introduced the data. We present the results in section 5. Last section concludes.

2. Literature review

Our paper builds upon three distinct streams of literature, each one representing a separate building block of our conceptual approach.

Firstly, we discuss separate channels through which monetary policy may indirectly affect its intermediate targets. These include long term nominal interest rate and bank lending rates as standard intermediate targets and financial assets and real estate prices as broad proxies for financial cycle characteristics. Secondly, we depart from the literature by discussing differences in monetary transmission mechanism conditional on set of idiosyncratic

properties of underlying economies. Thirdly, we provide an overview of recent advances in literature dealing with relationship between income inequality and monetary policy in order to build sufficient grounds for our hypothesis that persistent income inequalities might either limit or boost effectiveness of monetary policy effectiveness.

The investigation of transmission of monetary policy shocks to the bank lending rates (i.e. interest rate pass-through, IRPT henceforth) belongs to the standard toolkit of monetary policy analysis and, as is lies at the heart of utmost interest of all stakeholders involved, it is well researched in relevant literature. The most comprehensive overview of studies so far is provided by Gregor et al. (2019). On the contrary, the causes of country and bank-related heterogeneity in interest-rate pass through are, rather surprisingly, studied less often. On this account, Leroy and Luccotte (2015) find that, aside from the cyclical factors, level of banking competition plays a prominent role in hindering the homogeneity of IRPT in Europe. Using the meta-analysis approach, Gregor et al. (2019) show that the completeness of the IRPT to bank lending rates is positively affected by depth of the financial system, as well as by the history of central bank independence. Horvath et al. (2018) provide a tentative evidence that the environment of lower financial fragmentation in EA might positively contribute to homogeneity of IRPT conducted via standard policy tools.

Transmission of monetary policy shocks to the long-term yields has come to the forefront of research interest yet again as a consequence of the dysfunctional standard monetary transmission mechanism in the early months (years) following the outburst of the Global financial crisis in 2008. In gen-

eral, positive effects of QE policies were documented in the case of the USA (e.g., Baumeister and Benati, 2013; Hamilton and Wu, 2012 and others) or the UK (e.g. Joyce et al., 2011; D'Amico et al., 2012). Swanson (2015) confirms that the QE policies in the U.S. affected predominantly the longer term rates for government and corporate bonds, while forward guidance was more efficient over short maturities.

Before the crisis, the predominant stance in the literature held that the use of key policy rates to "lean against the wind", i.e. actively affecting the asset price behaviour, is too costly with uncertain results due to difficulties in recognizing formation of bubbles. With the crises experience in mind, proponents of a more active approach advocate otherwise. However, by the words of Gali and Gambetti (2015), no empirical or theoretical support seems to have been provided by the supporters. According to their model, the contractionary monetary policy even leads to a prolonged periods of increase in stock prices. As a follow up, Caraiani and Calin (2018) show that the response of stock prices to a monetary policy shock becomes negative when the unconventional monetary policy measures are taken into account as approximated by the shadow interest rate. Using a broader set of developed countries, Caraiani and Calin (2019) provide further evidence that in the majority of countries the stock price responds to a monetary contraction by decrease in a medium term. In a similar fashion, Paul (2017) finds that housing prices decrease in response to a monetary tightening. This finding is further supported by Andre et al. (2018) who look at the response of house prices to standard monetary policy shock. They report that housing prices respond negatively to a monetary policy shock, however, the existing

cross-country heterogeneity highlights the role of possible structural factors that may have affected monetary policy transmission mechanisms.

The relationship between income inequality and monetary policy is a complex one, not only because the effective conduct of the latter one is highly dependable on the underlying structure of financial system, banking sector in particular. As showed by Leroy and Lucotte (2015), Horvath et al. (2018) and Gregor et al. (2019), banking system characteristics fundamentally affect transmission of shocks to the intermediate targets of any monetary policy. Given the opposite direction of causality, the existing financial system structure might simply reflect inherent inequality distribution in an economy. Krueger and Perri build a theoretical model where structure of credit market is endogenous and may evolve responding to changes in income inequality. Tridico (2012) argues that recent increase in permanent income inequality which resulted from fall of workers' bargaining power has also brought about increase in demand for credit. Additionally, few authors have pointed out that in the long-run monetary policy has a tendency to react to persistent income inequalities by excessive monetary easing. Fitousse and Saraceno (2010) and Rajan (2010) support the opinion that depressed aggregate demand which reflected deepening of income inequalities prompted monetary policy to engage into periods of monetary expansion, which in turn led to over-accumulation of debt.

Saying that, it is unfortunate that most of the studies have so far focused on demonstrating the direction of causality stemming from monetary policy to inequality, rather than vice versa. This stream of literature has introduced several transmission channels through which the monetary policy might (un-

)intentionally affect wealth and income distribution. In general, effects of monetary policy shocks differ depending on the use of different tools. While the general consensus holds that standard monetary policy conducted via innovations to key policy rate affects the inequality (e.g. Coibion et al. 2017), final word on effects of unconventional measures is yet to be said (Colciago et al. 2019).

Among the standard tools, the indirect channel affecting the income of households, especially those with few or no liquid assets, is shown to play a prominent role (Ampudia et al., 2018). The indirect effects result from changes in labour income and employment in general equilibrium following the innovation into the key interest rate. Direct effects are produced via changes in households' net financial income and due to intertemporal substitution effect triggered by changes in saving behaviour. Asymmetric effects of monetary policy in standard models and during standard times are a well-known phenomenon. Along these lines, Coibion et al. (2017) show that contractionary monetary policy has a substantial and persistent re-distributive effects on income and consumption.

Regarding the unconventional monetary policy tools, their redistributive consequences stem from increasing value of investments which consequently triggers increase in income inequality by benefiting top income group (Saiki and Frost, 2014). On the other hand, the effects of raise in equity prices must not necessarily affect the current generation, but may ultimately be transferred to the wealth of the next generation (Bullard, 2014). Therefore, the unconventional monetary policy may be neutral, at least over the short-run. As in the case of standard measures, the indirect effects running via

respective adjustment in labour market, lead to changes in labour-generated income and employment, hence affecting overall income distribution. Empirically, estimates measuring effects of unconventional monetary policy vary substantially and produce inconclusive evidence.

In order to introduce inequality effects of monetary policy into standard theoretical models, one needs to assume presence of heterogeneous agents. In Auclert (2017) heterogeneous households are characterized by different marginal propensities to consume. Additionally, households operate under different initial conditions that result in different response to induced monetary policy shock. Areosa and Areosa (2016) distinguish agents according to the their provision of labour and their access to financial system. The group of households that does not react to monetary policy is thus described as households supplying unskilled labour and with no access to financial system, i.e. zero or small level of bank indebtedness. As proportion of unskilled agents increases, the number of agents directly reacting to interest rate changes decreases, which weakens the effects of monetary policy. As a consequence even by raising the interest rate more, the monetary authority generates milder effects.

The theoretical reasoning finds it reflection in the empirical literature. Recently, Voinea et al. (2018) show that income inequality affects transmission of monetary policy and its effectiveness via consumption channel in Romania. Households on the bottom side of the income distribution are more responsive to budgetary policies and do not respond to monetary policy shocks. The monetary policy is the most effective in influencing the consumption in middle income group that is characterized by higher levels of indebted-

ness as it eases consumption constraints on these households. High income households react to monetary policy in a lesser way than the middle income group. Overall, the smaller income inequality thus serves as an amplifier of monetary policy shocks and is conducive to more efficient and homogeneous impact of monetary policy transmission. Guerello (2018) looks at the marginal effects of standard and unconventional monetary policy on households' consumption and decompose them to contribution of inter-temporal and redistributive factor. According to her findings, mild growth in income dispersion smooths the transmission mechanism of standard monetary policy because it partially offsets the intertemporal substitution component. She concludes, that during normal times mildly high-income dispersion works as an accelerator mechanism for monetary shocks, however, income distribution might become an obstacle to the smooth transmission of the policy impulses in case of zero-lower bound.

3. Methodology

To estimate effect of conventional and unconventional monetary policy measures conditional on income inequality we rely on standard PMG (pooled mean group) technique introduced by Pesaran and Smith (1995) and Pesaran et al. (1999). This technique is widely used in studies examining completeness of monetary policy transition to bank lending rates (e.g. Belke et al., 2013; Illes et al., 2015; Avouyi-Dovi et al., 2017). We depart from the standard interest-rate pass-through literature in the following ways.

Firstly, in order to control for conditional effects of income distribution of individual countries we employ interacted PMG estimator as used in Leroy

and Lucotte (2015). Secondly, we provide four set of different estimates varying according to the different monetary tools employed during our analyzed period (as in Horvath et al., 2018). Thirdly, we investigate completeness of transition to not only the bank lending rate but also to long-term interest rates as well as other types of financial and real assets (i.e. stock prices, real estate prices). In order to ensure consistency of our estimates across different types of financial and real assets the list of control variables is kept unchanged across different specifications.

The benchmark interacted PMG model equation is given as:

$$\begin{aligned} \Delta r^b_{i,t} = \sum_{j=1}^{p} \Phi_j \Delta r^b_{i,t-j} + \sum_{j=0}^{q} \Pi_j \Delta r^m_{i,t-j} + \sum_{j=0}^{r} \Theta_j \Delta Z_{i,t-j} + \epsilon_{i,t} + \\ \beta_{0,i}(r^b_{i,t-1} - \beta_1 r^m_{i,t} - \beta_2 gini_{i,t-1} - \beta_3 r^m_{i,t} * gini_{i,t-1} - \sum_{j=4}^{u} \beta_j Z^u_{i,t} - \mu) \end{aligned} \tag{1}$$

where i denotes country, t denotes time, r^b_t represents the bank rate, r^m_t represents the market rate, μ stands for the mark-up, $gini_{i,t-1}$ stands for the measure of income inequality, $Z^u_{i,t}$ represents vector of control variables and $\epsilon_{i,t}$ error term.

Our primary objective is to estimate and interpret values of β_3 parameter that indicates effect of the particular variable on overall pass-through. Negative value of β_3 implies that the factor decreases overall pass-through from innovations to the monetary policy variable (e.g. the market rate r^m_t) to the dependent variable (i.e. the bank rate r^b_t).

The measure of income inequality enters only long-term equation as we

hypothesise that the effects of short-term innovations to the income distribution are negligent. Instead, the persistent nature of inequality-related times series favours their inclusion into the long-term relationship. From purely technical point of view, since data for inequality times series are available only on annual frequency and we advocate against use of simple extrapolation, the inequality measures are time invariant within each year. Hence, the first difference, if used, would equal to zero in eleven out of twelve monthly observations per each year.

Vector $Z^u_{i,t}$ might include various control variables, both bank or country-specific (see Leroy and Lucotte, 2015). In our case we control for country risk approximated by CDS premium.

The follow-up specifications aiming at assessment of effects of other than standard monetary policy measures (captured by money market rate) extend equation 1 in the following way:

$$\Delta r^b_{i,t} = \sum_{j=1}^{p} \Phi_j \Delta r^b_{i,t-j} + \sum_{j=0}^{q} \Pi_j \Delta r^m_{i,t-j} + + \sum_{j=0}^{r} \Theta_j \Delta Z_{i,t-j} + \sum_{j=0}^{s} \Lambda_j \Delta mp_{i,t-j} + \epsilon_{i,t} +$$
$$\beta_{0,i}(r^b_{i,t-1} - \beta_1 r^m_{i,t} - \beta_2 gini_{i,t-1} - \beta_3 mp_{i,t} * gini_{i,t-1} - \beta_4 mp_{i,t-j} - \sum_{j=5}^{u} \beta_j Z^u_{i,t} - \mu) \tag{2}$$

where $mp_{i,t}$ denotes respective type of unconventional monetary policy measure. As in the benchmark regression, our primary objective is to estimate and interpret values of β_3 parameter that captures potential effect of conditioning variables on overall pass-through. The hypothesised value of β_3

parameter differ depending on the measure of monetary policy tool. In the case of quantity-based indicators (e.g. QE/GDP) the positive β_3 parameter will indicate decrease in overall pass-through as the β_4 is hypothesised to obtain negative values.

Subsequently, the dependent variable r_t^b in the equation 2 is further replaced by the long-term interest rate r_t^l, stock market index s_t, and real property price index p_t. For the stock market index s_t and real property price index p_t, the coefficient of interest, the β_3 parameter, is expected to obtain positive (standard measures) or negative values (non-standard measure) in order to limit the effectiveness of monetary policy pass-through.

4. Data

We use monthly data for the period between January 2008 and October 2016 for a panel of 15 Euro Area (EA) countries. However, due to lack of data availability, we exclude Greece, Latvia, Luxembourg and Malta from our sample. Our dataset starts at the eve of the Global Financial Crisis in 2008 which allows us to neglect possible shift in monetary pass-through due to the crisis events, as observed in several studies (e.g. Hristov et al., 2014; Aristei and Gallo, 2014; Gambacorta et al., 2015).

As our dependent variables, we use financial market indicators that may be affected by monetary policies. Consequently, our first group of dependent variables includes interest rates on bank loans to households and firms - these include interest rates on four main loan categories - consumer and housing loans to households, as well as interest rates on small and large (below and above 1 million EUR) loans to non-financial corporations (NFCs). The

interest rates are for new business and all the data are from the ECB. Furthermore, apart from interest rates on bank loans, we also aim to investigate the affect of income inequality on monetary policy transmission specifically into long-term interest - to this end, we use yields on 10 years government bond yields obtained from Eurostat as a measure of long-term interest rates. Additionally, we also include stock market index among the dependent variables. The data stock market data are from Knoema database and represent average monthly closing value of main stock market index for each of the countries from our sample. The stock market data were indexed - with Index 100 for the first observation (i.e January 2008). Finally, we hypothesize that since the expansionary policy may lead to increased bank lending and may be associated with higher property prices, we also use property prices from the Bank for International Settlements (BIS) database as the last dependent variable. As for most countries, the property prices are only available in quarterly frequency, we linearly interpolate the data to monthly frequency (except for Ireland, where only monthly data were available). The property prices are the residential property prices represented by the pure prices for all dwellings.

In line with other studies (for example von Borstel et al., 2016 or Horvath et al., 2018) we use Eonia rate as a proxy for standard monetary policy. The Eonia rate is expressed as monthly average and the data are obtained from the ECB. Furthermore, we include the shadow rates, as proposed by Wu and Xia (2016), from the Quandl database. Horvath et al. (2018) argue that by taking into account the unconventional monetary policies, shadow rates may complement Eonia rate, as they are less constrained by the zero lower

bound (ZLB). Our measure of shadow rates takes the value of zero for all the observations, where the shadow rates were greater than zero - as the shadow rates can be used as a proxy for monetary policy measures when the policy rate equals has reached the ZLB. We also include sovereign CDS premia obtained from Datastream database in our regressions in order to control for sovereign credit risk.

Effects of unconventional monetary policies are usually studied and approximated by increase in central bank balance sheets (e.g. Gambacorta et al., 2014, Boeckx et al. 2017, von Borstel et al., 2016). However, as argued in Horvath et al. (2018), the use of total central bank balance sheet value mixes together two distinct categories of central bank balance sheet policies, the effect of pure quantitative easing conducted via purchase of government securities, and the effect of credit easing policies that might not need to results in overall increase of total central bank assets. In our approach we follow Horvath et al. (2018) and separate these two channels by distinguishing between QE policies and other unconventional monetary policy tools (open market operations, purchase of other than government bond securities). Consequently, as our measure of QE policies, we use the total holdings of government debt securities of respective national central banks (NCBs). Our measure of other unconventional monetary policies contains debt securities issued by the MFIs that are held by NCBs and the outstanding loans of NCBs to MFIs. The data on NCBs' balance sheet items are from ECB Statistical Data Warehouse. Both variables are expressed as share of GDP.

We use the Gini coefficient as our primary measure of income inequality.

In line with Voinea et al. (2018) we use disposable income (net of taxes, net of transfers) for calculation of Gini index. This allows us to ignore potential impact of national distributional fiscal policies which have dominated over changes in gross income during our sample period in most of the countries (Domanski et al. 2016). The data on income inequality are from the Standardized World Income Inequality Database (SWIID) and are lagged by one period in order to deal with the issue of reverse causality. As a robustness check, we only use the pre-crisis level of income inequality (i.e. from 2007) - in order to control for any changes in income distribution that may have been induced by the monetary policy in the crisis and post-crisis era. By only using the pre-crisis Gini coefficient, this coefficient becomes time invariant. As a result, in these regressions, we do not include the fixed Gini coefficient on its own, but we only include the interaction terms, which remain time variant. Finally, as another robustness check, we use a measure of wealth inequality to study the effect of inequalities on transmission of monetary policy. We use the indicator of wealth inequality from the Global Wealth Report, which is compiled by the Credit Suisse. Since the data on wealth inequality is not available for the entire covered period, we once again only use one observation for the wealth inequality measure for each country - as the data for 2007 are not available, we use the data from 2010, which is the earliest year for which the data on wealth inequality are available in the Global Wealth Report.

5. Results

In the following section we present our results from the baseline regression where we use the Gini coefficient as a measure of income inequality. Next, we discuss the findings of the robustness checks.

5.1. Baseline regressions

We start by interpreting results closely linked to the standard monetary policy pass-through behaviour before discussing conditional effects of income inequality. As expected, our findings show that short-term interbank interest rate (i.e. EONIA) had a positive, statistically significant and robust effect on bank loan rates over the long run. With the beta coefficients associated with EONIA mostly being close to one (i.e. indicating almost complete interest rate pass-through) and slightly higher in the presence of unconventional policy measures our results are in line with relevant literature (Gregor et al. 2019; Horvath et al. 2018).

The monetary pass-through to long-term interest rate yields diverse results with long-term coefficients varying from mild through complete to even overshooting effects of market rates once controlling for unconventional monetary policies. Interestingly, our results do not support the hypothesis of persistent effect of unconventional monetary policies on longer maturities. Yet, the short-term positive effects still materialize, as apparent from the short-run specification in the case of QE (Table 2) and shadow rate (Table 4).

Furthermore, a decrease in EONIA contributes positively to stock prices growth rates across most of the specifications, however the effects become at-

tenuated once including measures of unconventional monetary policies. Our finding thus support empirical evidence in Caraiani and Calin (2019), even though they contradict underlying line of reasoning (Caraiani and Calin, 2018). Contrary to Paul (2017) or Andre et al. (2018) we do not find a strong relationship between EONIA and property prices.

The CDS premiums also seem to affect all of our dependent variables in the expected direction - contributing to higher interest rates and having a stronger effect on long-term interest rates than on bank loan rates. As expected, higher CDS premiums also lead to lower stock prices and property prices.

Now we turn our attention to the estimated effects of underlying (persistent) income inequality. Since we hypothesise that the effects of income inequality are predominantly of a longer-lasting nature, we focus on interpreting coefficients relevant for the long-run equation part of the specification 1 and 2.

Table 1 presents the results for transmission of standard monetary policies. Firstly, our findings indicate that higher income inequality contributes to higher interest rates on housing and consumer loans, as well as to higher property prices. These findings are in line with our initial assumptions - as when income inequality is higher, larger proportion of households may be expected to rely on loans, so that they can sustain their consumption relative to higher income households which increases demand for loans. Alternatively, higher share of low-income households may face risk premium that translates into higher average loan rates, in general. Indeed, our findings across all the different specifications support this line of reasoning. Furthermore, based

on the coefficients of the interaction term, we may conclude that higher income inequality reduces the pass-through of standard monetary policies into housing loans interest rates. However, it turns out that corporate segment of bank loans behaves in a opposite direction, as the higher income inequality contributes do decrease in bank rates but with interaction term mitigating these effects.

Table 2 presents the results from specifications that study the effect of income inequality on transmission of QE policies. When controlling for QE, we once again find that higher income inequality contributes not only to higher interest rates on consumer loans but positively affects the growth of stock prices as well.

The second finding is in line with our prior expectations - as in the case of higher income inequality, the higher income households could be expected to invest more of their wealth in the stock market. As showed in Horvath et al. (2017), income inequality significantly contributes to the stock market capitalization, and as such may also positively contribute to the stock prices behaviour. Table 4 with QE policies replaced by the shadow rate makes this case even stronger. Nevertheless, we do not find an evidence that the income inequality affects the pass-through of QE policies into stock prices.

Conditional effects of income inequality could be found in the case of housing and large firm loans. We find statistically significant coefficients for the interaction term in the expected direction; while the QE did contribute to lower bank rates, the higher income inequality worked in the opposite direction and reduced the pass-through effect of QE policies into the bank loans. Similar, but stronger results for the conditioning effect of sustained

income inequality are observed in the case of other unconventional policies (Table 3). As in the previous case, the unconventional policy succeeded in lowering interest rates in three bank loan segments (consumer, housing, small firm loans). And once again, the higher income inequality seems to have hindered overall impact of other unconventional monetary policies.

The other intermediate targets remained unaffected by either the QE, or the credit easing policies, and in all the cases the income inequality does not seem to have played an important role in limiting the (non-existent) impact of unconventional monetary measures.

Finally, in Table 4 we use shadow rates as an indicator of overall expansionary monetary policies, as shadow rates are not constrained by the ZLB and are commonly used as a proxy for monetary policy expansion beyond the standard market rate movements (e.g. Caraiani and Calin, 2018). While the coefficients for Gini index remain broadly unchanged compared to results presented in Tables 1-3, the coefficient for the interaction term is only statistically significant in the specification with property prices serving as the dependent variable. However, even this result should be treated with enough grain of salt, as while for the remaining specifications and dependent variables, the error correction term is negative and statistically significant, for regressions with property prices the error correction term turns insignificant.

To summarize our results, income inequality seems to play an important role in explaining the underlying heterogeneity across bank loan rates targeted on consumers' loans segment, as initially hypothesised. On the top of that, the most accentuated impact of underlying income distribution on monetary pass-through is observed in the case of those unconventional mon-

etary measures that are conducted via open market operations (for example targeted long-term refinancing operations) and this effect is most pronounced in the case of bank loan rates. Lastly, stock prices behaviour might be affected by the underlying income distribution once controlling for presence of expansionary monetary policy, particularly if conducted via purchase of government securities. These findings further support arguments presented in Voinea et al. (2018) or Guerello (2018) who assert that smaller inequality may help smoothing out the transmission of monetary policy impulses into relevant intermediate targets, especially during times when its conduct is limited by the zero-lower bound. Assuming that monetary policy effects on overall income distribution are more of a transitory nature with less powerful impact (Ampudia et al., 2018), it ultimately remains a job for the fiscal policy to accommodate the call for a more re-distributive policies if effective monetary policy is one of the desired objectives, especially on the Euro Area-wide level.

Table 1: Effect of income inequality on transmission of standard monetary policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
Long-run equation							
EONIA	1.524***	4.235***	-0.093	0.818***	1.020	-3.727***	0.092
	(0.465)	(0.989)	(0.496)	(0.261)	(1.629)	(1.092)	(0.125)
CDS premium	0.002***	0.003***	0.006***	0.004***	0.014***	-0.002***	-0.003***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	(0.000)
Interact	-0.024	-0.098***	0.033*	0.003	0.002	0.107***	-0.004
	(0.018)	(0.030)	(0.017)	(0.009)	(0.053)	(0.033)	(0.004)
Gini	0.350***	0.131***	-0.078***	0.011	0.080	-0.016	0.016***
	(0.024)	(0.044)	(0.017)	(0.009)	(0.078)	(0.020)	(0.006)
constant	-3.852***	-2.471*	4.944***	1.218***	-2.141	5.484***	4.247***
	(0.642)	(1.483)	(0.472)	(0.253)	(2.426)	(0.680)	(0.148)
Short-run equation							
Error correction	-0.067***	-0.048***	-0.087***	-0.218***	-0.070***	-0.036**	-0.001
	(0.020)	(0.012)	(0.025)	(0.047)	(0.025)	(0.015)	(0.004)
D.EONIA	0.139	0.314***	0.482***	0.444***	-0.138	0.054***	0.015***
	(0.113)	(0.067)	(0.063)	(0.070)	(0.250)	(0.016)	(0.006)
D.CDS premium	-0.001	-0.000	0.000	0.000	-0.000	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
N	1482	1511	1511	1511	1223	1522	1505

Notes: Standard errors are in parentheses. Interact is defined as Eonia*Gini. * indicates significance at 10% level, ** indicates significance at 5% level and *** indicates significance at 1% level.

Table 2: Effect of income inequality on transmission of QE policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
Long-run equation							
EONIA	1.054***	1.071***	0.827***	0.915***	0.867***	-0.429***	0.019*
	(0.127)	(0.037)	(0.027)	(0.018)	(0.150)	(0.077)	(0.011)
CDS premium	0.001	0.003***	0.008***	0.002**	0.011***	-0.002***	-0.003***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)
Interact	-0.003	0.001*	0.002	0.002**	-0.001	-0.002	-0.000
	(0.003)	(0.001)	(0.001)	(0.001)	(0.007)	(0.001)	(0.001)
Gini	0.515***	-0.098***	-0.080***	-0.031	0.138	0.035*	0.000
	(0.081)	(0.022)	(0.019)	(0.021)	(0.157)	(0.021)	(0.015)
QE	0.132	-0.044*	-0.070*	-0.052*	0.036	0.048	0.012
	(0.092)	(0.024)	(0.039)	(0.027)	(0.223)	(0.034)	(0.017)
constant	-11.05***	4.944***	5.036***	2.353***	-3.290	3.895***	4.540***
	(2.251)	(0.638)	(0.574)	(0.594)	(4.820)	(0.680)	(0.416)
Short-run equation							
Error correction	-0.102**	-0.068***	-0.136**	-0.255***	-0.051***	-0.032***	-0.001
	(0.045)	(0.017)	(0.062)	(0.057)	(0.013)	(0.006)	(0.003)
D.EONIA	-0.772	0.221***	0.195	0.445**	-0.098	0.058***	0.009***
	(0.738)	(0.066)	(0.204)	(0.183)	(0.189)	(0.018)	(0.002)
D.CDS premium	0.006	-0.000	-0.001	0.001	0.001	-0.001***	-0.000
	(0.005)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
D.QE	-0.00137	-0.00262	0.000447	-0.0174**	-0.0492***	-0.00573***	0.000593***
	(0.010)	(0.002)	(0.005)	(0.009)	(0.015)	(0.001)	(0.000)
N	1373	1399	1399	1399	1141	1410	1393

Notes: Standard errors are in parentheses. QE represents our measure of quantitative easing policies, which are measured as central bank purchases of government securities and is expressed in logarithms. Interact is defined as QE*Gini. * indicates significance at 10% level, ** indicates significance at 5% level and *** indicates significance at 1% level.

Table 3: Effect of income inequality on transmission of other unconventional policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
Long-run equation							
EONIA	0.254*	1.064***	1.131***	0.900***	1.263***	-11.916	-0.012
	(0.134)	(0.028)	(0.064)	(0.016)	(0.220)	(26.570)	(0.010)
CDS premium	0.003***	0.002***	0.006***	0.003***	0.013***	-0.038	-0.003***
	(0.001)	(0.000)	(0.001)	(0.000)	(0.003)	(0.077)	(0.000)
Interact	0.005**	0.001**	0.002***	0.000	0.002	0.009	0.000
	(0.002)	(0.000)	(0.001)	(0.000)	(0.002)	(0.024)	(0.000)
Gini	0.772***	-0.116***	0.065***	0.010	-0.091	-0.546	0.009
	(0.086)	(0.016)	(0.022)	(0.014)	(0.072)	(1.459)	(0.008)
NMM	-0.160**	-0.017*	-0.063**	-0.005	-0.073	-0.230	-0.003
	(0.071)	(0.009)	(0.025)	(0.006)	(0.058)	(0.602)	(0.004)
constant	-14.810***	5.340***	0.037	1.266***	3.059	27.640	4.486***
	(2.605)	(0.484)	(0.724)	(0.403)	(2.421)	(57.810)	(0.219)
Short-run equation							
Error correction	-0.096	-0.075***	-0.097*	-0.233***	-0.062***	-0.001***	0.001
	(0.060)	(0.022)	(0.050)	(0.047)	(0.023)	(0.000)	(0.004)
D.EONIA	-0.694	0.211***	0.121	0.447***	-0.130	0.030**	0.009***
	(0.700)	(0.066)	(0.254)	(0.083)	(0.231)	(0.015)	(0.002)
D.CDS premium	0.005	-0.000	-0.001	0.001	0.001	-0.001***	0.000
	(0.004)	(0.000)	(0.007)	(0.001)	(0.002)	(0.000)	(0.000)
D.NMM	0.000	0.000	0.000	0.003**	-0.003	-0.000**	-0.000
	(0.003)	(0.001)	(0.001)	(0.001)	0.002	(0.000)	(0.000)
N	1373	1399	1399	1399	1141	1410	1393

Notes: Standard errors are in parentheses. NMM represents our measure of other unconventional monetary policies, which are measured as central bank purchases of securities issued by MFIs and central bank loans to MFIs and are expressed in logarithms. Interact is defined as NMM*Gini. * indicates significance at 10% level, ** indicates significance at 5% level and *** indicates significance at 1% level.

Table 4: Effect of income inequality on transmission of overall expansionary monetary policies (measured by shadow rates)

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
Long-run equation							
EONIA	0.834***	1.035***	0.801***	0.900***	0.545***	-0.284***	0.010
	(0.066)	(0.041)	(0.026)	(0.019)	(0.083)	(0.049)	(0.010)
CDS premium	0.001	0.003***	0.001***	0.004***	0.011***	-0.002***	-0.003***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Interact	-0.001	-0.011	0.012	0.002	0.027	0.005	0.006*
	(0.017)	(0.006)	(0.009)	(0.006)	(0.019)	(0.005)	(0.003)
Gini	0.324***	-0.065***	-0.035*	0.013	0.095**	0.034***	0.016**
	(0.028)	(0.011)	(0.019)	(0.011)	(0.038)	(0.008)	(0.007)
Shadow rate	0.103	0.378**	-0.257	-0.028	-0.243	-0.181	-0.192**
	(0.448)	(0.190)	(0.274)	(0.168)	(0.581)	(0.145)	(0.091)
constant	-2.872***	4.055***	3.908***	1.194***	-0.959	3.833***	4.193***
	(0.729)	(0.313)	(0.537)	(0.298)	(1.123)	(0.270)	(0.179)
Short-run equation							
Error correction	-0.067***	-0.070***	-0.100***	-0.217***	-0.129***	-0.044***	-0.002
	(0.021)	(0.015)	(0.030)	(0.047)	(0.033)	(0.013)	(0.004)
D.EONIA	0.149	0.287***	0.463***	0.446***	-0.220	0.060***	0.016**
	(0.117)	(0.068)	(0.064)	(0.069)	(0.291)	(0.016)	(0.006)
D.CDS premium	-0.001	-0.000*	0.000	0.000	-0.001	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
D.Shadow rate	-0.148*	-0.007	-0.051**	-0.082	0.305***	0.029***	-0.001*
	(0.076)	(0.006)	(0.024)	(0.051)	(0.072)	(0.005)	(0.001)
N	1482	1511	1511	1511	1223	1522	1505

Notes: Standard errors are in parentheses. Shadow rate represents our measure of expansionary monetary policies that is not constrained by ZLB and which takes value of zero for the months when the shadow rate was greater than zero. Interact is defined as Shadow rate*Gini. * indicates significance at 10% level, ** indicates significance at 5% level and *** indicates significance at 1% level.

5.2. Robustness checks

We check the robustness of our results in the following way. Firstly, we only include the pre-crisis level of Gini coefficient in our regressions - this enables us to control for possible effects of unconventional monetary policies on income inequality during the crisis and post-crisis era. The results of these regressions are reported in the Appendix A. For the sake of simplicity, we only report the coefficients for the variables of interest (full results are available upon request). Since the Gini coefficient is time invariant we exclude it from all specifications. The interaction term between time-invariant Gini coefficient and monetary policy measures is still present. The results from this robustness check broadly corroborate our findings from the baseline regressions - i.e. for standard monetary policies, we find negative coefficient of the interaction term for housing loans and a positive coefficient for the stock market. For the QE policies, we find that higher inequality did contribute to higher interest rates on larger firm loans and to higher long-term interest rates - but for the housing loans, the coefficient of the interaction term becomes negative. The results are rather similar for other unconventional policies - in this case, though, the interaction term for consumer loans interest rates is positive and statistically significant which is in line with the baseline regressions.

Secondly, as another robustness check, we test whether the wealth inequality also affects the transmission of monetary policy. We find that higher wealth inequality enhances the transmission of standard monetary policies only for the housing loans. Rather surprisingly, we do not find strong results for the transmission of QE policies, we only find a positive coefficient of the

interaction term for consumer loans interest rate and a negative one for the long-term interest rates. Nonetheless, the results for other unconventional policies are similar to the results for income inequalities for bank loan interest rates. Furthermore, we find that coefficients of interaction terms in the regressions with shadow rates are statistically significant and positive across most of the specifications.

6. Conclusion

In this paper we study the effect of the income inequality on the transmission of the monetary policy in the Euro Area member states during the crisis and post-crisis era. We select group of intermediate targets of monetary policy (bank loan rates, long-term interest rates, stock prices and property prices) and use the interacted panel error correction model to analyse the role of income inequality in the monetary pass-through.

We find that the income inequality affects the bank loan rates - especially the interest rates on consumer loans - which are affected positively by the level of income inequality. Additionally, we present tentative evidence that stock prices may also respond to the changes in underlying income distribution. Importantly, our findings indicate that income inequality might constraint transmission of monetary policy shocks. We show that higher income inequality reduces the pass-through of unconventional monetary policies into bank loan rates - especially in the case of unconventional policies other than QE. As a consequence, our results suggest that central banks should indeed be taking the level of income inequality into consideration when analysing effect of transmission into their intermediate policy targets.

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Appendix A

Table 5: Effect of income inequality on transmission of standard policies - controlling for pre-crisis income inequality

	Property	Bank loan rates			Long-term
Stock index	Consumer prices	Housing	Small Firm	Large Firm	interest rate
EONIA	-4.019***	2.253***	0.810	0.722***	0.632
-3.089***	-0.035				
Interact	0.146***	-0.039***	0.007	0.007	0.015
0.088***	0.001				
Error correction	-0.054***	-0.066***	-0.053***	-0.217***	-0.070***
-0.037***	-0.002*				
N	1482	1511	1511	1511	1223
1522	1505				

Table 6: Effect of income inequality on transmission of QE policies - controlling for pre-crisis income inequality

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.968***	1.081***	0.827***	0.920***	0.799***	-4.603	-1518981.0
Interact	-0.000	-0.001***	0.001	0.001**	0.009***	0.003	6.31086e+09
QE	0.054	0.045***	-0.053*	-0.023	-0.283**	-0.093	222747914.1
Error correction	-0.071***	-0.063***	-0.091***	-0.259***	-0.051***	-0.003***	-5.20e-16*
N	1373	1399	1399	1399	1141	1410	1393

Table 7: Effect of income inequality on transmission of other unconventional policies - controlling for pre-crisis income inequality

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.840***	1.069***	0.836***	0.899***	1.139***	-0.556***	-0.015
Interact	0.005***	-0.001***	-0.000	0.000*	0.002	0.001***	0.000**
NMM	-0.151***	0.023***	0.002	-0.010*	-0.070	-0.027***	-0.010**
Error correction	-0.062***	-0.068***	-0.097**	-0.227***	-0.042***	-0.022***	0.001
N	1373	1399	1399	1399	1141	1410	1393

Table 8: Effect of income inequality on transmission of overall expansionary policies - controlling for pre-crisis income inequality

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.068	1.016***	0.800***	0.903***	0.575***	-0.426***	0.020**
Interact	-0.477***	-0.007	0.020**	-0.001	-0.004	-0.005	0.001
Shadow rate	13.720***	0.308	-0.450	0.056	0.711	0.165	-0.072
Error correction	-0.064*	-0.061***	-0.098***	-0.216***	-0.127***	-0.034***	-0.002
N	1482	1511	1511	1511	1223	1522	1505

Appendix B

Table 9: Effect of wealth inequality on transmission of standard policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	3.978**	0.460	1.447***	0.840***	1.448	-1.073**	0.015
Interact	-0.039	0.010*	-0.006	0.001	-0.005	0.010	-0.000
Error correction	-0.028***	-0.062***	-0.053***	-0.217***	-0.070***	-0.033***	-0.002
N	1482	1511	1511	1511	1223	1522	1505

Table 10: Effect of wealth inequality on transmission of QE policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.515***	1.016***	0.957***	0.927***	1.130***	-1854680.2	1051.0
Interact	0.002*	-0.000	-0.001	-0.000	-0.004**	478664277.5	-3175.4
QE	-0.128**	-0.003	0.031	0.014*	0.296***	6754238.0	125861.1
Error correction	-0.038**	-0.066***	-0.118*	-0.250***	-0.068***	-7.84e-15*	1.16e-10
N	1373	1399	1399	1399	1141	1410	1393

Table 11: Effect of wealth inequality on transmission of other unconventional policies

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.549***	1.064***	1.491***	0.903***	1.148***	-0.595***	-0.007
Interact	0.001**	0.000**	0.001***	0.000	-0.000	0.000	-0.000
NMM	-0.054***	-0.027**	-0.053**	-0.004	-0.013	-0.004	0.005
Error correction	-0.070	-0.049***	-0.123**	-0.227***	-0.040***	-0.021***	-0.000
N	1373	1399	1399	1399	1141	1410	1393

Table 12: Effect of wealth inequality on transmission of overall expansionary policies (measured by shadow rates)

	Bank loan rates				Long-term		Property
	Consumer	Housing	Small Firm	Large Firm	interest rate	Stock index	prices
EONIA	0.761***	0.996***	0.833***	0.903***	0.570***	-0.415***	0.0136
Interact	0.107***	0.012***	0.008**	-0.001	0.006	-0.005*	0.006*
Shadow rate	-6.940***	-0.674**	-0.421	0.109	0.213	0.366*	-0.386***
Error correction	-0.060**	-0.062***	-0.069***	-0.216***	-0.127***	-0.035***	-0.001***
N	1482	1511	1511	1511	1223	1522	1505

7. Figures and Tables

Figure 1: Monetary pass-through to bank loans

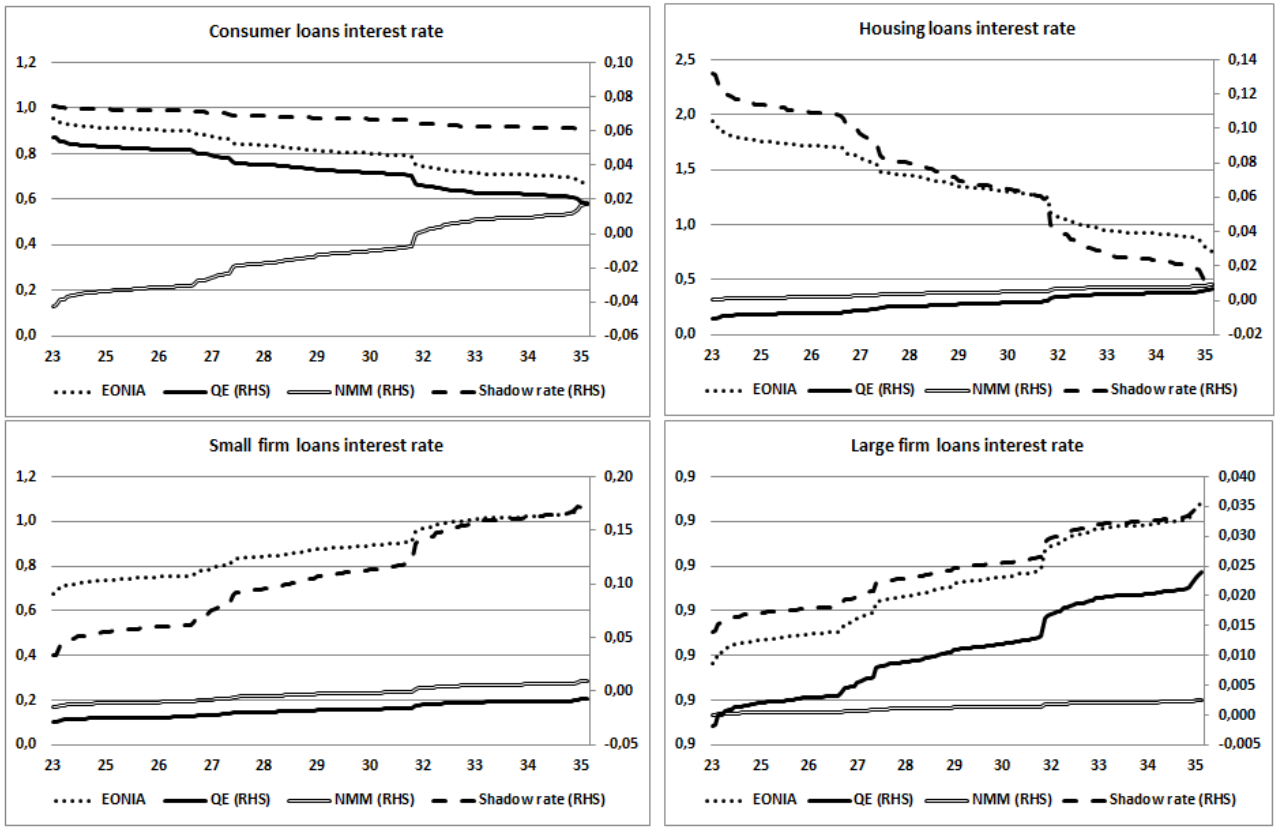

Figure 2: Monetary pass-through to other intermediate targets