MICRO LEVEL DATA FOR MACRO MODELS: THE DISTRIBUTIONAL EFFECTS OF MONETARY POLICY

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Keywords: Income Inequality, Monetary Policy, Local Projections, Survey Data, High-Frequency Data

JEL Classifications: C81, D31, E52, E58

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Micro level data for macro models: the distributional effects of monetary policy.[*]

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Abstract

In this paper we investigate the effect of standard and non-standard monetary policy implemented by the ECB on income inequality in Italy. We use a novel database based on the survey micro level data on Income and Living Conditions (EU-SILC, Istat) in a repeated cross-section experiment which enables us to compute measures of inequality and the distribution over time for different incomes and subgroups of individuals. The identification strategy is based on the monetary surprises estimated in the Euro area Monetary Policy Event-Study Database (EA-MPD) for the Euro area. Using a battery of Local Projections, we evaluate the impact of monetary policy by comparing the performance of the impulse response functions of our inequality measures in different policy scenarios: 1999-2012 (pre-QE) and 1999-2017 (including the QE period). The main findings show that an expansionary unconventional monetary policy shock compressed inequality of disposable, labor and financial income more persistently than a conventional monetary shock. These effects are heterogeneous and seem to benefit mostly the bottom of the distribution. The impact on financial wealth is ambiguous favoring the wealthy households mainly in the short-run. Our evidence suggests that QE is associated with a decrease in Italian households' inequality.

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1   Introduction

In the present study we investigate whether monetary policy, both conventional and unconventional, has affected income inequality in Italy focusing on household disposable income, earnings, financial capital income and wealth.

To cope with the consequences of the global financial crisis, central banks have used monetary policy to stimulate aggregate demand by implementing expansionary monetary policies since the end of 2008. They have responded to the crisis in an unprecedented way, on the one hand by reducing rapidly the official discount rate and on the other by adopting unconventional measures by launching medium and long-term refinancing operations and asset purchases to encourage banks to provide credit to firms and households. The objective was to pursue price stability and at the same time to favor economic recovery trough expansionary policies. However, after the sovereign debt crisis in 2011 and a second recessionary wave in 2012-13, since June 2014, the European Central Bank (ECB) has also adopted a series of new unconventional measures for the Euro area to continue providing uplift to the economy even when policy rates approach the lower bound. Furthermore the threat of deflation was countered by lowering long-term interest rates via the asset purchase programs (APP). Some observers see the low-level rates policy as an artificial state generated by the policies of central banks and argue that it threatens not only economic and financial stability, but social equity too, generating a trade-off between stability and equity. While, according to Bernanke (2015), monetary policy is not a key driver of increased inequality, as it is "neutral" or nearly so in the longer term, meaning that it has limited long-term effects on "real" outcomes like the distribution of income and wealth. For these reasons, the impact of monetary easing on inequality that has been largely ignored in the literature and practice of monetary policy has recently gained more attention. *«These unconventional measures follow exactly the same logic as the conventional ones: they make financing conditions more expansionary relative to the natural rate, and in doing so bring the economy back to balance and inflation back to our objective. But while this kind of monetary policy, is simply a continuity of what central banks*

have always done we know it has raised concerns. Those concerns have focused in particular on the side effects of monetary policy and its distributional consequences: between savers and borrowers, weaker and stronger countries, the rich and the poor. The question, in short, is whether there is a trade-off between stability and equity». Mario Draghi, President of ECB, DIW Europe Lecture, Berlin, 25 October 2016.

Although the large debate on the topic, the empirical literature is sometimes ambiguous and still scarce. Empirical studies for the US, the UK and Japan exploit survey data on household income at the quarterly level. The influential paper of Coibion et al. (2017) uses quarterly data from the US Consumer Expenditure Survey (CEX) in a VAR framework with narrative shocks to estimate the effects of conventional monetary policy on the Gini coefficients for consumption and income, but not for wealth. A few papers follow in the steps of Coibion et al. (2017) for other countries. Montecino and Epstein (2015), by analyzing both the QE period (2008-2010) and the post-QE period (2011-2013) in the US have found that an expansionary monetary policy, mainly in the form of QE, contributed to rising inequality. In particular, the dis-equalizing effects of increasing asset returns outweighed the redistributive effects of falling unemployment. Mumtaz and Theophilopoulou (2016) provide similar evidence for the UK using the Family Expenditure Survey (FES). In particular, they find that contractionary monetary policy shocks lead to an increase in earnings, income and consumption inequality and contribute to their fluctuation. Saiki and Frost (2014) exclusively focus on the impact of unconventional monetary policy (UMP) on inequality in Japan. They look at how the recent UMP affected inequality, using micro level data of Japanese households in a VAR framework. Their main results show that UMP widened income inequality after 2008Q3 as the Bank of Japan (BoJ) resumed its zero interest rate policy and reinstated UMP. This is largely due to the portfolio channel: asset prices may become overvalued while UMP is in place. Consequently wealthy households that tend to save their money in financial assets earn more income from dividends and capital gains. Using aggregate panel data of 32 advanced and emerging market countries over the period 1990-2013, Furceri et al.

(2018) find that contractionary monetary policy shocks increase income inequality while expansionary policy reduces inequality. However, the effect is asymmetric depending on the state of business cycle: policy tightening raises inequality less than easing lowers it.

With regard to the Euro area, empirical analyses are limited due to scarcity of proper household income, wealth and consumption surveys. Guerello (2017) recovers measures of income dispersion from the European Commission Consumer Survey and evaluates the effects of both types of monetary policy on income distribution. She finds that in the Euro area standard expansionary monetary measures typically reduce the dispersion on income distribution. However, during a prolonged period of zero-lower bound, even if the beneficial effects on the economy of conducting QE monetary policy are unarguable, for several European countries the positive effects of these policies might be associated with an increase in income dispersion. Lenza and Slacalek (2018) use the Household Finance and Consumption Survey (HFCS) by ECB and proceed in two steps relying on both aggregate and household-level data of the four largest Euro area countries (France, Germany, Italy and Spain). They first estimate the aggregate effects of a QE shock, identified by means of external instruments, in a multi-country VAR model. Afterwards, they distribute the aggregate effects across households using a reduced-form simulation on micro data, which captures the different channels of transmission. Recently, the work of Samarina and Nguyen (2019) investigates how monetary policy affects income inequality in 10 Euro area countries over the period 1999–2014 applying mixed-frequency data techniques as the data on income inequality are annual while all other variables are quarterly. The authors find that after a monetary easing shock, the macroeconomic channel reduces inequality by raising wages and employment. However the financial channel may weaken the equalizing effect of expansionary monetary policy, while the quantitative easing had no significant effect on wealth inequality in the Euro area. The equalizing effect is particularly evident in the periphery economies.

Focusing on Italy, Casiraghi et al. (2018) study the distributional implications of non-standard monetary policy adopted by the ECB by exploiting a rich micro dataset from the

Survey of Household Income and Wealth (SHIW) conducted by the Bank of Italy. The authors only exploit the cross-sectional dimension of the survey in 2010 that is the starting point to which they applied the changes in the macroeconomic and financial variables. They report that larger benefits from ECB's unconventional monetary policy measures accrue to households at the bottom of the income scale, as the effects via the stimulus to economic activity and employment, outweigh those via financial markets. They also find that the overall effects on wealth are negligible even though, the risk of an "expropriation of savers" is not generalized, since the decrease in the remuneration of savings can be compensated by capital gains. After 2010, is the impact of non-standard monetary policy for Italian households income distribution still negligible? Over the medium-term, are positive macroeconomic effects able to offset short-term negative financial effects on inequality? Does QE matter? We try to respond to such questions.

In doing so, our contribution is twofold: we use for the first time EU-SILC microdata on Italian households and living conditions (Istat) exploiting the survey in a repeated cross-sectional dimension to build inequality measures over time and for specific incomes and subgroups of individuals. Additionally, we adopt a new identification strategy for monetary policy shocks: to isolate the monetary policy surprises we use the Euro area Monetary Policy Event-Study Database (EA-MPD) by Altavilla et al. (2019a), which presents high-frequency data as intraday asset price changes around the ECB policy announcement, with the identifying assumption that within the day monetary policy does not react to asset prices, and therefore causality goes from monetary policy to asset prices.

Finally, inspired by the recent strand of literature we combine microdata with macro model estimating the monetary policy effects directly on *ad hoc* inequality indices computed at the individual household level. We focus mainly on two distributional channels – macroeconomic and financial – through which monetary easing may have opposite effects on income inequality. Monetary expansion stimulates output and job creation benefiting low and middle-income households and reducing income inequality. At the same time, lower interest rates lead

to higher asset prices and capital returns; this may increase income inequality by making rich households better off. Using a battery of Local Projections, we evaluate the impact of monetary policy by comparing the performance of the impulse response functions in different policy scenarios: 1999-2012 (pre-QE) and 1999-2017 (including the QE period). In doing so, we are able to assess the impact of both conventional and unconventional monetary policy. We capture the macroeconomic channel by GDP and employment reflecting on the household income composition, while the financial channel by share prices. The main findings show that an expansionary monetary policy compressed inequality in Italy in the medium-run through the income composition channel and for some sub-group of individuals ("borrowers"). These effects are heterogeneous and benefit mostly the bottom of the distribution in particular that of labor income. We also found that the impact on financial wealth is ambiguous favoring the wealthy households mainly in the short-run since in Italy stock prices appear to have reacted to a lesser extend with respect to the US and the UK. Overall, some evidence suggests that QE is associated with a decrease in Italian households' inequality even though the size of the effects is modest.

The remainder of the paper is organized as follows: Section 2 describes the main transmission channels of monetary policy. Section 3 describes the data and the methodology for the construction of the measures of inequality and the distribution of income and financial wealth. It outlines our empirical approach, based on a new identification strategy and local projection technique to assess the effects of both conventional and unconventional monetary policy shocks. Furthermore, it illustrates and interprets the main empirical results and robustness checks. Section 4 concludes.

2 The measure of inequality for the Italian incomes distribution

In this section, we briefly describe the Italian Survey on Income and Living conditions and the construction of measures of inequality and the distribution for total disposable income, labor income, financial capital income and financial wealth.

2.1 The Italian Statistics on Income and Living Conditions (EU-SILC)

The measures of income and wealth inequality are all constructed using The European Union Statistics on Income and Living Conditions (henceforth, EU-SILC), which is a survey aiming at collecting a large set of qualitative and quantitative information at individual and household level in member countries (Statistics on Income and Living Conditions. Regulation of the European Parliament. no. 1177/2003). It provides some crucial indicators on income, poverty, social exclusion in the European Union (i.e. at risk of poverty rate and the Gini coefficient). It is carried out yearly in different EU countries since 2004 and it is the reference source for comparative statistics on income distribution in Europe. Besides, it provides both cross-sectional and longitudinal data comparable across the participating European countries. The survey is conducted through household and personal interviews (all individuals over 16). The sample design is based on a two-stages scheme (municipalities and households), where the primary sample units (municipalities) are stratified by population size within each region. Italy, like most EU countries, adopted a rotational sample design, composed of four rotational groups, each to be followed-up for 4 years. Each year one-fourth of the sample is renewed. The overall sample is statistically representative of the population residing in Italy and it is about 20,000 households per year. In particular, in 2018, it amounts to 21,173 households (39,969 individuals), residing in about 680 municipalities.

Data collection is structured in three parts: a. General form to collect demographic

information related to each household member (sex, date and place of birth, citizenship etc.) and some information for each household member aged less than 16 years (the type of school attended, formal and informal childcare etc.); b. Household questionnaire to collect information about housing conditions, housing expenses, economic situation, material deprivation, household income components; c. Personal questionnaire for each household member aged at least 16 years to collect information on education, health, current or previous labor and, income by detailed components (employee, self-employment, pensions and other social transfers, financial and real capital, private transfers). Incomes and social benefits data collected by interviews are integrated with administrative register data, generally fiscal data, to improve the quality of statistical information.[1] Overall, all EU-SILC quantitative information are processed by using specific statistical procedures to delete outliers and impute missing data.[2]

In our dataset we matched all parts of the questionnaires, taking into account demographic information, household income components, information on education, health, current or previous labor and, income broken down by components. Even though not explicitly designed to measure wealth, the EU-SILC survey contains information on multiple sources of financial wealth. Following the OECD Household financial assets classification,[3] we derive a measure of financial wealth by summing the estimated amount held by households in four different components: currency and deposits, public bonds, shares and other bonds and equities, mutual funds and other assets. Finally, the dataset includes cross-sectional microdata for Italian individual households stacked from 2004 up to 2018. Overall, we gathered more than 640 thousand individual records over 15 years.

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[1] Detailed information in Törmälehto and Jäntti (2013).

[2] For further details see in Istat (2008).

[3] National Accounts of OECD Countries, 2019.

2.2   Measuring inequality

The detailed microdata do allow us to consider a wide range of inequality measures concerning the total disposable income before and after transfers, labor earnings broken down by salaries from employees and income of self-employed workers, financial capital income and financial wealth. These are the variables we consider in our analysis.[4]

Income variables are available at annual frequency and refer to the year before the survey (12 months before to the interviews). The EU-SILC provides information on net incomes however, starting from 2007 gross incomes are available as well. For the sake of homogeneity, in our analysis we consider net incomes, taking into account that since 2007 no relevant change has occurred in tax-rates and income brackets. However, as a further extension, we can compute inequality measures of total disposable income before social transfers in order to evaluate the impact of conventional and unconventional monetary shocks by isolating as much as possible the automatic stabilization effects of the transfer system. Furthermore, we can compute *ad hoc* inequality measures for some subgroups of individuals, i.e. borrowers vs savers, exploiting the rich information set on individual characteristics.

We exclude the incomplete income records and use the weights provided within the survey in order to compute inequality measures reflecting the Italian population structure. All the nominal variables have been expressed in real terms (2015 prices) using the annual aggregation of the Harmonised Index of Consumer Prices (HICP).[5] To adjust household income according to the household size we use the modified OECD equivalence scale and then we assign the equivalent household income to each member of the household, that is divided by the number of household members converted into equivalized adults. In other words we assume equal

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[4]Financial incomes is defined as the sum of income refer to the amount of interest from assets such as bank accounts, certificates of deposit, bonds, etc, dividends and profits from capital investment in an unincorporated business (less expenses incurred). Total disposable income is given by the sum of the earnings and financial income plus the one arising from other sources, as transfers (unemployment benefits, pensions, children allowances etc.), income from the rental of a property or land (after deducting costs such as mortgage interest repayments) minus taxes on income and social insurance contributions. Disposable income before transfers is given by the disposable income minus social transfers described above excluded old-age and survivor' benefits.

[5]Eurostat, 2018b. Harmonised Index of Consumer Prices (HICP).

intra-household division of income and approximate individual living standards by assigning each individual the equivalized household income.[6] In doing so, we can control for the number of adults and the number of children in the household.

Following Casiraghi et al. (2018), we consider mainly three measures of inequality: the Gini coefficient, the ratio between the 90th percentile and 10th percentile and, the ratio between the 75th percentile and 25th percentile. Additionally, we compute the 99th, 90th, 75th, 50th, 25th, and 10th percentiles for all the variables considered above. We construct these measures for all the definitions of income and wealth. Taken together, these are extremely valuable because they provide a complete overview of inequality, the distribution, and their dynamics. Moreover, with respect to the US CEX survey which does not include the very upper end of the income distribution (i.e. the top 1%) which has played a considerable role in income inequality dynamics since 1980 in the US and Europe, the EU-SILC includes even incomes at the top end of the distribution. Even though the tails of the distribution are likely to contain some measurement errors, we decide do not trim them. Since all incomes and wealth information refer to the previous year, automatically the EU-SILC inequality measures series shifts one year back, precisely from 2003 to 2017.

However, to cover the entire period of ECB communications, that is starting from 1999, we need a longer time span of the series because the survey, alone, does not cover such a long period time. As a first step, we compute a back-calculation of EU-SILC inequality income measures by exploiting the microdata from the Historical Archive of the Bank of Italy's Survey of Household Income and Wealth (SHIW). Specifically, we extended the series backwards till 1999, in such a way that it is possible to recover 19 observations for each inequality measures.

The SHIW has been carried out by the Bank of Italy since the mid-1960s and comprises about 8,000 households per year distributed over 300 Italian municipalities and provides

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[6]Household members are equivalized or made equivalent by weighting each according to their age, using the so-called modified OECD equivalence scale. This scale gives the following weight to household members: 1.0 to the first adult; 0.5 to the second and each subsequent person aged 14 and over; 0.3 to each child aged under 14.

information on individual household characteristics and on their balance sheet (incomes and wealth).[7] Baffigi et al. (2016), extensively examines how survey data are related to those coming from other sources (national accounts, tax data, censuses, other sample surveys as EU-SILC and so on), summarizing the main results of the numerous works carried out on this aspect.[8] The authors found that both SHIW and EU-SILC exhibit bias due to non-response and underreporting. They found also that the average household income and the Gini inequality index exhibit a sharp correlation between the two surveys even if there are some differences in the calculation of some aggregates such as those concerning self-employment or financial capital incomes.[9] The overall estimates obtained in the EU-SILC survey can be used for comparison with the corresponding SHIW measures with fine results. Thus, we compute common coefficients over the two surveys' common span for each inequality measures and the distributions. Then by taking the averages, we retropolate the EU-SILC inequality indexes of each income variables. Finally, we obtain a longer time span of yearly data 1999-2017 useful for the macro model aiming to estimate the effect of both conventional monetary policy and unconventional monetary policy actions. Specifically, the latter includes the zero lower bound period starting from the last quarter of 2012. Figure 1 in the Appendix A shows the trend of different measures of inequality we have retropolated for different components of income and for the financial wealth. Overall, all measures show a slightly increasing trend over the last eighteen years in Italy. Financial capital income exhibits more volatility with respect to total disposable and labor income, especially during and after the financial crises. Similar to the labor income inequality dynamic, in the last three years the financial inequality index shows a slight decrease.

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[7]SHIW Archive, Bank of Italy.

[8]Following this strand see also Jappelli and Pistaferri (2010) and Fagereng et al. (2016).

[9]In the EU-SILC survey, the income from self-employment coming from interviews is compared with that from administrative sources and the maximum of the two values is imputed in the estimate of household income. A similar procedure is adopted for financial capital incomes.

3   Empirical methodology and the identification strategy

To evaluate the effects of both conventional and unconventional monetary policy on the income distribution of individual households we use the monetary policy surprises estimated in the Euro area Monetary Policy Event-Study Database, (EA-MPD, henceforth) by C. Altavilla, L. Brugnolini, R. Gürkaynak, R. Motto and G. Ragusa, henceforth ABRGM. We focused on the effects of an expansionary monetary policy (MP) exploring the financial channel and the income composition channel (i.e. higher asset prices have a positive effect on capital income held by the wealthier while an increase in GDP, by expanding employment, could have a positive effect on labor income, offsetting the total effect on inequality). By using a battery of local projections, as Jordà (2005), we estimate a baseline policy scenario using the whole sample period including QE (1999-2017) and a "counterfactual" scenario without QE up to 2012. Finally, we examine the impact of unconventional monetary policy by comparing the two scenarios.

3.1   The Euro area monetary policy Event-Study Database

To identify monetary policy shocks, most empirical works on the Euro area use innovations in monetary policy rate, i.e. 3-month rate in case of conventional monetary policy shocks and the long term interest rate in case of unconventional monetary policy as in Guerello (2017) and Casiraghi et al. (2018). In related literature we find other identification strategies. Following Lenza and Slacalek (2018), the main identifying assumption to evaluate unconventional monetary policy is that an expansionary asset purchase shock decreases the term spread (defined as the difference between ten-year and three-month constant-maturity). In their simulation Casiraghi et al. (2018) running the quarterly model of Bank Italy (BIQM), adopt the same assumption as above. Broadly speaking, a monetary shock is identified as an innovation in the policy rate or in the monetary base that does not contemporaneously affect

both prices and output. The monetary shocks proposed, however, has two main issues. First, they are predicted by past information of other macro variables and autocorrelated with their past. Second, there is a potential information problem since central banks transfer information about the outlook of the economy around the policy announcements. Thus, it is difficult to disentangle a pure monetary policy surprise from one that arises, for instance, from central bank information. First, Romer and Romer (2004) identify innovations to monetary policy purged of anticipatory effects related to economic conditions, using the real-time forecasts of the Fed staff presented in the Greenbooks prior to each FOMC meeting. They construct a measure of MP shocks from the component of policy changes at each meeting that is orthogonal to the Fed's information set. Some of the recent works in this vein are Jarociński and Karadi (2020), who use stock-bond correlations to identify central bank information signaling as opposed to classical monetary policy surprises. This issue is even more concerning once we aggregate the monthly measure into a quarterly or an annual one. For these reasons, we use intraday interest rates changes around ECB policy announcements available in the Euro area Monetary Policy Event-Study Database, (EA-MPD, henceforth), compiled by ABGRM, regularly updated and freely available by authors. EA-MPD provides a framework to extract multidimensional surprises based on Gürkaynak et al. (2005) and Swanson (2017). EA-MPD makes available intraday interest rates changes in basis points and asset price changes in percentage points for the history of ECB Governing Council announcements and for a wide range of variables.

In detail, they report Overnight Index Swap (OIS),[10] sovereign yields, stock prices, and exchange rates. The assets covered are the OIS rates with 1, 3, 6 months and 1 to 10, 15, and 20 years maturities; German bond yields with 3 and 6 months and 1 to 10, 15, 20, and 30 years maturities; French, Italian, and Spanish sovereign yields with 2, 5, and 10 years maturities, the stock market price index and the stock price index comprising only banks,

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[10]OIS are Euro area-wide interest rate measures, not affected by country risk either as credit risk or as safe haven premia. The OIS contracts are over-the-counter interest rate swaps where the underlying reference rate is the Euro area inter-bank rate, EONIA. Unlike US Federal Funds Futures, which have fixed calendar month coverage, each OIS contract is fixed maturity.

and the exchange rate of the euro.

In contrast with FED, there are two steps in the ECB communication procedure: first, at 13:45 Central European Time (CET) the ECB releases a very short note where it states the decisions about the three main interest rates (the main refinancing operation rate, MRO, the marginal lending facility rate, MLF, and the deposit facility rate, DF); then, after forty-five minutes, at 14:30 CET, the president of the ECB reads the introductory statement (IS) which is a document containing the reasons underlying the choice of the interest rates, describing ECB's view about the economic situation and providing information on its future behavior. This part lasts around fifteen minutes and is followed by a forty-five-minutes session of questions and answers (Q&A).

To build the asset price/yield changes database, they take the price/yield difference in short windows on Governing Council dates. Given this information release structure, they calculate the changes reported in the database as the difference between the upper median and the lower median (Table 1, below).

Table 1: Timing of the ECB monetary policy announcements in EA-MPD

	Press Release 13:45 CET	Press Conference 14:30 to 15:30 CET	Monetary Event 13:45 to 15:30 CET
lower median $(lower_t^{med})$	10 min before 13:25-13:35	10 min before 14:15-14:25	10 min before 13:25-13:35
upper median $(upper_t^{med})$	15 min after 14:00-14:15	10 min after 15:40-15:50	10 min after 15:40-15:50
change $(upper_t^{med} - lower_t^{med})$	$Change_t^R$	$Change_t^C$	$Change_t^M$

They collect all the changes for all the instruments around the three windows and present

the Euro area Monetary Policy Event-Study Database (EA-MPD) as a single workbook.[11]

Causality is very hard to tease out in macroeconomics however, jumps in OIS and asset prices around monetary policy announcements represent a kind of natural experiment to identify the causal effect of a monetary policy surprise. High-frequency data are an essential input to study the effects of monetary policy communication. Hence the high resolution of the intraday data allows for the measurement of asset price changes separately for the ECB's Press Release Window, the Press Conference Window, and their union, the Monetary Event Window.

Following the Governing Council policy meetings, ABGRM estimate latent factors from changes in yields in such a way to provide structural interpretation[12] in extracting monetary policy surprises from these asset price changes and to define how many dimensions of policy action and communication market participants perceive in press releases and press conferences.

To understand what these latent factors were, they use the methods developed by Gürkaynak et al. (2005), which makes the factors admit macroeconomic interpretation, and follow Swanson (2017) in labeling the QE factor. In particular, they identify four monetary policy factors, labeling as Target, Timing, Forward Guidance (FG), and QE. The factors are orthogonal one each other by construction.

3.2   The identification of monetary policy shocks

Before turning to analyze the effects of MP shocks on inequality, we first investigate how expansionary monetary policy actions affect the Italian macroeconomic aggregates, as well as

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[11]For an accurate description of the methodology see the Appendix to *"Measuring Euro area Monetary Policy"* by Altavilla et al. (2019a).

[12]The matrix X^j, $j = $ *press release, press conference* has changes in 1, 3, and 6-months and 1, 2, 5, and 10-years yields in its seven columns, with each row corresponding to a policy date. This matrix is taken directly from the EA-MPD. The factor structure is

$$X^j = F^j \Lambda + e^j$$

where F are the common latent factors, Λ are the factor loadings, and e^j are the idiosyncratic variations of yields at different maturities. After that they analyze the press release and press conference windows separately and by principal components, estimate the factors and rotate them to provide a structural interpretation, as common drivers of yield changes.

the financial variables.

3.2.1 Data

We use the ABGRM database to identify innovations to monetary policy purged of anticipatory effects related to economic conditions in order to characterize the effects of monetary policy (MP) in Italy. We consider directly the following "exogenous" monetary changes on a daily basis (Figure 2, Appendix B): OIS 1-month and OIS 6-months, as the monetary instruments that allow us to identify mostly the effect of conventional monetary policy since they are consistent with the dynamic of Target and Timing factor loadings, respectively; OIS 2-years and 10-years Italian bond yield as the rates that, following the analysis by ABGRM, identify the unconventional monetary policy (see section 3.1) since they are consistent with the dynamic of Forward Guidance and QE factor loadings, respectively .

$\epsilon_t^{MP_i,m}$ describes the monetary changes that we are going to use separately in four different scenarios, where $MP_i = OIS1M, OIS6M, OIS2Y, IT10Y$ and m indicates that the surprises are monthly.

Since the Italian inequality measures are available on annual basis, to be more accurate in analyzing what are the main channels activated we first estimate the impact of monetary policy on Italian macroeconomic variables on quarterly basis (excluding the inequality measures), by comparing conventional and unconventional scenarios. To this purpose, we aggregate the monthly series of the monetary changes into quarterly $\epsilon_t^{MP,q}$, using a simple time sum and projecting these onto endogenous variables, one by one in order to estimate separately the impulse responses of standard and non-standard scenario.

The conventional monetary policy effects are evaluated over the period 1999q1-2012q4, while the non-standard effects of monetary policy are captured over the sample 1999q1-2017q4 that includes the QE stance of monetary policy since the QE factor is active mostly from 2014 onward. Before estimating the impulse response functions (IRFs), we verify that the monetary changes are not autocorrelated with their past. These issues are particularly

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concerning in the context of a local projection, in which the measure is included directly (and not as an instrument) and thus might lead to biased (and puzzling) results, as shown in Miranda-Agrippino and Ricco (2018). As expected, monetary surprises don't exhibit any relevant autocorrelation implying that we are isolating potential information problems about the outlook of the economy, as much as possible in a short temporal window.

However, to make sure that the $\epsilon_t^{MP,q}$ series is actually unanticipated at quarterly level, i.e. orthogonal to other macroeconomic variables, we perform the sufficient information test proposed by Forni and Gambetti (2014). First, we compute the first 5 principal components of a large dataset on the main Italian figures, based on the information criterion of Bai and Ng (2002).[13] The dataset that we use for the factors extraction counts over 80 quarterly series that cover all the main macroeconomic aggregates, and a number of financial indicators. Then, we perform a Granger causality test to check whether the principal components Granger cause $\epsilon_t^{MP,q}$. Results are shown in Appendix B Table 3. We conduct the regressions including up to four lags of the dependent variables. Whether we include lags of the factors or not, we don't reject the null of no Granger causation, for almost all the specifications.

Along with the four direct measures of monetary policy stance $\epsilon_t^{MP_i,q}$, we want to investigate how monetary policy affects the macroeconomic and financial transmission channels. To this aim, additional macroeconomic variables are considered in the analysis, namely real GDP, the GDP deflator in first difference, employment from the Eurostat database and the share price index for Italy from FRED St. Louis Data. Furthermore, to fully identify all the transmission channels of standard and non-standard monetary policy we include a proxy of the BBB bond spread estimated by Jarociński and Karadi (2020) to capture financial conditions in a conventional monetary scenario, as no excess bond premium measure is available for the Euro area. We aggregate at quarterly level the monthly BBB bond spread available over the period 1999q1-2016q4 and extend it up to 2017 quarters. We also include an additional spread variable measured as the difference between short- and long-term interest rates from

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[13]Bai and Ng (2002) propose a criterion which basically modifies the AIC and BIC in order to take into account both dimensions of the dataset, N and T, as arguments of the function penalizing overparametrization.

the ECB database (10 years government bonds). We use all the macroeconomic variables in log-levels except for the excess bond premium and the spread which are in basis points; GDP and the share price index are also expressed in real terms. All the variables are available at a quarterly frequency, over the period 1999q1-2017q4. Thus, in our model the list of endogenous variables is the following:

$$Y_t = [gdp_t, gdpdefl_t, employment_t, ebp_t, shareprice_t, spread_t] \tag{1}$$

3.2.2 The model

To compute the impact of monetary policy we estimate impulse responses on a quarterly basis with local projections (LP) along the lines of Jordà (2005), whose flexibility allows us to deal with a short sample size[14]. In fact, implementing the VAR methodology with short series would preclude recursive estimation and yield bias and inconsistent results. The LP approach consists in running a sequence of predictive regressions of a variable of interest Y on a structural shock for different prediction horizons (h). The model we estimate is the following:

$$Y_{t+h} = \alpha^{(h)} + \Sigma_{i=1}^I \psi_i^{(h)} Y_{t-i} + \beta^{(h)} \epsilon_t^{MP,q} + \eta_{t+h} \sim MA(h) \tag{2}$$

where Y_{t+h} represents the left hand side endogenous variables with four lags enter the regressions up to horizon h, $\alpha^{(h)}$ is a constant, Y_{t-i} is the control set with i lags and the corresponding estimated coefficients $\psi_i^{(h)}$, and η_{t+h} is the residual. As a benchmark, we set I=2.

The estimated coefficients $\hat{\beta}^h$, for $h = 0, ..., H$ represent the effects of the monetary policy shocks $\hat{\epsilon}_t^{MP,q}$, alternatively conventional and unconventional, at time t on the macroeconomic aggregates Y_{t+h} considered at time $t + h$[15]. As shown by Jordà (2005), the direct estimation

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[14]A recent paper by Plagborg-Møller and Wolf (2019) demonstrates that LP and VAR estimators are two dimension reduction techniques with common estimand but different finite-sample properties. However, in finite samples and with finite lag lengths, researchers must navigate a bias-variance trade-off at long horizons.

[15]Following the literature on monetary policy effects, it is conventional to assume that monetary policy shocks do not have contemporaneous effects on output, inflation, etc. but may have a contemporaneous effect

of the autoregressive coefficients $\beta^{(h)}$, for $h = 0 \ldots 16$, corresponds to estimating the impulse response functions without casting the Wold representation theorem. Hence, the IRF is given by the sequence of regression coefficients of the structural shock and it is consistent with asymptotic normality properties. The impulse responses are presented in the next section with 1 standard deviation confidence bands. The errors arising from this projection are vector moving average (VMA) processes of order h, that is except for $h = 0$, the errors are serially correlated. Due to this issue, the author suggests estimating the variance-covariance matrix using the Newey-West (1987) heteroskedasticity and autocorrelation consistent estimator (HAC). However, we don't include additional lags of the shock $\epsilon_t^{MP,q}$, as the sample autocorrelation function for each monetary surprise doesn't reveal a significant correlation between different lags, and since the inclusion of these would imply dropping observations.[16]

3.3 The transmission of conventional and unconventional monetary shocks

Far from a narrowing definition of conventional and unconventional monetary policy, we assess the impact of these monetary policy actions on the Italian economy using different identification strategies. First, we estimate the impact of standard monetary policy over the period 1999q1-2012q4 using alternatively OIS1M and OIS6M monetary surprises (consistent with Target and Timing factors, respectively), where short interest rate cuts were implemented; then, we estimate the effect of non-standard monetary policy over the entire sample 1999q1-2017q4 using alternatively OIS2y and IT10Y policy changes (consistent with Forward Guidance and QE factors, respectively). Finally, we are able to analyze the difference between the conventional and the Forward Guidance scenarios with respect to QE since from 2013q1

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on equity prices and spread. In our analysis this is not the case, since using quarterly aggregation, monetary policy shock may have a contemporaneous effect on all variables.

[16]While a vector autoregressive model (VAR) consumes data only along time with the lag dimension (p), LP consumes data both along the lag (p) and the lead (h) dimension, thus the lag-length selection is crucial (Brugnolini (2018)).

onward the policy rate has reached the zero lower bound (ZLB) and only non-standard tools have been active. To assess the impact of the conventional and unconventional tools, we take into account that monetary shocks might have a contemporaneous effect on all the macro variables.

The results are presented in Appendix C.1, Figure 3, where in the first and in the second line IRFs of conventional policy (OIS1M and OIS6M shocks, respectively) are compared with the QE impulse responses (IT10y shock). Over the reduced sample, 1999q1-2012q4, an expansionary monetary policy shock, that is a 1 point decrease of the monetary surprise, increases the Italian real GDP in the short-run, employment slightly rises, while inflation reduces on impact showing thereafter a puzzling dynamics. The effect on employment is less strong but more persistent with respect to GDP, while on impact the impulse response of the share price index shows an upsurge. As expected, the proxy of the excess bond premium for the Euro area goes down in the short run. These results are in line with the bulk of the theoretical and empirical literature on conventional monetary policy shocks.

An expansionary non-standard policy shock increases both the Italian real GDP and employment, in a more persistent way with respect to the conventional scenario. The effect on spread is sharply negative even in the long-run while the share price index shows a slightly positive reaction with respect to the upsurge in the conventional scenarios. The excess bond premium falls on impact and then exhibits an upward dynamics, whereas the response of prices is quite puzzling while inflation seems to be unresponsive to the QE stimulus. Famous seminal works on monetary policy, Leeper et al. (1996) and Christiano et al. (1999), show that an unexpected monetary tightening often leads to the price puzzle, and to a counterintuitive increase in inflation in the impulse response functions. Indeed, the unconventional monetary policy period is itself *sui generis*. As stated by Williamson et al. (2016), both the ECB and the Bank of Japan are still experiencing inflation below their targets and further unconventional monetary policy actions do not seem to help. Recently Cochrane (2017) states that near to the ZLB, inflation could be still stable and, therefore, an increase in the interest rates could

lead to a rise of inflation.[17]

In the third line of Figure 3, we can gauge the specific effect of Forward Guidance over the entire sample period with respect to the QE stimulus, using OIS2Y as monetary innovation. The advantage of using an interest rate longer than the targeted policy rate is that it incorporates the impact of forward guidance and therefore remains a valid measure of monetary policy stance also during the period when the federal funds rate is constrained by the zero lower bound (Jarociński and Karadi (2020)). The effect of Forward Guidance is similar to the QE for the GDP and the GDP deflator, while it is less effective for employment. The impact on financial variables is quite different, especially for the share price index that increases sharply than in the QE scenario probably because FG embedded the ECB policy intentions on anchoring inflation target below but close to 2%. FG shock reduces the spread, as expected. Indeed, it has a puzzling effect on prices due to the uncertainty of ECB's FG in 2012 and the second half of 2013, in maintaining an accommodative monetary stance.[18] Jarociński and Karadi (2020) found the same puzzling behavior of Euro area market participants after some crucial ECB's information surprises.

3.3.1 The transmission of monetary shocks: some robustness

To verify the consistency of these results, we consider a set of robustness checks. First, we verify whether the monetary surprises aggregated quarterly are purged somehow of anticipatory effects related to economic conditions. Specifically, following the orthogonality test procedure in Forni and Gambetti (2010) we regress the monetary surprises $\epsilon_t^{MP,q}$, one at a time, on four lags of the shock itself and four lags of the Italian GDP and its deflator in first difference, the consumer and business confidence. The former are included as indicators of

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[17]This view is known as *New Fisherian Hypothesis* and it is based on the Fisher Effect according to which the real interest rate is independent of economic activity in the long-run and so an increase in the nominal interest rate will be reflected only in a one-for-one increase in expected inflation. Cochrane (2017), after testing several New Keynesian models concluded that, near the ZLB, inflation positively reacts to the nominal interest rate also in the short-run.

[18]In short, the ECB's announcement on 4th July 2013, while allowing one-year interest rates to be anchored (Draghi, 2014), was not enough to coordinate the market operators' short-term expectations and keep them at low rate levels, causing sharp stock price volatility.

the Italian economic performance and the latter as forward-looking variables. The F-statistic obtained under the null hypothesis that the parameters of the lags of the variables are jointly zero is very much smaller than the 5% critical value, except for the regression regarding the QE surprise when we include the second and the third lag. All in all, we conclude again that there is no Granger causation almost for all the specifications and that the monetary surprises we include in the model are able to properly recover the effects of a monetary shock on the economy.

Additionally, we implement further robustness tests of our main results to different identification strategies of the monetary policy shock, and to the use of SVAR methodology.

First, we include in the local projection estimation the monetary policy surprises estimated for the Euro area by Jarociński and Karadi (2020)[19]. They found that the presence of information shocks embodied in central bank communication attenuates the estimated effects of monetary policy in the standard high-frequency information. Consequently, their estimates purged of this bias imply stronger monetary transmission.

The responses to an expansionary monetary shock purged from the information bias over the sample 1999q1-2016q4 are comparable to the QE ones (see Figure 4 in Appendix C.2). Only some differences arise: the increase in GDP is weaker and short-lived with respect to the QE impulse response; employment slightly rises while the response of share prices is sharply positive in the short-run. The spread also reduces but the effect is less evident with respect to the QE scenario. Results seems to reinforce our choice.

Second, we identified the monetary policy shock estimating a SVAR model with a combination of contemporaneous and sign restrictions. The identification strategy follows the scheme of Weale and Wieladek (2016), which relies on the sign restrictions presented in Table 2. It is implemented using the QR decomposition algorithm proposed by Rubio-Ramirez et al.

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[19]They separate monetary policy shocks from contemporaneous information shocks by analyzing the high-frequency co-movement of interest rates and stock prices in a narrow window around the policy announcement. Their estimates are on a monthly frequency over the period 1999m1-2016m12 so we obtain a quarterly measure by averaging.

Table 2: Sign restrictions

	Supply	Demand	Monetary Policy
GDP	+	+	/
GDPDEF	-	+	/
SSR	/	/	-
Spread	+	+	-
Share Price	+	+	+

Note: The table lists signs of reactions of endogenous variables (in the first columns) to a positive demand shock, a positive supply shock, and a negative monetary policy shock, respectively. The restrictions are imposed on impact and one period ahead.

(2010)[20].

Table 2 shows the sign restrictions we use for a positive demand shock, a positive supply shock, and a negative monetary shock, based on the literature. Instead of using assets purchase announcements, we introduce, as a monetary policy stance, the shadow short term rate (SSR, henceforth) by Krippner (2013) in its latest version updated to 2020[21] to fully cover the entire span 1999q1-2017q4 taking onto account the ZLB period around and after the global and sovereign debt crises. We apply to it a negative sign restriction representing an expansionary monetary policy; we consider also the spread between long and short term rate (10 years government bond - 3 months rate) and the share price index for Italy. All variables are in growth rates except for the SSR and the spread which are in basis points. Particularly, we are interested in identifying a monetary policy shock by assuming that monetary expansion leads to an increase in output and prices and to a decrease in the spread. The responses

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[20]Let $u_t = A\epsilon_t$, where $\epsilon_t \sim N(0_n, I_n)$ is a $n \times 1$ vector of structural disturbances and A is such that $AA' = \Sigma$. In order to identify all the shocks in the system we need at least $n(n-1)/2$ additional restrictions. The additional (sign) restrictions are imposed using the QR decomposition algorithm proposed by Rubio-Ramirez, Waggoner and Zha (2010): 1. Make a draw from a $MN(0_n, I_n)$ and perform a QR decomposition of the matrix with the diagonal of R normalized to be positive, where $QQ' = I_n$. 2. Assume that S is the lower triangular Cholesky decomposition of Σ (in principle any different decomposition such that $SS' = \Sigma$ will do the work). Compute the candidate impulse responses $IRF_j = C_j SQ'$, where C_j are the reduced form impulse responses, for $j = 0, \ldots, J$. If all the IRFs satisfy the sign restrictions, store them. If not, discard them and go back to the first step. 3. Repeat step 1 and 2 until M impulse responses are obtained (say, $M = 1000$ times).

[21]For more details see L. Krippner Shadow short rate (SSR).

are comparable to the baseline results (see Figure 5 in Appendix C.3), although the output increase is weaker while share prices upsurge on impact and then drop quickly over the entire horizon.

3.4 The Effects of Monetary Policy Shocks on Inequality

To capture the effects of conventional and unconventional monetary shocks on income inequality and the distribution, we adopt the same econometric technique described in the previous section, the local projection, and estimate a version of equation (2) using inequality measures and monetary surprises on an annual basis, defined as in section 2:

$$ Z_{i,t+h} = \alpha_i^{(h)} + \Sigma_{j=1}^{J} \rho_{i,j}^{(h)} Z_{i,t-j} + \Sigma_{k=1}^{K} \psi_k^{(h)} \epsilon_{t-k}^{MP,y} + \beta_i^{(h)} \epsilon_t^{MP,y} + \eta_{i,t+h} \qquad h = 0, ..., H \qquad (3) $$

where Z_i corresponds, alternatively, to:

- the Gini index,

- the (log) cross-sectional standard deviation for conducting robustness check

- the difference of log-levels between the 90th and the 10th percentile and the 75th and the 25th percentile

- and finally, the percentiles, expressed in logarithms, of the distribution P10, P25, P50, P75, P90 and P99.

Like the cross-sectional standard deviation, the use of logs requires the elimination of observations with values of zero. However, taking logs allows us to diminish the sensitivity to outliers. In fact, the advantages of the percentile differential in log-levels is that they are less sensitive to extreme observations in the tails of the distributions. Following Coibion et al. (2017), we construct each measure of inequality based on disposable income, disposable income before transfers as well as labor income, financial capital income and financial wealth.

The specification in (3) allows for a contemporaneous effect of the unconventional monetary policy shock on the inequality measure of interest[22]. At the same time we have the possibility to add some additional lags of Z and ϵ in each regression as controls. As a benchmark, we set $I = 1$ and $K = 1$ but the latter can change in each regression up to 3 lags. If on the one hand, the annual frequency could be a limit for the analyses of monetary policies on inequality, on the other hand it is more suitable to capture the effect on income distribution given the slow movements of the dispersion measures over a single quarter or even more a single month[23].

We have already verified the orthogonality of the surprises at quarterly level with respect to the first five principal components explaining most of the variance of the main macro variables for the Italian economy (see section 3.2). Consequently, the monetary surprises are aggregated annually by a simple time sum.

However, to make sure that over a year they are orthogonal to other signals transmitted by the ECB during the meetings and related to information about the state of the economy in the Euro area, we repeat the orthogonality test using the ECB projections (taking the ECB December release)[24] for output and inflation available on the ECB website. We compute the F-test by regressing the four monetary surprises $\epsilon_t^{MP_i,y}$ on a sets of five regressors, each at a time. In addition to the forecast within the same year and the forecast revisions as

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[22]Furthermore, it is particularly convenient given the small sample at hand and its robustness towards misspecification.

[23]To overcome the trade-off of using annual series in short samples and the statistical significance of the results, the empirical literature on measuring inequality provides different solutions. Some authors evaluate the effect on inequality in two steps. First, they estimate the impact on the macro variables using quarterly or monthly data and then they apply the estimated effects on the entire income distribution available on annual basis (see among others Lenza and Slacalek (2018), Ampudia et al. (2018), Casiraghi et al. (2018)). Inui et al. (2017) uses quarterly series to capture the effect on inequality in Japan working with local projections and a shorter sub-sample to estimate separately the impact of the unconventional monetary policy. Finally, Samarina and Nguyen (2019) apply mixed-frequency data techniques as the data on income inequality are annual while all other variables are quarterly. In our work, we have chosen to exploit the huge amount of information on incomes and characteristics of individuals over time coming from the EU-SILC cross-sectional data at the expense of a shorter time series. As a further extension, one could exploit at most other sources of data, such as high-frequency financial information from banking database to built a larger sample of proxies of inequality measures and get new estimates over a larger time span.

[24]Twice a year, both ECB staff (March and September) and Eurosystem staff (June and December) publish macroeconomic projections for the Euro area. The ranges indicate the projected average annual percentage changes. We take the central value of the ranges. The projections are a key element in sharpening the assessment of macroeconomic developments.

in Miranda-Agrippino and Ricco (2018), we include also the 1 year ahead forecast and the cumulated forecast derived by summing up forecasts referring to the same period between t and $t+1$. Table 4 in Appendix reports the F-values of each regressions. We reject the null hypothesis of no predictability, that is all the coefficients are equal to zero only for OIS1M in the second set of regressors (ECB 1 year ahead) and for OIS2y in the fourth and the ALL regression. The null is not rejected for almost all the combinations regressors-surprise. We note, however, that the bulk of predictability resides in the forecast revisions related to the OIS2y surprise reflecting the forward guidance. This is the case in which narrative surprises might be contaminated by announced policy shifts. All in all, results tell us that surprises, except for OIS2Y, are orthogonal to other signals coming from the ECB meetings over a year because the informational shock is likely to be absorbed over such a time span.

First we trace out the effect of an expansionary conventional monetary policy on inequality as a counterfactual scenario up to 2012. In this setup, the monetary policy surprise we use in equation (3) is:

$$\epsilon_t^{MP,y} = [OIS1M]$$

Then we compare it with the effect of an expansionary unconventional monetary policy on inequality using the whole sample 1999-2017 including QE. The monetary surprise we adopt in this version of model (3) is the following:

$$\epsilon_t^{MP,y} = [IT10Y]$$

The OIS1M changes are implemented to estimate conventional policy since they are consistent with the dynamic of the Target factor loadings, while IT10Y changes are suitable to evaluate unconventional monetary policy as they are consistent with the dynamic of the QE factor that is active from 2014 onwards. We assess the effect on inequality using OIS6M and OIS2Y (named Timing and FG, respectively) as well, but the estimates are less statistically

significant both at 1 and 1.65 confidence levels.

The impulse responses $\beta_i^{(h)}$, for $h = 0 \ldots 4$, are presented in the Appendix C.4 with 1 and 1.65 standard deviation confidence bands, computed with Newey-West heteroskedasticity and autocorrelation robust standard errors, as, except for h = 0, the errors are serially correlated.

3.5   Main results

As shown in Figure 6, we compare the effect of monetary surprises between the two periods (1999-2012 and 1999-2017, respectively): the effect of an expansionary monetary policy on total disposable income reduces inequality in Italy both in standard and non-standard time but, while in the first scenario the effect is short-lived and reverts after one year when the Gini index shows an upward trend, the impact of QE is dizequaling on impact and persistently equalizing starting from the second year onwards. The size of the equalizing effect is modest up to the third year: it exhibits indeed a marked reduction only in the long-run. Furthermore, the impulse responses of the P90-P10 and P75-P25 percentiles follow a puzzle dynamic in the conventional case, while they are more coherent in the unconventional scenario. Since policy rates have been unusually low for a long time, this result might suggest more persistent distributional effects than during a normal interest rate cycle (Domanski et al. (2016)).

Looking at the income distribution, the overall impact of an expansionary non-standard monetary policy is equalizing with respect to the conventional scenario for each percentile. The sign of the responses is the same for each percentile. However, the 10th percentile appears to be the one that benefits the most from the unconventional policy showing a persistent increasingly dynamic while the responses appear less significant for the remaining percentiles for which a slight increase is observed after the first year.

The effect of the unconventional monetary policy is also equalizing for both labor and financial incomes distribution, but with a different profile. Size and dynamics of labor income inequality measures are persistently equalizing over the entire sample. The effect of conventional monetary shock is totally dis-equalizing (Figure 6). Looking at the income

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percentiles, the bottom of the distribution, in particular the 10th and 25th, are the ones that benefit the most from the unconventional policy after one year, probably reflecting the slow recovery of employment in Italy after the financial crises. The top 1% benefited more on impact from an accommodative standard policy (Figure 9). Additionally, we are able to gauge the QE effect on employee and self-employment income. Figure 10 compares the responses of the monetary surprises related to the QE shock: the Gini index calculated on employee incomes decreases immediately after the shock while the effect on self-employment is slightly equalizing in the first year and then turn to be dis-equalized afterwards with a peak in the second year, giving back an ambiguous effect. Indeed, the IRFs don't fully reflect the recent recovery of self-employment labor income in Italy.

On the other side, financial income inequality shows quite different behavior: while in the conventional case the Gini coefficient decreases and upsurges after two years, in the unconventional scenario the Gini coefficient increases on impact and then decreases persistently from the second year onwards (Figure 7). This fall is mainly driven by the prompt rise in the 10th, 25th and 50th percentiles, with the former response displaying a higher magnitude. The responses appear largely delayed for the 90th and 99th percentiles, for which, if anything, an increase is observed only after three periods (Figure 11). These outcomes probably reflects different households behaviors: those who gained low financial incomes switched rapidly toward more profitable assets, as mutual funds (a widespread asset in Italy after the financial crises: from 2008 to 2016, they increased about of 5 percentage points. See Household Financial Assets, OECD). Even though under UMP, in Italy stock prices appear to have reacted to a lesser extend with respect to the US and the UK (see Figure 3), households at the top of financial income distribution kept their portfolio unchanged for a longer period benefiting from higher asset prices. All in all, both labor and financial incomes have contributed to lower inequality in disposable income confirming that the income composition channel has been activated during the QE period.

The responses of financial wealth and the wealth distribution are presented in Figure 7

and 12, respectively. While in the conventional case the Gini coefficient shows an up and down dynamic, in the unconventional scenario the Gini coefficient increases on impact and decreases after one year showing an unambiguous and persistent decline from the second period onward. Impulse responses of the other measures of financial wealth inequality exhibit a quite similar dynamic. Differently from the financial income distribution, this dynamic is mainly driven by the sharp rise in the top of the distribution, 75th, 90th and 99th percentiles, up to the second year. The top 1% reaches the higher benefits in the second period. Afterwards, the IRFs related to these percentiles exhibit a sharp downturn. Furthermore, the positive reaction of the bottom of the distribution up to 50th percentile is long-lived. The heterogeneous behavior of the wealth distribution is completely different in the conventional case: a 1 point decrease in the policy surprise, lowered all the percentiles meaning that the standard monetary policy works differently as it affects all families that hold securities and deposits. Taking into account that risky financial assets are almost exclusively held by the upper deciles of the gross wealth distribution, the financial segmentation channel seems to be activated under the non-standard monetary policy in favor of median and wealthy households with a peak in the second year and a sharp decline afterwards. Only in the long-run, the persistent decline of the Gini index reflects some gains for the bottom of the distribution.

3.6   Effects on sub-groups of households and other possible extensions

As a further extension, we consider some specific questions raised in the public debate. One is whether non-standard measures differ from conventional policies in the extent to which they may cause an "expropriation of savers" (Casiraghi et al. (2018)): monetary expansion makes borrowers better off by reducing the interest payments on debt (i.e housing mortgages), while savers holding deposits and securities face lower returns.

Following Guerello (2017), the other one concerns the redistributive role of fiscal policy after the global financial crises since low-income households tend to rely more on transfers

while middle-income households rely on labor income and those at the upper tail of the income distribution will rely relatively more on business and capital income (Colciago et al. (2019)). Consequently, we analyze the impact of QE on household disposable income before and after transfers.

At the end of 2017 in Italy, housing was the main investment for Italian households and it represents half of the gross wealth with a value of 5.246 billion euros although, since 2011, the ratio of dwellings to total assets declined in the following years, falling from 54 to 49 percent in 2017. Furthermore, the downward trend in residential housing prices in Italy, underway since 2012, has resulted in a reduction in the average value of housing and in the ensuing contraction in the value of housing wealth (BdI-Istat Report, 2019). According to the Household Budget Survey by Istat, in the same year, mortgagors represents the 19.6% of households living in their dwellings (13.4% in 2008). In addition with regard to financial capital, the share of deposits in the Italian financial portfolio increased slightly from about 10 to 13 percent between 2005 and 2017, while the share of securities strongly declined from about 8 to 3 percent in the same period and the shares and other equity fell from 12 to 9.7 percent (BdI-Istat Report, 2019).

Since EU-SILC survey makes available some information on households savings and housing tenure status (i.e. owners, mortgagors), we can analyze the impact of non-standard monetary policy on the so-called "savers" households, defined as families with capital income (real and financial) and without a mortgage (owners or not), and on the "borrowers" households, defined as families without capital income but with a mortgage (although other definitions to classify savers and borrowers are allowed) assessing whether the saving redistribution channel worked. According to Cloyne et al. (2018), housing tenure is a useful proxy for the balance sheet positions of households. Mortgagors, by definition, have sizable debt but also sizable wealth (which is typically tied-up in their house) while outright owners have sizable housing and other financial wealth. As shown in Figure 13 non-standard monetary policy, say QE, is dis-equalizing for savers. From the third period ahead, IRF shows a

downturn in dynamics probably because incomes from real and financial capital are not eroded sharply from low-interest rates like in a standard monetary policy. Even if on a lower magnitude, the impact for borrowers is equalizing indeed, meaning that the prolonged period of low-interest rates allows people to get access to cheaper loans, taking a larger advantage, due to their higher leverage. Italians are great savers. Despite their conservative financial habits, after the global financial crisis of 2008 they have been forced to consider other investments than government bonds and deposits. Therefore, savers appear to have been hit hard by non-standard monetary policies only in the medium run.

Turning our attention on the second issue, we find that redistributive policies might not have affected the distribution of income and its response to external shocks given the limited role played by fiscal policy in Italy in recent years due to fiscal compact rules adopted by Euro area countries after the sovereign debt crisis. Following Guerello (2017), the comparison of the Gini index of disposable income before and after social transfers (pension excluded) provided by the EU-SILC database can be considered as a proxy of redistributional effects of fiscal policy.[25]

Figure 14 shows that the effect of an expansionary monetary policy on disposable income before transfers reduces inequality in Italy both in standard and non-standard case. While in the first scenario the effect is almost null and short-lived (after two year the Gini index upsurges), in the second scenario, starting from the first year the impact of QE is persistently equalizing as shown its downward trend with respect to the conventional case. Furthermore, the impulse responses of the P90-P10 and P75-P25 inequality measures exhibit a more marked decrease meaning that low-income households have benefited more from the effect of monetary policy other then fiscal transfers, if anything.

For the sake of comparison, the effects before (Figure 14) and after transfers (Figure 6) show a downward dynamic. Furthermore, the response of the Gini index of disposable income before transfers starts decreasing one period before with respect the decrease of the Gini index

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[25]We do not use a pre-tax income as from 2007 till 2017 there were no significant changes in tax rates or tax brackets in Italy.

of disposable income after transfers, probably because following the sovereign debt crises tightening fiscal rules have limited government policy actions in Italy and other European countries. For these reasons the social tensions associated with fiscal consolidation in part stemming from the global financial crisis, have put the distributional impact of governments' tax and spending policies at the heart of the public debate in many countries. According to Bernanke (2015) it would be preferable to have more proactive fiscal policies and a more balanced monetary-fiscal mix when interest rates are close to zero.

3.7   Other robustness

We also conduct a robustness check analysis by adopting the same methodology with another measure of inequality for each scenario we have discussed above: the cross-sectional standard deviation of log-levels which reduces sensitivity to extreme values of the distribution by removing zero values. Figure 15 in Appendix C.5 shows the impulse response functions of disposable income, disposable income before transfers, labor income, financial capital income and financial wealth in both conventional and unconventional monetary policy scenario. The results are broadly consistent with what we found in the previous sections both for the short and the long-run dynamics.

Furthermore, to be sure that the QE surprise at annual level is actually unanticipated, we evaluate again the impact of an unconventional monetary policy purged from other macroeconomic shocks, such as demand (AD) and supply (AS) shock, on the main inequality measures. We first estimate a new monetary QE surprise by regressing $IT10y$ onto AD and AS shocks estimated in the VAR exercise described in section 3.3 and then aggregated annually by a simple time sum. The residuals of the following equation

$$IT10Y = \alpha + \beta AD_{t-1} + \delta AD_{t-1} + \gamma As_t + \phi As_{t-1} + \eta_t \tag{4}$$

are then considered as a measure of monetary policy shocks, say QE-purged surprise. We

then compare the effect on inequality using both the traditional QE surprise and the "purged" surprise. Figure 16 in Appendix C.5 shows that the impulse response functions after a QE-purged innovation exhibit downward dynamic. With respect to the traditional QE surprise, the effect is even more equalising after the first period for all incomes category. These results suggest that the monetary policy shock is well identified.

Finally, we experiment the sensitivity of IRFs to different lags length by including in the LP model exogenous monetary policy shocks up the first two lags. Results are not altered by these changes: an expansionary monetary policy reduces inequality and the equalizing effect is more evident and long-lived in the unconventional scenario rather then the conventional case.

4 Conclusion

In this paper, we investigate the effects of conventional and unconventional monetary policy shocks on income inequality in Italy exploiting for the first time the household survey microdata on Income and Living Conditions (EU-SILC, Istat) that allow us to compute inequality measures over time and for specific incomes and subgroups of individuals (savers vs. non-savers). To this aim, we focus mainly on the income composition channel and the financial channel.

Main results of the impact of a monetary policy shock on income distribution in Italy show that the equalizing effect of non-standard policy is more evident in the medium-run, with respect to the conventional scenario. The responses of the Gini coefficient to an expansionary monetary policy shock are small in magnitude and significant in the short-run up to two years. The overall impact is driven by the sharp reduction of labor income inequality measures (in particular those of employees) due to an increase in GDP and employment. The response of financial income inequality measures exhibits also an equalizing effect over the horizon, despite of a slight increase on impact due to the weak rise of share prices. When

we consider the response of disposable income before social transfers (pension excluded) we find that an equalizing effect of higher magnitude is strongly evident in the unconventional scenario meaning that fiscal policy did not have a crucial redistributive role in Italy during the crises and the recovery period. Looking at the income percentiles, the impact of an expansionary non-standard monetary policy is heterogeneous along the distribution. In particular the 10th percentile of the labor income distribution appears to be the one that benefits the most from unconventional policy showing an upward dynamic for the bottom of the distribution more pronounced than that of the top percentiles (the 75th, 90th and 99th). The evidence on financial income is very much alike to the disposable income responses with sharp heterogeneity across the distribution. The equalizing effect of the unconventional monetary policy is mainly driven by the bottom of the distribution while the response of the top 1% appears largely delayed. These findings suggests that an expansionary monetary policy reduces both labor earnings and financial income inequality, contributing to the decrease in total income inequality in Italy over the medium term. All in all, the income composition channel works in the right direction during the QE period even if the total impact on household incomes is modest and prolonged. Our results are less clear cut than the recent work on income inequality in the Euro area (see Lenza and Slacalek (2018) and Samarina and Nguyen (2019)) where the responses of the Gini coefficient to an expansionary monetary policy shock are also small in magnitude but significant in the short-run.

Turning our attention to the financial channel, the non-standard monetary policy shows at first glace an ambiguous effect favoring the median and wealthy households up to the second period. The top 1% reaches the higher benefits. Afterwards, the persistent decline of the financial wealth's Gini index reflects some gains at the bottom of the distribution, meaning that unconventional monetary policy is no longer "neutral" over the cycle. Quite differently from the results in Casiraghi et al. (2018), savers appear to have been "expropriated" during the QE period because they were not compensated enough by the capital gains while borrowers have benefited for a prolonged period from their higher leverage due to lower

interest rates. Hence, we can argue that differently for the US and UK equity prices were not the main drivers of rising inequality in Italy. Overall, some evidence suggests that QE is associated with a decrease in Italian household inequality in line with the Euro area's experience although its economic size is small. In this respect, other policies and economic forces could be responsible for the observed rise in income and wealth inequality in recent years holding important policy implications for government choices. Future research could investigate, for example, the key role of fiscal and redistributive policies and the extent to which the monetary-fiscal mix in Italy has been inadequate. Greater reliance on fiscal policy would probably give better results, and would certainly be easier to explain, than changing the target for monetary policy.

References

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., and Ragusa, G. (2019a). Measuring euro area monetary policy. Journal of Monetary Economics, 108:162–179.

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., and Ragusa, G. (2019b). Measuring euro area monetary policy. Working Paper Series 2281, European Central Bank.

Ampudia, M., Georgarakos, D., Slacalek, J., Tristani, O., Vermeulen, P., and Violante, G. L. (2018). Monetary policy and household inequality. Working Paper Series 2170, European Central Bank.

Baffigi, A., Cannari, L., and D'Alessio, G. (2016). Cinquant'anni di indagini sui bilanci delle famiglie italiane: Storia, metodi, prospettive (fifty years of household income and wealth surveys: History, methods and future prospects). Bank of Italy Occasional Paper, (368).

Bai, J. and Ng, S. (2002). Determining the number of factors in approximate factor models. Econometrica, 70(1):191–221.

Bernanke, B. (2015). Monetary policy and inequality. Ben Bernanke's Blog.

Brugnolini, L. (2018). About Local Projection Impulse Response Function Reliability. CEIS Research Paper 440, Tor Vergata University, CEIS.

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

Christiano, L. J., Eichenbaum, M., and Evans, C. L. (1999). Monetary policy shocks: What have we learned and to what end? Handbook of Macroeconomics, 1:65–148.

Cloyne, J., Ferreira, C., and Surico, P. (2018). Monetary policy when households have debt: new evidence on the transmission mechanism. Working Papers 1813, Banco de España.

Cochrane, J. H. (2017). The new-keynesian liquidity trap. Journal of Monetary Economics, 92:47–63.

Coibion, O., Gorodnichenko, Y., Kueng, L., and Silvia, J. (2017). Innocent bystanders? monetary policy and inequality. Journal of Monetary Economics, 88(C):70–89.

Colciago, A., Samarina, A., and de Haan, J. (2019). Central bank policies and income and wealth inequality: A survey. Journal of Economic Surveys, 33(4):1199–1231.

Domanski, D., Scatigna, M., and Zabai, A. (2016). Wealth inequality and monetary policy.

BIS Quarterly Review March.

Fagereng, A., Guiso, L., Malacrino, D., and Pistaferri, L. (2016). Heterogeneity in returns to wealth and the measurement of wealth inequality. American Economic Review, 106(5):651–55.

Forni, M. and Gambetti, L. (2010). Fiscal foresight and the effects of government spending.

Forni, M. and Gambetti, L. (2014). Sufficient information in structural vars. Journal of Monetary Economics, 66:124–136.

Furceri, D., Loungani, P., and Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. Journal of International Money and Finance, 85(C):168–186.

Guerello, C. (2017). Conventional and unconventional monetary policy vs. households income distribution: an empirical analysis for the euro area. Journal of International Money and Finance, 85.

Gürkaynak, R., Sack, B., and Swanson, E. (2005). Do actions speak louder than words? the response of asset prices to monetary policy actions and statements. International Journal of Central Banking, 1.

Inui, M., Sudo, N., and Yamada, T. (2017). The effects of monetary policy shocks on inequality in Japan. BIS Working Papers 642, Bank for International Settlements.

Istat (2008). L'indagine europea sui redditi e le condizioni di vita delle famiglie (eu-silc). Metodi e norme no. 37.

Jappelli, T. and Pistaferri, L. (2010). Does consumption inequality track income inequality in italy? Review of Economic Dynamics, 13(1):133–153.

Jarociński, M. and Karadi, P. (2020). Deconstructing monetary policy surprises—the role of information shocks. American Economic Journal: Macroeconomics, 12(2):1–43.

Jordà, O. (2005). Estimation and inference of impulse responses by local projections. American Economic Review, 95(1):161–182.

Krippner, L. (2013). Measuring the stance of monetary policy in zero lower bound environments. Economics Letters, 118(1):135–138.

Leeper, E. M., Sims, C. A., Zha, T., Hall, R. E., and Bernanke, B. S. (1996). What does monetary policy do? Brookings Papers on Economic Activity, 1996(2):1–78.

Lenza, M. and Slacalek, J. (2018). How does monetary policy affect income and wealth

inequality? Evidence from quantitative easing in the euro area. Working Paper Series 2190, European Central Bank.

Miranda-Agrippino, S. and Ricco, G. (2018). The transmission of monetary policy shocks.

Montecino, J. and Epstein, G. (2015). Did quantitative easing increase income inequality? SSRN Electronic Journal.

Mumtaz, H. and Theophilopoulou, A. (2016). The impact of monetary policy on inequality in the uk: An empirical analysis. Working Paper 783.

Plagborg-Møller, M. and Wolf, C. K. (2019). Local projections and vars estimate the same impulse responses. Unpublished paper: Department of Economics, Princeton University, 1.

Romer, C. D. and Romer, D. H. (2004). A new measure of monetary shocks: Derivation and implications. American Economic Review, 94(4):1055–1084.

Rubio-Ramirez, J. F., Waggoner, D., and Zha, T. (2010). Structural vector autoregressions: Theory of identification and algorithms for inference. Review of Economic Studies, 77(2):665–696.

Saiki, A. and Frost, J. (2014). How does unconventional monetary policy affect inequality? evidence from japan. Dnb working papers, Netherlands Central Bank, Research Department.

Samarina, A. and Nguyen, A. D. (2019). Does monetary policy affect income inequality in the euro area?

Swanson, E. T. (2017). Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. National bureau of economic research.

Törmälehto, V.-M. and Jäntti, M. (2013). 1. combining sample surveys and registers-an overview in the context of eu-silc. The use of registers in the context of EU–SILC: challenges and opportunities, page 13.

Weale, M. and Wieladek, T. (2016). What are the macroeconomic effects of asset purchases? Journal of Monetary Economics, 79(C):81–93.

Williamson, S. et al. (2016). Neo-fisherism: A radical idea, or the most obvious solution to the low-inflation problem? The Regional Economist, 24(3):2–23.
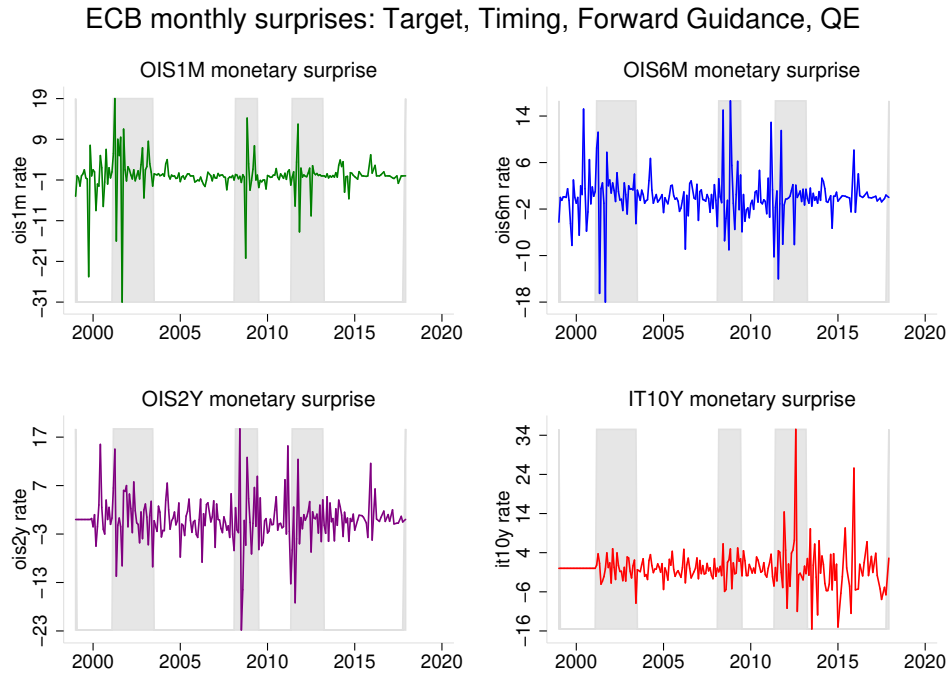
APPENDIX

A   INEQUALITY MEASURES

Figure 1: Measures of income and wealth inequality. Moving averages, Years 1998-2017.
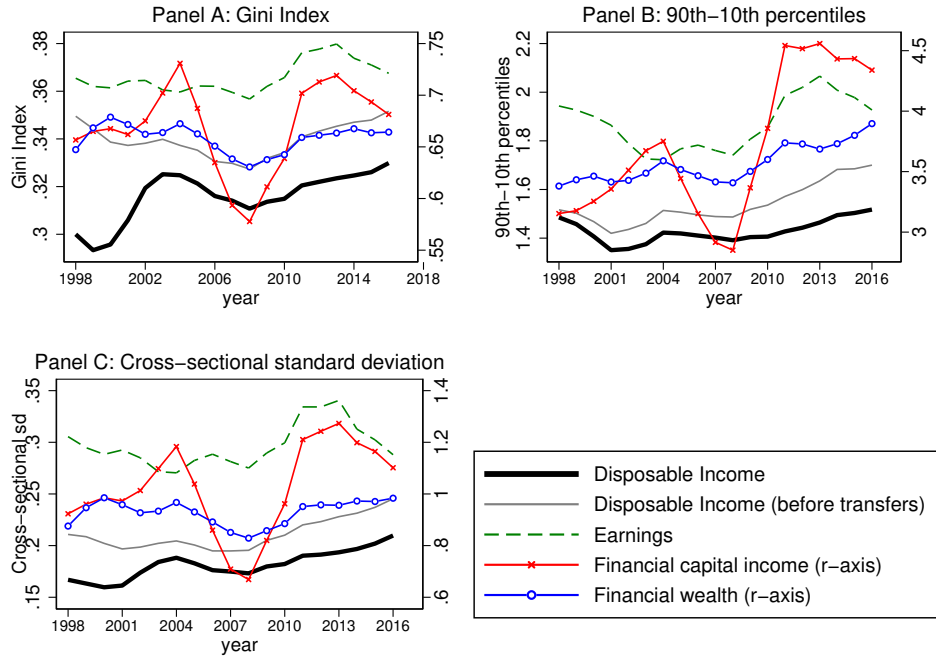
Note: Author's calculations using the EU-SILC survey (Istat). See Section 3.2 for details.

B   EA-MPD MONETARY SUPRISES

Figure 2: ECB Monetary surprises with recession dating (shaded area).

Note: Author's calculations based on EA-MPD dataset.

Table 3: Granger causality of the monetary surprises using the first 5 principal components

	0 lag	1 lag	2 lags	3 lags	4 lags
			OIS1M		
pc1	0.61	0.6	0.33	0.36	0.10
pc2	0.28	0.43	0.28	0.23	0.00
pc3	0.59	0.65	0.66	0.61	0.86
pc4	0.72	0.73	0.07	0.95	0.00
pc5	0.15	0.12	0.33	0.77	0.69
ALL	0.56	0.61	0.24	0.68	0.00
			OIS6M		
pc1	0.95	0.87	0.93	0.83	0.87
pc2	0.26	0.27	0.26	0.11	0.03
pc3	0.99	0.77	0.55	0.80	0.96
pc4	0.83	0.07	0.26	0.16	0.22
pc5	0.6	0.39	0.45	0.86	0.36
ALL	0.91	0.37	0.59	0.43	0.19
			OIS2y		
pc1	0.60	0.6	0.56	0.64	0.66
pc2	0.19	0.19	0.29	0.22	0.09
pc3	0.6	0.79	0.37	0.7	0.93
pc4	0.95	0.07	0.49	0.08	0.37
pc5	0.66	0.5	0.59	0.76	0.51
ALL	0.79	0.33	0.7	0.42	0.49
			IT10y		
pc1	0.02	0.04	0.15	0.13	0.12
pc2	0.72	0.56	0.64	0.57	0.51
pc3	0.76	0.81	0.87	0.80	0.38
pc4	0.17	0.96	0.15	0.62	0.16
pc5	0.54	0.58	0.14	0.26	0.33
ALL	0.15	0.42	0.25	0.43	0.12

Granger causality: p-values of the Wald test of the four monetary surprises by Altavilla et al. (2019b) aggregated quarterly on six sets of regressors representing the first 5 principal components. The sixth set (ALL) includes all pca1-pca5 series. 1999q1-2017q4.

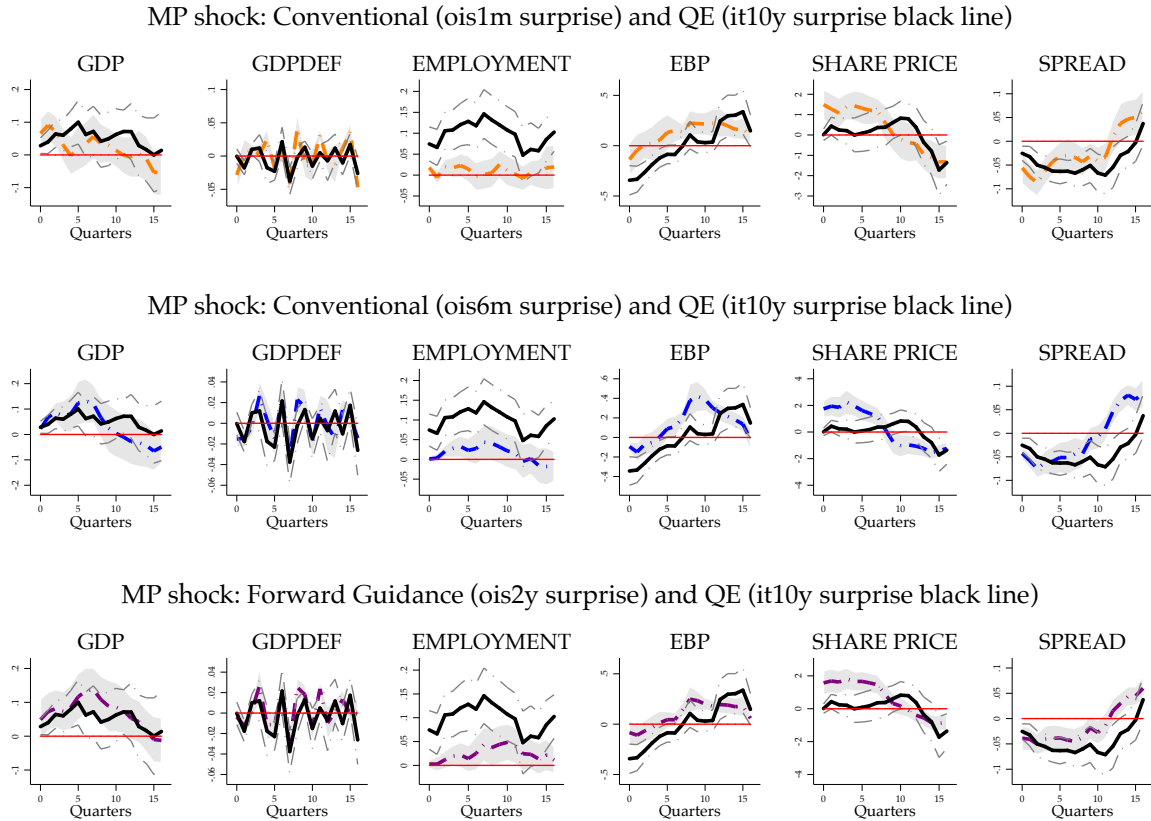Table 4: Orthogonality test to check for Central Bank Signalling

	OIS1M	OIS6M	OIS2Y	IT10Y
ECB Nowcast	0.49	0.86	0.05	0.38
ECB 1 year ahead	0.02	0.36	0.19	0.12
ECB Cumulated	0.45	0.38	0.1	0.14
ECB Forecast revision	0.47	0.88	0.00	0.37
ALL	0.27	0.57	0.03	0.5
N	17	17	17	17

Test of orthogonality: p-values of the F-test of the regession of the four monetary surprises by Altavilla et al. (2019b) aggregated annually on five sets of regressors including the BCE forecast on GDP growth and HICP growth within the same year, the forecast one year ahead, the cumulated forecast and the forecast revisions, taken one at a time. The first and the fourth regressions include one lag. The fifth set (ALL) includes all of the series. 2001-2017.

C   IMPULSE RESPONSE FUNCTIONS

C.1 CONVENTIONAL AND UNCONVENTIONAL MONETARY POLICY

Figure 3: IRFs of Conventional and unconventional monetary policy

MP shock: Conventional (ois1m surprise) and QE (it10y surprise black line)

MP shock: Conventional (ois6m surprise) and QE (it10y surprise black line)

MP shock: Forward Guidance (ois2y surprise) and QE (it10y surprise black line)

Note: Impulse responses of the different macroeconomic variables to a 100 bp. expansionary monetary policy shock using the baseline LP model excluding the measure of interest $Z_{i,t}$ from the system. All the responses are in percentage points; IRFs of EBP and spread are in basis points. The dash-dotted gray lines and light-shaded areas are 68% confidence bands.

C.2 UNCONVENTIONAL MONETARY POLICY. ROBUSTNESS CHECK COMPARING QE WITH JAROCINSKY AND KARADI MP SHOCK

Figure 4: IRFs of QE and JK monetary policy shock
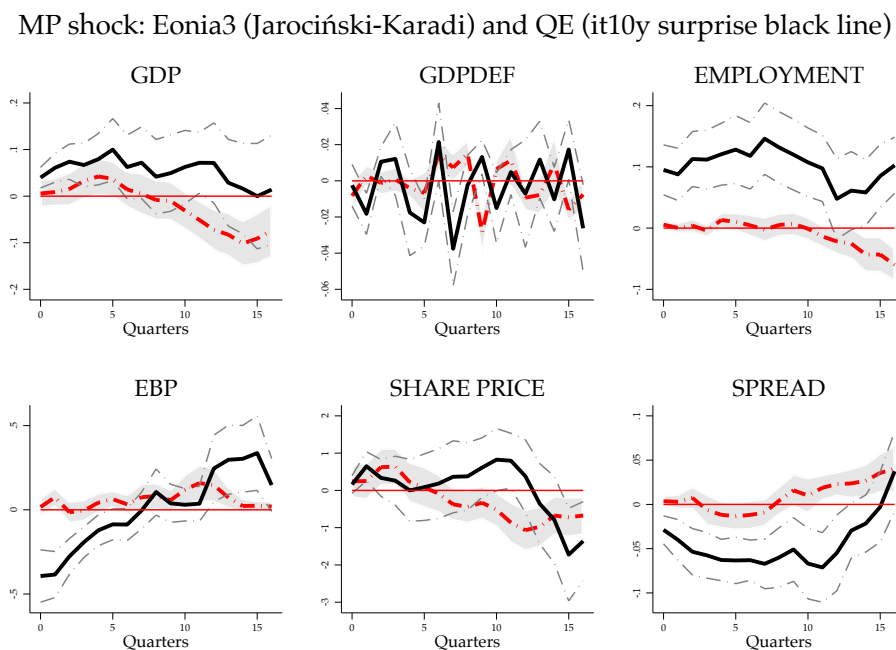
MP shock: Eonia3 (Jarociński-Karadi) and QE (it10y surprise black line)

Note: Impulse responses of the different macroeconomic variables to a 100 bp. expansionary monetary policy comparing QE shock (solid black line) with the Jarocinsky-Karadi high-frequency monetary policy shock (dashed red line) in LP model over the sample 1999q1-2016q4 excluding the measure of interest $Z_{i,t}$ from the system. All the responses are in percentage points; IRFs of EBP and spread are in basis points. The dash-dotted gray lines and the light-shaded areas are 68% confidence bands.

C.3 UNCONVENTIONAL MONETARY POLICY. ROBUSTNESS CHECK USING THE SHADOW RATE BY L. KRIPPNER IN A SVAR WITH SIGN RESTRICTIONS

Figure 5: IRFs of an expansionary monetary policy
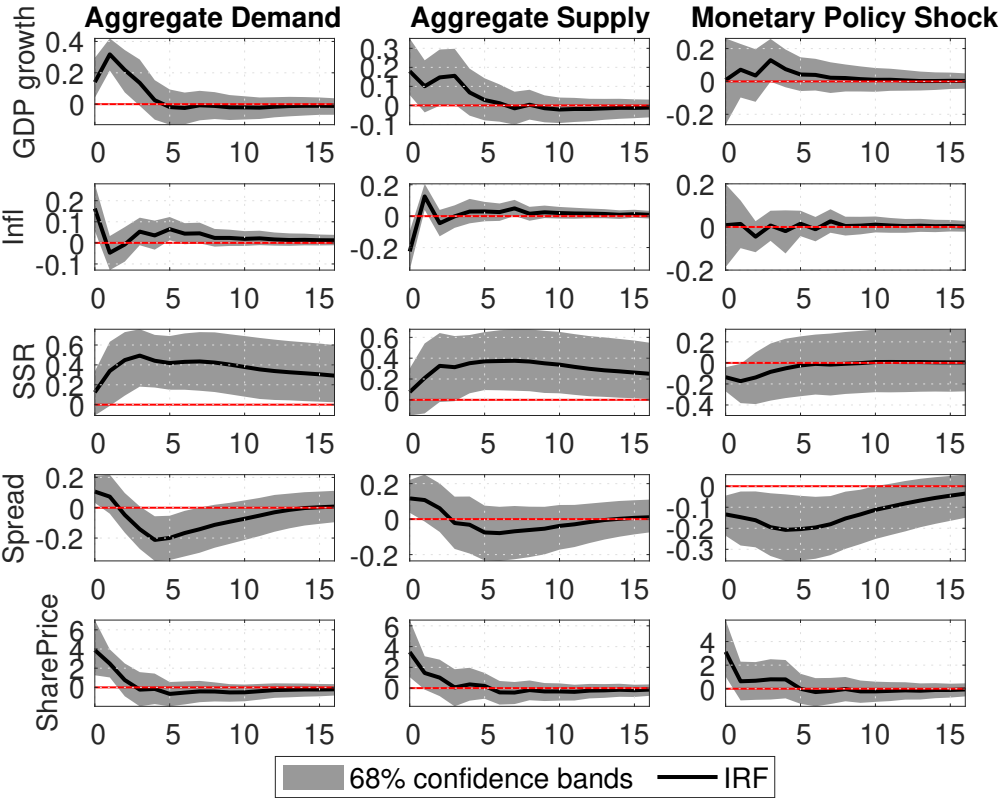
Note: Impulse responses of the different macroeconomic variables to a 100 bp. expansionary monetary policy shock using the shadow short rate (SSR) in a SVAR with sign restrictions excluding the measure of interest $Z_{i,t}$ from the system. All the responses are in percentage points; spread are in basis points. The solid line is the point-wise median. The gray-shaded areas are 68% probability bands.

Figure 6: IRFs of Conventional (blue dash-dotted line) and Unconventional (black line) monetary policy on disposable and labor income inequality measures
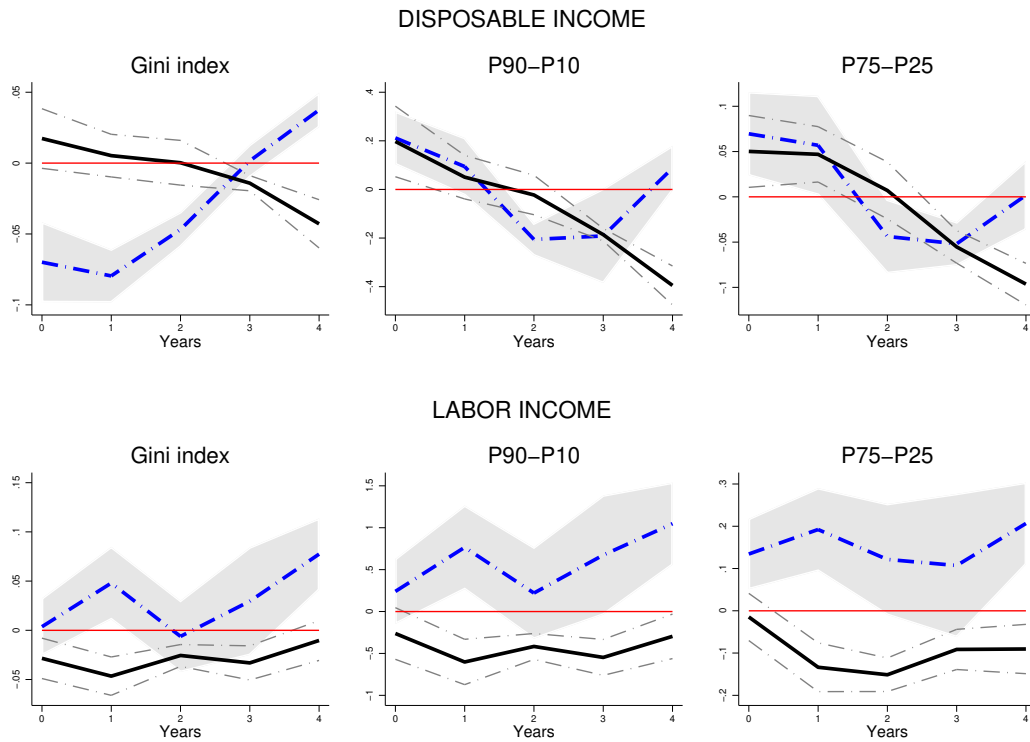

Note: Impulse responses of the Gini index (percentage points), P90-P10 and P75-P25 (difference of log-levels) to a 100 bp. expansionary monetary policy shock. The dash-dotted gray lines and light-shaded areas are both 68% confidence bands.

Figure 7: IRFs of Conventional (blue dash-dotted line) and Unconventional (black line) monetary policy on financial income and financial wealth inequality measures
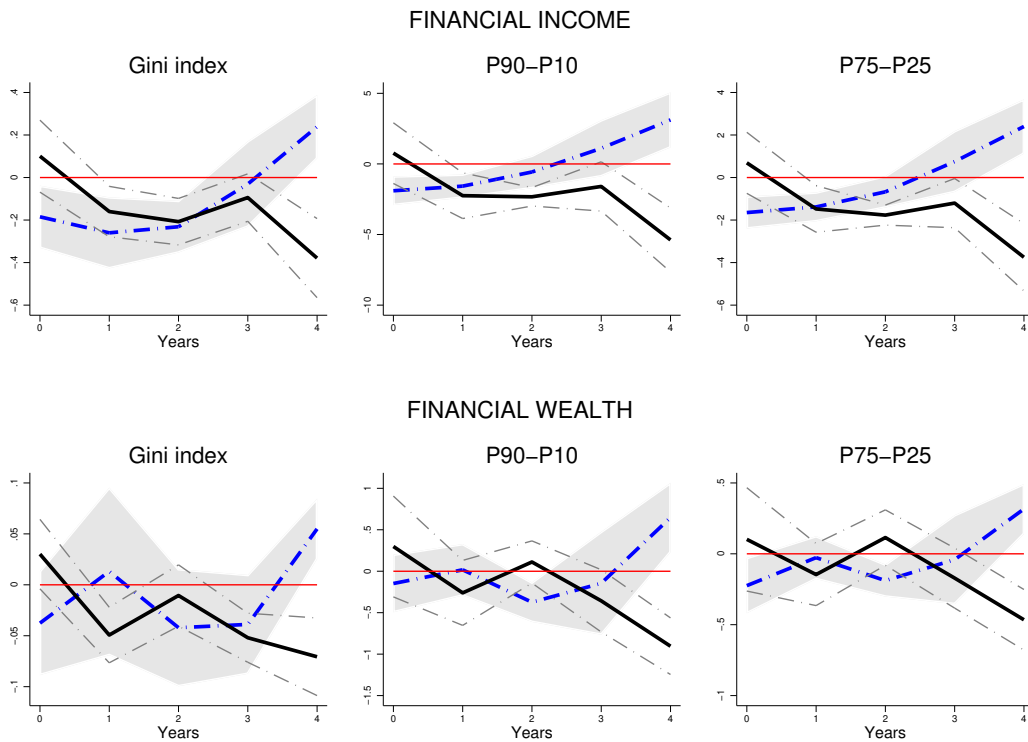
FINANCIAL INCOME

FINANCIAL WEALTH

Note: Impulse responses of the Gini index (percentage points), P90-P10 and P75-P25 (difference of log-levels) to a 100 bp. expansionary monetary policy shock. The dash-dotted gray lines and light-shaded areas are both 68% confidence bands.

Figure 8: IRFs of disposable income percentiles
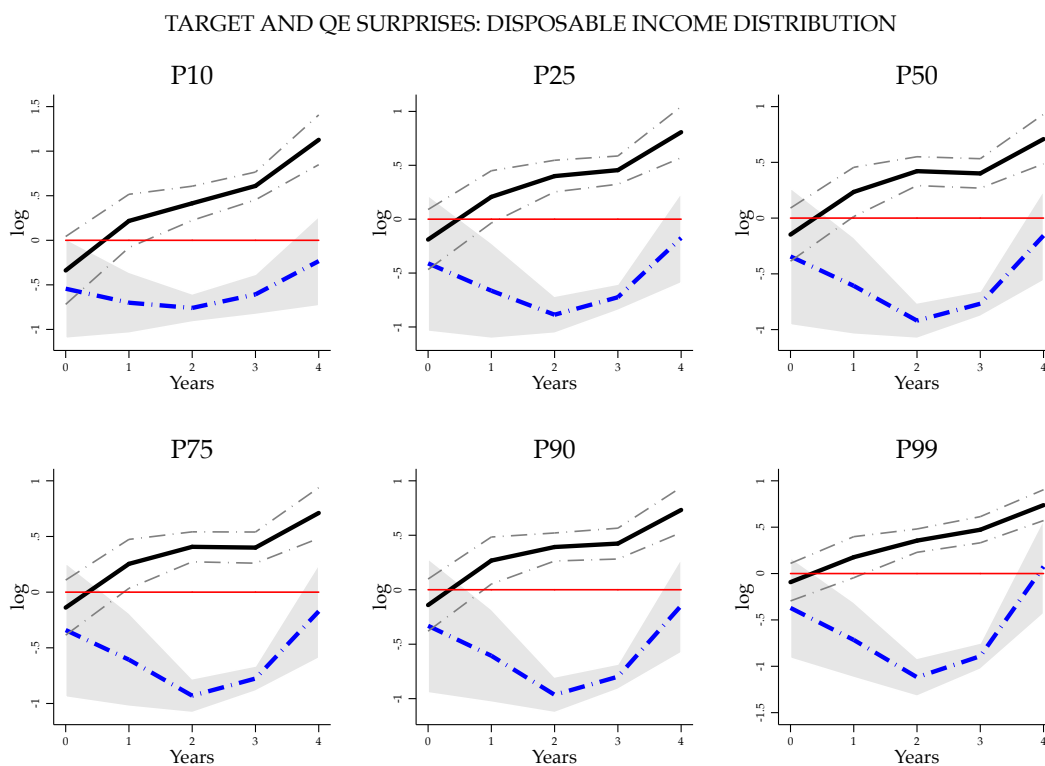
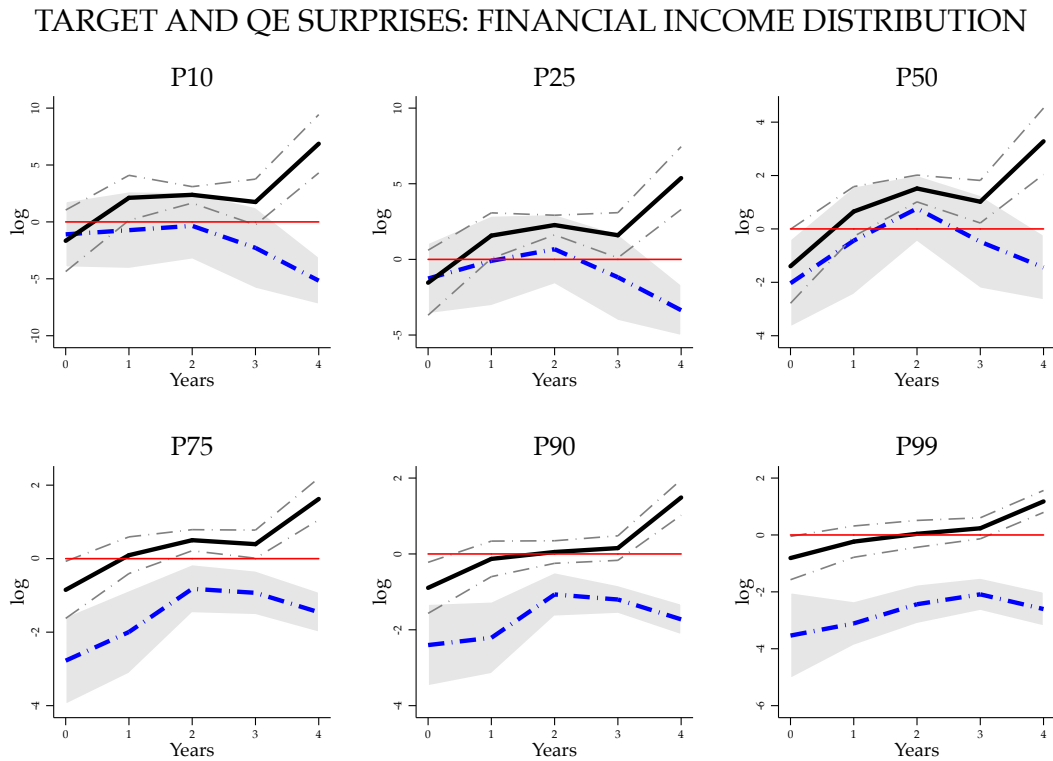TARGET AND QE SURPRISES: DISPOSABLE INCOME DISTRIBUTION

Note: Impulse responses of income percentiles in log-levels to a 100 bp. expansionary monetary policy shock both unconventional (black solid line) and conventional (blue dash-dot line). The dotted line and light-shaded areas are 68% confidence bands.

Figure 9: IRFs of labor income percentiles
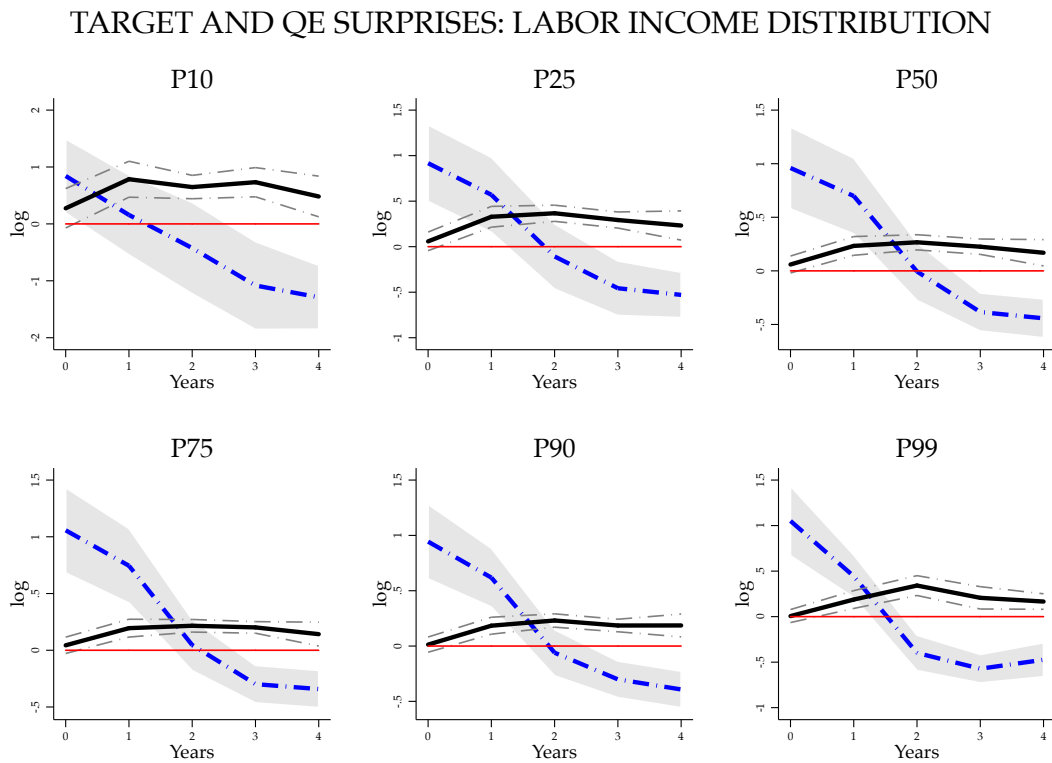
TARGET AND QE SURPRISES: LABOR INCOME DISTRIBUTION

Note: Impulse responses of income percentiles in log-levels to a 100 bp. expansionary monetary policy shock both unconventional (black solid line) and conventional (blue dash-dot line). The dotted line and light-shaded areas are 68% confidence bands.

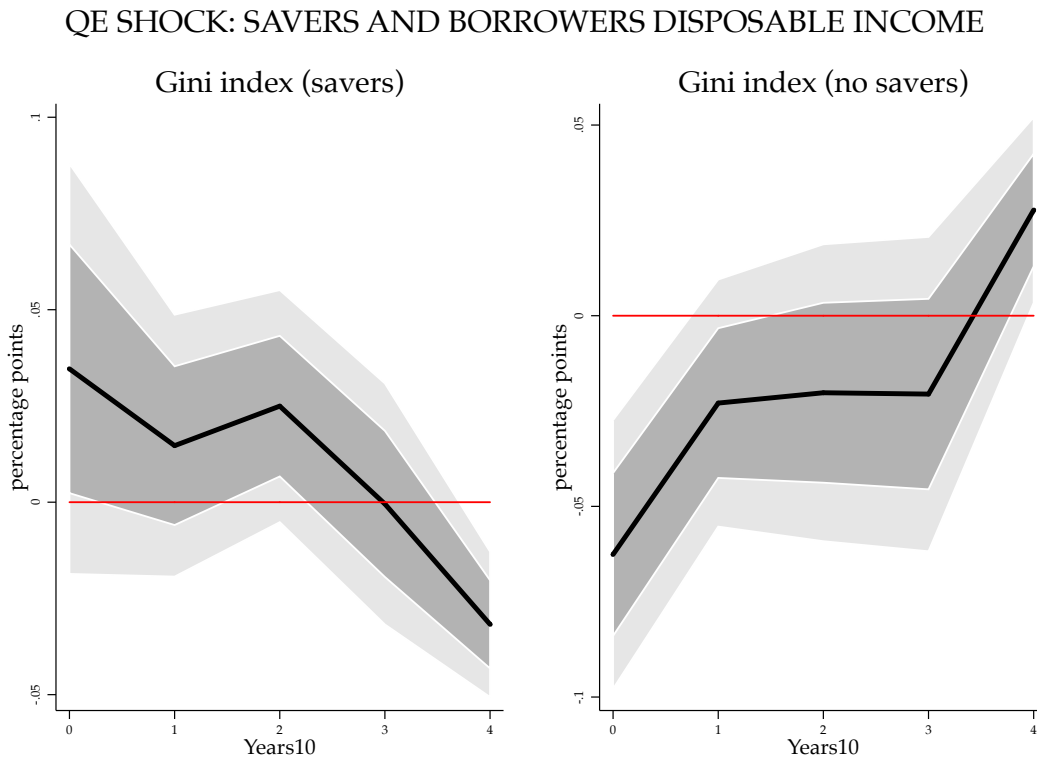Figure 10: IRFs of Unconventional monetary policy on employee and self-employment inequality

QE SHOCK: EMPLOYEE AND SELF-EMPLOYMENT INCOME
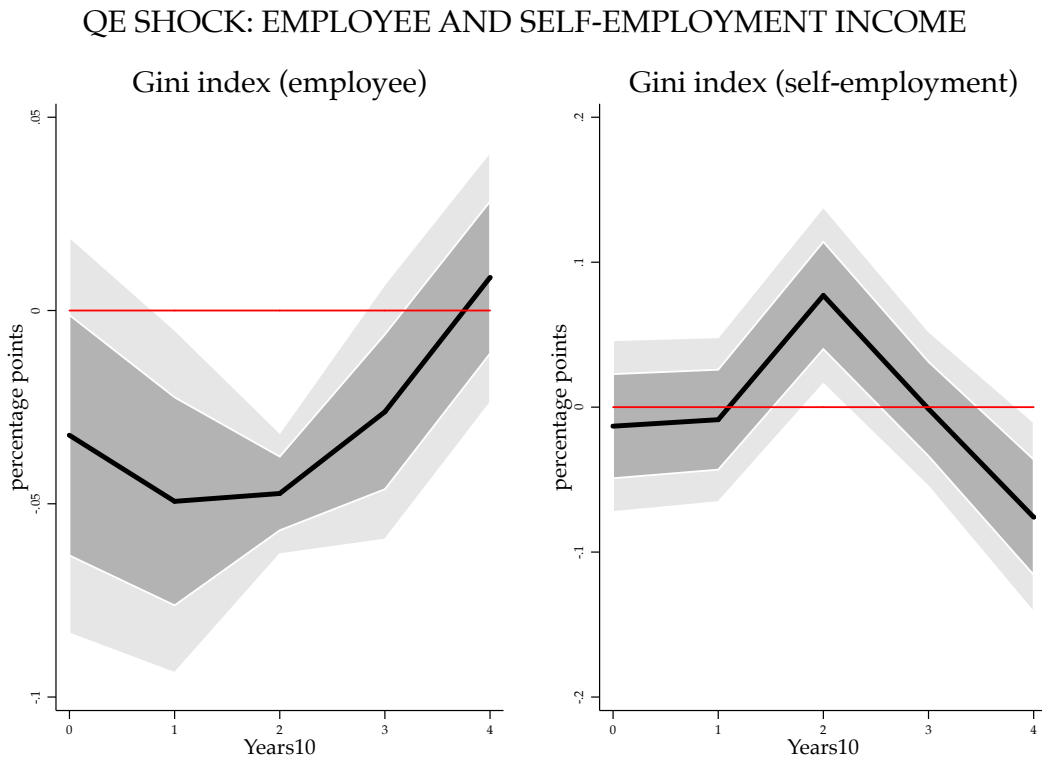
Note: Impulse responses of employee and self-employment the Gini index to a 100 bp. expansionary monetary policy shock. The dark and light-shaded areas are 68% and 90% confidence bands respectively.

Figure 11: IRFs of financial income percentiles

TARGET AND QE SURPRISES: FINANCIAL INCOME DISTRIBUTION

Note: Impulse responses of income percentiles in log-levels to a 100 bp. expansionary monetary policy shock both unconventional (black solid line) and conventional (blue dash-dot line). The dotted line and light-shaded areas are 68% confidence bands.

Figure 12: IRFs of financial wealth percentiles
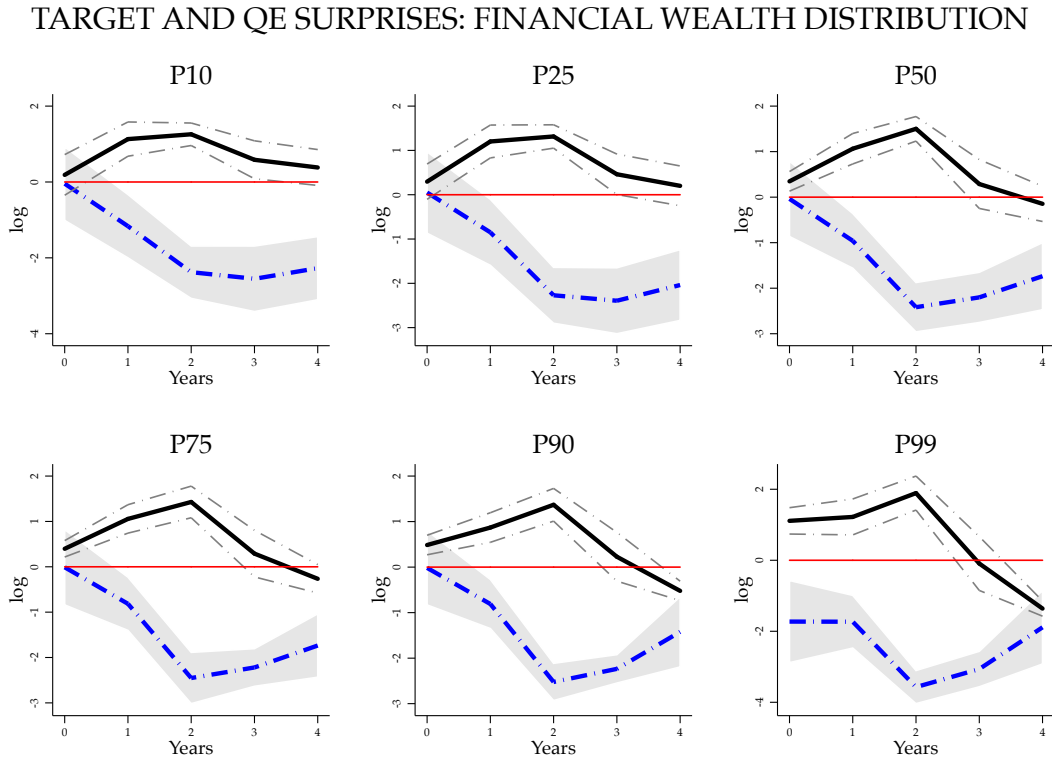
TARGET AND QE SURPRISES: FINANCIAL WEALTH DISTRIBUTION

Note: Impulse responses of income percentiles in log-levels to a 100 bp. expansionary monetary policy shock both unconventional (black solid line) and conventional (blue dash-dot line). The dotted line and light-shaded areas are 68% confidence bands.

Figure 13: IRFs of Unconventional monetary policy on savers and non-savers disposable income inequality

QE SHOCK: SAVERS AND BORROWERS DISPOSABLE INCOME

Note: Impulse responses of savers and non-savers the Gini index to a 100 bp. expansionary monetary policy shock. The dark and light-shaded areas are 68% and 90% confidence bands respectively.

Figure 14: IRFs of Conventional (blue dash-dotted line) and Unconventional (black line) monetary policy on disposable income inequality measures

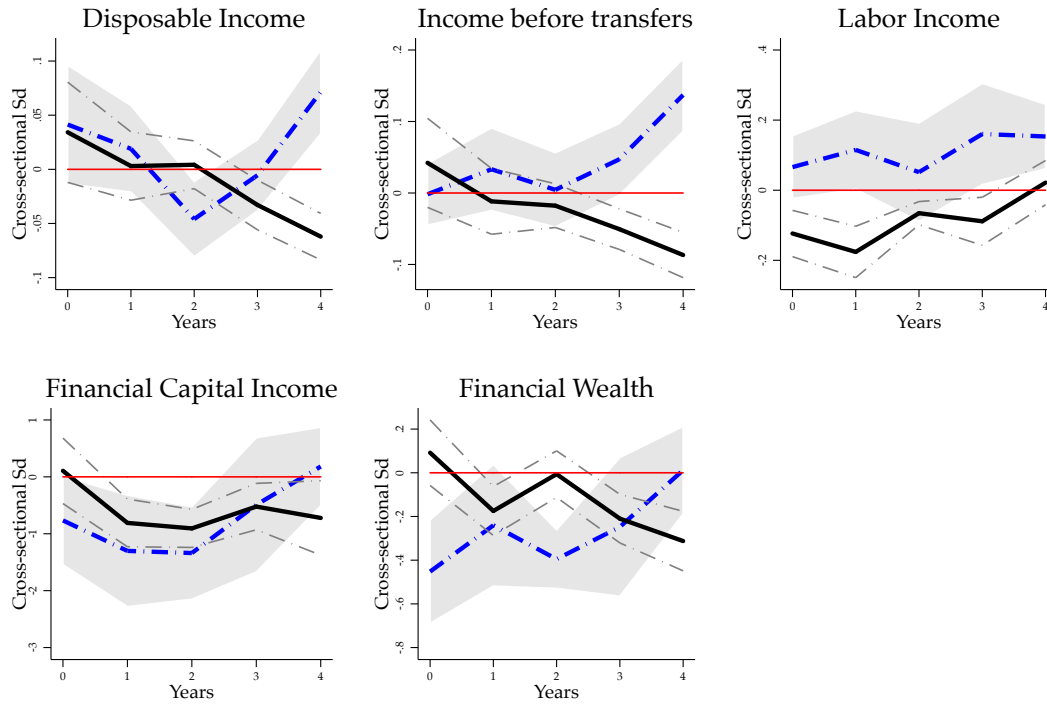DISPOSABLE INCOME BEFORE TRANSFERS
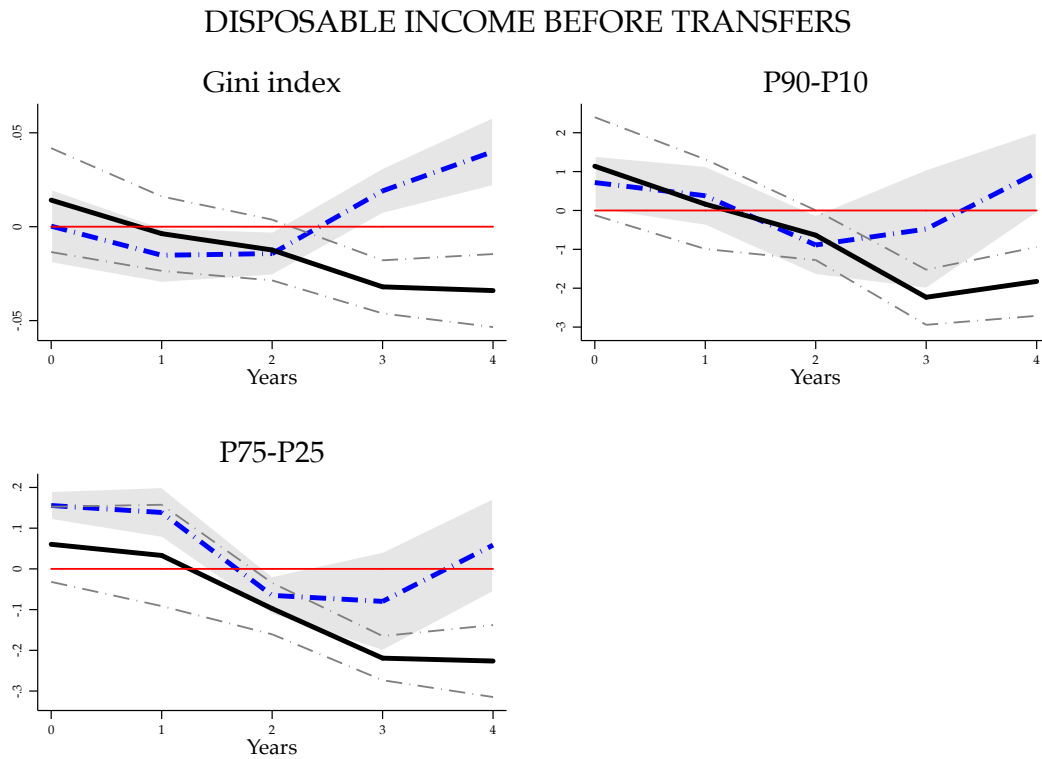
Note: Impulse responses of the Gini index (percentage points), P90-P10 and P75-P25 (difference of log-levels) to a 100 bp. expansionary monetary policy shock. The dash-dotted gray lines and light-shaded areas are both 68% confidence bands.

C.5 EXPANSIONARY MONETARY POLICY SHOCKS ON INEQUALITY MEASURES IN ITALY. ROBUSTNESS CHECK

Figure 15: IRFs of Conventional (blue dash-dotted line) and Unconventional (black line) monetary policy on log cross-sectional standard deviation measure of different incomes

Standard (Target-blue) and non-standard (QE-black) monetary policy shocks

Note: Impulse responses of Cross-sectional Sd to a 100 bp. expansionary monetary policy shock. The dash-dotted gray lines and light-shaded areas are both 68% confidence bands.

Figure 16: IRFs of QE-purged (green dash-dotted line) and QE (black line) monetary policy on the Gini index of different incomes

QE-purged (green) and QE (black) monetary policy shocks
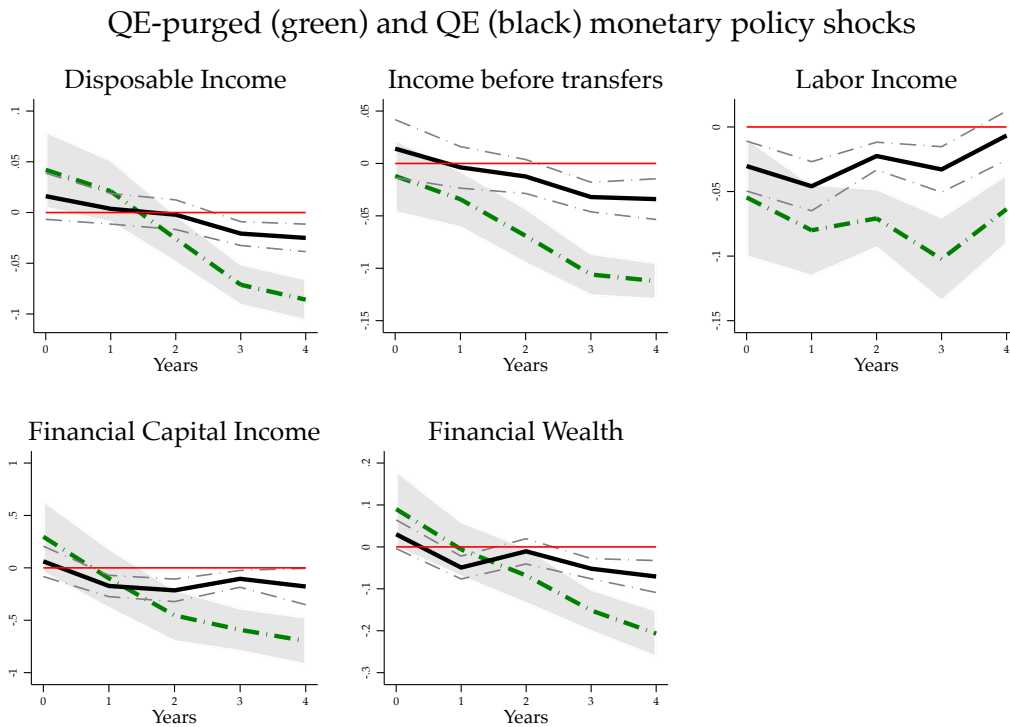
Note: Impulse responses of the Gini index (percentage points) of disposable income after and before transfers, labor income, financial income and financial wealth to a 100 bp. expansionary monetary policy shock. The dash-dotted gray lines and light-shaded areas are both 68% confidence bands.