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The impact of monetary policy on functional income distribution: a panel SVAR analysis (1970-2019)

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Abstract

In most countries, recurrent crises episodes due to financial disorder, the pandemic, and the recent war have increased income and wealth inequality. Moreover, since the 2008 crisis, major central banks have adopted highly expansionary conventional and unconventional monetary policies. Thus, attention towards the connection between monetary policy and inequality is surging. However, first, there is no consensus in the empirical literature on what the impact of monetary policy shocks on inequality is. Second, the literature is mainly focused on the effects of monetary policy on personal rather than functional income distribution. Third, the conventional hypothesis is for monetary policy to have at most an impact over the cycle but not in the long-run. Therefore, our work grounds on three objectives. First, we tackle the role of monetary policy in shaping functional income distribution by looking at the long-run behavior of real wages and the labor share of income. Second, we employ for the first time a panel SVAR methodology to a new panel dataset of 15 advanced economies during the 1970-2019 period. Third, differently from extant literature, we pose special attention to the so called 'cost' and 'labor market' channels of monetary policy. According to our results, a contractionary monetary policy shocks generates long-run adverse effects on the level of real wages. While the labor share initially rises because of the fall in GDP, the subsequent pronounced fall in real wages lets the labor share fall back to the pre-shock level.

Keywords

Monetary policy; functional income distribution; Panel SVAR; labor share; income inequality

JEL Codes

E24; E52; E58

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1. Introduction

In most countries, recurrent crises episodes due to financial disorder, the pandemic, and the recent war have increased income and wealth inequality. For instance, at the lower end of income distribution real household incomes fell substantially in countries hit hardest by the Great Recession (OECD 2015), and the recent Covid-19 pandemic has worsened the situation (Ahmed et al. 2020). Rising inequality can have many macroeconomic implications from both the real and financial perspectives. For example, Hsing (2005) shows that a higher Gini index hurts economic growth. Moreover, Rajan (2010) indicates that rising inequality is one of the main causes of a financial crisis. Since the 2008 crisis, major central banks have adopted highly expansionary conventional and unconventional monetary policies. It comes as no surprise that, on the one hand, several policymakers have shown attention to the distributional effects of such policies (e.g., Bernanke 2015; Draghi 2015). On the other hand, many researchers engaged with the topic, and accordingly "the last decade has seen an explosion of empirical and theoretical research on the links between monetary policy and inequality" (McKay and Wolf 2023, p. 121). However, there is no consensus in the empirical literature on the impact of monetary policy shocks on inequality (Colciago et al. 2019; McKay and Wolf 2023). In addition, it should be noted that the literature is mainly focused on the effects of monetary policy on personal income distribution, and not on functional income distribution (Kappes 2023). Notable exceptions can be found, among others, in the works of Christiano et al. (1997, 2005), Altig et al. (2011), Cantore et al. (2021).

In particular, our goal is to shed light on the effects of monetary policy on the long-run pattern of the distribution of income in terms of real wages and the labor share of income. In so doing, we want to address the possibility for monetary policy to affect income distribution not only in the short period but also on longer horizons (Colciago et al. 2019; Kappes 2023). Overall, we aim to provide three main contributions to the extant literature on the issue. First, we specifically address the impact of functional income distribution in terms of real wages and labor share and their behavior in the long-term. Second, we make use of a panel SVAR methodology, something which has never been done so far with respect to the literature at hand, and we apply it to a novel cutting-edge panel dataset of fifteen advanced economies spanning the 1970-2019 period. Third, we pose special attention to two channels of monetary policy. One is the so called 'cost' channel of monetary policy (Barth and Ramey 2001), which has never been tested before in connection with the issue at hand. The other is what we call the 'labor market' channel, to which we confer an autonomos role via the effects of unemployment shocks on our selected measures of functional income distribution.

According to our results, a contractionary monetary policy shocks generates persistent adverse effects on the level of real wages, and the results holds in the long-term as well.

What influence on the labor share is then the result of what happens to both the real wage and labor productivity (Cantore et al. 2021). In our framework, while initially the labor share rises because of the fall in GDP, the subsequent pronounced fall in real wages lets the labor share fall back to the pre-shock level.

The paper is structured as follows. Section 2 introduces to the relevant available literature and sets out our general framework for the investigation. Section 3 illustrates the data, the empirical method, and the identification strategy employed in the course of the empirical analysis. Section 4 is devoted to commenting the findings obtained in both the preferred empirical model estimated and the several robustness checks we decided to run. Section 5 concludes.

2. Empirical and Theoretical Background

Given the renewed relevancy assigned to inequality and monetary policy, it comes as no surprise that their interaction has been the subject of a long list of contributions. It suffices to look at the recent reviews of Colciago et al. (2019), Dossche et al. (2021), Kappes (2023), and McKay and Wolf (2023) to recognize the far-reaching extent to which such literature has grown. The academic environment is not the only place in which interest has spread, given that policymakers repeatedly conveyed great interest in the issue as well. For instance, former ECB Governor Draghi, former Fed Governor Bernanke, and former BoE Governor Mark Carney respectively stated that "monetary policy has positive distributional effects through macroeconomic channels. Most importantly, it reduces unemployment, which benefits poorer households the most" (Draghi 2015, quoted in Furceri et al. 2018), that "the distributional effects of monetary policy are complex and uncertain" (Bernanke 2015), and that "all monetary policy has distributional effects" (Carney 2016; the last two quoted in Saiki and Frost 2020).

According to Colciago et al. (2019) the overall evidence they gathered points to a mixed final assessment concerning the role of conventional monetary policy in shaping income and wealth inequality. This uncertainty carries over the results related to unconventional monetary policies as well. From a perspective which is much centered on the European case, Dossche et al. (2021) stress that recent ECB's expansionary monetary policy conducts are liable to have restrained income inequality. According to the authors, the beneficial effect in terms of inequality reduction ensuing from such expansionary policies is also noticeable given the ECB's lack of a specific mandate and tools designed to address the issue of income and wealth distribution. Yet, subdued inequality results from both direct (for example, differentiated house ownership across households) and indirect effects (for instance, better employment opportunities for poorer households). To the best of our knowledge, the two most recent reviews available in the literature are those of McKay and Wolf (2023) and Kappes (2023). McKay and Wolf (2023) address various facets of the monetary policy-inequality

nexus. In light of our work, the most interesting conclusion regards the fact that, although expansionary monetary policy may in principle affect households differently through a list of channels, its aggregate effect is considerably evenly distributed among them. Summing up, the authors single out that "low-income households benefit from a tighter labor market, middle-class households benefit from lower mortgage rates, and wealthy households benefit from capital gains on assets" (ibid., p. 122). In addition to this evidence, Kappes (2023) contends that on average available literature favors the view according to which conventional expansionary monetary policy and unconventional monetary policy reduce inequality. Additional considerations are spent pointing to the fact that how monetary policy impacts inequality depends on the degree of fiscal policy redistribution and the size of the wage share.

At first, it is important to note a point that tends to emerge from extant literature, namely the belief referring to the short-lived nature of the effects that monetary policy allegedly imparts to inequality trends. For instance, Colciago et al. (2019, p. 1224) mention that the contributions the author review are mostly engaged with investigating the cyclical influence of monetary policy, while "over the longer horizon, the distributional impact is likely to die out given the temporary nature of the effects of monetary policy shocks. Other factors, such as trade, labor market institutions, fiscal policy, and competition policies may be more relevant to explain trends in inequality". A different opinion is conveyed by Kappes (2023, p. 17), whose contention is for monetary to exert a significant role in shaping inequality, thereby suggesting "policymakers to avoid the repetition of long-established beliefs that the distributional impacts of monetary policy fade out in the long term, a view which is at odds with the best empirical evidence". As we will see in the results of our empirical investigation, our claim is that the impact of monetary policy can instead turn out to be persistent so as not to die out after cyclical fluctuations expire.

What we want to discuss next is the dearth of contributions posing the attention to income inequality based on the concept of functional income distribution. This can be seen in two respects. First, we can see it as a relative lack of contributions when compared to the analyses focusing on personal income distribution (Kappes 2023, p. 2). Second, we can see it as an absolute lack, given that the literature investigating the monetary policy impact on functional income distribution is meager. For instance, as mentioned by Cantore et al. (2021), even in an extensive literature review on monetary policy shocks by Ramey (2016) the issue of the influence on functional income distribution in the sense of real wages and the labor share does not find any place.

Nonetheless, some empirical works in the literature have investigated the effect of monetary policy on real wages, wage share, and profits with mixed results. To start with, Christiano et al. (1997) apply a recursive Structural Vector Autoregressive model (SVAR) to a U.S. dataset over a period from 1965 to 1995 and consider the effects of a

contractionary monetary policy shock on several quarterly variables, among which real wages and the ratio of profits to nominal output. They find that after a contractionary monetary policy shock real wages decline. Christiano et al. (2005) apply a similar analysis again to the U.S. and find that an expansionary monetary policy has a positive effect on productivity, real wages and profits. Moreover, Sims and Zha (1998), using policy shock measures that are not based on the recursiveness assumption, find results similar to those cited above. In contrast, in Altig et al. (2011), SVAR estimates do not show a significant response of real wages to a monetary policy shock. More recently, Latsos (2018) investigates the case of Japan, in which both productivity and real wage growth rates had been waning over time despite the ever-accomodative policies followed by the BoJ. According to the conclusions of the study, expansionary monetary policy can turn out to be detrimental to labor productivity and by this route to real wages as well. Second round adverse effects stemming from the initial propagation mechanism also involve a fall in household consumption, thereby further reinforcing the negative influence on capital accumulation and producitivity in the longer-run. Again on with a focus on real wages and the labour share of income, Cantore et al. (2021) apply SVAR techniques to assess the effect of monetary policy on these variables. They analyze the Great Moderation period for the US, Canada, Euro Area, Australia, and the UK.[1] The results indicate that a restrictive monetary policy has a negative effect on real wages and labour productivity. However, the labour share turns out to increase because labour productivity suffers a negative effect stronger than that on real wages.

A different viewpoint, which targets the behavior of the rate of profit in consequence of monetary policy changes, is employed by Gahn (2022), who analyses a panel of 11 Eurozone countries by means of an ARDL strategy. The author contends that a contractionary monetary policy positively impacts the rate of profit, and that it is possible to pin down a long-term relationship between the real rate of interest and the profit rate. Another study which stresses the effect on profits is that of Hartwig and Lieberknecht (2020), who estimate a Bayesian SVAR using quarterly U.S. data from 1993:Q2-2017:Q4 to provide empirical evidence about the influence of monetary policy shocks on corporate profits, real wages, firm dynamics, and aggregate productivity. The evidence seems to show a positive effect of an expansionary monetary shock on GDP and corporate profits due to the stimulus imparted to aggregate demand (as in Lewis and Poilly 2012). Wages and salaries respond comparably sluggishly and rise only slowly over the short-run.

Together with the issue of what type of inequality is subjected to analysis, it is also crucial to discern the different channels through which monetary policy can impact inequality. As we will briefly see, they are many and they can easily differ with respect to the several particular issues the analyses reviewed want to tackle. McKay and Wolf

[1] Additional evidence on the Japanese and European cases can be found in Israel et al. (2020), Samarina and Nguyen (2019), Saiki and Frost (2020).

(2023, pp. 122-128)[2] review how a monetary policy ease spreads across several channels. They pinpoint the following list. First, the income channel, through which an expansive shock positively affects labor income by means of a boost to the economy, giving rise to remarkably differentiated outcomes across households heterogeneous groups. Second, the nominal contracts revaluation channel, that operates through a rise in the price level ensuing from expansionary monetary policy. Given that borrowing and lending contracts are settled in nominal terms and are also distributed across households in a markedly uneven manner, a change in the price level will modify the real value of these settlements and will do so with differentiated outcomes. Third, the mortgages channel, in which borrowers benefit from both the previous effect and the lower nominal interest rate on the mortgage settlement generated by the monetary policy ease. Fourth, the asset prices channel, that works via the net effect of both a positive revaluation of stocks and real estate and a negative impact on their expected rates of return. Fifth, the intertemporal substitution channel, where a change in the rate of interest can induce household to reallocate consumption through time. Another five-channel list is provided by Kappes (2023, p. 4), according to whom we have: the earnings heterogeneity channel, the job channel, the capital income channel, the portfolio channel, and the debt burden channel. The first involves the fact that a monetary policy shock is liable to generate labor income reactions which are not homogeneous across households. The second again refers to heterogeneous responses to a certain monetary policy shock, but this with reference to the different reactions of employment. The third and fourth shift the attention from labor to capital income; the third channel is meant to look at how interest and profit incomes react to a monetary policy shock while the fourth channel considers whether capital gains or capital losses do arise after a shock. The fifth looks at the consequence in terms of interest payments for households ensuing from a monetary policy shock. Dossche et al. (2021) mention three channels. First, the savings remuneration channel, based on the differentiated effect a monetary policy shock exerts on households according to the exposure to and size and composition of debt-credit relationships. Second, the asset price channel, linked to the capital gains and losses originating from a given shift in monetary policy stance. Third, the household income channel stemming from the reaction of employment conditions. This last channel can be in turn decomposed into two related patterns. First, the fact that expansionary monetary policy helps people becoming employed. Second, the fact that employed individuals benefit from wage increases. Colciago et al. (2019) also isolate three fundamental channels of transmission. First, the income channel, which runs through the impact it engenders on the interests on borrowing and lending arrangements. Second, the wealth channel, operating according to how the value of stocks and real estate change following a monetary policy change.

[2] We must single out a notable point to be found in their classification. The authors are mostly interested in studying the effect of monetary policy on consumption - rather than income and/or wealth - of various households types to get a more straightforward link with well-being.

Third, the substitution channel, which, similarly to McKay and Wolf (2023) fifth channel, rests in the modification of the optimal allocation of consumption through time due to a change in the rate of interest.

Despite the long list of channels that have been identified in the reference literature, what is apparent is the complete overlook of the possibility for monetary policy to engender an effect on income distribution by means of the so called "cost channel". The latter refers to the fact that monetary policy shocks can cause both demand- and supply-side effects, and it may well be the case that a restrictive monetary policy causes prices to rise (Sims 1992), and with sticky wages there can be a conseuquent rise of the price-wage ratio engendering a fall in real wages. The literature has detected several episodes for such a channel. For instance, Barth and Ramey (2001) affirm that it is possible to detect a sizeable cost channel of monetary policy in several industries, that the results are robust to controls for a price puzzle and oil price shocks, and that such a channel appeared to be stronger up until the late Seventies. Similar findings are also offered by Chowdhury et al. (2006), who demonstrate the remarkable and straightforward impact of monetary policy on G7s' inflation patterns via a cost channel. Such an effect, the authors maintain, can well reverse the conventional response due to demand-side effect, thereby giving rise to the so called 'price puzzle'. Recently, Cucciniello et al. (2022) update such claims by empirically studying the case of the US during the 1959-2018 period. According to their results, the price puzzle remains visible also after 1979. Following this consideration, the authors also show that a monetary policy restrictive shock causes real wages to fall. Gaiotti and Secchi (2006) contribute to this strand of empirical analyses by addressing the presence of a cost channel of monetary policy in a large database drawn on Italian manufacturing firm. The authors maintain that there is a positive, significant, and non-negligible in size influence of interest rates on prices, and they rationalize such a finding by resorting to the role of working capital. Let us also recall the fact that the cost channel may also operate via the effect on rents, which in turn enter the calculations of the consumer price index (Dias and Duarte 2019).

With reference to the works hitherto reviewed, we will contribute in three main aspects. First, we specifically address the impact of functional income distribution in terms of real wages and labor share. Second, we make use of a novel cutting-edge panel dataset of fifteen advanced economies spanning the 1970-2019 period. Third, we make use of a panel SVAR methodology, something which has never been done so far with respect to the literature at hand. Fourth, we pose special attention to the 'cost' and 'labor market' channels of monetary policy (see Table 1), thereby introducing through the latter an influence never investigated before in this literature and through the former we test the role of elements which deliver effects that "are indirect in nature; for example, expansionary policy may lead to a tighter labor market, thus resulting in higher wages for workers" (McKay and Wolf 2023).

Table 1. Potential channels for monetary policy transmission to the economy. *Source*: authors' elaboration**.**

Transmission channel	Description	1st round expected effect	2nd round expected effect	3rd round effect
Cost channel	Higher cost of working capital for firms, higher rents (included into cpi).	Higher price level.	With sticky nominal wages, fall in real wages.	The labour share of income changes according to the relative strength of the effects on real wages and producitivity.
Activity channel	Tighter credit conditions for (private and public) borrowers.	Lower GDP level.	Lower productivity level, higher unemployment rate.	
Labor market channel	Worsening bargaining conditions for employees due to rising unemployment.	Lower nominal wage growth, reduced household spending.	Lower GDP level.	

3. Data and Methods

3.1 Data

In order to detect the macroeconomic effect of monetary policy on real wages, the labor share of income, the price level, and economic activity we make use of annual data for a panel of 15[3] advanced economies during the period 1970-2019[4]. Our analysis considers the following variables: the short-term interest rate (i), the long-term interest rate (long), the real Gross Domestic Product (GDP), the Gross Domestic Product deflator (P), a commodity price index (PCOM), the real compensation per employee (WR), the labour share of income (LS), and the unemployment rate (UN). The short- and long-term interest rates are taken from the AMECO dataset, OECD, and the Jordà-Schularick-Taylor Macrohistory Database (Jordà et al. 2017). GDP, unemployment rate, GDP deflator, labour share, and real compensation per employee (deflated with private consumption expenditure deflator) measures were retrieved from the AMECO dataset and OECD. Following the price puzzle literature (Sims, 1992; Christiano et al. 1999), to have a proxy for expected inflation, we also include in our model an energy commodities price index produced by the World Bank that is the same for all countries (expressed in U.S. dollars). To check the robustness of our analysis we also consider from the same source a non-energy commodities price index. In addition, we replace the GDP deflator with the consumer price index and the final consumption expenditure deflator, both taken from AMECO. Then, we use these two indicators to calculate real compensation per employee again. Finally, we also check the wage share indicator, replacing the adjusted labour share with the unit labour cost. Where necessary, the PPP index (from OECD) was used to convert variables to U.S. dollars. Except interest rates and the unemployment rate, all variables are expressed at logarithmic levels. Additional details on the construction of the variables and data sources are reported in Appendix A.

3.2 Methods

We make use of the Panel Structural Vector Autoregressive[5] (P-SVAR) model (Pedroni, 2013) to detect the effect of monetary policy on functional income distribution. This methodology takes into account responses to both idiosyncratic and common structural shocks, while permitting full cross member heterogeneity of the response dynamics

[3] More specifically, the countries analyzed are: Australia, Belgium, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, United States.

[4] Except for Japan (whose timespan begins in 1980), we have observations since 1970 for all other countries, so our estimates will be based on 740 observations.

[5] This technique has been used in several papers addressing various research questions. For example, Gahn (2021) applies it to the problem of determining the level of capacity utilization while in Deleidi et al. (2023) we find it to empirically test the Kaldor-Verdoorn law and in Montiel and Pedroni (2018) to analyze the trilemma of international economics. To our knowledge, the only work that applies it for monetary policy is Mishra et al. (2014) to study the transmission mechanism of bank interest rates. Therefore, no work has yet applied this methodology to analyze the distributional effects of monetary policy and we attempt to fill this gap in the literature.

(Pedroni, 2013, p. 180). In other words, we choose this methodology because it allows us to consider both heterogeneity present across the individual countries of the panel and cross-sectional dependence that is likely to arise from the fact that individual countries analyzed are responding not only to their own member specific idiosyncratic shocks, but also to shocks that are common across countries of the panel (Pedroni, 2013, p. 181). Moreover, in line with the empirical macroeconomic literature (Blanchard and Quah, 1989; Sims, 1992; Uhlig, 2005), the SVAR model enables us to isolate exogenous shocks to selected economic variables. However, for the methodology applied in this work such structural shocks can be decomposed into both common and idiosyncratic structural shocks, which are mutually orthogonal[6] and informative for our investigation (Pedroni, 2013, p. 182).

Therefore, we will analyze a panel[7] composed of $i = 1, \dots, N$ individual countries, each of which includes an $Mx1$ vector of observed endogenous variables, y_{it}, for $y_{m,it}$ with $m = 1, \dots, M$. Then, to take into account fixed effects and to simplify the notation in our analysis, the Panel SVAR considers the $Mx1$ vector of demeaned data $z_{it} = (z_{1,it}, \dots, z_{M,it})'$, where $z_{it} = y_{it} - \bar{y}_i$ with

$$\bar{y}_{\mathrm{m,it}} = T_i^{-1} \sum_{t=1}^{T_i} y_{\mathrm{m,it}} \quad \forall i, m.$$

As with any SVAR model we assume that variability in our data can be explained by unobservable structural shocks. For this, following Pedroni (2013) we consider an $Mx1$ vector of composite white noise shocks $\varepsilon_{m,it}, \varepsilon_{m,it} = (\varepsilon_{1,it}, \dots, \varepsilon_{M,it})'$ for each country, i, of the panel. These composite shocks are distributed independently over time but may be cross-sectionally dependent. A key assumption of our methodology is related to the existence of a common factor representation for this dependence, such that $\varepsilon_{m,it} = \lambda_{m,it} \bar{\varepsilon}_{m,t} + \tilde{\varepsilon}_{m,it} \quad \forall i, t, m$ where the two categories of mutually orthogonal structural shocks, $\tilde{\varepsilon}_{\mathrm{m,it}}$ and $\bar{\varepsilon}_{\mathrm{m,t}}$, represent, respectively, the country-specific idiosyncratic white noise structural shocks and the common white noise structural shocks shared by all countries of the panel, and $\lambda_{m,it}$ are the country-specific loading coefficients for the common shocks. In addition, in line with the SVAR literature, we extend three traditional assumptions applied to time series to the panel setting. Firstly, the structural shocks are assumed to be orthogonal with respect to each other for each

[6] Thus Pedroni (2013): "Specifically, the orthogonality conditions allow one to obtain the country specific loadings for the decomposition of the structural shocks into common and idiosyncratic components in a relatively efficient and transparent manner that does not require much data. The result is a sample distribution of heterogeneous individual country responses to the structural shocks that accounts for both the dynamic heterogeneity as well as the cross sectional dependency. It is this distribution which we then use to study the nature and pattern of responses among different countries."

[7] Because the time interval of the data for the n countries is different, the panel is unbalanced and the data are observed over $t = 1, \dots, T_i$ time periods; however, our methodology is particularly suitable for this type of panel (Mishra et al., 2014; p.120). As written by Pedroni (2013, p.181): "Furthermore, the technique can be used in unbalanced panels, which becomes particularly important for countries with varying degrees of data availability."

type, so that the various $m = 1, \dots, M$ idiosyncratic shocks are mutually orthogonal to one another, as are the various common shocks to one another. Furthermore, the variances of these unobserved shocks are taken to be arbitrarily normalizable (Pedroni, 2013, p. 183) and following Bernanke and Blinder (1992), the monetary policy shocks are estimated using the short-term interest rate.

At this point, we estimate a Panel SVAR model that consists of the following 7 variables:

$$i - PCOM - P - WR - GDP - UN - LS$$

In line with Christiano et al. (2005), Castelnuovo and Surico (2010), Cantore et al. (2021), exogenous monetary policy shocks will be identified through a recursive approach based on a Cholesky factorization. Besides being the most historically used method in identifying monetary policy shocks, another important advantage of Cholesky factorization is that it does not require explicit measures of MP surprises, which allows us to include in the analysis even those nations where we lack proxy variables for these shocks. Moreover, Cantore et al. (2021, p. 1603), studying the effect of monetary policy on the wage share, show that impulse responses based on our identification are not so different from those obtainable by other methods, such as proxy SVAR[8]. However, for Cholesky identification the ordering of variables matters (Christiano et al., 1999). The identification assumption is that a monetary policy shock influences all variables in the model within the year. But this implies that the policy rate does not respond contemporaneously to all the macroeconomic shocks affecting prices and real variables. The main explanation for this identification is related to the fact that the monetary policy decision can be influenced only by those variables available within the year and not by those available with a lag (Sims, 1992; Leeper et al., 1996; Sims and Zha, 1998; 2006; Fragetta and Melina, 2013). As there are delays in publishing data on production and prices, the central bank can only observe the past value of these variables when setting the rate of interest because the contemporary data are not available when the monetary policy decisions have to be taken (Sims and Zha, 2006). Another element seems to us to support our identification and it relates to how long it takes monetary policy to have effects on real variables. Usually with higher frequencies, e.g., quarterly, or even monthly data, the literature points out that it is difficult for a change in interest rates to have effects over the same period in which it is implemented. However, over an annual period it seems to us more likely that monetary policy can

[8] From Cantore et al. (2021, p. 1615): "As shown, the responses using proxy and Cholesky identification virtually overlap for all five variables. However, comparing confidence sets in Figures 2 and B1 (Online Appendix), we can see that the bands around the proxy responses are larger than for the Cholesky responses. Therefore, the Cholesky VAR seems to be more precise and we choose to use it for estimation."

have effects on these variables, and therefore we consider it appropriate to place interest rates as the first variable in our order[9].

By imposing such identification in a Panel VAR model with only 1 lag, we compute structural shocks to estimate impulse response functions (IRFs) showing the dynamic effects produced by a monetary policy shock on the variables included in the model. In addition, to assess the relevance of the labor market channel, we also analyze the effects of a shock to the unemployment rate (UN). Following Pedroni (2013) and Mishra et al. (2016), IRFs are reported with the median as well as the 25th and 75th percent quantile responses among the 15 countries in our sample. Finally, we obtain estimates for idiosyncratic shocks - which are country-specific - and for common shocks - which are shared among the panel countries. From the combination of these two shocks, we estimate the effects on different variables of a composite monetary policy shock, which will be discussed in the next section.

4. Findings

We start by looking at the IRFs related to our main econometric model, namely the one we exposed in the previous section ran over the entire sample of 15 countries and over the entire timespan (1970-2019). We will focus our attention on the composite[10] shock by considering a contractionary shock to the short-term interest rate and unemployment rate as shown in Figure 1 and 2 (in Table 2 and 3 are the elasticities corresponding to a shock normalized to 1 percent).

At first, we focus on what we called the 'cost channel' of monetary policy. We do so starting from the GDP deflator response to the policy shock. As we can see in Figure 1, we get a positive and lasting increase of the GDP deflator; as shown in Table 2, such a response takes up a value of about 1.7% after 10 years.[11] Together with this, we also take into account the reaction of the activity levels, which in our model are given by GDP and the unemployment rate. While the former persistently falls, the latter persistently rises to an extent of 0.22% after 10 years. When we consider what Dossche et al. (2021) label the 'household income' channel, we can suppose that the labor market slack induced by the restrictive policy causes nominal wage growth to slow down with respect to a more accommodative monetary stance.

These two outcomes concur in delivering the fall in the real wage level which, according to the evidence we offer, is of a magnitude of about -0,56% after 10 years

[9] Also in favor of this ordering is the work of Fragetta and Melina (2013, p.833) who apply a graphical modeling theory and observe that: "Graphical modeling suggests that only high-frequency data are in the information set of the central bank when it sets the interest rate".

[10] Common shock and idiosyncratic shocks are given in Appendix B.

[11] It is important to stress the fact that, by including a measure of commodity prices as in Sims (1992) and subsequent literature, we also control for an element that could in principle solve the price puzzle, thereby capturing inflation expectations. More recently, Cantore et al. (2021) follows a similar strategy by including an index for commodity prices.

(Table 2). This result is in line with the findings provided by Christiano et al. (2005), in which we have a fall in real wages after a shock analogous to ours. In addition, we also show the non-transitory nature of the income distribution channel of monetary policy: far from being short-lived, the fall in real wages do not tend to fade over an horizon as long as 10 years.

We now move the attention to the behavior of the wage share. As we can see, our outcome is analogous to the findings in Cantore et al. (2021): after an initial phase in which we have a rise in the wage share (after 3 years, it has risen by 0.36%), the latter steadily reverses its previous increase and it lands after 10 years roughly to its initial value. Such a result can be rationalized by considering the usual wage share decomposition into two elements, namely the ratio between the real wage and labor productivity. As we just saw, real wages continuously fall after the monetary contraction, and so does GDP. Given the contemporaneous rise in the wage share, what can be surmised is that labor productivity falls more than real wages in the short term. However, when we move to a medium- to long-term, GDP stabilizes whereas real wages keep on falling steadily. At the same time, as mentioned, the wage share starts falling back to its pre-shock levels. Hence, we can suppose that, contrary to what happens in the short-run, while productivity remains at its new level, the sustained real wage fall causes the wage share to move back to the pre-shock situation. Such an overall finding is in line with those of Cantore et al. (2021), who also resort to the real wage-productivity decomposition of the wage share to explain their outcomes.

Figure 1. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i).

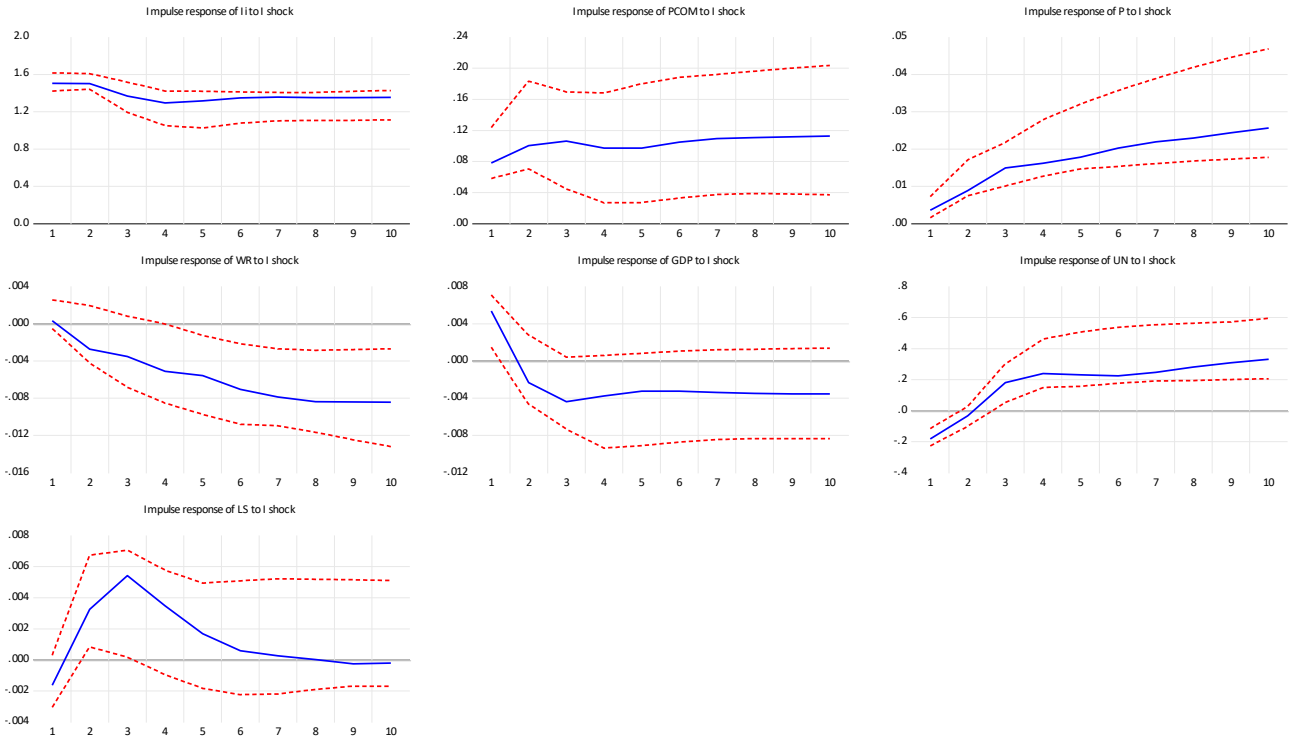


Table 2. Effects of a Monetary policy composite Shock (i) normalized to 1 percent, in parentheses the year in which the highest and lowest values occur.

	P	WR	GDP	UN	LS
First Period	0,24	0,02	0,36	-0,12	-0,11
Last Period	1,70	-0,56	-0,24	0,22	-0,01
Highest Value	1,70 (10)	0,02 (1)	0,36 (1)	0,22 (10)	0,36 (3)
Lowest Value	0,24 (1)	-0,56 (10)	-0,24 (10)	-0,12 (1)	-0,11 (1)

What we hitherto discussed is a somewhat 'classical' analysis of monetary policy distributive effects. In what follows, we want to shine a light on one specific channel that we want to quantify in more depth. In particular, we refer to the 'labour market' channel, whose main determinant in our framework is the level of the rate of unemployment. We said previously that the restrictive monetary shock causes the unemployment rate to rise in the long-term. As we can see in Figure 2, such a rise is also liable to cause additional distributive effects. Specifically, we have that an increase in the rate of unemployment is associated with a persistent decrease in both real wages and the labor share. The effects are both long-lasting. As shown in Table 3, both the real wage and the labor share decrease by 1,5% after 10 years. In light of these findings, it is not surprising that monetary policy tends to turn more accommodative after the rise in the rate of unemployment.

Note that in this case we do not take into account the further effect that the unemployment shock has on GDP, therefore we are silencing the channel that runs through labor productivity. Indeed, contrary to what we found previously concerning the monetary policy shock, in this case we see a persistent fall in the labor share in line with what we would expect. The labor share decreases and it does not revert back to the pre-shock level in the long-run. Thus, while the monetary policy shock engendered both an 'activity' and a 'labor market' impact, the unemployment shock is only limited to the second channel. Hence, in this way we isolate the pure effect running through the bargaining power of workers, without reference to the effect stemming from labor productivity patterns.

Figure 2. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN).

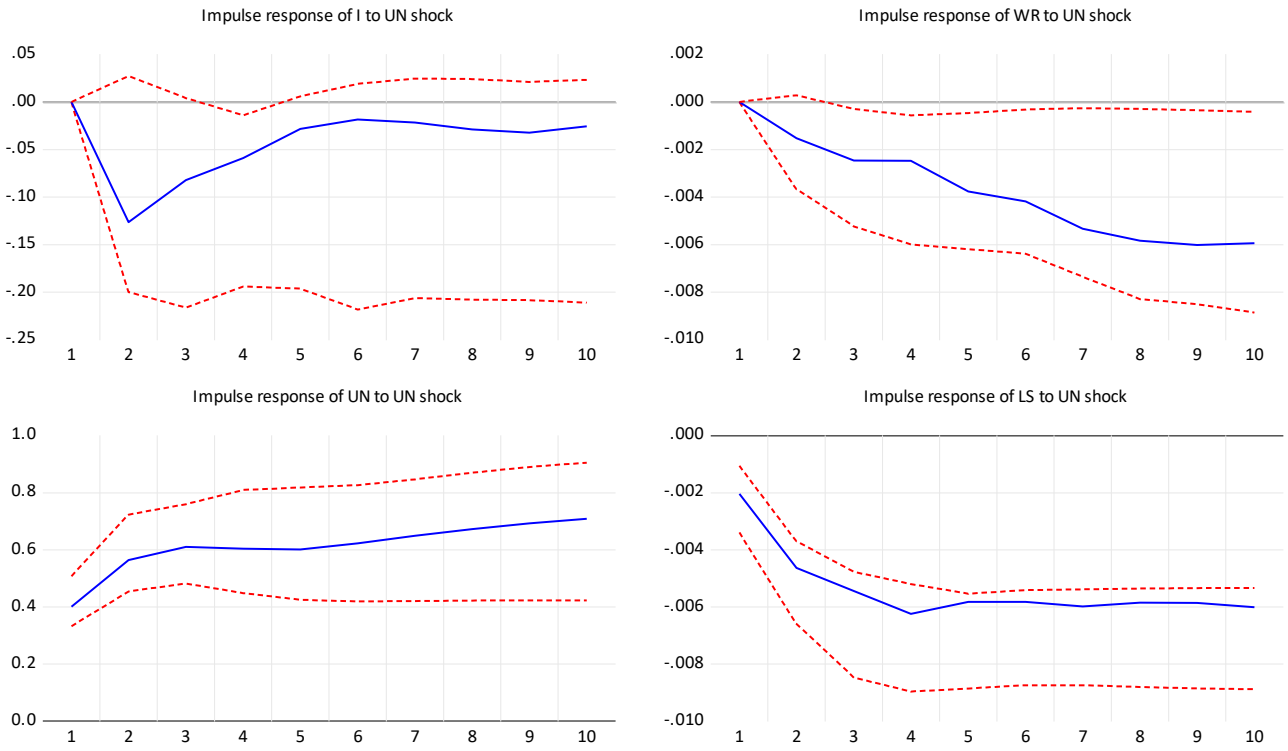


Table 3. Effects of an Unemployment rate composite Shock (UN) normalized to 1 percent, in parentheses the year in which the highest and lowest values occur.

	I	**WR**	**LS**
First Period	-0,32	-0,38	-0,51
Last Period	-0,06	-1,48	-1,50
Highest Value	-0,05 (6)	-0,38 (2)	-0,51 (1)
Lowest Value	-0,32(2)	-1,50 (9)	-1,56(4)

Robustness Checks

At this point we check the robustness of our results by considering different measures of the variables of interest. Due to space limits, in this section we comment only on estimates from models based on a different measure of the wage share and real wages, given the extreme importance of these variables for our work. In addition, following the literature we take sub-periods and sub-samples from different countries to see if the time span and the sample chosen affected the results shown above. Specifically, we re-estimate our model both without the crisis period and by narrowing the panel to 10 countries, including 5 EU and 5 non-EU countries[12]. However, the remaining robustness checks are provided in appendix B.

To check the robustness of our results, first, we deflate nominal wages with the GDP deflator instead of the private consumption expenditure deflator. As shown in Figure 3, a restrictive monetary shock equally produces a persistently negative real wage response that would have a negative peak of -0.5 percent 10 years after the shock. This value is in line with the previously commented IRF of the real wage. However, the elasticity of the real wage to a shock to the unemployment rate appears to be less important than that already analyzed, although the sign of the effect remains persistently negative, confirming the relevance of the labor market channel (Figure 4).

[12] Specifically, the panel of 10 countries is as follows: Australia, Canada, France, Italy, Germany, Japan, Netherlands, Spain, the United Kingdom, and the United States.

Figure 3. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: real wages (WR) deflated with GDP deflator.

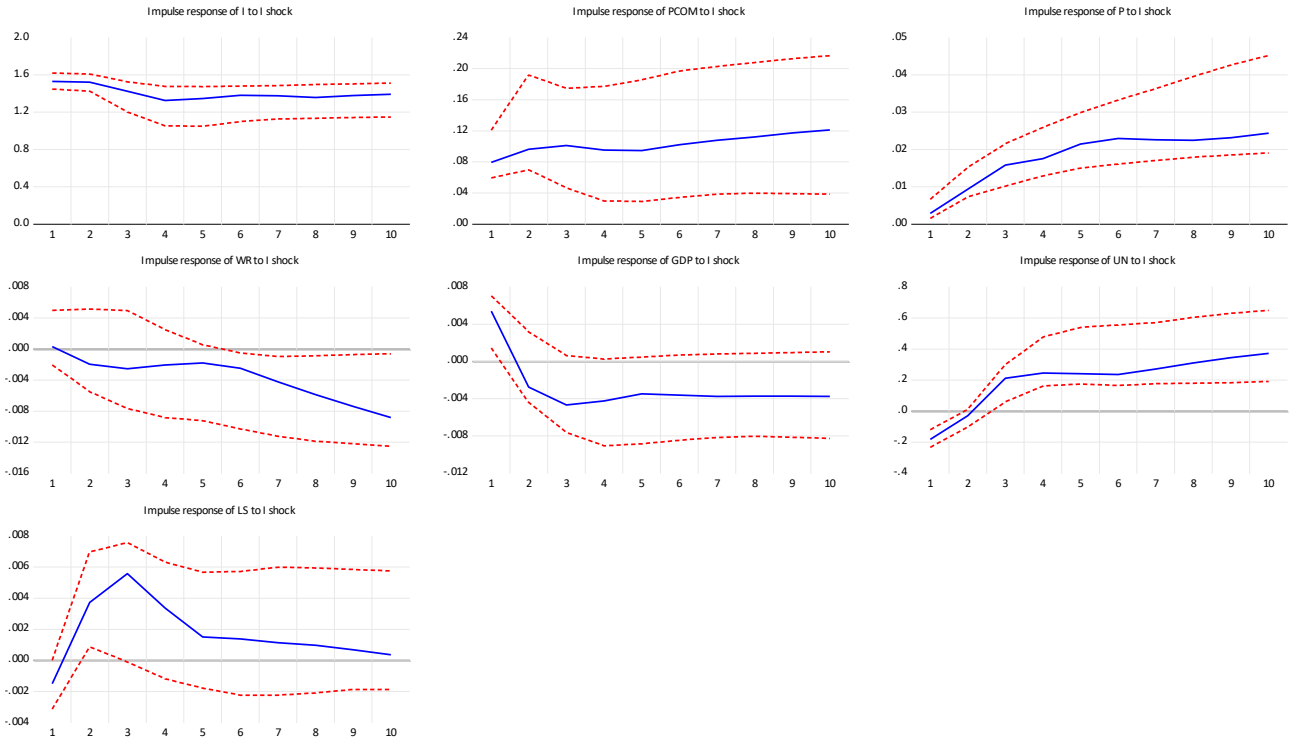
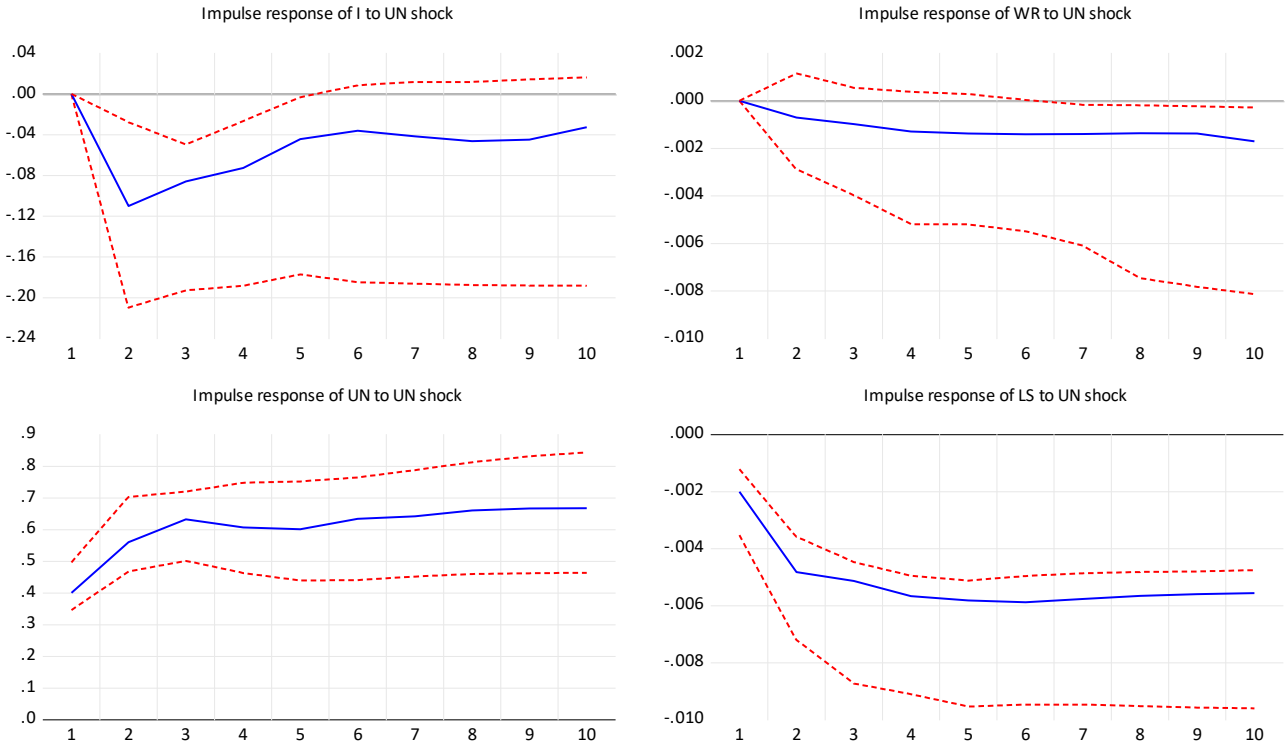


Figure 4. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: real wages (WR) deflated with GDP deflator.



Then, we also control for a different measure of the wage share by including instead of the adjusted wage share an indicator of the unit labor cost. In any case, the indications from our model are no different (Figure 5 and 6). In fact, following a contractionary monetary policy shock, the wage share initially rises and then returns to zero in the long run. Again, a 1 percent shock to the unemployment rate leads to a 1.5 percent decrease in the wage share in the long run. Therefore, if interest rate increases were able to increase the unemployment rate, they could have persistently large effects on income distribution for this channel.

Figure 5. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Wage share expressed as Unit Labor Cost (LS).

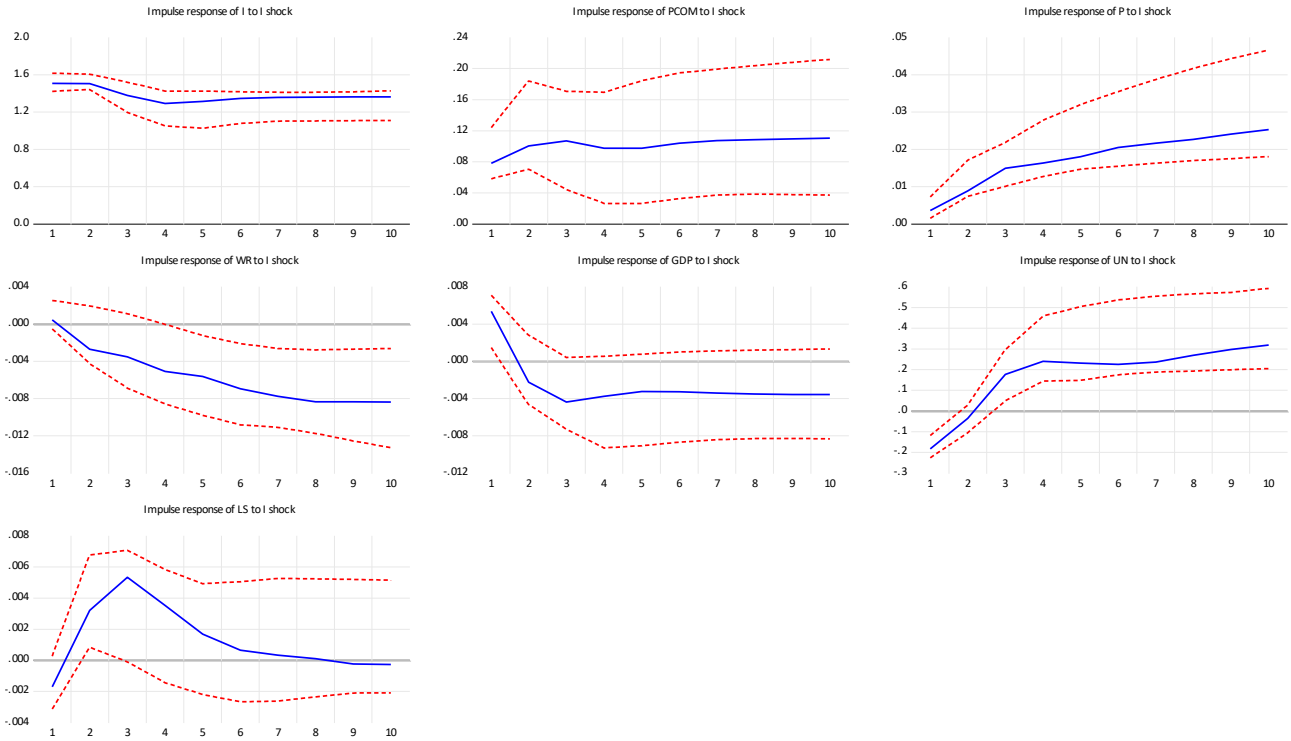
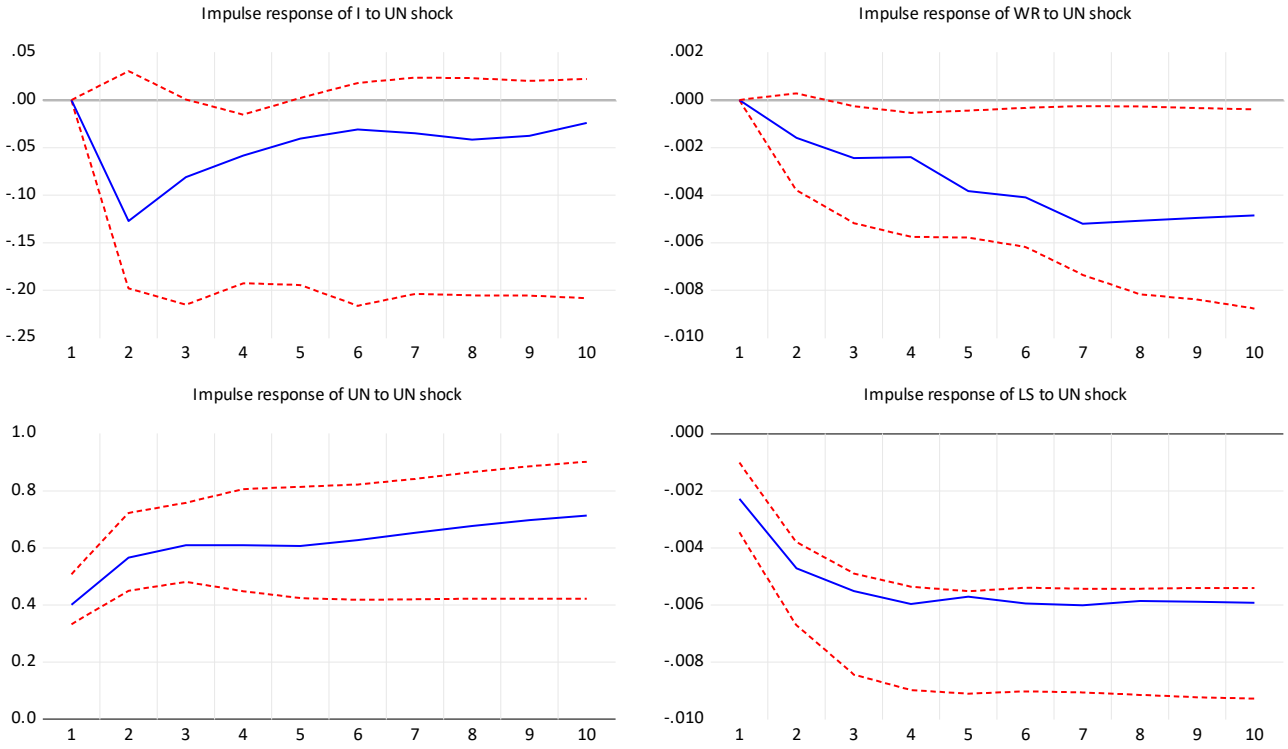


Figure 6. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Wage share expressed as Unit Labor Cost (LS).



In addition, to detect the influence of the crisis period with near-zero nominal interest rates, we re-estimate our model to 2007. There appears to be no obvious difference in the cost channel: as shown in Figure 7, the contractionary monetary policy shock causes an increase in prices that is reflected in a decrease in real wages, with very similar impulse responses compared to the baseline model. Instead, there appears to be a more pronounced response in economic activity levels, with GDP having a negative peak after 3 years of -0.7 percent while the unemployment rate would peak at 0.4 percent after 10 years. Interestingly, the wage share in this case would remain above zero even in the final periods of the horizon analyzed. Following our previous explanation, this could be motivated precisely by the greater fall in GDP (compared to the base model), which would depress labor productivity even more, whose decline would be greater than that of the real wage. Therefore, the analysis of Cantore et al. (2021) would be confirmed, whereby a positive response of the wage share to an increase in interest rates would not be motivated by growth in the real wage but rather by a major decrease in labor productivity that would offset the fall in wage levels. Conversely, the elimination of the Great Crisis period does not seem to change the effects of a shock to the unemployment rate that appears to drastically depress workers' shares of the functional income distribution (Figure 8).

Figure 7. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Pre-crisis period.

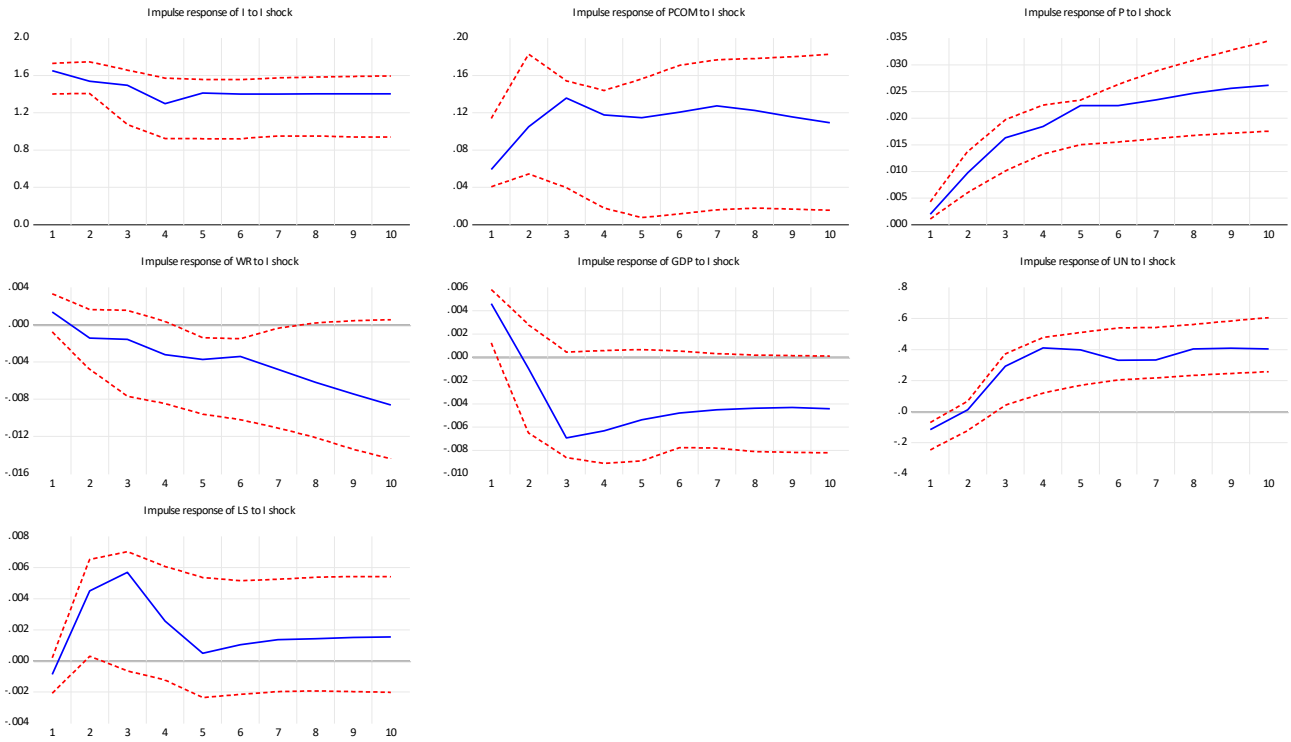
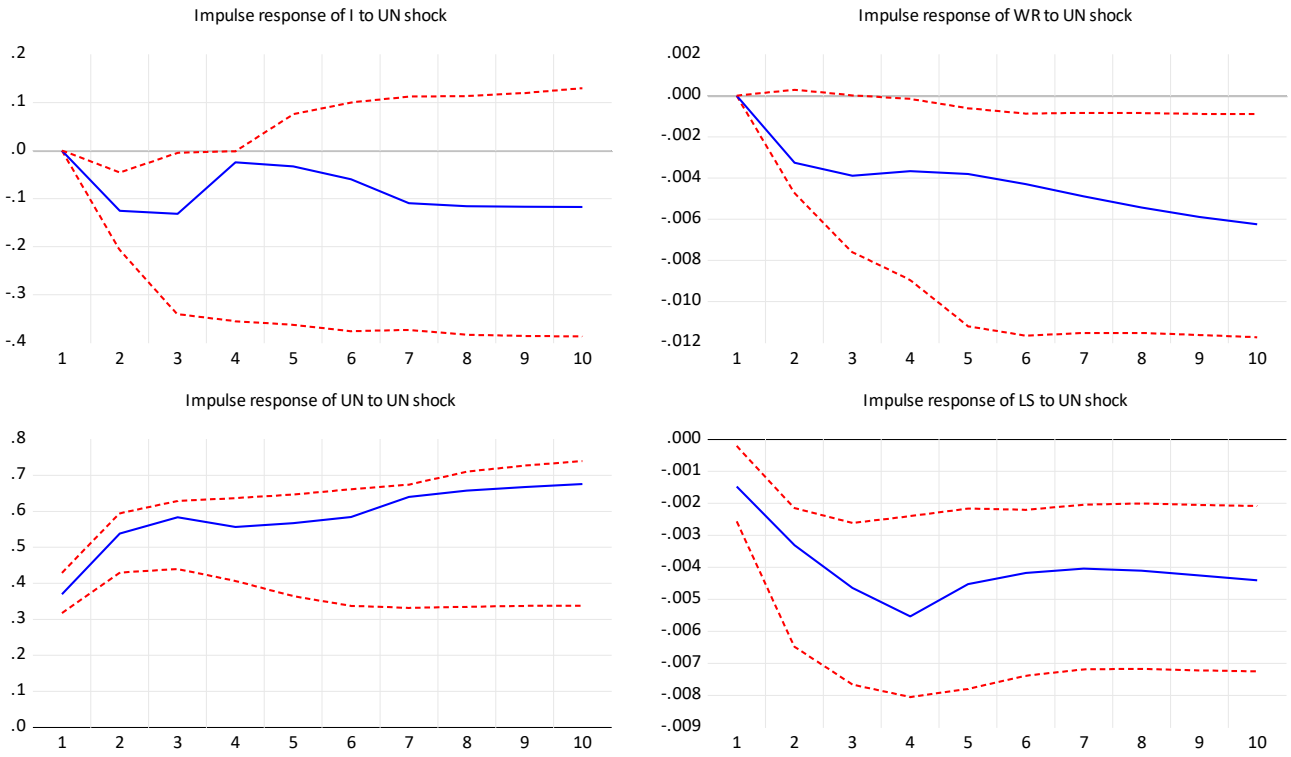


Figure 8. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Pre-crisis period.



Finally, having controlled for the time period, we now control for the heterogeneity of the countries analyzed. Specifically, we chose a sub-sample of 10 historically advanced countries, consisting of the G7 countries plus 3 other developed economies such as Australia, the Netherlands, and Spain. First, it should be considered how the monetary policy shock now stands at around 1 percent while in the 15-country panel it was at 1.5 percent. But despite this, both prices and real wages show to have elasticities quite similar to the base model, thus justifying a more important cost channel and real wage response for these countries (Figure 9). Conversely, while being of the expected sign, the response of the wage share and unemployment rate would have a smaller magnitude however justified by the lower strength of the shock than in the model with 15 countries. This is not true for the response of GDP, which would show only a temporary and not a persistent decrease to the monetary policy shock, unlike in the base model. The latter point would again note how the negative effect of restrictive monetary policies seems to affect the unemployment rate more persistently than GDP. Therefore, in Figure 10, we analyze again the effects of a shock to the unemployment rate on the selected variables, showing both a persistent fall in real wages and the wage share.
Thus, as with the other robustness checks, we find that an increase in interest rates, through both the cost channel (with an increase in prices) and the labor market channel (with an increase in the unemployment rate), could have long lasting effects on real wage levels and the functional distribution of income.

Figure 9. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Sub-sample of 10 countries.

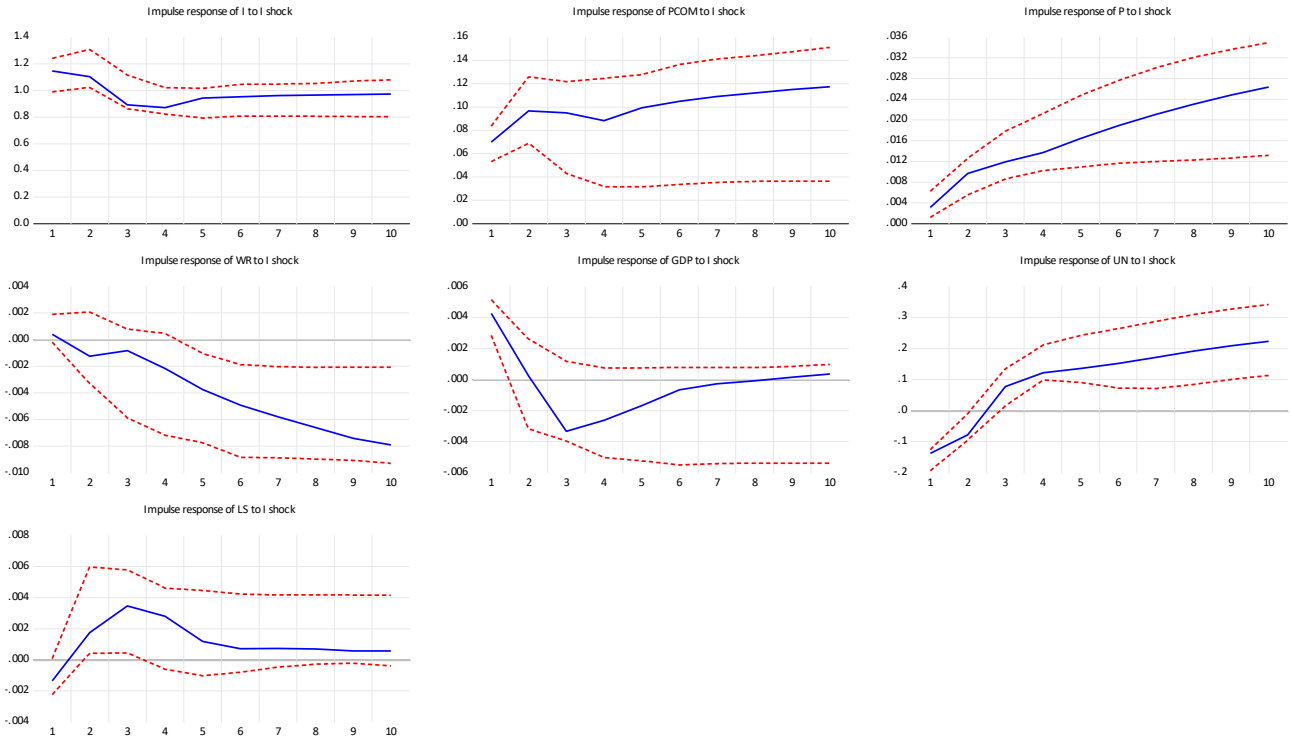
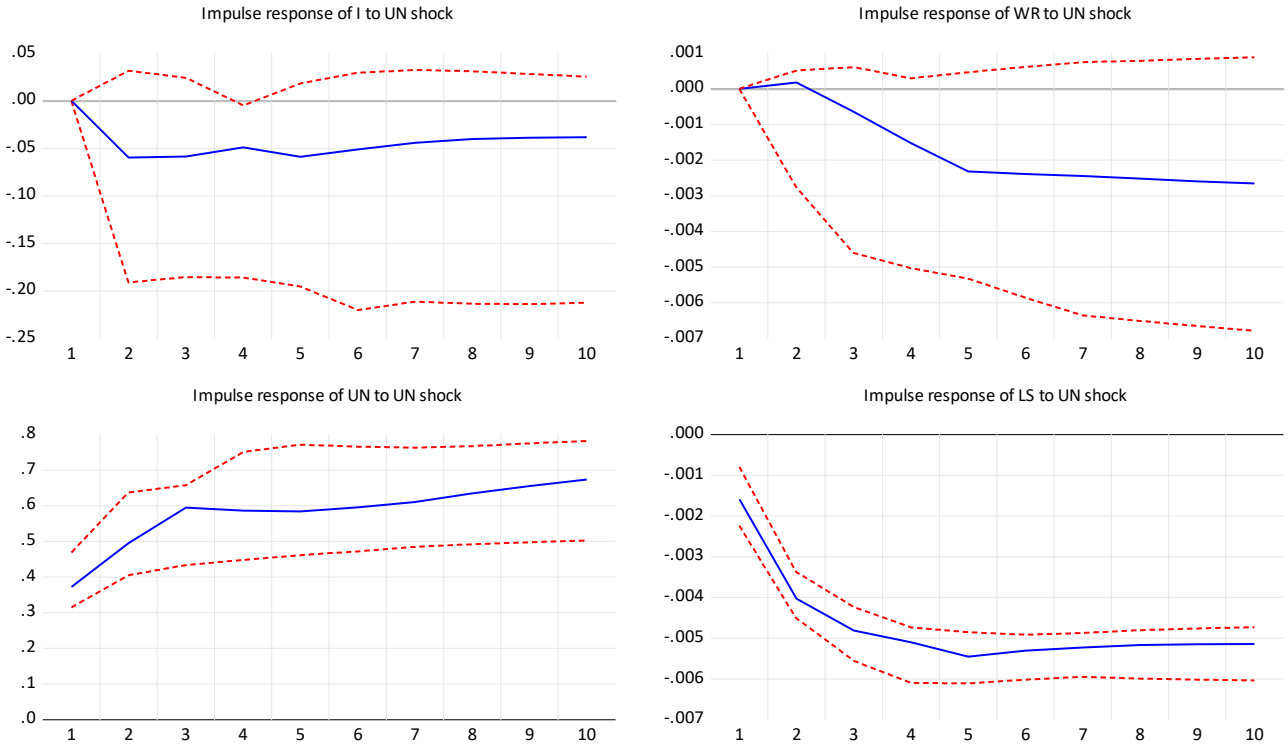


Figure 10. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Sub-sample of 10 countries.



5. Conclusions

Given the now long-lasting adoption of both conventional and unconventional monetary policies by major central banks, the topic of their interaction with inequality has attracted a great deal of attention. Our focus in the present work has been directed at the investigation of whether monetary policy can have a long-lasting influence on functional income distribution in the form of the real wage level and the size of the labor share of income. To such end, we first brought into play two channels of monetary policy which are seldom given prominency in this strand of literature, namely what we called the 'cost' and 'labor market' channels. We made use of a panel SVAR methodology, applying it to a novel panel dataset of fifteen advanced economies spanning the 1970-2019 period.

We considered a contractionary shock to the short-term interest rate and unemployment rate. For what concerned the 'cost channel', we started from the GDP deflator response to the policy shock, thereby getting a positive and lasting increase for it. For what concerned the 'activity' and 'labor market' channels, we saw that while GDP persistently falls, unemployment persistently rises. Analogously to Christiano et al.

(2005), we find that there is a fall in real wages, and such a fall can be attributed to both the influences we just mentioned. Therefore, we find that the income distribution channel of monetary policy is non-transitory, as it persists over a 10-year horizon.
Moreover, when we turned the attention to the labor share of income, we found that, analogously to Cantore et al. (2021), after an initial phase in which the labor share rises, it then steadily reverses by returning over the 10-year horizon to its pre-shock level. We attribute such a behavior to the joint influence of the policy shock to both real wages and productivity. At last, we go beyond traditional analyses of monetary policy by giving prominency to the 'labour market' channel. When restrictive monetary shock causes the unemployment rate to persistently rise, this results in a persistent decrease in both real wages and the labor share.

Hence, by looking in particular at the 'cost' and 'labor market' channels of monetary policy, we were able to find out a persistent and sizeable influence of monetary policy on functional income distribution in the form of real wages and the labor share of income. In our view, additional efforts must be spent on employing non-linear methods which would allow to better account for labor market spillover effects on income distribution within studies targeting the impact of monetary policy.

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APPENDIX

Appendix A – Data sources

Variable	Note	Source
Short term interest rate (i)		Ameco (Italy and UK); Jordà, Schularick, Taylor Macro Dataset (Spain and Sweden); OECD, Economic Outlook No 112 - November 2022 (Australia, Belgium, Canada, Finland, France, Germany, Japan, Netherlands, Norway, Portugal, United States)
Long term interest rate (Long)		OECD, Economic Outlook No 112 - November 2022
GDP Deflator (P)		OECD Stats Economic Outlook
Consumer Price Index (P)		AMECO
Private consumption expenditure deflator	Used to deflate Nominal compensation per employee	AMECO
Real compensation per employee (WR)	Computed as: Nominal compensation per employee in PPP deflated with private consumption expenditure deflator	AMECO (Gross Domestic Product, Income approach)
Real compensation per employee (WR)	Computed as: Nominal compensation per employee in PPP deflated with GDP deflator	AMECO (Gross Domestic Product, Income approach)
Real Gross Domestic Product (GDP)	Gross domestic product (expenditure approach) Constant prices, constant PPPs, OECD base year	OECD National Accounts
Adjusted Labour Share (LS)		AMECO
Unit Labour Cost (LS)		AMECO
Energy commodities price index (PCOM)	Expressed in U.S. dollars	World Bank
Non-Energy commodities price index (PCOM)	Expressed in U.S. dollars	World Bank
Purchasing power parities (PPP)	Purchasing power parities for GDP, National currency per US dollar	OECD, PPPs and exchange rates
Unemployment rate (UN)		AMECO

Appendix B – Additional robustness checks

Figure 11. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy common Shock (i).

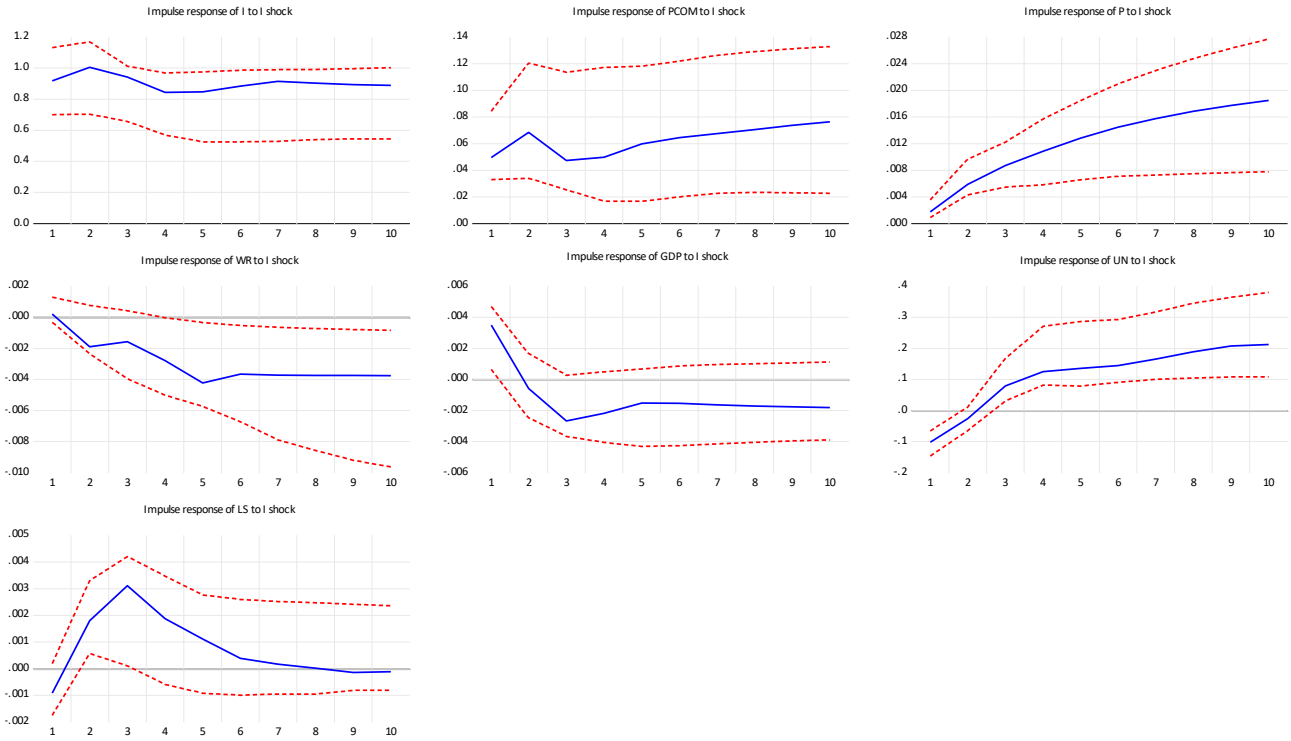

Figure 12. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate common Shock (UN).

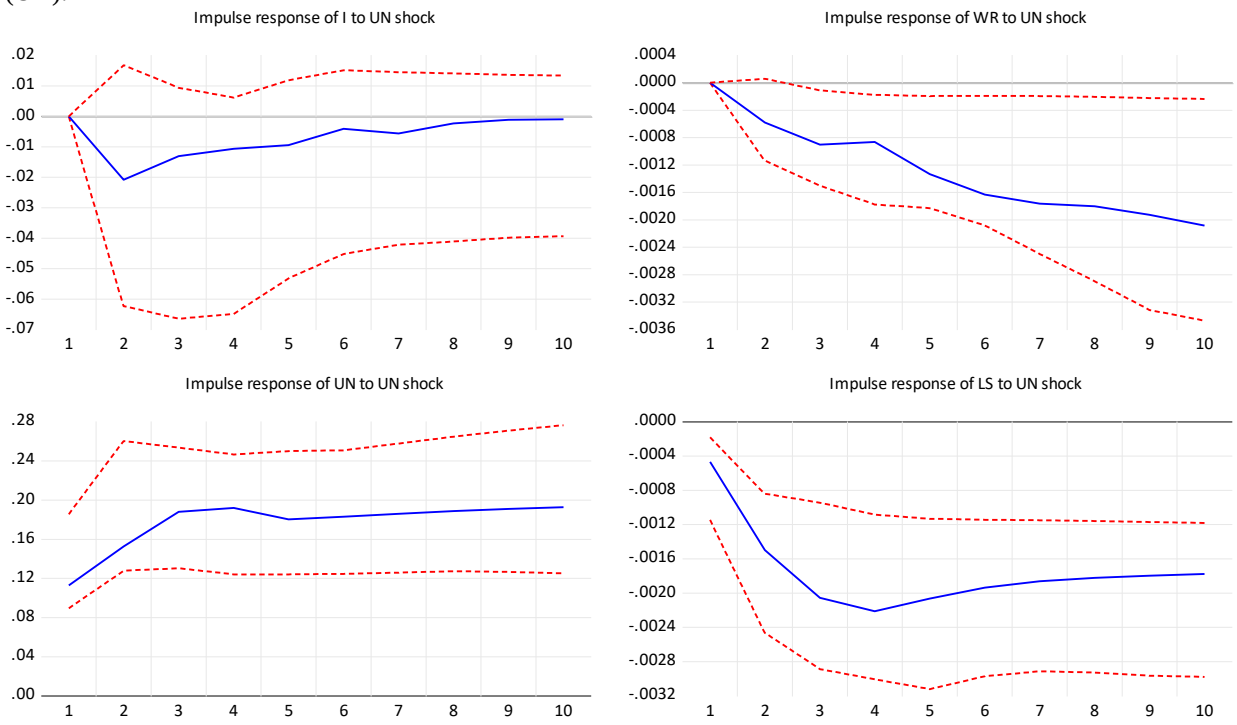

Figure 13. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy idiosyncratic Shock (i).

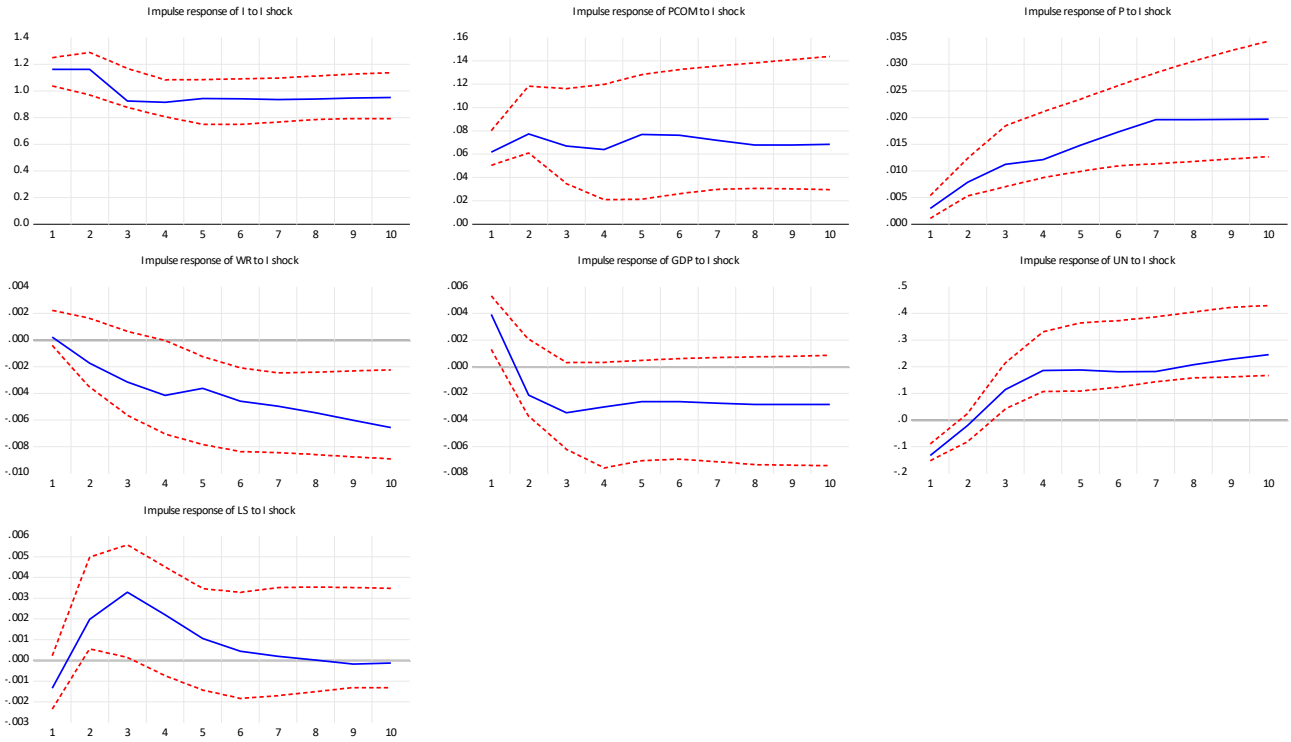

Figure 14. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate idiosyncratic Shock (UN).

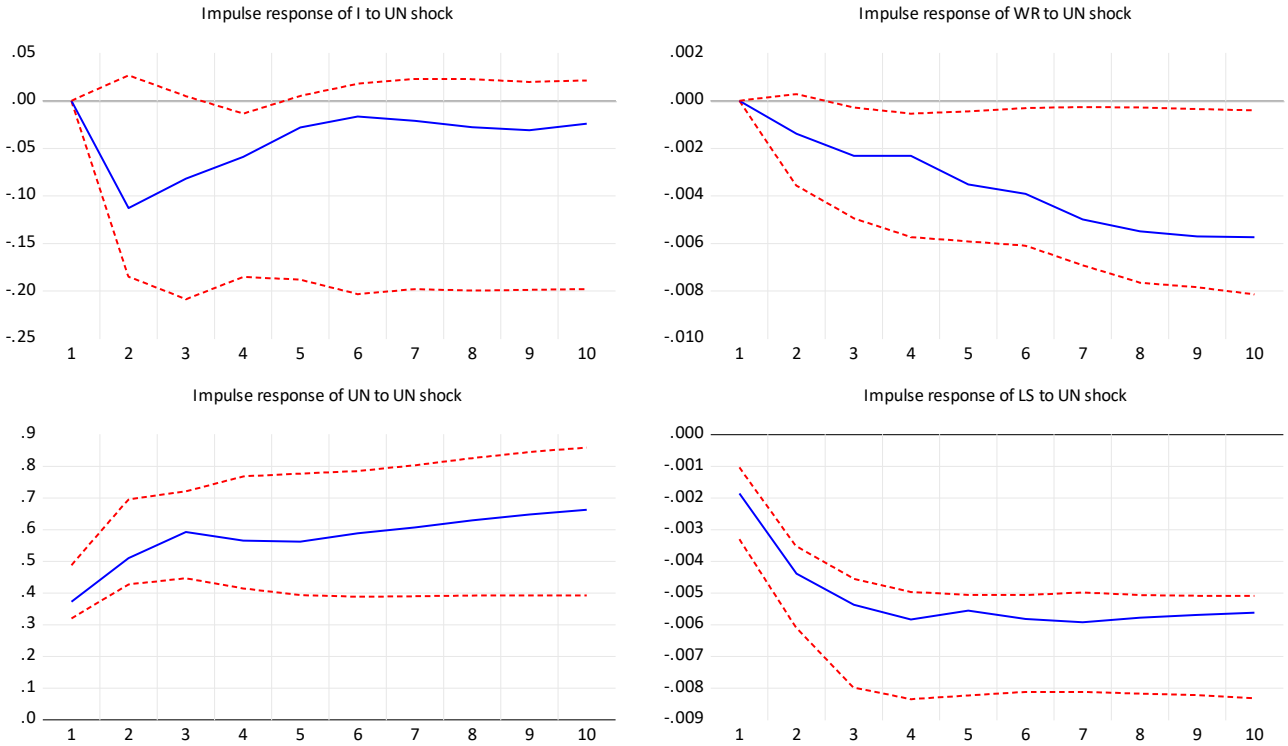

Figure 15. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Different ordering of variables in the Panel SVAR.

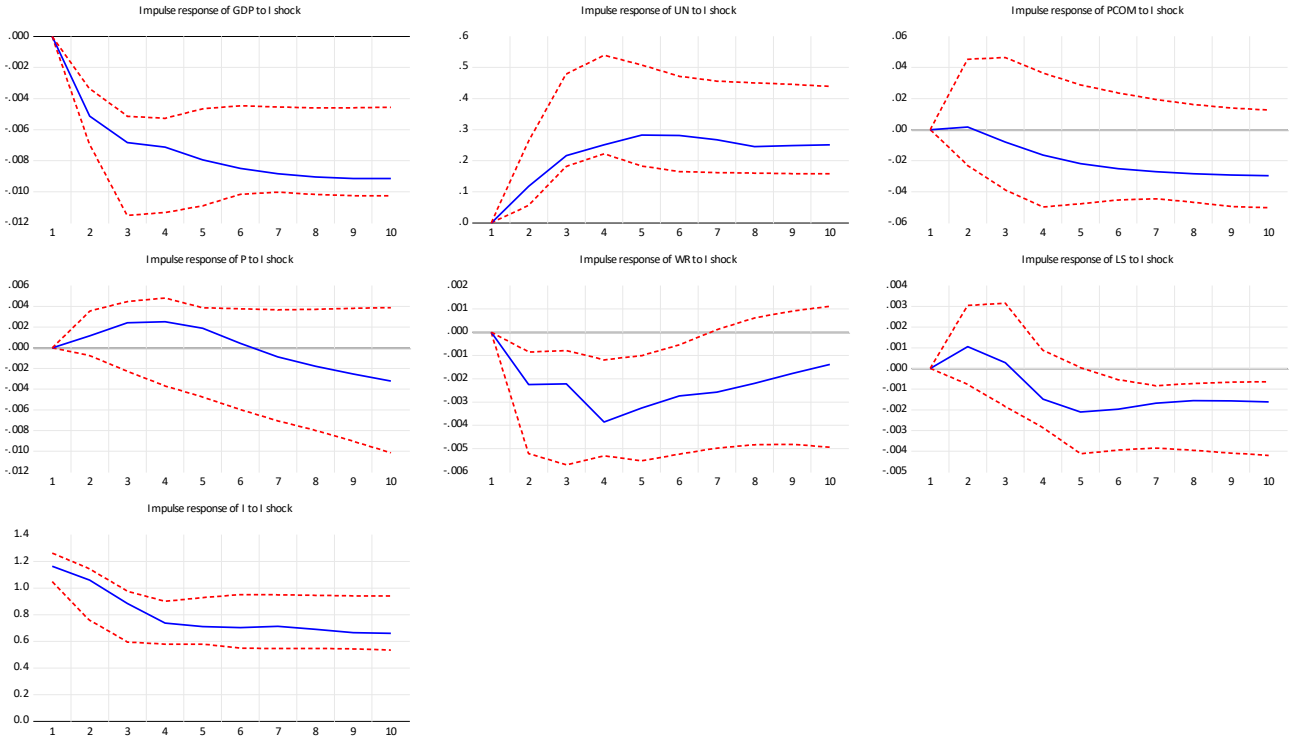

Figure 16. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Different ordering of variables in the Panel SVAR.

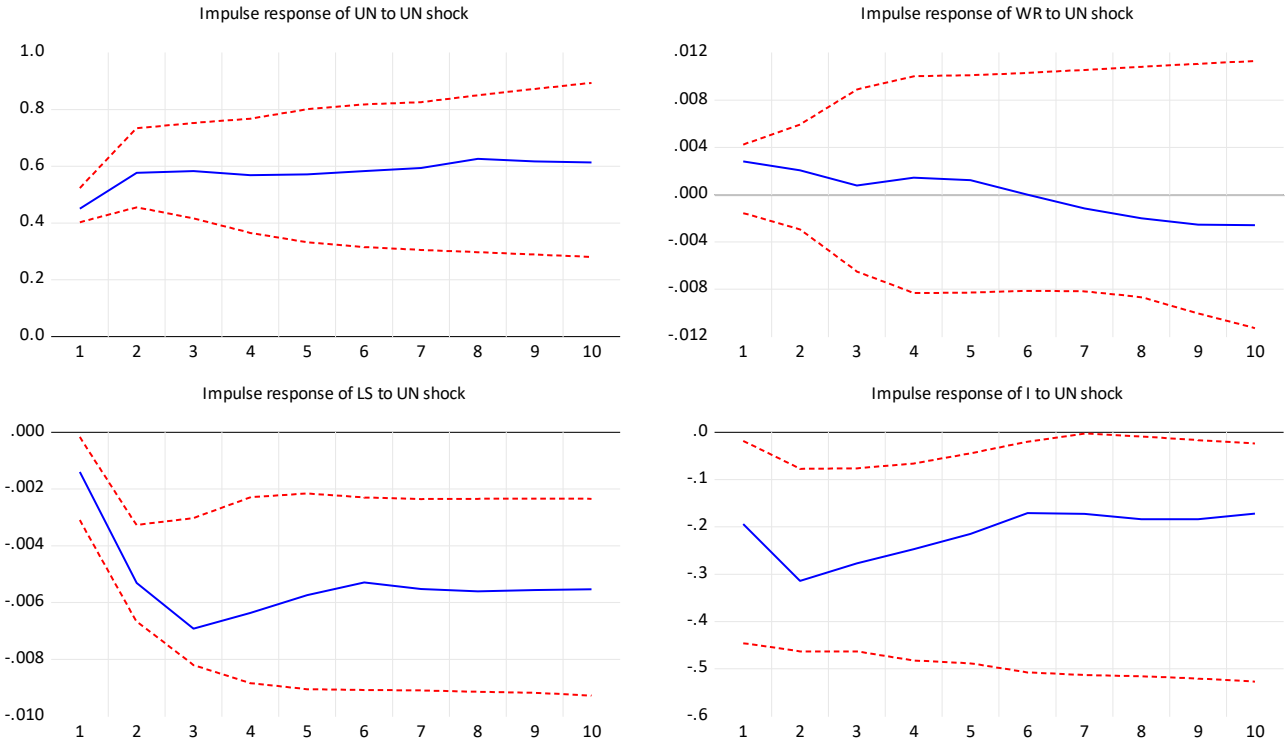

Figure 17. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Panel VAR estimated with 2 lags instead of 1.

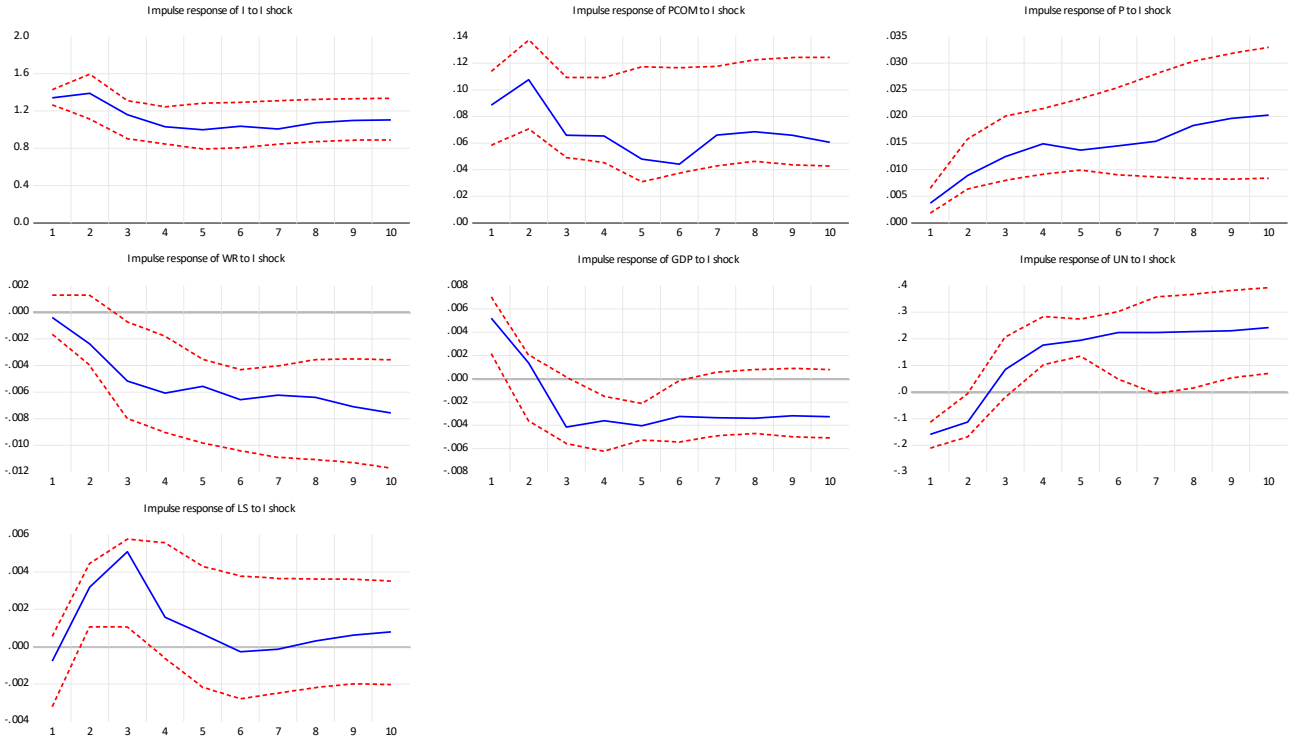

Figure 18. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Panel VAR estimated with 2 lags instead of 1.

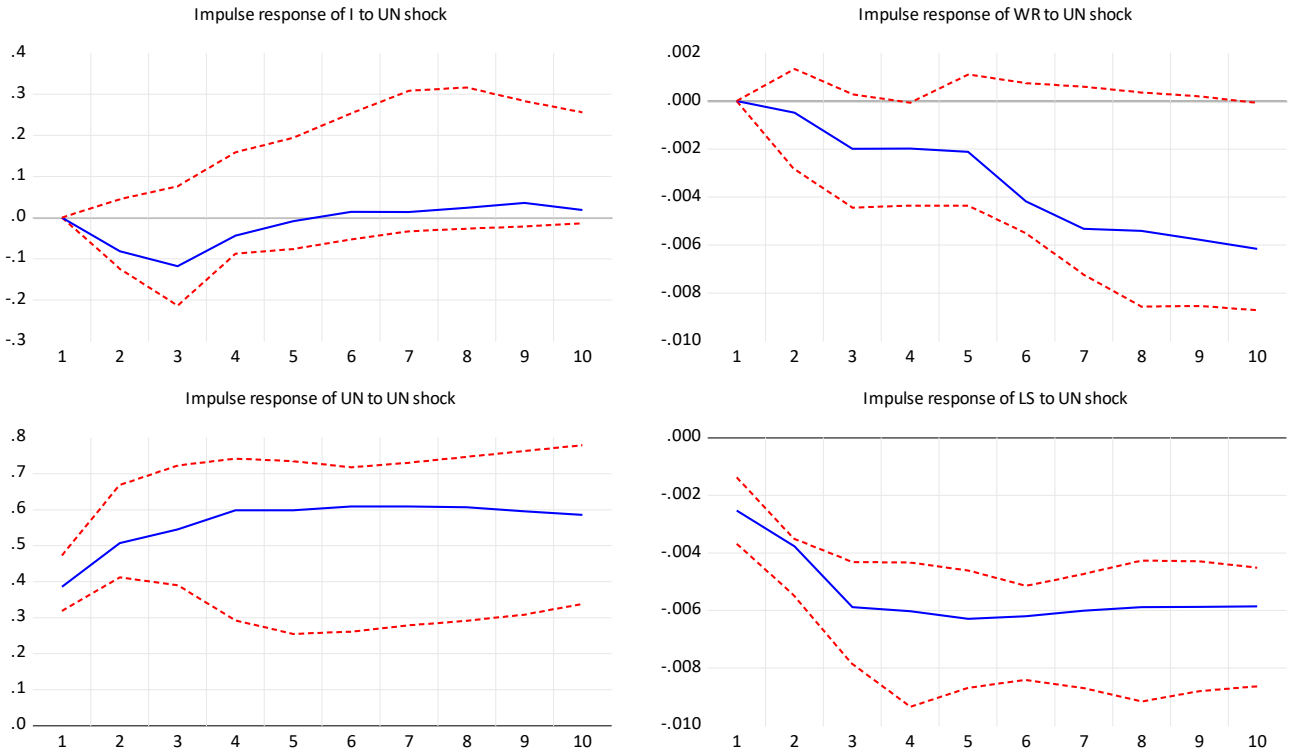

Figure 19. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Prices of non-energy commodities instead of prices on energy commodities (PCOM).

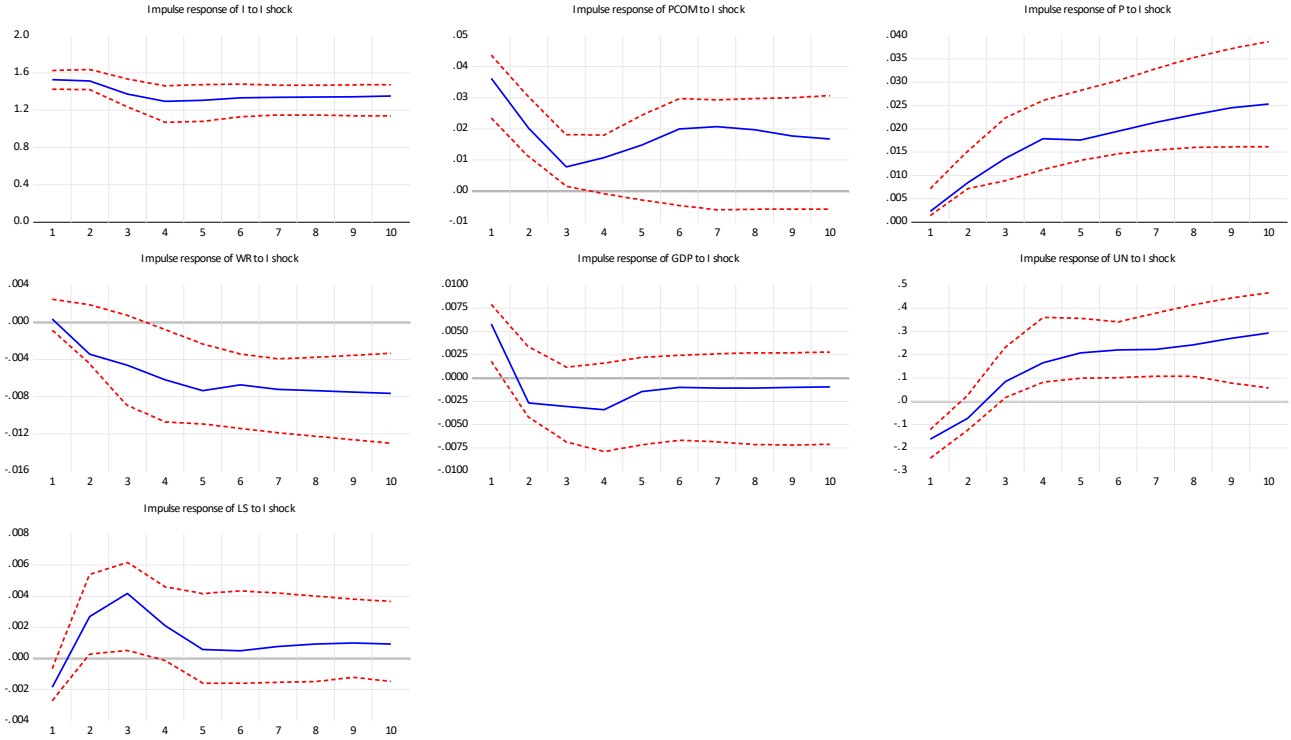

Figure 20. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Consumer price index instead of GDP deflator (P)

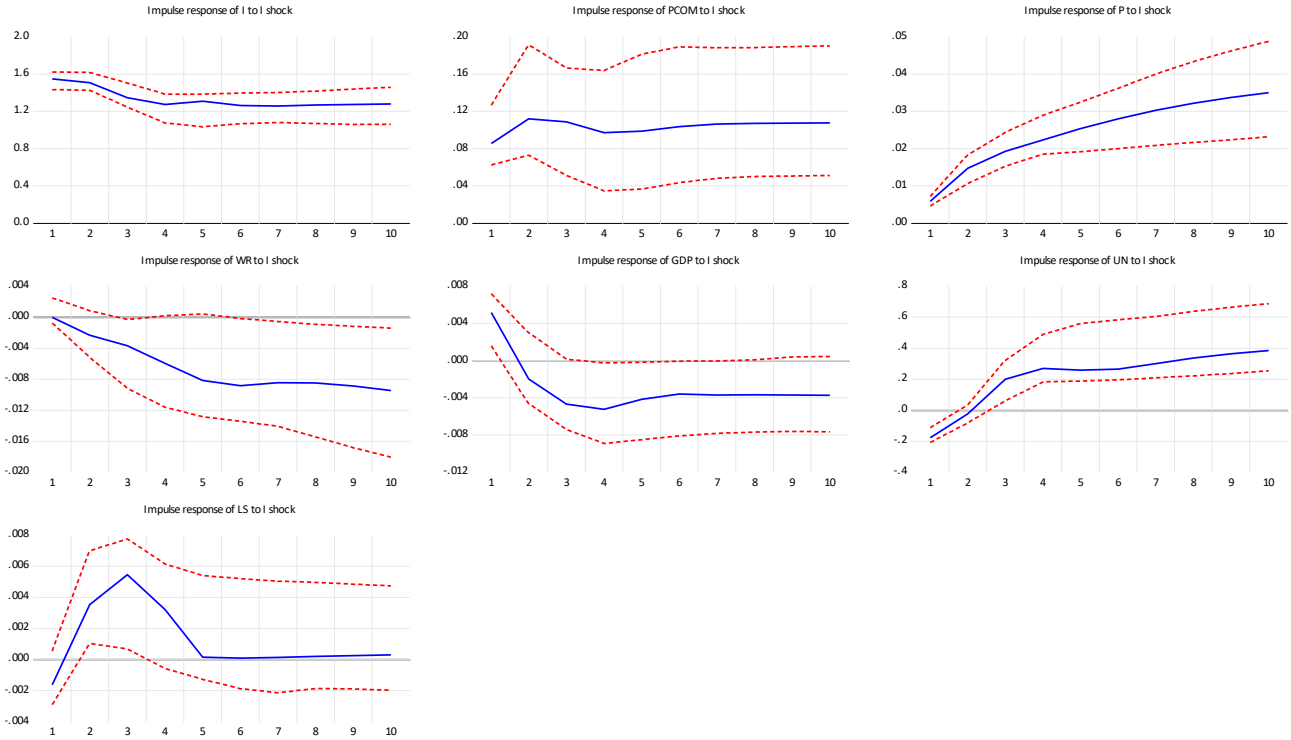

Figure 21. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Sub-sample of G7 countries.

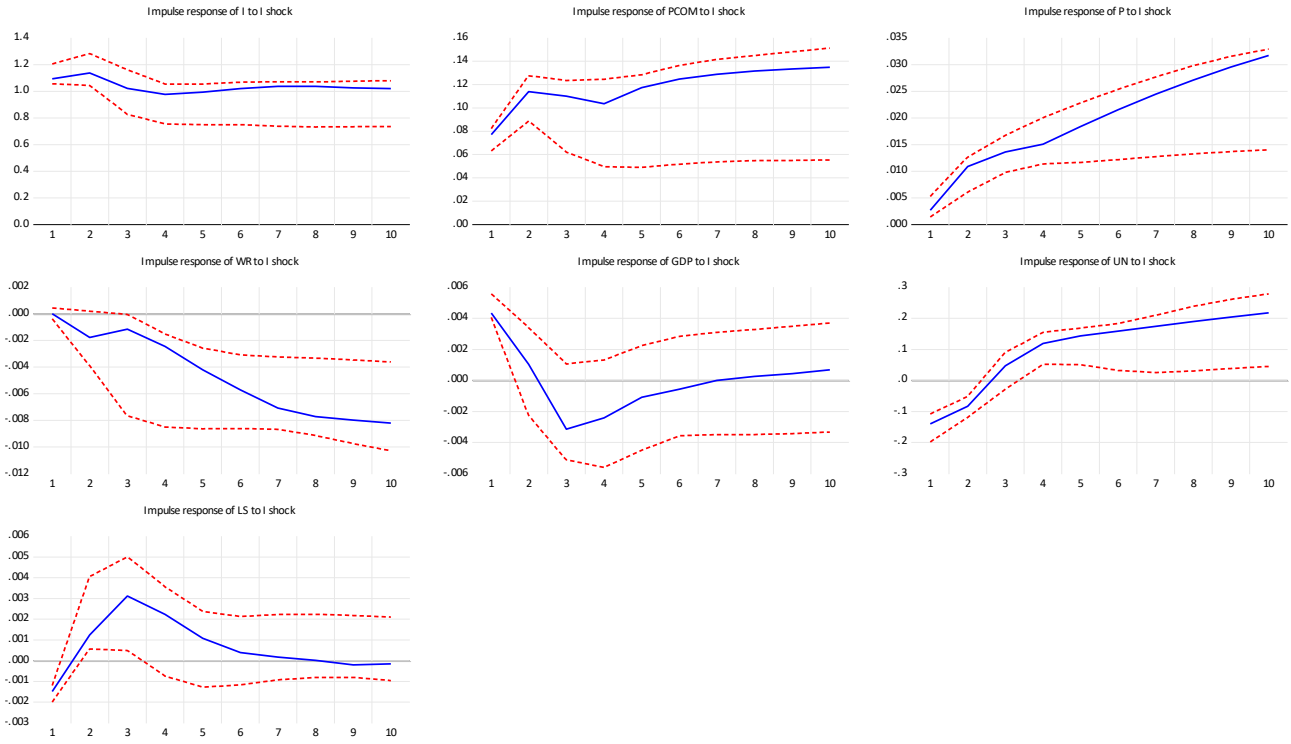

Figure 22. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Sub-sample of G7 countries.

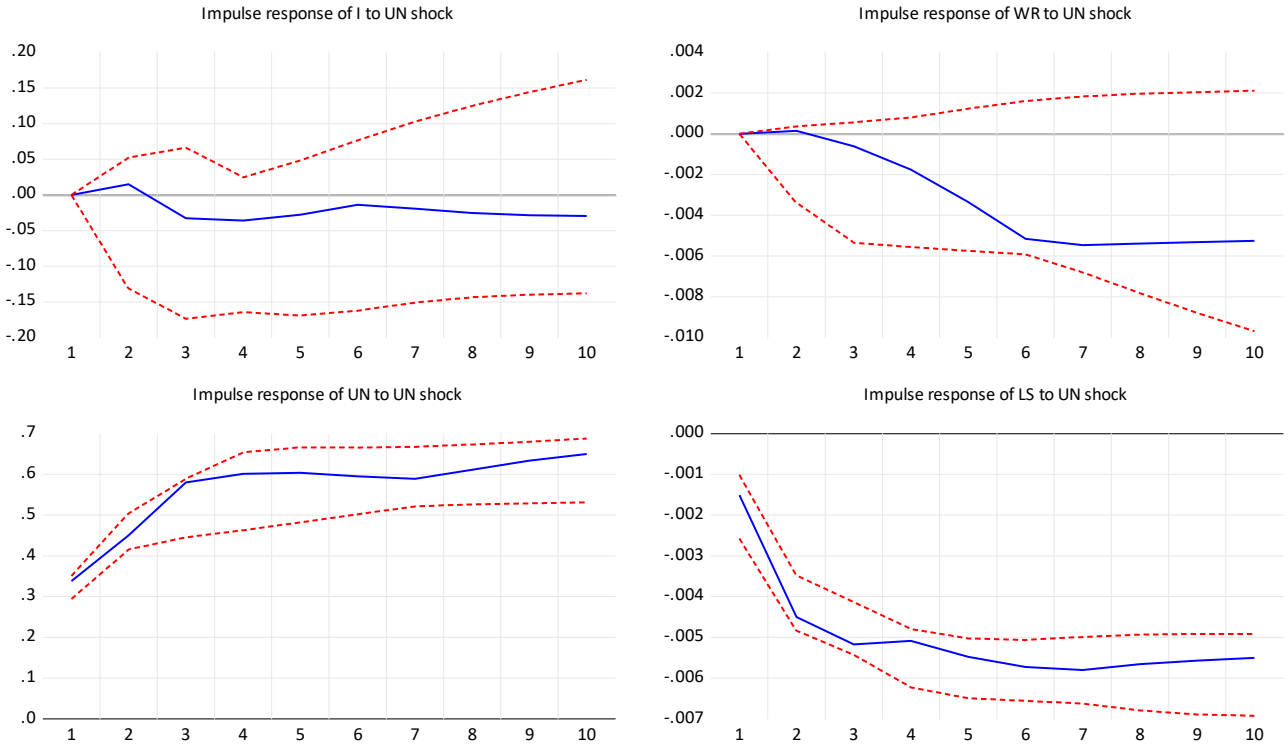

Figure 23. Impulse Response Functions, Model 1 – 1970-2019, Monetary policy composite Shock (i), Robustness check: Long-term interest rate instead of Short-term interest rate (i).

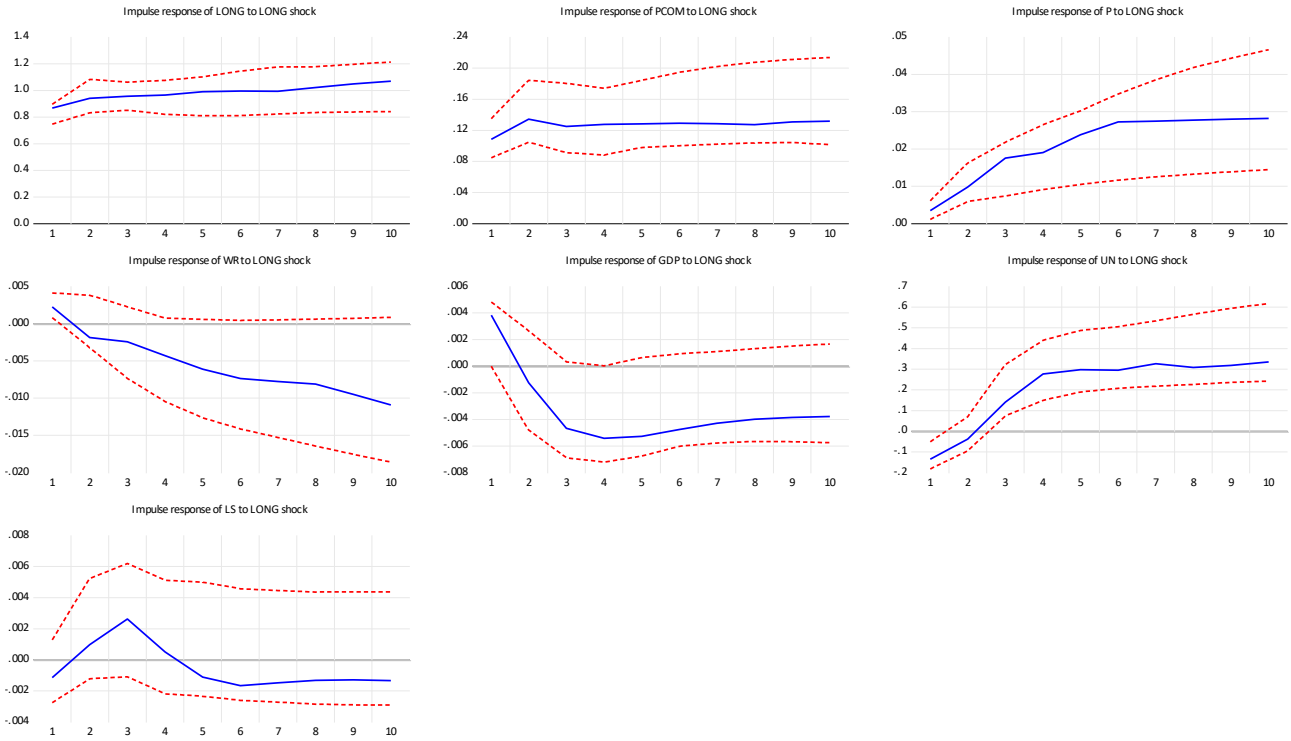

Figure 24. Impulse Response Functions, Model 1 – 1970-2019, Unemployment rate composite Shock (UN), Robustness check: Long-term interest rate instead of Short-term interest rate (i).