Oil supply shocks and the labor share: Evidence from the euro area

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Abstract

Oil supply shocks generate income losses to economic agents in oil-importing economies. Understanding how these losses are distributed and who bear the burden is an open empirical question. This paper explores the impact of oil supply shocks on the labor share of income and its main components. Using data from the euro area for the period 1999-2019, I provide evidence of a positive response of the labor share to increasing oil prices. Rising real product wages and a temporary decline in labor productivity explain the countercyclicality of the labor share. The procyclical response of productivity is caused by employment falling less than economic activity. I also find evidence of a decline in firms' capacity utilization, pointing to labor hoarding and variable capacity utilization as theoretical mechanisms that can explain the response of the labor share.

Keywords: Oil shocks, labor share, functional distribution of income, labor productivity.

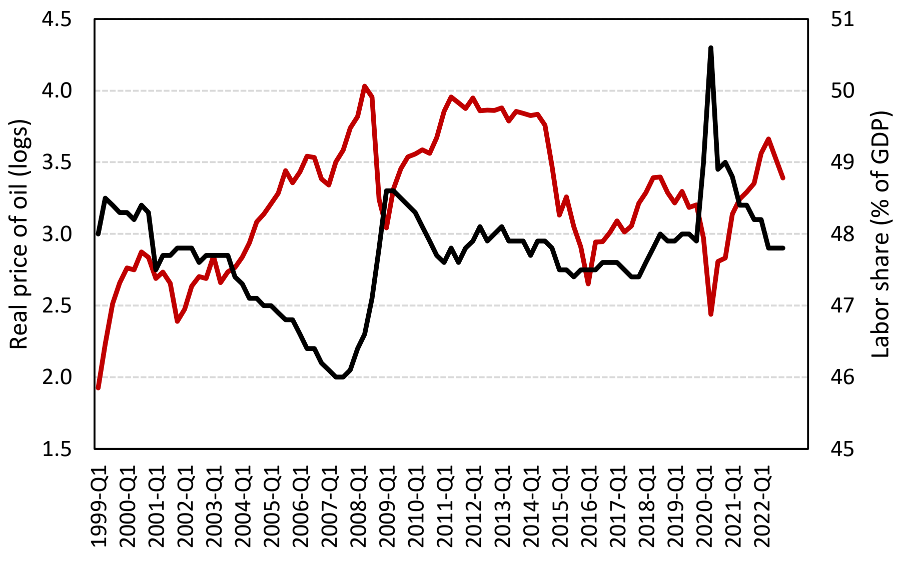
1. Introduction

The rise in global energy prices that hit the euro area, among other countries, in 2021-22 has renewed the interest of academic and policymakers in the distributional consequences of energy price shocks. Understanding how the income losses caused by energy price shocks are distributed is of great interest, especially if in the next decades, most economies are expected to face more volatile energy prices (Schnabel, 2022) as a consequence of the adverse effects of climate change and the impact of the actions taken during the energy transition.

From a point of view of the functional distribution of income, it has been argued that firms have responded to the surge in energy prices in 2021-22 by raising their own prices in order to protect or even increase their profit margins (Weber and Wasner, 2023; Nikiforos et al., 2024), thus further contributing to the surge in inflation, and at the expense of a lower labor share, defined as the share of total income that accrue to workers. During this episode, it has been found that unit profits were the main contributor to euro area domestic inflation (Arce et al., 2023; Hansen et al., 2023). This has translated into an increase in the profit share (Hansen et al., 2023). According to this narrative, higher energy prices cause a decline in the labor share.

Figure 1 displays the evolution of the real price of oil and the labor share in the euro area since 1999. It can be observed that during the 2021-22 episode, the labor share and the price of oil has moved in opposite directions. This correlation, although far from perfect, it is also observed during other episodes. However, the labor share, as well as the real price of oil, fluctuates over the business cycle in response to other shocks such as global demand, monetary and fiscal policy or productivity shocks. Therefore, inferring a causal relation from oil prices to the labor share is not straightforward and require a careful identification approach.

Figure 1. Evolution of the labor share and the real price of oil in the euro area (period 1999-2022).



Source: U.S. EIA, FRED and Eurostat. *Notes:* the red line represents the real price of oil and the black line denotes the labor share.

In this paper, our main goal is to estimate the causal effect of an oil supply shock on the labor share in the euro area and analyse the main channels of transmission. To isolate exogenous oil price fluctuations, I employ a high-frequency identification approach based on the movements of the price of oil around OPEC announcements (Känzing, 2021). Using the local projections approach with instrumental variable (Jordà, 2005; Jordà et al., 2015), I estimate the dynamic effect of these shocks on the labor share, its main components, namely, real product wages, total hours worked and real GDP, as well as other macroeconomic variables, allowing us to inspect the channels through which fluctuations in the price of oil transmit to the macroeconomy and affect the labor share.

I provide evidence that an increase in the price of oil caused by an oil supply disturbance leads to a temporarily higher labor share, which returns to its pre-shock level in the medium-term. Therefore, I find that the labor share is countercyclical conditional on oil supply shocks. This positive response is caused by i) an increase in real product wages, that is, real wages deflated by the GDP deflator, which is the real wages measure that matters for the labor share; ii) and a transitory decline in labor productivity, as real GDP falls quicker and deeper than total hours worked.

Regarding the transmission mechanisms, I find that the positive response of real product wages is caused by an increase in nominal wages and a small decline in the GDP deflator. It is important to take into account the differences in the response of real consumer wages and real product wages. Since the euro area is an oil-importing country, higher oil prices creates a wedge between both measures. Our findings show that real consumer wages, which are the ones that matters for workers' decisions, initially falls due to the grow in consumer prices and then recover as nominal wages try to catch up with consumer prices, a finding that is in line with the conflict theory of inflation (Rowthorn, 1977; Lorenzoni and Werning, 2023). Therefore, the increase in real product wages and its positive contribution to the labor share is consistent with a fall in real consumer wages and workers purchasing power.

The second channel of transmission of oil shock to the labor share is the procyclicality of labor productivity. To further inspect this channel, I estimate the response of firms' capacity utilization and the unemployment rate. Our findings show that the oil supply shocks generate a fall in employment, measure as total hours worked, an increase in the unemployment rate, as well as a temporary decline in capacity utilization. The fall in labor productivity despite the surge in unemployment points towards labor hoarding as a possible explanation (Horning, 1994). This theory suggests that firms face labor adjustment costs related to the cost of hiring, recruiting and firing, so that they smooth labor adjustment over time. This mechanism has also been suggested as an explanation for euro area procyclical labor productivity (Lewis et al., 2019).

Our findings show that the response of the labor share to oil supply shocks is countercyclical, that is, the labor share increase as economic activity contracts. This result is in contrast to previous literature based in industry cross-sectional variations (Castro-Vincenzi and Kleiman, 2022; Çürük and Rozendaal, 2022) that find that the labor share falls as energy and intermediate inputs prices raise. Our finding highlights the importance of taking into account general equilibrium effects. I find that the propagation of an oil supply shock is akin to a negative aggregate demand shock, therefore, just considering the cross-industry effects would miss some important transmission mechanisms.

Related literature. This paper contributes to the literature that analyses the effect of energy and commodity prices on the labor share. Çürük and Rozendaal (2022) analyse the impact of energy prices on the labor share in 15 European countries using cross-industry data, while Castro-Vincenzi and Kleiman (2022) study the effect of commodity and oil price shocks on the labor share in the US, also employing industry data. Both works conclude that higher energy prices translate into a decline of the labor share. I complement this literature by analysing this relationship from an aggregate time-series approach, which allows to consider the general equilibrium effects of the oil supply shock that cross-industry analysis rule out. Our findings suggest that considering the general equilibrium effects is of relevance for correctly estimating the macroeconomic propagation of this shocks.

This paper is also linked to the literature that studies the fluctuations of markups and the labor share over the business cycle and its response to macroeconomic shocks. This strand of the literature has analysed the transmission of technology shocks (Rios-Rull and Santaeulàlia-Llopis, 2010; Nekarda and Ramey, 2020; Hur, 2021; Qui and Rios-Rull, 2022; Bergholt et al., 2022), monetary policy shocks (Nekarda and Ramey, 2020; Cantore et al., 2021; Quiu and Rios-Rull, 2022), fiscal policy shocks (Nekarda and Ramey, 2020) and demand shocks (Hur, 2021). I contribute to this literature by studying the transmission of oil supply shocks. Oil shocks are considered to be an important driver of macroeconomic fluctuations, so that, understanding their implications for the functional distribution of income and the labor market is crucial to discipline the models used for the analysis of the transmission of this type of shocks.

Finally, this paper contributes to the literature on the macroeconomic transmission of oil shocks in oil importing countries, especially the transmission to the labor market. Peersman and Van Robays (2009) show that oil supply shocks in the euro area produce an increase in nominal wages and a temporary surge in real consumer wages, while unemployment raises. They also find an increase in the GDP deflator, suggesting that firms pass-though the higher nominal wages to prices, although the price-wage ratio falls, which means that the pass-through is incomplete. Our analysis show that, although nominal wages increase after the oil shock, real consumer wages temporarily decline, as found in Forni et al. (2015). I also contribute by analysing and comparing the response of real product wages and real consumer wages, finding that the former increase after the shock, driven by increasing nominal wages and a slight fall in the GDP deflator, opening up a wedge between real product and consumer wages. Finally, Forni et al. (2015) show that an oil supply shock leads to an increase in hours worked and a fall in capacity utilization, suggesting that capital-energy complementarities plays an important role in the transmission of oil shocks. However, I find that both capacity utilization and hours worked decline after an oil shock, which, considered together with the small but negative response of the GDP deflator, it may indicate that oil shocks rather transmit to the macroeconomy as adverse aggregate demand shocks (Edelstein and Kilian, 2009; Hamilton, 2009; Castelnuovo et al. 2024).

The rest of the paper is organised as follows: section 2 describes the empirical strategy and the data used in the analysis; section 3 presents the main results and discuss the links to the previous findings; and section 4 concludes.

2. Empirical Strategy

Most of oil price fluctuations are endogenous responses to development in the oil market, such as global economic activity shocks or speculative demand shocks. This implies that the macroeconomic response to oil price fluctuations differs depending on the source of such fluctuations (Kilian, 2009). Therefore, it is crucial to isolate oil supply shocks to analyse the causal effect of oil price fluctuations on the labor share and its components. I follow the high frequency identification approach proposed in Känzing (2021). Specifically, I identify oil supply surprises as the change in the price of oil around the day of OPEC announcements about future oil production. Känzing (2021) shows that these oil supply surprises represent oil supply news that are exogenous to oil market conditions. Finally, the daily surprises are aggregated at monthly frequency.

The monthly oil supply surprises series is used as external instrument in a Proxy-SVAR (Mertens and Ravn, 2013; Stock and Watson, 2018) representing the global oil market, where the endogenous variables are the real price of oil, world oil production, world oil inventories, world industrial production, US industrial production and US consumer price index. This allows to recover the oil supply news shocks, ε_t, identified using oil supply surprises as external instrument. Finally, I aggregate this oil supply news shock at quarterly frequency, since the dataset, which comprises national account series, is only available at this frequency.

To evaluate the causal impact of oil supply news shocks, I employ LP-IV (Jordá et al., 2015). I estimate the following regression at each horizon *h*:

$$y_{t+h} - y_{t-1} = \alpha^h + \beta^h Poil_t + \sum_{i=1}^{p} \gamma_{t-i}^h X_{t-i} + u_{t+h} \quad (1)$$

Where y_t is the outcome variable of interest at time $t + h$ and β^h is the cumulative impact of the shock on the outcome variable *h* periods ahead. $Poil_t$ represents the real price of oil, in logs. Since most oil price variations are endogenous, I instrument the log real price of oil with the shock ε_t previously identified, as in Miyamoto et al. (2024). As outcome variable, I include the labor share and its components, that is, real product wages, total hours worked and real GDP, all in logs. To understand the transmission mechanism, I also include as outcome variable capacity utilization, the consumer price index (HICP), nominal wages, real consumer wages, the GDP deflator and the unemployment rate. X_{t-i} is a vector of control that includes lagged values of the outcome variable, as well as real GDP, HICP, the real price of oil and the shadow interest rate, as estimated in Wu and Xia (2017, 2020)[1]. I also include a quadratic trend. Since I are using quarterly data, I select a conservative lag order of p=4. Newey-West heteroskedaticity and autocorrelation

[1] We use the EONIA rate as the interest rate from 1999Q1 to 2008Q3 and the shadow rate (Wu and Xia, 2017; 2020) thereafter.

consistent (HAC) standard errors are computed to account for the serial autocorrelation that the error term presents by construction.

2.1. Data

I use quarterly data for the euro area, spanning the period from 1999Q1 to 2019Q4. Our sample starts with the introduction of the euro in 1999 and ends in 2019 prior to the outbreak of the COVID-19 pandemic.

The outcome variables included in the analysis are the labor share, defined as total compensation of employed divided by Gross Domestic Product (GDP), real product wages, defined as nominal compensation of employed deflated by the GDP deflator and divided by total hours, as in Cantore et al., (2022), real GDP, the Harmonized Consumer Price Index (HICP), total hours worked and capacity utilization, the latter obtained from the European Comission Business and Consumer Surveys. Total hours worked is detrended using the HP filter. The real price of oil is the Brent spot price deflated by the U.S. CPI. I also include as control the euro area short-term nominal interest rate. Since the nominal interest rate was at the zero lower bound during part of the sample, I substitute the EONIA rate with the shadow rate (Wu and Xia, 2017) after 2008Q4. All the variables are included in log-levels except the short term interest rate, that is included in levels. Table A1 in the annex summarize the description and sources of all the variables.

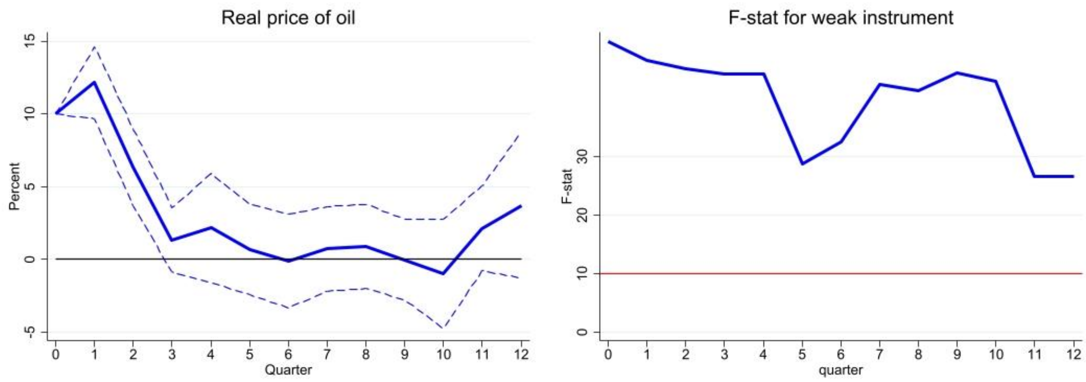
Finally, the oil supply news shock series that is used as instrument for oil price shocks, is obtained from Känzing (2021), who estimate a Proxy-SVAR model for the oil market that includes six variables: the real price of oil, world industrial production, global oil inventories, world oil production, US industrial production and US Consumer Price Index. It uses oil price fluctuations around OPEC meetings as instruments to finally estimate the shock series. I convert the shock series from monthly to quarterly frequency by taking the cumulative sum.

3. Results

3.1. Main results

In this section, I present the Impulse Response Functions of the labor share, its components and the rest of outcome variables to an oil supply news shock. I normalize the shock to represent a 10% increase in the real price of oil on impact. Figure 2 panel A shows the response of the real price of oil. It increases on impact and start falling back to its initial level after a few quarters. Figure 2 panel B shows the Kleibergen and Paap (2006) F- statistic for Iak instruments. The results corroborate that the instrument is relevant.

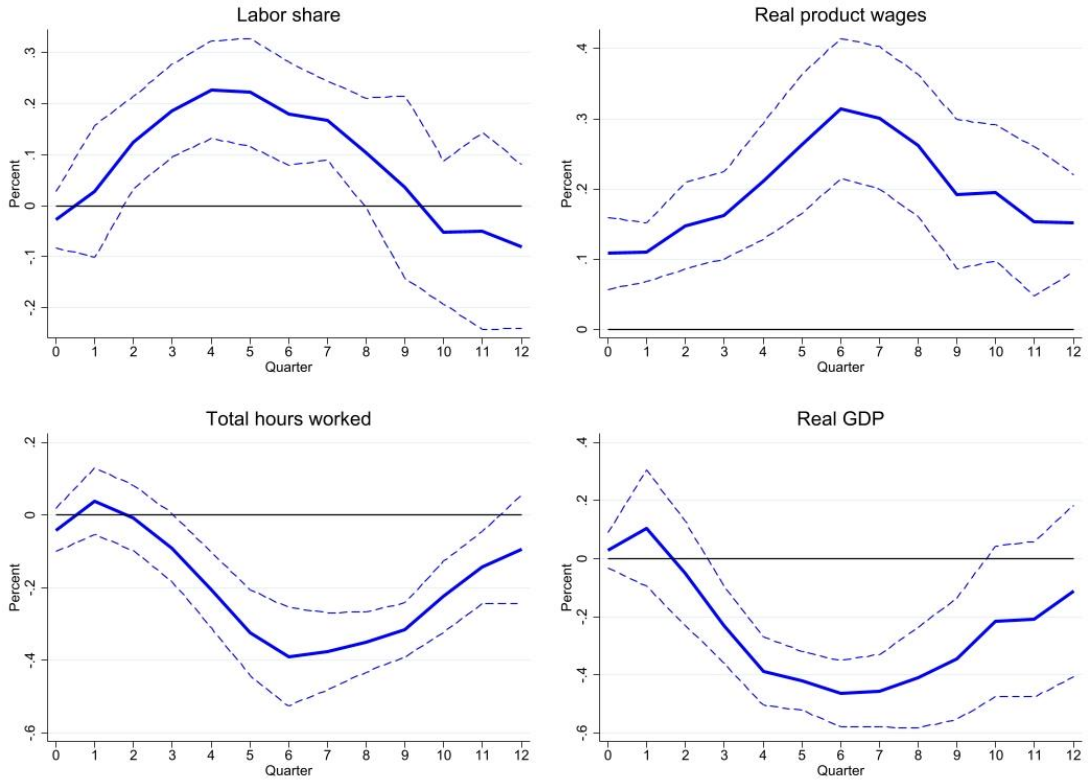
Figure 2. Response of the real price of oil to an oil supply news shock



Notes: The left panel displays the dynamic response of the real price of oil to an oil supply news shock that increase the price of oil by 10% on impact. Dashed lines denotes 90% confidence intervals. The right panel displays the Kleibergen and Paap (2006) F-stat for weak instruments.

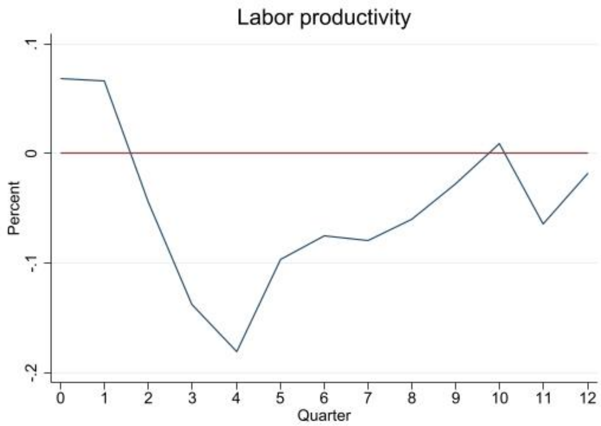
Figure 3 shows the dynamic response of the labor share and its components to an increase in the price of oil. The labor share presents a hump-shape response. It is muted on impact, but it cumulatively increases until reaching a maximum after four quarter. Then, it reverses to its initial level at the end of the horizon. Real GDP fall after an oil shock, reaching a through after six quarters and going back to its pre-shock level at the end of the horizon. Hours worked follow a similar pattern than real GDP, falling initially and reversing back after six quarters. For its part, real product wages increase persistently for 6 quarters and partially reversed afterward. Therefore, the increase in the labor share is caused by a positive response of real product wages, together with a lower decline in total hours worked compare with the decline in GDP, causing labor productivity to decline, thus contributing to the higher the labor share. Figure 4 shows the implied evolution of labor productivity, which I obtained as the difference between the response of GDP and total hours worked. I observe that labor productivity progressively decline in the first quarters, reaching the trough in the fourth quarter, when the labor share reaches its peak. After that point, labor productivity come back to its initial level, as hours worked continued to fall and GDP recovers. This response of labor productivity is in line with the empirical evidence provided in André et al. (2023) using cross-industry data for OECD countries.

Figure 3. Response of the labor share and its components to an oil supply news shock



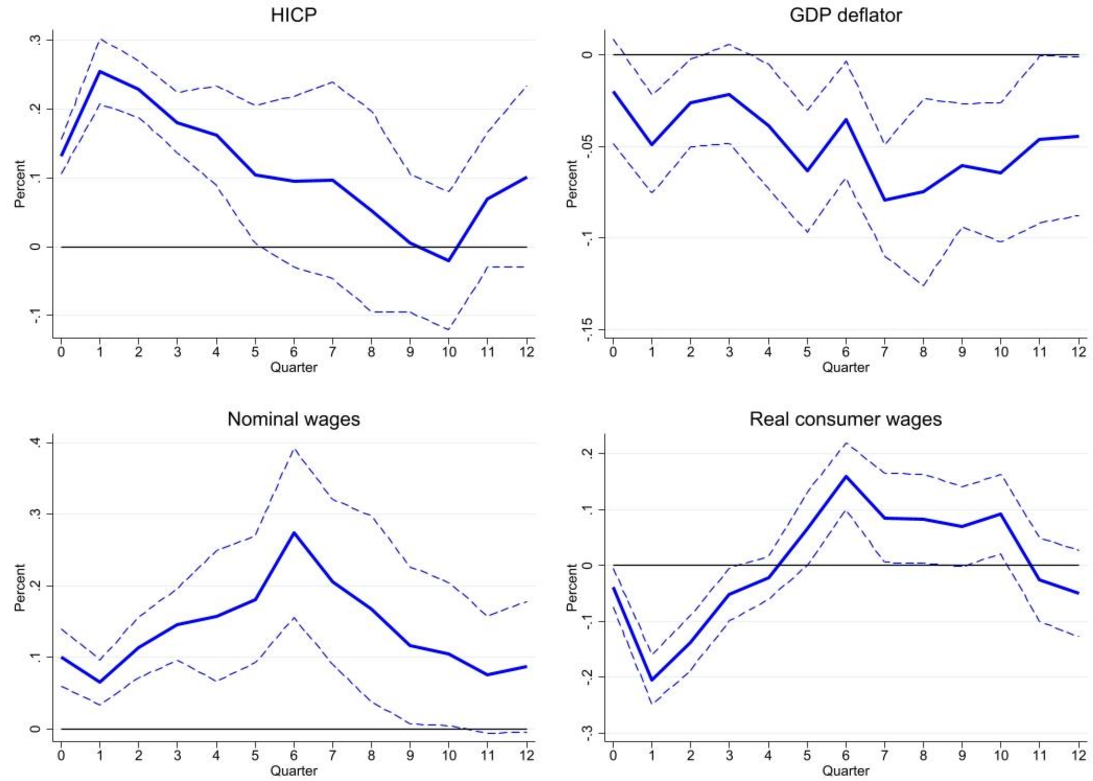
Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

Figure 4. Implicit response of labor productivity to an oil supply news shock



Notes: This figure represents the implicit response of labor productivity to an oil supply shock that increase the price of oil by 10% on impact. It is obtained as the difference between the coefficients of the IRFs of real GDP minus total hours worked.

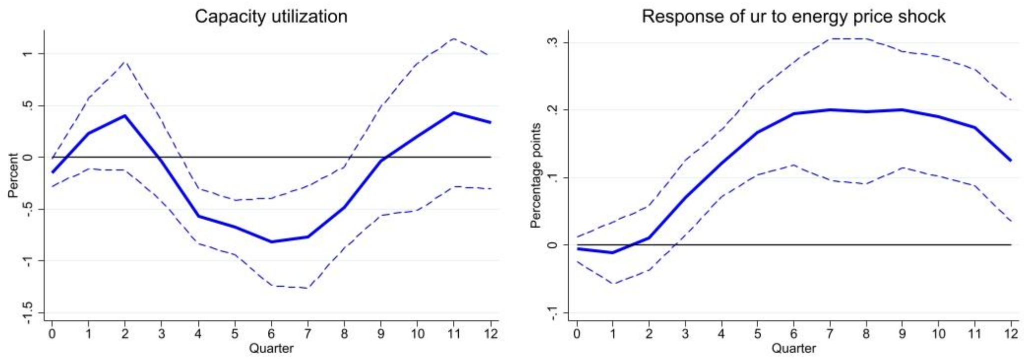
Figure 5. Response of prices and wages to an oil supply news shock



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

The positive response of real product wages after an increase in the price of oil deserves further analysis. I compare the response of real product wages to the response of the GDP deflator, nominal wages and real consumer wages, the latter defined as nominal wages deflated by HICP. Results are displayed in Figure 5. I find that real consumer wages decline initially as headline inflation increase. However, they recover and become positive after one year and stabilize afterward. This evidence is in line with the theoretical results of Lorenzoni and Werning (2023) which suggests that, after a supply shock that depress real wages, workers try to recover their losses and bargain for higher nominal wages in order to catching up with the previous increase in consumer prices. It can also be observed how nominal wages persistently increase after the shock but at a rate below the price index, although they reach the peak later and reverse slower than prices, allowing workers to recover their purchasing power. Since real consumer wages are what matter for workers, this explain why real product wages increases, since the GDP deflator does not increase after the shock as consumer price does. Indeed, I find that the GDP deflator falls, a results that may be explained for the recessionary effect of oil shocks, suggesting that oil price shocks are akin to negative demand shocks, as pointed out in Edelstein and Kilian (2009) and Castelnuovo et al. (2024).

Figure 6. Response of capacity utilization and unemployment to an oil supply news shock



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

The fact that labor productivity is found to be procyclical after an oil supply shock is also at odd with standard macroeconomic theory. Common New Keynesian and RBC models suggest that labor productivity is countercyclical, since a lower labor demand leads to higher marginal product of labor as long as the latter is decreasing on hours worked. Therefore, a possible explanation for the procyclical labor productivity and countercyclical labor share is labor hoarding (Horning, 1994) or cyclical factor utilization (Bils et al., 1994), that is, firms does not adjust labor as much as it is desired since hiring and firing have costs. In this situation, firms might reduce capacity utilisation during periods of recession and increase it during booms. I estimate the response of capacity utilisation in the euro area and I find that it declines some quarters after the shock, following a response very similar to real GDP, providing some evidence about this mechanism. This mechanism has also been suggested as an explanation for the procyclical productivity found in the euro area conditional on demand shocks (Lewis et al., 2019).

3.2. Robustness

In this section, I test the robustness of the results to different approaches to identified oil supply shocks, alterantive econometric methods and different specifications. First, I estimate our specification using alternative oil supply shocks (Baumeister and Hamilton, 2019; Caldara et al., 2019). Secondly, I estimate the impulse response using an internal instrument SVAR. Finally, I use alternative specifications to estimate the effect of oil supply shocks.

a. Alternative oil supply shocks

Identifying exogenous variations in the price of oil is crucial for estimating the causal effect of oil supply shocks. However, the literature has used different approaches to identified such shocks, leading to different conclusions about how these shocks are transmitted to the price of oil and the macroeconomy. Caldara et al. (2019) identify oil supply and demand shocks using a SVAR model of the global oil market where they embed demand and supply elasticities that they previously estimate employing narrative episodes of drops in oil production. Baumeister and Hamilton (2019) also identified different oil supply and demand shocks through a Bayesian SVAR model, where their main contribution is the use of informative priors about the parameters of the model based on external information. To check the robustness of our results to the choice of the identification approach, we estimate the same set of IRFs using alternatively the oil supply shocks of Caldara et al. (2019) and those of Baumeister and Hamilton (2019) as instruments.

Figures B1 and B2 in the Annex show the response of the outcome variables to an oil supply shocks identified using Caldara et al. (2019) and Baumeister and Hamilton (2019) shocks as instruments, respectively. I normalize the coefficients to represent a 10% increase in the price of oil on impact. It can be observed that, even though the transmission of these shocks somehow differs from the one obtained in the baseline model, it is still found a countercyclical response of the labor share, that is, it increases after a positive oil supply shock.

Oil supply shocks identified using Baumeister and Hamilton (2019) shows a more persistent response of the real price of oil, as well as the HICP. Economic activity is only affected with some delay, since real GDP, hours worked and capacity utilization initially increase and then start declining after some quarters. However, the negative impact is more persistent. As a consequence, the labor share only start increasing after some quarters, when economic activity contracts while the real product wage increases, but its positive response persist after 12 quarters. On the contrary, Caldara et al. (2019) oil supply shocks present a more immediate negative effect on real GDP and hours worked but the effect dissipates after some quarters. This translates also into a quicker but less persistent positive response of the labor share.

b. Evidence from a SVAR

Impulse Response Functions from Local Projections and SVARs tend to converge in large samples (Plagborg-Møller and Wolf, 2021). However, in finite samples, the results of both methods may differ. In this section, I estimate an "internal instrument" recursive SVAR (Plagborg-Møller and Wolf, 2021) using the previously identified oil supply news shocks from Känzing (2021) as instrument. I estimate the following reduced-from VAR:

$$y_t = c + \sum_{p=1}^{4} A_1 y_{t-p} + H u_t \qquad (2)$$

Where $y_t = [\varepsilon_t, x_t]$ is a vector that contains the previously identified oil supply news shock and x_t, which is a vector of endogenous variables that includes the real price of oil, real GDP, HICP, the labor share, real product wages, total hours and the interest rate, all in logs except the interest rate that enters in levels. The impact response of the shock is recovered using a recursive ordering. The instrument variable ε_t is order first, therefore, the first column of the matrix *H* contains the impact response of the endogenous variables to an oil supply news shock.

Figure B3 displays the impulse response functions. These results are similar to those obtained in the baseline model, although the confidence intervals are wider, which is due to the higher number of parameters that are estimated in the SVAR compared to the LPs estimates, as all the endogenous variables are included in the same estimation. However, the main conclusions hold, that is, an increase in the price of oil leads to a surge in the labor share, caused by an increase in real product wages and a temporary fall in labor productivity.

c. Alternative specifications

In this section, I estimate the response of the outcome variables using two alternative specifications. First, I estimate the model including directly the previously identified oil supply news shock, instead of using this variable as instrument. The IRFs are estimated using OLS. Secondly, in the baseline model, the short term interest rate is proxied by the shadow rate (Wu and Chia, 2017) after 2008Q3. I substitute the shadow rate with the euro area 12-month interest rate.

Figure B4 shows the results when using the identified shocks directly in the regressions while Figure B5 displays the results obtained from the specification where the short-term interest rate is proxied by the euro area 12-month interest rate. The findings are very similar to those obtained in the baseline model, proving the robustness of them to the use of alternative specifications.

4. Discussion and Conclusions

I study how the labor share reacts after an oil supply shock in the euro area and analyse the main channels and mechanisms behind its response. I find that the labor share increases for some quarters after coming back to its initial level. The positive response is related to an increase in real product wages as well as a temporary decline of labor productivity, caused by a more pronounced fall in GDP than in employment, the latter measured as total hours worked.

Our findings oppose previous results in the literature. Castro-Vincenzi and Kleiman, (2022) and Çürük and Rozendaal (2022) find that an increase in energy prices leads to a decline in the labor share. However, our approach differs from the one used in these papers, since they use cross-industry variations to identify the effects of energy shocks, which automatically rules out any aggregate or general equilibrium effects. Our approach using time-series allows us to consider these aggregate effects, which are important as oil shocks propagates through the economy. Additionally, they use a shift-share approach to identify the causal impact of energy price on the labor share, which does not distinguish the source of the shock driving the energy price. Since most oil prices fluctuations are caused by global economic activity shocks (Kilian, 2009) whose impact on the domestic economies is different from those of a supply shocks, their results are not directly comparable with the ones in this paper.

I interpret our results as a combination of wage rigidity and firms' labor hoarding behaviour. The positive response of real product wages is a consequence of an increase in nominal wages, which has been previously found for the euro area (Peersman and Van Robays, 2009; Neri, 2024), as workers try to recover the initial fall in real consumer wages caused by the increase in consumer prices. This response is in line with the prediction of the conflict theory of inflation (Lorenzoni and Werning, 2023), that states that a supply shock initially depress real consumer wages but they recover gradually as nominal wages grow in order to catch up with inflation. I conclude that the increase in real product wages and the labor share that I find is consistent with a fall in workers purchasing power, measured by real consumer wages. Labor hoarding is another mechanism that may be at work, which would help us explain the procyclical response of productivity. I find evidence that firms reduce capacity utilization after the oil shock, while hours worked decline less that real GDP. This result is consistent with those found in the labor hording and variable capacity utilization literature (Horning, 1994; Basu, 1996), although these papers mostly focus on the propagation of aggregate demand shocks. Most recently, González and Ramaswamy (2024) also developed a model with endogenous capacity utilization that generates a procyclical labor productivity and countercyclical labor share conditional on demand shocks.

However, other mechanisms may be also at work producing these results. For example, an oil price shock might lead to a sectoral reallocation from energy-intensive sectors to the rest of the economy. As long as energy-intensive sector are less labor-intensive, a reallocation to less energy-intensive and more labor-intensive sector would translate into higher average real wages and aggregate labor share. Further analysis focusing on the sectoral response in terms of labor share and economic activity would be needed to study this sectoral reallocation channel.

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Annex A. Data sources and decription

Table A1. Variables used in the regressions.

Variable	Description	Sources
Labor share	Compensation of employees divided by GDP, seasonally adjusted	Eurostat
Real price of oil	Brent price of oil deflated by the US CPI	US EIA and FRED
Real product wages	Compensation of employees divided by total hours worked and divided by the GDP deflator	Eurostat and ECB
Real consumer wages	Compensation of employees divided by total hours worked and divided by HICP index	Eurostat and ECB
Total hours worked	Thousand hours worked per quarter, seasonally adjusted	ECB
Real GDP	Gross Domestic Product, volume (index 2010 = 100), seasonally adjusted	Eurostat
GDP deflator	Nominal GDP divided by real GDP	Eurostat
Nominal wages	Compensation of employees divided by total hours worked	Eurostat
HICP	Harmonised Index of Consumer Prices, (index 2015 = 100), seasonally adjusted	Eurostat
Capacity utilization	Percentage level of productive capacity utilization, seasonally adjusted	European Comission
Unemployment rate	Unemployed divided by total active population, seasonally adjusted	Eurostat
Short-term interest rate	EONIA interest rate after 2008Q3, Wu and Chia (2017) shadow rate afterwards	Eurostat and Jing Cynthia Wu webpage
12-month interest rate	12-month EURIBOR interest rate	Eurostat

Annex B. Additional results

Figure B1. Response of outcome variables to an oil supply shock identified using Caldara et al. (2019) supply shocks.

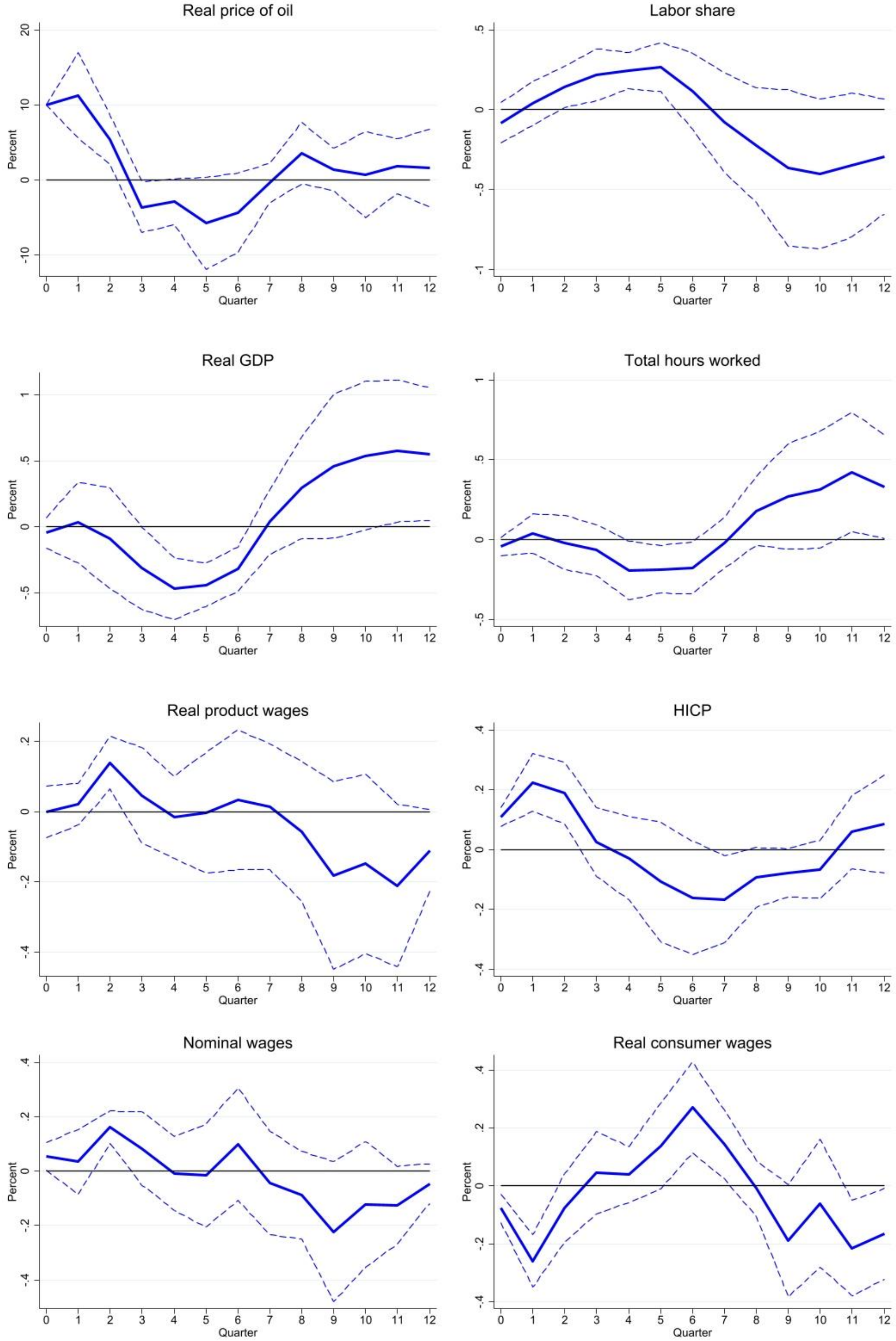
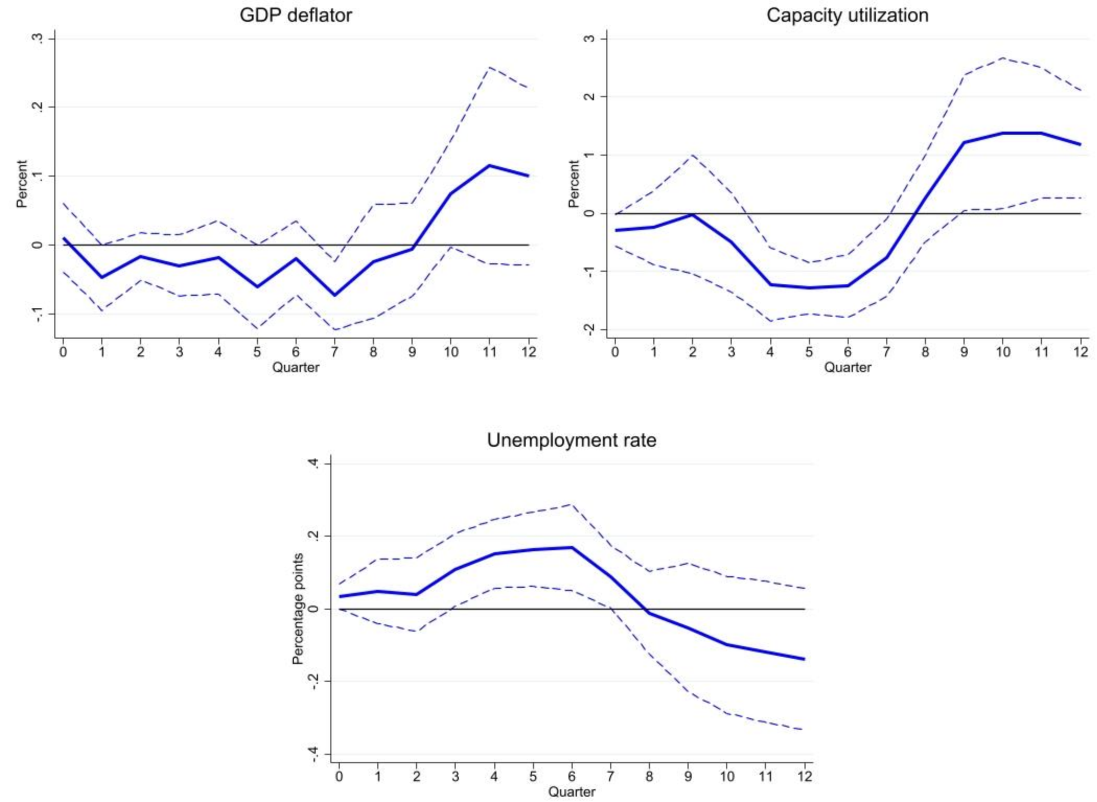


Figure B1. (continued)



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

Figure B2. Response of outcome variables to an oil supply shock identified using Baumeister and Hamilton (2019) supply shocks.

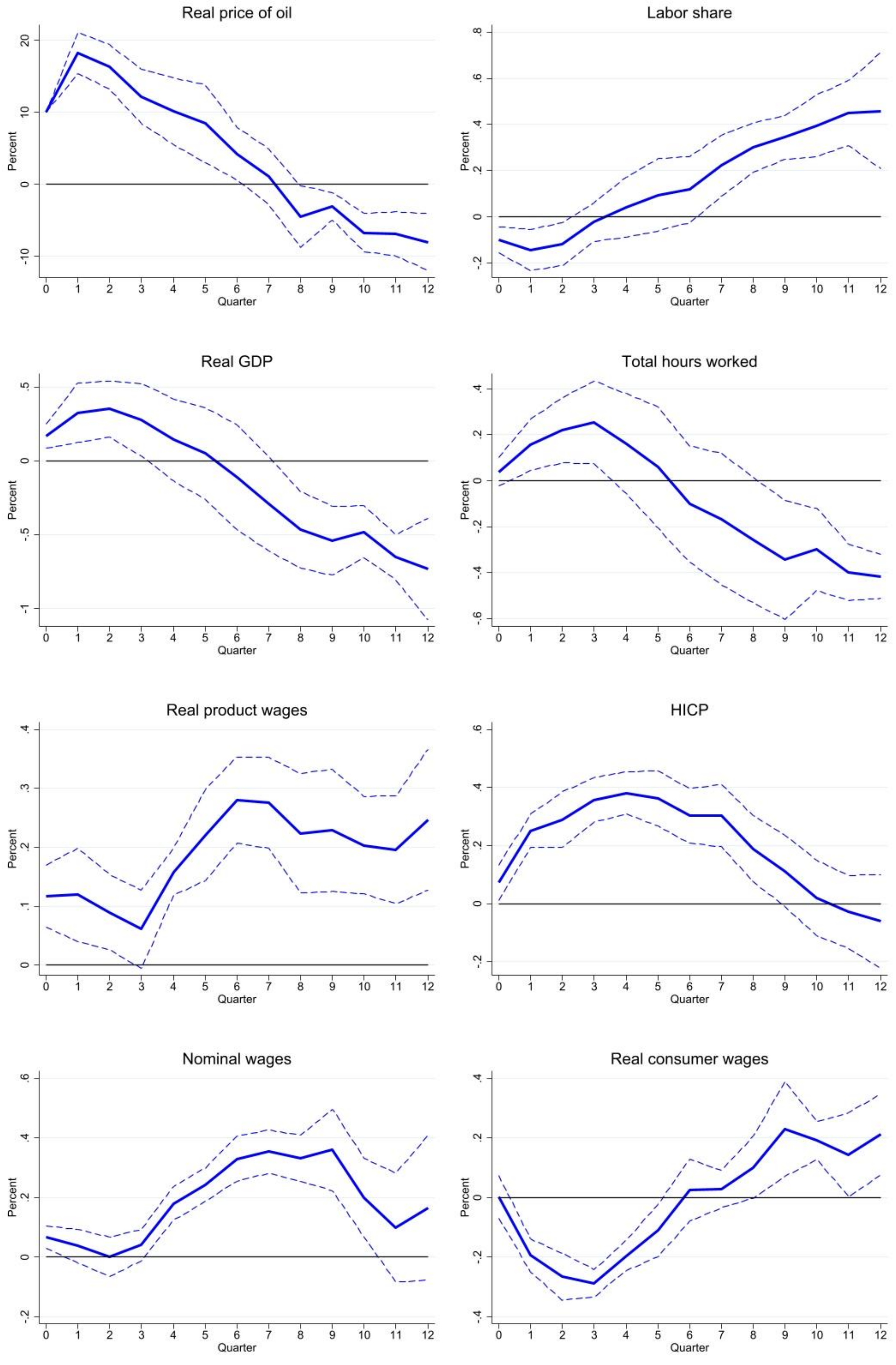
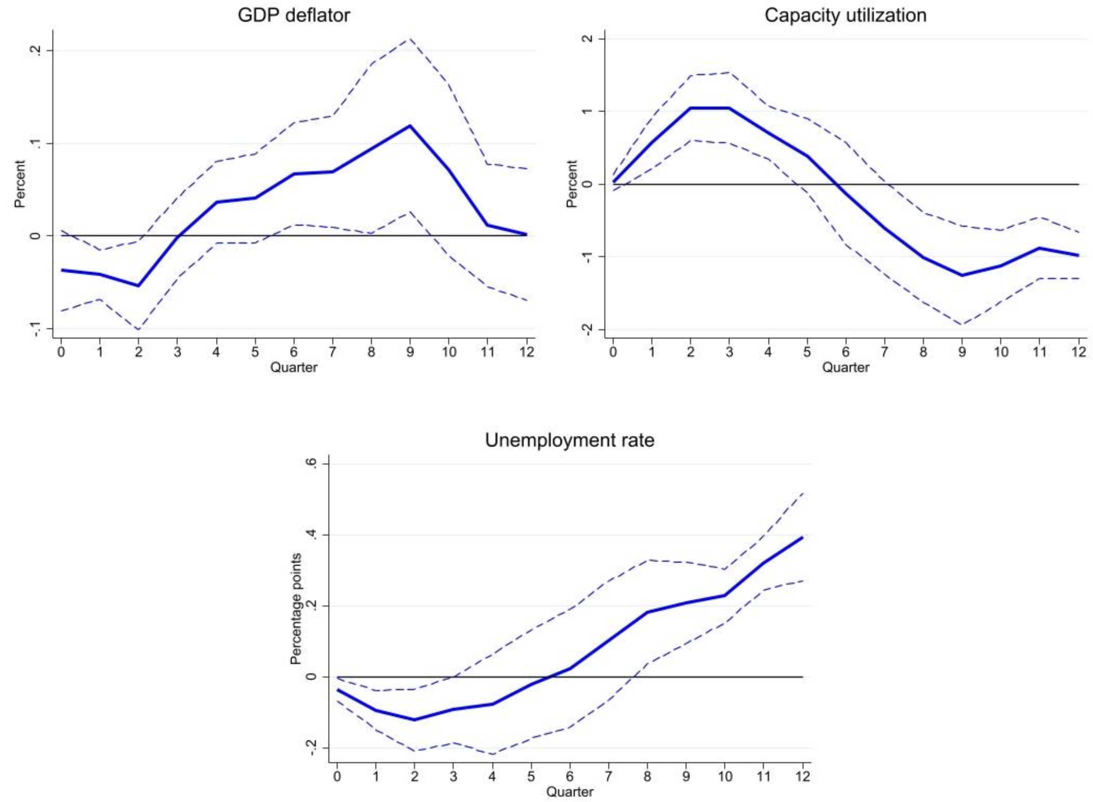
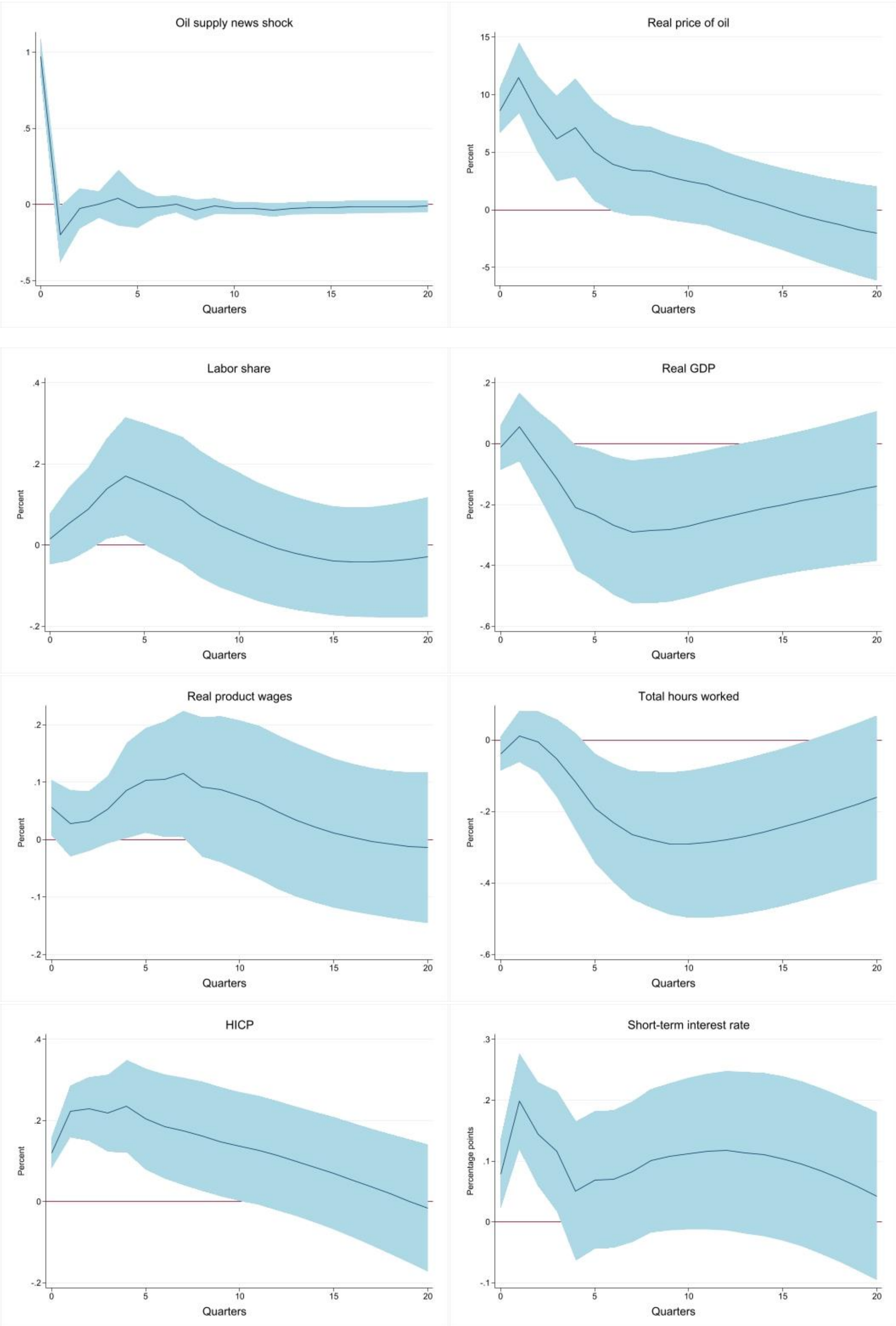


Figure B2. (continued)



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

Figure B3. Response of outcome variables to an oil supply shock identified using an "internal instrument" SVAR.



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil. Blue area denotes 90% confidence intervals.

Figure B4. Response of outcome variables to an oil supply news shock. Alternative specification using OLS-LPs with observed shock.

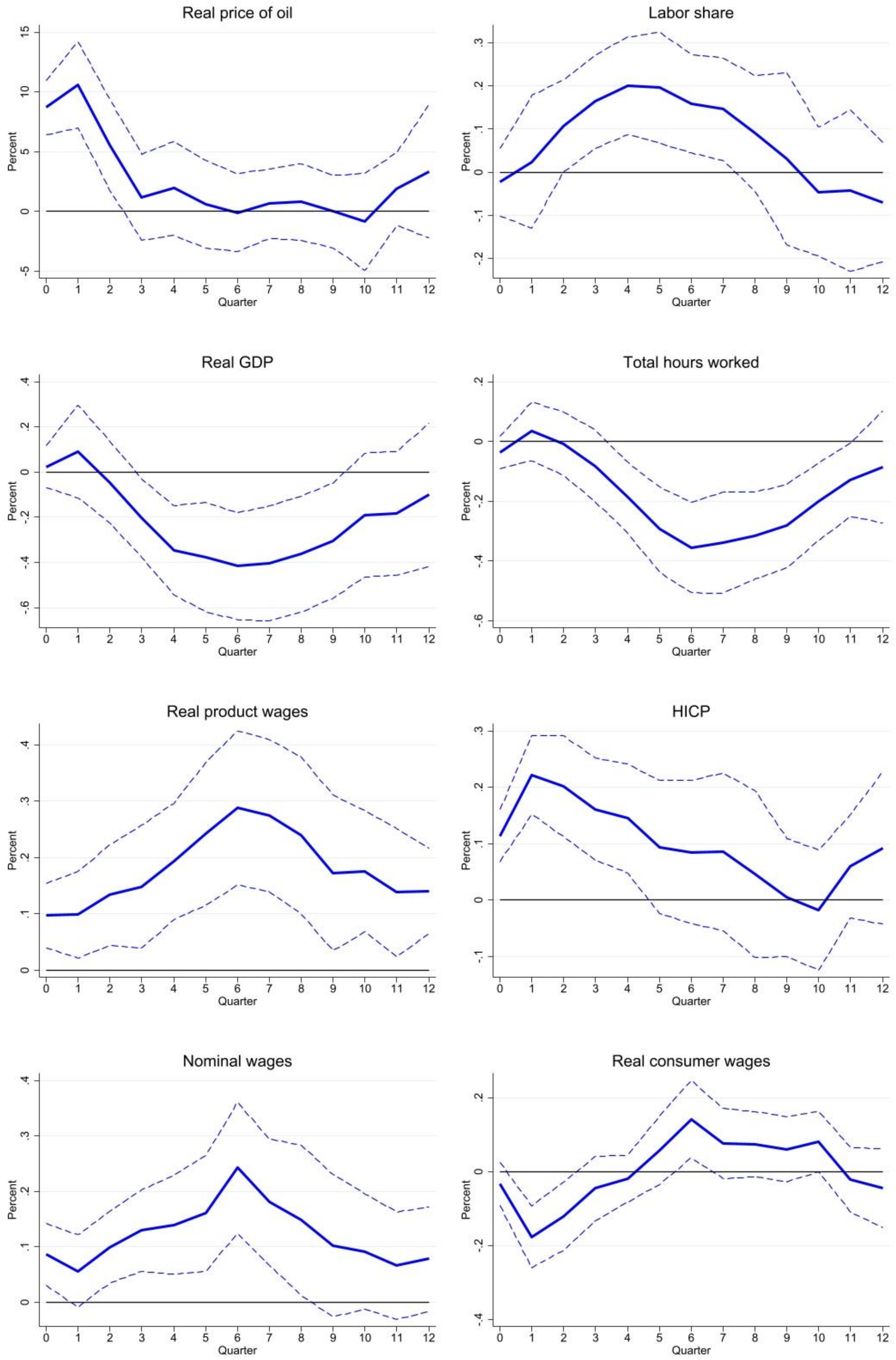
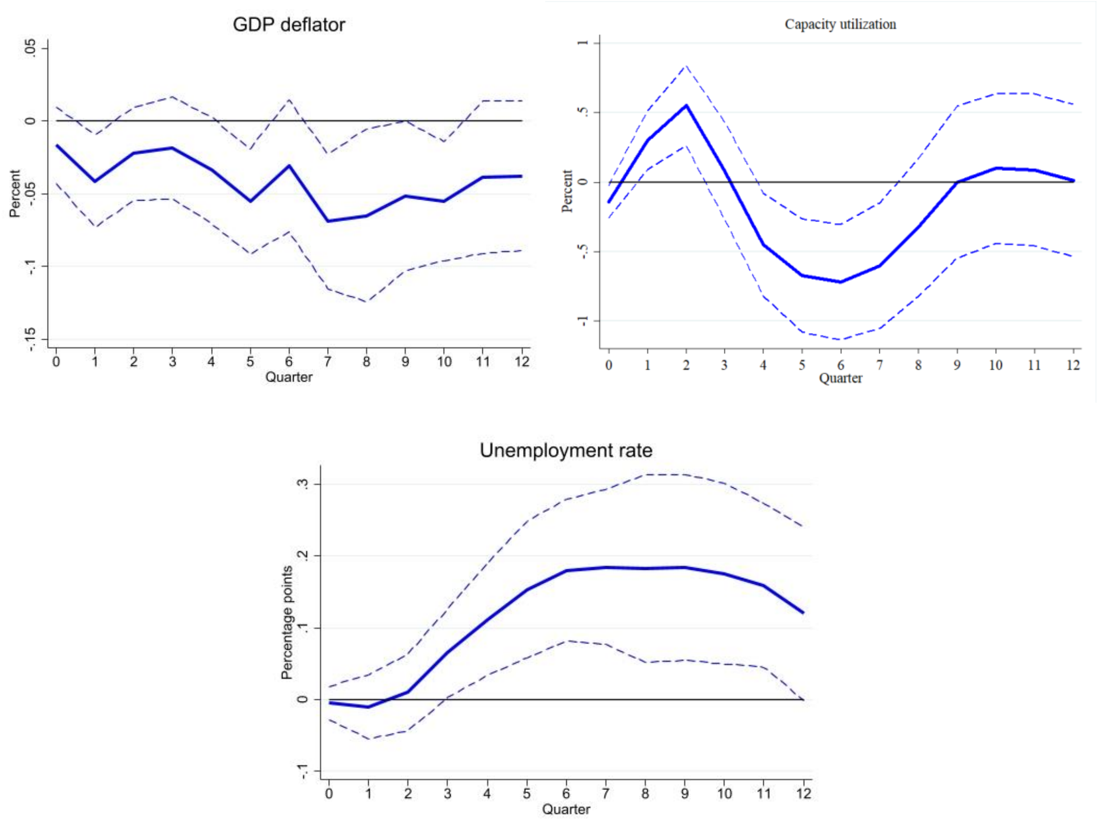


Figure B4. (continued)



Notes: Blue lines denote the response of the outcome variable to an oil supply news shock that increases the price of oil by 10% on impact. Dashed lines denote 90% confidence intervals.

Figure B5. Response of outcome variables to an oil supply news shock. Alternative specification using 12-month interest rate.

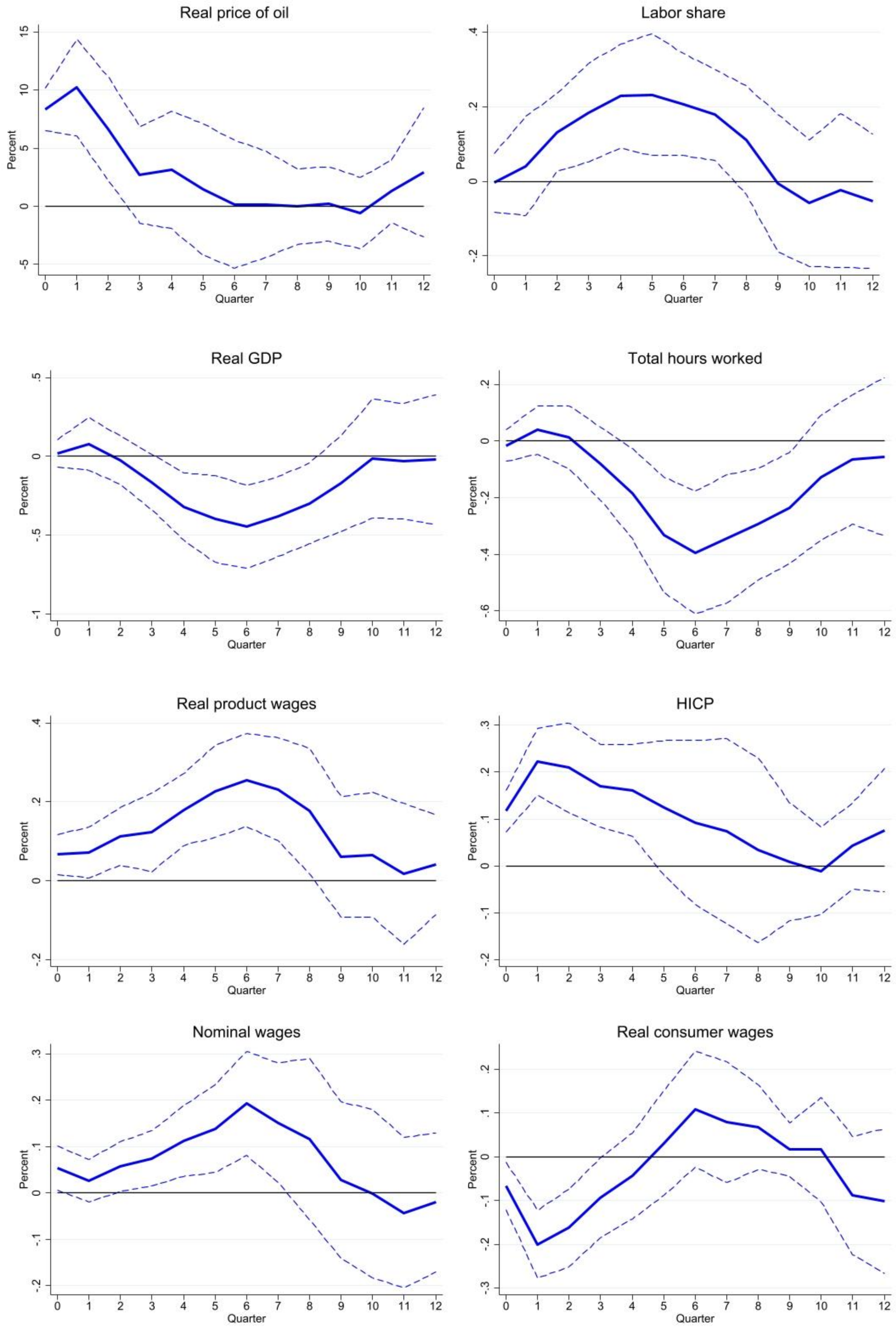


Figure B5. (continued)