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Euro area, oil and global shocks: An empirical model-based analysis

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ABSTRACT

We assess the impact of oil shocks on euro-area (EA) macroeconomic variables by estimating with Bayesian methods a two-country New Keynesian model of EA and rest of the world (RW). Oil price is determined according to supply and demand conditions in the world oil market. We obtain the following results. First, a 10% increase in the international price of oil generates an increase of about 0.1 annualized percentage points in EA consumer price inflation. Second, the same increase in the oil price generates a decrease in EA gross domestic product (GDP) of around 0.1% and a trade deficit, if it is due to negative oil supply or positive oil-specific demand shocks. Third, it generates a mild EA GDP increase and a trade surplus if due to a positive RW aggregate demand shock. Fourth, the increase in the oil price over the 2004–2008 period did not induce stagflationary effects on the EA economy because it was associated with positive RW aggregate demand shocks. The drop in RW aggregate demand contributes to explain the 2008 fall in oil prices, EA GDP and inflation.

1. Introduction

The following facts characterize the role of oil in the euro-area (EA) economy.[4] First, oil dependence, defined as oil imports as a percentage of total gross oil consumption, has been close to 100% since the 1960s. Second, oil products are the most important component of final energy consumption, representing 44% of the total. Third, the weight of oil inputs in production (around 5%) and the limited short-term substitutability of oil inputs imply that the rather volatile oil price widely affects production costs and, therefore, prices and output. Fourth, oil price pass-through into fuel price is complete and quick. Fifth, taxes and margins constitute a large share, around 60%, of fuel prices.

In this paper we evaluate the macroeconomic effects of oil shocks on the EA by developing and estimating with Bayesian methods a two-country New Keynesian dynamic stochastic general equilibrium (DSGE) model of the EA and the rest of the world

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(RW) that allows for an explicit role of oil. The model is developed in line with the above stylized facts. Its main features are a world market for crude oil and, as in Finn (2000), the need of fuel to use physical capital in the production of manufacturing goods. The price of crude oil is set in the world oil market, in RW currency, and is the same in both EA and RW, once corrected for nominal exchange rate fluctuations. Oil supply is exogenously set by the RW. For oil demand, in both EA and RW there are firms that, under perfect competition, produce fuel (energy) from crude oil (according to a linear production function). Energy is then sold to firms in the domestic manufacturing sector, that need it as input for production. World demand of oil depends not only on world production of manufacturing goods, but also on an oil-specific demand component. The latter is inversely related to the efficiency in the use of energy, i.e. it is proportional to the amount of energy – and hence oil – needed for running capital at a given capacity.

Consistent with empirical evidence, EA imports crude oil. Moreover, the EA fuel price is the sum of the crude oil price, refining margins, distribution margins and (value added and excise) taxes. The margins and taxes are captured in a rather stylized but tractable way by a time-varying term (wedge) between the crude oil price paid at the border and the fuel price paid by firms. Other features of the model are in line with the New Keynesian open-economy framework.

We estimate the model on EA and RW quarterly data over the 1995–2012 period and obtain the following results. First, a 10% increase in the international price of oil generates an increase of about 0.1 annualized percentage points (p.p.) in the EA consumer price index (CPI) inflation. Second, the same increase in the oil price generates a decrease in EA gross domestic product (GDP) of around 0.1% and an EA trade deficit if it is due to negative oil supply or positive oil-specific demand shocks. Third, it generates a mild EA GDP increase and a trade surplus if due to a positive RW aggregate demand shock. Fourth, results crucially depend on the magnitude of the wealth effect associated with the oil price change. Specifically, conditional on the estimated parameters, a permanent oil supply shock would induce a relatively large medium-run decrease in EA GDP (−0.3%) and increase in EA inflation (0.2 p.p.), while a RW aggregate demand shock that does not induce an oil price increase would have relatively large effects on EA GDP. Fifth, the increase in the price of oil over the 2004–2008 period did not induce stagflationary effects on the EA economy because it was associated with positive RW aggregate demand shocks. The drop in RW aggregate demand contributes to explain the 2008 fall in oil prices, EA GDP and inflation. Finally, our results are robust to changes in the key parameters related to the transmission mechanism of oil shocks.

Our paper is, to the best of our knowledge, the first to assess the macroeconomic effects of different oil price shocks on the EA with an estimated open-economy DSGE model.

Jacquinot et al. (2009) use a calibrated large-scale open-economy DSGE model to assess the impact of oil price shocks on EA inflation. Consistent with their approach, we distinguish across the various sources of oil price changes but, different from them, we estimate the model with Bayesian methods. Therefore, we are able to perform a quantitative analysis based on estimated impulse response functions, forecast error variance decomposition and historical decomposition.

Using a Structural Vector Autoregression (SVAR) model estimated on EA data, Peersman and Van Robays (2009) distinguish different sources of oil price changes: oil supply shocks, oil-specific demand shocks, and global economic activity shocks. European Central Bank (2010) reports the macroeconomic effects of oil price shocks on EA using a variety of models. Our results are in line with those of the above mentioned contributions. Specifically, they are similar to those obtained with the European Central Bank's New Area Wide Model (NAWM), an estimated DSGE model of the EA economy, enriched with bridge equations for the energy component of the CPI.[5] Our model implies larger macroeconomic effects – in line with those obtained by traditional (estimated) macroeconometric models of the EA economy and by the SVAR of Peersman and Van Robays (2009) – under the common assumption of a permanent oil price shock.

Finally, our paper contributes to the strand of the literature that has developed structural models to evaluate the macroeconomic effects of oil shocks. For the US, Bodenstein et al. (2011) use a large-scale two-country open economy DSGE model to assess the impact of different oil shocks on the US trade balance under alternative assumptions on the strength of the relative wealth effect across countries associated with changes in the relative prices of oil. Kilian et al. (2009) provide estimates of the effects of demand and supply shocks in the global crude oil market on several measures of oil exporters' and oil importers' external balances. They show that the effect of oil demand and supply shocks on the merchandize trade balance and the current account depend on the source of the shock and critically on the response of the nonoil trade balance. Different from these contributions, we develop and estimate a structural model for the EA economy.

The rest of the paper is organized as follows. The next section reports the model setup. Section 3 describes the estimation procedure. Section 4 reports the results. Section 5 concludes.

2. The model

We develop a two-country model. One country is labeled as Home (it corresponds to the EA), the other as Foreign (it corresponds to the RW). The size of the world economy is normalized to one. The size of the Home country is n $(0 < n < 1)$, the size of the Foreign country is $(1 - n)$. [6]

Main features of the model are a world market for crude oil and the need of oil to use physical capital for producing intermediate goods in the manufacturing sector. Remaining features are in line with the New Keynesian open-economy framework.

[5] See Christoffel et al. (2008). The NAWM does not explicitly formalize the transmission mechanism of oil shocks.

[6] We assume that the size of the country is equal to the number of domestic firms in each sector and domestic households.