Global Oil Prices, Recessions and Monetary Policy: the Role of Nontradeables

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December 12, 2014

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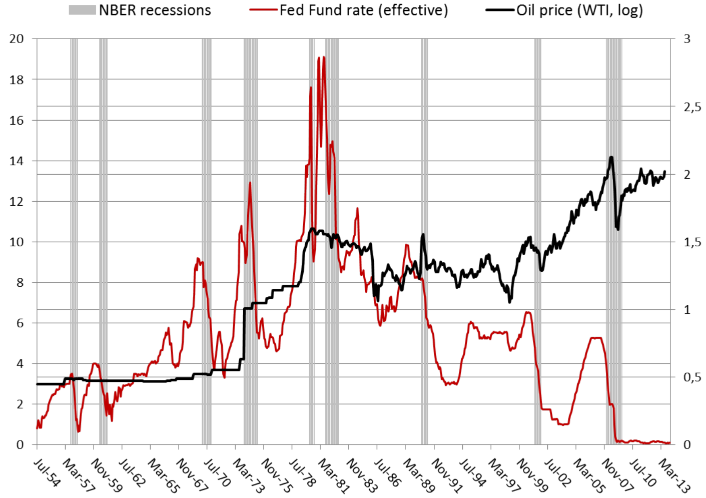
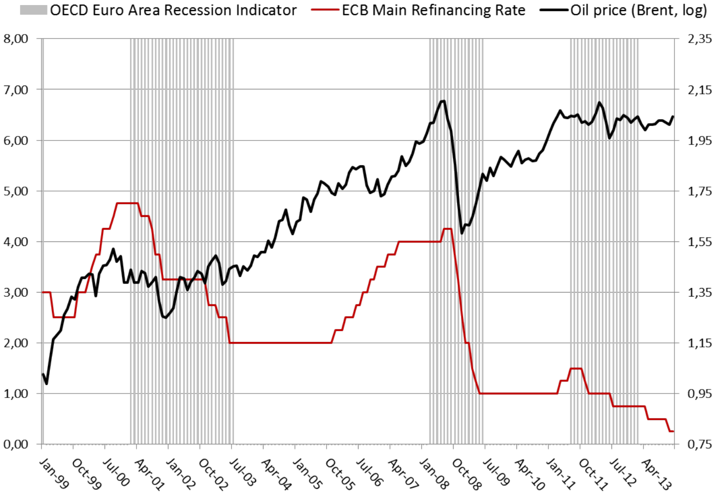
Motivation

Oil and recessions in the US



Motivation

Oil and recessions in the Euro Area



Motivation

- Usually, macroeconomists (and policy makers) consider oil price shocks as pure exogenous supply shocks
- Last decade experience: rising global (especially Chinese) activity and rising oil prices
- Recent literature points out that the source of the oil price shock matters for aggregate outcomes and monetary policy (*cf.* Kilian, 2009, AER; Bodenstein *et al.*, 2012, IMF ER)

Motivation of this study:

- Not everything is traded!
- What role do nontradeables (mainly services) play for the link between rising global oil prices and US recessions?
- Is systematic monetary policy response amplifying potential recessionary sources?

Oil and the Macroeconomy in the Literature

- Hamilton (1983, 1996, 2011): All post war US recessions except one were preceded by rising oil price
- Bernanke *et al*. (1997, 2004): *important part of the effect of oil price shocks on the economy results not from the change in oil prices, per se, but from the resulting tightening of monetary policy*
- Some closed economy DSGE models address recessionary impact (*inter alia* Leduc and Sill, 2004)
- Open economy models with endogenous oil prices (*inter alia* Bodenstein *et al*. 2012)

Empirical Strategy

- Estimate two-country, two-sector DSGE model with data of the global oil market and the US economy
- Historical decomposition

Model Overview

- Two countries (US and Rest of the World) of unequal size
- Two broad sectors (manufacturing and services)
- Sticky prices (NOEM literature, *inter alia* Ferrero *et al.* 2008, Povoledo 2012, Rabanal and Tuesta 2013)
- Global oil-supplier (*cf.* Campolmi, 2008)
- Monetary policy responds to domestic aggregates

Consumption of a Representative Agent

The representative agent maximizes

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta_t \psi_t \left[\ln C_t - \frac{N_t^{1+\varphi}}{1+\varphi} \right] \tag{1}$$

with φ being the inverse of the Frisch elasticity of labour supply and $\psi_{t+1} = (\psi_t)^{\rho_\psi} exp(\xi_{\psi,t+1})$ denoting an impatience shock.

In every period the agent consumes

$$C_t \equiv \left[(1-\gamma)^{1/\phi} (C_{T,t})^{\frac{\phi-1}{\phi}} + \gamma^{1/\phi} (C_{N,t})^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}} \tag{2}$$

where γ is the share of services and ϕ is the elasticity of substitution between manufacturing and services.

$$C_{T,t} \equiv \left[(1-\delta)^{1/\theta} (C_{TH,t})^{\frac{\theta-1}{\theta}} + \delta^{1/\theta} (C_{TF,t})^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}} \tag{3}$$

where δ is the share of foreign goods and θ is the elasticity of substitution between home and foreign manufacturing.

Consumption of a Representative Agent

Budget constraint home:

$$\frac{B^i_{H,t}}{P_t R_t} + \frac{S_t B^i_{F,t}}{P_t R^*_t \Phi(\frac{S_t, B_{F,t}}{P_t Y_t})} = \frac{B^i_{H,t-1}}{P_t} + \frac{S_t B^i_{F,t-1}}{P_t} + \frac{W^i_t}{P_t} N^i_t - C^i_t - \Pi^i_{TH,t} + \Pi^i_{N,t} + D^i_t$$

- S_t: nominal exchange rate
- $B_{H,t}$ and $B_{F,t}$ denominates international holdings of home and foreign bonds
- $\Phi(...)$: international financial transaction cost function (assures stationarity, *cf.* Benigno 2009)
- $\Pi_{TH,t}$, $\Pi_{N,t}$, D_t, F_t: profits from firms in both sectors, the global oil supplier and the financial intermediary.

- Foreign agent can only trade foreign bonds (*cf.* Benigno P 2001, Benigno and Thoenissen 2003, Ferrero *et al.* 2008)

Production Technology in Both Sectors

Technology for firm f_l:

$$Y_{l,t}(f_l) = Z_{l,t} N_{l,t}(f_l)^{1-\alpha_l} O_{l,t}(f_l)^{\alpha_l} \tag{4}$$

for $l \in \{TH, N\}$ and oil share α_l.

Technology evolves according to

$$Z_{l,t+1} = (Z_{l,t})^{\rho_{Z_l}} exp(\xi_{Z_l,t+1}). \tag{5}$$

Sticky Prices

- Calvo price setting: $1 - \varphi_N$ and $1 - \varphi_{TH}$ firms can reset prices every period, respectively
- Globally, the law of one price is assumed

Endogenous Global Oil Price

The global oil price is determined by global oil demand (factor demand from the production sectors) and supply, where the law of one price holds

$$\frac{P_t^o}{P_t} = \frac{1}{O_t^{Supply}} \times [\frac{\alpha_{TH}}{1-\alpha_{TH}} W_{TH,t} N_{TH,t} + \frac{\alpha_N}{1-\alpha_N} W_{N,t} N_{N,t} + + \frac{\alpha_{TH}^*}{1-\alpha_{TH}^*} W_{TH,t}^* N_{TH,t}^* + \frac{\alpha_N^*}{1-\alpha_N^*} W_{N,t}^* N_{N,t}^*] \tag{6}$$

and third party oil production is given by

$$O_{t+1}^{Supply} = (O_t^{Supply})^{\rho_{O_S}} exp(\xi_{t+1}^s). \tag{7}$$

Monetary Policy

Taylor rule:

$$R_t = \overline{R}^{(1-\nu_r)} R_{t-1}^{\nu_r} \left(\frac{P_t / P_{t-1}}{\Pi} \right)^{(1-\nu_r)\kappa_\pi} (Y_t / Y_{t-1})^{(1-\nu_r)\kappa_y} \exp(\xi_r) \tag{8}$$

where ν_r denotes interest rate smoothing, κ_π and κ_y are Taylor type coefficients and ξ_r is an i.i.d. disturbance (MP shock).

Solution and Estimation of the Model

- Estimation of the log-linearized model with a Bayesian approach and data from 1974:I until 2007:IV

Data:

- US data:
  - Quart. growth rate CPI for services ($\pi^{obs}_{N,t}$); *OECD MEI*
  - Quart. growth rate PPI for manufacturing ($\pi^{obs}_{T,t}$); *BLS*
  - Index real manufacturing output ($Y^{obs}_{T,t}$); *OECD MEI*
  - Index real services output ($Y^{obs}_{N,t}$); *BEA*
  - Gross quarterly Federal funds rate (R^{obs}_{t}); *IMF IFS*
- Global data:
  - Real price of oil (P^{obs}_{Oil}/P^{obs}); *US Energy Department, BLS*
  - World crude oil production (O^{obs}_{s}); *US Energy Department*
  - Kilian global real economic activity index, based on shipping freight rates ($y_T + y^*_T = rea^{obs}$)

Shocks that Alter Oil Prices

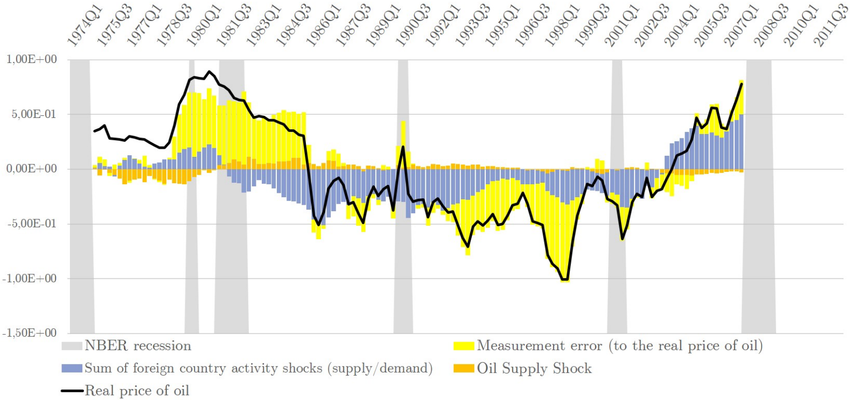
Country specific shocks

- Demand shocks: direct demand-shocks to sectoral output (e.g. manufacturing), impatience shocks, monetary policy shocks
- Supply shocks: technology shocks in the two sectors

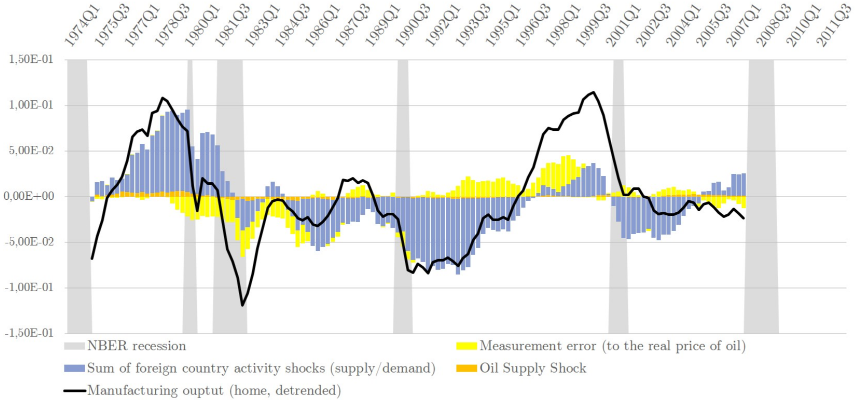
Global shocks

- Shock to oil production (supply shock)

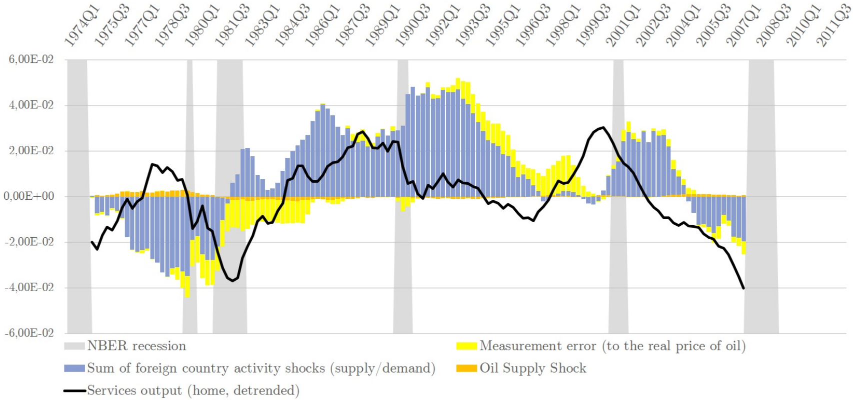
Historical Effects of Foreign Shocks on the Global Oil price



Historical Effects of Foreign Shocks on US Manufacturing



Historical Effects of Foreign Shocks on US Services



Findings for the 70's/80's double dip recession and the Great Recession run-up

- Global activity raises oil prices and domestic tradeable output
- Services output contracts

Important mechanisms in the model

- Foreign manufacturing demand shock leads to an increase in the global oil price and also US manufacturing production; at the same time relative real prices of US services increase (sticky nominal prices imply a contraction in services output)
- The effect of foreign technology shocks on the US sectors is in general ambiguous and depends on the period

Conclusion

Findings for the 70's/80's double dip recession and the Great Recession run-up

- High global activity increases oil prices and domestic manufacturing output whiles services output contracts
- On net the central bank increases the policy rate as a response to foreign activity shocks
- Endogenous and exogenous oil price changes do not play much of a role

Policy implications

- Observing oil prices alone is misleading.
- Underlying shocks of global oil price changes matter for sectoral outcomes.
- Monetary policy does not fit all sectors.

Additional material

Empirical strategy

- Estimate two-country, two-sector DSGE with data of the global oil market and the US economy
- Historical decomposition
- **Compare the imputed DSGE shock structure to the shock structure obtained by a minimal theory VAR of the global oil market (Kilian, 2009, AER)**

SVAR Comparison

Employing the SVAR approach of Kilian (2009) to identify sources of oil price movements

$$A_0 X_t = \alpha + \sum_{i=1}^{24} A_i X_{t-i} + \varepsilon_t$$

where $X_t = (\Delta prod_t, rea_t, rpo_t)'$ and ε_t describes a vector of structural shocks. The shocks are identified by assuming a recursive structure of A_0^{-1} . The reduced form errors e_t can be decomposed into

$$e_t = A_0^{-1} \varepsilon_t \Leftrightarrow$$

$$e_t \equiv \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\text{oil supply shock}} \\ \varepsilon_t^{\text{aggregate demand shock}} \\ \varepsilon_t^{\text{oil specific-demand shock}} \end{pmatrix}$$

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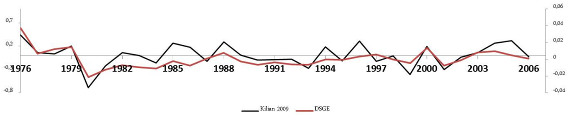
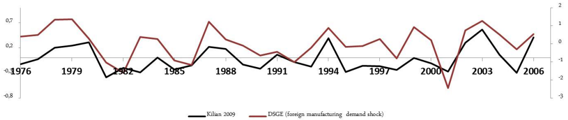
Comparing the sources of oil price movement with the SVAR shocks of Kilian (2009, AER)

Oil supply shock



Global activity shock



Oil-market specific demand shock