Macro-prudential Policies in a Commodity Exporting Economy

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BIS CCA Research Network Conference, 2013

Outline

Motivation

- Colombia, like many Emerging Economies, is a small open and commodity exporter economy.

- There is a strong and positive association between the cyclical component of the real price of exports and the cyclical component of real GDP and credit. But a negative association with risk premium and the RER.

- How does monetary *and* macroprudential policies cope with commodity price shocks and how do they transmit in a three-sector economy?

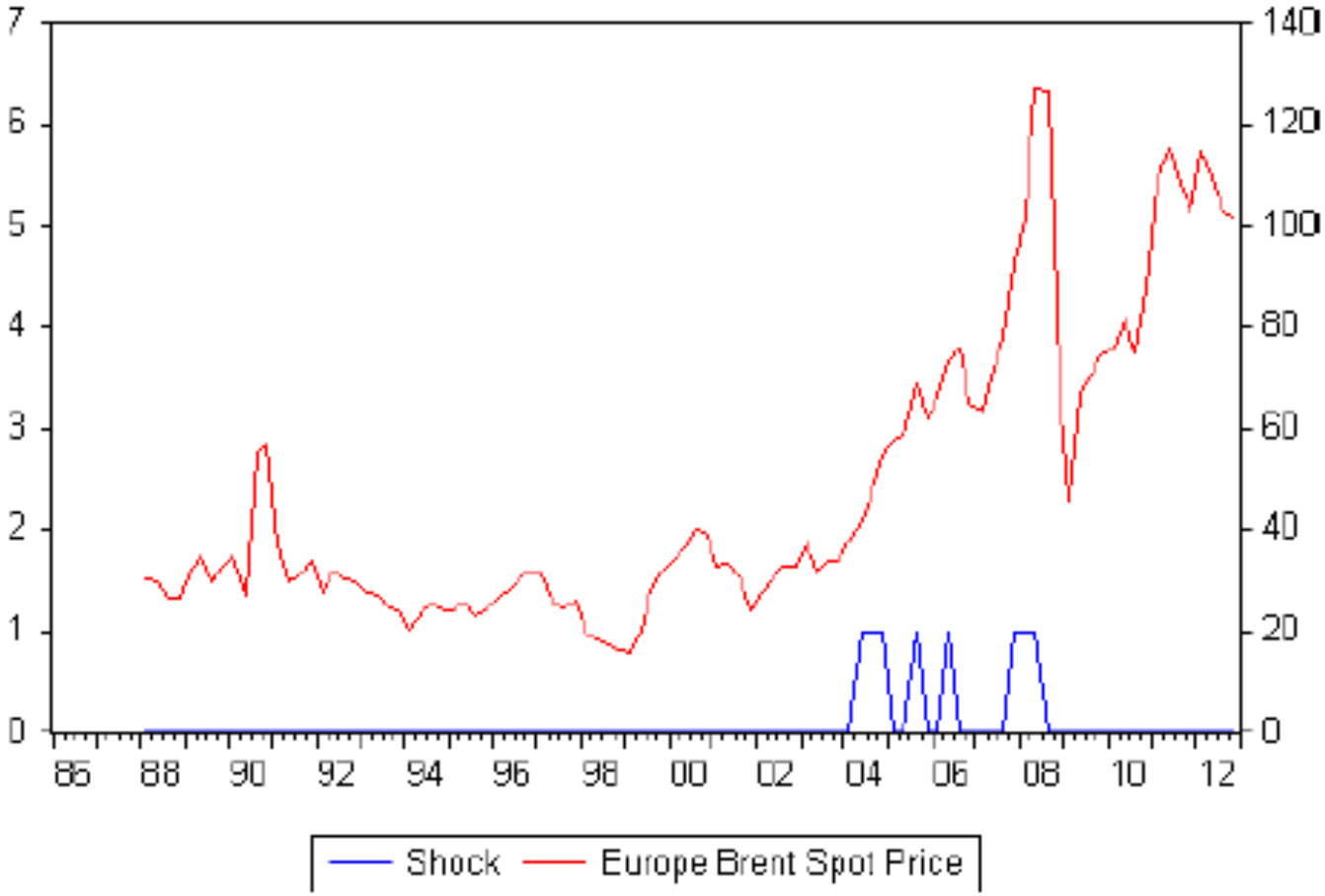
- We calibrate/estimate the model to use it for monetary policy analysis to assess the *sectoral and aggregate* benefits/costs of conventional and unconventional instruments in the face of commodity shocks.

Outline

Identifying an oil price shock

- We follow Hamilton (2003) to find the quarters during which there were oil price shocks. Hamilton defines an oil shock as a large increase in the oil price.
- An oil shock is defined as the maximum value of the oil price during the last 36 months. An oil shock event occurs when the oil shock is larger than two standard deviations.

Oil price shock

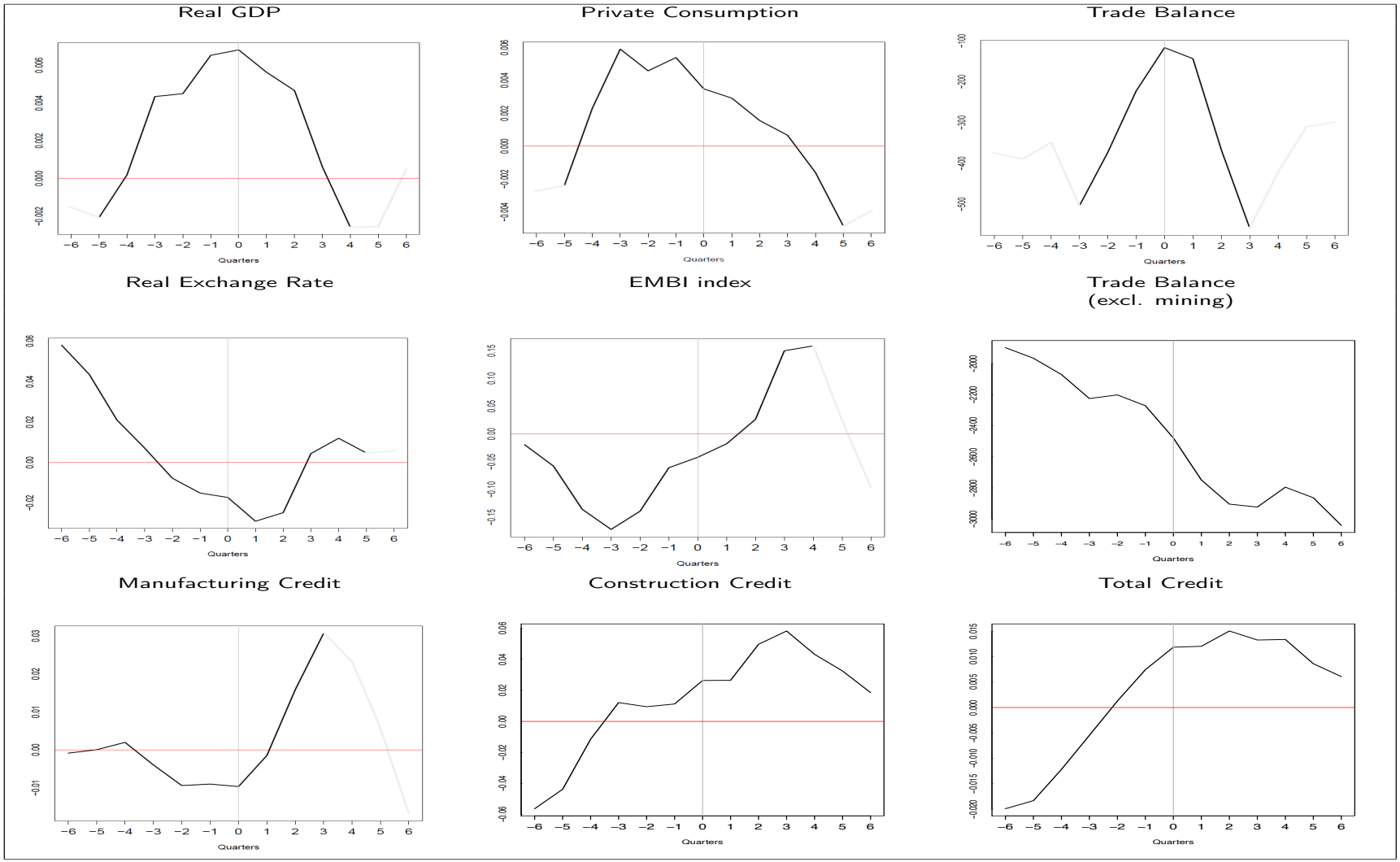


Outline

Event analysis

- Once the oil price shock is defined, we take the average evolution of the cyclical component for each variable six quarters before and after the oil shock.
- The value of zero in the horizontal axis represents the date of the oil price shock event.
- The red line shows a measure of the long run level.

Macroeconomic variables



Results

- Country risk premium falls and stays below normal levels while the oil price increase and jumps right after the fall in the price.
- Real GDP and private consumption increase above trend during oil price hikes and fall back after the price reversal.
- Total real credit to the private sector expands above normal as oil prices increase, and scales back down about two quarters after the price shock vanishes. Credit to tradable sector contracts and credit to nontradable sector expands during the booming phase.
- The peso appreciates steadily in real terms against the US dollar during the oil price boom and depreciates sharply thereafter.
- The total TB improves during three quarters before oil price peak, and deteriorates after the price collapse. The non-oil TB deteriorates during the boom and fails to recover after the price collapse.

Outline

General description of the model

- DSGE small open economy model with tradable and non-tradable sectors, together with an oil endowment sector.
- Nominal prices in the non-tradable sector are rigid. In this sector, each firm set prices by maximizing profits under costly price changes as in Rotemberg (1982).
- The price of the tradable is flexible and equals the foreign price.
- We add a financial sector that includes both the central bank and commercial banks.

Households

$$\max \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left(z_t^u \frac{c_t^{1-\sigma}}{1-\sigma} - \chi \frac{h_t^{1+\eta}}{1+\eta} \right) \right]$$

$$c_t + d_t = (1-\zeta)\, q_t oil_t + \tau_t + \xi_t^N + w_t^h h_t + (1+r_{t-1})\, d_{t-1}$$

- Supply labor to firms, h_t
- Consume final goods (tradable and nontradable), c_t
- Save in the form of bank deposit, d_t
- Receive the revenues from
  - the resource sector, $(1-\zeta)\, q_t oil_t$
  - Retailers, ξ_t^N
  - Government, τ_t

Entrepreneurs

tradable and nontradable ($j = N, T$)

$$y_t^j = z_t^j \left(\alpha^{\frac{1}{\omega}} \left(h_t^j \right)^{\frac{\omega-1}{\omega}} + (1-\alpha)^{\frac{1}{\omega}} \left(k_{t-1}^j \right)^{\frac{\omega-1}{\omega}} \right)^{\frac{\omega}{\omega-1}}$$

- Produce an homogeneous good, y_t^j.
- Hire labor from households, h_t^j
- Buy capital from the capital producer firm and finance these payments by their own funds, n_t^j, and taking loans from banks.

$$l_t^j = p_t^{kj} k_t^j - n_t^j$$

- During the production process, each entrepreneur is subject to an idiosyncratic shock that affects the productivity of its capital as in Bernanke, Gertler and Gilchrist (1999)
- Once the production is made, entrepreneurs sell back the (depreciated) capital to the capital producer firm.

Retailers

Nontradable

$$\max \xi_t^N = p_t^N y_t^N - p_t^W y_t^N - p_t^N \frac{\kappa}{2} \left(\frac{\left(1+\pi_t^N\right)}{\left(1+\pi_{t-1}^N\right)^{\iota} \left(1+\bar{\pi}\right)^{1-\iota}} - 1 \right)^2$$

- Operate in a monopolistic competition environment
- Buy the homogeneous nontradable goods from entrepreneurs, differentiate it at no cost and sell it to households and to the capital producer firms.
- There are nominal price rigidities in the nontradable sector, as each firm maximizes profits under costly price changes as in Rottemberg (1982).

Capital good producers

tradable and nontradable ($j = N, T$)

$$k_t^j = z_t^{x^j} x_t^j + (1-\delta)\, k_{t-1}^j - \frac{\psi}{2}\left(\frac{x_t^j}{k_{t-1}^j} - \delta\right)^2 k_{t-1}^j$$

- Acting in a perfectly competitive environment.
- Every period buy investment goods and old capital net of depreciation
- Transform these into new capital at a quadratic cost.

Comercial Banks

tradable and nontradable ($j = N, T$)

- Operates under perfect competition and each bank is owned by households.
- Make commercial loans to entrepreneurs, l_t^j, by taking deposits from households, d_t, and borrowing from international financial markets, $b_t^\star$.
- Financial intermediation is subject to frictions, in particular a CSV problem on the side of the asset side of the banks, which shows up in loan interest rates in the form of spreads.

$$\mathbb{E}_t\left[r_{t+1}^{kj}\right] = \left(\frac{n_t^j}{p_t^{kj} k_t^j}\right)^{-\nu_t^j} (1 + r_t)(rp_t)$$

- Banks can also purchase sterilization bonds from the central bank, b_t.

Government and Central Bank

- The balance sheet of the central bank includes international reserves ri_t^* and sterilization bonds b_t,

$$q_t ri_t^* = b_t$$

- Monetary policy rule responds to deviations of inflation relative to the target $\overline{\pi}$,

$$i_t = i_{t-1}^{\rho_i} \left(\bar{i} \left(\frac{\pi_t}{\overline{\pi}} \right)^{\varphi_\pi} \right) \exp\left(\varepsilon_t^{\mu} \right)$$

Macroprudencial policies

- FX intervention rule responds to RER deviations from its steady state value,

$$q_t ri_t^* = \bar{ri}^* - \Psi_q \left(\frac{q_t}{\bar{q}} - 1 \right)$$

  Two objectives:
  1. maintaining the ratio of reserves to the GDP (a proxy of a reserve adequacy indicator) and
  2. attaining a operational target for the RER.

- Regulation premium rule responds to credit deviations from its steady state value,

$$rp_t = \exp\left(\mu_{rp} \left(\frac{l_t}{\bar{l}} - 1 \right) \right)$$

Oil production and risk premium

- The value of oil activities in the economy evolves exogenously according a process:

$$oil_t = \rho_{z^{oil}} oil_{t-1} + (1 - \rho_{z^{oil}}) \log\left(\overline{oil}\right) + \varepsilon_t^{oil}$$

- The revenues from oil activities are transferred to households. Thus, they affect the households budget constraint. Also, they improve the interest rate premium that the economy faces when borrowing abroad,

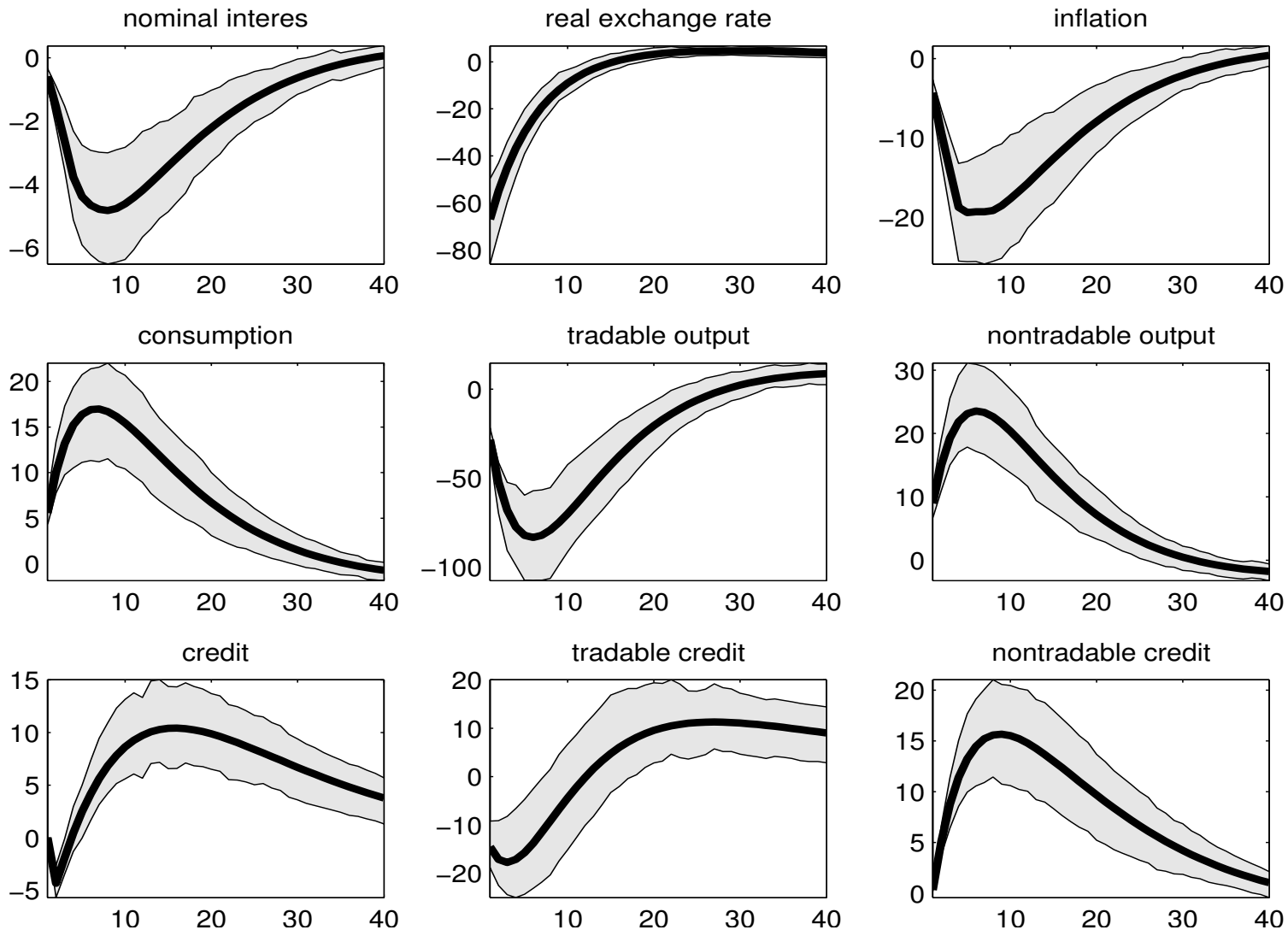
$$(1 + i_t^*) = (1 + \bar{r}^*)(1 + \pi_t^*) z_t^{i^*} \frac{\exp\left(\nu_{b^*}\left(\frac{q_t b_t^*}{GDP_t} - \bar{b}^*\right)\right)}{\exp\left(\nu_{oil}\left(oil_t - \overline{oil}\right)\right)}$$

Outline

Calibration / estimation

- There are three types of parameters in the model
  - The first type of parameters are those that affected the steady state of the model and therefore are chosen in order to match the long run relations observed in the data
  - The second type of parameters mainly affect the dynamic behavior of the model. These are estimated using Bayesian techniques.
  - The third type of parameters are those that determine the presence of macroprudencial policies. During the estimation the parameters that determine the FX intervention Ψ_q and the macroprudencial regulation μ_{rp} are set equal to zero.

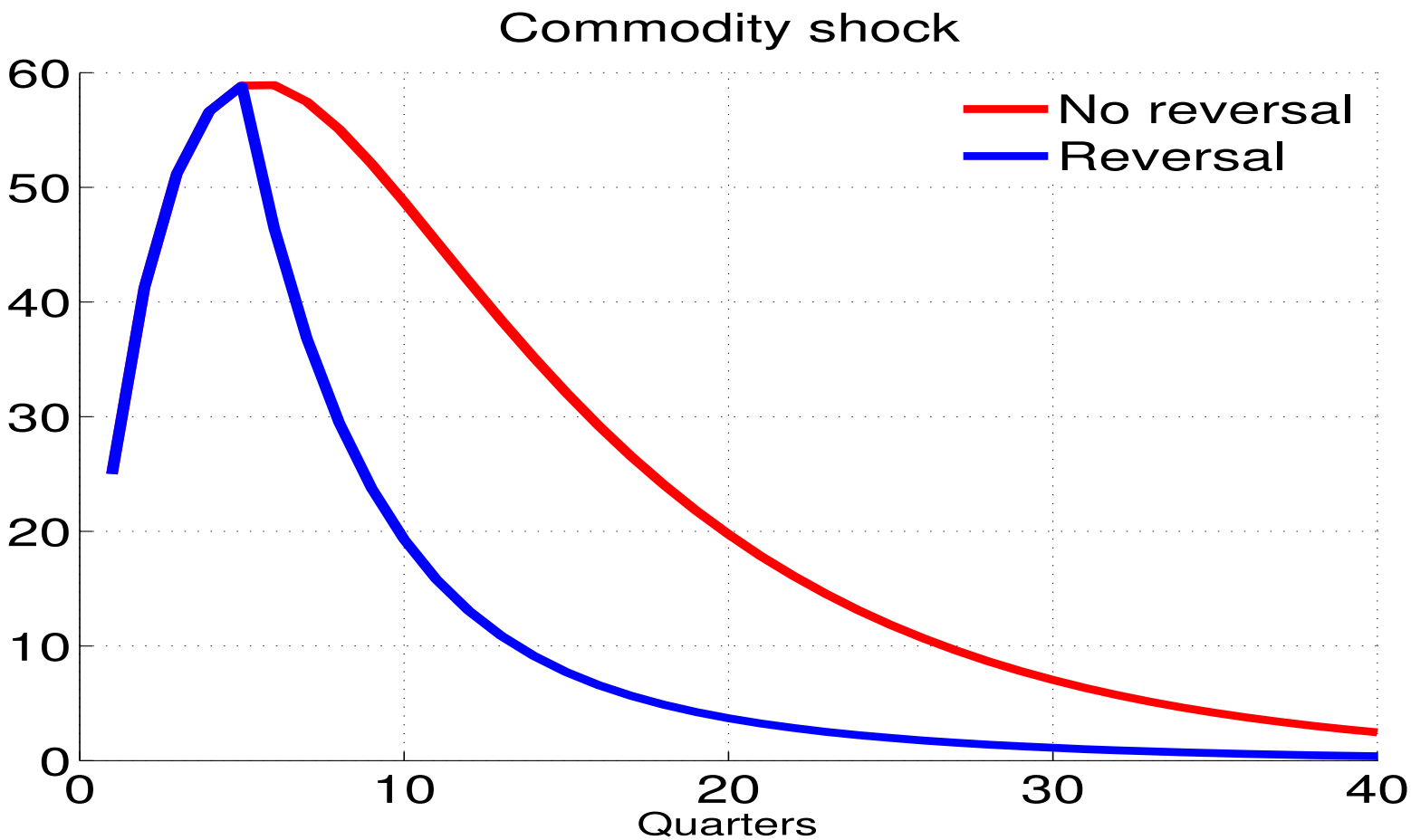
IRFs oil shock



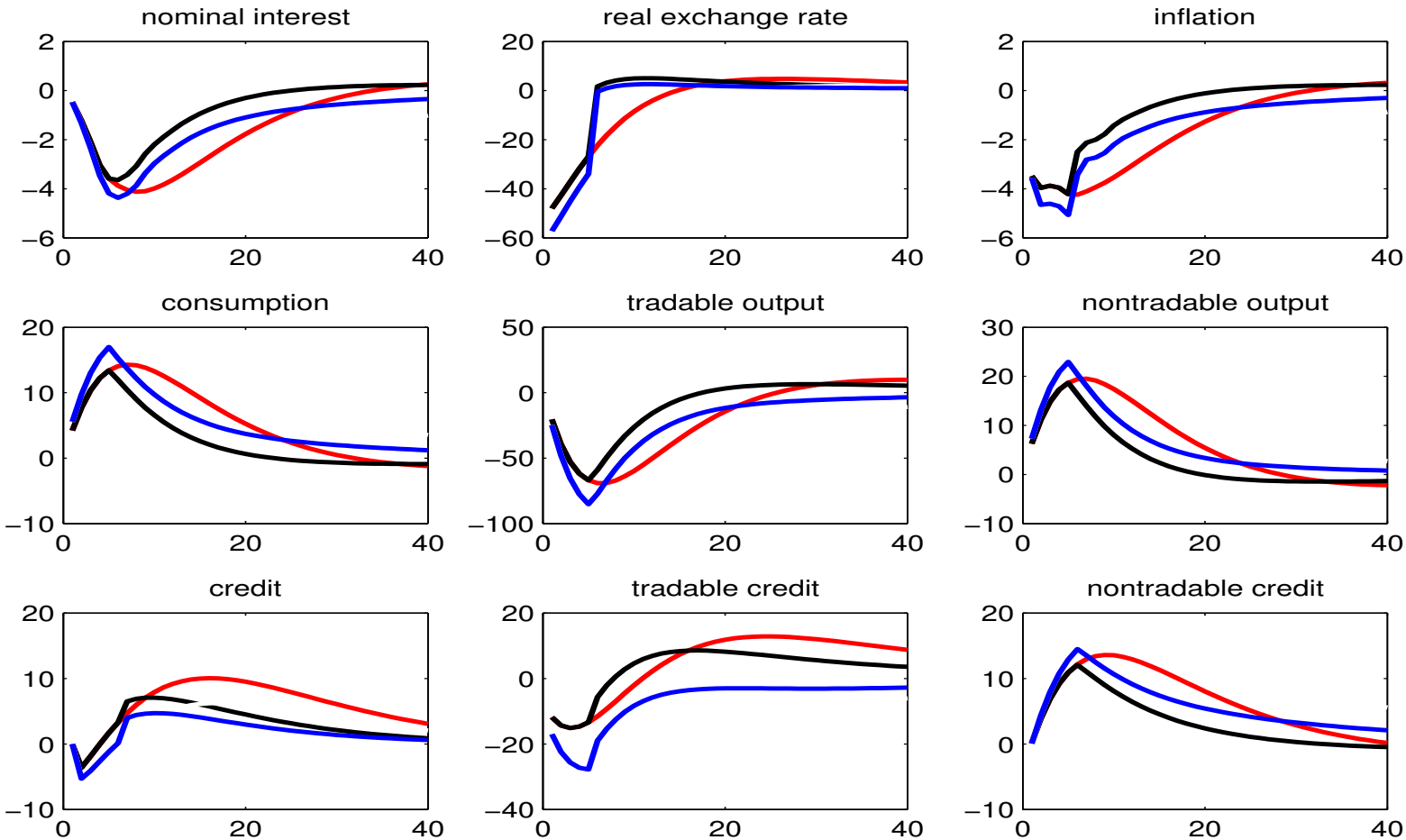
Unexpected commodity reversal

- We perform a counterfactual experiment that capture the idea of a unexpected sudden reversal in commodity prices.
- To mimic the dynamic pattern of a typical commodity shock, we modify the process for oil_t as an AR(2) process. The parameters of the AR(2) process are configured in such a way that after an initial increase in the price of oil agents can expect additional increases in the future (tracing a hump shape).
- Then, an unexpected negative shock is added six quarters after the initial commodity price hike.

Commodity reversal



Results


nominal interest
real exchange rate
inflation
consumption
tradable output
nontradable output
credit
tradable credit
nontradable credit

Results without macroprudencial policy

- No reversal and a CB follows a Taylor rule **(red line)**:
  - A real appreciation that lowers tradable output and expands nontradable output.
  - Private credit is allowed to increase.
  - Monetary policy would have to be tightened to deal with non tradable inflation.
- With reversal and a CB follows a Taylor rule **(black line)**:
  - There is a sharp real depreciation together with a fall in aggregate consumption.
  - Nontradable debt also contracts and nontradable inflation declines strongly at the time of the reversal.
  - Investment in the tradable sector increases and credit returns to tradable sector and output recovers.

Results with macroprudencial policy

- With reversal and a CB follows a Taylor rule and with macroprudencial policy **(blue line)**
  - Commercial credit is stabilized as the policies are designed to do, this happens even with a looser monetary policy.
  - Exchange rate pass-through lowers tradable inflation and dominates the nontradable inflation pick-up.
  - The macro-prudential policy has sectoral consequences.
  - Credit to tradable sector falls even further during the boom
  - Credit to nontradable sector expands more rapidly
  - There is a sharper real exchange rate appreciation.
  - Consequently, once the commodity boom reverses, total commercial credit reacts less, nontradable credit contracts less and tradable credit reacts more slowly.

Final Remarks

Too early to write!