Monetary policy implications for an oil-exporting economy of lower long-run international oil prices

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Banco de la República

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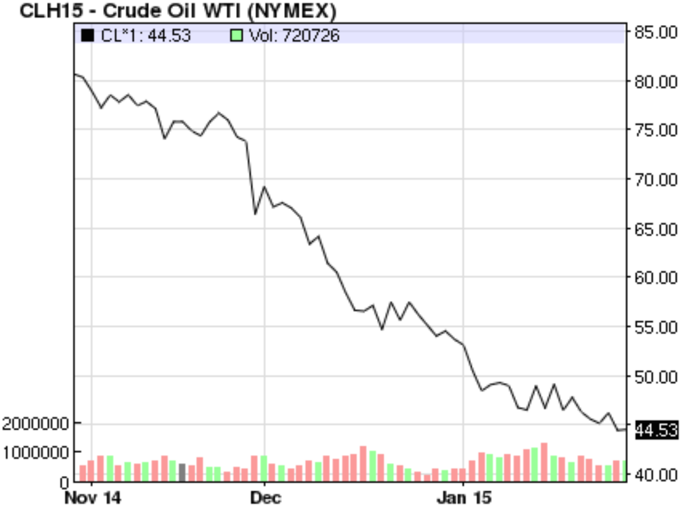
Outline

Motivation



CLH15 - Crude Oil WTI (NYMEX)
CL*1: 44.53
Vol: 720726
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
44.53
40.00
2000000
1000000
0
Nov 14
Dec
Jan 15

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- We conduct a quantitative assessment of the impact of an *unexpected permanent* change in oil prices in an oil-exporting economy and derive its monetary policy implications.

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- How does monetary policy in an oil-exporting economy cope with a sudden and long-lasting reversal of international oil prices?
- We conduct a quantitative assessment of the impact of an *unexpected permanent* change in oil prices in an oil-exporting economy and derive its monetary policy implications.
- Our approach: first, understand the consequences on the economy's NFA, usually assumed exogenous by many models which rely on approximation solution methods. Then, couple it with monetary policy models.

Outline

The policy question and the problem

Small scale Bewley Models
- Single-good Economy
- Two-good Economy
- Oil Exporting Economy

Monetary policy models
- Simple New Keynesian
- Sectoral Financial Accelerator
- Sectoral financial accelerator model

Final Remarks

The problem

A small open economy representative agent chooses consumption to maximize:

$$E_0\left[\sum_{t=0}^{\infty}\beta^t\frac{c_t^{1-\sigma}}{1-\sigma}\right]$$

subject to

$$c_t = y_t - b_{t+1} + Rb_t.$$

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- $b_{t+1} \in [-\phi, 0]$ with R given: incomplete financial markets and net debtor economy.
- If $\beta R < 1$ then, b has a LR distribution (PS/BAH model).

A global solution: discrete dynamic program

Let $e=(y,b)$, discretize it and find optimal rule $b_{t+1}=\tilde{b}(e)$ such that

$$v(e)=\max_{\tilde{b}(e)\in[-\phi,0]}\frac{(y-b'+Rb)^{1-\sigma}}{1-\sigma}+\beta P\left(\tilde{b}(e)\right)v(e). \tag{1}$$

where $P\left(\tilde{b}(e)\right)$ is the OTPM and depends on β, R, σ, ϕ, $E[y]$ and $V[y]$.
Experiment: expected income $E[y]$ falls unexpectedly and permanently from $\bar{y}$ to $\underline{y}$, keeping $V[y]$ constant.

Transitional dynamics

- Under high oil prices $\bar{e} = (\bar{y}, \bar{b})$ there is a $\bar{P}$ with ergodic distribution $\bar{f}$. Oil prices fall unexpectedly, implying a fall in expected income to $\underline{y}$.

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- Agents reoptimize and solve problem (1), find a new set of optimal rules, $\underline{P}$, ergodic distribution, $\underline{f}$, and long run value of expected debt, $E\left[b\right] = \underline{f} \times b = \underline{b}$. Thus, the economy falls from $\bar{e} = \left(\bar{y}, \bar{b}\right)$, previously, to wake up at $\underline{e} = \left(\underline{y}, \bar{b}\right)$ and eventually settle at $\underline{e} = \left(\underline{y}, \underline{b}\right)$.

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- The evolution of the economy can be characterized by a sequence of probability functions, $\{f_t\}_{t=0}^{\infty}$ which can be computed iteratively $f \leftarrow f\underline{P}$ and starting from f_0. Since $\underline{P}$ is a well behaved Markov chain, the sequence of distributions eventually converges to $\underline{f}$.

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- We use this sequence of distributions to compute the expected path of debt, $\{E_t[b] = f_t \times b\}_{t=0}^{\infty}$.

Calibration

- We set $E[y] = 1$ and $V[y] = 0.026^2$ to match annual (HP-filtered) Colombian annual GDP moments. Fix $R = 1.035$ and take $\sigma = 4$ from estimated models at CB. And set $\beta = 0.96$ and $\phi = 0.4$ to match 30% external debt to GDP ratio and a fraction of international financial exclusion of 16%.

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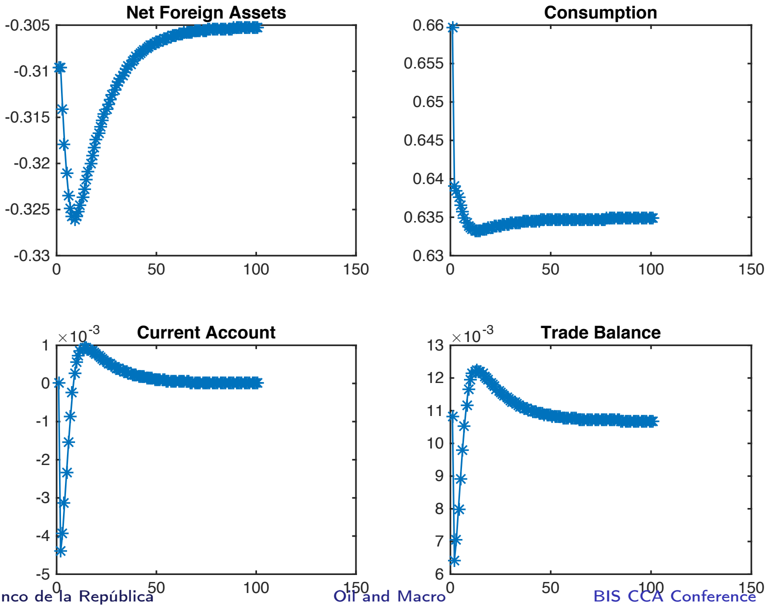
- Considering an autonomous level of absorption, which is present in the data but not in the model economy, the model delivers a 31% debt to GDP and a ratio of financial exclusion of 12%.
- Consumption is procyclical and highly autocorrelated, as in the data, but is about one-third smoother. The current account and the trade balance are also highly correlated in the model as in the data, however the model results are at odds with a well-documented fact which is that both are counter-cyclical in emerging economies.

Macro response to a permanent fall in income



Outline

The model

$$v(y^T, b) = \max_{b' \in [-\phi, 0]} \frac{c^{1-\sigma}}{1-\sigma} + \beta E_{y^T} \left[v(\left(y^T\right)', b') \right] \tag{2}$$

$$c_t = \left[a \left(c_t^T \right)^{-\mu} + (1-a) \left(c_t^N \right)^{-\mu} \right]^{-\frac{1}{\mu}}$$

$$c_t^T = y_t^T + p_t^N y^N - b_{t+1} + R b_t + A^T$$

$$c_t^N = y^N + A^N$$

$$p_t^N = \frac{1-a}{a} \left(\frac{c_t^T}{c_t^N} \right)^{1+\mu}$$

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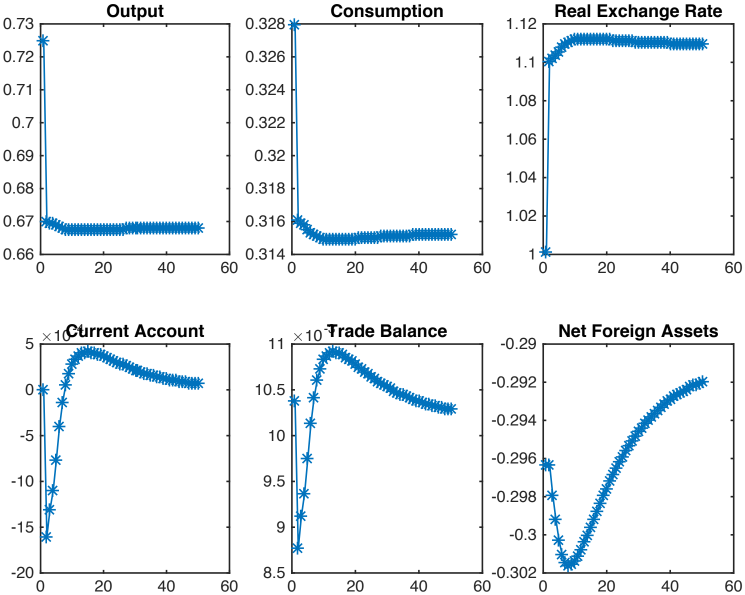
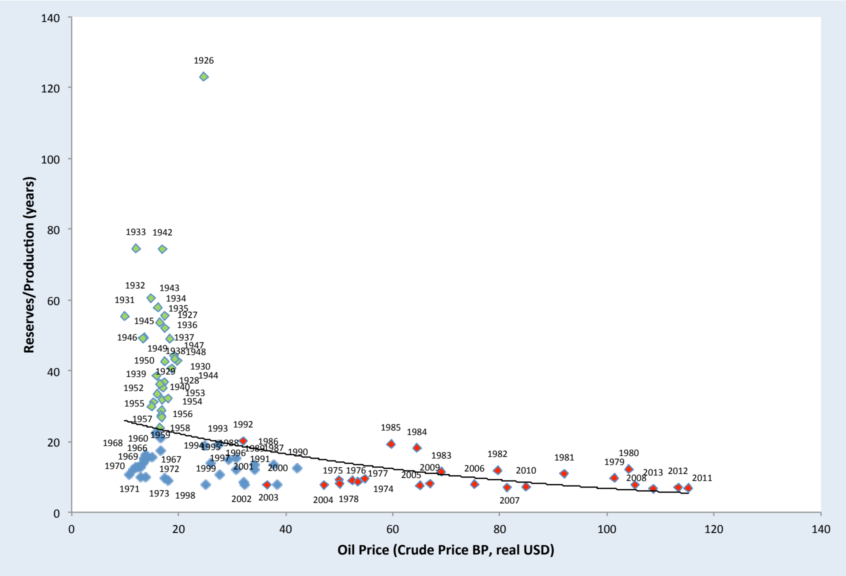


Outline

Oil prices and reserves



Oil sector

Economy has a stock of oil $s \in [0, \bar{s}]$ and every year d units can be discovered randomly. A representative oil firm can extract $x \in [0, s]$ units of oil at a cost $C(s, x)$ to sell internationally at the relative price p_x (in units ot tradable). The stock of oil evolves as $s' = s - x + d$, and the firm seeks to:

$$v(s) = \max_{x \in [0,s]} \{p^x x - C(s,x) + \delta E_d [v(s - x + d)]\}.$$

Optimality requires that

$$p^x = C_x(s,x) + \delta E_d [\lambda(s - x + d)]$$

$$\lambda(s) = C_s(s,x) + \delta E_d [\lambda(s - x + d)].$$

Non-oil economy

Associated with this program there is an optimal oil extraction policy, $\tilde{x}(s)$, which the rest of the economy takes as given, thus the resource constraint of the economy becomes:

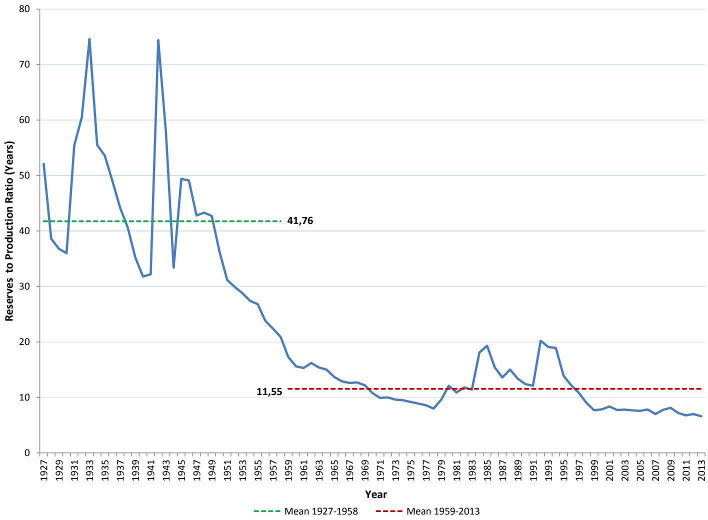
$$c_t^T = y_t^T + p^x \tilde{x}(s) + p_t^N y^N - b_{t+1} + Rb_t + A^T$$

and

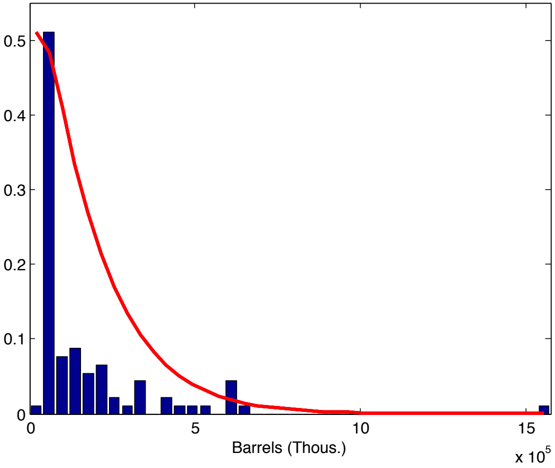
$$c_t^N = y^N + A^N.$$

Thus, with two assets, optimal borrowing is $\tilde{b}'(s, b)$, and at any given point in time, NFA are not only the summary of debt history but also of oil reserves history.

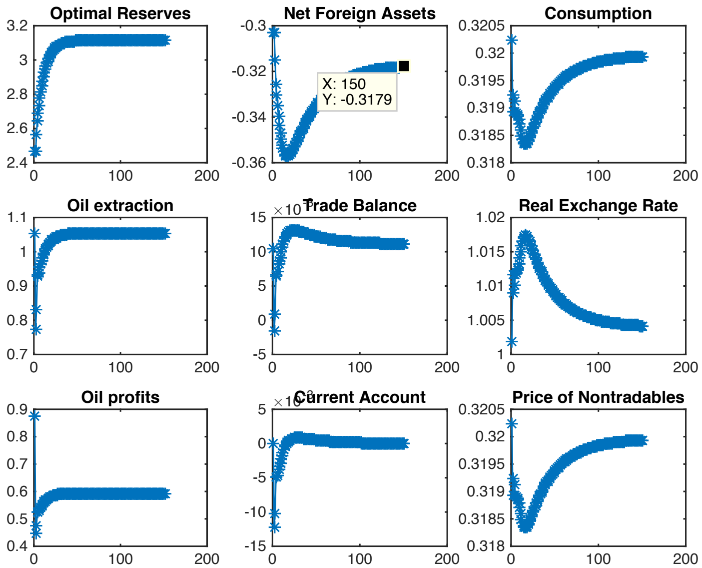
Calibration I



Calibration of discoveries



Macro response to a permanent fall of oil prices



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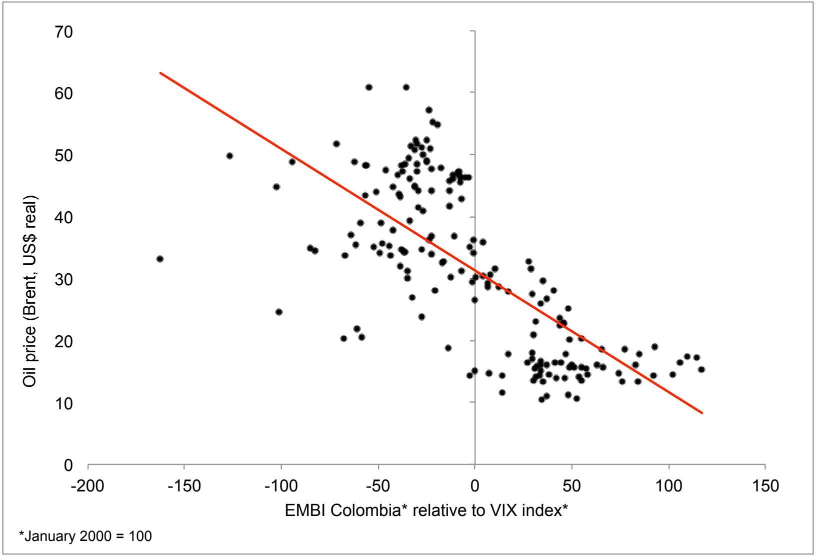
- However, these models leave aside many features of reality that are of interest to policy makers and central banks.
- We now turn to the reaction of monetary economies to unexpected permanent changes in oil prices, taking as given the NFA adjustment of the oil economy.

Outline

A channel outside the previous models



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- Key: country risk premium depends on both b and $p^x s$.
  Micro-founded version of this: Hamann and Restrepo (2015).

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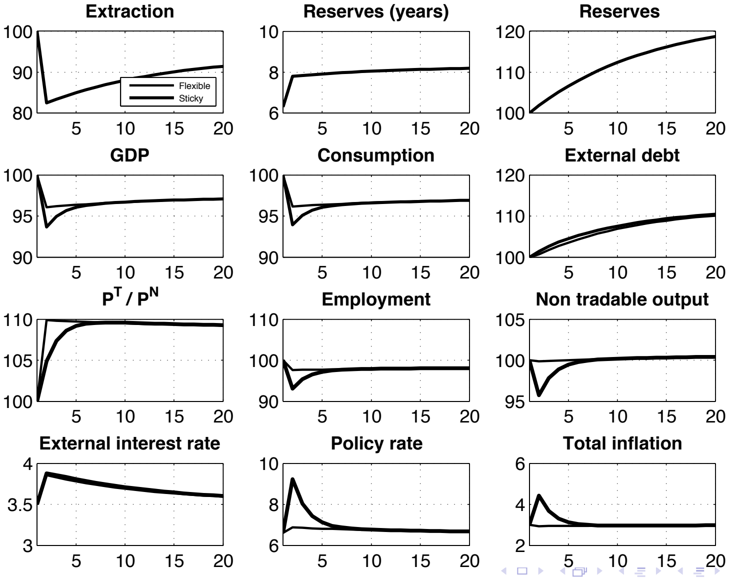

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- Key: financial accelerator (BGG) in *both sectors* where net worth is influenced by valuation effects.

Key 1: Financial accelerator

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

- Perfectly competitive banks make commercial loans to entrepreneurs, b_t^j, by taking deposits from households, d_t, and borrowing from international financial markets, $b_t^\star$.

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- Financial intermediation subject to frictions (CSV problem) on the side of the asset side of the banks. Thus, spreads depend on firms' net worth, n_t^j and the value of capital, $p_t^{k^j} k_t^j$.

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

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- We define a "regulation premium", rp_t, as *any* policy that increases credit costs.

Key 2: Conventional and unconventional tools

- Monetary policy rule: reacts to deviations of *total* inflation relative to the target $\overline{\pi}$

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

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- Regulation premium rule: reacts to credit deviations from its long-run value

$$rp_t = \exp \left(\mu_{rp} \left(\frac{cr_t}{\overline{cr}} - 1 \right) \right)$$

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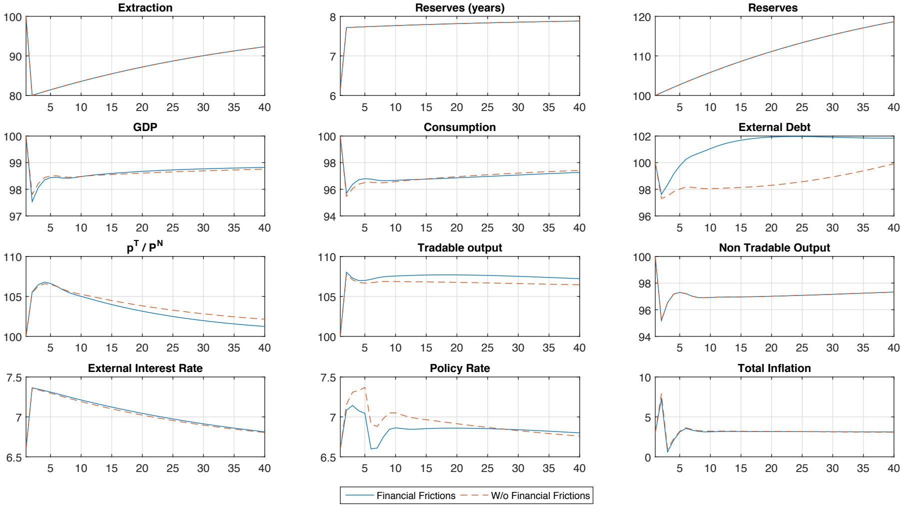
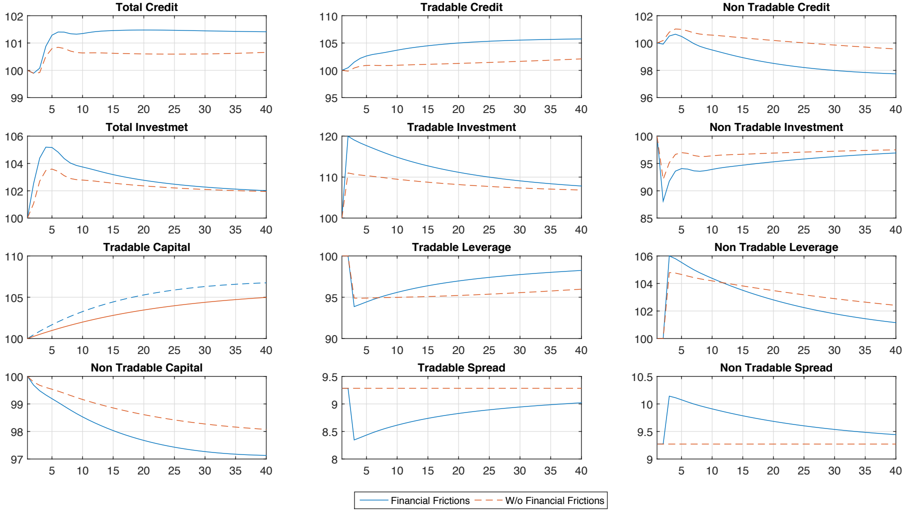
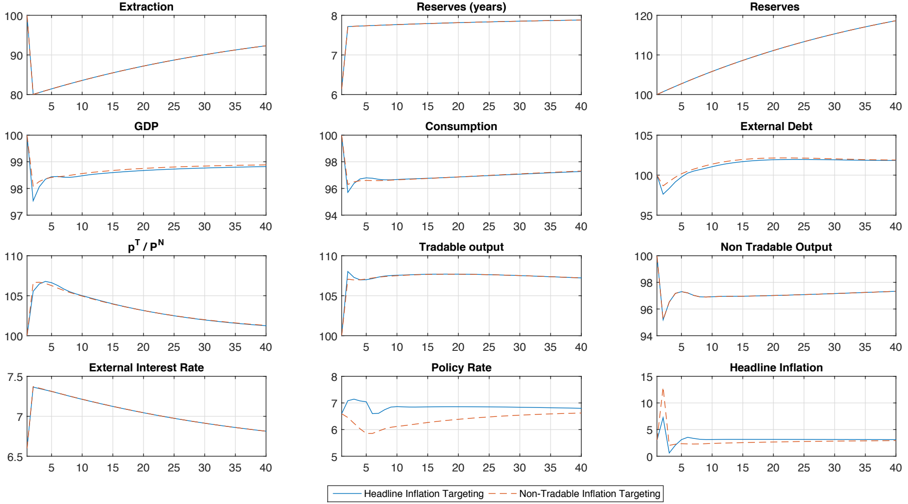


Macro response to a permanent fall of oil prices II



What if the central bank targets NT inflation?



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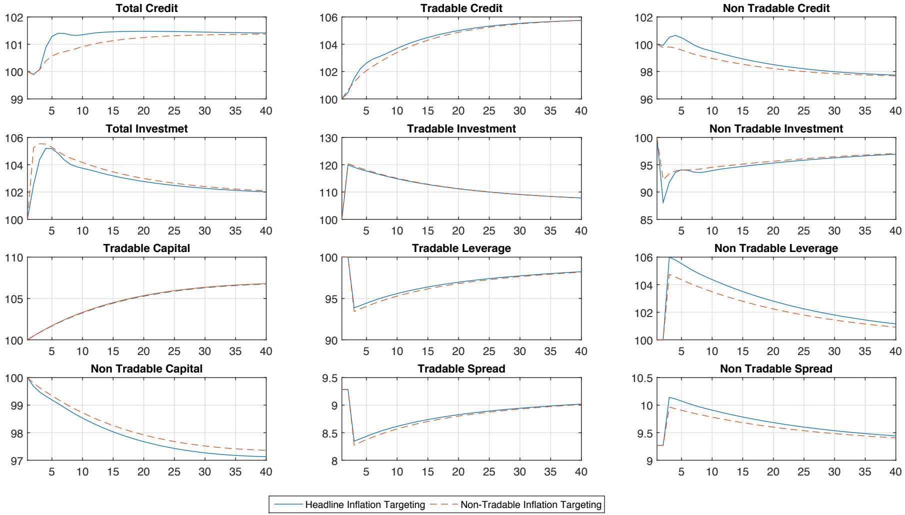

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- To do: fiscal implications. May be relevant if one drops Ricardian equivalence

Supplementary figures I