Monetary Policy, Oil Stabilization Fund and the Dutch Disease

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Introduction

- This paper analyzes the role of monetary and fiscal policies in an oil exporting economy to see to what extent in the aftermath of a positive oil price shock, the deindustrialization phenomenon, as defined in the Dutch disease literature, occurs
- We build a small open oil exporting model using a multi-sectoral medium-scale DSGE framework as in Christoffel et al 2008 and Stahler and Thomas 2012.
- Our paper is related to two strands of the literature using dynamic stochastic generalequilibrium (DSGE) models.

Introduction

- This first one focuses on the influence of public investment in resource-rich low-income countries Berg et al., 2013 and Alter et al., 2017.
- This literature has interesting distinguishing features for our purpose.
- On the one hand, public investment exerts an influence on the productivity in the nontraded and traded good sectors, this latter exhibiting learning-by-doing externalities.
- On the other hand, public investment suffers from distortions such as a low public investment efficiency, absorptive capacity constraints in the economy, and institutional failures through project selection weakness.

Introduction

- The second strand of literature focuses on macroeconomic stabilization policy in theaftermath of oil price shocks.
- On the monetary policy side, the respective effectiveness of alternative rules and the role of foreign exchange reserve have been extensively investigated Lama and Medina, 2012; Dagher et al., 2012; Faltermeir et al., 2017.
- On the fiscal side, Pieschacón (2012) and Arezki and Ismail (2013) highlight the influence of fiscal smoothing rules to manage both short- and medium-term effects of a commodity windfall

Introduction

Our paper differs from the previous literature on two main points.

- On the one hand, we combine different monetary rules with fiscal policy to assess their effectiveness to face Dutch disease effect. From this standpoint, we depart from the literature that considers this policy-mix in a short-term stabilization perspective.
- On the other hand, while an extensive literature on oil exporting countries tends to focus either on high-income economies Arezki and Ismail (2013) and Lama and Medina, 2012 or low-income and lower-middle-income economies (IMF, 2012; Berg et al., 2013), we analyze upper-middle-income oil exporters.

The Model

Households

- The country is populated by an unit mass of households, $h = [0, 1]$.

The period t utility function of the household is defined as:

$$U_t\left(\cdots\right) = \epsilon_t^B \left(\ln\left(c_t - h g_{\Theta,t}^{-1} c_{t-1} \right) + \theta_M \epsilon_t^M \ln\left(m_t\right) - \epsilon_t^L \frac{\left(L_t\right)^{1+\psi}}{1+\psi} \right), \quad (1)$$

- Each period, the representative household faces the following budget constraint:

$$\left(1+\tau_t^c\right) c_t + p_{I,t} i_t^p + m_t + \left(b_t^d + z_t b_t^*\right) = inc_t + \epsilon_{t-1}^Q R_{t-1} \frac{b_{t-1}^d}{g_{\Theta,t} \Pi_t} \quad (2)$$

$$+ \frac{m_{t-1}}{\Pi_t g_{\Theta,t}} + z_t \left(g_{\Theta,t}^* \Pi_t^*\right)^{-1} \left(\varkappa_{t-1} R_{t-1}^* b_{t-1}^*\right)$$

The Model

Firms

The economy has two types of non-oil firms:

- Intermediate firms that behave as monopolistic suppliers of their differentiated goods and final goods firms that use bundles of those intermediate goods to produce final goods for consumers to invest in or consume.
- We also include, as in Catao and Chang (2012) an "enclave" export sector, which may approximate the reality of countries whose exports are dominated by oil.

The Model

Firms : Intermediate goods

The domestic market has three types of intermediate goods firms:

1. a continuum of domestic intermediate goods firms $h_t(f)$ indexed by $f \in [0, 1]$ that produce differentiated intermediate goods that are sold domestically,
2. a continuum of export intermediate goods firms $x_t(f)$ that produce differentiated intermediate goods that are sold exclusively to domestic exporting firms, and
3. a continuum of import intermediate goods firms $im_t(f)$ that import differentiated intermediate goods that are produced abroad and sold without any transformation to domestic final-good firms.

Domestic and non-oil export intermediate goods firms use both labor $L_{i,t}(f)$ and effective capital stock $\tilde{k}^{p}_{i,t}(f) = u_t g^{-1}_{\Theta,t} k^{p}_{i,t}(f)$ for $i = H, X$ to produce an output of $\upsilon_t(f)$ for $\upsilon = h, x$ according to the following constant returns to scale technology:

$$\upsilon_t(f) = \epsilon^a_t \left(k^g_{i,t}\right)^{\eta} \left[\tilde{k}^p_{i,t}(f)\right]^{\alpha_i} \left[L_{i,t}(f)\right]^{1-\alpha_i-\eta} - \Phi \quad (3)$$

- There exists a continuum of domestic retailer firms which import goods in international trade market where the law of one price holds "*at the dock*".
- In order to generate incomplete exchange rate pass-through into import prices, we follow Monacelli (2003) and assume that intermediate importing firms behave as a monopolistic firm when setting home currency price of imported goods.
- Therefore, deviations from the law of one price assumption, hence incomplete exchange rate pass-through, occur due to the optimal mark-up problem that importing firms have to face when setting prices.

- Prices in the three intermediate goods sectors (home, export and import) are assumed to be sticky and set in staggered fashion à la Calvo (1983).
- That is, a fraction $(1-\theta_i)$ of randomly selected firms is able to set new prices $\tilde{p}^{o}_{i,t}(f)$ each period, whereas a fraction θ_i of firms keeps their prices unchanged and simply follow the following indexation rule:

$$p_{i,t}(f) = \frac{\Pi_{i,t-1}^{\gamma_i}}{\Pi_t} p_{i,t-1}(f) \tag{4}$$

with $i = \{H, X, IM\}$.

The Model
Oil firms

- In contrast to other sectors, oil firms take the international price as given and operate in a perfect competition environment.
- It uses capital, labor, and the oil endowment eo_t to produce crude oil o_t, which is entirely exported abroad.
- The oil firm takes as given the international world crude oil prices $p_{O,t} = z_t p^*_{O,t}$ and maximizes profit :

$$\Pi_{O,t} = \left(1 - \tau^o_t\right) o_t - \frac{w_{O,t}}{p_{O,t}} L_{O,t} - r^k_{O,t} \tilde{k}^p_{O,t} - \frac{p_{EO,t}}{p_{O,t}} eo_t \qquad (5)$$

subject to the production function

$$o_t = \epsilon^o_t \left(\tilde{k}^p_{O,t}\right)^{\alpha_o} \left(eo_t\right)^{\theta_o} \left(L_{O,t}\right)^{1-\alpha_o-\theta_o} - \Phi_o \qquad (6)$$

The Model

Firms : final good

- Final goods firms that produce non-oil private consumption good $q_t^{C_{NO}}$ and investment good q_t^I transform a bundle of differentiated domestic and import intermediate goods using an aggregate production function.
- In contrast, we assume that final public consumption goods q_t^G are produced using only domestic intermediate goods.
- We make the same assumption for exporting firms. Final export goods are produced using only export intermediate goods.

The Model

Monetary policy

We assume that the central bank chooses its policy rate R_t according to the following Taylor rule:

$$\frac{R_t}{\bar{R}} = \left(\frac{R_{t-1}}{\bar{R}}\right)^{\rho_R} \left[\left(\frac{y_t}{y_{t-1}}\right)^{r_y} \left(\frac{\Omega_t}{\bar{\Omega}}\right)^{r_\omega}\right]^{1-\rho_R} \exp\left(\eta_t^R\right) \tag{7}$$

The evolution of the supply of money m_t in the economy is given by the following equation:

$$m_t - \frac{m_{t-1}}{g_{\Theta,t}\Pi_t} = b_t^m - \frac{b_{t-1}^m}{g_{\Theta,t}\Pi_t} + z_t\left(res_t^* - \frac{res_{t-1}^*}{g_{\Theta,t}^*\Pi_t^*}\right) \tag{8}$$

where the foreign exchange reserves hold by the central bank is assumed to be governed by the following law of motion:

$$z_t res_t^* = z_t \frac{res_{t-1}^*}{g_{\Theta,t}^*\Pi_t^*} + \phi_{res}\tau_t^o\left(p_{O,t} - \bar{p}_O\right) o_t \tag{9}$$

The Model
Fiscal policy

- The specificity of the model for oil exporting is that an important part of the government's revenue and spending depend on oil revenue.
- In this study, we introduce the oil revenue through the royalties τ_t^o that the government collects from oil firms.
- More importantly, we assume that the government establishes their budget based on the fixed oil price of $\bar{p}_O$, and saves the windfall $\left(p_{O,t} - \bar{p}_O\right) o_t$ in an OSF f_t.

The Model
Fiscal policy

- In addition, the government uses interests earned from the fund and the central bank holdings of foreign exchange reserves res_t^*. Thus, the government is subject each period to the following budget constraint:

$$\epsilon_{t-1}^{Q} R_{t-1} \frac{b_{t-1}^{d}}{g_{\Theta,t}\Pi_t} + p_{H,t} g_t + \frac{b_{t-1}^{m}}{g_{\Theta,t}\Pi_t} = b_t^d + b_t^m + \tau_t^w w_t L_t$$
$$+\tau_t^c c_t + t_t + \left(1 - \phi_{I^g}\right) \tau_t^o \bar{p}_O o_t + z_t \left(\varkappa_{t-1} R_{t-1}^* - 1\right) \frac{res_{t-1}^* + f_{t-1}}{g_{\Theta,t}^* \Pi_t^*}$$
$$+ \left(p_{RO,t} - z_t p_{O,t}^*\right) c_{RO,t} + swg_t \qquad (10)$$

- Following Benkhodja (2014), refined-oil consumed domestically is produced abroad with a price that evolves according to:

$$p_{RO,t} = (1 - \upsilon_{RO})\, g_{\Theta,t}^{-1} p_{RO,t-1} + \upsilon_{RO} z_t p_{O,t}^{*} \tag{11}$$

- We further assume that the government uses the surplus revenues earned from the oil-exporting sector to stabilize oil revenues against international oil price fluctuations and to support the lagging sector (export) and domestic producers. Namely, we let the OSF f_t evolve according to:

$$\begin{aligned} z_t \tilde{\Theta}_t \left(f_t - \bar{f}\right) &= z_t \tilde{\Theta}_t \left(g_{\Theta,t}^{*} \Pi_t^{*}\right)^{-1} \left(f_{t-1} - \bar{f}\right) + \tau_t^{o} \left(p_{O,t} - \bar{p}_O\right) o_t \\ &\quad - \left(swg_t - \overline{swg}\right) - \left(swt_t - \overline{swt}\right) \end{aligned} \tag{12}$$

The Model

Fiscal policy

- The terms swg_t and swt_t represent the amount the government takes from the OSF to temporarily finance fiscal deficits and to support the lagging sector that might be hurt by the Dutch disease phenomenon. We define these as

$$\begin{aligned} swg_t &= \upsilon_{swg} z_t \tilde{\Theta}_t \left(g^*_{\Theta,t} \Pi^*_t \right)^{-1} f_{t-1} \\ swt_t &= \upsilon_{swt} z_t \tilde{\Theta}_t \left(g^*_{\Theta,t} \Pi^*_t \right)^{-1} f_{t-1} \end{aligned}$$

- with $0 < \upsilon_{swg}, \upsilon_{swt} < 1$. We assume that the public investment $i^g_{i,t}$, for $i = \{H, X\}$ is productivity-enhancing for the lagging sector and domestic producers, and evolves according to:

$$\begin{aligned} p_{I,t} i^g_{H,t} &= \frac{1}{2} \phi_{I^g} \tau^o_t \bar{p}_O o_t \\ p_{I,t} i^g_{X,t} &= \frac{1}{2} \phi_{I^g} \tau^o_t \bar{p}_O o_t + swt_t \end{aligned}$$

Finally, public spending is governed by the following rule:

$$\frac{g_t}{\bar{g}} = \left(\frac{g_{t-1}}{\bar{g}}\right)^{\rho_G} \left[\left(\frac{y_t}{y_{t-1}}\right)^{g_y} \left(\frac{swg_t}{\overline{swg}}\right)^{g_{swg}}\right]^{1-\rho_R} \exp\left(\eta_t^G\right)$$

where parameter ρ_G indicates the degree of interest-rate smoothing and $\eta_t^G \rightsquigarrow$ iid $\mathcal{N}\left(0, \sigma_G^2\right)$ is an exogenous government spending policy shock. Parameters g_y and g_{swg} are policy coefficients that measure the degree of the government response to output and OSF changes, respectively.

Description	Param	Values
Structural parameters		
International oil price elasticity of demand	η_O	0.80
Export price elasticity of demand	η_X	0.80
Household's labor supply elasticity of substitution	η_l	0.8
Parameter for risk premium	ψ	0.01
Share of home export in global demand	κ_X	0.05
Parameter of productivity enhancing public capital	η	0.05
Share of oil proceed accum as exchange rate reserves	ϕ_{res}	0.3
Share of oil proceed dedicated to public investment	ϕ_{Ig}	0.5
Weight of home goods (prod proc of final non-oil cons)	$\upsilon_{C,NO}$	0.47
Constant elasticity of substitution (final non-oil consum)	$\eta_{C,NO}$	0.80
Weight of home goods (prod process of final invest g)	υ_I	0.25
Constant elasticity of substitution (final investment g)	η_I	0.70

Description	Param	Values
Monetary Policy		
Inflation coefficient	r_{π}	$\infty, 0, 0$
Core-inflation coefficient	$r_{\pi_{no}}$	$0, \infty, 0$
Exchange rate coefficient	r_z	$0, 0, \infty$
Interest rate smoothing	ρ_r	0.65
Steady-state		
Constant growth rate of labor-aumenting technology	$\overline{g}_{\Theta}$	1.004
Government spending - output ratio	$\overline{g}_y$	0.46
Foreign CPI inflation	$\overline{\Pi}^*$	1.004
Share of exchange rate reserve in terms of gdp	$\overline{res}_y^*$	0.86
Share of oil stabilization fund in terms of gdp	$\overline{res}_f$	0.32

- We analyze the impulse responses functions of several keys macroeconomic variables in the aftermath of an international oil price shock.
- Our impulse responses functions investigate the effectiveness of alternative monetary rules to limit a Dutch disease effect by combining them with fiscal policy
- Fiscal policy rests on two variables: on the one hand, different values of the parameter of share of OSF dedicated to support trading (export) sector, and, on the other hand, the inclusion of the enhancing productivity coefficient (EPC) associated to public spending as in Berg et al (2013).

Results

Is there a Dutch disease effect?

- Three monetary policy rules are calibrated: an inflation targeting rule (hereafter IT rule), a fixed exchange rate rule (hereafter ER rule) and domestic oil price inflation rule (Frankel rule).
- To interpret our results, it important to note that the impulse responses functions related to the baseline model represent the optimal responses of the economy to the oil shocks.
- In this perspective, to draw lessons about the effectiveness of fiscal and monetary policy to limit the Dutch disease effect, we introduce a set of nominal and real frictions.

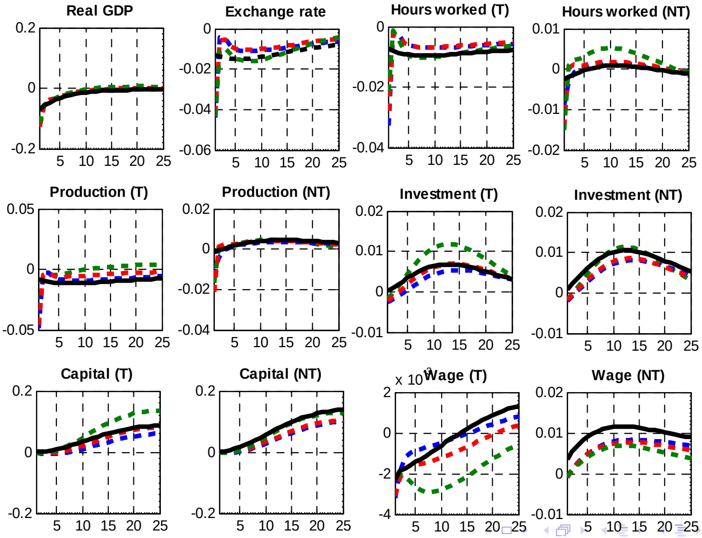
Results

Is there a Dutch disease effect?

- Such frictions lead the economy to respond in a suboptimal way to shocks. The final step is to compare the baseline model and the responses of the model under different rules.
- The response of our selected variables will be relative to that of our baseline model.
- In these cases, this is the gap between both responses (baseline and sticky price-sticky wage models with monetary rules) that will provide information on the occurrence of the Dutch disease effect.

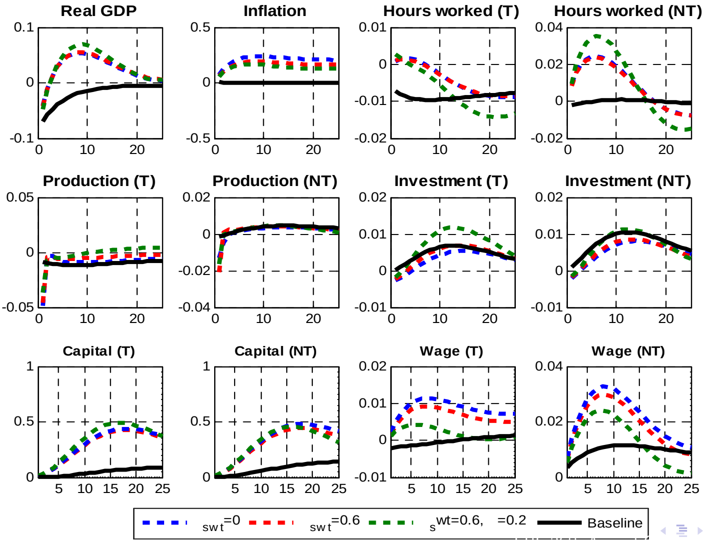
Results

Inflation targeting regime



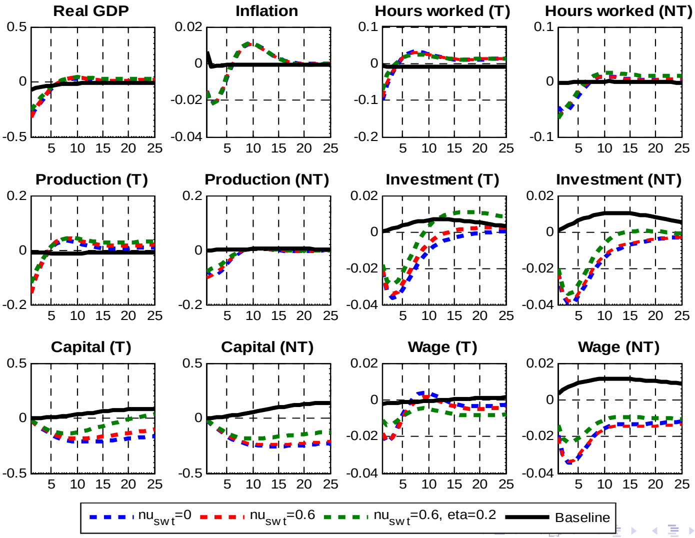
Results

Fixed exchange rate



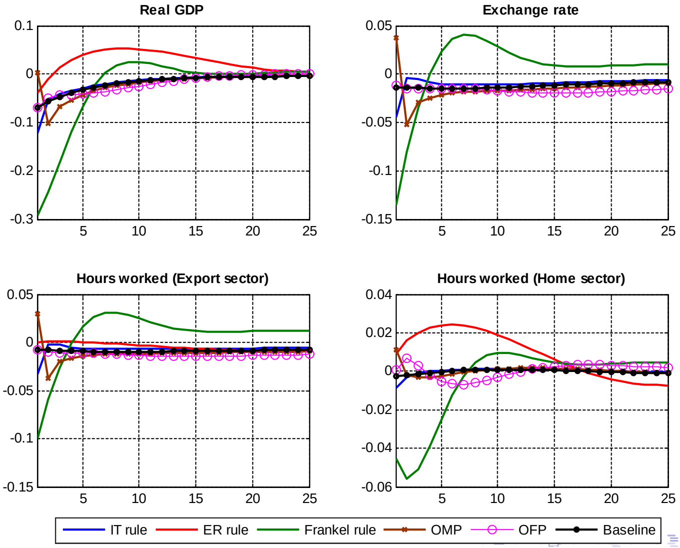
Results

Real oil price targeting (Frankel rule)



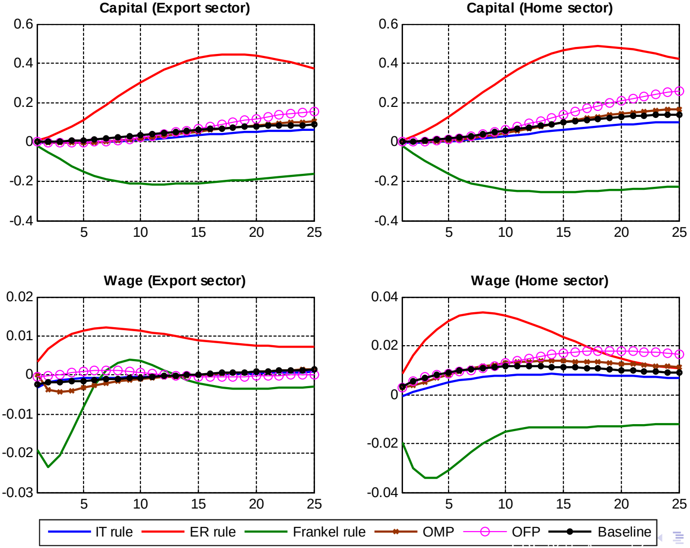
Results

Optimal policy



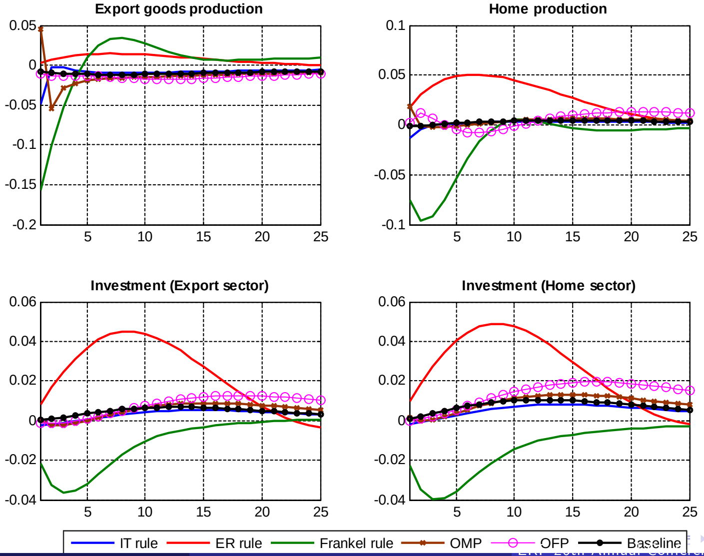
Results

Optimal policy



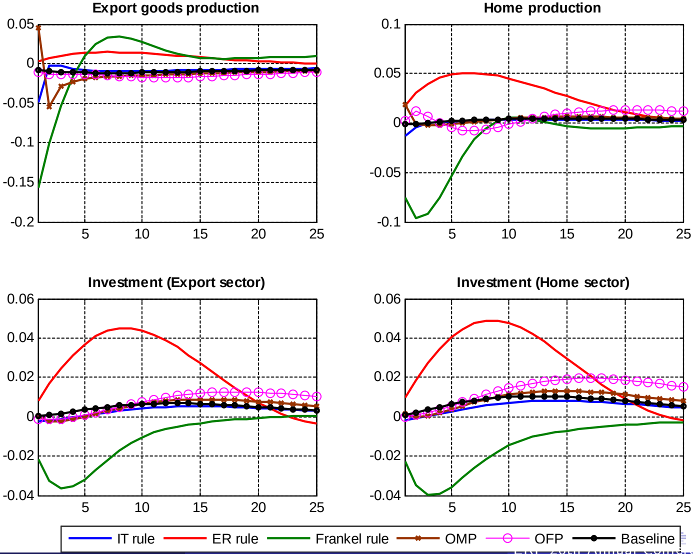
Results

Optimal policy



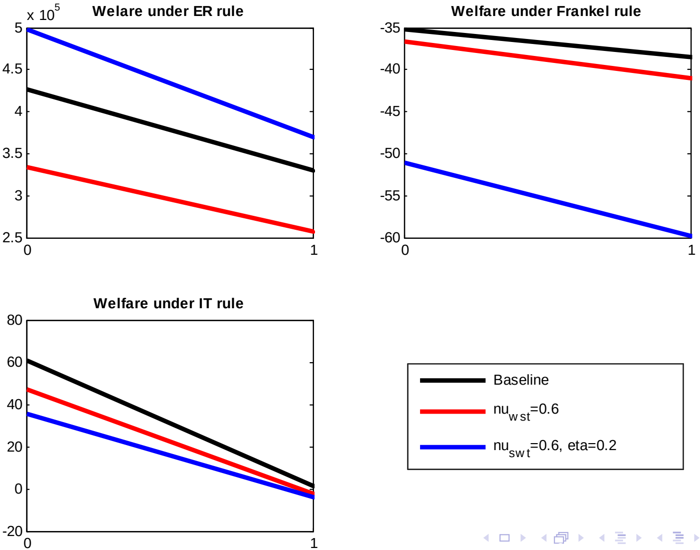
Results

Optimal policy



Results

Welfare analysis



Conclusion

- In this paper, we studied the role of fiscal and monetary policies during a windfall episode in an oil exporting economy.
- Our main purpose was to compare the responses of our model's variables in the aftermath of a positive oil price shock under three monetary rules (Inflation targeting rule, Exchange rate peg and Frankel rule) combined with government intervention (a share of oil stabilisation fund dedicated to support trading (export) sector, and the inclusion of the enhancing productivity coefficient (EPC) associated to public spending as in Berg et al (2013).

Conclusion

- Our main findings show that the Dutch disease occurs only under inflation targeting and oil price inflation rules.
- The fixed exchange rate monetary rule seems to be effective to prevent a Dutch disease effect.
- Also, under IT rule, the decline in export sector tends to shrink gradually as the rise in the share of oil stabilisation fund.
- The decline in export goods production is completely resorbed when we combine the share of OSF with a positive coefficient of enhancing productivity.
- This is not the case when oil price inflation rule is considered. Finally, optimal monetary and fiscal policies do not give better results than ER rule which provides also the highest welfare gain.