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Current Account Surplus, Fiscal Policy and Money Market Equilibrium

ABSTRACT

In this paper, we base our policy analyses and simulations on three different specifications of a DSGE model developed for an oil rich country and check the impact of the oil windfalls. The first proposed specification is a classical one with a Taylor rule and the second one is a recently new specification with a money growth rule. Beside two familiar specifications, we propose a new specification which introduces money market equilibrium issues in the short run. We show that all three specifications allow the fiscal authority to act as the main actor in propagating and amplifying the effects of the oil price shocks to the rest of the economy. When an oil shock hits the economy, its first round effect operates through oil fund transfers to the budget. The second round effects result from an increase in government consumption and government investment expenditures, which augments public capital affecting total factor productivity (TFP) and production, as well as the aggregate demand. We also find that despite significant differences, all three specifications demonstrate similar response dynamics.

JEL classification: E35, E47, E58, E61

Keywords: Fiscal Policy; Oil Windfalls; Public investment; Market Disequilibrium; Oil rich country

Introduction

In this paper, we develop a New Keynesian framework to study the effects of oil windfalls in a small open economy with abundant natural resources. Specially, the CIS oil rich economies (Russia, Kazakhstan and Azerbaijan) constitute good examples for such economies, so we build a new Keynesian model which takes the main economic characteristics of those countries into consideration. In the model framework, we separate the non-oil production sector from the oil sector in which the production does not require any factors and grows exogenously. We explicitly model the Oil Fund which is aimed to serve as a stabilization fund and safeguard resources for the future generation.

More importantly, we elaborately specify the fiscal authority and define different rules for the fiscal spending, which are supposed to be followed by the authority. In fact, the fiscal authority is a crucial player in those economies as it determines the distribution of the oil revenues from the sale of exports. That is, the fiscal spending is the most essential and influential channel that affects economic cycle and distributes the oil revenues among the different sectors of the economy.

The fiscal expenditures are allocated between the purchase of consumption and investment goods which are mainly directed towards the infrastructure construction. Therefore, the fiscal expansion has two direct consequences - in the short run, it boosts the aggregate demand through the purchase of consumption and investment goods, but in the medium term, it augments the total factor productivity (TFP) through the infrastructure investments, thus contributing to the production capacity of the economy.

The attitude of the fiscal authority determines the nature of the spending and its effects on the economy. If the fiscal authority credibly commits to a rule-based fiscal spending policy, it dampens out the fluctuations and stabilizes the economy. However, if it follows a discretionary policy and adjusts the fiscal expenditures based on the level of the oil revenue inflows, then the fiscal policy exhibits pro-cyclical nature. The monetary authority attempts to stabilize the economy through using the monetary instruments in its disposal. It fixes the exchange rate and intervenes to absorb an excess supply/demand of the foreign currency reserves in the FX market.

Given the scales and spesifics of these countries inteqration to the global financial markets and the capital account mobility, they can pursue independent monetary policy despite the maintained fixed exchange regime. This seems to be contradicting to the Mundell's famous "impossible trinity" concept, which says that under fixed exchange rate and perfect capital mobility, an independent monetary policy is impossible. However, in a recent study Montiel and Pedroni (2013) show that domestic monetary policy can be effective even under a fixed exchange regime if sufficient deviations from the UIP condition is allowed.

Therefore, we describe the monetary authority with three specifications. In the first specification, we assume that the monetary authority follows a Taylor rule to determine the domestic interest rate. In the second specification, we integrate the FX market into the model and assume that the monetary authority enjoys a certain degree of control over the money supply. The third specification introduces "a temporary disequilibrium" concept into the model. "A temporary disequilibrium" concept in a New Keynesian framework might sound a contradiction to the dominant view in Economics that markets are "always in equilibrium". However, a temporary disequilibrium is a familiar concept from Error Correction models in Econometrics and Leland Yeager's (1956) work on monetary disequilibrium theory.

Here, we assume that the fiscal overspending and pro-deficit policy followed by the fiscal authority leads to a temporary disequilibrium in the money market. Over time, the money gap shrinks down through three channels which in the end establishes equilibrium in the market.

In the next section, we provide a brief overview of the Azerbaijan economy and talk about its main characteristics. In the third section, we give a concise description of the New Keynesian model, and in the last section we discuss effects of oil windfalls on the economy and summarize our findings.

An overview of the Azerbaijan economy

Azerbaijan has demonstrated strong economic growth over the last decade. The external position of overall country improved from negative to a stable positive balance. The average current account surplus was estimated to have risen to 12 percent of GDP over 2003-2010.

The establishment of SOFAZ and resources accruing to the fund supplied government with the new financial resources. The State Oil Fund (SOFAZ) was established to serve as a stabilization institution and to safeguard oil revenues for future generations.

Theoretical Model

The economy consists of a representative household, firms operating at the non-oil sector, the oil sector, the Oil Fund, fiscal and monetary authorities and an external sector.

Household Sector

The economy is inhabited by a representative household who allocates its income among consumption and investment goods, and makes decision on the holdings of domestic currency as well as government bonds (foreign bonds) in every period. It supplies homogenous labor to the firms and earns rents from supplying necessary capital to the production sector. Therefore, the household maximize the utility,

$$U = E_t \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma_C}}{1-\sigma_C} + \frac{\gamma_M}{1-\kappa_M} \left(\frac{M_t}{P_t}\right)^{1-\kappa_M} - \psi \frac{l_t^{1+\tau}}{1+\tau} \right]$$

under the budget constraint

$$P_t C_t + P_t I_t + M_t + (\varepsilon_t^{RP} R_t)^{-1} B_t + ((1-\Gamma_{B^*}(e_{B_t^*}, \varepsilon_t^{RP^*}))R_t^*)^{-1} e_t B_t^* + \Theta_t + \Xi_t =$$
$$(1-\tau_W) W_t l_t + R_{K,t} K_{t-1} + M_{t-1} + B_{t-1} + e_t B_{t-1}^* + D_{H,t}$$

where E_t denotes expectation term, β discount factor, C_t aggregate consumption, l_t labor supply, M_t domestic currency stock, P_t the overall price level. In the budget constraint, I_t indicates investment expenditures, B_t government bonds, R_t interest rate, K_t capital stock, $R_{K,t}$ the nominal return on the capital, W_t the nominal wage rate, $D_{H,t}$ dividends and τ_W income tax and e_t the domestic price of per unit foreign currency.

Production Sector

There are two sectors in the economy – oil and non-oil sector. It is assumed that the oil sector is totally an extraction sector where the production does not require any input. The non-oil sector is composed of intermediate and final goods producers.

Intermediate goods producers

There are continuum of intermediate goods producers and each produces a differentiated product yn_t^j where $j \in [0,1]$. The intermediate firm j produces an output by renting capital and hiring labor using the Cobb-Douglas technology defined below:

$$yn_t^j = A_t \left(K_{t-1}^j\right)^{\alpha} \left(l_t^j\right)^{1-\alpha}$$

where A_t denotes public capital augmented technology whose law of motion is as follows:

$$\frac{A_t}{\overline{A}} = \left(\frac{A_{t-1}}{\overline{A}}\right)^{\rho_A} \left(\frac{K_{G,t-1}/\overline{K}_G}{l_t/\overline{l}}\right)^{\chi(1-\rho_a)} \left(\frac{\varepsilon_{A,t}}{\overline{\varepsilon}}\right)$$

where $\chi \in [0,1]$ is a scaling factor, $K_{G,t}$ denotes public capital, $\varepsilon_{A,t}$ is a technology shock and variables with bar represents the steady state values of the respective variables. In the case of $\chi = 0$ the technology shock evolves according to the AR(1) process as in the classical case.

When a firm sets the price $P_{H,t}^j$ for its products, it faces a quadratic adjustment AC_t^j cost defined below:

$$AC_t^j = \frac{\varphi}{2}\left(\frac{P_{H,t}^j / P_{H,t-1}^j}{\Pi_{H,t-1}} - 1\right)^2 P_{H,t} yn_t$$

Final goods producers

In addition, the heterogeneous domestic goods are assembled by intermediate goods producers into private consumption and investment as well as government consumption bundles using the CES production technology.

Oil Sector, Oil Fund and External Sector

The production in the oil sector is fully an exogenous process and does not require any inputs. The revenues in the national currency OR_t obtained from the oil export are partly used to close the non-oil deficit of the state budget and the rest accrues at the State Oil Fund.

The oil fund resources OF_t^* are managed in USD and earn R_t^* every period. Certain amount of Fund resources (FuT_t) is transferred to the government budget. Hence, the Oil Fund's resources accumulate according to the following law of motion:

$$OF_t^* = OF_{t-1}^* + R_t^* \frac{(OR_t - FuT_t)}{e_t}$$

Government Sector

Government collects taxes from households and issues bonds to finance its fiscal expenditures (G_t). In addition, every period a part of oil revenues is transferred from the Oil Fund to the budget. Government also holds deposits, $D_{G,t}$, at the Central Bank and collects income taxes from households. Therefore, the budget constraint of the government is as follows:

$$P_{H,t}G_t = FuT_t + \left(\frac{B_t}{R_t} - B_{t-1}\right) - \left(D_{G,t} - D_{G,t-1}\right) + \tau_W W_t l_t + (M_t - M_{t-1})$$

Government spending on public investment is composed of two parts (i) a constant share of its expenditure on investment (ii) a temporary increase in oil revenues. The dynamics of the public investment and the public capital are provided below:

$$I_{G,t} = \omega_G \overline{G} + \omega_{Oil}\left(G_t - \overline{G}\right)$$

$$K_{G,t} = (1-\delta)K_{G,t-1} + \nu I_{G,t}$$

Monetary Authority

Monetary authority is modeled using three different specifications (i) classical Taylor and fixed exchange rule (ii) monetary growth rule in the spirit of Taylor rule (iii) short-run money market disequilibrium specification.

In the classical specification of the monetary authority, the model is closed using Taylor rule and uncovered interest rate parity condition (UIP).

$$\frac{R_t}{\overline{R}} = \left(\frac{R_{t-1}}{\overline{R}}\right)^{\rho_R}\left(\left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\phi_\Pi}\left(\frac{yn_t}{\overline{yn}}\right)^{\phi_Y}\right)^{1-\rho_R}\left(\frac{\varepsilon_{R,t}}{\overline{\varepsilon}_R}\right)$$

In the second specification, it is assumed that the monetary authority sets the exchange rate using a simple rule and intervenes to the foreign exchange (FX) market to absorb excess supply or demand of foreign currency.

Therefore, the changes in the money supply can be defined as the changes in NFA, changes in the net claims on government and growth in the money supply net of NFA and government deposits and can be written as follows:

$$M_t - M_{t-1} = \mu_t\left(M_{t-1} - NFA_{t-1} - D_{G,t-1}\right) + \left(NFA_t - NFA_{t-1}\right) + \left(D_{G,t} - D_{G,t-1}\right)$$

Here, μ_t reflects the monetary authority's ability to control money growth net of NFA and government deposits.

$$\hat{\mu}_t = \rho_\mu \hat{\mu}_{t-1} + (1-\rho_\mu)(-\eta_Y \hat{yn}_t - \eta_\Pi \hat{\pi}_t) + \hat{\varepsilon}_{\mu,t}$$

The monetary authority's intervention which determines the changes in NFA can be defined as follows:

$$NFA_t - NFA_{t-1} = \left(FuT_t - P_{F,t} IM_t\right) - MA_{FX,t}$$

To close the model, we assume that the monetary authority follows the simple rule to set the exchange rate:

$$\frac{e_t}{e_{t-1}} = \left(\frac{e_{t-1}}{e_{t-2}}\right)^{\rho_e}\left(\frac{\Pi_t}{\Pi_{F,t}}\right)^{\xi(1-\rho_e)}$$

The third specification differs from the second one in some aspects though most part of the second specification is retained throughout the model. Here, we assume that the money market is in a temporary disequilibrium which can be eliminated through three potential channels: the price adjustment channel, the real income channel and the foreign asset channel. Therefore, money disequilibrium gap evolves according to the law of motion defined below:

$$\hat{gap}_{M,t} = \rho_{GM}\hat{gap}_{M,t-1} + (1-\rho_{GM})\left(-\varpi_\Pi \hat{\pi}_t - \varpi_Y \hat{yn}_t + \varpi_{FX}\hat{nfa}_t\right) + \hat{\varepsilon}_{GM,t}$$

where $gap_{M,t} = \left(\log\left(\frac{M_t}{P_t}\right) - \log\left(\frac{M_t^d}{P_t}\right) \right)$ and variables with hat over them denotes the log deviation of those variables from their respective steady state values.

Calibration

We choose some parameters based on Azeri data and for some others we borrow from the existing literature. The steady-state ratios are calculated using the available time series from national income accounts and analytical balance of the CBAR and the rest of the parameters are borrowed from the related literature.

Parameters	Values	Source/Method
β	0.99	Based on Huseynov and Ahmadov (2012)
γ_M	0.09	Based on Huseynov and Ahmadov (2012)
γ_{B^*}	0.01	Taken from literature
κ_M	10.0	Based on previous estimates
σ_C, τ_L	1.0	Taken from literature
ψ	4.7	Calculated using steady-state solution of the model
τ_W	0.14	Income tax rate for the first income bracket
γ_C, γ_I	0.5	Calculated using consumption basket
μ_C, μ_I	0.23; 0.12	Calculated using data on imported goods
α	0.35	Calculated using data from input-output table
θ	6.0	Based on survey evidence
φ	59.0	Standard value in literature
χ	0.1	Based on data
$\omega_G, \omega_{Oil}\, \nu, \iota$	0.41; 0.11; 0.1; 0.25	Calculated using respective database

The Experiment and Discussion

In this section, we conduct an experiment and measure the effects of oil windfalls (oil price increase) on the economy. When the economy experiences a rise in oil revenues due to a upward price movements in its oil exports, the Oil Fund transfers all incremental increase in oil revenues to the government budget. Provided with additional financial resources, government expands its fiscal expenditures which leads to the increase in the government expenditures on consumption and public investment goods. Therefore, the oil price increase affects the system through the fiscal sector - government purchases of consumption and investment goods boosts the aggregate demand whereas the public infrastructure investment augments the production capacity of the economy through TFP. With

this specification, we adequately capture the short and medium term effects of the fiscal expansion in oil rich countries.

The increase in the aggregate demand, thus in income, stimulates the household consumption and consequently, leads to the rise in the level of imports. In our specification, the imported investment goods react to the oil price shock much more strongly than do consumption goods.

Because of the increase in the aggregate demand the economy also experiences jumps in the prices of goods and factors of production. That is, the domestic price level, real wage and the marginal cost increase. However, the imported prices demonstrate reverse dynamics and decrease relative to the domestic prices. The real exchange rate appreciates. The monetary authority rises the domestic interest rate to fight against the economic overheating and stabilize the economy. In all specifications, the domestic interest rate increases and the monetary authority reacts in the similar way to the economic fluctuations.

Overall, the model adequately reflects the effects of oil windfalls in a small open economy with some degree of international financial integration. We have captured the fact that the fiscal authority is an important player and forms an important channel in the distribution of the oil windfalls. It has been established that the fiscal expansion resulting from a rise in oil revenues has two consequences - in the short run, it increases the aggregate demand and in the medium run, it contributes to the production capacity of the economy. We also showed that even under the fixed exchange rate, the monetary policy is partially effective and directed towards stabilizing the economy. Finally, we have also demonstrated that the monetary disequilibrium approach also exhibits similar dynamics with the other two specifications.

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Appendix

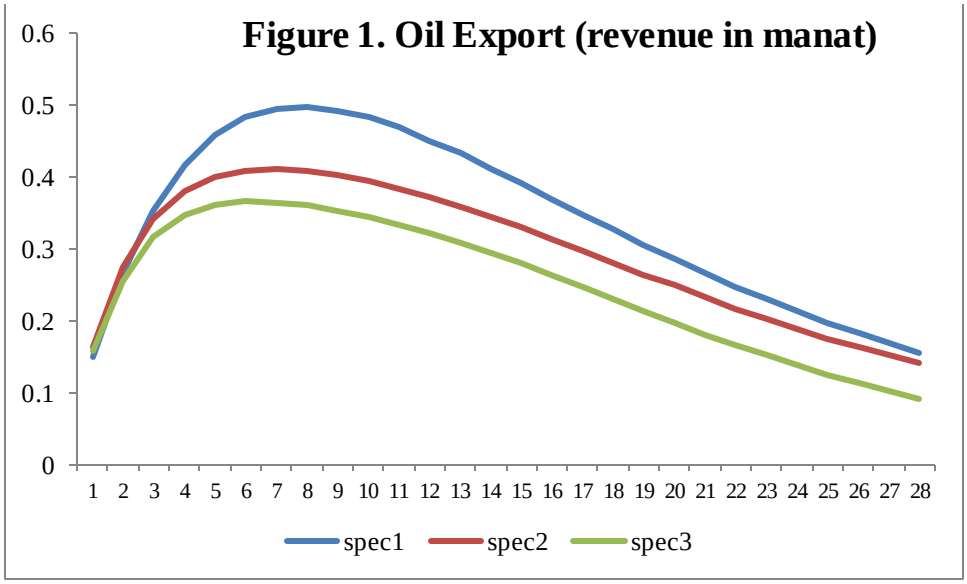
Figure 1. Oil Export (revenue in manat)
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

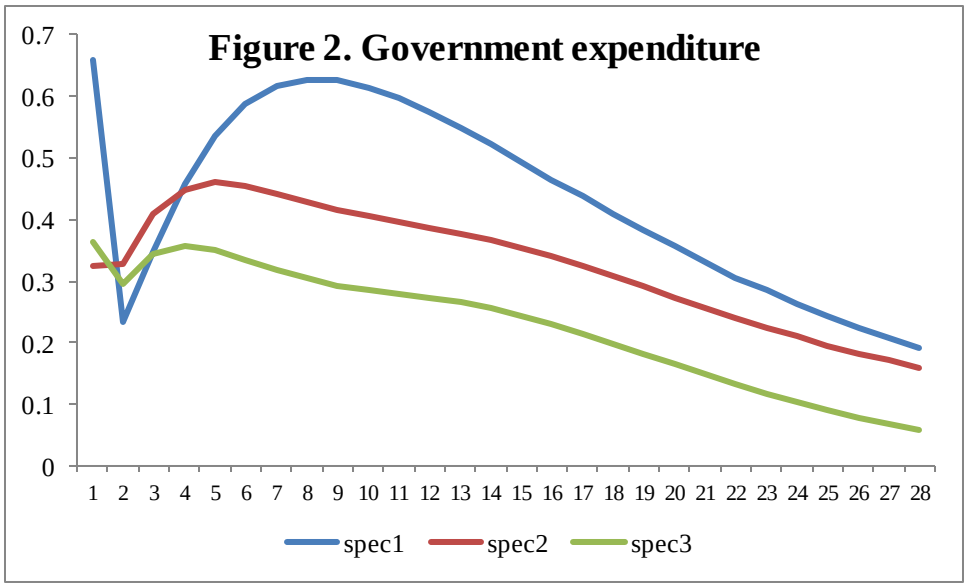
Figure 2. Government expenditure
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
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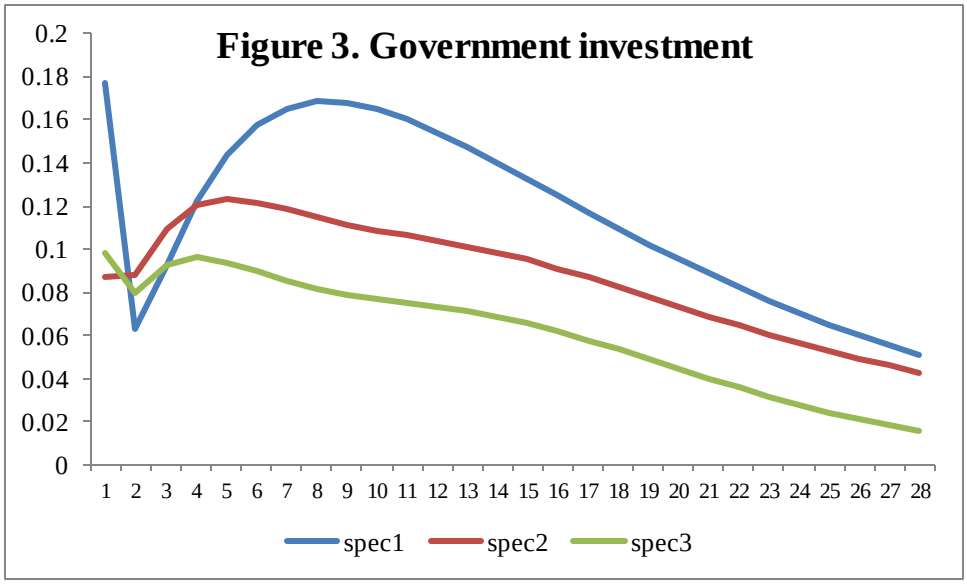
Figure 3. Government investment
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
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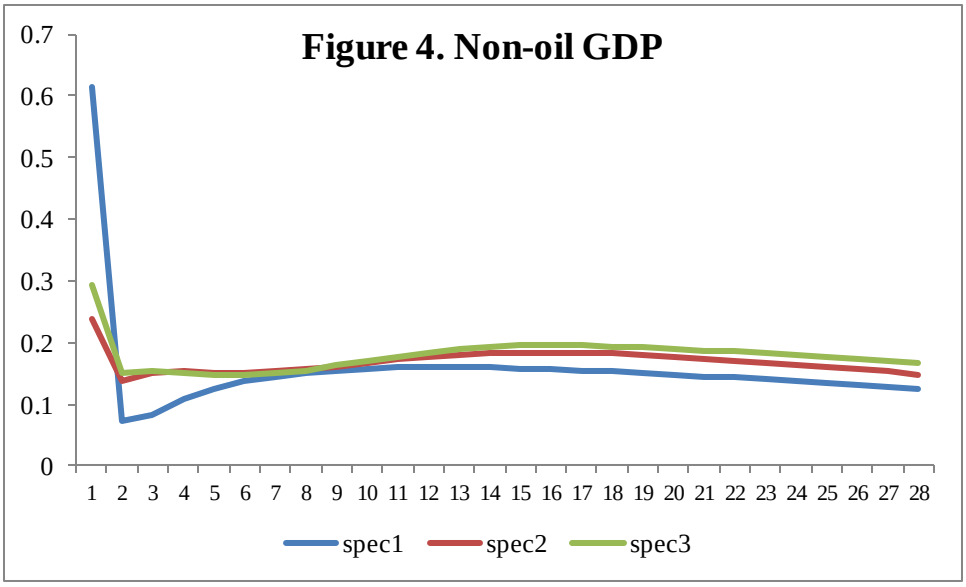
Figure 4. Non-oil GDP
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

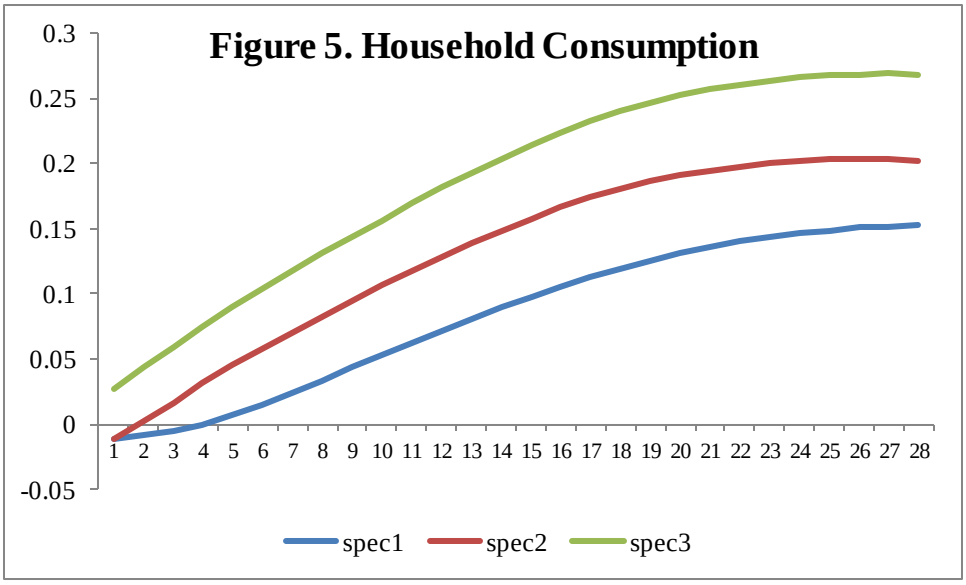
Figure 5. Household Consumption
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

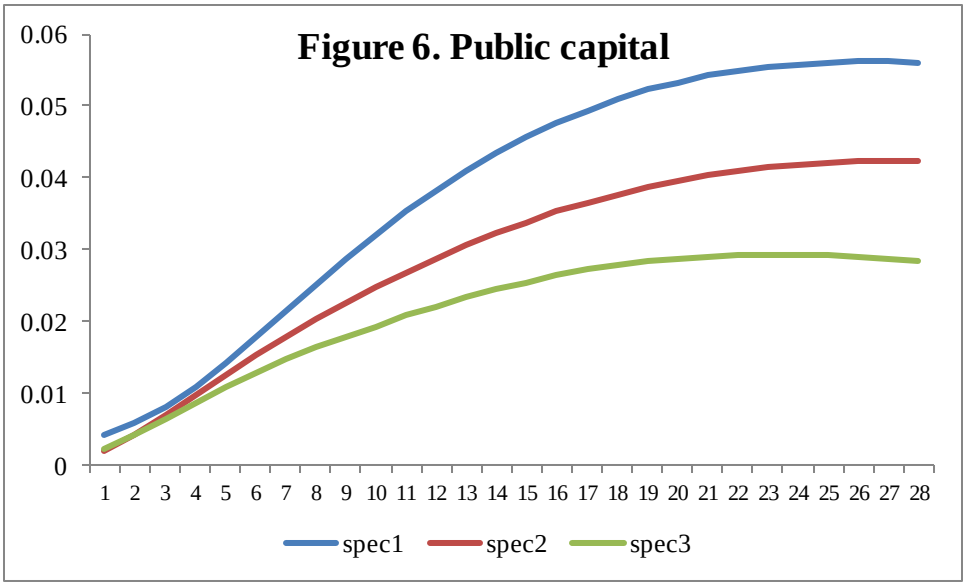
Figure 6. Public capital
0.06
0.05
0.04
0.03
0.02
0.01
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

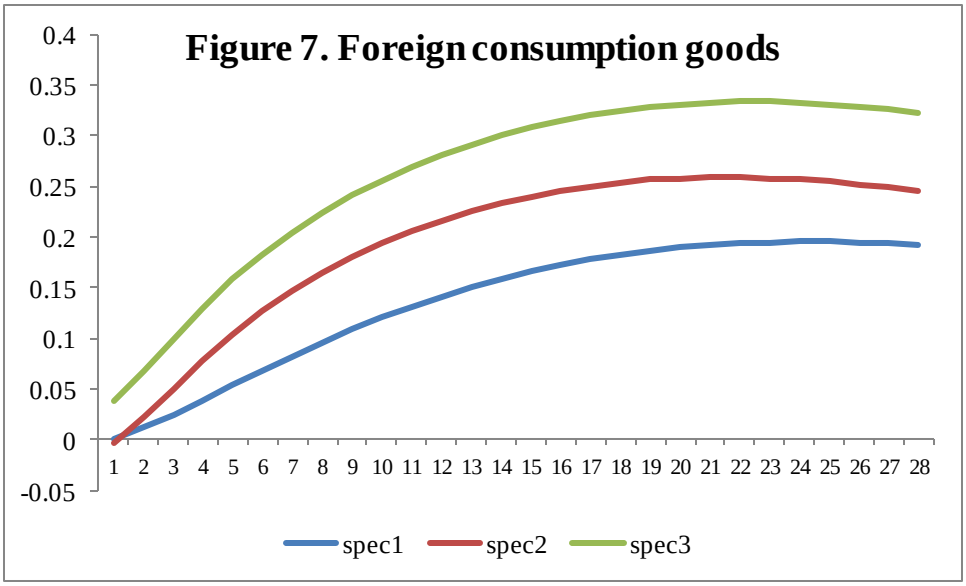
Figure 7. Foreign consumption goods
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

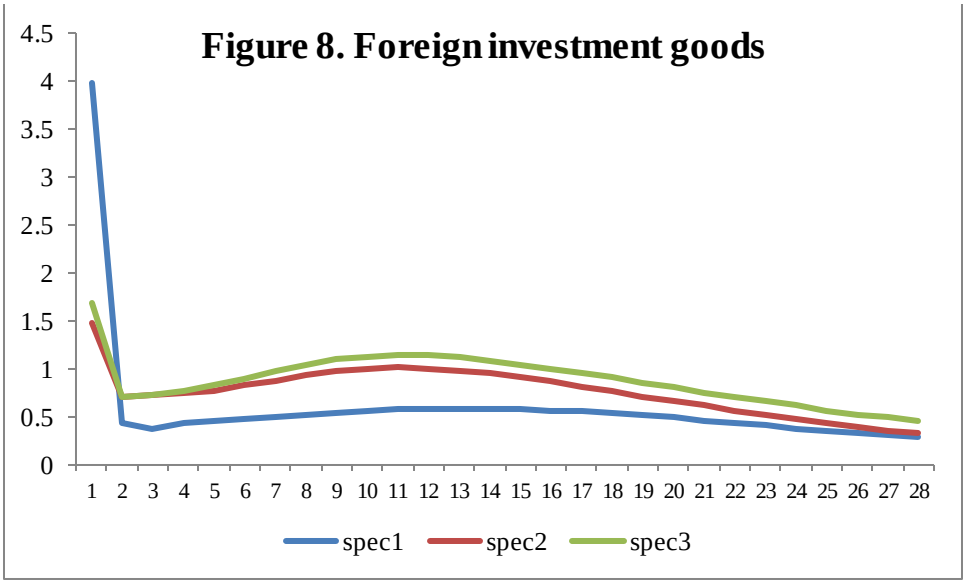
Figure 8. Foreign investment goods
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

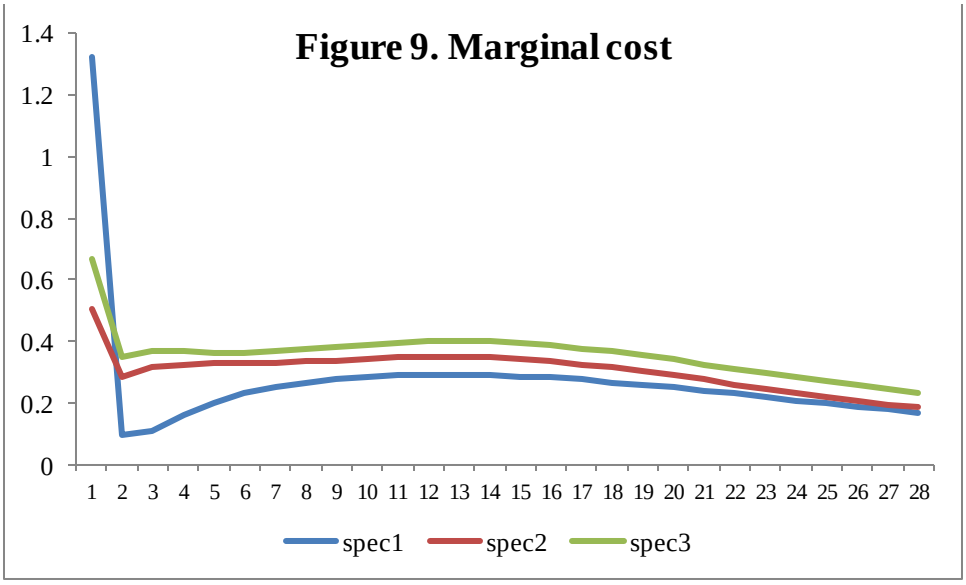
Figure 9. Marginal cost
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

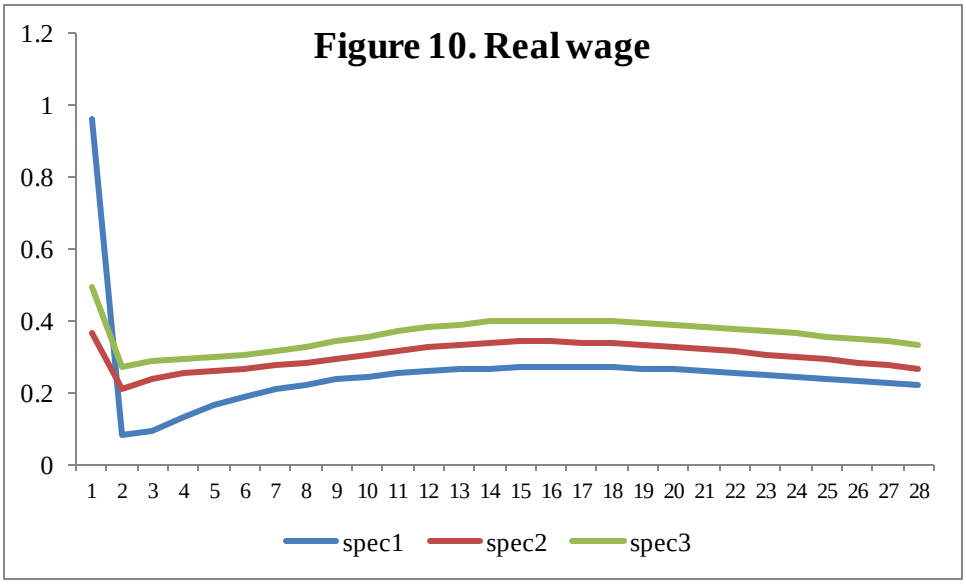
Figure 10. Real wage
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

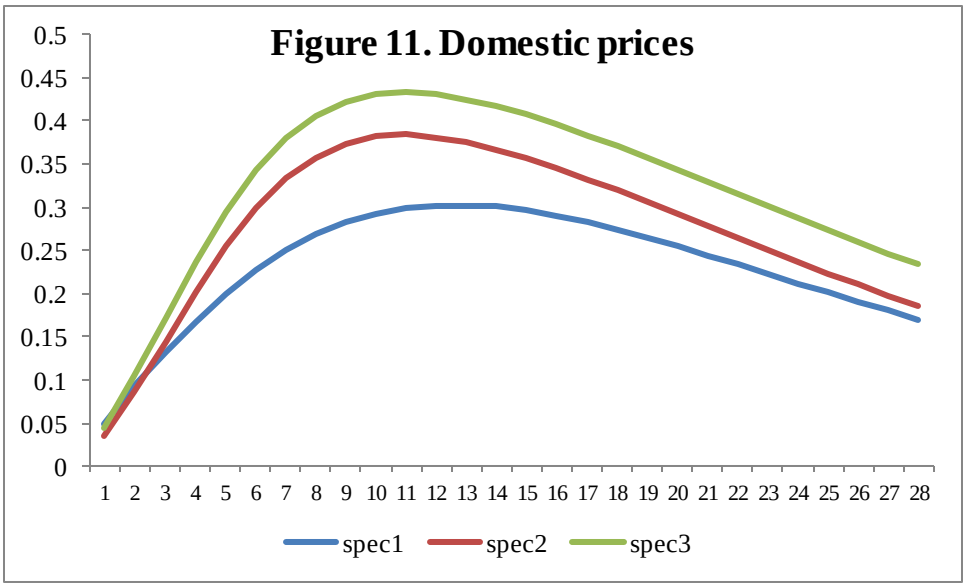
Figure 11. Domestic prices
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

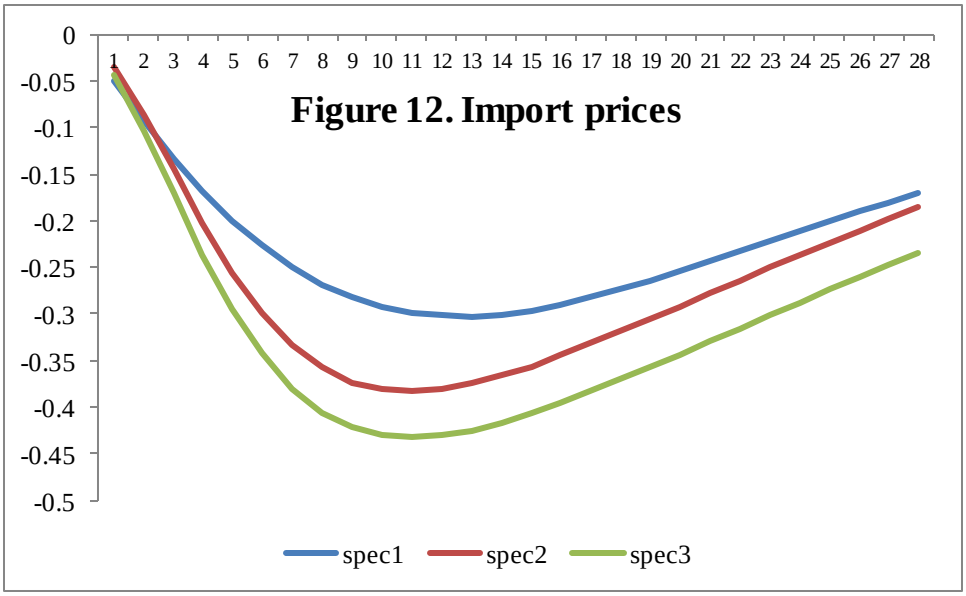
Figure 12. Import prices
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
-0.35
-0.4
-0.45
-0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
spec1
spec2
spec3

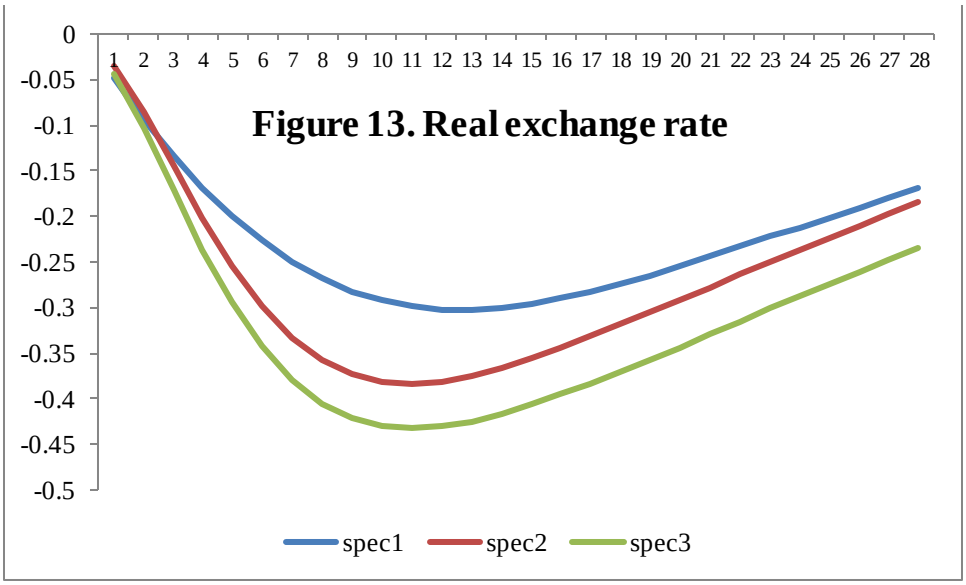

Figure 13. Real exchange rate

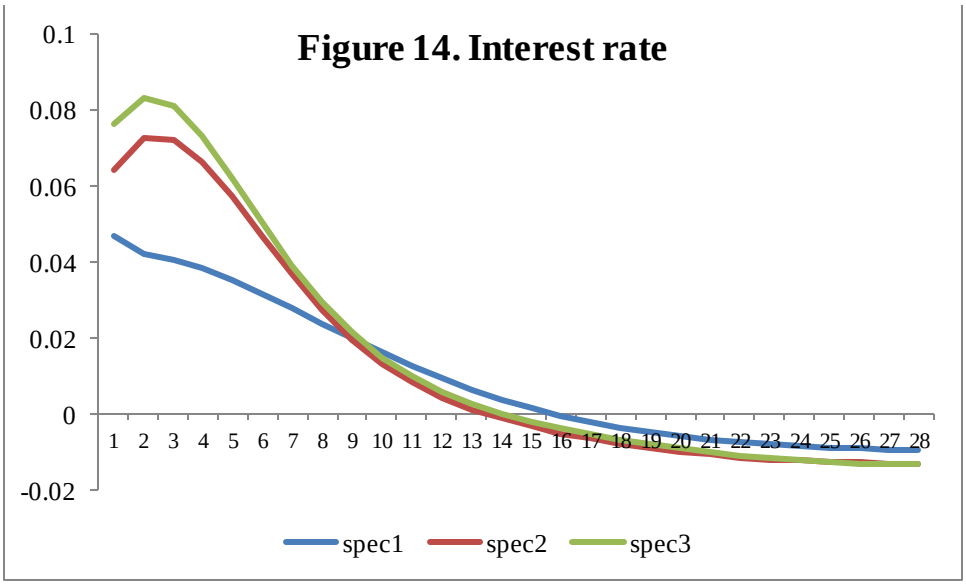

Figure 14. Interest rate