Monetary policy in oil exporting countries with fixed exchange rate and open capital account: expectations matter

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Abstract: Nominal interest rate is generally assumed to follow an UIP condition when the exchange rate is fixed, and the capital account is opened. Consequently, domestic interest rate is determined by foreign rates and the risk premium. This paper shows that for an oil exporting country like UAE, adjusting nominal interest rate only to foreign rate could be economically inconsistent. In fact, what really matters with exchange rate is expectations, and for an oil exporter country like UAE these expectations are significantly impacted by oil prices. By incorporating a market-expected exchange rate mechanism in a semi-structural New Keynesian Model, this paper highlights the importance of this mechanism and provides a consistent analytical framework.

Key words: Monetary policy, exchange rate, New Keynesian Model, UIP condition, Bayesian estimation.

JEL classification: C11, C32, E30, E52, O24.

I. Introduction

The rise of financial and real uncertainties over the past decades has increased the importance of understanding the transmission of economic shocks and policy actions. The swings in commodity prices, the normalization of monetary policy in the US, as well as concerns about European union demonstrate the importance of understanding how shocks and policy choices affect an economy. Consequently, a growing interest has been given to the macroeconomic modelling to assist policy-makers in their decisions, particularly for monetary policy. Nevertheless, research and publications in the field has been dominated by standard economic structures that consider an inflation-targeting (IT) monetary policy that has a full control on short-term interest rates and tries to keep inflation expectations in line with the central bank target. In real-life world, other economic structures and monetary strategies exist.

This paper sheds light on the specific case of UAE economy, an oil exporter country with a fix exchange rate and an open capital account. In fact, the policy orientation of the UAE gives priority to the exchange rate with a fix and stable nominal exchange rate. Probably, this choice is motivated by the credibility and the low inflation provided by this type of regime that could lead to a more stable economic environment and faster economic growth[1]. However, under a fix exchange rate regime it is difficult to keep monetary autonomy without imposing capital controls[2]. Consequently, standard DSGE and New Keynesian models that assume a full control on domestic short-term interest rates without considering foreign interest rate are hardly suitable for UAE. In addition, and as this paper argues, what really matters with exchange rate is expectations, and for an oil exporter country like UAE these expectations are significantly impacted by oil prices.

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[1] The assessment of the costs and benefits of alternative exchange rate regimes has been hotly debated for decades but, overall, no clear answer has been given regarding the superiority of any regime. See for example Baxter and Stockman (1989), Calvo and Reinhart (2002), Levy Yeyati and Sturzenegger (2001, 2003), Reinhart and Rogoffs (2004), Cúrdia and Finocchiaro (2010) and Farhi and Werning (2014).

[2] The impossible trinity by Fleming (1962)- Mundell (1963) defines clearly the circumstances of an independent monetary policy that affects substantially the economy: with fixed exchange rate, monetary autonomy is regained only by imposing capital controls, while under flexible exchange rate, monetary policy is already independent and there is no need for restricting international capital mobility.

Therefore, a consistent analytical framework for UAE economy should at least consider the exchange rate regime fixity, the capital account openness and the oil prices importance. This paper suggests a modelling approach that capture these aspects through a semi-structural model. Such approach combines the advantages of fully structural models and those composed of reduced-form equations. A set of core structural economic relationships determine the evolution of the economy and the empirical fitting is improved by reduced-form equations. The theoretical model is composed of five main blocs: the output bloc (IS curve), the inflation bloc (Phillips curve), the unemployment bloc (Okun's law), the monetary conditions bloc, the external bloc (World demand, US monetary policy and inflation and oil prices). To endogenously distinguish between structural and cyclical changes of variables[3], a state-space representation is adopted for the model which parameters are estimated using Bayesian techniques.

The rest of the document is presented as follows. The second section highlights some particularity of oil exporting economies such UAE with fix exchange rate and open capital account. The third section presents the details of the theoretical specification adopted in this work. The last section discusses the results and presents some shock simulations and their implications for the conduct of monetary policy.

II. The economics of fixed exchange rate and open capital account in an oil exporting country

Small scale New Keynesian models[4] as well as larger macroeconomic models[5] usually neglect non-IT monetary policy strategies and the nominal anchor for monetary policy in these models is inflation expectations. Even when the role of the exchange rate in monetary policy is considered, it is assumed that the central bank uses the interest rate instrument to target both inflation and the exchange rate[6]. Typically, authors use a standard New Keynesian model with interest rates as the only monetary

[3] The model endogenously captures and estimates the potential output, the NAIRU, the neutral interest rate and the equilibrium exchange rate in addition to the cyclical variables such the output gap.
[4] See for example Clarida et *al.* (1999) or Woodford (2003).
[5] See for example Christiano et *al.* (2005) or Smets and Wouters (2008).
[6] See for example Natalucci and Ravenna (2002), Batini *at al.* (2010) and Nordstrom *et al.* (2009).

policy instrument and the exchange rate role is explored by including an explicit exchange rate term into the monetary policy rule. As mentioned by Benes *et al.* (2013), monetary policy rule in these frameworks has the following form:

$$i_t^T = \bar{\iota} + \alpha\,\hat{\pi}_t + \delta\hat{y} + \mu\Upsilon \quad (1)$$

Where (i^T) is the target level of interest rate, $\hat{\pi}$ the inflation gap, $\hat{y}$ the output gap and the exchange rate behavior term Υ which can have several functional forms.

Roger *et al.* (2009) suggested a slightly different framework where monetary policy rule is an exchange rate-based inflation targeting. In this framework, the exchange rate, rather than an interest rate, is used as the operating instrument for monetary policy:

$$\hat{q}_t = \rho\,\hat{q}_{t-1} + (1-\rho)[\,\sigma\,\hat{\pi}_t + \sigma\,\hat{y}] + v_t \quad (2)$$

$\hat{q}$ is the real exchange rate gap and v_t is a shock to this gap. Roger *et al.* (2009) argue that this approach could be implemented directly through unsterilized intervention in the FX market. Or alternatively, the central bank could use a very short-term domestic interest rate to move the exchange rate to the desired level.

For UAE economy, such approaches are unsatisfactory for two main reasons. First, an important spread between domestic and foreign interest rate will create an arbitrage which will encourage FX speculation and could turn into a speculative attack. In fact, the availability of choice between foreign and domestic assets -due to the open capital account- implies an uncovered interest rate parity (UIP) condition. Consequently, domestic and foreign interest rates differential must be equal to the relative changes in nominal exchange rate. In fact, if the central bank chooses to freely use its interest rate and keep it low comparing to foreign interest rates, investors would be tempted to move their assets abroad and enjoy the higher yield. This will cause pressure on nominal exchange rate to depreciate and the central bank should either increase its rate, intervene in the FX market or float the exchange rate.

Second, economic agents react essentially to the expected changes in the nominal exchange rate. Even with a spread between domestic and foreign interest rate, investors will be discouraged to speculate against domestic currency if the currency is expected to appreciate. For UAE, an expected increase in oil prices means an enrichment of the economy, a GDP improvement and a higher demand for the local currency. In this case, the FX market will expect an appreciation of the exchange rate rather than a depreciation if the central bank let down the peg. In other words, investors will be discouraged to speculate against domestic currency when oil prices are increasing, because the nominal exchange rate will appreciate if the central bank decide to face the speculation by floating exchange rate. Considering this mechanism is important because it helps the central bank to define a coherent nominal interest rate with the state of the economy. In standard modelling approaches, the UIP condition concerns is to guarantee the consistency of domestic interest rate with foreign interest rates and the risk premium. In this paper, the market-expected exchange rate mechanism has also the concerns of other important factors such the oil prices for UAE.

III. Modelling monetary policy in oil exporting economy with fixed exchange rate and open capital account

This paper suggests a modelling approach that capture these aspects through a semi-structural New-Keynesian model[7] composed of five main blocs: the output bloc, the inflation bloc, the unemployment bloc, the monetary conditions bloc, the external bloc.

The output bloc –IS curve:

The adopted specification assumes that real GDP (*Y*) is determined by its long-term potential ($\bar{Y}$) and the output gap (*y*):

$$Y_t = \bar{Y}_t + y_t \quad (3)$$

The process of potential GDP ($\bar{Y}$) is supposed to contain two equations as following:

$$\begin{cases} \bar{Y}_t = \bar{Y}_{t-1} + G_t + \varepsilon_t^{\bar{Y}} & (4) \\ G_t = \theta G^{ss} + (1-\theta) G_{t-1} + \varepsilon_t^G & (5) \end{cases}$$

[7] The theoretical model is inspired from Chafik (2018). However, a small open economy is assumed in this paper and the model incorporates exchange rate, oil prices and a simplified external sector bloc.

This representation assumes that the potential output ($\bar{Y}$) evolves according to a growth rate (G) which is a function of its steady-state (G^{ss}) and the adjustment speed (θ). This process involves two types of shocks: a level shock ($\varepsilon^{\bar{Y}}$) and a growth rate shock (ε^{G}). The two shocks will lead to a permanent change in the level of potential output, but in the second case the rise or fall will take place gradually.

The output gap dynamics follows an augmented IS curve, where φ_1 is the inertia coefficient, φ_2 the coefficient of the real monetary condition index (mci_t), φ_3 the coefficient of the oil prices, φ_4 the coefficient of World's output gap and ε^y is an aggregate demand shock:

$$y_t = \varphi_1 y_{t-1} - \varphi_2 mci_t + \varphi_3 oil\_prices_t + \varphi_4 y_t^{world} + \varepsilon_t^y \qquad (6)$$

The inflation bloc –Phillips curve:

The inflation (π) is described through a New-Keynesian Phillips curve with forward-looking inflation expectations (π_{t+1}) and real marginal costs (rmc_t):

$$\pi_t = \lambda_1 \pi_{t+1} + \lambda_2 rmc_t + \varepsilon_t^{\pi} \qquad (7)$$

Real marginal costs are the weighted average of output gap as an approximation of domestic producers' costs, and the real exchange rate gap (z_t^{gap}) for importers' costs. An increase in the output gap means a higher domestic production costs, while an exchange rate depreciation means a higher importation costs -both in real terms:

$$rmc_t = \lambda_3 y_t - (1 - \lambda_3) z_t^{gap} \qquad (8)$$

The unemployment bloc –Okun's law:

This block links the unemployment rate (U_t) to the output gap through a dynamic Okun's law:

$$\begin{cases} U_t = \bar{U}_t - u_t & (9) \\ u_t = \tau_2 u_{t-1} + \tau_1 y_t + \varepsilon_t^u & (10) \\ \bar{U}_t = (\tau_4 \bar{U}^{ss} + (1 - \tau_4)\bar{U}_{t-1}) + g\bar{U}_t + \varepsilon_t^{\bar{U}} & (11) \\ g\bar{U}_t = (1 - \tau_3) g\bar{U}_{t-1} + \varepsilon_t^{g\bar{U}} & (12) \end{cases}$$

Equation (9) assumes that the unemployment rate is determined by the equilibrium unemployment rate ($\bar{U}$) -the NAIRU- and the cyclical unemployment rate (u). The latter is linked to the output gap (y) using equation (10) which is an Okun's law. Equations (11) and (12) determine the equilibrium unemployment rate which is supposed to depend on its steady-state ($\bar{U}^{ss}$) and the variations of the trend ($g\bar{U}$). These equations (11 and 12) allow the equilibrium unemployment rate to vary over time and to deviate from its steady-state.

The monetary conditions bloc:

This bloc defines the monetary condition index (mci_t) which impact the aggregate demand. The monetary condition index is the weighted average of the real interest rate gap (rr_t^{gap}) and the real exchange rate gap (z_t^{gap}):

$$mci_t = \rho_3 rr_t^{gap} - (1 - \rho_3) z_t^{gap} \qquad (13)$$

A higher gap of real interest rate implies a tighten monetary conditions, while a higher real exchange rate gap implies a loosening of monetary condition. In fact, more the real interest rate gap increases more the aggregate demand is discouraged because of the higher money costs. In contrast, more the real exchange rate gap increases more the aggregate demand is encouraged due to the lower import costs.

The real interest rate gap is the difference between the real interest rate (rr_t) and the neutral real interest rate ($rr_t^{neutral}$) -equation (16). The first one is implied by Fisher-equation (equation (14)) where nr_t is the nominal interest rate and π_{t+1} is the expected inflation. The neutral real interest rate is the real interest rate consistent with the potential growth of output (G) that would prevail if output gap is zero (equation 15).

$$\begin{cases} rr_t = nr_t - \pi_{t+1} & (14) \\ rr_t^{neutral} = \rho_4 rr_{t-1}^{neutral} + (1 - \rho_4) G_t + \varepsilon_t^{rr^{neutre}} & (15) \\ rr_t^{gap} \;= rr_t - rr_t^{neutral} & (16) \end{cases}$$

The nominal interest rate results from the UIP condition as the sum of US nominal interest rate (nr_t^{US}), the risk premium ($prem_t$) and the differential between market-expected nominal exchange rate ($s_t^{market\_expected}$) and the nominal policy exchange rate (s_t^{policy}).

$$nr_t = \left(s_t^{market\_expected} - s_t^{policy}\right) + nr_t^{US} + prem_t + \varepsilon_t^{nr} \qquad (17)$$

The nominal policy rate is fixed by the central bank[8] and the market-expected nominal exchange rate is assumed to depend on the policy exchange rate and expected increases in oil prices (oil_prices_{t+1}):

$$s_t^{market\_expected} = \rho_1 s_t^{policy} + (1-\rho_1)oil\_prices_{t+1} + \varepsilon_t^{s^{market\_expected}} \qquad (18)$$

The risk premium is determined by its inertia (pem_{t-1}), a steady-state ($prem^{ss}$) and it is subject to exogenous shock (ε_t^{prem}).

$$pem_t = \rho_2 pem_{t-1} + (1-\rho_2)prem^{ss} + \varepsilon_t^{prem} \qquad (19)$$

The real exchange rate gap is the difference between the real exchange rate (z_t) and the equilibrium real exchange rate (z_t^{eq}).

$$z_t^{gap} = z_t - z_t^{eq} \qquad (20)$$

The real exchange rate (z_t) is equal to the nominal exchange rate adjusted by inflation differential ($\pi_t^{US} - \pi_t$).

$$z_t = s_t^{policy} + (\pi_t^{US} - \pi_t) \qquad (21)$$

The equilibrium real exchange rate (z_t^{eq}) is the real exchange rate that prevail when the economy is growing by its potential (G).

$$z_t^{eq} = \rho_5 z_{t-1}^{eq} + (1-\rho_5)G_t + \varepsilon_t^{z^{eq}} \qquad (22)$$

[8] As it is a policy decision, it is a fixed in the model to 3.6725 AED per USD.

The external bloc:

The aggregate demand of the UAE economy is also sensitive to oil prices and world GDP (equation 6): When the oil prices increase, this will lead probably to an increase in public and private revenues that will encourage demand and increase the GDP. The increase of world aggregate demand would also increase the external demand addressed to UAE (oil and non-oil exports), and the GDP will increase too.

Oil prices are also a determinant of market expected exchange rate (equation (18)) as well as US interest rate and inflation that are respectively needed for the UIP condition (equation (17)) and for the real exchange rate calculation (equation (21)). Consequently, four main equations are added to the model in this external bloc. These equations describe the correspondent variables dynamics in a simplified way, but it has the advantage to allow the assessment of external shocks effects on the UAE economy.

$$\begin{cases} y_t^{world} = \mu_1 y_{t-1}^{world} + \varepsilon_t^{y^{world}} & (23) \\ \pi_t^{US} = \mu_2 \pi_{t-1}^{US} + \varepsilon_t^{\pi^{US}} & (24) \\ nr_t^{US} = \mu_3 nr_{t-1}^{US} + \varepsilon_t^{nr^{US}} & (24) \\ oil\_prices_t = \mu_4 oil\_prices_t - \varepsilon_t^{oil\_prices} & (25) \end{cases}$$

The model parameters are estimated for the UAE economy on yearly basis using Bayesian approach[9] for the period 2009-2017[10]. The results of this estimate as well as the assumptions are presented in Appendix 2. The dynamic properties of the estimated model in reaction to different shocks are presented in the next section.

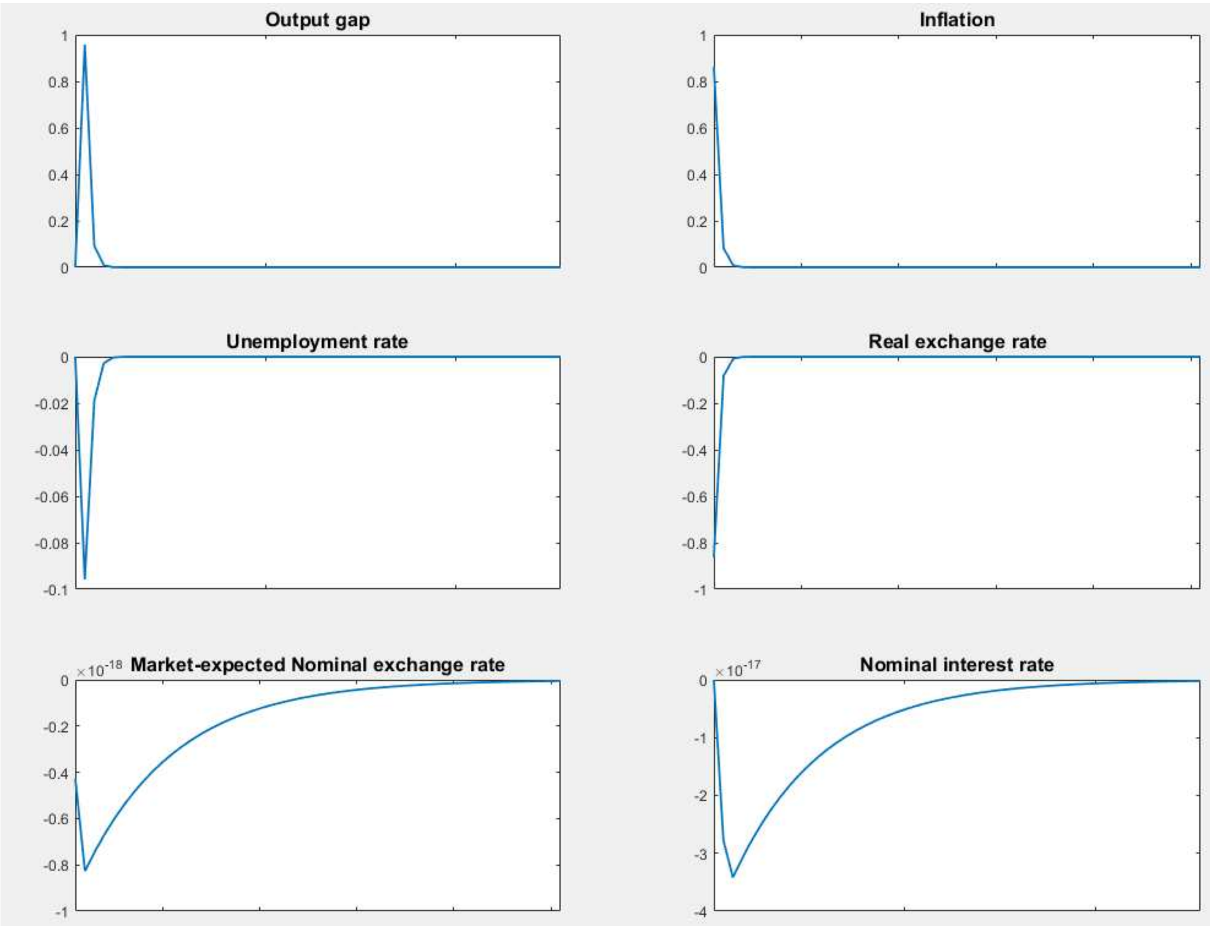
IV. Shocks transmission, monetary policy response and the role of market-expected exchange rate mechanism

[9] More precisely, a regularized likelihood maximization according to Ljung (1999) approach. Estimates of unobservable variables are obtained using a multivariate Kalman filter integrated to the estimation approach.
[10] Appendix 1 provides a descriptive table of the data used.

This section describes the transmission mechanisms in the UAE economy within the estimated model through four different shocks[11]: a demand shock, an inflation shock, a shock to US nominal interest rate and an oil prices shock. The analysis puts the scoop on the role of the real exchange rate in shocks transmission as well as the dynamic of the nominal interest rate and market-expected exchange rate mechanism. The objective is to show that for an oil exporting country like UAE, adjusting nominal interest rate only to foreign rate could be economically inconsistent when facing some external shocks such oil prices increases.

1. **Demand Shock**

Figure 1: Simulation results of a demand shock



Source: Author.

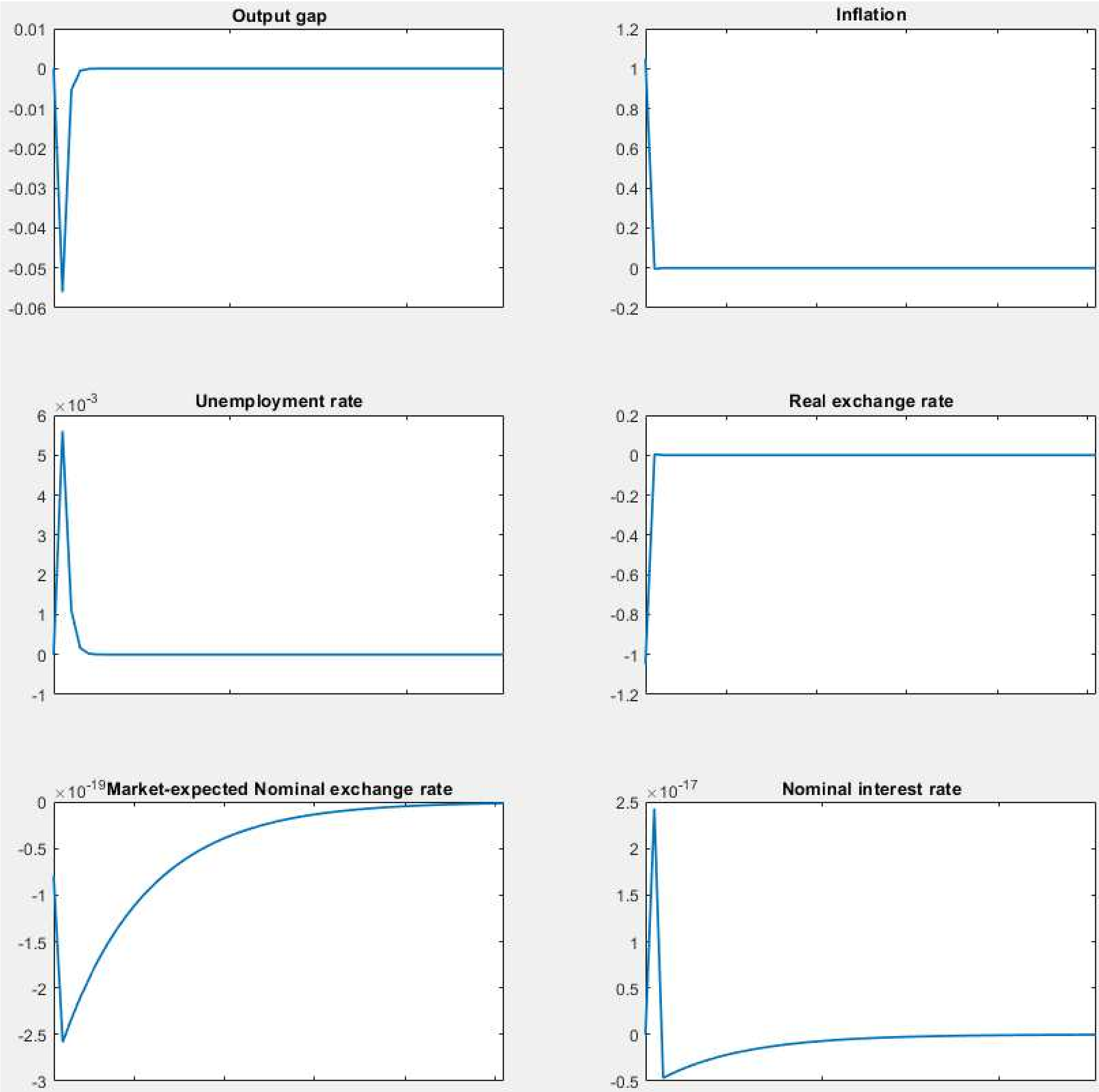
The higher demand leads to a higher inflation, a lower unemployment rate and a real exchange rate depreciation. The transmission of this domestic shock and the economy's adjustments are done

[11] All shocks simulate a temporary one period increase of 1% of the corresponding variable.

through the real exchange rate. Consequently, the nominal interest rate and market-expected exchange rate almost did not react (see Figure 1). In fact, the output gap improvement decreases the unemployment rate and increases the real marginal costs in the economy which lead to a higher inflation. As the nominal exchange rate is fixed, this inflation leads to a real exchange rate depreciation that makes the real marginal costs even higher, but in the same time, makes the real monetary conditions tighter. Consequently, demand is discouraged, and the shock is absorbed.

2. Inflation Shock

Figure 2: Simulation results of an inflation shock

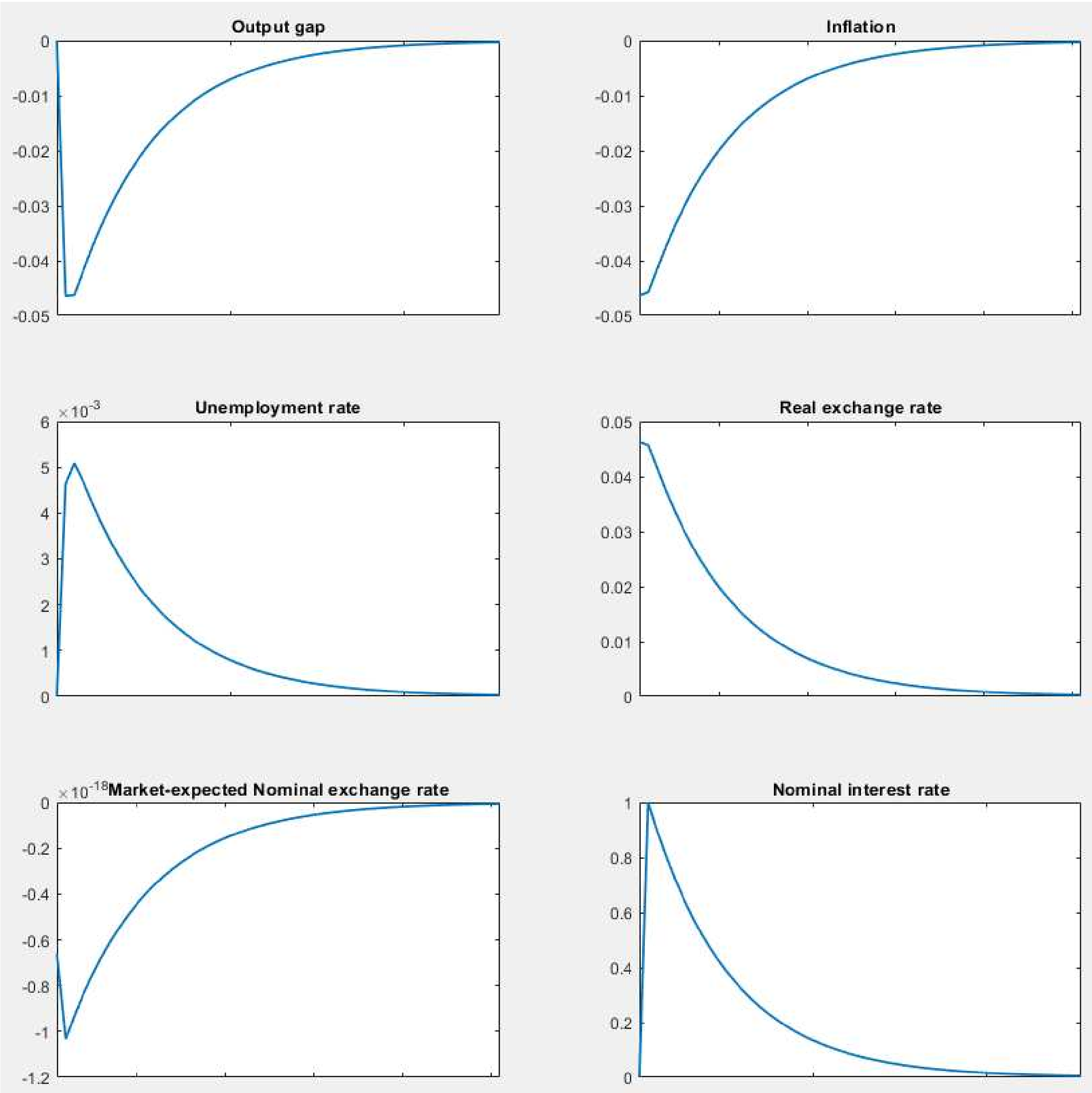


Source: Author.

For this positive inflation shock, the real exchange rate immediately adjusts to the higher inflation. Consequently, real monetary conditions become tighter and the output gap slightly drops, and the economy is adjusting through demand (see Figure 2). In fact, the lower output gap decreases the real marginal costs which reduce inflationary pressures and leads to looser monetary conditions, mainly through a second-round real exchange rate appreciation. Here too, the central bank does not have to use the nominal interest rate to react to the inflationary pressure or to the output drop because the adjustment is done through the real exchange rate mechanism.

3. Shock to US nominal interest rate

Figure 3: Simulation results of a shock to US nominal interest rate

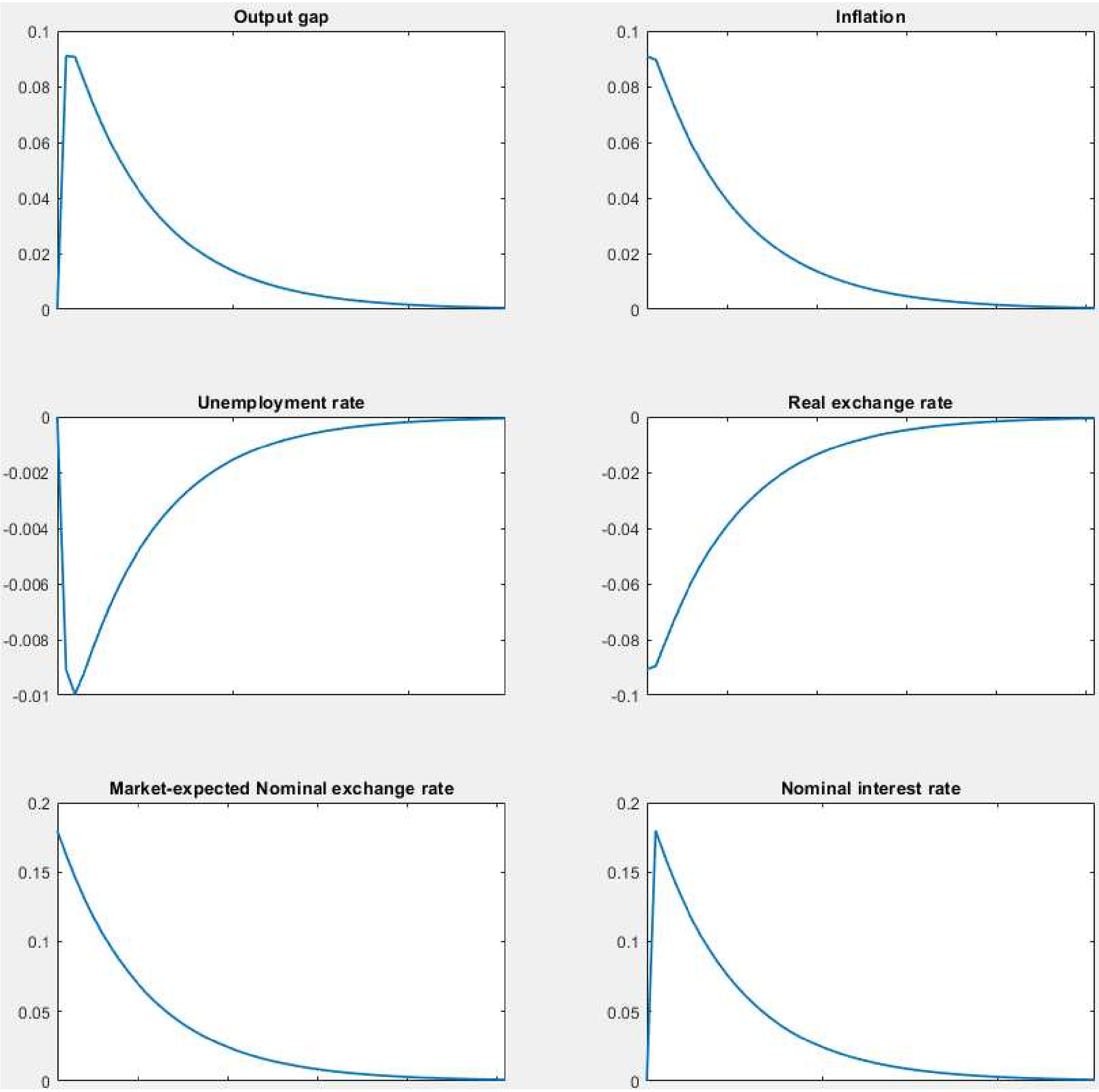


Source: Author.

In this case, the central bank will need to increase the nominal interest rate to discourage arbitrage between domestic and foreign assets. This makes the monetary condition tighter and discourages the demand which leads to a decrease in inflation. The real exchange rate depreciates and improves the monetary conditions which absorb the negative effect of the interest rate increase on demand (see Figure 3).

4. Oil prices shock

Figure 4: Simulation results of an oil price shock



Source: Author.

The importance of the market-expected exchange rate mechanism is clearly illustrated in this shock. In fact, the oil prices increase positively impacts expectations and leads to a spread between the nominal policy exchange rate and the market-expected exchange rate. In other words, the oil prices increase makes the domestic currency more valuable. Consequently, the central bank will need to increase its nominal interest rate to stabilize the economy and ensures the economic consistency (see Figure 4). In fact, the increase of oil prices implies a higher demand that leads to a lower unemployment rate and a higher inflation. Consequently, the real exchange rate depreciates, and the demand is encouraged even more. The nominal interest rate increase will counter these monetary conditions loosening implied by the real exchange rate depreciation and stabilize the economy.

V. Conclusion

This work suggests a framework for policy analysis in economies with fixed exchange rate and open capital account that are oil exporters. The analysis puts the scoop on the role of the real exchange rate in shocks transmission as well as the dynamic of the nominal interest rate and market-expected exchange rate mechanism. In such economies, the adjustments are done mainly through the real exchange rate. However, this paper shows the existence of a market-expected exchange rate mechanism that should be considered by central banks when reacting to oil prices shocks.

In fact, oil exporting economies are expected to improve, and the domestic currency is expected to become more valuable when the oil prices increase. The fixity of the nominal exchange rate implies an adjustment through the nominal interest rate to close the spread between policy and market-expected exchange rates, and to absorb the inflationary pressures and stabilize the economy. This work provides a tool to assess the consistency and the coherence between the nominal interest rate and the rest of the economy. The results of this paper seem intuitive and relevant, but do not claim to be perfect. Indeed, several improvements can be made, such adding the fiscal bloc or net foreign assets dynamics. Also, even if the long-run equilibrium of the economy and the external sector are endogenous, there are not very developed and cannot handle some effects such wealth mechanisms and contagion. Studying these aspects would surely contribute to the improvement of the understanding and may even lead to more interesting results.

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Appendix 1: Used data

The model is estimated on annual data of the UAE economy over the period 2009-2017. The variables used are:

1. **Real GDP**
   - Source: International Monetary Fund.
   - Unit: UAE Dirham.
   - Methodological Details: Constant prices.
2. **Inflation**
   - Source: World Bank.
   - Unit: Percentage.
   - Methodological Details: Annual growth rate of Consumer Prices Index.
3. **Unemployment rate**
   - Source: International Labor Organization.
   - Unit: Percentage.
   - Methodological Details: In percent of labor force.
4. **Nominal interest rate**
   - Source: Central Bank of the UAE.
   - Unit: Percentage.
   - Methodological details: Annual average of daily 1- year Emirates interbank offered rates.
5. **Oil prices**
   - Source: International Monetary Fund.
   - Unit: USD per barrel.
   - Methodological details: Dubai Crude Oil (petroleum), Dubai Fateh 32 API.
6. **US nominal interest rate**
   - Source: Organization for Economic Co-operation and Development.
   - Unit: Percentage.
   - Methodological details: Annual average of 3-month interbank rates for the United States.
7. **US Inflation**
   - Source: Organization for Economic Co-operation and Development.
   - Unit: Percentage.
   - Methodological details: Annual growth rate of Consumer Prices Index.
8. **World GDP**
   - Source: International Monetary Fund.
   - Unit: US Dollars.
   - Methodological details: Constant prices.

Appendix 2: Bayesian estimation results of model parameters for the UAE economy

Parameter	,Description	Prior	L. bound	U. bound	Distribution	Mean	Std	Dof	Posterior
theta	Adjustment speed of potential growth to steady state	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
phi1	Output gap inertia	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
phi2	Monetary conditions impact on output gap	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
phi3	Oil prices impact on output gap	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
phi4	World output gap impact on output gap	0.50	0.10	0.90	beta	0.50	0.10	nan	0.90
lambda1	Expectations impact on Inflation	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
lambda2	Real marginal costs impact on inflation	0.50	0.10	0.90	beta	0.50	0.10	nan	0.90
lambda3	Output gap weight in Real marginal costs	0.50	0.10	0.90	beta	0.50	0.10	nan	0.90
tau1	Output gap impact on unemployment gap	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
tau2	Unemployment gap inertia	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
tau3	NAIRU speed of variations	0.50	0.10	0.90	beta	0.50	0.10	nan	0.90
tau4	Adjustment speed of NAIRU to steady state	0.50	0.10	0.90	beta	0.50	0.10	nan	0.10
rho1	Policy exchange rate impact on market-expectation	0.50	0.01	0.80	beta	0.50	0.01	nan	0.80
rho2	Risk premium inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
rho3	Real interest rate weight in monetary condition index	0.50	0.10	0.80	beta	0.50	0.01	nan	0.47
rho4	Neutral real interest rate inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
rho5	Equilibrium real exchange rate inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
mu1	World output inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
mu2	US inflation inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
mu3	US nominal interest rate inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
mu4	Oil price inertia	0.50	0.30	0.90	beta	0.50	0.10	nan	0.90
std_E_LGDP_BAR	Shock to level of potential output	0.20	0.01	3.00	invgamma	0.20	0.01	nan	1.68
std_E_G	Shock to growth rate of potential output	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.10
std_E_Y	Shock to output gap	2.00	0.01	3.00	invgamma	2.00	0.01	nan	2.98
std_E_PIE	Shock to inflation	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.10
std_E_UNR_GAP	Shock to unemployment gap	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.10
std_E_UNR_BAR	Shock to NAIRU	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.46
std_E_G_UNR_BAR	Shock to growth rate of NAIRU	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.11
std_E_NIR	Shock to nominal interest rate	2.00	0.01	3.00	invgamma	2.00	0.10	nan	0.96
std_E_RIR_eq	Shock to neutral real interest rate	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.10
std_E_S_EX	Shock to market-expected nominal exchange rate	2.00	0.01	3.00	invgamma	2.00	0.10	nan	0.96
std_E_Z_eq	Shock to equilibrium real exchange rate	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.10
std_E_prem	Shock to risk premium	0.20	0.01	3.00	invgamma	0.20	0.01	nan	3.00
std_E_W_Y	Shock to World output gap	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.24
std_E_oil_price	Shock to oil price	0.20	0.01	3.00	invgamma	0.20	0.01	nan	3.00
std_E_US_PIE	Shock to US inflation	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.83
std_E_US_NIR	Shock to US nominal interest rate	0.20	0.01	3.00	invgamma	0.20	0.01	nan	0.22