A Small Open Economy Model: Assessing the Role of Monetary Policy in Egypt

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Abstract

This article presents a macroeconomic model of the Egyptian economy, first estimated following a simultaneous equations approach and using quarterly data over the period 2002q1 – 2017q2. This model, within a small open economy framework, features four equations describing the evolution of the main macroeconomic variables: real GDP growth rate, monetary policy rate, inflation rate and real effective exchange rate. Next, to draw causal interpretation from the interaction of these variables that could be useful for the conduct of monetary policy in Egypt, the model is complemented by a VAR approach featuring an exogenous block that is identified in a recursive way. The main results shed light on the role of anticipations in the business cycle, the primacy of the exchange rate over the interest rate as monetary policy transmission channel and the procyclicality of the latter. The effect of the external sector on the Egyptian business cycle is more ambiguous.

Keywords: Macroeconomics, Small Open Economy Model, Monetary Policy

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1 Introduction

Egypt has been suffering for several years from a deteriorated macroeconomic environment. As a mere illustration, the World Economic Forum (2017) ranked Egypt 132 among a total of 137 economies in terms of macroeconomic environment. In order to bring solutions to this issue, the free floating of the Egyptian Pound (EGP) was declared by the Central Bank of Egypt (CBE) on November 3, 2016, leading to an immediate 48% devaluation of this currency as the nominal exchange rate rose from 8.8 to 13 EGP per US Dollar (US$). This hike in the nominal exchange rate continued the following days and reached a value superior to 17 EGP per US$ (IMF, 2017b). This reform was required in order to obtain a US$12 bn loan from the IMF, but a shock of this magnitude does not occur without consequences on an economy. First assessments tend to evidence a rise in inflation (that has declined but remains relatively high since), an increase in output, lower non-oil imports and a hike in exports (IMF, 2018).

In this context, it becomes crucial to understand the monetary policy transmission mechanisms in Egypt in order to anticipate the impacts of an intervention. The objective of this article is to elaborate a macroeconomic model that represents the short-term and medium-term dynamics of the Egyptian economy. This model features four equations describing the evolution of the real GDP growth rate, the monetary policy interest rate, the inflation rate and the real effective exchange rate.

By estimating this model from quarterly date over the period 2002q1 – 2017q2 using the simultaneous equations method and then implementing a VAR model that is identified by a Cholesky recursive scheme and that features an exogenous block, this article makes several contributions to the existing literature. First, it analyses the short-term and medium-term dynamics of the post-2011 Revolution Egyptian economy. Then, by including a component capturing the anticipations in the real GDP growth rate equation, it illustrates that if it is true that consumption habits are a determinant of output, prospective behaviour is also such a determinant. Finally, it assesses the effectiveness of monetary policy transmission channels and allows therefore to formulate policy recommendations.

Corbo and Tessada (2003) develop a model of the Chilean economy and highlight the essential role of monetary policy credibility to control inflation, while Arbatli and Moriyama (2011) underline the weakness of the interest rate pass-through effect on inflation and the procyclicality of the monetary policy in Egypt between 2005q3 and 2010q2. Various authors, including Imbs (2004), use a simultaneous equations system to investigate the macroeconomic relationships within a small open economy framework. Ilzetzki and Vegh (2008) use this method to evidence a positive causal link between output and public expenditure in 49 developing countries.

The main results of this article validate the use of a new Keynesian IS curve and

evidence the primacy of the exchange rate over the interest rate as the monetary policy transmission channel in Egypt. The procyclicality of this policy is also highlighted, and the dynamics between the external sector and the Egyptian economy remains unclear.

The second section of this article reviews the literature on the macroeconomic modelling of developing countries within the framework of small open economies. Section 3 describes some stylized facts about the Egyptian economy, section 4 presents the empirical methodology as well as the data used, and section 5 describes the results. Finally, section 6 concludes and formulates policy recommendations.

2 Literature Review

For several decades, the Egyptian economy has been characterised by persistent imbalances (Zaki, 2017, and Herrera, Selim, Youssef and Zaki, 2010). Its currency devaluation on November 3, 2016 and the implementation of a floating exchange rate regime are not the first attempt to carry out these reforms in Egypt (Al-Mashat, 2008). In this context, it is particularly important to study the monetary policy transmission mechanisms. This section, after discussing the theoretical aspects of economic modelling, will present the findings of the literature on small open economy models applied to developing countries and on macroeconomic models of the Egyptian economy.

2.1 Theoretical discussion

Since the 1990s, the Dynamic Stochastic General Equilibrium (DSGE) models have been developed and adopted by numerous economic agents such as governments, central banks and international organizations. The DSGE models are based on the Real Business Cycle (RBC) models that appeared during the 1980's, and they explicitly incorporate nominal rigidities, following in this sense the Keynesian tradition.

Fève and Collard (2008) compare the relative performances of Vector Autoregressive (VAR) models and DSGE models on the growth rates of U.S. hourly labour productivity and hours worked between 1959 and 2003. Their results lead to the conclusion of a higher predictive capacity of DSGE models, which, in addition to their structural specification, gives them an advantage compared to the VAR models when identifying the structural shocks and their effects on the dynamics of aggregate variables.

In the same direction, McKibbin and Stoeckel (2018) argue for a greater complexity of DSGE models. The authors incorporate three extensions to a baseline model in order to take into account the linkages between global trade and financial markets, the role of relative prices (between different economic sectors) and the variations of risk premium. According to the authors, this complexification is both necessary and desirable in order

to understand the consequences of a great number of contemporary economic shocks and the issues on the conduct of economic policy.

Nevertheless, the popularity of this type of models among economists is at the centre of sharp debates, and their large-scale use has been criticized recently, with varying degrees of vigour, by different authors.

In a policy brief, Blanchard (2016) adopted a nuanced position, pointing out both the defaults of DSGE models and the flexibility they offer to adopt a high number of improvements, as well as their central place in the future of macroeconomics. The author details four limitations inherent to the actual DSGE models: hypothesis that, instead of being simplifying, simply do not correspond to observations, non-convincing estimation methods and normative implications, and a poor ability for result dissemination outside a small circle of specialists. He continues stating two desirable evolutions of DSGE models: a lesser insularity in order to include the advances from research in other fields of economics as well as less centric and better-defined place among the global offer of macroeconomic models. The author elaborates on this idea in an article the following year (Blanchard, 2017).

Stiglitz (2017) elaborates a more profound critic to DSGE models. Stating that these models have proved unable both to predict the more striking economic events since World War II and to provide useful recommendations to elaborate economic policy responses, the author criticizes the way these models assess several questions, and particularly the uncertainty and risk-management, two phenomena that lied at the heart of the 2008 global crisis. His plea in favour of an alternative reference macroeconomic model, instead of a complexification of DSGE models, is principally grounded on the structural incapacity of the theoretical framework of such models to predict the most important economic events, due to the absence of endogenization of the economic shocks, among others.

Considering the critics DSGE models have been subject to, it seems reasonable to use alternative approaches to identify and investigate the monetary policy transmission channels of the Egyptian economy. To do so in other contexts, additionally to the VAR models, various authors have chosen to use a simultaneous equation approach.

Among these authors, Imbs (2004) uses a simultaneous equations model to assess the linkages between trade of goods, financial opening, specialization and business cycles synchronization between different regions. His results evidence a non-negligible effect of specialization on the business cycle, as well as an increased synchronization among regions with strong financial linkages, despite an increased specialization.

Ilzetzki and Vegh (2008), using quarterly data for 49 countries over the period 1960 – 2006, build a system of simultaneous equations and estimate it with the OLS, among other methods, to find a causal link of output on public expenditure in developing countries. The

authors reach the conclusion that fiscal policy is procyclical in developing countries and that public expenditures have an expansionary effect on output, once the reverse causality issue is solved. Their investigation also highlights the intensification of the business cycle in developing countries through the transmission channel of fiscal policy.

Before reviewing the literature on the Egyptian economy, a discussion on the results of macroeconomic modelling in the context of developing countries is presented hereinafter.

2.2 Small open economy models of developing countries

Despite a high degree of heterogeneity, a great number of developing countries can be qualified as small open economies. The cases of the economies of Latin America and the Middle East and North Africa (MENA) are particularly interesting for this article.

In a general framework, not particularly focused on developing countries, Galí and Monacelli (2002) appraise three alternative monetary policy regimes through a small open economy model featuring rigid prices à la Calvo: domestic inflation targeting, consumer price index (CPI) targeting and fixed exchange rate. The authors highlight an arbitrage between (real and nominal) interest rate stabilization on the one hand, and output gap and inflation stabilization on the other hand: domestic inflation targeting stabilizes the inflation and the output gap at the cost of an increased volatility of the exchange rate, while CPI targeting and fixed exchange rate have the opposite effect. In addition, the authors obtain an implicit loss function for the consumer suggesting, under their hypothesis, that domestic inflation targeting is te optimal monetary policy. These results are of particular interest in the actual Egyptian context.

In the case of Argentina and Mexico, two emerging economies, García-Cicco, Pancrazi and Uribe (2010) observe that a RBC model, in which productivity shocks explain the aggregate fluctuations, is unable to replicate the economic cycles observed during the period 1900 – 2005. An augmented version that features different uncertainty sources has a greater ability to replicate the economic cycle when it is tested on Argentinian data.

Mukherjee and Bhattacharya (2011) take into consideration fourteen developing countries that have adopted an inflation targeting monetary policy regime, as well as five countries from the MENA, including Egypt, that are likely to adopt such a regime. Taking consumption and investment as the dependent variables instead of GDP, the authors claim that the interest rate is an effective monetary policy transmission channel in developing countries and that this channel remains unaltered after an inflation targeting regime is adopted. Their results also evidence several differences between the economies from the MENA and other developing economies: the opening of the capital account, in the MENA region, tends to promote private consumption instead of private investment, while the development of the domestic financial sector has a positive direct impact on

these two variables.

The Egyptian economy has characteristics that are similar to those of various Andean countries, Chile and Peru among others. Indeed, these developing countries, even if they do not rely on a unique commodity, are rentier economies to a relatively large extent (gaining large revenues from the Suez Canal and oil in the case of Egypt, or from copper, zinc and silver in the case of the Andean countries) and complement their exports primarily with traditional agricultural products or low value-added manufactured goods. Except for Chile, they also share the characteristic of having a high informal sector. Additionally, Chile and Peru can be considered as sources of inspiration for implementing the actual reforms in Egypt, as these two countries have already adopted a flexible exchange rate as well as an inflation targeting monetary policy regime and have maintained strong macroeconomic fundamentals, with low inflation, sound public finances management and an average but robust growth rate.

Acosta-Ormaechea and Coble (2011) assess the monetary policy transmission mechanisms comparing two economies with an established inflation targeting regime (Chile and New-Zealand) with two economies that have adopted this regime recently (Peru and Uruguay). The interest rate channel is effective both in Chile and New-Zealand, while the exchange rate channel prevails in Peru and Uruguay. Nevertheless, the exchange rate fades as a monetary policy transmission channel as the economy advances in the process of dedollarization.

Han (2014) builds a small model featuring four equations describing the aggregate demand, an expectations-augmented Phillips curve, a Taylor rule and the covered interest rate parity condition. The author analyses the effects of different external risks on Peru: the tightening of the US monetary policy and the slowdown of Chinese investments. His results suggest that the Peruvian economy is sensitive to these shocks and that they would ease with a higher degree of dedollarization and of flexibility of the exchange rate.

Castillo, Montoro and Tuesta (2009) build a small DSGE model incorporating a secondary currency that partially substitutes the domestic one to define and analyse the Peruvian monetary policy. This model includes real, monetary and financial rigidities. The authors, in line with Han (2014), conclude that dedollarization is key to increase the monetary policy ability to affect the output and to diminish the vulnerability of the economy to external shocks. Their simulations also highlight the importance of the Central bank credibility to anchor the private sector's anticipations in order to prevent excessive fluctuations and to control inflation.

In order to model the response of the Chilean economy to shocks that make it deviate from its stationary equilibrium, Corbo and Tessada (2003) build a small open economy model featuring four equations: the first one describes the output gap evolution, the

second one that of the real exchange rate, the third one that of inflation, and the fourth one is the Taylor rule. The value of each of these dependent variables dependes on both its own lagged values and other variables lagged and contemporary values. The equations of the Taylor rule and of the inflation dynamics include future values, that can be assimilated to rational expectations. The authors' results tend to confirm the high dependence of the Chilean economy to the external sector. Additionally, the prospective comportment of agents and monetary policy credibility of the Central bank allow this organization to carry out an anti-inflation policy. Nevertheless, rigidities due to inflation inertia lead to costs in terms of output gap.

After having presented the results of the literature on macroeconomic modelling in selected developing countries, it is possible to analyse the specificities of the Egyptian case.

2.3 Macroeconomic Models of the Egyptian Economy

While the recent economic literature on Egypt has focused to a large extent on the impacts of the Egyptian Pound devaluation, various authors have chosen to proceed through alternatives to macroeconometric models. Zaki, Ehab and Abdallah (2017) assess the effects of the devaluation on the intensive and extensive margins of exports using a gravity equation applied to microeconomic data on Egyptian firms from different sectors. Noureldin (2017) uses the OLS estimation method, as well as an Error Correction Model (ECM), to estimate the equilibrium of the real exchange rate and its deviations from this equilibrium as a function of the economic fundamentals over the period 2001q3 – 2017q3.

Nevertheless, various earlier articles have used different macroeconomic models to assess the behaviour of the Egyptian economy. Moursi and El Mossallamy (2010) build a small open economy DSGE model featuring flexible exchange rate, perfect capital mobility and a Taylor rule type monetary policy reaction function. Their results, over the period 2002m1 – 2008m8, suggest that the CBE has adopted an anti-inflation and interest rate-softening policy, and that shocks on external output have a significant impact on Egypt's GDP growth rate, inflation and interest rates. The authors observe also that the real interest rate only has a marginal impact on the Egyptian business cycle.

VAR models have also been applied to the Egyptian case. Hassan (2003) uses a SVAR (or Structural VAR) model to assess the monetary policy transmission mechanisms during the period 1992 – 2002. The author reaches the conclusion that monetary policy only has a limited effect through the credit channel and that Foreign-exchange reserves respond more to domestic credits than to nominal exchange rate. As Moursi and El Mossallamy (2010), Al-Mashat and Billmeier (2007), appraising the monetary policy transmission channels in Egypt based on a VAR model between 1996m1 and 2005m6, obtain results suggesting

that the exchange rate has an important role in the propagation of monetary shocks to production and to prices. Their results also point out a weak impact of the interest rate before 2005.

Other authors have used Computable General Equilibrium (CGE) models to assess different economic policy measures. El-Said, Löfgren and Robinson (2001) use a CGE model to evaluate the long-term impacts of four different development approaches on growth and distribution. Thissen and Lensink (2001) also use a CGE model to assess the macroeconomic impacts of a devaluation in Egypt. Their calibration method allows for variations in the parameters between different periods, for the modelling of different expectations structures (rational or adaptative) and for the inclusion of financial markets, and they are therefore able to analyse the medium-term impacts of a devaluation. The authors conclude from their study that a devaluation has a strong short-term impact on the current account, but also that this impact weakens in the medium-run, no matter which type of expectations is used. They also reach the conclusion that a devaluation will have a significant impact on the output, and that this impact will remain strong in the medium-run. However, if it is true that this impact on output is positive when expectations are adaptative, it becomes negative with rational expectations, due to a strong initial impact on the rates that companies face.

Helmy and Zaki (2017) use a CGE model and a Granger causality test to test the twin deficits hypothesis, which they reject observing that the current account deficit is primarily determined by its own dynamics. The authors highlight an inverse causal relation, from the current account deficit to the budget deficit, and test the Feldstein-Horioka puzzle, that they also reject partially due to a high degree of capital mobility in Egypt.

Finally, Arbatli et Moriyama (2011) include a small open economy model of Egypt to the Global Projection Model (GPM) of the IMF. As Corbo and Tessada (2003), the authors use the output gap, the real effective exchange rate, the inflation and the monetary policy rate as dependent variables. Their data cover the period spanning from 2005q3 to 2010q2. Observing that the interest rate is a weak transmission mechanism in Egypt, the authors' conclusions are in agreement with those of Moursi and El Mossallamy (2010) and Al-Mashat and Billmeier (2007). They also reach the conclusions that a depreciation has a positive impact on the domestic output, that supply shocks and inflation expectations are important determinants of inflation and that the nominal interest rates are procyclical and therefore amplify the economic fluctuations during the period observed.

3 Stylized Facts

Due to the free-floating of the Egyptian Pound, among other reasons, the IMF approved on November 11, 2016 a US$12 billion Extended Arrangement Under the Extended Fund Facility for Egypt (IMF, 2017a). This agreement aims at eliminating some of the structural imbalances of the Egyptian economy, particularly the monetary and external ones. Zaki (2017) offers a presentation of these imbalances and evidences, among others, the lack of transparency of the monetary policy. Indeed, no inflation target has been defined and no activity report from the CBE indicates which technical measures have been adopted for the economy to converge towards a low inflation rate. The official abandoning of nominal exchange rate defence since November 2016 should allow the CBE to focus on the inflation rate once the initial shock on prices is absorbed, but this process is likely to take time (Noureldine, 2018) and no normative changes have been observed as the monetary policy objective is still determined by law no. 88 of 2003, which sets no specific medium-term inflation target nor band width.

The model built in this article features four equations describing the dynamics of the real GDP growth rate, of the monetary policy rate, of the inflation rate and of the real effective exchange rate between 2002q1 and 2017q2. In this section, a brief description of the evolution of these variables will be provided, after having mentioned the different phases of the Egyptian business cycle (see Zaki, 2017).

The period spanning from 2002 and 2008 is characterised by relatively high annual real GDP growth rate, especially from 2004, when a package of economic reforms was set up. After having reached growth rate superior to 7%, GDP growth decelerated as a consequence of the 2008 global crisis, before a sharp drop during the 2011 Revolution. The economic recovery was difficult as the quarterly growth rate did not exceed 3.3% until 2014. It reached a level of 4% in 2015 and remained above it since[1].

Table 1: Descriptive statistics of the main variables of interest

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	Mean	SD	Min	Max
Real GDP Growth Rate	62	0.04	0.03	-0.04	0.17
Inflation Rate	62	0.10	0.06	0.03	0.30
Real Effective Exchange Rate	62	122.6	25.3	84.2	171.4
Monetary Policy Rate	62	0.10	0.01	0.09	0.14

[1]The data for real GDP growth rate cited in this paragraph are extracted from the World Economic Outlook in the October 2017 edition.

In this context, the evolution of the four variables of main interest for this model can be summed up in Table 1. The year-on-year quarterly real GDP growth rate was on average 4.3% over the period, reaching a low point at -4.3% in 2011q1, that is during the most intense revolutionary events, and a maximum of 16.7% in 2007q4, just before the 2008 global crisis. The year-on-year inflation rate was on average 10.2% over the period, with a minimum of 2.6% and a maximum of 30.3% in 2017q2. The monetary policy rate, built as the mean value of the deposit and the lending rates set by the CBE, fluctuated between 8.5% and 14.1%. The real effective exchange rate, set at 100 in 2007m12 and for which an increase denotes a real appreciation of the Egyptian Pound with respect to the basket of currencies of Egypt's main trading partners, fluctuated between 84.2 and 171.4 over the period, with an average of 122.6.

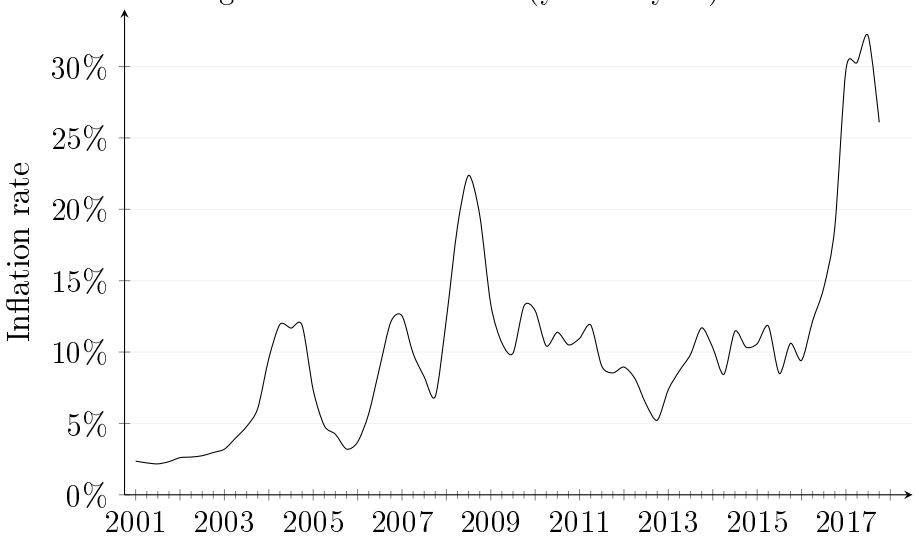
Figure 1: Real GDP Growth Rate (year-on-year)

Sources: IFS, CBE.

Figures 1 to 4 allow to observe the dynamics of the four variables of main interest over the whole period. The main data sources are the CBE and the International Financial Statistics (IFS) database from the IMF.

Inspecting the evolution of real GDP growth rate (Figure 1), the cycles previously mentioned appear clearly: high growth rates from 2004, a first drop in 2008 followed by another one in 2011, when the quarterly growth rate became negative, and a recovery characterized by a high volatility and rates below their level of the pre-2008 period. While the devaluation on November 3, 2016 does not seem to have negatively impacted the Egyptian economy's growth rate, the year-on-year quarterly inflation rate suffered a positive shock of high magnitude (Figure 2). Its evolution seems to have followed three phases: a positive trend characterized by a high volatility between 2002q1 and 2009q4, a relative stagnation around a level of 10% between 2010q2 and 2016q1 and a sharp increase

Figure 2: Inflation Rate (year-on-year)

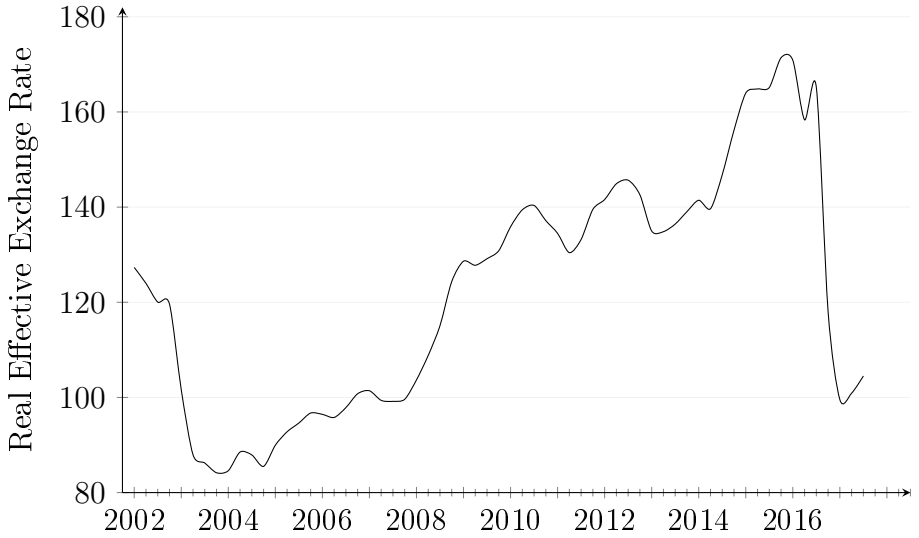


Source: CBE.

from 2016q2, until exceeding 20% in 2017. These three phases of the inflation rate seem to fit well with the GDP cycle of high growth until 2008, of modest recovery following the two negative shocks in 2008 and 2011, and of adjusting as a response to the nominal exchange rate liberalization.

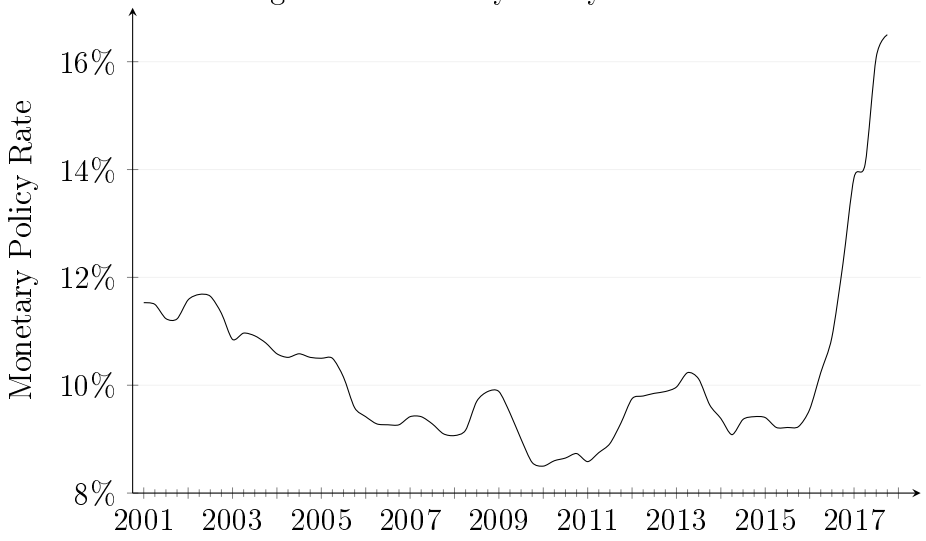
With respect to the evolution of the real effective exchange rate (Figure 3), the period is characterized by a constant appreciation of the Egyptian Pound in real terms from 2003q2 until a sharp depreciation in 2016q4. The relative stability of the nominal interest rate over the period, associated with an average inflation rate higher than 10% can explain this phenomenon.

Figure 3: Real Effective Exchange Rate



Source: Bruegel. An increase in the REER denotes an appreciation.

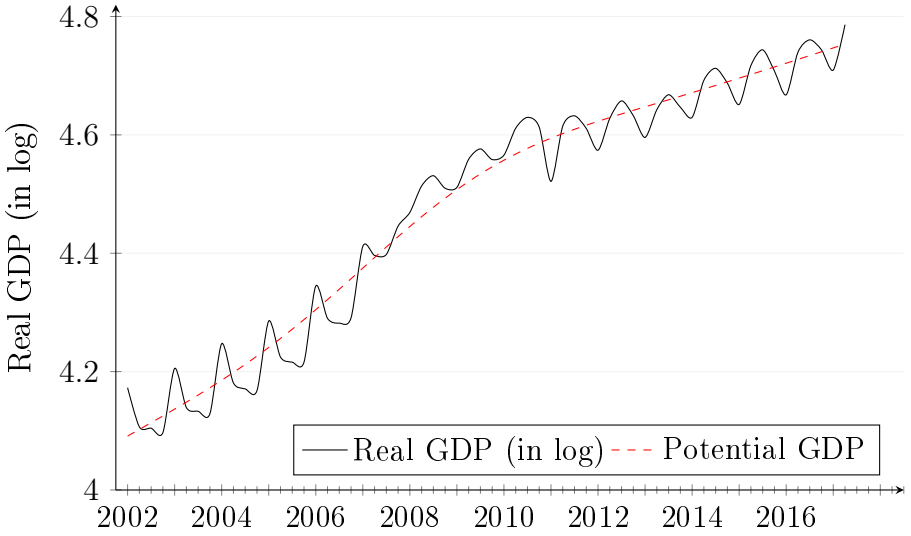
Figure 4: Monetary Policy Rate



Source: IFS. Construction by the author.

The monetary policy rate (Figure 4) seems, like the inflation rate, to have followed three phases: a downward trend between 2002q1 and 2008q1, followed by a relative stagnation associated with fluctuations of a higher amplitude between 2008q2 and 2016q1, and a sharp increase from 2016q2. This first observation of the monetary policy rate, although partial and poorly detailed, allows to venture the hypothesis of a graduation from a procyclical, expansionary monetary policy during the high-growth period before 2008 (consistent to the results of Arbatli and Moriyama, 2011) to a monetary policy aiming at controlling inflation, contractionary when the latter accelerated during the most recent period.

Figure 5: Real GDP and Potential Real GDP (in log)

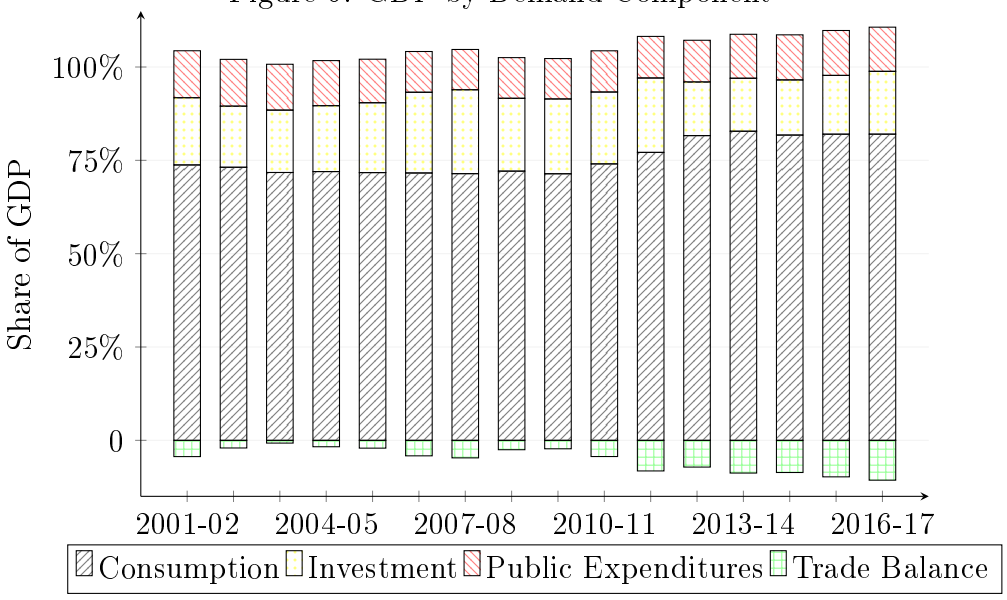


Sources: IFS, CBE. Computation and construction by the author.

Figure 5 focuses on the real GDP of the Egyptian economy. Frequently, the output gap is the variable that will most likely be included in macroeconomic models (Corbo and Tessada, 2003, among others) aiming at analysing the business cycle. The evolution of real GDP is marked by an upward trend over the whole period and a seasonal cyclicality phenomenon. A Hodrick-Prescott (HP) filter has been applied to its non-seasonally adjusted logarithm in order to dissociate the tendency, or potential output, from the short-term fluctuations, or output gap. Nevertheless, a simple sight allows to detect a rupture in the seasonality between 2008q2 and 2011q1. These two dates correspond to the 2008 crisis and the Egyptian Revolution in 2011. A closer look at this time series allows to observe that yearly peaks in output during the period 2011 – 2017 are inverted compared to the period 2002 – 2008q2: the seasonal peak is reached in q3 from 2001, but it was reached in q1 during the period prior to the 2008 financial crisis. Because of this characteristic, the statistical technique of seasonal adjustment of this series proves ineffective and it is not possible to use the output gap to assess the short-term dynamics of Egyptian real GDP. For this reason, it is preferable, in the Egyptian case, to use the year-on-year quarterly real GDP growth rate.

Figures 6 describes the GDP decomposition by the demand components and Figure 7 presents the GDP decomposition by economic sector.

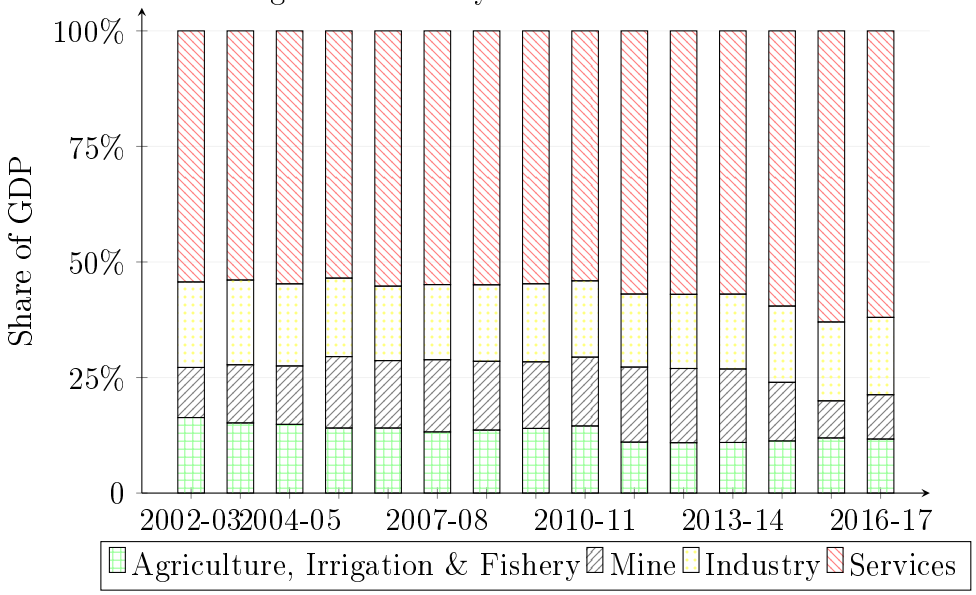
Figure 6: GDP by Demand Component



Source: CBE. Fiscal Year 2001-02 spans from July 2001 to June 2002.

As evidenced in Figure 6, consumption is, by far, the first demand component, with a share accounting for 70% to 80% of GDP between 2001q1 and 2017q2. The investment fluctuates between 15% and 20% of GDP, but its share declines in 5.5 percentage points

Figure 7: GDP by Economic Sector



Source: CBE. Fiscal Year 2002-03 spans from July 2002 to June 2003.

in 2012, falling from 20% to 14.5%. Public expenditures appear to be relatively low and fluctuate between 11% and 12.5% of GDP, while the foreign trade has a negative contribution to the GDP, the trade balance being in deficit over the whole period.

When decomposing the GDP by economic sector (Figure 7), it clearly appears that the service sector dominates the Egyptian economy, with a share of between 55% and 60% of GDP. The modest share of agriculture, irrigation and fishery shrinks over the period, from 16,5% to 11,5% of GDP between 2002q2 and 2017q2. While the share of mining activities in GDP is almost divided by two, from 15.9% in 2013 to 8% in 2015[2], the share of industry remains stable at around 17%.

4 Empirical Strategy and Data

4.1 Specification

In order to model the short-term and medium-term dynamics of the Egyptian economy, the small open economy macroeconometric model developed in this article, inspired by Corbo and Tessada (2003), features four equations whose endogenous variables are the real GDP growth rate (equation 1), the monetary policy interest rate (equation 2), the inflation rate (equation 3) and the real effective exchange rate (equation 4).

[2]This spectacular result appears nonetheless coherent with the evolution of commodity prices, in particular oil.

$$y_t = \alpha_1 + \alpha_2 y_{t+1} + \alpha_3 y_{t-1} + \alpha_4 y^*_{t-1} + \alpha_5 capflows_{t-1} + \alpha_6 reer_{t-1} + \alpha_7 mpr_{t-1} + \varepsilon_t \quad (1)$$

Equation (1) is an IS curve describing the dynamics of the real GDP growth rate, y_t, instead of the output gap, for the reasons mentioned previously. A great number of studies, such as Stracca (2010), highlight the importance of expectations as a determinant of output. Incorporating the future value of the real GDP growth rate, y_{t+1}, equation (1), following the new Keynesian tradition and relying on the hypothesis of rational expectations, takes into account the role of the agents' expectations in their decisions of consumption and investment. The past values of the Egyptian real GDP growth rate, y_{t-1}, and of the real GDP growth rate of Egypt's main trading partners, y^*_{t-1}, are also included among the independent variables. To rule out endogeneity due to a potential reverse causality, the logarithm of the available capital flows, $capflows_{t-1}$, has been included among the independent variables, instead of the capital inflows in Egypt. These flows account for both the foreign direct investments and the portfolio flows from the European Union, the United States of America, China and Saudi Arabia. Finally, the lagged value of the logarithm of the real effective exchange rate, $reer_{t-1}$, and the lagged value of the monetary policy rate, mpr_{t-1}, are also included as explanatory variables.

$$mpr_t = \beta_1 + \beta_2 \pi_{t+1} + \beta_3 y_t + \beta_4 mpr_{t-1} + \beta_5 mpr_{t-2} + \mu_t \quad (2)$$

Equation (2), the Taylor rule of the Egyptian economy, represents the monetary policy reaction function. The monetary policy rate, corresponding to the mean value of the deposit and the lending rates set by the CBE, depends on the expected value of the one period ahead inflation, π_{t+1}, on the contemporary domestic real GDP growth rate, at period t, as well as on the two immediate lagged values of the monetary policy rate, at periods $t-1$ and $t-2$.

$$\pi_t = \gamma_1 + \gamma_2 \pi_{t+1} + \gamma_3 y_{t-1} + \gamma_4 reer_{t-1} + \gamma_5 \pi_{t-1} + \gamma_6 \pi_{t-2} + u_t \quad (3)$$

Equation (3) describes the dynamics of inflation in the Egyptian economy. As in the case of the previous equations, it relies on the hypothesis of rational expectations, the expected value in period t of inflation in $t+1$ being assumed to be equal to π_{t+1}, the actual value of inflation in $t+1$. The other explanatory variables are the immediate lagged value of the domestic real GDP growth rate and the logarithm of the real effective exchange rate, as well as the two immediate lagged values of inflation

$$reer_t = \delta_1 + \delta_2 y_t + \delta_3 reer_{t-1} + \delta_4 reer_{t-2} + v_t \quad (4)$$

Finally, Equation (4) describes the dynamics of the real effective exchange rate (in logarithm), the variable embodying the main link between the Egyptian economy and the external sector. This exchange rate is built by Darvas (2012) taking into account 138 trading partners. The explanatory variables are the domestic real GDP growth rate and the two immediate lagged values of the (logarithm of the) real effective exchange rate. With this specification, there is a coherence among equations (2), (3) and (4), each of them including on the right-hand side of the equation the two immediate lagged values of their respective dependent variables.

Each of the equations includes a random shock: ε_t in equation (1), μ_t in equation (2) u_t in equation (3) and v_t in equation (4). These random shocks are assumed to have a zero-mean value, a constant variance and to be non-autocorrelated. They are therefore assumed to be white noise. Each of the equations also includes a constant term: α_1 in equation (1), β_1 in equation (2) γ_1 in equation (3) and δ_1 in equation (4).

This model will be econometrically estimated as a system of simultaneous equations. Following Wooldridge (2002), the identification of each of these equations is assumed to be verified if the order condition, that is necessary but not sufficient, is verified. The author adds that an equation within a system of simultaneous equations verifies the order condition if the number of exogenous variables excluded from the equation is at least equal to the number of endogenous variables in the right-hand side. Based on this criterion, each of the equations satisfies the order condition and the model is therefore assumed to be identified. By default, the main statistical softwares estimate a simultaneous equations model using the method of Three-Stage Least Squares (3SLS). It is also possible to use the Two-Stage Least Squares (2SLS) and the Seemingly Unrelated Regression (SUR) methods. However, for this model, the results do not differ significantly between these three approaches, and the 3SLS is the only one to estimate the model as a system of equations, and not following an equation-by-equation procedure. Furthermore, the 3SLS method has potentially better properties in finite set than the alternatives (Wooldridge, 1999). For these reasons, the 3SLS method is chosen for the estimation of this model.

As the parameters of such a model are not the structural parameters of the economy, it is possible to highlight interesting correlations, but no causal interpretation can be robustly inferred from the results of the estimation. To establish causal links, two approaches can be followed: one can resort to instrumental variable or, as an alternative, to Structural VAR models. This article uses this second approach.

The simultaneous equations model is complemented with a VAR model of the Egyptian economy that contains 6 equations. In addition to the four endogenous variables of the previous model, the VAR model also incorporates an equation for the real GDP growth rate of the trading partners and for the availability of capital flows. In order to uncover

the structural parameters, the identification strategy follows a recursive way, through the Choleski decomposition. However, in order to remain within a small open economy framework, the variables that are determined within the external sector must not be affected by the evolution of the Egyptian economy. For this reason, following Franken, Le Fort and Parrado (2006), this model features a block exogeneity restriction. Therefore, the domestically determined variables cannot affect the international bloc that comprises the real GDP growth rate of the trading partners and the availability of capital flows, but these two variables are interrelated among each other.

The Choleski decomposition relies on identification assumptions that are explicitly based on economic theory. Therefore, the identification of the structural parameter is achieved using a series of assumptions. Firstly, the availability of capital flows reacts contemporaneously to the output of the trading partners, while the opposite is not true. Secondly, all domestic variables react contemporaneously to the international variables. Thirdly, the monetary policy rate responds contemporaneously to the variables that can be observed in the short term, such as prices and the exchange rate, but not to activity (output). Fourthly, the prices of goods respond contemporaneously to the variables that affect them directly, the international prices. As the nominal exchange rate is not included in the model and was fixed until 2016q4, domestic prices do not respond to the exchange rate. Fifthly, the real effective exchange rate also responds contemporaneously to the variables that directly affect it, *i.e.* the international and domestic prices of goods and services. Sixthly, the real GDP responds to all the other variables but can only affect them with a lag.

Based on the Schwarz and the Hannan-Quinn Information Criterions, this VAR model includes two lags. This model also satisfies the stability condition, as all the inverse roots lie inside the unit circle[3]. Furthermore, it is worth mentioning that the results of this are robust to modifications in the specification, as no qualitative changes emerge. The only qualitative difference observed when the position of the real effective exchange rate is altered (in both directions) is the appearance of the well-known price puzzle. However, this phenomenon is only slightly significant and does not last longer than two periods.

4.2 Data

The data of the Egyptian real GDP are taken from the CBE and IFS databases, as well as the inflation rate and the monetary policy interest rate. The data for the real GDP of Egypt's trading partners come from the IFS and the World Development Indicators (WDI) databases. The data for the capital flows mainly come from the IFS database and are

[3]Including four lags, which is what would intuitively be preferred in the case of a VAR model with quarterly data, does not affect this stability condition.

complemented by data from the United Nations Conference on Trade and Development (UNCTAD) database for the foreign direct investments between 2001 and 2004. Finally, the data of the Egyptian real effective exchange rate with respect to 138 trading partners come from a dataset issued by Bruegel.

The availability of capital flows corresponds to the 28 members of the European Union (except for Austria, Cyprus, Luxembourg and Belgium due to missing data for some years), the United States of America, China and Saudi Arabia. The real GDP growth rates of the trading partners are built from the IFS dataset, that includes an index number with a value of 100 in 2010, and the WDI dataset, that includes the GDP in 2010 US$. This variable includes the seasonally-adjusted series of the 28 members of the European Union, the ASEAN countries and China, South Korea and Japan, as well as the member states of the Arab League (except for Somalia, Tunisia, Libya, Syria and Qatar due to missing values). The relative weights of the different trading partners have been computed using data from the International Trade Centre database.

Each time series is quarterly and covers the period spanning from 2002q1 to 2017q2. There is therefore a total of 62 observation, but only 58 of them appear in the estimation results. The use of real GDP growth rates for Egypt and its trading partners instead of the output gap leads to missing data in 2002q1 and 2017q2 (due among other reasons to the use of the y_{t+1} variable). Furthermore, including the logarithm of available capital flows generates two additional missing values. This loss of quantitative information is nevertheless offset by a qualitative benefit.

5 Results

5.1 The Simultaneous Equations Model

Table 2 presents the results of the estimation of the simultaneous equations model by the 3SLS method. Each equation has 58 observations, the R^2 of equation (1) is superior to 0.6 while this value is superior to 0.9 for each of the remaining equations. The p-value corresponding to the Chi-squared statistic is inferior to 5% and close to zero for each equation. As a consequence, each of the equations is able to explain a high share of its endogenous variable's variance, and the hypothesis H_0 of global non-significance is rejected for each equation. A set of dummy variables for (civil year) quarters 2, 3 and 4 has been added to each equation to control for potential seasonality effects.

The evolution of the Egyptian real GDP growth rate, the main variable of the model but also the most fragile as explained in section 3 (stylized facts), is globally in line with the economic theory. The choice to include the variable y_{t+1}, the new Keynesian component of the equation corresponding to the rational expectations of the agents is

Table 2: Results of the Simultaneous Equations Model

VARIABLES	(1) y_t	(2) mpr_t	(3) π_t	(4) $reer_t$
y_{t+1}	0.373***			
	(0.099)			
y_{t-1}	0.321***		-0.062	
	(0.098)		(0.064)	
y^*_{t-1}	-0.325**			
	(0.162)			
$capflows_{t-1}$	-0.006			
	(0.007)			
$reer_{t-1}$	-0.046**		-0.016	1.386***
	(0.018)		(0.011)	(0.119)
mpr_{t-1}	-1.025***	1.579***		
	(0.373)	(0.094)		
π_{t+1}		0.028***	0.515***	
		(0.006)	(0.045)	
y_t		-0.023**		0.412
		(0.011)		(0.337)
mpr_{t-2}		-0.610***		
		(0.099)		
π_{t-1}			0.729***	
			(0.097)	
π_{t-2}			-0.138	
			(0.092)	
$reer_{t-2}$				-0.422***
				(0.124)
$quarter_2$	0.014	-0.000	-0.002	-0.004
	(0.009)	(0.001)	(0.005)	(0.022)
$quarter_3$	0.012	-0.000	-0.003	0.020
	(0.008)	(0.001)	(0.005)	(0.022)
$quarter_4$	0.017**	-0.001	-0.003	-0.015
	(0.008)	(0.001)	(0.005)	(0.022)
$constant$	0.387***	0.002	0.069	0.150
	(0.146)	(0.004)	(0.050)	(0.211)
Observations	58	58	58	58
R-squared	0.617	0.954	0.917	0.927
Chi-squared	100.38	1300.29	696.23	764.99
Estimation method	3SLS	3SLS	3SLS	3SLS

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

completely justified by the results. Indeed, the expectations seem to be a driving force of the business cycle as an increase of one unit in the anticipated value at t of the real GDP growth rate in $t+1$ is associated with an increase of 0.37 units in the real GDP growth rate at period t. Because these variables are not in logarithm, it is possible to reason in terms of units or percentage points, *i.e.* in terms of hundredth of units. The real GDP at t is also positively correlated to the real GDP at $t-1$, as an increase of one percentage point in the real GDP growth rate during the preceding period is associated with an increase of 0.32 percentage points in the current real GDP growth rate.

The variables y^*_{t-1} and $capflows_{t-1}$ embody the external sector. The p-value of the available capital flows estimator being superior to 5%, this coefficient is not statistically different from 0 at the 5% level of significance and therefore does not seem to be positively correlated with the Egyptian business cycle. However, the coefficient of the trading partners' real GDP growth rate is negative and statistically significant. Furthermore, it is economically significant, as an increase of 1 percentage point in the trading partners' real GDP growth rate is associated with a 0.33 percentage points drop in the Egyptian real GDP growth rate. This result in counterintuitive and seems to be in opposition to the economic theory: a higher trading partners growth rate is associated with increased exports prospects as well as a higher availability of long-term foreign capital. In addition to the non-significance of the availability of capital flows, the hypothesis, not tested by this model, of a positive impact of global growth on energy commodities prices could explain the negative relationship between Egypt's trading partners real GDP growth rate and its own. Another hypothesis could account for this result: while GDP growth accelerated in 2011 in advanced economies as many of them were recovering from the 2008 crisis, Egypt's GDP growth rate fell sharply from the 2011q1 Revolution and due to the political instability of the following periods, several quarterly growth rates being even below zero. This hypothesis would therefore suggest that, over the period considered by this article, the short-term and medium-term dynamics of the real GDP in Egypt responded to a greater extent to internal shocks and stimulus than external ones. Additional variables would have to be included to the model in order to shed lights on this characteristic.

The estimator of the real effective exchange rate is negative and statistically significant at the 5% level. This result is consistent with the economic theory: a depreciation of the domestic currency has a positive impact on the GDP because it creates incentives to increase the exports and substitute the imports, whose price increases due to a higher relative value of foreign currencies, by domestically-produced goods. This result is also highly significant from an economic standpoint, as a 1% depreciation in the real effective exchange rate is associated to an increase in GDP of 0.046 units, *i.e.* of 4.6 percentage points.

Contrary to the results in Goodhart and Hofmann (2005) for the G7 economies, the monetary policy rate coefficient is statistically and economically significant. In accordance with the theory, an increase in the monetary policy rate, which corresponds to a contractionary monetary policy, is associated with a negative impact on the real GDP growth rate in the short-term due to a fall in the returns on investment and increased incentives to save instead of consuming. The coefficient's value of -1.025 indicates that an increase of one percentage point in the monetary policy rate is associated with a 1.03 percentage points drop in real GDP growth rate. The sacrifice ratio of an anti-inflation monetary policy in terms of output growth appears to be high in Egypt.

The results from equation (2) are also stimulating. The monetary policy rate at period t, the dependent variable, is significantly correlated with its two immediate lagged values. The coefficient of the expectations at t of inflation at $t+1$ is positive and statistically significant and seems to indicate that this interest rate can be used as a monetary policy instrument to control inflation. An increase of one percentage point in expected inflation at t for the following period is associated with a modest increase of 0.03 percentage points in the monetary policy rate by the CBE. Finally, the coefficient of the Egyptian real GDP growth rate is statistically significant at the 5% level and negative: a one percentage point drop in the growth rate is associated with an increase of 0.02 percentage points in the monetary policy rate. Despite the fact that this effect appears to be quantitatively low, it is nevertheless economically significant: the negative sign and the statistical significance of the coefficient evidences the procyclicality of the monetary policy in Egypt. This result suggests a possible amplification of the business cycle due to the EGB's reaction to different shocks that affect the Egyptian economy. In such a case, the sacrifice in terms of output, and therefore in terms of employment and consumption, necessary to achieve a decline in the inflation rate appears to be relatively high.

The equation (3) describes the dynamics of inflation in Egypt. Since the devaluation of the Egyptian Pound, this variable has been the focal one and has received much attention: its rate increased sharply and exceeded 30% year-on-year in 2017q1. The results presented in column (3) of Table 2 suggest that inflation mainly responds to its own dynamic in Egypt, as the coefficients of the lagged real GDP growth rate and the lagged real effective exchange rate are not statistically significant. If it is true that the coefficient of inflation at $t-2$ is not significant either, inflation at period t depends positively, to a high degree, on its own lagged value and its expected future value. An increase of one percentage point in the lagged inflation rate is associated with an increase of 0.73 percentage points in the inflation at period t, while a one percentage point increase in the expected inflation rate is associated with a 0.52 percentage points increase in the inflation at period t. This response of inflation to its own dynamics is an additional indication of the difficulties to

implement an anti-inflation monetary policy in Egypt.

Lastly, the results from equation (4) also highlight the fact that the real effective exchange rate (expressed in logarithm) responds mainly to its own dynamics. The real GDP growth rate coefficient is not statistically significant, and the real effective exchange rate at period t is positively correlation with its value at $t-1$: a 1% increase in the real effective exchange rate at $t-1$ is correlated with a 1.39% increase in this variable at period t. This variable is also negatively, but weakly, correlated with its own value at $t-2$. This internal dynamics of the real effective exchange rate does not seem as robust as the inflation's own dynamics, as it appears to be less permanent.

The majority of the empirical results obtained from this model are in line with the economic theory. As Corbo and Tessada (2003) find in the case of Chile, inflation does not seem to depend significantly on the past values of the real GDP growth rate in Egypt. However, these authors reach the conclusion that the Chilean business cycle is highly dependent on the external sector, while the results presented in table 2 seem to suggest the contrary in the Egyptian case. These results are also the opposite of the findings of Moursi and El Mossallamy (2010) for Egypt. Nevertheless, the results from this model are still incomplete and a more extensive study is still needed in order to reach a conclusion.

Additionally to the significant impact of the interest rate, the results, in agreement of the Al-Mashat and Billmeier's (2007) findings, highlight the important role of the real effective exchange rate on production, while the impact of this variable on the inflation rate does not seem significant. Furthermore, various results are similar to those of Arbatli and Moriyama (2011). Indeed, a depreciation has a positive impact on the real GDP growth rate and the expectations of future inflation are an important determinant of inflation. One of the main results from this model, the procyclicality of the nominal interest rate, is also in line with the results of these authors for the period 2005q3-2010q2: it seems that this characteristic of the monetary policy in Egypt has lasted over the entire past decade.

5.2 The VAR Approach

Figure 8 presents the responses of the real GDP growth rate to a positive innovation to various variables. The fact that none of these responses is statistically significant seems to suggest that in this model, the real GDP growth rate is primarily determined by its own dynamics. This result is consistent with the results from the simultaneous equations model and is confirmed byt the variance decomposition analysis (table 3): shocks to the real GDP growth rate explain 85% of the variance of this variable after one quarter, and still 63% after two years.

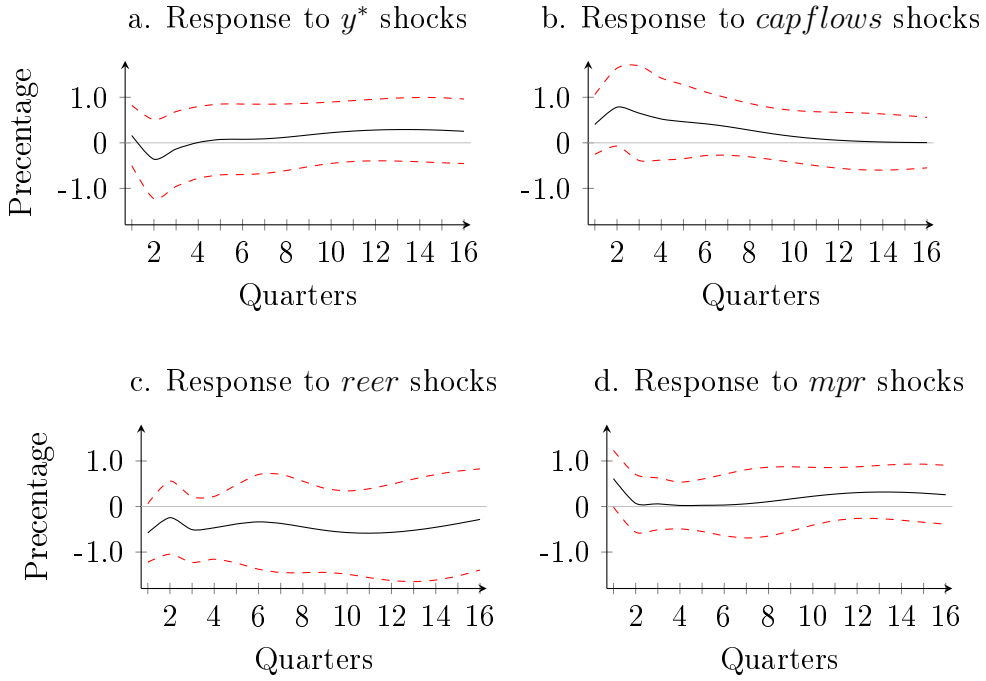
Figure 8.a., as well as the variance decomposition analysis, seems to confirm the hypothesis of a mere negative correlation instead of a structural relationship between Egypt's

Table 3: Egyptian Real GDP Growth Rate Variance Decomposition

Quarter	Std. Error	y^*	$fluxcap$	π	$reer$	mpr	y
1	0.03	0.40	2.51	0.63	5.21	5.78	85.47
2	0.03	1.86	9.25	3.41	4.74	4.52	76.22
3	0.03	1.75	12.06	4.80	6.58	3.84	70.97
4	0.03	1.60	13.55	4.87	8.03	3.52	68.42
5	0.03	1.56	14.68	4.66	8.88	3.34	66.89
6	0.03	1.56	15.59	4.52	9.50	3.22	65.61
7	0.04	1.57	16.16	4.50	10.33	3.15	64.29
8	0.04	1.64	16.27	4.66	11.60	3.15	62.68

trading partners real GDP and its own: the short-term response of the Egyptian real GDP to a positive innovation on its trading partners' real GDP is not statistically significant and a shock on this variable only explains a small share of Egypt's real GDP fluctuations.

Figure 8: Response of Egyptian Real GDP Growth Rate



The negative relationship between the Egyptian real GDP growth rate and the real effective exchange rate seems also to be confirmed, although no causal link can be inferred as the response of the real GDP growth rate is not statistically significant (Figure 8.c.). However, shocks on the real effective exchange rate explain a non-negligible share of the Egyptian real GDP variance, reaching 12% from the second year. Additionally, if it is true that the monetary policy rate seems to be highly correlated with the real GDP of Egypt

(Table 2), it is not one of its determinants: the response of the real GDP growth rate to a positive innovation to the monetary policy rate is not statistically significant (Figure 8.d.), and the share of the real GDP growth rate's variance explained by the monetary policy rate is systematically inferior to 6% and decreases to 3% after the first year.

Figure 9: Response of Monetary Policy Rate

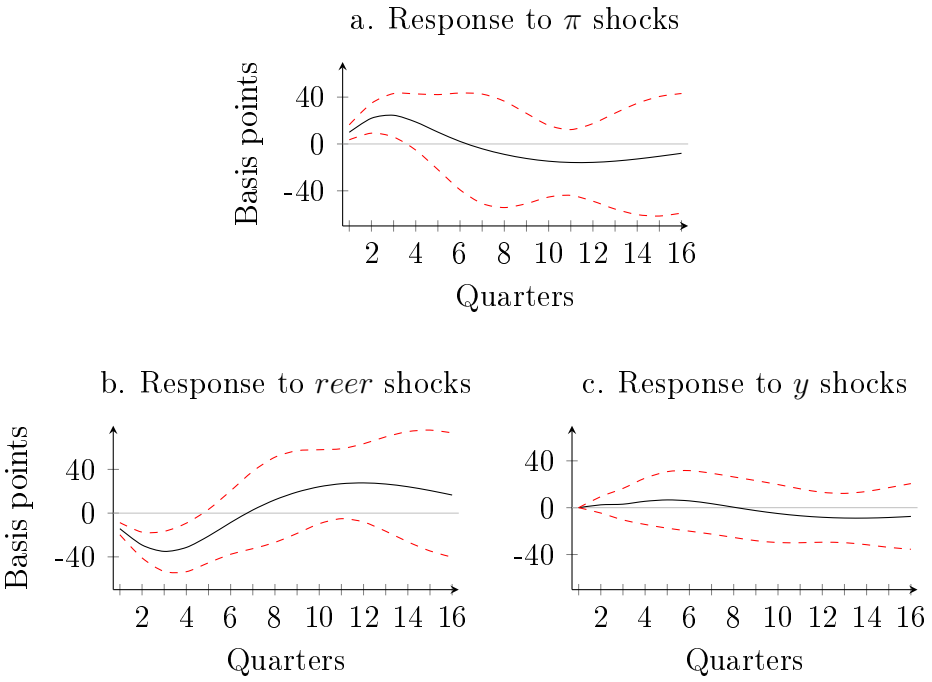


Figure 9 presents the response of the monetary policy rate to a positive innovation to the inflation rate (Figure 9.a.), to the real effective exchange rate (Figure 9.b.) and to the real GDP growth rate (Figure 9.c.). As evidenced in Figure 9.a., a positive innovation to inflation leads to a rise in the monetary policy rate, and this confirms that this interest rate is used as a monetary policy instrument to try to control the inflation rate. The monetary policy rate's variance decomposition shows that shocks on inflation explain between 15% and 20% of the monetary policy rate fluctuations during the first year. However, Figure 10.c. shows that the inflation does not respond significantly to a positive innovation to the monetary policy rate: this instrument does not have the ability to stabilize the business cycle and therefore cannot be qualified as an effective monetary policy transmission channel in Egypt.

Figure 9.b. highlights that the monetary policy rate responds negatively during four quarters to a positive innovation (*i.e.* to an appreciation) to the real effective exchange rate: the decline in the monetary policy rate evidences the use of this instrument to try to offset the hike in the real effective exchange rate in order to maintain the country's

Table 4: Monetary Policy Rate Variance Decomposition

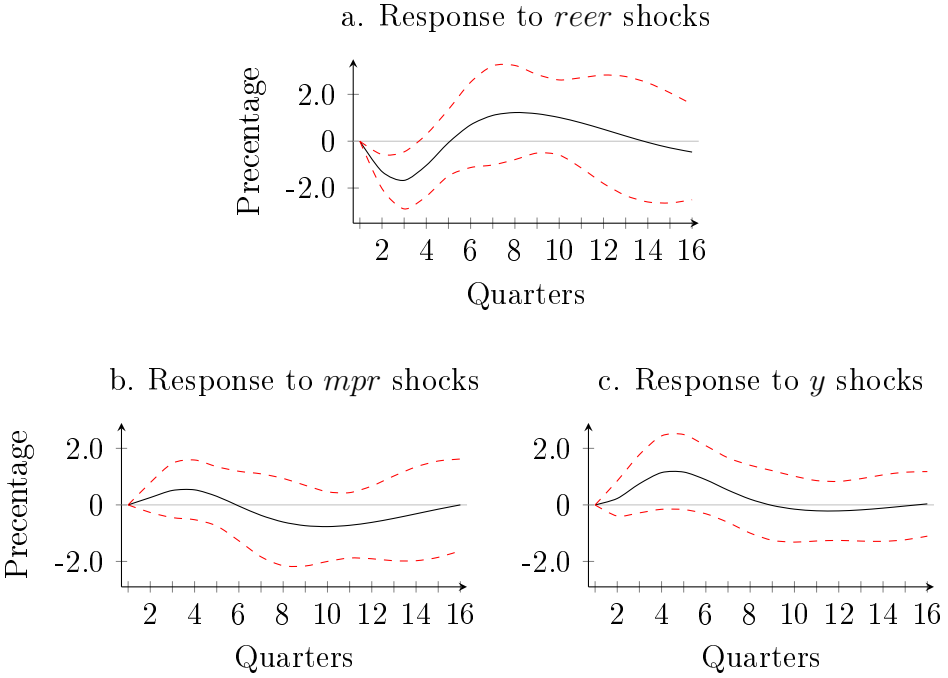
Quarter	Std. Error	y^*	$fluxcap$	π	$reer$	mpr	y
1	0.26	0.17	0.00	15.12	30.81	53.90	0.00
2	0.53	0.39	1.85	20.81	37.67	39.07	0.21
3	0.76	2.35	4.06	20.35	39.22	33.76	0.26
4	0.93	5.36	5.44	17.92	38.10	32.65	0.52
5	1.02	8.22	6.13	15.80	35.76	33.24	0.86
6	1.06	10.31	6.42	14.57	33.55	34.07	1.09
7	1.08	11.45	6.49	14.19	32.40	34.32	1.15
8	1.10	11.72	6.41	14.43	32.68	33.65	1.12

competitiveness and to promote exports. Simultaneously, Figure 10.a. shows that the inflation also responds negatively, during three quarters, to a positive innovation to the real effective exchange rate. This result, corresponding to a decline in the relative prices of imported good with respect to the domestic goods, allows to make explicit the mechanisms that lead to the positive correlation between the expected inflation and the monetary policy rate observed in Table 2. The variance decomposition of the monetary policy rate (Table 4) and of the inflation rate (Table 5) evidence the fact that shocks to the real effective exchange rate have substantial effects on the fluctuations of these variables in a two years period: these shocks explain between 30% and 40% of the monetary policy rate fluctuations and between 10% and 23% of the fluctuations of the inflation rate.

Unlike the results from the equation (2) in the system of simultaneous equations, which showed a negative relationship between the real GDP growth rate and the monetary policy rate, Figure 9.c. highlights that the monetary policy is not structurally procyclical in Egypt. How can these results be reconciled? The real GDP growth rate variance decomposition (Table 3) shows that from the second quarter, shocks to the capital flows availability are the second factor affecting the variance of real GDP. Figure 8.b. evidences that the real GDP growth rate tends to respond positively to a positive innovation on capital flows availability, while such an innovation will likely lead to a real effective exchange rate appreciation and therefore, in reaction, to a lower monetary policy rate (Figure 9.b.): therefore, it is possible to observe an increase in the real GDP growth rate at the same time as a decrease in the monetary policy rate while none of these two variables structurally responds to the other, as Figures 8.d. and 9.c. show. Nevertheless, the response of the real GDP growth rate to an innovation to the capital flows availability is not significant, and the shocks affecting them seem to be responsible for the real effective exchange rate fluctuations to a very limited extent only: no definitive conclusion can be drawn while the real GDP dynamics is not evidenced in greater details.

Figure 10 highlights, as explained previously, that the inflation rate structurally re-

Figure 10: Response of inflation



sponds to the real effective exchange rate instead of the monetary policy rate and the business cycle. The inflation variance decomposition (Table 5) confirms the results obtained with the simultaneous equations model and presented in Table 2: the inflation dynamics is characterized by a high persistence, and the shocks to this variable still explain 59% of its own variance two years after their realization. This result confirms the difficulties faced by the monetary policy rate to be considered a monetary policy transmission channel: the inflation rate depends on innovations to the real effective exchange rate, and while the monetary policy rate partially reacts to the inflation fluctuations, it is not efficient enough to stabilize them.

Table 5: Inflation Variance Decomposition

Quarter	Std. Error	y^*	$fluxcap$	π	$reer$	mpr	y
1	0.02	0.03	0.07	99.90	0	0	0
2	0.04	0.02	0.06	89.04	10.17	0.41	0.31
3	0.05	0.43	0.14	78.42	17.37	1.27	2.37
4	0.05	0.76	0.19	71.90	18.65	2.06	6.44
5	0.06	0.73	0.20	68.55	17.79	2.26	10.46
6	0.06	0.92	0.46	65.76	18.36	2.15	12.34
7	0.06	1.57	0.90	62.44	20.48	2.38	12.23
8	0.06	2.39	1.31	58.99	22.78	3.15	11.38

6 Conclusion

This article presents a model of the Egyptian economy, within a small open economy framework, that aims to highlight some of its characteristics that must be considered for the conduct of monetary policy. The model features four equations: a new Keynesian IS curve describing the dynamics of the real GDP growth rate, a Taylor rule, or response function of the monetary policy, describing the determinants of the monetary policy interest rate, and two equations describing the dynamics of inflation and of the real effective exchange rate. The estimation of the model was performed through a simultaneous equations approach using quarterly data over the period 2002q1 – 2017q2. Subsequently, to uncover its structural parameters, a VAR model of the Egyptian economy was identified through the Choleski decomposition approach. For this model to remain within the small open economy framework, that is, to ensure that domestically determined variables do not affect foreign variables, this model was restricted to feature an exogenous block.

The main empirical results allow to reach some conclusions on the Egyptian economy over this period. Firstly, the use of a new Keynesian IS curve seems appropriate and illustrates the importance of the anticipations of agents as determinants of the business cycle. Secondly, even though the monetary policy rate and the real GDP growth rate are significantly, negatively correlated and the impulse-response function indicates that the CBE uses this interest rate to try to stabilise the real GDP growth rate, it appears that the business cycle does not respond structurally to the monetary policy rate. Indeed, an analysis of the variance decomposition shows that the monetary policy rate is more responsive to the real effective exchange rate than to the inflation, and that inflation fluctuations themselves depend to a large extent on real effective exchange rate shocks: a depreciation will lead to a hike in both inflation and monetary policy rate. Instead of the interest rate, the real effective exchange rate seems to be the main monetary policy transmission channel over the period. Thirdly, the role of the external sector on the Egyptian business cycle remains ambiguous. The availability of capital flows does not have any positive, statistically significant effect on the Egyptian output, and no variable of the economy structurally responds to this variable, although a non-negligible share of real GDP growth rate fluctuations is explained by capital flows shocks. Furthermore, while Egypt's real GDP growth rate is negatively correlated to its trading partners' real GDP growth rate, only a small share of its fluctuations is explained by shocks on its partners' business cycle, and these do not appear to lead to any structural response from the Egyptian economy. Therefore, no conclusion can be drawn before having a better understanding of Egypt's real GDP dynamics, but these evidences suggest a weak dependence of the Egyptian economy to the external sector. Lastly, pointing out a procyclical, although non-structural, monetary policy over the period, the results of this article identify a phenomenon of major

importance with respect to the Egyptian business cycle.

Several policy recommendations can be grounded on these conclusions. In the context of the free-floating of the Egyptian Pound, a higher degree of independence of the Central Bank of Egypt and the establishment of a dual mandate featuring an explicit medium-term inflation target would allow to make the fight against inflation more effective, while lowering the costs of such a stabilization in terms of production and employment. In this regard, a regular, transparent and explicit communication would be key to anchor the agents' anticipations. As the anticipations converge towards the target, these are in turn to be endogenized when modelling the Egyptian economy to perform forecast analysis: despite harsh criticism, DSGE modelling of the Egyptian economy could result useful. Such reforms would prove to be primordial steps towards the adoption of a contracyclical monetary policy, a fundamental element for the economic policy to be capable of stabilizing the business cycle and therefore guarantee a better protection and a higher well-being to all the citizens, and particularly to the most vulnerable.

Further research could aim at reaching a better understanding of Egypt's real GDP dynamics, through the incorporation of fiscal policy and investment variables, and its relationship to the external sector. Studying the expectations formation within the Egyptian economy and its impacts for the strengthening of the interest rate as a monetary policy transmission channel would also prove useful, especially in the context of limited financial inclusion. Finally, as monetary policy is likely to have important distributive effects that could determine its own sustainability, an assessment of the transmission mechanisms to income inequality represents another line of research.

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