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Sources of real exchange rate fluctuations in Egypt

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Abstract

Purpose – This paper aims to empirically investigate the sources of real exchange rate fluctuations in Egypt using structural vector autoregression (SVAR). The data covers the period between 1980 and 2016, where exchange regime has been changed more than once.

Design/methodology/approach – This paper investigates the source of real exchange rate fluctuations for the period between 1980 and 2016 using the SVAR method. The SVAR method will incorporate real gross domestic product (GDP), real effective exchange rate (REER) and price level in a multidimensional equations system. However, impulse response function (IRF) and error variance decompositions (EVDC) will be generated by the system to have a behavioral insight of real exchange rate in response to economic shocks.

Findings – The IRF and EVDC results indicate a significant impact of demand shocks over the real exchange rate relative to supply shocks and monetary shocks in the period between 1980 and 2016. On the other hand, monetary shocks will have a negligible effect on the real exchange rate in the short run and converging to its previous level in the covering period of the study.

Originality/value – In the best of the authors' knowledge, the topic of the source of the real exchange rate fluctuations in Egypt has not been discussed in a wide range due to the lack of time series data. However, this study provides constructed data for REER for Egypt with the published method in the International Monetary Fund (IMF). Furthermore, the study involves theoretical and econometric modeling to ensure the reliability of the economic results.

Keywords Exchange rate, Egypt, SVAR, Demand shocks, Supply shocks

Paper type Research paper

1. Introduction

Since the beginning of the new millennium, Egypt has started to adopt various measures to reform its exchange rate policy to reduce fluctuation and volatility in the real value of the Egyptian pound. By early 2003, the Egyptian central bank announced a shift from a fixed exchange rate regime to a managed float regime. However, this step was not enough to achieve significant improvement in the exchange rate market. The foreign reserves continued to shrink, the unofficial rate continued to diverge significantly from the official rate, the inflation rate continued to increase to double digits, the trade deficit continued to deteriorate, and the foreign currency continued to be in short supply in the domestic market. By November 2016, the Egyptian central bank announced in an official statement that it would move to a "Liberalized exchange rate in order to create an environment for a reliable and sustainable supply of foreign currency." As a result, the Egyptian pound lost more than 80% of its value, and inflation skyrocketed to more than 25%. Thus, this paper is interested in

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studying the behavior of the real exchange rate in Egypt and the sources of its fluctuation and volatility over the last thirty years. Two major explanations have provided the causes of real exchange rate volatility. The first model, known as the disequilibrium approach, focuses on the role of nominal shocks (financial market disturbances) in causing transitory movements in exchange rates. The equilibrium or real economy view, which is the second model, suggests that real rates adjust in response to changes in real macroeconomic variables. According to this view, permanent real shocks are responsible for fluctuations in both real and nominal rates. To determine the significance of permanent and momentary shocks on exchange rates, it is crucial to construct an empirical model, as emphasized by Farrant and Peersman (2005). This study examines the effects of three distinct shocks, specifically, supply shocks, demand shocks and monetary shocks, on fluctuations in the real exchange rate. The result provides an explanation for the behavior of real exchange rate fluctuations for the Egyptian Pound within a framework of trade effect that has been indirectly imposed via real effective exchange rates (REERs). While using real rate is suitable to track exchange rate fluctuations, the use of the effective exchange rate is advancing the analysis to gain broad insight into the reality of the sources of real exchange rate fluctuations. This is a major contribution of this paper compared to the most studies that analyze Egyptian Pound real exchange rate fluctuations.

The rest of the study is divided as follows: Section 2 provides an overview of exchange rate policies and movements in Egypt of the last 30 years, Section 3 presents a literature review and the empirical model is presented in Section 4, the results and discussion are provided in Section 5 and Section 6 concludes the findings of the study.

2. Brief overview of the exchange rate policy and movements in Egypt

In 1991, Egypt tied its currency to the US$ but discontinued this policy in the middle of 2000. The country faced mounting pressure on the value of its currency since 1998, triggered by capital flight after the Asian financial crisis and terrorist attacks at home and abroad, which hurt the tourism industry. Additionally, the US$'s appreciation against the euro and yen contributed to Egypt's declining competitiveness. At first, Egypt tried to manage these challenges by intervening in the foreign exchange market and implementing tighter credit policies, but these measures failed to stem the decline in official reserves or to spur economic growth. In mid-2000, Egypt allowed its currency to float within a band, which did not alleviate exchange rate pressures. Following the September 11 attacks, these pressures increased further, leading to a more than 35% depreciation of the pound against the dollar from mid-2000 to early 2003. Consequently, foreign currency became scarce in the official market and a parallel exchange market emerged. Recently, Egypt shifted to a floating exchange rate regime, which resulted in a 20% depreciation of the pound, but improved the availability of foreign exchange in the official market.

3. Review of literature

Before factors affecting the real exchange rate became topical issues in the literature, the main channel by which real exchange rates fluctuate was widely ascribed to changes in monetary factors. While some still hold a consensus view on its potency for volatility, it is grossly discredited among others. Carvalho *et al.* (2019) state that persistent depreciation of the real exchange rate results from monetary shocks. Prior, Goldfajn and Gupta (2003) and Adeoye and Olufemi (2014) asserted that exchange rate fluctuations are significantly affected by monetary policy variables. While Goldfajn and Baig (1999) argued that tight monetary policies assist crisis-battered countries' currencies in regaining their strength, Adeoye and Olufemi (2014) admit that monetary instruments are ineffective in stabilizing exchange rate movement in Nigeria. Hilde (2008), however, proposed that although there was short-term overshoot in the appreciation from monetary policy shocks, the real exchange rate steadily gravitated back to its long-run equilibrium.

As noted above, scholarship on monetary factors as the singular determinants of real exchange fluctuation has lost ground within the intellectual space of new open economy macroeconomics, especially with the recent overwhelming empirical evidence from developing nations. In recent decades, some scholars (who have begun to research new open economy macroeconomics) have claimed that the Dornbusch (1976)—upon which above studies were developed—building block of exchange rate fluctuation, argued to be largely attributed to monetary policy shocks, has long been dismantled by substantive results of the effects of real economic shocks, such as trade and financial liberalization, productivity shocks, capital flow and government spending on volatility in the real exchange rate. In earlier research debates, Obstfeld and Rogoff (1995) and Sutherland (1996) stressed that trade and financial liberalization diminish shocks to the real exchange rate movement. This debate encouraged a wide spectrum of studies to consider developing nations as laboratories for testing these real factors on fluctuations in the real exchange rate.

Calderon (2004) argued that the inclusion of trade openness among other macroeconomic fundamentals allows for better explanatory power in predicting the fluctuation in the real exchange rate. The empirical result of Mpofu (2016) is also consistent with this finding, concluding that trade openness attenuates the effects of volatile fundamentals on the real exchange rate. Contrary to the mainstream monetary approach, the study came out with an influential report that real factors such as trade openness have a sizable influence on real exchange rate movement. These research papers draw heavily on and corroborate the prominent work of Hau (2002) in that there is an inverse relation between trade openness and real exchange rate volatility. For Hau, it is incontrovertible to argue that trade openness and the real exchange rate are inversely linked on both theoretical and empirical grounds. In his past paper, Hau (2000) and later Obstfeld and Rogoff (2000) opined that an integrated and trade liberalized economy is expected to have less fluctuation in its exchange rate. It is believed that countries with open economies tend to be faced with more price level flexibility than when they close their borders to the world. Intuitively, the authors argued that price adjustment in an open economy will be more frequent and easily transmitted between borders and could be capable of assuaging the wide fluctuation in the real exchange rate that results from shocks. This evidence is not different from that asserted by Bleaney (2008), Sergiu (2007), Calderon and Kubota (2009).

Still on real factors, another strand of empirical research papers dwells heavily on the relative productivity differential. Even though the productivity effect holds true, a few studies counter the Balassa (1964) and Samuelson (1964) effect on the volatility movement of the real exchange rate. This model showed earlier that the real exchange movement is significantly determined by the productivity growth differential between non-tradable and tradable sectors across countries. Loko and Tuladhar (2005) contradict the B-S model and offer several other factors causing real exchange rate depreciation in the Yugoslavia Republic of Macedonia. The authors believe the country suffers from technological growth, which only allows the production of low-quality goods, leading to lower prices. It is then claimed that the real exchange rate movement is related to a prolonged transition process, which results from the continual relative decline in the quality of its tradable reference commodity basket *vis-à-vis* its trading countries. Another related study (Christoph, 2004) on the accession countries in the European Union faults studies that earlier attributed currency appreciation to only the Balassa-Samuelson productivity effect and highlights that evidence shows that real exchange rate appreciation is a response to the productivity effects that result from the investment demand conduit. While there has been criticism of this time-honored effect, one influential work maintained that the new version of the B-S effect, the Harrod-Balassa-Samuelson effect, can only be substantiated if we allow for a few changes. That is, "the positive effect on the real exchange rate works through the tradable-based real exchange rate and weak relation to the relative price differential between traded and nontraded sectors," as stated by Jaewoo and Man-Keung (2003).

This set of studies considering financial liberation but ignoring macroeconomic fundamentals is not free of criticism. A large body of literature claims that financial openness has a negative side, whether on a continental or global scale. The two major financial crisis experiences of the past two decades tell us that economies with considerable financial exposure and a small foreign reserve base suffer more exchange rate fluctuations in the face of a crisis. Fratzscher (2009) disclaims the widespread consensus of the speculated depreciation of the US$ in the event of a global financial crisis but shows that the reverse is the case. As it turns out, most countries with high financial debts with the United States and unfavorable current account standing were the ones faced with larger depreciation in their currencies. As it was imperative for the economy to address the financial crisis, it was necessary to repatriate foreign investments from these countries, which put pressure on US$ and caused its appreciation. Since most developing countries lack significant reserves to buffer heavy capital flight, intuitively, this leads to currency depreciation. While the paper admits that global financial liberalization is good, crisis may create hard times for policy-makers in countries that do not have sound macroeconomic fundamentals to cushion the effect of vulnerability in the event of capital repatriation.

Kohler (2010), in comparing three financial crises (Asian Crisis, Russian Debt Default and Global Financial Crisis), as in previous papers, opined that the search for save haven currencies and the impact of interest rate differentials led to the depreciation of the currencies of the countries that were not at the center of the financial chaos in 2008. However, the author did find that these countries, currency depreciation began to reverse after the uncertainties were perceived to be limited. As highlighted above, the outcome of financial repatriation, stemming from the high demand for liquidity by USA investors, deteriorates the currencies of the developing countries where those investments were domiciled. A prior study conducted by Mark (2009) exhibits a different crisis impact in contrast to the 2008 global financial turmoil originating from the United States. The author argues that financial liberalization in the region before the Asian Crisis made affected countries (especially Thailand) vulnerable to the unprecedented turnaround of initial international capital flows. He blames the crisis on unchecked openness, which exposed the region to the financial speculative attack and as the predicament rose during the period, the need to service international debts resulted in high capital outflow, leading to the domestic currency depreciating against hard currencies. Instinctively, these two financial crises are the same in terms of the observed heavy fluctuations in real exchange rates during the financial quagmire, but they differ in that both events led to profound depreciation in the developing nation currencies that were connected to the crises.

A large body of literature exists on the impact of Dutch disease on the real exchange rate volatility of oil-exporting developing countries. Even though there have been disparate opinions on the impact of the resource curse on the real exchange rate in these countries, the discourse on this impact is clear. That is, these oil exporting nations experience volatility at some points in the span of the economic cycle resulting from changes in world oil prices. In the work of Trevino (2011), the appreciation of the real exchange rate is consistent with the resource curse. Trevino examined these countries (all of which are from the African continent) and suggested an economic framework through which Dutch Disease transmits into currency appreciation. He concludes that the higher wages prevailing in the resource-based sector soon transferred to the general increase in domestic prices relative to foreign prices. This eventually led to a higher price of domestic currency.

In other topical studies in the literature, the impact of remittances in domestic economies has been widely associated with the similar influence oil discovery on the currency of oil exporting developing countries. Its impact on the real exchange rate has, however, attracted different opinions from scholars in the literature. Acosta *et al.* (2009) submit that the argument that remittances pose the same hazard as the oil type of Dutch Disease is unrealistic and

provides little evidence for the changes in real exchange rates. The study demonstrates that the weakness of this Dutch Disease was a result of several associated difficulties. The homogeneity of factors that makes it easy to reallocate among traded and nontraded sectors causes the large remittance inflow from abroad to be absorbed by traded goods demand, which brings about a smaller change in the real exchange rate. On another note, the countercyclical effect of the remittance inflow on long-run changes in domestic output undermines any long-run real exchange rates fluctuation which is resulting from such remittance receipt. The argument also holds that less or unchanged in the long-run equilibrium real exchange rates may occur to any nonmonetary economy that wholly allocates its remittance inflow to traded goods. However, in the monetary economy, the impact of a large remittance inflow may cause currency depreciation. Barrett (2013) supports this inverse relationship and convincingly states that Jamaica has experienced a fall in its currency *vis-à-vis* others despite large remittance receipt into the country.

Tuuli (2015) and Hassan and Holmes (2013) contradict this nature of studies that condemn the presence of the Dutch Disease form effect in most nations that enjoy remittance inflow. Unlike those on the other end of the spectrum, previous studies have maintained that hefty capital inflows in the form of remittances pair with currency appreciation, resulting in the attrition of nations' trade competitiveness in the international markets. Another continuum of studies, such the influential paper of Acosta *et al.* (2009), supports the claim of Dutch Disease in these recipient nations; however, the authors find that in a sophisticated and well-developed financial market, there is evidence for a retention of trade competitiveness in the midst of large remittance inflow. This type of inflow does not worsen the level of trade competitiveness in these recipient nations.

Even though these two divergent studies vary in their submissions on Dutch Disease presence on nations with large remittances, as Brahim *et al.* (2018) would suggest, certain factors may undermine its risks. The influential work of Barajas *et al.* (2011) notes factors such as trade and financial openness, flexibility in the factor market that allows high factor mobility among sectors and remittance receipt, which performs a countercyclical function. Last, Keefe (2014) blames the fluctuation in the exchange rate to fluctuations in the credibility of policy-makers, institutional frameworks and high exchange rate pass-throughs in countries with high remittance inflows. The study convinces us that in a dollarized economy that maintains a stable supply of foreign currency, remittances will attenuate exchange rate fluctuation, providing the same effect as trade openness.

In a similar Egypt economy, Morales-Zumaquero (2006) analyzes the source of real exchange rate fluctuations in developing European countries mostly Eastern and Central of Europe with different outcomes. The relative prices of nontraded goods have driven the real exchange rate in managed exchange rate countries. However, the variance of the real exchange rate is unstable in the advanced economy. Furthermore, real shocks have a dominant effect on the real exchange rate in the transition economy. On the other hand, Apergis and Karfakis (1996) used SVAR methodology to examine source real exchange rate fluctuations in Greece. They found that supply shocks are the main source of fluctuations in the real exchange rate.

Myanmar has changed its exchange rate regime at different points of time according to Kubo (2013). The change in the regime caused sharp fluctuations in the real exchange rate relative to other South Asian countries' currencies. However, using the SVAR model to analyze the source of fluctuations in the real exchange rate, resulting in persistent real shocks, mostly drives the fluctuations.

Investigating three countries with similar economic structures from different continents creates a broad capacity for comparison. Drine and Rault (2009) examine the source of real exchange rate fluctuations in Morocco, Philippines and Uruguay. They use SVAR to observe the impacts of external shocks, domestic shocks, demand shocks and nominal shocks. The results indicate that real shocks have driven real exchange rate fluctuations mostly in the

three countries. However, nominal shocks have a negligible impact on price except in Morocco. This result indicates that monetary policy is weak in controlling and promoting the competitiveness of the economy in the two countries. On the other hand, Sfia (2006) analyzed Tunisian real exchange rate fluctuations with the SVAR method. The study has found that the real exchange rate is mostly determined by real shocks in the short run and that supply shocks have the lead in the long run. However, real shocks have a greater impact on relative prices, indicating that monetary policy is powerless in promoting the competitiveness of the economy. Furthermore, Tokmakciogul and Ozcelebi (2020) estimated the Bayesian vector autoregression (BVAR) model as well as the time-varying SVAR model to assess the impact of shadow short rates on the treasury Euro-Dollar rate and stock returns. They found that volatility in stock returns and financial bubbles would be minimized by shadow short rates of the treasury Euro-Dollar rate. Furthermore, forecast error variance decompositions (FEVDs) illustrate that monetary policy has unclear clarification for credit risk. However, monetary policy has an impact in controlling asset price bubbles and financial crises via stock returns, which are directly affected by monetary policy. Additionally, monetary policy indirectly impacts credit risk via its impact on the treasury Euro-Dollar rate.

4. Methodology

4.1 A theoretical model of the real exchange rate

In detecting the real exchange volatility sources in Egypt, this paper estimates a three-equation open macro model proposed by Clarida and Gali (1994) based on earlier studies of Dornbusch (1976), Obstfeld (1985) and Blanchard and Quah (1989). The following model presents a standard three-variable vector autoregressive (VAR), employing a long-run identification scheme

$$y_t^d = d_t + \delta q_t - \sigma[i_t - E_t(p_{t+1} - p_t)] \tag{1}$$

$$p_t = (1 - \varnothing)E_{t-1}P_t^e + \varnothing p_t^e \tag{2}$$

$$m_t^s - p_t = y_t - \gamma i_t \tag{3}$$

$$i_t = E_t(s_{t+1} - s_t) \tag{4}$$

The model presented above employs is Investment-Saving and Liquidity preference-Money supply (IS-LM) framework which includes two equations for price setting for goods, services and capital. Equation (1) illustrates the demand side of the economy for goods and services, expressed through IS equation that are representing an open economy. In this equation, the relative demand on output y_t^d is affected by relative demand shocks d_t, real exchange rate q_t and differentials of real form of interest rate. Equation (2) calculates the relative prices at time t, (p_t) is average weighted expected price arise within market's clearance which is balancing market output at time t. The standard for LM model is shown in Equation (3). The relative real money balances ($m_t^s - p_t$) are depending on relative output and interest rates deferential. Equation (4) establishes the relative interest rate based on covering parities condition for the interest rate, where (s_t) representing exchange rate in its nominal term.

The stochastic process is mostly governing the relative output supply, relative output demand and relative money Clarida and Gali (1994). Furthermore, relative form of supply and money following random walk process. The effect of supply shocks as well money shocks effect is permanent. Whoever, model allows elements being momentary as well permanent effect for the relative shocks of demand d_t.

$$y_t^e = y_{t-1}^s + \varepsilon_t^s \tag{5}$$

$$d_t = d_{t-1} + \varepsilon_t^d - \alpha\varepsilon_{t-1}^d \tag{6}$$

$$m_t = m_{t-1} + \varepsilon_t^n \tag{7}$$

The model solution, which can be represented as the evolution over time of the flexible price equilibrium, is as follows:

$$y_t^e = y_t^s \tag{8}$$

$$q_t^e = \frac{\left(y_t^s - d_t\right)}{\delta + [\delta(\delta+\sigma)]^{-1}\sigma\alpha\varepsilon_t^d} \tag{9}$$

$$p_t^e = m_t - y_t^s + \gamma(1+\gamma)^{-1}(\delta+\sigma)^{-1}\alpha\varepsilon_t^d \tag{10}$$

The model solution has shown three types of shocks existing. The shocks are forming from supply, demand and monetary. This solution constitutes motivated forces for distinction of relative output (y_t), real exchange rate (q_t) and relative price levels (p_t). Most notably, the solitary shocks are influencing relative output are supply shock, while supply and demand shocks are influencing exchange rate, and all three shocks are influencing price level.

4.2 Model framework

This section expands upon aforementioned model and conducts an estimation of a three-variable VAR system as stated in Abou-Zaid and Alabdulwahab (2013). In this system, $X_t = [\Delta y_t \Delta q_t \Delta p_t]$, where $y_t = (y_{t\,home} - y_{t\,ROW})$, representing the disparity between real income in Egypt and real income for the rest of the world (ROW). Furthermore, variable q_t denotes the REER, while $p_t = (p_{t\,home} - p_{t\,ROW})$ refers to the divergence between domestic price and price for the ROW. The utilization of prices and output aims identifying any shocks which may have an asymmetric impact on global economy.

In term of stationarity, y_t, q_t and p_t should be integrated of order one, thus the variables in X_t are stationary. Trivariate moving average model in the structural disturbances has the form of the following matrix

$$\begin{bmatrix} \Delta y_t \\ \Delta q_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} C_{11}(L)\, C_{12}(L)\, C_{13}(L) \\ C_{21}(L)\, C_{22}(L)\, C_{23}(L) \\ C_{31}(L)\, C_{32}(L)\, C_{33}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^s \\ \varepsilon_t^d \\ \varepsilon_t^n \end{bmatrix}$$

where ε_t^s, ε_t^d and ε_t^n are jointly uncorrelated. Identification of shocks is established via enforcing a condition that aggregate demand shocks do not have a long-term influence on the level of real output, whereas monetary shocks do not impact the level of either real output or real exchange rate in the long run. This restriction is expressed as the cumulative effect of demand which is monetary shocks on Δy_t being zero in the long run, as indicated by Stazka-Gawrysiak (2006).

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial\left(L^i \varepsilon_t^d\right)} = 0 \tag{12}$$

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial\left(L^i \varepsilon_t^n\right)} = 0 \tag{13}$$

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta q_t)}{\partial\left(L^i \varepsilon_t^n\right)} = 0 \tag{14}$$

The identification approach described above has a crucial benefit in that it does not impose any concurrent restrictions on the system. Thus, the immediate response of the endogenous

variables to different types of innovations can be entirely established based on the data, as noted by Stazka-Gawrysiak (2006).

4.3 Data and data description

The data is obtained from the International Financial Statistics database (IFS), World Bank database and World Economic Outlook (WEO). The variables used are seasonally unadjusted annual data for real gross domestic product (GDP), which was acquired from the IFS database. The REER was calculated based on IMF formula [1]. The price level which is the Consumer Price Index (CPI) for Egypt was acquired from the IFS database and that for the ROW was acquired from the World Bank database. The data consist of one-sample runs from 1980 to 2016. For reliable results, the cutoff date for data used is 2016, marking the beginning of the new exchange rate regime (liberalization).

The VAR model can be estimated in different structures. The model can take into account the linearity of the relationships between the variables in the focus model. Ozcelebi and Tokmakciogul (2022) used the Time-Varying Parameter Vector AutoRegressions (TVP-SVAR) model to examine the asymmetric effect of geopolitical risk on oil prices and oil production. They found that the effect of geopolitical risk is symmetric over oil prices and oil production. Furthermore, Ozcelebi (2019) investigated internal and external economic factors' impacts on the Exchange Market Pressure Index (EMPI) in countries of Eastern Europe, such as the Czech Republic and Poland, as well as in Russia and Iceland. The study used the SVAR model to examine the asymmetric impact of internal and external economic factors on the EMPI in the focused countries. Poland and the Czech Republic have shown that exchange market pressure is reduced by the improvement of the Current Account Balance (CAB), which is a result of impulse response function (IRF) assessment. Asymmetry in the EMPI may be present when inflation changes. However, a decline in the current account balance would denote more speculation activities in Poland and Iceland. Furthermore, increasing the level of the interest rate and inflation would result in an increase in the exchange rate in the focused countries. On the other hand, the EMPI would not be reduced by the decrease in the inflation rate, which was the case in Iceland and Russia.

To ensure the linearity of the model, following Ozcelebi and Tokmakciogul (2022) and Ozcelebi (2019), the Ramsey Regression Equation Specification Error Test (RESET) was used in the regression. The result shows that the model is free of error specification, and we fail to reject the null that the fitted regression is free of error specification since the t value is 0.7826 with a p value of 0.4394. For a robustness check, we estimate positive and negative attitudes for the explanatory variables to test their impact on the exchange rate. The Wald test shows no difference between positive and negative attitude impacts on the real exchange rate for real GDP and the Consumer Price Index as explanatory variables. The Wald t values for both variables are 0.8232 (0.4201) and −1.0427 (0.3095), respectively, indicating that we fail to reject the null hypothesis that the negative and positive impacts are the same over the dependent variables.

To ensure the stationarity of the data and properly specify the VAR system, we perform augmented Dickey–Fuller unit root (ADF) and Akaike information criterion (AIC) tests. Table 1 presents the results of the ADF and AIC tests, which indicate the presence of the unit

ADF statistic	y	q	p	Δy	Δq	Δp
Egypt	0.84	−1.017	−1.47	−2.64	−2.94	−1.93
Lags	2	3	2	1	2	1

Note(s): The ADF critical values for 34 observations sample period are −2.61 (10%), −2.94 (5%) and −3.62 (1%)

Table 1.
Unit root and stationary tests

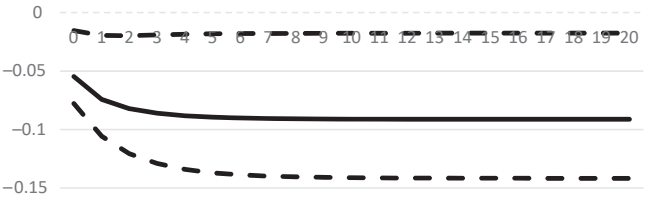
root for the data in its level term. However, we applied ADF test after taking the first difference of the data and ADF has reject the presence of unit root in the data in its first difference. Hence, we model the variables in their first differences.

The lag length is affected by data observations size where small size of the data is suggested to be selected using Akaike Information Criterion (AIC) based on Liew (2004). Akaike Information Criterion (AIC) performs efficiently in selecting maximum lag length over Hannan–Quinn Criterion (HQC), Bayesian Information Criterion (BIC) and Schwarz Information Criterion (SIC) in data that has a length below 60 observations. The Akaike Information Criterion (AIC) has been performed toward finding an optimal lag length for the model. Based on AIC method, the value at 4 lags is −17.1747, which is lower than the AIC value at lags 3 and 5 where their values are respectively −17.2604 and −17.5631. To ensure lag length selection, we checked the HQC criteria, which indicated the same lag period with values −16.80, −16.58 and −16.83 for lags 3, 4 and 5, respectively.

5. Empirical results

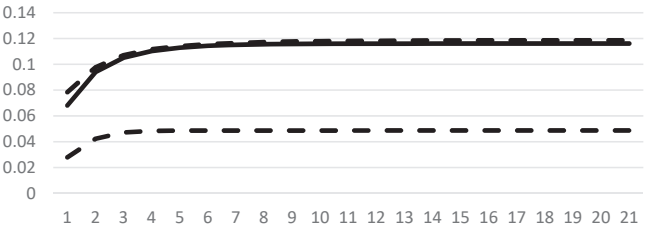
The results are based on running a VAR model for the variables y_t, q_t and p_t in the first difference, since the variables are nonstationary in levels. The maximum lag is initially set at 12, and the likelihood ratio tests suggest that the VAR can be reduced to four lags. Subsequently, we estimate the VAR using four lags and enforce the restrictions specified in Equations (12) to (14). The error variance decomposition (EVDC) and IRFs, which are standard in VAR techniques, are utilized to examine the dynamic impacts of real, nominal and financial (monetary) factors on the real exchange rate.

Impulse response function has been presented in Figures 1–3. The dynamic response of real exchange rate to supply, demand and monetary shocks has been framing within 90% confident intervals. The supply shock has an immediate depreciation in the real exchange rate in Egypt as shown in Figure 1. In approximately of five periods of time, exchange rate would reach its level in the long-run. However, a permanent appreciation of exchange rate has been induced by demand shock. Furthermore, the real depreciation of Egyptian pound is predicted to be permanent by the model since the demand shock is permanent as is set in the model solution.



Source(s): Figure by authors

Figure 1.
Response of the real exchange rate to the supply shock



Source(s): Figure by authors

Figure 2.
Response of the real exchange rate to the demand shock

It takes longer for the exchange rate to relapse to its long run as a result of a demand shock relative to a supply shock. Note that the monetary shock impact on the real exchange rate for both periods is almost negligible. This does not imply, however, that monetary or financial shocks do not impact the exchange rate. These shocks would simply have a brief impact on the value of the Egyptian pound depending on the magnitude of the shock as in Figures 2 and 3. That is, immediately after the Central Bank of Egypt decided to free float the Egyptian pound, an immediate depreciation occurred in the value of the currency in the official market. One can claim that this depreciation is not negligible. However, considering the real value of the currency in the black market and taking into account that this paper uses the REER rather than nominal or real rates, we can easily conclude that movements or fluctuations in the real value of the Egyptian pound, notably in the long run, are not caused by policy-oriented changes such as monetary shocks, returning to real shocks such as demand or supply shocks. In an interview with Bloomberg on January 2019, the Central Bank of Egypt's chairman confirmed our view in his brief as he stated that there will be more volatility in Egyptian pound against international currencies until investors accept the fact there will be no going back to fixed exchange rate system by Egyptian Central Bank.

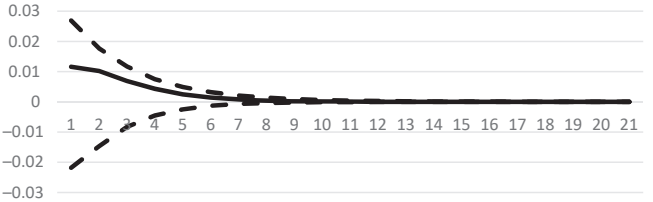
The variance decomposition results for the real exchange rate reported in Table 2 support our above argument.

The variance of the level of the real exchange rate is divided into two parts, namely unanticipated real shocks due to supply and demand and nominal shocks arising from monetary factors. As presented in Table 2, the results show that in Egypt, real shocks are responsible for a significant portion of the conditional variance of the level of the real exchange rate, both in the short and long term. At a 4-quarter horizon, more than 99% of the variance in predicting the level of the real exchange rate is due to real shocks. Specifically, the demand shock accounts for 61% of the 4-quarter variance in forecasting the level of the real exchange rate, while approximately 38% is attributable to the supply shock. It is worth noting that the short-term and long-term effects of the shocks are similar, and their contribution to fluctuations in the real exchange rate in Egypt remains consistent across different horizons.

Indeed, shocks, whether real or nominal, are unexpected events that affect real economic activities and macroeconomic indicators in all countries and notably lower- and middle-income developing nations, which are more vulnerable to shocks partly because they have less diversified economies with a narrow range of production and export industries.

Demand-side shocks, which are real shocks, are positive or negative surprises that affect one or more of the components of aggregate demand, which subsequently affects planned spending. These shocks vary from changes in wages, profits, liquidity and access to credit to changes in government finances, tax rates, international trade and interest rates. Also, vary to changes in expectations about future income, employment trends, or inflation.

Over the period of study, Egypt experienced several sudden and transitory disruptions of prices caused by unexpected, market shifting events that changed the perception of the



Source(s): Figure by authors

Figure 3.
Response of the real exchange rate to the nominal (monetary) shock

Period	Supply shocks	Demand shocks	Financial shocks
0	0.3854	0.5973	0.0173
1	0.3826	0.6066	0.0107
2	0.3808	0.6121	0.0071
3	0.3800	0.6149	0.0051
4	0.3797	0.6164	0.0039
5	0.3796	0.6173	0.0031
6	0.3796	0.6178	0.0026
7	0.3798	0.6181	0.0022
8	0.3799	0.6182	0.0019
9	0.3801	0.6183	0.0017
10	0.3802	0.6183	0.0015
11	0.3803	0.6183	0.0014
12	0.3805	0.6183	0.0012
13	0.3806	0.6183	0.0011
14	0.3806	0.6183	0.0011
15	0.3807	0.6183	0.0010
16	0.3808	0.6183	0.0009
17	0.3808	0.6183	0.0009
18	0.3809	0.6183	0.0008
19	0.3809	0.6183	0.0008
20	0.3809	0.6183	0.0007

Source(s): Authors' estimation

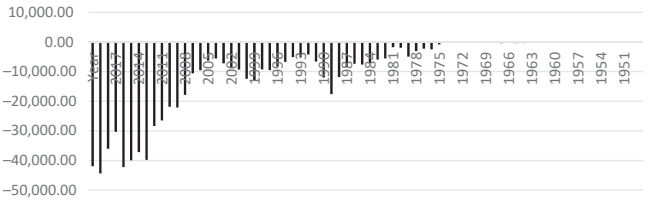
Table 2.
Forecast error variance decomposition of the real exchange rate for Egypt

demand dynamics of a good or service. Subsidy removal on food and oil products and distortionary tariffs on imports are some examples.

One of the major causes of demand shocks in Egypt during the period studied is the trade deficit. According to the data presented in Figure 4, Egypt has been recording trade deficits since 1980. Lately and since 2004, the deficit has been growing tremendously as imports have grown at a faster rate than exports, mostly due to a rise in Egypt's major imported goods, such as petroleum and wheat. Egypt also imports mineral and chemical products, agricultural products, livestock and foodstuffs, machinery and electrical equipment and base metals, the volume of which has been increasing over the last 10 years.

Because of the current account deficit in Egypt, the country has started borrowing capital from various foreign sources to make up for the deficit. The excess demand of the foreign currency and excess supply of the Egyptian pound relative to foreign demand on Egyptian products have lowered the country's exchange rate.

As the deficit has continued to increase over the years, the government has tried to maintain a constant trade deficit by applying tariff taxes and quota systems for some products, which may cause an increase in wasteful rent seeking.



Source(s): Figure by authors

Figure 4.
Trade balance of Egypt

Although a decline or removal of import tariffs may result in lost government revenues, it helps lower the distortionary effects of tariffs and taxes. Konan and Mascus (2000) argue that the impact of trade liberalization in Egypt on the fiscal integrity tax regime is a major concern of policy-makers. Their results indicate a certain kind of interaction between trade and domestic taxes. That is, to maintain government revenue neutrality, fiscal authorities need to raise domestic taxes as much as they lower tariffs. However, certain trade liberalization measures, such as the unification of tariff rates or preferential elimination of tariffs on European imports, can result in increased government revenues as economic activities shift towards sectors that are heavily taxed domestically. In contrast to radical reforms, these measures may lead to a reduction in domestic taxes while maintaining an equal-yield tax system. The main trading partners are European (38% of total exports and 31% of total imports) and Arab countries (28% of exports and 13.5% of imports). Others include the United States, China and India.

Moreover, the disruption of the price level in Egypt because of domestic or/and foreign shocks has caused high volatility in the inflation rate, which is depicted in Figure 5 and consequent fluctuations in the exchange rate that affect foreign currency reserves, as shown in Figure 6. As a general rule, inflation differentials between Egypt and its trading partners keep changing the purchasing power of the Egyptian pound and thus the value against foreign currency.

For example, as inflation increases in Egypt, the purchasing power of the pound drops relative to other currencies and the currency depreciates.

A negative demand shock can also bring about negative multiplier effects and a negative accelerator effect on the level of investment spending. Political instability can be a chief negative attribute that draws foreign investment away to other countries that have more political stability and less economic risk. On the other hand, our results also indicate an important role of supply shock in the volatility of the exchange rate in Egypt. The supply side

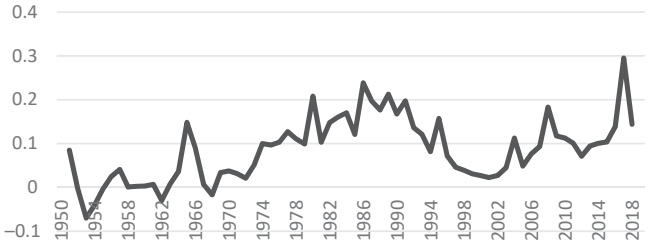


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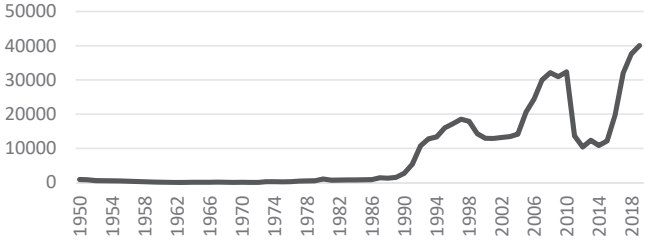
Figure 5.
Inflation from 1950 to 2018



Source(s): Figure by authors

Figure 6.
Reserve from 1950–2018

impact on the real exchange rate is mainly due to total factor productivity loss, high unemployment rates, investment deficiencies and the misallocation of resources in the Egyptian economy.

Over the period of study, the Egyptian economy underperformed relative to its major trading partners in terms of labor productivity and employment rates. The IMF (2017) reports that Egypt's employment elasticity of growth has been relatively low. That is, the Egyptian economy has not generated enough jobs, and most economic activity has been concentrated in capital rather than labor-intensive industries. Kamaly (2006) argues that since capital is the most important source of growth in Egypt, and due to its inherited volatility, the growth trend of real output seems to closely follow that of physical capital, and any observed downward trend in output growth is the direct outcome of the deficiency in capital accumulation.

In addition, it appears that smaller enterprises in Egypt exhibit more job creation activity compared to their larger counterparts. According to El Mahdi and Nawar (2014), approximately seventy percent of private nonagricultural jobs are created by micro, small and medium-sized firms. Sectors that have exhibited significant job growth, such as retail trade, construction and transportation, have largely done so within the informal economy. However, many of these jobs have been low quality and low productivity, and the companies that create them face significant constraints on their expansion.

The analysis of GDP per capita in Egypt shows that the main factor driving GDP growth is capital deepening. However, according to the IMF (2017), the high contribution of capital to growth cannot be attributed to high investment or total factor productivity gains, suggesting that investment has not been efficiently allocated to improve productivity within sectors or to facilitate structural changes by reallocating resources towards more productive industries. As a result, the total factor productivity contribution to growth has become negative in the 2000s.

Our research findings indicate that the supply side's underperformance has contributed significantly to the real exchange rate depreciation.

Furthermore, McMillan and Rodrik (2011) argue that workers tend to move towards sectors with low productivity growth, but their productivity level decomposition approach may not accurately reflect the marginal productivity of additional workers absorbed by these sectors, which could be low and thus depress productivity growth rates.

Finally, our model suggests that less likely the variance in forecasting the level of real exchange rate can be described by monetary shocks. However, the effect of monetary shocks approaches zero starting from the fourth period of time.

The response of real exchange rate to nominal shocks shows motivating form as real exchange rate depreciated. However, this depreciation is in favor of nominal inactivity in commodity prices and some overshooting of the nominal exchange rate. Meanwhile, the real exchange rate is the relative price of domestic goods – a nominal shock leads to a nominal depreciation of domestic currency that surpasses the upsurge in the price level; hence, the real exchange rate depreciates. Furthermore, the difference between real and nominal shocks is not only based in the magnitude of the impact but also in its nature. IRFs clearly show that real shocks have a permanent impact on the real exchange rate, while nominal shocks can only be a temporary effect.

In the short run, our results may not be consistent with some empirical support for disequilibrium models of the exchange rate (e.g. Dornbusch, 1976) that attribute short-run volatility in nominal and real exchange rates to nominal shocks. Our result, however, is consistent with the results of Clarida and Gali (1994) and Thomas (1997) for developed countries and with those of Wang (2004) and Sfia (2006) for developing countries.

Our results are also consistent with economic theory and empirical evidence that point out that nations with lower and middle income are more likely exposed partially to shocks due to their undiversified economics sectors with limited production and weak export industries.

More likely, demand shock can be motivated by government monetary intervention, regulations change in major aspect, natural catastrophes and technologies frailer. However, disruption in prices can be accrued due to unexpected event in the market shifting the demand as well the supply separately or together in sudden and temporary moment.

Traditionally, in a Keynesian model, a change in consumer expectations is represented by a "demand shock" which is an external factor to the (IS) equation. Previous empirical research in this area shows that a significant portion of output volatility can be attributed to demand shocks, which are informally linked to alterations in private sector expectations. However, in this paper, a model is constructed based on the fundamental source of uncertainty, which includes long-term changes in aggregate productivity that are not directly observed by agents in the economy. Businesses and consumers establish prospects of these changes based on a public signal that reflects a variety of publicly accessible data relevant to estimating long-term productivity, such as statistics on macroeconomic aggregates and financial prices, as well as news about technological advancements in specific sectors of the economy. The central assumption of this study is that the public signal is flawed, meaning it contains significant noise. This noise, or "news shock," causes aggregate errors in agents' expectations about productivity, resulting in eccentricities from a natural level for output. This will display the typical characteristics of aggregate demand shocks. They are transient and produce positive correlations between output, inflation and employment. In contrast, definite productivity shocks within this setting have characteristics of aggregate supply shocks. They produce negative correlations between output as main variable and inflation as well employment.

The model's depiction of money supply is highly stylized, and the assumed process for money supply is quite conventional, tending to reduce the effects of news shocks while increasing the effect of actual productivity shocks. This is due to the expected rate of return on money holdings being constant and the price level being mean-reverting under the assumptions made (since $u_t \sim \ddot{u}d(0,\sigma u^2)$). As a result, a news shock results in a provisional increase in the price level, implying that the expected real interest rate faced by consumers rises after a news shock. In this sense, the model includes an inherent instinctive stabilizer that inclines to decrease consumers' spending when a news shock occurs. Evaluating a dynamic model with a more explicit illustration of monetary policy quantitatively is a task for future work.

6. Conclusion

This study investigates the source of real exchange rate fluctuations in Egypt between 1980 and 2016. We use the structural vector autoregression (SVAR) method to estimate a model built to enhance EVDCs and IRFs. The IRF indicates that supply shocks will cause an immediate depreciation of the real exchange rate of the Egyptian pound. The real exchange rate then reaches its new long-run level after five periods. On the other hand, the impact of demand shocks on the real exchange rate is permanent. It accounts for almost two-thirds of fluctuations in the real exchange rate and results in a long period of stability in the new level relative to supply shocks. Meanwhile, monetary shocks have a negligible effect on the exchange rate in the short run.

This result supports Barajas *et al.*'s (2011) argument that remittance effects resemble oil revenue effects on the economy in oil-abundant countries. Egypt as a recipient of aid and foreign support. Moreover, our result is consistent with Morales-Zumaquero (2006), where a country in the transition phase will have demand shocks as the main source of real exchange rate fluctuations. Additionally, Kubo (2013), Drine and Rault (2009) and Sfia (2006) provide similar results, as they examine countries that have similar economic structures to those in Egypt. On the other hand, Apergis and Karfakis (1996) present a result in contrast to our result, as they study the Greek economy, which is similar to the Egypt economy. This

contradiction of the source of real exchange rate fluctuations may result from the European Union restricting members of the union from an excessive use of their fiscal policy. However, Apergis and Karfakis's (1996) result might be a good example of monetary policy implementation when compared to countries that have less monetary policy effectiveness.

One major advantage of this study lies in its feature of highlighting the major source of fluctuations in the real exchange rate in Egypt. In controlling for real and nominal shocks, policy-makers should focus on minimizing demand distortions in the short run to stabilize the value of the pound. The government should assess its expenditures to ensure that demand disturbances will not result in exchange rate instability. Additionally, the government should analyze the imports bill, which puts more pressure on the Egyptian pound and invest locally in goods with high demand for foreign currency to be independent of importing them. Moreover, monetary authorities should evaluate their policy effectiveness in the economy to ensure their goal achievement after policy implementation. As the results show that monetary policy has a negligible impact on the exchange rate, the central bank of Egypt should reassess its monetary policy regarding inflation targeting or exchange rate fluctuations to ensure its effectiveness. In short, monetary policies regarding stabilizing the exchange rate through interest rate changes to attract more foreign capital seem to be ineffective in the long run. That is, higher interest rates may prompt capital inflows in the short run, but in the long run, Egypt experience a reverse in capital flows, which offset the impact of the monetary policy. The latest liberalization of the exchange rate in Egypt and the adoption of a free-floating regime may be major solutions to the current issue.

Notes

1. The real effective exchange rate has been calculated based on Brodsky's (1982) method. The trade weighted reaches a maximum of 78 percent of total trade during the period of study and a minimum of 67 percent. Exchange rates, trade values, and country CPI values were obtained from WEO, the Direction of Trade Statistic (DOT) database and the International Financial Statistic (IFS) database, respectively.

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