التأثيرات الاقتصادية الكلية للتدخل في سعر الصرف في الاقتصادات الناشئة خلال الفترة (٢٠٠٠- ٢٠٢٢): حالة مصر

The Macroeconomic Impacts of foreign Exchange Intervention in the Emerging Economies during the period (2000-2022): The Case of Egypt

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Abstract

Foreign exchange intervention is a critical monetary policy tool employed by central banks in emerging market economies (EMEs) to manage exchange rate volatility, ensure financial stability, and achieve broader economic objectives. Unlike advanced economies, where floating exchange rates are prevalent, EMEs often face unique challenges such as capital flow volatility, underdeveloped financial markets, and heightened sensitivity to external shocks. These factors amplify the importance of foreign exchange intervention as a mechanism to stabilize currencies and safeguard economic progress. Accordingly, Central banks should be careful about their likely interventions in foreign exchange because there is a cost for any intervention. In this paper, we focus on examining the macroeconomic consequences of foreign exchange intervention (FXI) and exchange rate rigidity in the hopes of gathering some insights for the choice of exchange rate system and the effectiveness of the FX Interventions. The study utilizes Time Varying Vector Autoregressive (TV-VAR) model with monthly data. The study found that FXI has significant effect on exchange rate, while, the effect of FXI shock on exchange rate and exchange rate volatility before devaluation is higher than after devaluation; the effect of exchange rate on inflation is higher after devaluation and this reflects the higher pass-through effect of exchange rate on inflation that increases with devaluation in developing countries.

المستخلص:

يترتب على التدخلات المحتملة للبنوك المركزية في سوق النقد الأجنبي أثار وتكاليف متنوعة. وتركز هذه الورقة على دراسة النتائج على مستوى الاقتصاد الكلي للتدخل في الصرف الأجنبي، ومدى استقرار سعر الصرف بهدف الوصول لأكثر نظم سعر الصرف كفاءة وفاعلية. تستخدم الدراسة نموذج الانحدار الذاتي المتغير زمنيا (TV-VAR). وقد توصلت الدراسة أن للعملات الأجنبية تأثيرا كبيرا على سعر الصرف، في حين أن تأثير صدمة العملات الأجنبية على تقلب سعر الصرف وسعر الصرف قبل خفض قيمة العملة أعلى منه بعد تخفيض قيمة العملة. ويكون تأثير سعر الصرف على التضخم أعلى بعد تخفيض قيمة العملة، وهذا يعكس ارتفاع تأثير سعر الصرف على التضخم الذي يزداد مع انخفاض قيمة العملة في البلدان النامية.

يعد التدخل في مجال النقد الأجنبي أداة هامة للسياسة النقدية تستخدمها البنوك المركزية في اقتصادات الأسواق الناشئة لإدارة تقلبات أسعار الصرف، ضمان الاستقرار المالي، وتحقيق أهداف اقتصادية على المستوى الكلي. وعلى العكس من الاقتصادات المتقدمة ، غالبا ما تواجه الاقتصادات الناشئة تحديات فريدة مثل تقلبات تدفق رأس المال ، والأسواق المالية غير المتطورة ، والحساسية المتزايدة للصدمات الخارجية. وتزيد هذه العوامل من أهمية التدخل في مجال النقد الأجنبي كآلية لتحقيق الاستقرار في العملات وحماية التنمية الاقتصادية. ووفقا لذلك ، يجب على البنوك المركزية توخي الحذر بشأن تدخلاتها المحتملة في النقد الأجنبي لأن هناك تكلفة لأي تدخل. وتركز هذه الورقة البحثية على دراسة نتائج التدخلات في سعر الصرف الأجنبي (FXI) على الاقتصاد الكلي وتقلبات سعر الصرف بهدف الوصول إلى اختيار أفضل نظام لسعر الصرف ولفعالية التدخلات فى سوق العملة الأجنبية.

1. Introduction

Foreign exchange intervention is an important tool for central banks in many emerging market economies (EMEs). In the past, a fixed exchange rate (pegged to the US dollar) was a popular option for developing countries, especially those transitioning toward market economies. However, the capital account crises and exchange rate collapse that took place in the late 1990s revealed the vulnerability of a fixed exchange rate especially after the breakdown of the Bretton Woods system, and resulted in the wide perception that simple pegs might be too risky and that a country should either adopt a hard peg via monetary unions or use a free-floating exchange rate without government intervention (Kim & Sheen, 2017: Jin, et al., 2022).

The objective of this study is to evaluate the effectiveness and implications of foreign exchange intervention in EMEs, as it is vital for policymakers, economists, and financial markets. Despite extensive research on foreign exchange intervention, significant gaps remain, most studies focus on advanced economies, with limited exploration of how interventions function under the unique conditions of EMEs. Also, the short-term impacts of intervention are relatively well-documented, while its long-term implications on growth, external debt, and institutional credibility require further investigation. Accordingly, this paper seeks to cover this gab by considering the case of FXI in Egypt as one of EMEs, using TV-VAR. This study aims to bridge these gaps by offering a comprehensive analysis of foreign exchange intervention in emerging markets, emphasizing its strategic importance and multifaceted implications. In the context of Egypt, foreign exchange intervention is a critical component of monetary policy, especially given the country's reliance on external financing, its exposure to global economic shocks, and the structural challenges within its financial system. Despite its importance, Existing studies on foreign exchange intervention in Egypt primarily focus on short-term policy responses without thoroughly assessing their medium- to long-term implications for economic stability and growth. Also, TV-VAR allows researchers to model these evolving dynamics, providing a more accurate and nuanced understanding of how interventions influence exchange rate volatility under varying conditions.

The IMF review of exchange rate regimes (2009) points out that the appropriate choice of exchange rate regime should depend on country-specific contexts: A rigid exchange rate regime helps anchor inflation expectations and sustain economic output, but it simultaneously puts greater constraints on macroeconomic policies, increases vulnerability to crises, and impedes macroeconomic adjustments against external shocks (Husain et al., 2005).

The collapse of the Argentine peso in 2002 once again shifted mainstream views regarding the optimal choice of an exchange rate regime by raising new doubts about the viability of hard pegs. Hence, an exchange rate regime does not necessarily have to be a clean float or a hard peg, but in practice, can be an intermediate regime that lies between the two regimes. (Akinci et al., 2006: Adler et al., 2020).

In this paper we evaluate exchange rate interventions for Egypt by dividing it as following: introduction, theoretical background, a quick glance on Egypt, Model, empirical analysis, and finally conclusion

2. Theoretical background

Foreign exchange (FX) interventions are policy actions undertaken by a country's central bank or monetary authority to influence the value of its currency in the foreign exchange market. These interventions are driven by a variety of objectives and are executed using specific tools. Understanding the reasons for interventions, their impacts, and associated costs provides insight into their effectiveness and strategic implementation. In this theoretical overview we are going to discuss reasons and tools of interventions, Impacts of FX Intervention, and Costs of Intervention.

2.1.   Reasons and Tools of Intervention.

Foreign exchange market intervention is defined as trying to change the value that market participants put on a particular currency, as Friedman (1953) proposes that an easy way to decide when the central bank should intervene is when intervention will be profitable. That is the central bank should buy (sell) currencies when they are below (above) equilibrium values. On the other hand, the monetary authority intervention is said to be effective if its intervention will

return the exchange rate to the equilibrium level, or it will reduce the volatility of the exchange rate (Cavallino, 2019).

Now, it can be observed that the popularity of using an intervention instrument for managing exchange rate declined among industrialized economies but increased in emerging market economies EMEs (Bruno & Shin, 2015: Das, 2019). They use a large amount of frequent and infrequent interventions to achieve specific policy objectives. These objectives include correction of exchange rate level and misalignment of rates, curbing exchange rate volatility for smooth market functioning, ensuring liquidity, curbing excessive foreign exchange market speculation and accumulating required foreign exchange reserve for insurance and precautionary motives (Karacadag & Guimaraes 2004; Menkhoff, 2013).

According to Fanelli & Straub (2020), More than half of the central banks report intervening to maintain price stability, financial stability when a capital inflow surge threatens domestic financial stability, interventions can absorb the excess liquidity and help offset its impact on domestic credit growth, and in 38% of the cases Intervention to mitigate costs of exchange rate overshooting or to smooth the economic adjustment process.

Central banks can use FX interventions to stabilize capital flows and moderate domestic credit growth in various ways. For example, buffering sharp depreciations limits adverse balance sheet effects on domestic borrowers and foreign investors (Bruno and Shin, 2015: Fratzscher et al., 2019). For this reason, FX intervention may have benefits that go beyond the consequent accumulation of reserves. These balance sheet effects, in turn, could lead to large capital outflows and second-round effects. Similarly, when monetary easing triggers the unwinding of carry trades, FX intervention can increase the currency's expected excess return and limit capital outflows and accelerated with trading volume. (Cravino & Levchenko, 2017: Fernández et al., 2016 and Hartwig, 2020).

The methods and tactics of foreign exchange interventions depend on intervention objectives and the environment. There are mainly two ways of intervention: **Sterilized interventions,** which are money supply neutral, do not influence the exchange rate through monetary disequilibrium. Instead, by altering the relative supply of domestic and foreign bonds, such interventions

engineer a portfolio reallocation in the market in response to the divergence of the rates of return on domestic and foreign assets. The assumption of perfect asset substitutability that underlies the monetary approach has to be relaxed in the portfolio balance channel for sterilized intervention to work. If assets are assumed to be perfect substitutes, agents would not be concerned about the relative supplies of assets since their primary concern will be only the total size of the portfolio.(Blanchard, et al., 2016)

Intervention can be used as a signaling device – i.e., to signal a Central Banks monetary policy intentions. To establish the credibility of signals, interventions should be followed up by monetary policy actions; Intervention can also be used to signal authority's perceptions about a fundamentals justified "fair/right" value of the currency and thereby contribute to anchor market expectations. (Blanchard et al., 2015; Burdekin et al., 2019; Cavallino, 2019; taylor, 2001; Adler et al., 2020; Di Giovanni et al., 2013; Fratzscher et al., 2015).

Sterilized FXI may also generate macroeconomic impacts via the signaling channel by revealing the central bank's policy intentions, thereby influencing market expectations. Sterilization policies themselves are not without costs. If the central bank sterilizes by issuing central bank notes, it has to bear the interest rate charges on central bank notes. If the central bank raises the reserve requirement ratio, the cost is effectively passed on to the commercial banks, which may in turn raise the lending cost to borrowers. If the commercial banks respond to the higher reserve requirement ratio by shifting businesses off their balance sheets or to the non-bank sector, they will create shadow banking businesses and increase financial stability risks. (Gabaix and Maggiori, 2015; Chang and Velasco, 2017; Cavallino, 2019; Fanelli and Straub, 2020)

On the other hand, **Non-sterilized intervention** purchases (sales) give rise to higher (lower) money stock, which in turn lead to exchange rate depreciation (appreciation) as per the monetary approach to exchange rate. As per this approach, any money stock mismatch resulting from non-sterilized interventions may get reflected in change in the exchange rate, both under flex price and sticky-price conditions.(Fatum & Hutchison, 2003)

There has been much debate in the literature concerning the effectiveness of foreign exchange intervention in both the long run and the short run. The overwhelming theoretical and empirical evidence suggests that non-sterilized intervention to influence the domestic money supply is far more effective at moving the exchange rate in the desired direction than sterilized intervention. From the standpoint of a Central Bank, both sterilized and non-sterilized intervention channels are important because while the former has implications for the interest rate scenario, the latter can influence the monetary base and hence, the aggregate money stock. Sterilized and Non-sterilized interventions can generally influence the market through three channels:

- **The portfolio channel,** gets established where there is imperfect substitutability of foreign and domestic assets and central bank intervention induces market participants to rebalance their portfolio according to the supply of domestic assets (Gourinchas & Jeanne 2013.; Guzman, et al., 2018 Hassan & Mansour 2022; Taylor, 2004). Increase in substitutability of the assets makes this channel weak.

- **Signaling channel**, Intervention can be effective through the signaling channel if it is perceived as a credible signal on the future stance of monetary policy. To the extent that intervention, even when sterilized, influences expectations on future money supply, then it can influence the exchange rate. Which works even in a perfectly substitutable financial market. This idea was further popularized by empirical works of Dominguez (1992) and Dominguez and Frankel (1993). Intervention might change perceptions of one or more of the factors that are relevant to different groups of market participants. This channel assumes that central banks enjoy information superiority, and they release additional information on future policy actions through intervention operations. This changes the expectation of the market participants and influences the exchange rate. Indeed, Gabaix, & Maggiori (2015) and Reitz & Taylor (2008) suggested a coordination channel based on market microstructure approach. According to them, central bank intervention acts as a coordination channel between market expectations of the heterogeneous participants. The central bank intervention (in the form of orders) and the resulting coordination of heterogeneous market participants may facilitate the stabilization of the

market and provide liquidity to the illiquid market. (Woldie & Siddig, 2019). A signaling channel, shifts market participants' expectations about macroeconomic fundamentals or future policy.

- **The order flow channel,** the microstructure approach emphasizes the effects of order flow, market participants, information asymmetries, and price discovery in the foreign exchange market. Central bank trades are assumed to emit information to the market, which modifies exchange rate expectations and ignites a tide of foreign exchange orders, magnified in part by trend-chasing traders (Lyons, 2001). Intervention-induced order flow, in turn, tends to increase short-term exchange rate volatility. (Menkhoff, 2013). So, there is a relationship between order flow and subsequent price action that is different from the relationship between trading volumes and price action and has better predictive qualities than the relationship between news releases on conventional fundamentals and subsequent price action. Market professionals are perhaps able to detect from order flow patterns forces that are relevant to the exchange rate, and act on that information in a way that helps shape exchange rate behavior. Central banks may be able to alter order flows with their own orders. This channel may be more effective in emerging market economies where markets are less liquid. As documented by Ho and McCauley (2003), foreign exchange markets in most emerging market economies do tend to be relatively small with bid-ask spreads that appear to be less uniform (and wider than those in industrial economies. This indicates less liquidity. In this context, Getachew, Siddig (2019) and Taylor (2005) have focused on the traditional channels, such as the monetary policy channel, when intervention is not sterilized. Even when fully sterilized, intervention may change the risk premium, which occurs when domestic and foreign bonds are imperfect substitutes (the portfolio balance channel); alter the expected future values of the exchange rate and interest rate (the signaling channel); and affect the order flows of traders, and market liquidity more generally (the microstructure channel).

These channels are believed to be stronger in EMEs than in advanced economies because of the lower substitutability of EME assets for other assets, and due to smaller market size. And the information

advantage of the central bank is often greater, given its role as the regulator and supervisor of the financial system. (Tobal & Yslas 2016 and 2021).

2.2. Impacts of FX Intervention

A key challenge in estimating the macroeconomic impacts of FXI arises from the endogenous nature of FXI. FXI is often triggered by contemporaneous changes in macroeconomic variables, such as the exchange rate, yet the implementation of FXI will in turn affect the same macroeconomic variables, making it difficult to identify the causal impact from FXI. Many studies have resorted to the use of either instrumental variables to identify the exogenous variations in FXI, or the use of high-frequency data and event-study techniques to resolve reverse causality. For example, Simatete (2004) has studied the impact of the intervention by the central bank of Zambia. The author used the GARCH model to measure the impact of intervention on the exchange rate. She found that this intervention by the monetary authority increases the level of the exchange rate, but it reduces its volatility. Further, Jin et al.,(2021) investigated both the effectiveness and potential consequences of FXI in China, Based on VAR analyses across 26 countries, they showed that while FXI is effective in mitigating nominal exchange rate fluctuations in the short run, its impact on the real exchange rate is less significant. Their results suggest that while FXI can limit adjustments of the nominal exchange rate, it simultaneously induces the real exchange rate to adjust through domestic prices, which may not be conducive to countering the impacts of external shocks. Specifically, we find that in the face of external financial shocks, countries with more intensive use of FXI experience greater general and asset price volatility compared to countries with a free-floating exchange rate.

These results show that interveners experience greater deflationary pressure in the aftermath of an external shock, Although FXI is often relied upon as a policy tool to reduce market volatility, we find no evidence that FXI can mitigate domestic asset price volatility and a limited impacts on the real exchange rate. We find that real exchange rates among intervening countries adjust more flexibly than nominal exchange rates do, suggesting that the stability of the nominal exchange rate may be achieved at the expense of greater domestic volatility which are unintended domestic consequences. Nakajima,

(2011) studied foreign exchange interventions in Mexico and Turkey. They indicated that interventions in developing economies might be more effective than those of developed economies. They claimed that some emerging market countries intervene in amounts that are large relative to market turnover. They used different foreign exchange and banking regulations that effectively restrict the size of the market and can increase the central bank`s control.

On the other hand, Merza (2015) investigated the effect of foreign exchange intervention on the level and volatility of the exchange rates for some emerging economies in Europe using event study analysis. The finding of this paper asserts that appropriate central bank communication might improve the effect of intervention. Further, Goyal and Arora (2010) stated that the aim of the Indian exchange rate policy is to decrease volatility. In their study of the Indian economy, they used daily and monthly data sets. Using the GARCH model, they found that foreign exchange intervention by the Central Bank of India (CBI) was effective for the period under examination. This result is consistent with the stated goal of the CBI. Though the CBI`s tools have a lot of potential, they were found to be ineffectively used. Furthermore, Rishad et al., (2021) investigated FXI impacts and its effectiveness using an ARDL and GARCH model with monthly and weekly data from June 1995 to June 2019. The findings are in consensus with the existing theoretical arguments about central bank interventions in the EMEs. Accordingly, it was found that a 1% purchase of foreign exchange reserve (net intervention) depreciates Indian Rupee by 0.255%. Indian Rupee appreciating (depreciating) through purchase (sale) intervention in short run clearly indicates that the central bank is employing a "leaning against the wind" policy. As a fast-growing economy, India draws tremendous amount of capital inflow for exploiting the advantages of high-interest rate, which creates pressure on Rupee to appreciate. But the impact of net intervention is very little because it is challenging to prevent appreciation pressure in the presence of high-interest rate differentials. Such asymmetric intervention causes accumulation of foreign exchange reserve beyond the conventional reserve requirement limits.

Moreover, Fanelli and Straub (2020), showed that the Cost of maintaining the accumulated reserve may conflict with the practicing inflation targeting policy. However, intervention should not be used as a frequent policy

instrument to defend the exchange rate misalignments. Instead, policies should be more concerned toward strengthening financial market infrastructure and economic fundamentals. They also showed that the exchange rate in India seems to have been unidirectionally influenced which is measured as fall in the US interest rate. On the contrary, a rise in US interest rate does not affect exchange rate. They attribute this evidence to asymmetric control over capital flows i.e., capital outflows are not as free as capital inflows.

Burdekin et al., (2019) studied the central bank interventions in four Latin American countries, Colombia, Chile, Peru, and Mexico. She found that the result of intervention was different whether selling or purchasing foreign currency. Also, she found that volatility is decreased by interventions; however, the intervention`s size does not play a major role in that matter. Similarly, Cravino and Levchenko (2017) examined the causal relationship between central bank intervention and the exchange rate in India. He used monthly data for the period December 1997 to December 2011. The empirical findings suggested that there was causality-in-variance, in one direction, from exchange rate to intervention by the central bank. These results were robust whether the exchange rates were measured by the spot rate or the forward rate. So this research suggested that the volatility was not influenced by central bank purchases of foreign currency in the market.

On the other hand, Kumar, et al (2022) found that there was no agreement about the effectiveness of foreign exchange intervention. In many cases, intervention had no constant effects on the exchange rate and might have even worsened exchange rate volatility. Finally, García-Verdúy and Zereceroz (2014) have assessed the effectiveness of two kinds of interventions. The "dollar auctions with minimum price" were applied for the period October 2008 to April 2010, and the "dollar auctions without minimum price" was implemented from March to September 2009. Their analysis followed the event study microstructure approach. They used the bid-ask spreads as a measure of liquidity. The results demonstrated no sign of an effect in the bid-ask spread for the first kind of intervention and showed a significant decline in the spread for the second kind of intervention. They concluded that the aims of these two interventions were, respectively, to give liquidity and to support the situation in the foreign exchange market. (Merza, 2015).

Further, Girardin and Lyons (2007) also found the same result on Japanese intervention by using daily data. Dominguez (2003) found that Federal Reserve interventions were able to regulate the exchange rate behavior. The competency of an intervention can be accelerated through the size of intervention and its execution immediately after the macroeconomic announcements (Fatum & Hutchison, 2003; Humpage, 1999). But the study of Goodhart and Hesse (1993) failed to find any evidence of a positive influence of intervention on exchange rate. They further claimed that the central banks actively operate in relatively thin market, during the episodes of high volatility or when exchange rate deviates from the equilibrium. On the contrary, Kim and Sheen (2002) argued that the Reserve Bank of Australia holds off its intervention operation in a volatile market. Researchers point out that intervention in the EMEs are more effective than those in the industrialized market, because of the relative size of the market and the liquidity conditions. But a concerted intervention is found to be more successful than a single country intervention in an industrialized economy because of its ability to influence in-depth market with high market turnover (Pınar Ardıç & Selçuk, 2006; Tobal & Yslas, 2021; OECD, 2014).

Some researchers focused on the relationship between transparency of intervention policies on the effectiveness of intervention (Woldie & Siddig, 2019; Settlements, 2005; Peren & Han Gur, 2009; Mano,et al., 2019; Karacadag & Guimarães, 2004; Jin, 2022). Indeed, insah (2013) analyzes the effects of intervention on the level and volatility of the exchange rate in Mexico and Turkey, two emerging countries that have floating exchange rate regimes. The paper finds mixed evidence on the effectiveness of intervention. In Mexico, foreign exchange sales have a small impact on the exchange rate level and raise short-term volatility, while in Turkey, intervention does not appear to affect the exchange rate level but reduces its short-term volatility. In both cases, the findings are consistent with officially stated policy objectives, which aim to minimize the effect of intervention on the exchange rate, but cast doubt on claims that intervention is a useful tool for smoothing volatility. Although these findings cannot be generalized to other emerging markets, intervention's apparently limited effectiveness highlights the need for central banks to use their scarce foreign reserves selectively and parsimoniously.

Vadivel (2011) and Egert & Komarek (2005) showed that in the case of Peru most studies by the central bank's staff demonstrate that intervention has been successful in dampening exchange rate volatility in the context of the country's partially dollarized economy (Hofman et al., 2020). As pointed out by Batini et, al. (2008), foreign exchange intervention could be a component of the optimal policy in a dollarized economy, to stabilize inflation and output. Some studies show that interventions have also been successful in Brazil and Poland, even though these countries have differed markedly from Peru in terms of balance sheet conditions. In the case of Brazil, Kohlscheen (2012) shows that small changes in dollar purchases/sales by the central bank led to large changes in private sector pricing behavior, as seen from order flows. This could be taken as indirect evidence that the monetary authority has a coordinating role in price setting in the foreign exchange market. Central bank reported that the impact depends on the direction of intervention, implying a certain asymmetry in the central bank's influence over the exchange rate. While dollar sales by the central bank have had a statistically significant effect on exchange rate volatility, dollar purchases have led to higher rather than lower exchange rate volatility.

Pattanaik and Sahoo (2003) examined the impact of intervention with monthly data after the implementation of the floating regime in India. They found that RBI tried to curb the exchange rate volatility primarily, but its reaction toward exchange rate misalignment was less. RBI intervention was tentatively successful in achieving these objectives. Other scholars further substantiated these findings by using monthly intervention data (Kumar et al., 2022: Rishad et al., 2021, Mano, et al., 2019)

Money supply, imports, and speculation are found to be three important macroeconomic fundamentals that significantly influence the volatility of Somali informal exchange rates. It is evident, from these findings, that money supply is a key factor to the volatility of Somali informal exchange rates, and thus Somali policymakers should stress on producing effective regulatory on its monetary issues (Gourinchas & Jeanne, 2013).

2.3.   Costs of Intervention

The empirical results presented herein suggest that while interveners experience less nominal exchange rate volatility in response to external shocks,

they bear the consequence of additional adjustments in domestic general and asset prices. Such macroeconomic consequences can be costly but may be overlooked or underestimated as they may not be directly observable. FXI can also incur more direct costs, including the buildup of external imbalances, loss of foreign reserves, suppression of external investment returns, underdevelopment of the foreign exchange market, and conflicting goals between monetary policy and exchange rate policy, which we briefly discuss next. FXI may impede timely adjustments of the balance of payments in response to negative external shocks. FXI that attempts to counter depreciation pressure can slow the adjustments of the balance of payments. The IMF's External Balance Assessment (EBA) conducts an empirical analysis and finds that FXI results in a buildup of external imbalances, especially in countries with capital account restrictions (Phillips et al., 2013).

Another costly consequence of FXI is that it can put the central bank in a dilemma by creating conflicting goals between inflation and exchange rate targets. An important mandate of the central bank is to maintain price stability, but inflation targets may be compromised if the central bank simultaneously attempts to achieve an exchange rate target. Many studies showed that intervention in general turns to be ineffective. For some reasons as:

(i)   If exchange rate is primarily decided by the demand and supply positions in the foreign exchange market, only a large volume of intervention relative to the turnover in the foreign exchange market can make an intervention successful. But, the amount used by the Central Banks to intervene generally represents only a small proportion of both daily market turnovers and demand supply mismatch;

(ii)   If the exchange rate is interpreted as the relative price (value) of national money, non-sterilized interventions can always change the supply of money in relation to demand in one country and thereby influence the exchange rate. But again, the change in the stock of money resulting from intervention may not be very significant.

(iii)   If the exchange rate is viewed as the relative price of financial assets denominated in different national currencies (i.e., the asset market approach to exchange rate determination), sterilized interventions could affect the exchange rate by altering the supply of domestic bonds vis-a-

vis bonds denominated in foreign exchange. In relation to the large stock of publicly traded domestic and foreign bonds, the change in the demand-supply position caused by sterilized intervention operations may, however, be very marginal. (Gabaix & Maggiori, 2015).

(iv)   Non-sterilized intervention purchases (sales) give rise to higher (lower) money stock, which in turn lead to exchange rate depreciation (appreciation). As per this approach, any money stock mismatch resulting from non-sterilized interventions may get reflected in change in the exchange rate, both under flex price and sticky-price conditions. Therefore, it is more like a monetary policy instrument rather than an instrument for attaining the exchange rate objective.

(v)   Moreover, non-sterilized intervention generally operates as a constraint to independent conduct of monetary policy whereas sterilization helps in regaining monetary policy independence. Not many Central Banks may even tolerate large variability in short-term money market rates resulting from non-sterilized intervention, particularly in view of the fact that short-term interest rate is being increasingly relied upon by them as the primary operating instrument of monetary policy.

(vi)   Risk of speculative attack under fixed-but-adjustable peg exchange rate regimes, an announced exchange rate target provides a clear level that the authorities are obliged to defend. As in the Asian financial crisis in 1997, provided numerous examples of speculative attacks on currencies where those limits had been threatened, and consequential expectations of possible devaluation had reached critical levels. For example, Hungary's experience with speculative attacks in 2003, which motivated a switch to covert intervention.(Ghosh et al., 2016)

There are numerous examples of central banks seeking invisibility during interventions. Guzman, et al., (2018) survey reported that around half of developing and transition economy central banks did not announce their presence in the market when intervening. The authorities in Indonesia and South Africa, amongst others, indicate a preference for not being seen when intervening. The Monetary Authority of Singapore avoids disclosure of the limits of the exchange rate range that has been determined to be consistent with achieving the inflation target. In several other countries, including the Czech

Republic, Korea and Poland, the authorities indicate that contemporaneous disclosure is determined on a case-by-case basis.

Despite the potential merits of using FXI, most studies do recognize that FXI is not a free lunch and should be used only under very rare circumstances. And there are potential costs associated with FXI.

3. A quick glance in Egypt

In 2001 Egypt announced a crawling peg regime. Then the adoption of a floating ER regime in January 2003. For these purposes it is not sufficient to determine whether a country has adopted a floating exchange rate. It is also important to analyze how heavily and in what ways the exchange rate is managed. Correcting the disequilibrium in the foreign exchange market in Egypt and ending up the one-way speculation option helps in correcting other macroeconomic variables in the Egyptian economy. For instance, El-Ramly and Abdel-Haleim (2008) has found that the devaluations of the Egyptian Pound over the period from 1982 to 2004 have an initial contractionary effect on output in Egypt. Massoud and wallet (2014) has found an impact of exchange rate movements on domestic prices. CPI and PPI are affected by the movements in exchange rate of the Egyptian Pound.

Massoud and wallet (2014) showed that the CBE was using the ER of the Egyptian Pound against the dollar as an anchor for monetary policy in Egypt and allowing it to move more flexibly against the euro and the British Pound. Another point that supports our argument is that since the CBE adopted the new system in the exchange market with the auctions for USDs in December 2012, the ER of the Egyptian Pounds has fluctuated against the USD dollar and against both the Euro and the British Pound.

With the implementation of the ERSAP, the Egyptian authority adopted a managed floating ERR leading to a devaluation from LE 2 per dollar to LE 3.4 per dollar between February 1991 and December 2000 (Hendi,2007). This period was characterized by a steady increase of reserves from 3.1 billion dollars in January 1991 until it reached its peak of 19.1 billion dollars in September 1997, as shown in figure (1) (Central Bank of Egypt, 2010) in 2004, 2005, and 2006, the IMF classified Egypt's ERR to a de facto "Managed

Floating with no predetermined path for ER" combined with a "Monetary Aggregate Target" policy framework (Massoud and wallet, 2014).

The value of the pound has improved to LE 5.80 per dollar, the inflation rate increased to 15.9% and 16.1 %, measured as WPI and CPI respectively, and the reserves increased from 14.8 billion dollars by the end of June 2004 to 22.4 billion dollars by the end of February 2006 (Khamies, 2012) as depicted in figure(2) and (3). In 2008, the IMF changed its classification to a Conventional Fixed Peg Arrangement with the ER as a nominal anchor, and in 2009 the IMF reclassified it to a "Managed Floating with no Predetermined Path for ER". By the end of 2011, it was reclassified as a "Craw-Like Arrangement" and few months later, in 2012, it was reclassified as a "Stabilized Arrangement". On the 3rd of November 2016, the CBE decided to float the pound. The decision has been made after a period of economic instability, a shortage of foreign currency inflows and political disruptions (Hassan & Mansour, 2022).

The floatation aimed at boosting external competitiveness, encouraging foreign investors, increasing transparency, and fighting against the black market which was trading at a double-the-official price. to identify the determinants of the Egyptian ER against both the US dollar most studies concluded that interest rates, imports, and political stability are the most influential variables. In 2007, Hendi conducted another study aimed to identify the most influential factors in determining the value of the Egyptian pound. The study used the Hedrick and Prescott model and the co-integration model on data for the period from 1980 to 2002. The study concluded that there are only three variables with a significant effect on the ER, which are the budget deficit, the trade deficit, and the local credit, while government spending, exports, imports, gross domestic product, foreign assets, international reserves have not shown a significant effect. (awad, 2010 and CBE, different issues)

In another attempted to clarify the determinants of the ER in Egypt during the period from 1991 to 2013, Bakr (2014) conducted a study applying the ordinary least squares and concluded that the most influential variables in determining the ER are trade deficit (71%), followed by inflation rates (44%) and local credit (32%). The study has also found that the ER and budget deficits. In 2015, Rofail and Hosni published a study which used co-integration and VECM to assess the real ER in Egypt from 1974 to 2012. They found that productivity differentiations and government consumption caused an

appreciation in the real ER, and concluded that the effect of openness of the economy is dominated by the substitution effect as it leads to a depreciation in the real ER equal to the effect of the investment share.(Mansour and Soliman, 2021)(Kamel, 2019).

Figure1. Nominal Exchange rate of Egypt development during the period January 2000 to December 2022
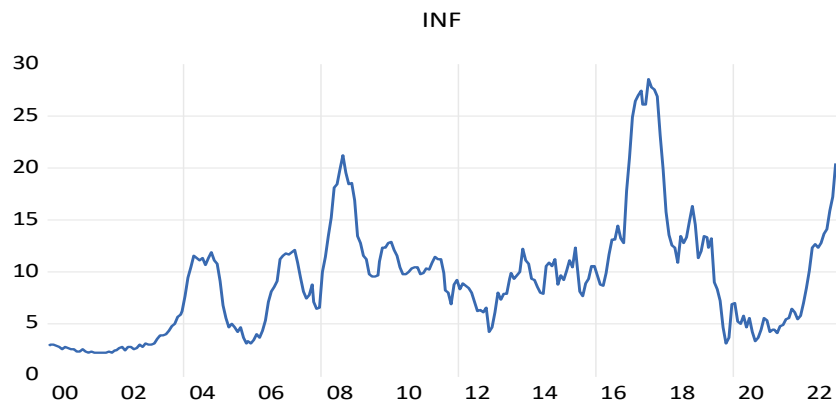

Source: International Monetary Fund, Data base, Different Years.

As we notice, figure (1) illustrates the nominal exchange rate development of Egypt from January 2000 to December 2022. The exchange rate increased through time with a steady pattern during the period (2000-2016) during this period, the exchange rate exhibits a gradual and controlled increase, reflecting a relatively stable monetary environment. Policies like a managed exchange rate regime likely helped mitigate volatility. Whoever, the global financial crisis (2008-2009) might have led to shifts in exchange rates due to its impact on emerging markets. In November 2016, the significant spike occurred, coinciding with the Central Bank of Egypt's decision to float the Egyptian pound. This move was part of an economic reform program supported by the IMF. It aimed to address chronic dollar shortages and encourage foreign investment. The pound devalued sharply, reflecting the transition to a free-floating exchange rate regime. The data includes sharp rise after 2022 indicating a sharp depreciation of the Egyptian pound. this might reflect the impact of global inflationary pressures, rising commodity prices, or Economic disruptions caused by the COVID-19 pandemic and

the Russia-Ukraine conflict. The chart shows a steep increase in the exchange rate in 2022 and continued reliance on foreign debt, making the pound vulnerable to external shocks.

Figure 2. Development of annual inflation in Egypt during the period January 2000 to December 2022

INF

Source: International Monetary Fund, Data base, Different Years.

Figure (2) shows that during the Periods (2000–2006) and (2009-2015), Inflation showed moderate levels, fluctuating between 2% and 10%, with occasional peaks. Which indicates a generally stable economic environment with manageable inflation. Also, there was two inflationary peaks the first during the periods (2007-2008) and (2016-2017) this can be explained by global events such as the food and fuel price crises that affected many emerging economies, the floating of the Egyptian pound and subsidy cuts, which caused price levels to surge. As we notice, there is a sharp increase in inflation in year 2022, likely due to global economic disruptions (such as the COVID-19 pandemic's and the Russia-Ukraine conflict) and domestic economic challenges.

Figure 3. Development of Real exchange rate

Source: International Monetary Fund, Data base, Different Years.

There is a steady decline in the real exchange rate during the period (2000-2004), indicating a possible depreciation of the currency in real terms during this period. From 2004 onwards, the real exchange rate begins to appreciate, reflecting a strengthening of the currency in real terms. During the period (2010-2016), the exchange rate exhibits more volatility, with several peaks and troughs, indicating periods of both appreciation and depreciation. However, there was a Sharp Drop on 2016 reflecting a significant and a sudden depreciation is evident in 2016, likely due to a major economic or policy shift, such as the liberalization of the exchange rate. The period (2017-2022) was characterized by Recovery and Stabilization as the exchange rate shows signs of recovery and stabilization, although there still some fluctuations. There is another drop in year 2022, possibly signaling renewed economic pressures and currency adjustments.

As a conclusion, the overall trend reflects key economic events in Egypt, such as policy changes, external shocks and structural adjustments impacting the real and nominal exchange rate and causing inflation also to fluctuate during the period (2000-2022).

4. Model

The majority of previous empirical literatures which analyzed the effectiveness of exchange rate interventions used the Vector Autoregressive (VAR) approach (Pinar Ardic & Selcuk, 2006; Tobal and Yslas, 2016; Lee and Kim, 2020) which models many variables as endogenous variables to explore the dynamic interactions between included variables. We can express our set of endogenous variables as following:

$$Y_t = [FXI_t, exr_t, IR_t, CPI_t, IPI_t, EGX30_t, TB_t, exrv_t) \quad (1)$$

Where, FXI_t is foreign exchange rate interventions approximated by monthly changes in Egyptian central bank foreign reserves which similar to Ding and Wang (2022) and Adler et al. (2019); Mano et al., (2019) exr_t is nominal exchange rate of the Egyptian pound vs US dollar which the increase value means depreciation for the Egyptian pound; IR_t is interest rate differentials; CPI_t denotes the consumer price index; IPI_t the industrial production index; $EGX30_t$ the level of the Egyptian stock market EGX30 index; TB_t is the trade balance which is the value of exports minus the value of imports; and finally $exrv_t$ exchange rate volatility which is calculated by GARCH model.

The reduced VAR model might be represented as the following:

$$Y_t = \beta_0 + \sum_{j=1}^{P} \beta_j Y_{t-j} + \varepsilon_t \quad (2)$$

Where:

Y_t is K x 1 vector including K time series; ε_t is an K x 1 vector of error terms; β_0 is an K x 1 vector of intercept terms; β_j is an K x K coefficient.

However, the intensive parametrization of the reduced VAR model causes to instability problem with both structural inference and out-sample forecasting.

Instability problem in VAR model can be resolved by utilizing Bayesian techniques with given informative priors (Koop and Korobilis, 2010). Further, Primiceri (2005), Nakajima (2011) and Del Negro and Primicerio,(2015), Hartwig (2020) Koop, (2009)developed the time-varying parameter VAR

approach with a stochastic volatility (TVP-VAR). The model can be represented as following:

$$\beta_t Y_t = d_t + C_{1,t} Y_{t-1} + \cdots + C_{p,t} Y_{t-p} + \sum_t v_t \qquad (3)$$

Where, Y_t is a vector of endogenous variables which included in the model; d_t is a constant vector of time varying coefficients; $C_{i,t}$ is a matrix of time varying coefficients associated to the lagged endogenous included variables; β_t is contemporary time-varying coefficients; $\sum_t$ denotes to the time-varying standard error matrix; v_t denotes to a vector of structural innovations with a multivariate standard normal distribution?

5. Empirical study

2.1. Data

The empirical analysis will be based on monthly data from 2000:M1 to 2022M12. Data includes nominal exchange rate, Consumer price index, interest rate differentials between Egypt and US, stock market index, Industrial production index as approximation for the real production, trade balance as the difference between the value of exports and imports. In addition to, the stock of foreign reserves (FXI).

We obtain data from the central bank database, the international monetary fund database (International Financial statistics; IFS), and the website of the ministry of economic development.

5.2. Results

Unit root tests in table (1) state that all variables have unit root in the level but stationary in first difference therefore, we will depend on the first difference form for all variables.

Table (1).
Unit root test

	FXI	exr	exrv	CPI	IR	EGX30	IPI	TB
Level	-1.41 (0.57)	0.96 (0.99)	-0.62 (0.85)	-2.55 (0.1)	-1.53 (0.5)	-2.35 (0.15)	-2.1 (0.24)	-0.89 (0.78)
First difference	-6.4 (0.00) ***	-7.64 (0.000) ***	-8.7 (0.00) ***	-4.58 (0.00) ***	-7.02 (0.00) ***	-6.7 (0.00) ***	-15.6 (0.00) ***	-12 (0.00) ***

Source: Authors Calculations

In order to analyze the effectiveness of foreign exchange interventions, Impulse responses functions for each FXI, EXR and EXRV are explored. Figure 4 shows the effect of FXI on macroeconomic variables. The previous figure states that Effect of FXI on exchange rate continues to the end of time span which is 36 months. Where, the effect of FXI on exchange rate volatility disappear within the first year during nine months. Further, the response of stock market index and trade balance to FXI shock is very small. While, the response of inflation, interest rate and industrial production to FXI shocks disappear within the first six months. Therefore, FX has significant effect on macroeconomic aggregates.

Further, Figure 5 captures responses of variables to shock in exchange rate. We can see that the effect of exchange rate's shock on FXI is positive and continues to long period which applies that exchange rate shock positively effect on FXI. In addition, exchange rate shock positively affects stock market, interest rate, and trade balance; which applies that the deprecation of national currency has a significant impact on these macroeconomic variables.
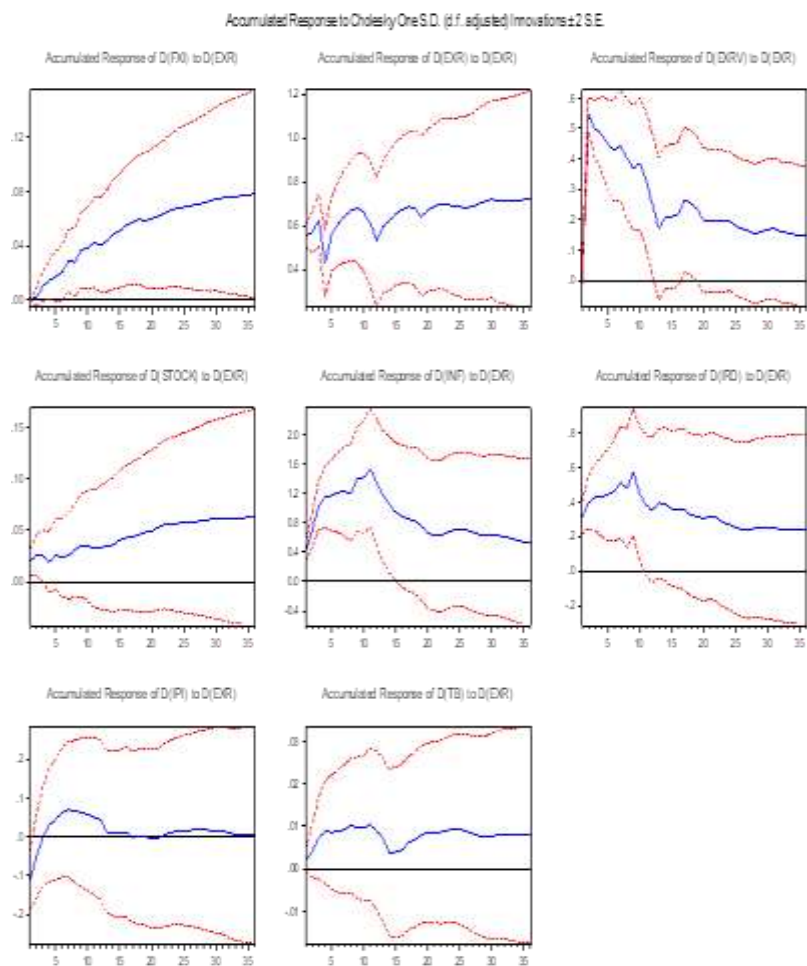
Furthermore, Figure 6. Depicts responses of variables to shock in exchange rate volatility. Where, the shock has negative effect on industrial production and trade balance but this shock has positive effect on inflation and a small effect on FXI.

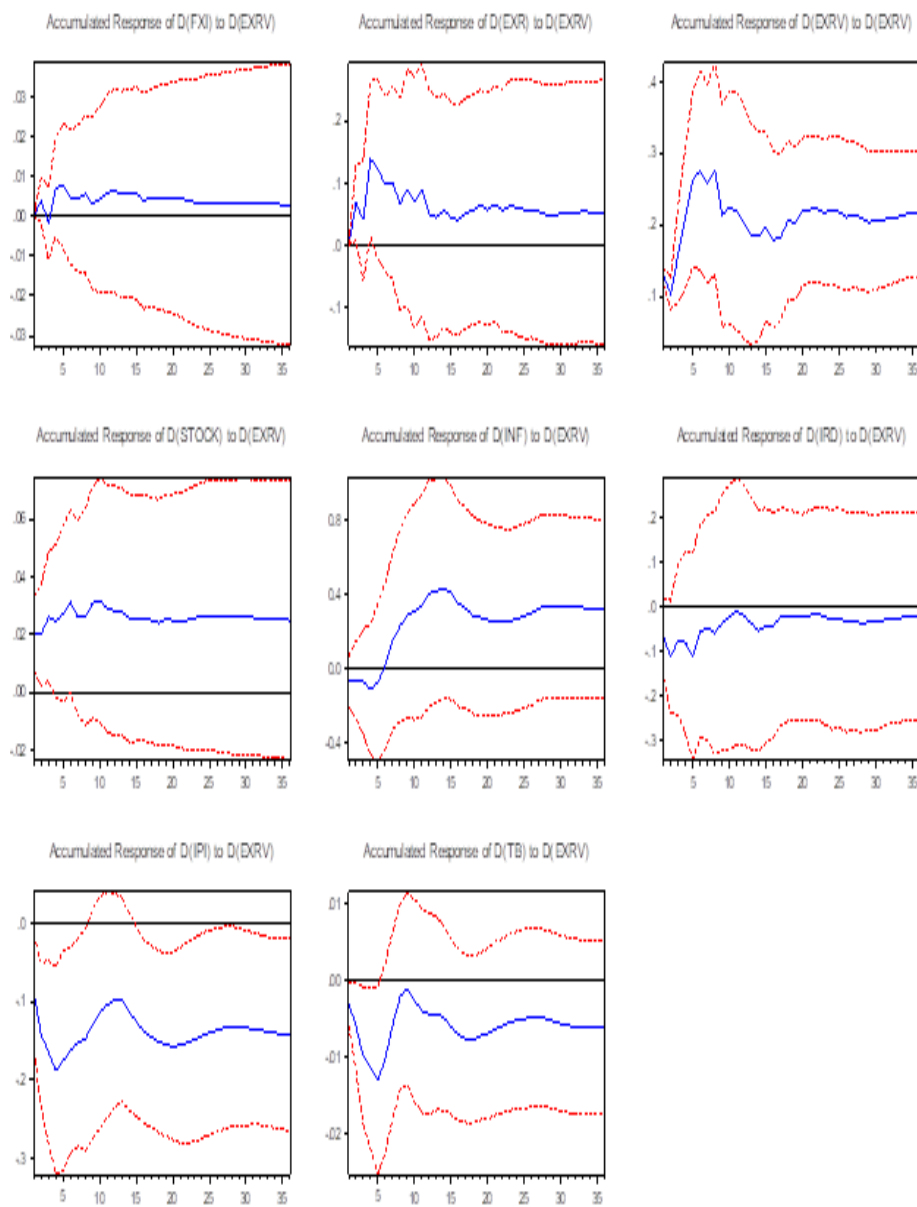**Figure 4. Impulse response of FXI**
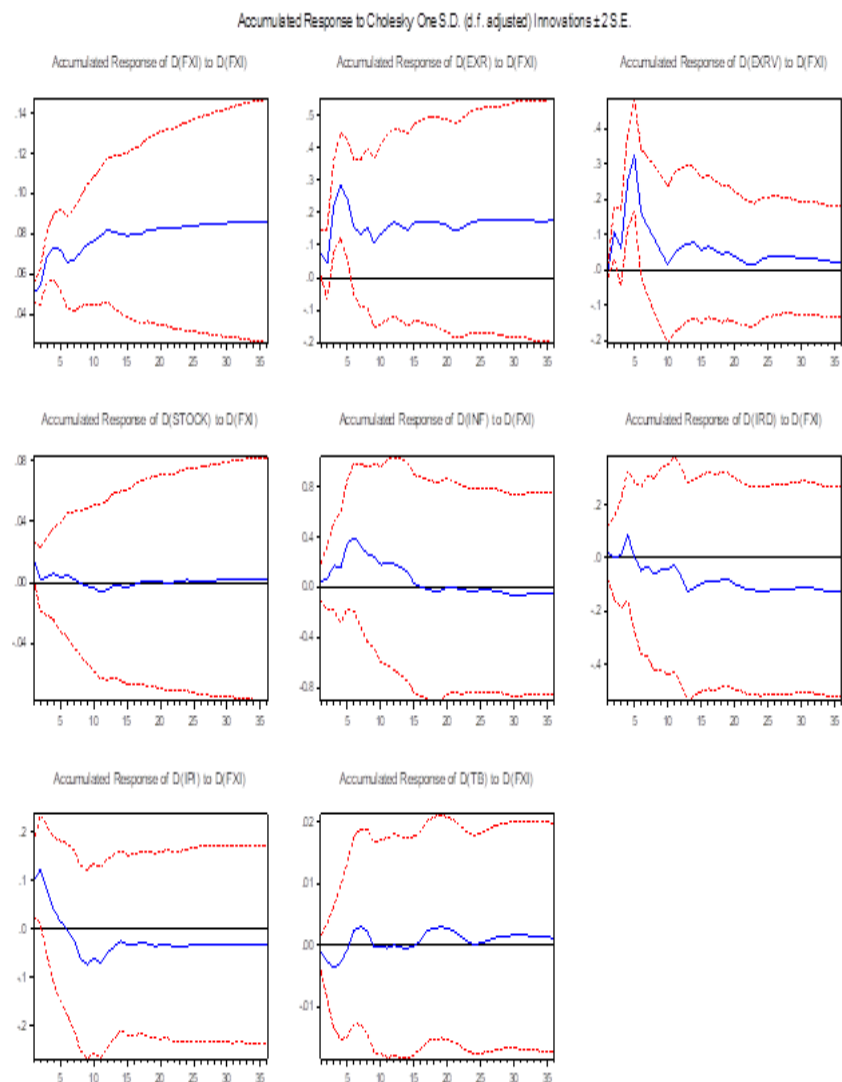
Source: created by the authors.

Figure 5. Impulse Response of Exchange rate

Source: created by the authors.

Figure 6. Impulse response of EXRV

Accumulated Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.
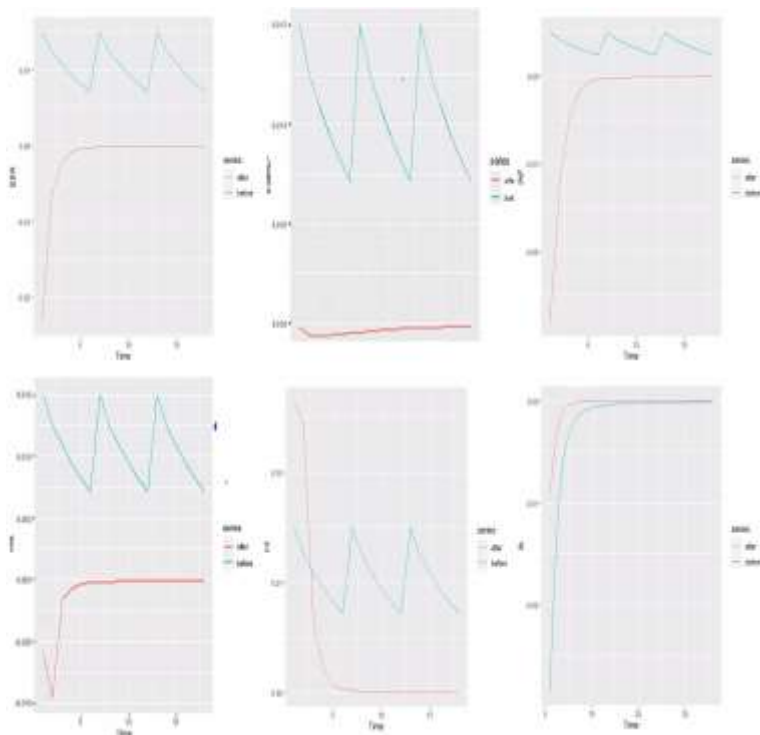

Source: created by the authors.

We estimated TVP-VAR model for the variables and then we generated changeable impulse response functions for before and after the exchange rate devaluation which occurred in the end of 2016. A figure (4) depicts the impulse for FXI on other variables over the periods before and after devaluation. We can observe that the effect of FXI shock on both EXR and ERV before the devaluation is higher than after devaluation, which implies the fact that in fixed or completely managed exchange rate regime central bank gives more concerns on exchange rate and exchange rate volatility. Similarly, the effect on inflation, stock market, interest rate is higher in before period. Finally, the effect on trade balance is higher during after devaluation period.

Further, effect of EXR shock on FXI is higher in the period before devaluation while the effect of EXR shock on EXRV is higher in the period after devaluation, which reflects the fact of the high effect of uncertainty associated with devaluation decision in Egypt. The effect of exchange rate on inflation is higher after devaluation and this reflects the higher pass-through effect of exchange rate on inflation that increases with devaluation in developing countries. As these countries mainly depend on the foreign countries to fulfill their need from foods and raw materials. Finally, the effect of exchange rate shock on trade balance is higher in after devaluation period but this effect disappears within the first year and becomes almost the same.

Moreover, Effect of EXRV shock on FXI is higher in the period before devaluation and this effect continue for more than two years. This implies that monetary authority is observing exchange rate volatility under pigged exchange rate regime and any huge deviation over the stable level, they are trying by intervening in the exchange rate market to limit this variation. Figure (7) also depicts the response of inflation to exchange rate volatility which is higher in the period after devaluation. This requires an enough package of requirements before devaluation which can control uncertainty about the price of national currency in the market. Similarly, this uncertainty generates inflation pressures in the market continues with high levels for all assessed periods.
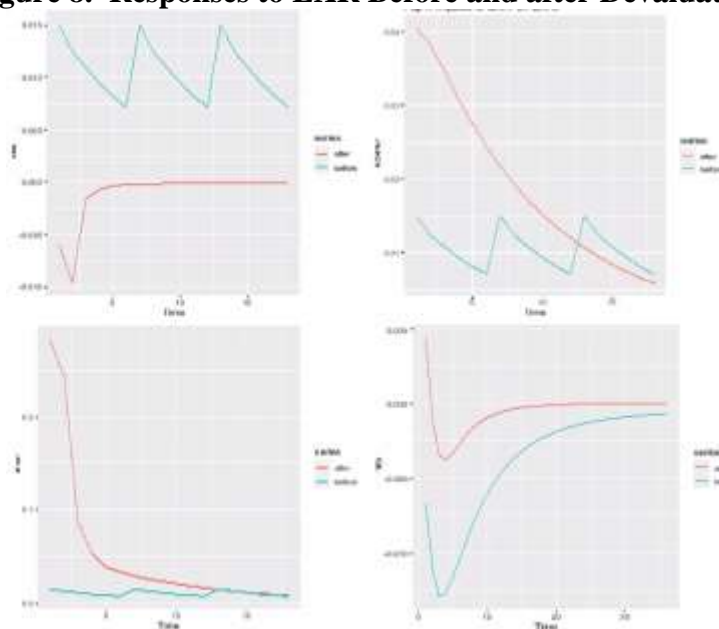
Figure 7. Responses to FXI Before and after Devaluation

Source: created by the authors.

Notes: responses include variables in the figure which is first row includes: exchange rate, exchange rate volatility, inflation. While, second row includes: EGX30, interest rate differentiation, trade balance.

The green line for before devaluation where the red line for after devaluation.

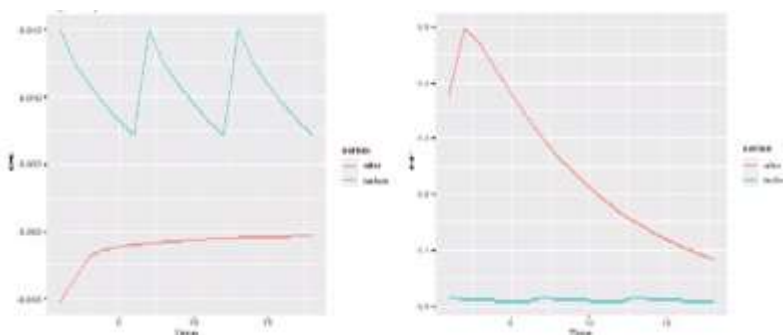**Figure 8. Responses to EXR Before and after Devaluation**

Source: created by the authors.

Notes: responses include variables in the figure which is first row includes: foreign reserve, exchange rate volatility. While, second row includes: inflation, trade balance.

The green line for before devaluation where the red line for after devaluation.

Figure 9. Responses of macroeconomic variables to EXRV

Source: created by the authors.

Notes: responses include variables in the figure which are: foreign reserve and inflation.

The green line for before devaluation where the red line for after devaluation.

The responses of macroeconomic variables are depicted on figure (9), exchange rate fluctuations have varying impacts on macroeconomic variables. Some variables (e.g., inflation or output) may react strongly and require time to stabilize, while others remain unaffected. The differences in responsiveness highlight the importance of understanding the transmission mechanisms in the Egyptian economy, such as the pass-through effect of exchange rates on prices and trade.

Conclusion and policy recommendation

Overall, this analysis indicates that best practice in open emerging economies subject to boom-bust cycles in external financing is the complementary use of traditional macroeconomic policies with interventions in foreign exchange markets and capital account regulations.

While studies in the 1980s had largely rejected the effectiveness of interventions in foreign exchange markets, subsequent studies have contested those earlier results and have shown that interventions are ineffective. Pursuing a stable and competitive exchange rates can promote economic development, and given the instability of global financial markets, this requires flexible and sustained interventions. These interventions and instruments need to be used in combination with, and in coordination with each other and a range of other monetary, macro-economic and micro-instruments, including, most notably, industrial policies. Macro-stability and industrial policies may enhance the effectiveness of a stable and competitive exchange rate as a tool for development and diversification; and to the extent that these policies succeed in enhancing diversification, they can contribute to macro-stability. Exchange (Guzman et al., 2018). Future studies can focus on the effectiveness of economic policies within different exchange rate regimes.

Based on the results the study can recommend by the following:
- Gradual move from exchange rate interventions to free floating as the interventions have significant effect in many macro variables.

- Decreasing the level of interventions should be associated with plans to control on uncertainty in the economy.
- Adopting a plan for controlling high inflation pressures with resulted from increasing the level of exchange rate with adopting more flexible exchange rate regime.
- Prepare suitable policies to compensate for the negative effects on stock market after moving to new regime.
- Providing full support to exporters while moving the official exchange rate to increase the benefit from the reduction in the official exchange rate.
- Adopting suitable policies which can control uncertainty about the price of national currency in the market. This is because uncertainty generates inflation pressures in the market continue with high levels for all assessed periods.

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