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Ibrahim L. Awad[1]

A COMPARATIVE STUDY OF SEIGNIORAGE: EGYPT AND QATAR[2]

This study adopts the model of CB's balance sheet and government budget identity developed by Klein & Neumann (1990) to investigate the question of "Will the effect of monetary seigniorage on CPI inflation and real GDP growth be differentiated based upon the adopted monetary policy regime and the initial source of seigniorage?" The study compares Egypt and Qatar, as both countries apply asymmetric monetary policy regimes. Conclusions by structural VAR model are: (i) monetary seigniorage does not affect either CPI inflation or GDP growth in Egypt. The opposite is true in the case of Qatar. (ii) in contrast to the case of Qatar, the mechanism of the money supply channel is broken in Egypt because the central bank of Egypt applies a sterilization policy to maintain dual objectives for monetary policy, namely foreign exchange rate and inflation rate.
Keywords: Monetary Seigniorage; Fiscal Seigniorage; Structural VAR Model; Central Bank's Balance Sheet
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1. Introduction

Two concepts of seigniorage are reported in the literature (Klein, Neumann, 1990, Neumann, 1992; Bjerg, et al, 2017); the opportunity cost seigniorage and the monetary seigniorage. The concept of opportunity cost seigniorage is based upon the so-called state theory of money which regards the issuance of money as a credit with the state that individuals and banks are forced to hold it (Bjerg, et al., 2017; Bell, 2001). Hence, if money is viewed as a zero-interest loan to the government then seigniorage equals the interest savings by the government because of being able to issue securities (or currency) with zero interest rate or force commercial banks to hold reserves at zero interest or below the market interest rates. Therefore, the government revenue from issuing money is equivalent to the private sector's loss from forgone interest earnings by holding currency (or securities) with zero interest rates (Gross, 1989; Klein, Neumann, 1990; Groeneveld, Visser, 1997).

[1] *Ibrahim L. Awad, Assistant professor of economics, Department of Finance and Economics, College of Business and Economics, Qatar University, Doha, Qatar, P.O. 2713, e-mail: ibrahim.ibrahim@qu.edu.qa.*
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Empirically, the opportunity cost seigniorage is less attractive because the choice of a benchmark nominal interest rate is somewhat arbitrary and hence the estimates of seigniorage under this approach are differentiated and lack consistency over time, given the change of the nominal interest rate as it is being used as a monetary policy instrument by central banks (CBs).

The second concept of seigniorage which is the 'monetary seigniorage' is defined as the difference between the face (or nominal) value of base money and its cost of production and maintenance. Thus, the monetary seigniorage measures the actual wealth transfer from the private sector to the CB. Bjerg, et al. (2017), however, argue that the concept of seigniorage should include both money issuance by the CB and the treasury, and revenues derived from money creation by commercial banks.[3]

There are many factors that may explain the reliance of governments on seigniorage. (i) The first factor is political instability. Cukierman et al. (1992) argue that the higher the level of political instability the higher the level of myopic government behaviour which translates into a higher level of seigniorage. Myopic governments maintain an inefficient tax system to constrain the behaviour of future governments. However, they compensate the shortage of tax revenue by collecting large seigniorage. (ii) The second is the size of the shadow economy or tax evasion. The shadow economy includes all legal goods and services produced within the economy but concealed from tax authorities (Schneider, Montenegro, 2010). Thus, a large shadow economy is associated with a low capacity to collect taxes and hence increases the reliance of government on seigniorage to offset tax evasion. (iii) The third is the natural resource rents which represent an important source of revenue for the government. The higher the natural resource rents, the less reliant on seigniorage and taxation by the government (Jensen, 2011; Elbahnasawy, Ellis, 2016). (iv) The fourth is the level of corruption within the economy. As corruption deprives the government of additional resources, the government relies on seigniorage to finance its operations. Yousefi (2014) finds evidence that the government compensates for lost revenue because of corruption by increasing the rate of monetary expansion to exploit seigniorage. (v) Finally, the fifth factor is the CB's independence from the government. That is political independence (i.e., the ability of central banks to select the final objectives of monetary policy) and/or economic or operational independence (i.e., the CB adopts freely its monetary policy instruments). The higher the level of CB independence, the lower the level of seigniorage and hence inflation.

Obviously, all the above-mentioned determinants of monetary seigniorage are somehow related to a common factor which is "chronic budget deficit or equivalently insufficient tax revenues." As monetary seigniorage represents a transfer of wealth from the private sector to the CB and then to the government budget, this paper utilizes the model of the CB's balance sheet and the government budget identity developed by Klein & Neumann (1990) to investigate the question of "Will the effect of monetary seigniorage and fiscal seigniorage on the CPI inflation and real GDP growth be differentiated based upon the adopted monetary

[3] Given the fact that seigniorage has historically been a source of income to the state, Benes and Michael (2012) and Bjerg, et al. (2017) argue that the prerogative to create money by commercial banks must be shifted back to the government and central banks by imposing 100% reserve banking.

policy regime and the initial source of seigniorage (i.e., being seigniorage initially comes from the assets side or the liabilities side of the CB's balance sheet)?

The study investigates this question in Egypt and Qatar, as both countries apply two differentiated monetary policy regimes, and they have a different experience with the budget deficit and fiscal dominance. The study adopts descriptive and analytical methodologies to investigate the theoretical aspects of monetary seigniorage and to compare monetary seigniorage indicators and the CB's balance sheet between Egypt and Qatar. In addition, the study relies on the structural VAR model to analyze the association between monetary seigniorage and CPI inflation and real GDP growth in Egypt and Qatar.

The remainder of this paper is as follows. Section 2 analyzes the aspects of monetary seigniorage. Section 3 analyzes the association between monetary seigniorage, the CB's balance sheet, and budget deficit. Section 4 compares monetary seigniorage indicators, the CB's balance sheet, and macroeconomic outcomes in Egypt and Qatar. Section 5 discusses the VAR model, variables, and empirical results. Section 6 offers concluding remarks.

2. Aspects of Monetary Seigniorage

Neumann (1992), Klein & Neumann (1990), Groeneveld and Visser (1997), and Bjerg, et al. (2017) regard monetary seigniorage as the total profit derived from money production and maintenance. A simple dynamic form of the monetary seigniorage comes as follows:

$$\mathrm{M_t} = \mathrm{M_{t-1}} + \Delta\mathrm{M_t} \tag{1}$$

$$\mathrm{S_{mt}} = \Delta\mathrm{M_t} - \mathrm{c}\Delta\mathrm{M_t} \tag{2}$$

$$\mathrm{S_{mt}} = \mathrm{S_{mt1}} + \mathrm{S_{mt2}} \tag{3}$$

$$\mathrm{S_{mt1}} = \mathrm{d_{t-1}}(\mathrm{M_{t-1}}) \tag{4}$$

Equation (1) accounts for the money supply at the current period where ΔM_t denotes the change in the monetary base (or equivalently, the production or printing of new money by the CB) at the current period. Equation (2) defines net monetary seigniorage, S_{mt}, as the difference between the change in the monetary base, ΔM_t, and the cost of production and maintenance of money, $c\Delta M_t$, where c represents the average cost of production and maintenance of money. According to Equation (3), monetary seigniorage falls into two components, noninflationary seigniorage, S_{mt1}, and inflationary seigniorage, S_{mt2}. Based on Fisher (1911) 'equation of exchange' and Friedman (1956 and 1971), the noninflationary seigniorage, S_{mt1}, occurs when growth in the monetary base is consistent with the long-run growth rate of real GDP as accounted for by equation (4). That is, given the velocity of circulation in the long run, the noninflationary seigniorage at the current period, S_{mt1}, equals the lagged monetary base, M_{t-1}, times the long-run growth rate of real GDP, d_{t-1}. Combining equations 2 through 4, the inflationary seigniorage, S_{mt2}, is accounted for by equation (5) as follows:

$$\mathrm{S_{mt2}} = \Delta\mathrm{M_t} - \mathrm{d_{t-1}M_{t-1}} - \mathrm{c}\Delta\mathrm{M_t} \tag{5}$$

Equation (5) defines inflationary seigniorage as it is the printing of new money that exceeds the noninflationary limit of money growth which is consistent with the long-run real GDP growth, d_{t-1}. In other words, given $c\Delta M_t$=0, inflationary seigniorage is zero if growth rate in money supply ($\frac{\Delta M_t}{M_{t-1}}$) is equivalent to the long-run growth rate of real GDP, d_t.

Obviously, not all monetary seigniorage will cause a rise in the inflation rate. It is the inflationary seigniorage, but not the noninflationary seigniorage, that could lead to an escalation of the rate of inflation.

Friedman (1971) regards inflation produced by the issuance of fiat money as a tax on cash balances. The real yield from the inflation tax equals the inflation rate times real money stock (or monetary base), such that:

$$\mathrm{RITR_t}\left(\equiv \frac{\mathrm{S_{mt2}}}{\mathrm{P_t}}\right) = \pi_t * \frac{\mathrm{M_t}}{\mathrm{P_t}} \qquad (6)$$

Where, $RITR_t$ stands for Friedman's real inflation tax revenue (synonymous to real inflationary seigniorage, $\frac{S_{mt2}}{P_t}$), π_t stands for the long-run inflation rate, and $\frac{M_t}{P_t}$, denotes real money stock[4].

Basically, inflationary seigniorage reflects the case of fiscal dominance where the CB is coerced to finance the budget deficit. That is, if the CB cannot resist the government's demands for financing the budget deficit, then the CB is not factually independent (Awad, 2008, 2009).

3. Monetary Seigniorage and Budget Deficit

3.1. Monetary policy regimes and CB's balance sheet

The level and evolution of the monetary base and its counterparts in the CB's balance sheet are governed by the monetary policy regime and monetary policy objectives. Basically, the evolution of the CB's balance sheet comes from the demand for money. The growth in nominal GDP leads to higher demands for money balances by the private sector and, hence, higher demands by commercial banks for loans from the CB to meet their reserve requirements. To maintain its operational target, and, hence, achieve the final goals of monetary policy, the CB responds to commercial banks' demands by supplying the required reserves thereby monetary base expands.

[4] The term "real inflationary seigniorage", $\frac{S_{mt2}}{P_t}$, from equation 5 is consistent in meaning with the term "real inflation tax revenue, in equation 6, RITR. Yet, the two formulas are expected not to deliver identical results because equation 5 considers the cost of production and maintenance of the new issued money, $c\Delta M_t$. In addition, the supply shocks may affect the rate of inflation reported in equation 6. That makes equation 5 more relevant for estimating inflation tax revenue, or 'inflationary seigniorage', than does equation 6.

However, a change in the CB balance sheet can be referred to as an initial growth on the assets side which exceeds the demand for money on the liabilities side. The liabilities side is then characterized by either excess reserves or absorption operations of excess reserves by the CB. The sterilization process through the absorption of excess reserves may not be fully implemented given the large scale of excess reserves caused by the growth in the assets side. Importantly, the initial growth on the assets side is mostly caused by government loans from the CB and/or growth in foreign assets because of intervention by the CB in the foreign exchange market to maintain a targeted rate of foreign exchange (Rule, 2015).

Under the exchange rate targeting regime, the CB holds a significant amount of foreign assets and stands ready to intervene in the foreign exchange market to maintain the targeted price of foreign exchange. The intervention by the CB in the foreign exchange market in response to domestic currency depreciation or appreciation pressures will affect the size of the CB's balance sheet. For instance, the response of the CB to depreciations pressures will result in a decline in the foreign assets and hence a contraction in the CB's balance sheet, and vice versa.

If, instead, the CB simultaneously maintains multiple objectives for monetary policy, such as maintaining internal and external stability of the domestic currency, the CB will target the foreign exchange rate and use the nominal interest rate to stabilize the economy. In such a case, the CB will practice a sterilization process to maintain the two targets. That is the CB intervenes in the currency market to build up foreign reserves, but this will result in excess reserves on the liabilities side of the CB's balance sheet which in turn may jeopardize price stability. To maintain price stability, the CB will absorb excess reserves through open market operations and, hence, the nominal interest rate moves up[5].

Currently, the goal of price stability represents the primary goal of monetary policy to most CBs. If the CB, however, is obliged to contribute to financing a budget deficit, the CB will probably be unable to maintain the goal of price stability[6].

3.2. The CB's balance sheet and budget deficit

Klein & Neumann (1990) regard monetary seigniorage from two sides. On one hand, it represents a wealth transfer from the private sector to the CB. On the other hand, it is mainly used for financing the government budget deficit. Based on the model of the CB's balance sheet and the government budget identity developed by Klein & Neumann (1990), we derived equation (7)[7] which links the change in the monetary base both to the budget deficit and other components of the assets side of the CB's balance sheet as follows:

[5] Under the impossible trinity hypothesis, such a policy of sterilization will not continue so long. Given a free capital mobility, the CB cannot independently move nominal interest rate and maintain fixed exchange rate simultaneously for so long time.

[6] Indeed, the contribution of the CB in financing budget deficit represents a direct monetization of government debt that could lead to poor macroeconomic outcomes and high inflation. As a result of this, many countries prohibit the direct financing of government debt by the CB. For instance, the Maastricht Treaty, which governs the European Union, includes such a prohibition. For more details on the CB balance sheet, see Rule, G. (2015).

[7] The derivation of equation 7 is available upon request.

$$\Delta M_t = \Delta A_t + [\Delta B_t + \Delta D_t + e\Delta F_t + \Delta N_t] \quad (7)$$

Equation 7 shows that the change in the monetary base on the liabilities side of the CB's balance sheet, ΔM_t, is matched by changes in both fiscal and non-fiscal factors on the assets side. Non-fiscal factors on the assets side are the factors that are not related directly to financing the budget deficit. They include the purchasing of government debts by the CB in the secondary market, ΔB_t, loans offered by the CB to commercial banks, ΔD_t, acquiring net international reserves through intervention in the foreign exchange market, ΔF_t, where e denotes the nominal exchange rate and the change in other items of the assets side of the CB balance sheet, ΔN_t[8].

The fiscal factors that affect monetary seigniorage, however, are explained by the change in the government loans from the CB, ΔA_t, or equivalently the fiscal seigniorage, as follows[9]:

$$\Delta A_t = BD_t - \Delta TB_t - R_t \quad (8)$$

Where the size of fiscal seigniorage or new government loans from the CB, ΔA_t, is based upon the outstanding part of the budget deficit, BD_t, which is not covered by either issuing new government bonds to commercial banks, ΔTB_t, or by profits transferred by the CB to the government budget, R_t. Budget deficit, BD_t, however, is accounted for by equation 9 as follows:

$$BD_t = (G - T)_t + b(TB)_t + a(A)_t \quad (9)$$

Where, $(G - T)_t$ denotes the primary budget deficit which is the difference between government expenditure, G, and government taxes, T. $b(TB)_t$ denotes interest expenditure on government bonds, i.e., $(TB)_t$ stands for total government bonds and b stands for the nominal interest rate on government bonds. $a(A)_t$ represents the interest expenditure on government loans from the CB, i.e., a stands for the interest rate on government loans from the CB and $(A)_t$denotes total government loans from the CB.

In comparison to equation 2, equation 7 underscores the composition of the monetary seigniorage, S_{mt}, given the cost of production and maintenance of newly produced money, $c\Delta M_t$. Clearly, both fiscal and non-fiscal factors in equation 7 are positively related to the monetary seigniorage.

In comparison to equation 5, equation 7 underscores fiscal and non-fiscal factors that cause a change in the monetary seigniorage thereby inflationary seigniorage, S_{mt2}, occurs, given the long-run growth rate of real GDP, d_{t-1} and the cost of production and maintenance of

[8] Ellis and Elbahnasawy (2017) investigate the question of how the degree of exchange rate management affects the relationship between seigniorage and the government's natural resource revenues. One conclusion of this study is that under a fixed exchange rate regime an increase in the natural resource rents results in an increase in the domestic monetary base and, hence, an increase in the monetary seigniorage.

[9] Rao, Nasir H. (2011) defines fiscal seigniorage as it includes government loans from the CB and profits transferred from the CB to the government budget and revenue from coinage.

money, $c\Delta M_t$. Consistent with equation 7, Edwards and Tabellini (1991) and Roubini (1991) found evidence for a positive correlation between budget deficit and seigniorage.

The association between monetary seigniorage and government loans from the CB is complicated especially when the CB adopts a sterilization policy to coordinate monetary policy objectives. Equation 7 highlights the fact that the change in the monetary base does not necessarily reflect the amount of seigniorage channelled to the government through government loans from the CB. For instance, if the new government loan from the CB is partly matched by an opposite change in some non-fiscal factors, the overall change in the monetary base will not be equal to the change in the government loans from the CB. Also, the monetary base is fixed if the CB applies full-scale sterilization so that the change in the government loans from the CB is totally offset by a change in the non-fiscal factors. Thus, whether or not the government loans from the CB cause monetary seigniorage, it is a practical question that needs to be verified.

In addition, when the CB extends loans to the private sector, reserves on the liabilities side of the CB's balance sheet will increase. Neumann (1996) defines total seigniorage, S_t, as the gross resource flow to the government sector is associated with base money creation. Accordingly, total seigniorage, S_t, in such a case is defined as:

$$S_t = S_{mt} + i^p A^p_{t-1} + i^F A^F_{t-1} \quad (10)$$

Where, S_{mt} is the monetary seigniorage and $i^p A^p_{t-1}, i^F A^F_{t-1}$ are the interest revenue from private sector debt and foreign sector debt, respectively[10].

To sum up, it is the outstanding uncovered part of the budget deficit, but not all of the budget deficit, that may cause fiscal seigniorage or government loans from the CB. Yet, government loans from the CB will not necessarily cause a rise in the monetary seigniorage if the CB sterilizes its effect on the monetary base.

4. Monetary Seigniorage in Egypt and Qatar

4.1. The evolution of the CB's balance sheet

The Qatar Central Bank (QCB) is targeting the foreign exchange rate where the domestic currency, the Qatari Riyal, is fixed with the US dollar at an average price of QR 3.64 per USD since 2001[11]. The natural resource rent plays a significant role in the Qatari economy where the gas and oil relative share in GDP reaches 38.6% in 2020[12]. Given a fixed exchange rate regime, the change in the monetary base on the liabilities side, and, hence, monetary

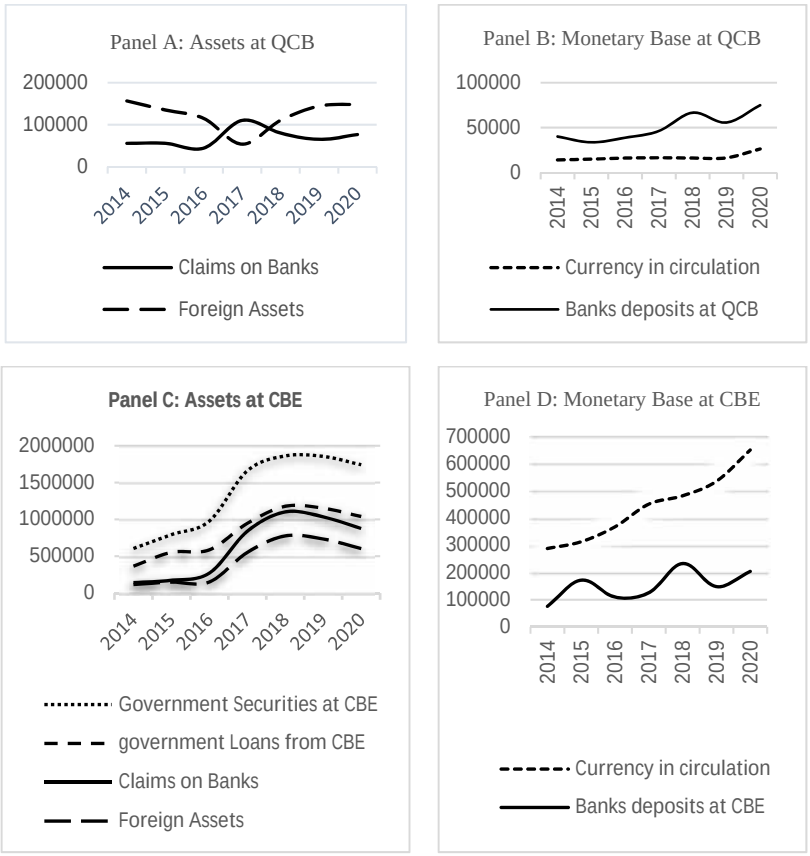
[10] Basically, the interest revenue from loans offered by the CB to private and foreign sectors is included in the CB net profits and only the distributed part of the CB net profits, R_t, is transferred to the government budget as stated by equation 8 in the text above.

[11]http://www.qcb.gov.qa/English/PolicyFrameWork/ExchangeRatePolicy/Pages/ExchangeRatePolicy.aspx.

[12] QCB, The Forty Fourth Annual Reports 2020. Available at; http://www.qcb.gov.qa/English/Publications/ReportsAndStatements/Pages/AnnualReports.aspx.

seigniorage, is based upon the growth in the oil and gas sector. That is growth in real GDP through gas and oil exports leads to an expansion in the monetary base. Figure 1, Panel B, exhibits a steady growth in the monetary base during the period of 2014-2020, except for the crises of 2017 when some Arab countries cut their diplomatic and economic ties with Qatar[13]. With the onset of the crises, the QCB intervened in the market to mitigate financial panic by providing banks with additional liquidity, thereby banks' reserves rose.

Figure 1: Balance sheet of the ECB and the QCB



Source: Figure 1 is prepared by the author. Data on CB's balance sheet is collected from QCB and CBE Annual Reports; in different years.

Jensen (2011), and Elbahnasawy and Ellis (2016) indicate that countries with high resource rents rely less on both inflationary seigniorage and taxation. This is correct in the case of Qatar where the asset side of the QCB's balance sheet (Figure 1, Panel A) does not include

[13] On 5 June 2017, Saudi Arabia, the United Arab Emirates, Bahrain, and Egypt cut diplomatic and all economic relations with Qatar. In January 2021, however, a process of reconciliation started to resume diplomatic and economic ties.

any government loans from the QCB. The influential part of the assets side of the QCB's balance sheet, however, is the foreign assets. To maintain the fixed foreign exchange rate, the QCB builds a significant amount of foreign assets thus free reserves of commercial banks (included in "banks deposits at QCB", Panel B) in the liabilities side and hence monetary seigniorage goes up, as shown in Panel B.

As for Egypt, the CBE announced the floatation of domestic currency in November 2016 especially after mounting pressures on the Egyptian pound and influential losses in the international reserves. Immediately after the floatation, the Egyptian pound depreciated by more than 50 percent and the CBE responded instantly by raising the nominal interest rate by 300 basis points to prevent the collapse of the domestic currency. One week after the floatation, the IMF approved a loan of $12 billion to Egypt and released the first tranche of $2.7 billion. Yet, the currently de facto foreign exchange rate regime in Egypt cannot be considered as a floated one because of systematic intervention by the CBE in the currency market to maintain the foreign exchange rate within some targeted limits[14].

Basically, the CBE maintains dual objectives for monetary policy. On one hand, the CBE has an explicit monetary policy goal which is a goal of price stability[15]. On the other hand, the CBE has an additional implicit goal of monetary policy which is targeting the foreign exchange rate. Figure 1, Panel C shows a significant increase in the foreign reserves after 2016 because of the CBE intervention in the currency market to hold foreign assets.

In addition, the CBE is not factually independent as it is mandated to channel funds to the government to finance the budget deficit[16]. Unlike the QCB, the balance sheet of the CBE incorporates both government loans and government securities. Panel C, Figure 1, shows a successive increase in government loans and government securities in the CBE's balance sheet, especially during the last 5 years. As mentioned earlier, despite the absorption operations to sterilize the effect on the monetary base, the holdings of foreign assets, government securities, and government loans will eventually cause an expansion in the monetary base, thereby causing monetary seigniorage to skyrocket. Figure 1, Panel D, shows a successive increase in the monetary base and, hence, monetary seigniorage in Egypt during the last 5 years.

[14] The de facto foreign exchange rate regime in Egypt is classified by IMF (2020) as a crawl-like arrangement where exchange rate remains within a narrow margin of 2% relative to a statistically identified trend for six months. For more details, see: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions, 2020. Available at: https://www.imf.org/en/Publications/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions/Issues/2021/08/25/Annual-Report-on-Exchange-Arrangements-and-Exchange-Restrictions-2020-49738.

[15] https://www.cbe.org.eg/en/MonetaryPolicy/Pages/MonetaryPolicyFramework.aspx.

[16] Factual independence of the CB requires; (i) legal instrument independent; (ii) non-existence of the government representatives in the MPC as voting members; and (iii) no obligation for CB to finance budget deficit. Such requirements are not available in the case of the CBE under the Law No. 88 of the year 2003, amended by the Law No. 162 of the year 2004 and the Law No. 93 of the year 2005. In addition, such requirements are not available under the new promulgated law of the CBE and banking system No. 194 of the year 2020 (Awad, 2008 and 2009).

4.2. Seigniorage and macroeconomics outcomes

Unfortunately, there is no available data from the CBE and the QCB on the cost of production of domestic currency including banknotes and reserves[17]. Given that the cost of producing banknotes is relatively small, we may use the average cost ratio by some other CBs as an approximation for the cost ratio at the CBE and the QCB. According to the data released by the Bank of England and the Federal Reserve Bank, the average cost ratio of a newly produced banknote is roughly $0.001[18]. Based on equations 2, 4, and 5, we calculated the monetary seigniorage, the inflationary seigniorage, and the noninflationary seigniorage for Egypt and Qatar during the period of 2001-2020.

Table 1: Seigniorage indicators in Egypt and Qatar (2002-2020)

		2002-2010	2011-2020
Egypt	Seigniorage/GDP %	4.2	3.3
	Government loans/seigniorage %	31	120
	Total natural resources rents (% of GDP)	11.54	7.4*
Qatar	Seigniorage/GDP %	3	0.13
	Government loans/seigniorage %	-2.1	0.0
	Total natural resources rents (% of GDP)	35.5	26.7*

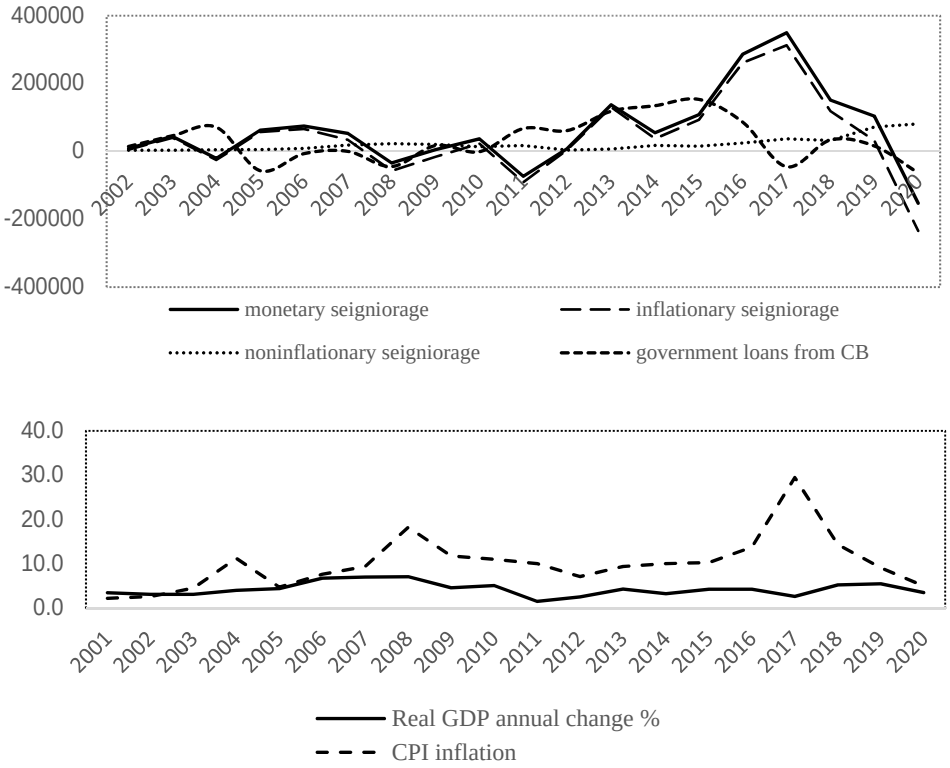
** calculated as an average for the period of 2011-2019.*
Source: Calculated by the author from data available at; IMF-IFS and the EIU. Total natural resources rents (% of GDP) calculated from WB-WDI.

Table 1 compares some seigniorage indicators in Egypt and Qatar during the periods of 2002-2010 and 2011-2020. The ratio of seigniorage/GDP in Egypt is higher than in Qatar, especially during the sub-period of 2011-2020. In addition, the ratio of government loans/seigniorage in Egypt jumped from 31% during 2002-2010 to 120% during 2011-2020, whereas it reached zero or negative in Qatar during the whole period. Natural resource rents to GDP in Qatar are roughly three times more than its counterpart in Egypt. This in part may explain why Egypt relies more on seigniorage than Qatar.

[17] Major differences between banknote and reserves come as follows; the cost of producing banknotes is relatively small and includes the cost of security features, and the cost of the printing and distribution network. Yet, the banknote is a zero-interest paying liability. Unlike banknotes, the cost of producing reserves is almost zero. However, reserves are often an interest paying liability where many CBs remunerate required reserves to ensure that reserves do not play a monetary policy role (Rule, 2015).

[18] The Bank of England released figures showing the average cost of a banknote during 2017 and 2018. It was between 7 and 8 pence per note. Available at; https://www.bankofengland.co.uk/freedom-of-information/2020/questions-about-banknote-production. In addition, the Federal Reserve Bank provides details in 2021 on the printing costs of Federal Reserve notes for each denomination that rages between 6.2 cents per note (for denominations of $1 and $2) and 14 cents per note (for a denomination of $100) available at; https://www.federalreserve.gov/faqs/currency_12771.htm.

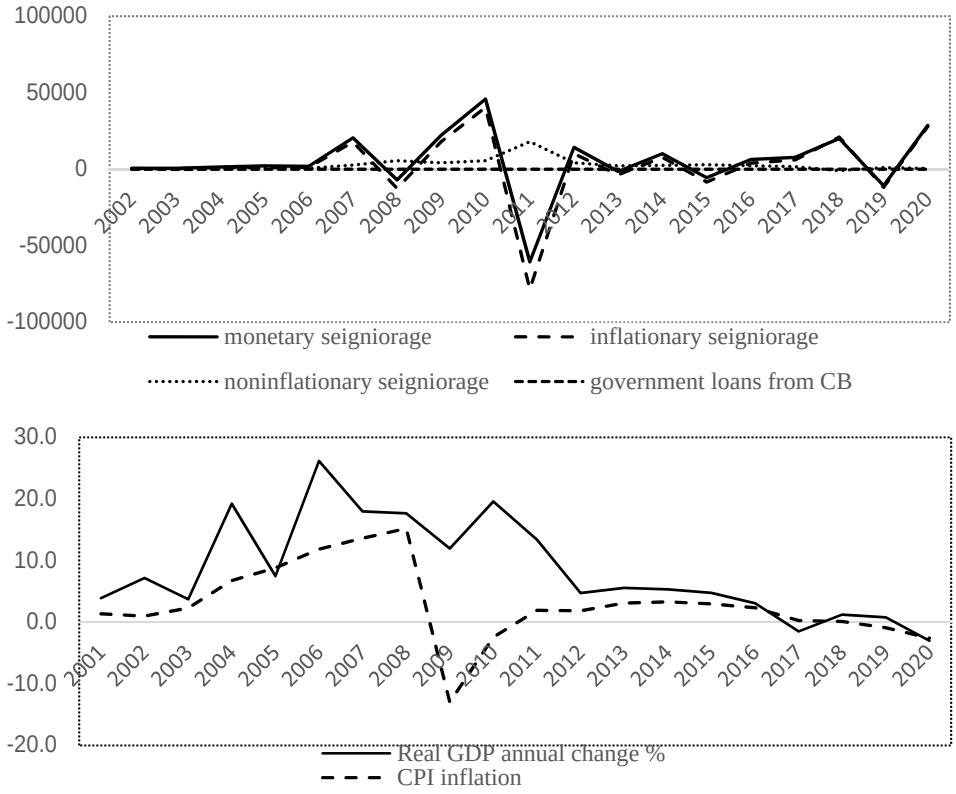
Figure 2. Seigniorage indicators and macroeconomic variables in Egypt (2001-2020)



Source: Figure 2 is prepared by the author. Data on the monetary base and claims on the central government to the CB is available at; IMF, international financial statistics (IFS). Real GDP annual change and CPI inflation are fetched from; the economist intelligence unit (EIU). Other indicators are calculated by the author.

Figure 2 highlights the movements of seigniorage indicators and macroeconomic variables in Egypt during the period of 2001-2020. Clearly, the association is reversed between CPI inflation and both monetary seigniorage and inflationary seigniorage, except for the years after 2015. Yet, the evolution and volatility of monetary seigniorage are not associated with real GDP growth in Egypt. This is consistent with the above analysis that the growth in the monetary seigniorage in Egypt is affected by developments of the assets side of the CBE's balance sheet, i.e., fiscal seigniorage or government loans. In addition, the change in government loans from the CBE is negatively related to movements in the monetary seigniorage. This partly explains the intervention by the CBE to sterilize the effect of government loans on the monetary base despite being unable to resist the government's demand for new loans.

Figure 3. Seigniorage indicators and macroeconomic variables in Qatar (2001-2020)



Source: Figure 3 is prepared by the author. Data on the monetary base and claims on the central government to the CB is available at; IMF, international financial statistics (IFS). Real GDP annual change and CPI inflation are fetched from; the economist intelligence unit(EIU). Other indicators are calculated by the author.

In contrast to the case of Egypt, Figure 3 detects a close association between the change of monetary seigniorage and real GDP growth in Qatar. This confirms the, above, analysis that the major source of seigniorage in Qatar comes from the liabilities side of the QCB's balance sheet. That is the growth in real GDP through gas and oil exports leads to an expansion in the monetary base because of the rise in net foreign assets.

5. Model, Variables, and Empirical Results

5.1. VAR Model and Variables specifications

The main contribution of structural VAR model estimations is to obtain non-recursive orthogonalization of the error terms for the purpose of impulse response analysis. A structural VAR model takes the following representation[19].

$$A\ (L)\ Z_t = \varepsilon_t \tag{11}$$

Where Z_t is a (k x 1) vector of endogenous and exogenous variables, A (L) is a (k x k) matrix polynomial in the lag operator (L), and ε_t is a (k x 1) vector of unknown structural innovations. To find unknown structural (or orthogonal) innovations, a reduced form of Z_t is derived as follows:

$$\text{Define, } A\ (L) = A_0 + A^0(L) \tag{12}$$

Where A_0 is the contemporaneous coefficient matrix on L^0 in A(L), and A^0 (L) is the coefficient matrix in A(L) without contemporaneous coefficient A_0. By substituting (12) in (11) and rearranging, we get:

$$Z_t = -\ H\ (L)\ Z_t + V_t) \tag{13}$$

Where H = $A_0^{-1}\ A^0$ and $V_t = A_0^{-1}\varepsilon_t$. To identify structural shock, ε_t, from reduced form residuals V_t, restrictions (n2 – n)/2 must be imposed on A_0 or, equivalently, A_0 must be imposed as a lower triangular matrix[20].

Variables of the structure VAR model, Z_t, including the growth rate of net foreign assets, $GNFA_t$, the growth rate of monetary seigniorage, GM_{0t}, the growth rate of real GDP, $GGDP_t$, and the CPI inflation rate, $CPII_t$, respectively. All variables are introduced in the first difference to maintain stationarity. Thus, the baseline identification scheme comes as follows:

$$Z_t=[d(GNFA_t)\quad d(GM_{0t})\quad d(GGDP_t)\quad d(CPII_t)] \tag{14}$$

The order of variables in (14) reflects our implied assumptions over the model's variables that real GDP growth and CPI inflation respond contemporaneously to changes in monetary seigniorage and net foreign assets. In addition, the growth of monetary seigniorage (on the liabilities side of the CB's balance sheet) responds contemporaneously to changes in the growth of net foreign assets (on the assets side of CB's balance sheet), whereas the growth

[19] For more details, see; Awad (2014).

[20] Given that the diagonal elements of A_0 are all unity, A_0 contains $n^2 - n$ unknowns. In addition, there are n unknown values var (ε_t), thus the total unknown values equal n^2. To identify n^2 unknowns from the estimated variance/covariance matrix with $(n^2 + n)/2$ known independent elements, it is necessary to impose an additional $n^2 - [\ (n^2 + n)/2] = (n^2 - n)/2$ restrictions on the system (Enders, 2004).

of net foreign assets responds to changes in the growth of monetary seigniorage after one lag, i.e., one year.

5.2 Empirical Results

Tables 2 and 3 highlight the stationary variables in Egypt and Qatar at different significance levels. According to Augmented Dickey-Fuller and Kwiatkowski-Phillips-Schmidt-Shin, all variables are integrated order zero or I~ (0).

Table 2. Test Results for Unit Roots-Egypt

	Augmented Dickey-Fuller			Kwiatkowski-Phillips-Schmidt-Shin		
Variables	Without Trend	With Trend	Lag Length using AIC	Without Trend	With Trend	Bandwidth using Bartlett Kernel
$d(GNFA_t)$	-9.3**	-12.44**	1	0.5*	0.5**	18
$d(GM_{0t})$	-4.75**	-4.39*	1	0.5*	0.5**	18
$d(GGDP_t)$	-5.11**	-4.93**	1	0.11	0.08	3
$d(CPII_t)$	-5.13**	-5.05**	1	0.21	0.1	4

*** and * indicate significance at the 1% and 5 % levels, respectively.*

Table 3. Test Results for Unit Roots-Qatar

	Augmented Dickey-Fuller			Kwiatkowski-Phillips-Schmidt-Shin		
Variables	Without Trend	With Trend	Lag Length using AIC	Without Trend	With Trend	Bandwidth using Bartlett Kernel
$d(GNFA_t)$	-5.5***	-5.29***	1	0.44*	0.43***	15
$d(GM_{0t})$	-7.07***	-6.89***	1	0.36*	0.36***	13
$d(GGDP_t)$	-3.66**	-2.31	3	0.16	0.116*	1
$d(CPII_t)$	-5.25***	-5.09***	0	0.27	0.26***	9

(***) , (**) and (*) indicate significance at the 1% , 5% , and 10% levels, respectively.

Based on the order of variables in the baseline identification scheme 14, we estimate a structural VAR model using the above-mentioned stationary variables in Tables 3 and 4 over the period of 2002-2021. The lag length detected by the LR test statistic, FPE test, and HQ information criterion is two lags, where the model satisfies the stability condition that all roots are inside the unit circle.

Panels A and B, Figure 4, compare the response to a structural innovation in growth in net foreign assets, $d(GNFA_t)$ between Egypt and Qatar. Clearly, a positive shock in the growth of net foreign assets causes a significant decline both in the growth of monetary seigniorage, $d(GM_{0t})$, and the CPI inflation rate, $d(CPII_t)$, in Egypt. The opposite is correct for Qatar where a positive shock in the growth of net foreign assets causes an insignificant increase both in the growth of monetary seigniorage and the CPI inflation rate. However, Egypt and Qatar are similar regarding the insignificant effect of a shock in growth in net foreign assets on the change in the growth of real GDP, $d(GGDP_t)$.

Figure 4. Response to Structural Innovation in Net Foreign Assets-Egypt and Qatar

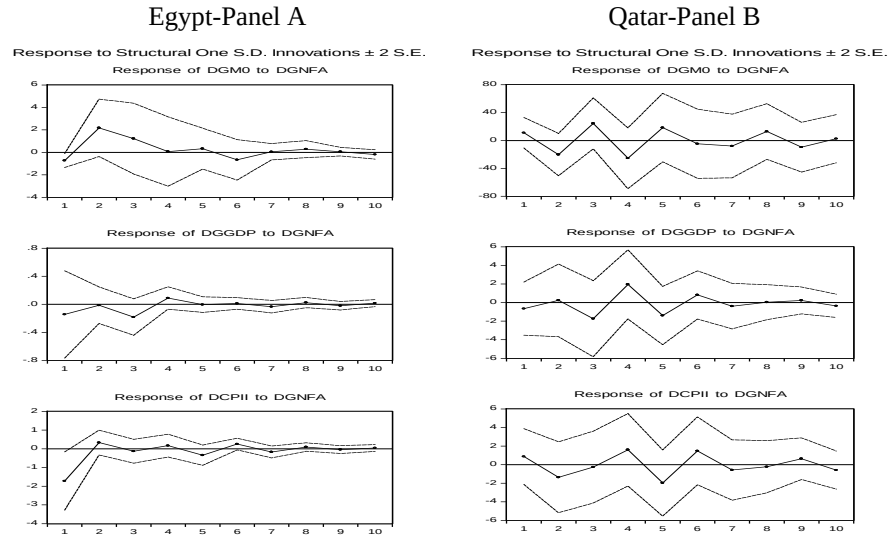
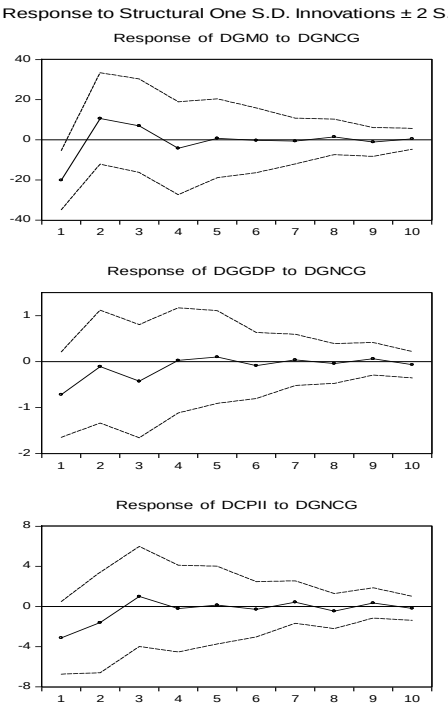


Figure 5. Response to Structural Innovation in Growth in Net Claims on the Central Government to the CBE



As mentioned earlier, the CBE maintains dual objectives of monetary policy, i.e., maintains a goal for price stability and a goal for the exchange rate. Hence, the CBE is practicing a sterilization policy to offset the effect of growth in net foreign assets with the growth in monetary seigniorage by cutting monetary seigniorage, thereby the speed of CPI inflation declines. On the contrary, the QCB does not maintain dual objectives for monetary policy as it is exclusively targeting the foreign exchange rate, thereby growth in net foreign assets directly transmits to growth in monetary seigniorage.

For robustness to the case of Egypt, we substitute the change in the growth of net foreign assets, $d(GNFA_t)$, with the change in the growth of net claims on central government to the CBE, $d(GNCG_t)$ where both variables are on the assets side of the CB balance sheet. Figure 5 shows responses of growth of monetary seigniorage, $d(GM_{0t})$, CPI inflation, $d(CPII_t)$, and real GDP, $d(GGDP_t)$ to a structural positive shock in the growth of net claims on the central government to the CBE, $d(GNCG_t)$. Clearly, the responses reported in Figure 5 are very close to that reported in Figure 4, Panel A. This confirms the above conclusion that the CBE is practising a sterilization policy to maintain dual objectives for monetary policy, i.e., the CBE responds to a positive shock in $d(GNCG_t)$ on the assets side by cutting monetary seigniorage on the liabilities side, thereby both the speed of CPI inflation and real GDP growth declines.

Figure 6. Response to Structural Innovation in Growth in Monetary Seigniorage

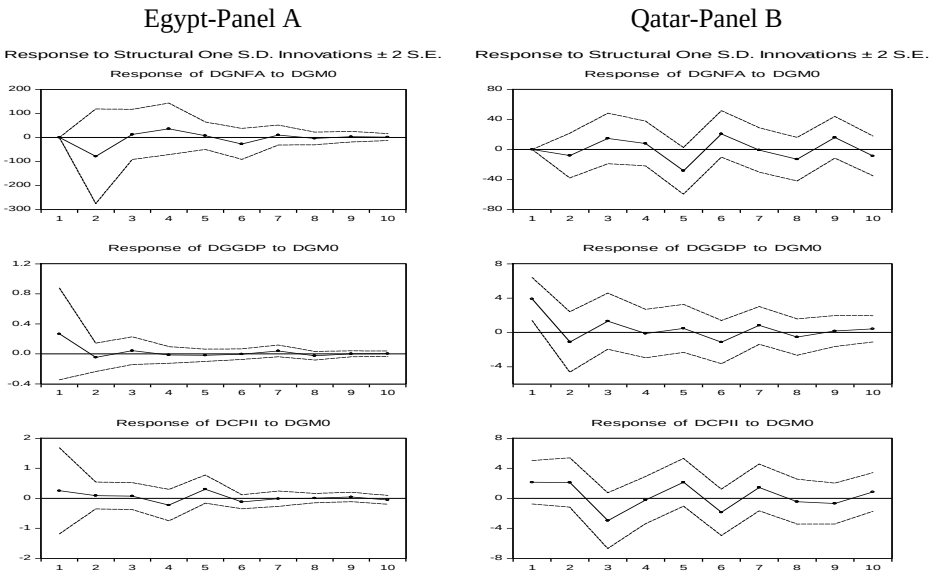


Figure 6 reports the responses to a structural positive shock in monetary seigniorage in Egypt and Qatar. As for Egypt, a positive shock in the growth of monetary seigniorage has an insignificant effect on real GDP growth and on CPI inflation. On the contrary, a positive

shock in the growth of monetary seigniorage in Qatar has a positive significant effect both on real GDP growth and on CPI inflation (at a 10% significance level).

This result indicates that, in contrast to the case of Qatar, the mechanism of a money supply channel is broken in the case of Egypt. Maintaining dual objectives for monetary policy renders the assets side of the CBE's balance sheet as more dominant than on the liabilities side. In other words, movements in the monetary seigniorage no longer respond to the side of demand for money as it undergoes the sterilization process.

In a nutshell, under a hybrid monetary policy regime which incorporates dual monetary policy objectives, like in the case of Egypt, the effect of monetary seigniorage on CPI inflation and real GDP is obsolete because the CB sterilizes changes in the money supply to maintain the objective of the foreign exchange rate. On the contrary, under the exchange rate targeting regime where the CB does not apply the sterilization policy, like in the case of Qatar, the association is straightforward between changes in monetary seigniorage and movements in CPI inflation and real GDP growth, i.e., high growth in the monetary seigniorage causes a high inflation rate and a high real GDP growth rate.

6. Conclusion

This paper utilizes the model of the CB's balance sheet and the government budget identity developed by Klein & Neumann (1990) to investigate the question of "Will the effect of monetary seigniorage on the CPI inflation and real GDP growth be differentiated based upon the adopted monetary policy regime and the initial source of seigniorage (i.e., being seigniorage initially comes from the assets side or from the liabilities side of the CB's balance sheet)? Descriptive and analytical methodologies are used to investigate the theoretical aspects of monetary seigniorage and fiscal seigniorage. In addition, a structural VAR model is used to quantify the structural effect of monetary seigniorage and fiscal seigniorage on CPI inflation and real GDP growth. The study is applied to Egypt and Qatar, as both countries adopt asymmetric monetary policy regimes, and they have different experiences with budget deficits and fiscal dominance.

Descriptive investigations revealed the following theoretical aspects of monetary seigniorage and fiscal seigniorage; (i) the outstanding uncovered part of the budget deficit may result in more government loans from the CB, i.e., fiscal seigniorage. (ii) Government loans from the CB cause a rise in the monetary seigniorage, if the CB does not sterilize its effect on the monetary base. (iii) Escalation of the rate of inflation occurs if a rise in the monetary seigniorage leads to a rise in the inflationary seigniorage. (iv) Inflationary seigniorage occurs when the growth rate in the monetary seigniorage exceeds the growth rate in real GDP. (iv) Inflationary seigniorage reflects the case of fiscal dominance where the CB is coerced to finance the budget deficit through fiscal seigniorage. (v) The existence of fiscal dominance along with dual objectives for monetary policy and sterilization process by the CBE have disrupted the association between change on the liabilities side of the CBE balance sheet and the change of demand for money.

Structural VAR model analysis of responses of CPI inflation and real GDP growth to shocks of monetary seigniorage and fiscal seigniorage reveals the following conclusions: (i) the effect of monetary seigniorage on CPI inflation and real GDP growth is weak and insignificant in the case of Egypt. Maintaining dual objectives for the exchange rate and the inflation rate under a hybrid monetary policy regime gives the CBE no choice but to sterilize changes in monetary seigniorage, thereby the mechanism of the money supply channel is idle. (ii) In contrast to the case of Egypt, the QCB exclusively targets the foreign exchange rate, hence the mechanism of the money supply channel is functioning properly where the effect of monetary seigniorage on CPI inflation and real GDP growth is significant.

The implications of the above conclusions are as follows: (i) given the hypothesis of the impossible trinity, it is not valid for the CBE to both maintain a target for the exchange rate and run a stabilizing monetary policy under free capital mobility. Thus, devaluation or floatation of the Egyptian pound is inevitable if the CBE is going to use monetary policy instruments to achieve the goal of price stability as a primary goal of monetary policy. (ii) Even though the goal of price stability is given priority among other objectives of monetary policy, the CBE will fail to stabilize the economy under fiscal dominance and the coercion of the CBE to finance the budget deficit. Thus, prohibiting the financing of the budget deficit by the CBE, i.e., fiscal seigniorage, is an indispensable task to achieve the goal of price stability. (iii) The floatation of the Egyptian pound in conjunction with prohibiting the financing budget deficit by the CBE will help the CBE to appropriately manage the level and direction of monetary seigniorage in response to the demand for money.

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