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SEIGNIORAGE REVENUE AND INFLATION IN THE GHANAIAN ECONOMY

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ABSTRACT

Governments may finance their budget deficits through aid, debt or borrowing from domestic and external sources. One of the reliable sources of government financing is the creation of base money. Meanwhile, the amount of money governments collect through money creation does not grow monotonically with monetary expansion over time. Also, higher monetary growth leads to higher expected future inflation and (through the Fisher effect) to higher nominal interest rates. This study therefore investigated the seigniorage maximizing level of inflation and confirmed the existence of seigniorage Laffer curve in Ghana. A quadratic estimation technique following Samimi-Jafari (2009) was used for the estimation. Interestingly, the high seigniorage maximizing level of inflation suggests that the economy of Ghana is far below the threshold of declining seigniorage revenue. Therefore, seigniorage as a financing source remains viable for the Ghanaian economy.

Keywords: Inflation Tax, Seigniorage Laffer Curve, Budget Constraint, Ghana.
JEL Classification: E31, E51, E62.

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1. INTRODUCTION

The monopoly of governments to produce money is an important source of financing government expenditure. Brunner and Meltzer (1971) assert that money has a vast social productivity from the enormous reduction in transaction and information costs that it provides by serving as a medium of exchange. One of the policy instruments a government has at its hand when thinking about financing its expenditures is the collection of seigniorage The revenue from money creation is called seigniorage. The term seigniorage dates back to the early middle ages when it was common for sovereigns of countries to finance some of their expenditures from the profit they earn from coinage of money. Drazen (1985) opined that there is no single measure of seigniorage that is generally applicable. He further noted that the measurement depends on the model and on the policy environment been investigated. According to Buiter (2007), Seigniorage refers to the difference between the face value of a coin and its costs of production and mintage. In fiat money economies, marginal and printing costs are effectively zero. Printing fiat money is therefore highly profitable and is regulated and often monopolized by the state.

The analysis of the sources of Central Bank revenue or seigniorage is part of a tradition that is both august and inconsistent. In the eighteenth century, Thornton (1802), including such

classics as Bresciani-Turroni (1937) and Cagan (1956). Friedman (1971), Phelps (1973), Sargent (1982, 1987) and Sargent and Wallace (1981) have made important contributions to seigniorage. Empirical investigations include King and Plosser (1985), Dornbusch and Fischer (1986), Anand and van Wijnbergen (1989). Recent theoretical investigations include Sims (2004, 2005) and Buiter (2004, 2005). Modern advanced textbooks/treatises such as Walsh (2003) and Romer (2006) devote considerable space to the issue.

There are two common measures of seigniorage, the resources appropriated by the monetary authority through its capacity to issue zero interest fiat money. The first is the change in the monetary base. The second measure is the interest earned by investing the resources obtained though the past issuance of base money in interest bearing assets. This interest is the risk-free nominal interest rate on financial instruments other than base money between periods. A distinct but related concept to seigniorage and Central Bank revenue is the inflation tax. The inflation tax is the reduction in the real value of the stock of base money caused by inflation.

Meanwhile, the link between seigniorage and inflation has been established and is estimated to be in the form of a Laffer curve. In this relationship, the maximum amount of seigniorage occurs at a particular inflation rate. Smaller amounts of seigniorage occur at both high and low rates of inflation, presenting the dual equilibria advocated by Bruno and Fischer (1990). The focus of this paper is therefore to determine the optimal inflation rate, the maximum amount of seigniorage and the effect of inflation tax in the Ghanaian economy.

2. REVIEW OF RELATED LITERATURE

In monetary concepts, seigniorage is measured by the real value of changes in base money. Monetary seigniorage denoted is defined as the net change in base money outstanding, deflated by the consumer price level. This is shown as:

$$S_M = \Delta M / P$$

In the above model, M is nominal base money (including currency in circulation and deposits of banks at the central bank), P is the price level, D is difference operator. The concept has been widely used in the theoretical and empirical literature, for example by Cagan (1956, pp. 77-86), Friedman (1971, pp. 848-850) and Fischer (1982, pp. 300-305). The wide usage of this measure is partly explained by the fact that data necessary to calculate this measure are easily obtainable. This is closest to the idea of a government financing current payments by taking loans directly at the central bank or what is commonly understood as “using the printing press”.

Opportunity cost seigniorage is defined as the total opportunity cost of money holders and is measured as the nominal interest rate multiplied by the real base money. The question been addressed is that what additional real income would agents have earned if they held interest-earning assets instead of money. The real interest forgone in this case constitutes the opportunity cost. Algebriacally, this is expressed as:

$$S_O = rM / P$$

In the model, M denotes the total base money and *r* is the nominal rate of return on assets and P is the general price level. This measure takes into account the opportunity costs borne by the government and has also been broadly investigated in the literature; see for example Marty (1978, pp. 437- 452) and Phelps (1973).

The opportunity costs will arise if the government has to finance its expenditure through the issuance of interest-bearing bonds instead of issuing noninterest-bearing currency. By using a nominal interest rate instead of a real interest rate, it is assumed that money holders increase

nominal balances in face of inflation to keep the real value of base money constant. Most estimates of seigniorage for developed economies use an opportunity cost concept with a short-term interest rate, e.g. a money market rate. In contrast to the monetary concept which calculates revenues from newly printed balances, the opportunity cost concept takes into account the fact that the central bank receives returns from a stock of assets accumulated by the outstanding quantity of base money.

Another caveat as noted by Schobert (2002) on the original idea of the opportunity cost concept is considered. Issuing bonds is not the only way of eventually balancing the budget, when seigniorage is not available. Lost fiscal revenues from seigniorage could also lead to a reduction in government expenditures, an increase in foreign aid or even an increase in illegal sources of revenues. Opportunity costs would then have to be assessed on a wider economic perspective, including lost output due to lower government expenditures and consequently less tax revenues.

The fiscal concept of seigniorage focuses on the net revenues the fiscal authorities obtain from central banking operations, which are not only linked to the creation of base money but also to its management and which are distributed to the fiscal authorities. Klein and Neumann (1990) have called it fiscal seigniorage; it has also been occasionally called "total seigniorage". This idea as formulated by Schobert (2002) is written as:

$$S_F = i(a + b_{cb}) + c + v - k$$

Where the term $i(a + b_{cb})$ describes the revenue of the portfolio of assets held at the central bank, which comprises assets outside the government sector, a , and government bonds held at the central bank, b_{cb}. The issuance of base money in order to finance current expenditures – "money printing" is shown by c. It reflects a claim to the government, which is held against base money issued for the fiscal purpose of financing government consumption. Costs, k , arise with the issuance and management of base money. Valuation changes, v, occur in the asset portfolio accumulated by previous issues of base money and are included in the measurement because they arise with having a monopoly in base money.

There exists a body of work on the issue of seigniorage and its optimal value. Most empirical studies are based on Cagan's (1956) paper. Given that wealth in real terms and real income are relatively stable under hyperinflation, Cagan (1956) assumes that in a period of high inflation, changes in demand for real balances largely result from the extreme fluctuation in prices. That is, money demand is a function of the expected rate of inflation rather than of the nominal interest rate. The optimal seigniorage is calculated by applying the steady-state conditions to the revenue-maximising rate of money growth. Under steady-state conditions, when the quantity of money rises at a constant rate, expected inflation is assumed to be equal to actual inflation, and the quantity of real balances does not change over time.

A study on inflation, seigniorage, and the Laffer curve by Easterly et al. (1995). They developed a model of money, inflation, and seigniorage using data from eleven high-inflation countries in the time period 1960-1990. They calculated the theoretical seigniorage-maximizing inflation rate using several different equations and statistical methods. The seigniorage-maximizing rates they calculate range all the way from 42 percent to infinity.

Kiguel and Neumeyer (1995) in another important paper on the inflation-seigniorage link for Argentina, which studied the inflationary events of Argentina from 1979 to 1989. Their findings were that Argentina's revenue-maximizing inflation rates are around twenty to thirty percent per month. They concluded that these rates were quite high. Moreover, while investigating the relationship between seigniorage and inflation in Argentina in the periods 1979-80, 1982-84, and 1986-1987, they found that the coefficient of the transactions variable, represented by GDP, was not significantly different from zero.

3. METHOD AND MATERIALS

3.1 Theoretical Framework and Methodology

The theory that links seigniorage and government finances can be traced through the familiar government budget constraint. The starting point is a representative agent model in which the government must satisfy both an intertemporal budget constraint and, in every period, a static budget constraint. Following Fischer and Easterly (1990) there are four ways of financing the public sector deficit: by printing money, running down foreign exchange reserves, borrowing abroad, and borrowing from domestic agents.

Each of the different ways of financing the deficit has its own problems. For example, foreign reserve use can lead to exchange rate crises, while foreign borrowing may lead to an external debt problem. The printing of money to finance the deficit may also lead to inflation. With the exception of money printing, there are limitations on the extent to which a government can pursue these financing options. The static budget constraint is expressed

$$D = G - T = \Delta B + \Delta M \quad (1)$$

Where D is the government deficit, G is government expenditure, B is government debt, T is tax receipts and M is the money supply. It says that budget deficit can be financed by issuing money or by government debt through the issue of bonds. Following Burnside (2004), the government's budget constraint can be expressed as: net issuance of debt = interest payments – primary balance – seignorage. There is common knowledge that aisde money creation, the main method of financing government expenditure is debt; domestic and foreign. The net issuance of debt is gross receipts from issuing new debt minus any amortization payments made in the period. The identity can be written as

$$B_t - B_{t-1} = I_t - X_t - (M_t - M_{t-1}) \quad (2)$$

The subscript t indexes time, measured in years, B_t is the stock of public debt at the end of period t, I_t is interest payments, X_t is the primary balance (revenue minus non interest expenditure) and M_t is the monetary base at the end of period t. This is modified as

$$I_t = (1 + i_t^d)B_{t-1} + E_t(1 + i_t^f)B_t^* \quad (3)$$

where i_t^d is domestic interest rate, i_t^f is foreign interest rate. The primary balance can be expressed as

$$X_t = G_t - T_t \quad (4)$$

where G_t is government expenditure and T_t is revenue. The government budget constraint can be expressed as:

$$G_t - T_t + I_t = \left(D_{t+1} - D_t\right) + \left(M_{t+1} - M_t\right) \quad (5)$$

Where $G_t - T_t + I_t$ = PD, is the primary balance. Building on the above, the study extends further the framework to differentiate domestic debt from foreign debt, the government budget constraint for period t in terms of domestic currency is

$$PD_t = (B_t^d - B_{t-1}^d) + E_t(B_t^* - B_{t-1}^*) + (M_t - M_{t-1}) \quad (6)$$

Interest payments on both domestic and external debt are separated to give the formulation a richer economic meaning as surmised by Rutayasire (1990) where PD is the government primary balance for period t, which is to be financed by seignorage, net domestic

and external indebtedness. Interest payment, (I_t) on both domestic and foreign debt as $I_t = i_t^d B_t^d + E_t i_t^f B_t^*$. A further extension of the framework is the incorporation of aid. This modification is informed by the fact that aid has become a major component of the budget of Ghana especially after 2000 till date. Following the formulation by Dinh (1999), aid as a component can be expressed to have a reducing effect on the deficit and consequently a change in debt levels. Taking into consideration the Domar (1940) framework and therefore substituting interest payments from equation (4.3), the government budget constraint for period t in domestic currency can be expressed as:

$$G_t - T_t + i_t^d B_t^d + E_t i_t^f (1-\square_t) B_t^* = \Delta B_t^d + E_t \Delta B_t^* (1-\square_t) + \Delta M_t \quad (7)$$

Where ΔB_t^d is the change in domestic debt, ΔB_t^* is change in external debt and ΔM_t is change in the monetary base. Aid is represented by $\square$. All other variables as explained before. Normalize equation (4.7) by dividing by nominal income, $P_t Y_t$. Where P is the price level and Y is real GDP. To express in real terms we divide by P. For simplicity, assume there is no aid financing.

$$\frac{G_t}{P_t} - \frac{T_t}{P_t} + \frac{i_t^d B_t^d}{P_t} + \frac{E_t i_t^f B_t^f}{P_t} = \frac{\Delta B_t^d}{P_t} + \frac{E_t \Delta B_t^*}{P_t} + \frac{\Delta M_t}{P_t} \quad (8)$$

Following from the last component of equation (8), $\frac{\Delta M_t}{P_t}$ is the real resources the government acquires through increases in the nominal money balances the public is willing to hold. In a discrete time mode, seigniorage denoted as S_M, in period t is given by

$$S_M = \frac{\Delta M_t}{P_t} = \frac{M_t - M_{t-1}}{P_t}$$

A useful way to rewrite this expression is as

$$S_M = \frac{M_t - M_{t-1}}{P_t} = \pi_t m_{t-1} + (m_t - m_{t-1}) \quad (9)$$

Where $\pi_t = (P_t - P_{t-1}) / P_t$ and $m = M / P$. This expression emphasizes two distinct sources of seigniorage. First is the inflation tax, the amount people must give to the government to hold their real money balances constant in that face of rising prices. Second is the public's desire to alter its real money holdings, given the inflation rate. The government can buy real goods and services that the private sector produces with money that is (virtually) costless for the government to print if the private sector is willing to hold paper money that the government supplies. The real resources that the government acquires in this way equal its seigniorage revenue. To define seigniorage we need not know how or why the private sector is willing to accept the government's fiat money; all that matters is that there is a demand for it.

4. RESULTS AND DISCUSSION

The analysis of seigniorage is often most of the time based on inflation tax, a term coined by Friedman (1953). This reflects the fact that a nations monetary authorities can increase monetary seigniorage by increasing the supply of base money relative to its demand. The resulting price level reduces the real value of the public's real money holdings and

therefore the public would demand more nominal base money to make up for the price-level-induced decline in its real cash balances.

In this sense, we can interpret π in equation (9) as the inflation tax rate and *m* as the tax base. When the inflation rate is zero, the government gets no revenue from inflation, while the amount of inflation tax received by the government would increase as the inflation rate rises. But as the inflation rate rises, people would reduce their holdings of money base due to the fact that monetary base is now more costly to hold. Thus, individuals hold less currency, and banks hold as little excess reserves as possible, and eventually the real monetary base falls so much that the total amount of inflation tax revenue received by the government falls (Dornbusch and Fischer, 1994: 555-556). This relationship is estimated following the Jafari-Samimi (2009) model to demonstrate the relationship between inflation and seigniorage. This equation is:

$$S_M = a_o + a_1\pi - a_2\pi^2 + \varepsilon \quad (10)$$

Where $a_o > 0, a_1 > 0, a_2 < 0$ and ε is a white noise residual

By optimizing the equation using simple calculus, setting the first derivative to zero, and solving for inflation, the optimal rate of inflation π^*, is found to be equal to

$$\pi^* = -a_1 / 2a_2 \quad (11)$$

The maximum amount of seigniorage is found by plugging the optimal inflation rate back into the initial equation. Solving and rearranging yields maximum seigniorage as

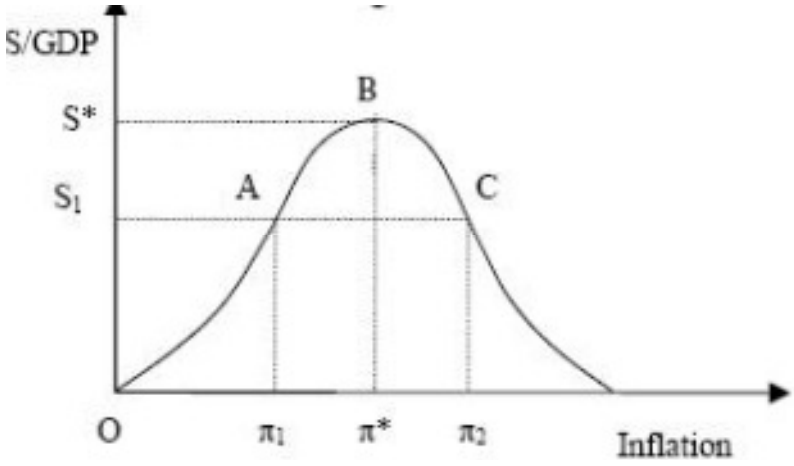
$$S_M^* = -a_1 / 4a_2 \quad (12)$$

The theoretical postulation of the Laffer curve is presented in figure 1 where point B gives the maximum seigniorage and π_0 is the seigniorage maximising level of inflation. In figure 2, S represents the seigniorage revenue as a proportion of the GDP and π the domestic inflation rate. The seigniorage maximizing inflation rate is B with an inflation rate of π^*. Before this point the higher the inflation rate the larger the seigniorage revenue by means of an increase in the base money, and to the right of the point B, the higher the domestic inflation the lower the seigniorage revenue, since economic agents would try to avoid holding base money balances so that they can protect themselves from incurring inflation tax by reducing real monetary balances in their hands. Further, seigniorage revenue can be collected by imposing different inflation rates such as π_2 and π_1, where the tax rate is higher but the tax base is lower, that is the wrong side of the seigniorage maximizing Laffer curve in the latter case with respect to the former. In this line, the former coincides with the correct or efficient side of the Laffer curve, in which there is still opportunity for a higher seigniorage at higher inflation rates.

The data employed is annual data of inflation and money supply from 1980 to 2010 compiled from Bank of Ghana annual reports. The trend analysis of the variables in the model reveal that inflation and money supply have appreciated in value over the 31 year period as shown in figure 2.

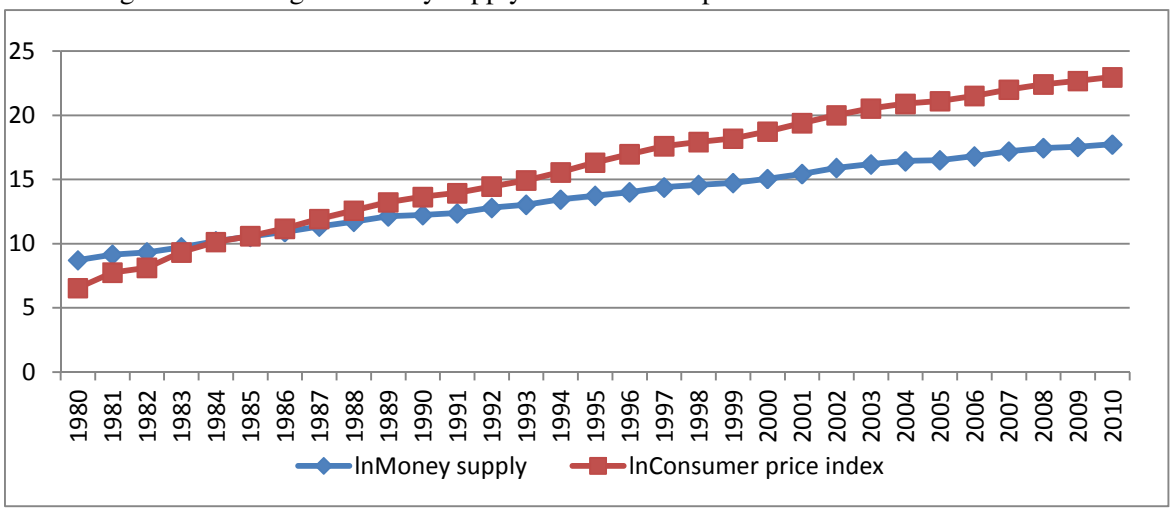
The computed inflation tax values for the period of study have positive values throughout. The highest occurred in 1981 and lowest in 1992. Seigniorage revenue on the other hand, involves changes in money base and have assumed both negative and positive values for the period. These have been everywhere lower than inflation tax except in 1992 and 2007. The highest seigniorage received for the period is 3.5% and the lowest at -3.9%, both expressed as percentage of GDP. This is shown in figure 3.

Fig. 1 The Laffer curve



Source: Adapted from Jafari Samimi et. Al (2012)

Fig. 2 Natural logs of Money supply and consumer price index

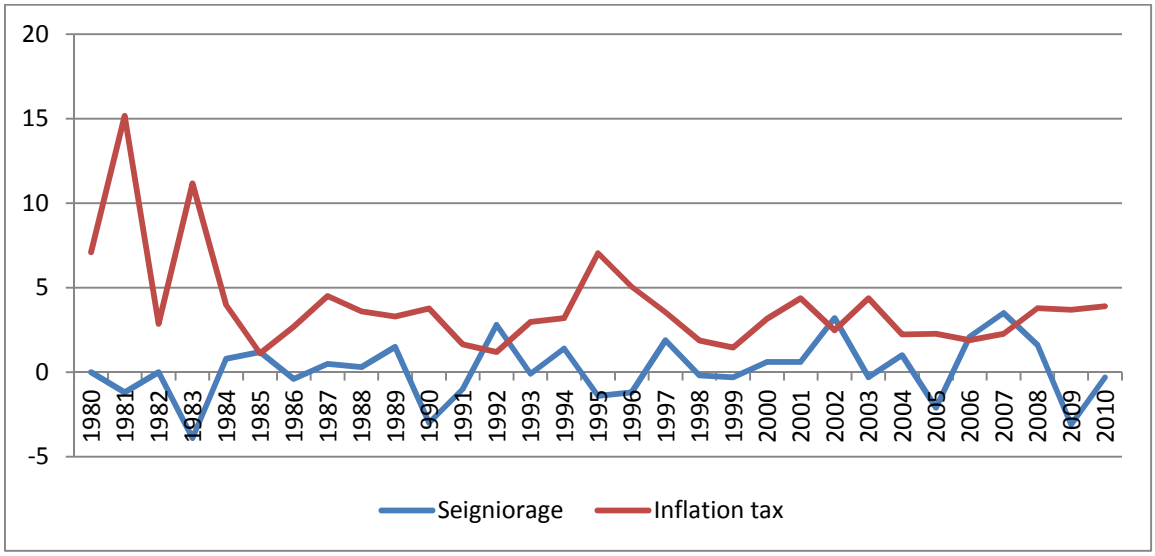


Source: Author's construct

It is seen that the public sector seems to rely on seigniorage and inflation tax revenue to a maximum of 3.0%. Besides, relatively high and accelerating periods of inflation do not necessarily require for larger seigniorage, as the higher levels of inflation result in substantial erosion in the real demand for money and reduce the base of the tax. To compute the maximum rate of inflation tax[1], we invoke equation (12) and the result is that the seigniorage maximising rate of inflation stood as high as 180%. Inflation rates as at now are lower that the seigniorage maximising rate of inflation. This result is similar to the finding by Mueller (2007) where the seigniorage maximising rate of inflation was 153%. For the Laffer curve, we first estimate the parameter a_1 and a_2 in equation (10). The estimated relationship between seigniorage and inflation is then used to examine the Laffer curve hypothesis. The respective curve is computed from estimating equation (10) with seigniorage as the dependent variable. Denoting the estimated parameters by a yields:

[1]The budget identity of the of public sector states that the excess public sector outlays over revenues may be financed by printing money. Some economists regarded seigniorage as a form of inflation tax. As inflation rate increases, the response of velocity to the inflation rate also gives rise to what is termed the seigniorage Laffer curve, in which the revenue from the inflation tax (seigniorage) first rises then falls with increases in the rate of inflation

Fig. 3 Signiorage and inflation tax expressed as percentage of GDP



Source: Authors' construct

Table 1. Laffer curve estimation.

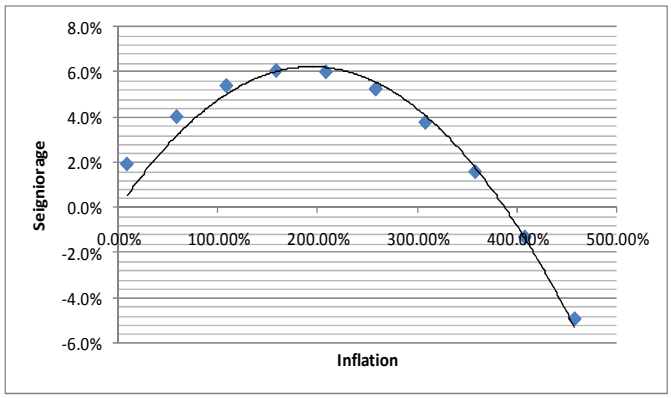
Variable	Coefficient	t-statistic
a_0	0.0149	1.901
a_1	0.0515	1.318
a_2	-0.0143	-0.474

$\overline{R}^2 = 0.27$ $DW = 2.003$

Source: Authors' construct

The coefficients have the expected signs as the valus for a_1 and a_2 are positive and negative respectively. Furthermore, a_0 is statistically significant at the 5% level whereas a_1 is statistically significant at the 10% level. Meanwhile a_2 is not statistically significant. Monetary theory suggests that when the inflation rate passes a certain threshold, seigniorage revenue falls. The curve drawn as shown in figure 4 is a result of estimating seigniorage as a quadratic function of the rate of inflation. The estimated parameters imply that seigniorage revenue begins to fall once inflation exceeds the 180% computed using equation (12). The profits accruing from government monopoly in issuing base money yields profits to the economy. This only presents declining returns at very high levels of inflation.

Fig. 4: Seigniorage Laffer curve for the economy of Ghana



Source: Authors' construct

5. CONCLUSION

Seigniorage remains a viable and an attractive source of government financing for the Ghanaian economy. The average inflation rate in Ghana is far below the seigniorage maximising rate of inflation implying that government tries to maximise revenue through inflation tax. The seigniorage Laffer curve thus holds for the economy of Ghana. Since all inflation rates up to now are lower than Seigniorage maximizing rate of inflation, government could consider it as a revenue source.

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