

## A DUAL EVIDENCE ON THE OPTIMAL USE OF SEIGNIORAGE IN GHANA

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### **Abstract**

There is by now enough evidence that Ghana relies to some extent on the use of seigniorage to finance its budget. This study however, further the empirical scholarship on the optimal path the economy follows in its use of seigniorage within two analytical models. We have provided evidence to reject Barro's (1979) tax-smoothing hypothesis. In the case of Ghana, there is no positive long run relationship between the tax rate and the rate of inflation. Additionally, following Andrabi (1997) game-theoretic model, we provide further evidence that seigniorage is not used optimally in the public finance scheme in the Ghanaian economy because in contrast to the prediction of the model, there is no significant positive relationship between seigniorage and transitory output. The implication of our finding is that the economy of Ghana appears to find itself on the wrong side of seigniorage maximizing revenue Laffer curve.

**Key Words:** Seigniorage, tax-smoothing hypothesis, transitory income.

### **Introduction**

Public expenditure in the Ghanaian economy has shown persistent growth since independence. Among the litany of alternatives for financing government expenditure, one that has received much attention from economists is creation of money to finance the budget most notably because of the distortions it introduces into the economy.

The conventional term for government revenue from money creation is known as seigniorage which is measured simply as the real change in money stock or the product of money growth times real balances. The level of seigniorage on the face of it depends positively on the money growth and real money balances. In the literature, it is normally expressed as a fraction of output as the rate of money growth times the ratio of real money balances to real income.

Its use has received historical defense and condemnation alike. Keynes, in defense of the use of money creation as cited by Agenor and Montiel (2006) notes "government can live for a long time ... by printing paper money. That is to say, it can by this means secure the command over

real resources, resources just as real as those obtained by taxation. The method is condemned but its efficiency up to a point must be admitted... so long as the public use money at all, the government can continue to raise resources by inflation..."In Ghana, Bawumia (2008) reports that the level of seigniorage use in Ghana stands at 8% as compared to 2% in OECDs and 5% in sub-Saharan Africa.

The key issue with respect to financing the budget deficit with seigniorage has to do with optimality. Seigniorage revenue is intimately related to the rate of money growth. The temptation to increase money growth would jeopardize the economy as the economy exceeds the seigniorage maximizing rate (the optimum point of the Laffer curve). At such point, the economy suffers a lot as *Tanzi-Olivera* effect begins to raise its ugly head. In this case, since taxes levies have lags and are put on previous income and inflation reduces the level of previous output, the budget deficit worsens as conventional taxes would not be forthcoming as expected and the temptation to create more money increases though such increases in money growth yields unsatisfactory or no revenue. Increases in money supply fuels inflation, build inflationary expectations, increase the nominal interest rate and further increase the opportunity cost of holding money and lead further to the decline in real money balances which would eventually reduce the level of seigniorage for every possible increase in money supply. It has been argued that when inflationary expectations become so in-built, then currency substitution (dollarization) and barter trade arises which would drastically reduce real money balances and hence seigniorage. Therefore understanding the optimal path the economy follows in its use of seigniorage revenue is very crucial.

We have provided evidence to reject Barro's (1979) tax-smoothing hypothesis.

In this study, we have provided a dual evidence that Ghana does not follow an optimal path in the use of seigniorage. We found that, there is no positive long run relationship between the tax rate and the rate of inflation. Additionally, following Andrabi (1997) game-theoretic model, we provide further evidence that seigniorage is not used optimally in the public finance scheme in the Ghanaian economy because in contrast to the prediction of the model, there is no significant positive relationship between seigniorage and transitory output. The implication of our finding is that the economy of Ghana appears to find itself on the wrong side of seigniorage maximizing revenue Laffer curve.

### **Literature Review**

Click (1998) reported estimates of seigniorage for 90 countries for the period 1971-90. Seigniorage as a proportion of GDP ranged from 0.38% to 14.8% with more than half of the countries having less than 1.7% and about 75% of them having less than 2.5%. Seigniorage as a proportion of government spending ranged from 1% to above 20% with ten countries above this level. On average, seigniorage was about 2.5% of GDP and financed about 10% of government spending. Haslag (1994) in his study, using 67 countries reports that approximately three fourth of the countries collect on average less than 2% of GNP through seigniorage. He noted that Ghana relies most heavily on seigniorage collecting revenue equal to 10% of output through seigniorage.

Historical condemnation in the use of seigniorage has come from Bailey (1956), Mundells (1965), Marty (1967), and Friedman (1958). But Phelps (1973) believes that against the backdrop that government has no sources of lump-sum taxes and that government only has distortionary taxes available for financing expenditure, it will be optimal to rely on seigniorage to some

degree. Reducing the nominal rate of interest to zero would increase the inefficiencies by the higher level of other taxes needed to replace lost inflation tax revenues.

The approach for optimizing the use of seigniorage has attracted a great deal of attention in the literature. One such approach is known as the tax-smoothing hypothesis. Models of the tax-smoothing hypothesis are derived from the microeconomic foundation of optimizing agents with budget constraint and an objective function mainly the minimization of distortions associated with seigniorage and tax financing. Mankiw (1987), Grilli (1989), Poterba and Rotemberg (1990) Trehan and Walsh (1990) and others have developed models in which seigniorage and conventional taxes were set to minimize deadweight losses across all available taxes and time periods in consonance with Barro (1979 and 1986). Mankiw (1987) model worked for USA but Poterba and Rotemberg (1990) found different results for other OECD countries. Yao and Chu (2014) found that Taiwanese data are in favor of the tax smoothing hypothesis. The models have however failed woefully in most developing countries.eg.Saadik (2003). One explanation that has received enough attention in the literature by Aizenman (1992), Andrabi (1997) and Click (1998) is that in some countries seigniorage could react as a residual source of government revenue and the tax-smoothing hypothesis would not suffice. In this case, seigniorage increases as the other sources of revenue decrease and will not finance permanent government expenditure but only the transitory component of government spending

In Ghana, Insah and Ofori-Boateng (2013) used the quadratic estimation technique due Samimi-Jafari (2009) to estimate the seigniorage revenue maximizing laffer for Ghana. They found that Ghana is far below the threshold of declining seigniorage revenue. Quartey (2010) found “that the revenue maximizing rate of inflation was 9.14 over the period 1990-2006. Thus, the seigniorage maximizing rate of inflation is below the inflation, indicating that the economy was operating on the wrong side of the laffer curve. He showed further that, the revenue maximizing inflation rate is not necessarily a growth maximizing one”.

### **Theoretical Model**

In this paper, we use two main theoretical models to further the empirical scholarship on the optimal use of seigniorage in Ghana. We use the extended tax smoothing hypothesis models of Trehan and Walsh (1990) and Andrabi (1997) theoretic decentralization game approach. In the former case, we replicate the work of Ashworth and Evans (1998) using a more modern data series in cognizance of the fact that the Ghanaian economy has gone through major economic reforms since 1998. Data for this study was obtained from the Bank of Ghana, ISSER annual releases of the State of the Ghanaian economy and the World Bank. The data used is annual and spans the period from 1983-2010.

The main message of the Trehan and Walsh (1990) framework is that actual tax policies reflect the intertemporal optimization policy of the fiscal and monetary authorities (see Trehan and Walsh ,1990 for a full exposition of the extended tax-smoothing model). It is assumed that the authorities jointly seek to finance an exogenous path of real government expenditures through both taxation revenue and seigniorage while minimizing the expected present discounted costs of doing so. Over time, inter-temporal optimality requires that the expected marginal distortionary costs from raising the two sources of revenue be equalized for each of the two revenue sources. This yields two optimality conditions. It is also required in the model that for intra-temporal optimality condition to be met, then the marginal cost of raising revenue by an additional unit of

tax should be equated to the marginal benefit from lowering seigniorage by the same amount. This also yields another optimality condition.

With respect to the second model, Andrabi (1997) argued that seigniorage could act as a residual source of revenue. This has long been recognized by Aizenman (1992), Click (1998) and Saadik (2003). Aizenman initially theorized that in settings where budget decision is decentralized, the Nash solution would be sub-optimal and there would be higher inflation rate. Andrabi (1997) characterized a dynamic theoretic game in which players can cooperate to ensure a tax-seigniorage mix close to the social optimum. This would be consistent with a situation where seigniorage covaries positively with transitory output. It also emanated from the model that a positive relationship between current government expenditure and transitory output strengthens the former relationship. For a full exposition of this, the reader is referred to Andrabi (1997). Another refutable hypothesis from the model is that trend growth in output should reduce the level of seigniorage. See Andrabi (1997) for full formal treatment of the model.

### Methodology

Within the two analytical frameworks, we would provide two empirical methodologies for investigating the optimal use of seigniorage in Ghana. Our first methodology uses the Engle-Granger causality test to investigate the long run relationship between seigniorage and the tax rate. In the second model, we run a simple OLS test to find the effect of transitory output on seigniorage. We describe and concurrently use each approach in turn in the next section on methodology.

### Model 1: Extended Tax Smoothing Hypothesis

In the extended tax-smoothing hypothesis, three main time series variables are used to test these hypothesis: log of tax rate  $\ln\tau_t$ , log of the velocity of money  $\ln\left(\frac{m}{y}\right)_t$  and inflation rate  $\pi_t$ . Earlier research work assumed that velocity of money was constant, eg, Mankiw(1987), Roubini (1991). But the assumption of constant velocity is difficult to be sustained. Velocity of money indeed changes and such affects governments ability to raise the required revenue from seigniorage. This has huge implication for any tax-smoothing purposes. Therefore in the testing stage relaxing the assumption of constant velocity would yield far richer results. This study takes this path.

Following Trehan and Walsh (1990), we would estimate the model:

$$\ln\tau_t = \alpha_0 + \left(\frac{\beta}{\alpha}\right)\pi_t + \left(\frac{1}{\alpha}\right)\ln\left(\frac{y}{m}\right)_t \quad [1]$$

We conduct several tests to refute the tax smoothing hypothesis. Testing the hypothesis would require that one investigates the unit root (stationary or non-stationary) properties of the time series variables under consideration. If the variables are  $I(1)$ , then the next stage would be to test their cointegrating properties. Earlier test like Roubini (1991) that assumed constant velocity of money falsified the hypothesis when they could not find a unique cointegrating vector for the tax rate and inflation. Such result have been found to be misleading. When one relaxes the constant velocity assumption, and found all variables to be non-stationary, then any unique cointegrating vector between any two pair of the variables would falsify the model. There would only be a cointegrating relationship of all variables are  $I(1)$  and their linear combination has a unique cointegrating vector.

Additionally, the extended tax-smoothing hypothesis requires some parametric restrictions to be met, i.e., the estimated coefficients should be of the right sizes and signs. Theoretically, we expect a positive relationship between the tax rate and the rate of inflation Mankiw (1987) as well as a positive relationship between the tax rate and the velocity of money. Together, these tests would constitute a composite test for the tax-smoothing hypothesis.

Table 1 reports the unit root tests for log tax, log velocity and inflation rate. Table 1.2 reports the cointegrating tests for the variables using two alternative tests of unit root, the ADF and KPSS which complement each other. The null hypothesis of the former is that the variable is non-stationary. The null hypothesis of the latter is that the variable is stationary.

Table 1.:Unit root tests for log Tax rate, inflation rate and log money velocity

Variable(s)	ADF	KPSS
	Test statistic	Test statistic
Log Tax rate( $\ln\tau_t$ )	[-1.757*, -2.22**]	0.794
Log Velocity( $\ln(y/m)_t$ )	[-3.669*, -3.939**]	0.283
Inflation rate( $\pi_t$ )	[-2.586*, -3.193**]	0.458

The asterisks\* and \*\* indicates tests with Constant and Constant and Trend respectively

### Results from Model 1

The unit root tests indicate that both inflation rate and the tax rate are non-stationary. However, this study finds the velocity ratio to be stationary per the unit root tests from both the ADF and the KPSS.

Given that, the velocity of money satisfies the assumption of constant velocity of money, our task for testing the tax smoothing hypothesis reduces to testing the cointegrating relationship between the log tax rate and the inflation rate. A unique cointegrating vector between the two variables would constitute a case for the tax smoothing hypothesis. Table 2 reports the cointegrating relationship between the two variables using the Engle-Granger approach. We however estimated model [2] since the velocity ratio was found to be stationary.

$$\ln\tau_t = \alpha_0 + (\alpha_1)\pi_t + e_t \quad [2]$$

Table 2: Engle-Granger Cointegration Test for Tax rate and Inflation

Variable(s)	coefficient	t-ratio
Constant( $\alpha_0$ )	2.781	31.40
Inflation rate( $\pi_t$ )	-0.007	-3.843
$e_{t-1}$	-0.282	-2.125

$e_{t-1}$  is the coefficient of the residual from the regression  $\Delta e_t = \omega e_{t-1} + \epsilon_t$

### Discussion of Results from Model 1

Our results from Table 1.B indicate that there is no long run relationship between inflation and the tax rate. Besides, the coefficient is of the wrong sign-as we see a negative relationship instead of the a priori positive. It appears the evidence is at odds with optimal tax-smoothing hypothesis. The hypothesis has been refuted by the data. As far as the Ghanaian case is concerned, the tax

smoothing thesis does not hold in line with Ashorth and Evans (1998) even under different data series. Our finding that Ghana does not follow an optimal path in its use of seigniorage revenue is in line with Udoh (2011) who studied the optimal use of seigniorage in the two countries, namely, Ghana and Nigeria in the West African Monetary Zone.

### **Model 2: Seigniorage as a Residual Source of Revenue**

We now undertake a test of the optimal use of seigniorage using Andrabi (1997) game theoretic approach. Within this framework, optimal use of seigniorage implies that there is a positive relationship between seigniorage and transitory income. We measured seigniorage as a fraction of output following Cagan (1956), Marty (1968), Friedman (1971), Fischer (1982), Barro (1982) Cukierman, Edwards and Tabellini (1992), Click (1998), Haslag (1995), Andrabi (1997), Saadi-sedik (2003).

We used three different decomposition methods to obtain transitory and trend output. These included The H-P filter, The First difference (FD) and the Deterministic Trend (DT) Decomposition methods. For the H-P filter, we used three different smoothing parameters ( $\mu$ ) which penalize the variability in the data. The parameter  $\mu$  is positive and the trend becomes smoother the larger the value of ( $\mu$ ). Hodrick-Prescott suggests that for quarterly data,  $\mu = 1600$ . For annual observations they suggest  $\mu = 100, 400$ . Baxter and King (1999) also argue that if  $\mu = 10$  for annual data, better results are generated. It has been argued however that the H-P decomposition has smaller fluctuations and is less smooth relative to their counterparts such as the Phase Average Trend (PAT). This study will use annual data and report the results for  $\mu = 10, 100$  and 400. (See Zarnowitz and Oyildirim (2003) for a full exposition on decomposition methods).

The deterministic Trend Decomposition represents macroeconomic time series as the sum of the deterministic trend and stochastic deviations treated as the residual cyclical component. Zarnowitz and Ozyildirim (2003) noted that the cost of using a linear trend is that the deviations (cycles) from it contain indiscriminately all business-cycles, growth cycle and shorter irregular movements combined.

Within the second analytical model, following from Andrabi (1997) theoretic-game approach, we hypothesized that seigniorage covaries positively with transitory increases in output. This study would therefore estimate the model:

$$Seig_t = \beta_0 + \beta_1 Cycoupt_t + \varepsilon_t \quad [8]$$

$Seig_t$  and  $Cycoupt_t$  refer to seigniorage and cyclical output respectively. Per our inference and in consistent with the theory, we expect the coefficient on cyclical (transitory) output to be positive. i.e.,  $\beta_1 > 0$

The model also predicts that a positive correlation between transitory output and current government spending ( $\Delta EXP_t$ ) will strengthen the positive relationship between seigniorage and transitory output. We shall find the relationship between current government expenditure and cyclical output with the model:

$$\Delta EXP_t = \delta_0 + \delta_1 Cycoupt_t + w_t \quad [9]$$

Since current government expenditure and cyclical output must be positively related, we expect the coefficient of cyclical output to be greater than zero. i.e.  $\delta_1 > 0$

To capture the effect of current government spending on the relationship between transitory output and seigniorage to strengthen the position that indeed seigniorage use increases as transitory output (such as during booms), the study will estimate model:

$$Seig_t = b_0 + b_1 Cycoupt_t + b_2 \Delta EXP_t + e_t \quad [10]$$

The effect of using the first difference government expenditure is to remove the trend that may be present in government expenditure since we are interested in current government expenditure. First differencing also makes the series stationary to be amenable to the use of a simple OLS regression method. Even when we condition the relationship between seigniorage and transitory increase in output on the covariation of seigniorage and current government expenditure, the study expects the coefficient on cyclical output to be positive. i.e.  $b_1 > 0$ .

**Results from Model 2**

In what follows, we present the results of our study. A unit root analyses of the time series variables involved; seigniorage, transitory/cyclical output and current government expenditure, indicated a rejection of the unit root hypothesis, indicating that the variables are stationary. We however, did not report our results in the study. We use a simple ordinary least square regression for our estimation because we found the series to be stationary.

**Table 3: Relationship between cyclical output and current government expenditure**

H-P filter	$\delta_0$	$\delta_1$
$\mu = 10$	-0037(0.242)	0.071(0.072)
$\mu = 100$	-0.032(0.239)	0.075(0.066)
$\mu = 400$	-0.027(0.23)	0.082(0.063)
First Difference filter	-0.082(0.248)	0.013(0.046)
Deterministic trend	-0.061(0.234).	0.079(0.062)

Numbers in parenthesis are standard errors

**Table 4: Results for the conditional and unconditional covariation of seigniorage and transitory output on current government expenditure**

$H - P$	$\beta_0$	$\beta_1$	$b_0$	$b_1$
$\mu = 10$	8.698(1.077)	0.173(0.269)	8.763(1.085)	0.243(0.279)
$\mu = 100$	8.582(1.635)	0.111(0.254)	8.763(1.54)	0.186(0.266)
$\mu = 400$	8.587(1.642)	0.045(0.248)	8.757(1.568)	0.116(0.261)
First Difference	8.766(1.522)	0.173(0.163)	8.712(1.446)	0.185(0.165D)
Deterministic trend	8.53(1.602)	0.036(0.22)	8.678(1.543)	0.111(0.242)

Notes: Numbers in parenthesis are standard errors. The first two columns is the result for the unconditional variation of seigniorage and cyclical output and the last two columns is the result for the conditional covariation of seigniorage and cyclical output on current government expenditure.

**Discussion of Results from Model 2**

As expected a priori, from Table 3.1A, there is a positive relationship between current government expenditure and transitory output. From Table 3.1B, we also recorded a positive relationship between seigniorage and transitory output for the conditional and unconditional cases. Across all the decomposition methods our results are consistent. Even in the case of the H-P, we found consistent results across the different smoothing parameters. However, none of these positive relationships is statistically significant. Given our earlier results that a positive

relationship exists between current government expenditure and transitory output, our position has been solidified as the former case provides support for the latter. This result is also in line with earlier studies as Insah and Ofori-Boateng (2013) who used the quadratic estimation technique due Samini-Jafari (2009) to estimate the seigniorage revenue maximizing laffer for Ghana as well as Quartey (2010) who found that Ghana is far below the threshold of declining seigniorage revenue. The differences in our results only stem from our methodologies.

### **Conclusion**

We sought to characterize the behaviour of the Ghanaian economy with regard to the optimal use of seigniorage. We examined two main models that could adequately account for the optimal use of seigniorage in Ghana. In Trehan and Walsh (1990) model, we examined the refutable hypothesis of the famous tax-smoothing hypothesis. The unit root and the cointegrating properties of the key variables of the model, namely, the tax rate, inflation rate and the velocity of money were studied. The study found that whereas the tax rate and inflation rate have unit roots, velocity of money is stationary. We proceeded to find the cointegrating properties of inflation and the tax rate. Apart from the failure of the data to meet the parametric requirement that the signs be positive, we never found any unique cointegrating vector between the two variables. We are convinced, based on our results that the tax-smoothing hypothesis does not hold for the Ghanaian economy. Our result is dissimilar to Ashworth and Evans(1998) only in terms of the stationary velocity assumptions. According to A-E, from 1965-1993, the velocity of money was non-stationary.

Following the advice of Click (1998), Saadek (2003), Aizenman (1992), Andrabi (1997), we followed the debate that seigniorage could act as a residual source of revenue in which case it would not finance permanent government spending. We use the theoretic game model by Aizenman (1992) and Andrabi (1997) to examine the optimal use of seigniorage under such circumstance-which circumstance is that seigniorage is used as a residual source of revenue. Following Andrabi (1997) dynamic cooperative game analysis, we tested the refutable hypothesis that, if seigniorage acts as a residual source of revenue, then it should follow the path that it covaries positively with transitory output and that such relationship is strengthened if current government expenditure is positively correlated with transitory output. We use different decomposition methods to obtain the transitory components of output in the Ghanaian economy. We indeed found a positive relationship between seigniorage and transitory output but such relationship is not significant. The study concludes that, seigniorage is not used as a residual source of revenue in Ghana.

We recommend for future studies that an estimation of the optimal level of seigniorage in line with the suggestions of Nolan (2009) and hence money growth should be done to ensure the economy can stay within optimal boundary in the use of seigniorage.

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