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INNOVATION ACCOUNTING OF TAX-REVENUE DRIVERS: COINTEGRATION EVIDENCE FROM GHANA

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ABSTRACT

This study uses cointegration, and innovation accounting analysis to examine the volatility and extent of the short-term and long-term relationships between the drivers of tax revenues and tax revenues in Ghana from 1980 to 2011. The principal and consistent discovery from this study is that cocoa farmers' tax (CFTAX) is the least volatile and import taxes (IMPTAX), is the most volatile in the observed period. The estimated cointegrating relationships identify at least two long-run vectors for the drivers of tax revenues. We also find that among the drivers of tax revenues, the cocoa farmers' income taxes are the quickest to adjust to long-run equilibrium in the current year. The forecast error variance decompositions reveal that the cocoa farmers' income taxes are the strongest endogenous of the VAR system driver of tax revenues, and that they play a dominant role in Ghanaian tax revenues in the observed period. The empirical evidence supports the descriptive statistics that cocoa farmers' income tax revenues remain the largest and most reliable source of income for the Ghanaian economy. Since tax revenues from cocoa farmers continue to drop because of falling cocoa futures and low production, Ghanaian policymakers must diversify their tax-revenue drivers to include a sales tax on discretionary goods and services such as imported tobacco and imported alcohol. As tax revenue increase option has become elusive, the hardline option is to gradually eliminate government expenditures in the areas of colonial delicacies such as free fuel, chauffeurs for government officials (ministers and members of parliament etc), excessive per diems from the president to other government officials and many more, just to mention but few.

JEL: C32, F33, H6, O11, P51

KEYWORDS: Cointegration; Innovation Accounting; VAR Models, Macro-Dynamics, Tax-Revenue Drivers, and Ghana

INTRODUCTION

At the microstructure, individuals in many transitional economies live leveraged consumption lifestyles as they cannot balance their income statements periodically. Generally, voluntary savings are low, leading to poor capital formation (net worth from the balance sheets is always negative) over time. Persistent budget constraints put many at the disadvantage by not paying their fair shares of the tax burden and avoiding taxes through tax loopholes, and non-compliance government policies. Adverse financial statements by the citizens are transferred indirectly to the government by decreases in total tax revenues from year to year. Therefore, the budget deficit story runs from individuals in the country to the nation as a whole. The tax base continues to dwindle as the informal sector grows and few people pay their fair shares of the tax burden. The tax system continues to be inefficient because of weak compliance and enforcement mechanisms. The informal sector has increased relative to the formal sector (money laundering and currency trafficking as well as drugs and other underground activities) and without discretionary taxing powers of the government of Ghana, there will be no improvements in the tax base (few drivers of tax revenues (Amoako-Adu, 1984). As the government tax revenues continue to lag behind the high

expenditure associated with economic development, the budget deficits have continued to grow over time. The continued widening budget deficit has been a major constraint to fiscal and debt sustainability.

In 2011, government revenue as a percentage of Gross domestic product was 19.13%, lagging behind government expenditure as percentage of Gross domestic product by 5% (24.35%). In 2013, the gap between the government revenue as a percentage of GDP and expenditure as a percentage of GDP further widened about 10%, (16.72% - 26.72%). In 2015, the gap between government revenue as a percentage of GDP and expenditure as a percentage of GDP dropped to 6% (19.20% - 25.72%). The projection for the 2016 indicated that by the end of 2016, the government expenditure would stand at GHC45.0 billion and revenues at GHC32.638 (about deficits of–GHC12.87 billion). The sad story is that the budget deficits are not going to get better over time as the economy is not growing and tax reforms and collections are also riddled with bribery and corruption. Most African countries are in transition (Keller, 2007) and their economies are not generating sufficient revenues to offset government expenditures. Governments derive revenues for development from taxes and other sources such as exports, foreign aids, and loans. Lower tax revenues in both established and transitional economies lead to deficits and higher debts, higher interest rates on debts, and fewer development projects for citizens. Government revenue sources and taxation policy are of great concern to government, leaders, and economists because of the effects of insufficient revenues on the political, social, and economic development of African countries (Kayaga, 2007).

Reducing deficits is a concern for both developed and transition economies. Osei and Quartey (2005) indicate that for the past two decades, Ghana depended on foreign aid to meet a gap between government revenues and expenditures (deficits). They suggest that government can resolve deficit problems by either generating more tax revenue or reducing expenditures. Reducing expenditures would harm key sectors of the economy like education, health, and infrastructure that have helped reduce poverty. Increasing economic performance in total revenue will reduce deficits, and limit Ghana's dependence on foreign aid. Governments of both developed and transition economies have a legitimate interest in understanding the factors that drive total tax revenues (Clausing, 2007). The in-depth insight on the inherent riskiness of the various drivers of government revenue will help policy-makers, administrators, and leaders of Ghana and similar transition economies to develop policies to reduce negative performance indicators that influence the fluctuation of inflow of revenue. Some effective tax administration strategies included simplified tax laws (Bird, 2014), targeted potential taxpayers (Shome, 2004), and cooperative compliance model instead of deterrence strategies to enforce compliance (Whait, 2012). A personal income tax with a volatility rate of 5% and company tax rate of 10% was an indication to policymakers that personal income taxes inflow was more certain than company taxes inflow.

This study adds to the empirical literature by setting for itself three goals, which we pursue in the following ways: First, we reexamine the nature and degree of the volatility of the drivers of tax revenues. Second, we employ the error-correction term (ECT) for the selected autoregressive distributed lag (ARDL) model to find out the length of the degree (speed of convergence to equilibrium) to which each drivers of tax revenues is out of equilibrium. If the speed of adjustment of a driver of tax revenues is slow, this may indicate that it is temporarily out of equilibrium. The larger the error-correction coefficient (in absolute value), the faster the driver's return to equilibrium, once shocked. Whatever is in fact true? Third, we use the variance decomposition analysis to determine which driver of tax revenues is able to withstand political, economic and global shocks in the long run. In other words, how long is each of the drivers of tax revenues able to deal with shocks? Are the shocks long or short lasting? The rest of this article is organized as follows: section 2 reviews the empirical literature, section 3 presents data sources and research methodology, section 4 discusses the study empirical results, and section 5 offers conclusions, discussions, limitations and future research.

LITERATURE REVIEW

Osei and Quartey (2005) show a disturbing phenomenon in Ghana with respect to drivers of total revenue, which are, direct taxes, indirect taxes, and non-tax revenues. They find that between 1980 and 2002, direct tax revenue as a percentage of total revenue ranged between 19.5% and 33%. Between 1983 and 1985 direct taxes increased but they declined to 21.9% of total tax revenue in 1986, increased in 1987 to 24% and 31.2% in 1988, declined to 19.5% by 1991 and increased again to 29.3% between 1992 and 1997 and 32.7% between 1999 and 2002. Indirect taxes as a percentage of total tax revenue ranged between 66.9% and 80.5% of total tax revenue between 1980 and 2002. The Individual tax rate is a progressive tax with the top rate of 25% while the corporate rate ranged from 32.5% to 25% between 2001 and 2006.

As Prichard (2009), notes in 1995, Ghana introduced the original value-added tax (VAT) of 17.5% to replace the sales tax. Since then, the VAT went through changes, including a withdrawal of the tax in 1995 following public protest against it, reintroduction of the tax at a 10% rate in 1998, which increased to 12.5% in 1999 and 15% in 2003. Osei and Quartey (2005), observed that, indirect taxes have contributed more to tax revenue than direct taxes. Direct and indirect taxes in Ghana averaged 26.1% and 73.9% respectively of total tax revenue over the period 1980 to 2002. The taxes identified and measured in a study by Akazili, Gyapong, and McIntyre (2011) include direct taxes (such as income taxes and company taxes), and indirect taxes (such as the VAT, the National Health Insurance Levy, fuel levies, and import duties), which together accounted for over 95% of the total revenues from tax collection in Ghana in 2010**.**

In a review of Ghana's tax systems sponsored by the U.S Agency for International Development, Agribusiness Commercial, Legal, and Institutional Reform AgCLIR (2008) argued that Ghana's taxation agencies provided adequate information to encourage compliance across all types of taxes at each level of society. All societal segments agreed that the taxation administration was too centralized, requiring central offices to tend to tax business and make payments. Critics of the Ghanaian tax system claimed that there were not enough Internal Revenue Services (IRS) centers throughout the country, and that IRS processing was slow, if mostly functional. In response to these criticisms, additional IRS offices have been established to meet the needs of agribusiness workers and other entrepreneurs.

Goerke (2007) assessed the effects of Company tax behaviors on personal income taxes and concluded that a manager's income depends on whether the firm's activities are detected or not, and that as a result, Company and personal income tax evasion choices cannot be separated. Focusing on the United States, and using a survey instrument as a research tool, Pantuosco and Seyfried (2004) investigated a shift in the tax burden away from company taxes as a result of the decline in the manufacturing sector. Company tax revenue in Ghana increased from 7.4% to 18% between 1983 and 1988 and declined to 8.4% by 1993. Kusi (1998) attributed the decline to the reduction in the marginal rates of company taxes. A study on variation among member countries of the Organization for Economic Cooperation and Development regarding the size of corporate income tax revenues as a function of gross domestic product (GDP) from 1979 to 2002 helped to explain the variation as a function of the statutory tax rate, the breadth of the tax base, corporate profitability, and the corporate sector's share of the economy or GDP (Clausing, 2007). The conclusion can be replicated to explain the volatility of the Company tax revenue in Ghana from 1980 to 2011. These studies used statistical analysis but stopped short of establishing a rigorous empirical relationship between corporate taxes and total tax revenues.

Self-employed workers and Small and medium-sized Enterprises (SMEs) remain an important part of Ghana's business environment (Amidu, Effah, & Abor, 2011). According to Kayanula and Quartey (2000), the dynamic role SMEs in developing countries has been highly emphasized as the means for these countries to industrialize and reach other development goals. According to Abor and Quartey (2010), SMEs account for about 92% of Ghana's businesses, providing approximately 85% of manufacturing employment, and representing 70% of Ghana's GDP. Workers in SMEs represent 61% of overall employment (Abor &

Quartey, 2010). Robson and Freel (2008) investigated the characteristics of exporters in the three main non-governmental sectors of the Ghanaian economy (manufacturing, services, and agriculture) and concluded that since 1980 as a result of the Ghanaian government's reform efforts, the focus had shifted to significantly reducing state-based economic interventions or replacing them with market mechanisms, reflecting ideological commitments to market economics and capitalism (Briggs & Yeboah, 2001; Robson & Freel, 2008). Parker, Riopelle, and Steel (1995) conclude that the SMEs in Ghana and Malawi employed between 15.5% and 14.09% in 1993. Other authors have given figures from 22% to 61% that varied over time (Abor & Quartey, 2010; Daniels & Ngwira, 1993; & Gallagher, 1993). The variance in these statistics may mean that self-employed workers and SMEs do not report accurate figures or that they do not pay significant taxes because many SMEs, recently formed, have low profits. Again, these studies did not find an empirical relationship between the SME taxes and total tax revenues in the observed periods.

Cocoa production generated major contributions to the country's revenues, GDP, and net national income as a result of direct and indirect taxes on cocoa producers and processors (Ocansey, 2010). Cocoa production in Ghana fell by 74% over two decades until the government enacted policies entitling farmers to higher percentages of international market prices (Breisinger et al., 2008). Breisinger et al. (2008) find the decline in taxes collected from Ghana's cocoa farmers' contributed directly to a reduction in government revenues from an average of 16% in the 1960s to 12% in the 1990s, to approximately 5% in 2005. And yet, despite depressed production and revenue cocoa export receipts still averaged 60% of annual foreign exchange earned by Ghana, and 13.7% of the GDP, causing it to remain a major source of government revenue (Asare, 1987; Atta, 1981). According to Codexa Capital (2012), Ghana experienced positive economic momentum after government reforms in the 1990s, and much of the growth in GDP resulted from cocoa production. Kolavalli and Vigneri (2011) noted that, following the 1990s, cocoa farmers and their families experienced improved living standards relative to other food crop farmers and a reduction in poverty from approximately 60% in 1990 to 24% in 2005.

The increased reduction in cocoa taxes resulted in less revenue for the government. Blankson (2012) indicated that during the three years prior to 2012, Ghana produced more cocoa because of the Ghana Cocoa Board's interventions. These interventions included paying farmers 80% of the world cocoa market price to discourage smuggling to neighboring countries for illegal sale. The board embarked on a six-year replanting of cocoa trees nationwide and provided jobs for youth in the cocoa areas. Increased employment in the cocoa sector helped increase personal income tax receipts, resulting in an infusion of approximately $1.5 billion into the Ghanaian economy (Blankson, 2012). These studies were limited to empirical analysis of cocoa farmers' income taxes and total tax revenues. Obeng,Brafu-Insaidoo, and Ahiakpor (2011) analyze the quantitative effects of import liberalization on tariff revenue in Ghana to examine how different components of the sources of change in import taxes contributed to changes in import tax revenue. They find that Ghana lost revenues as a result of liberalization, which reduced average official duty rate levels, but gained revenues from currency depreciation. Obeng, Brafu-Insaidoo, and Ahiakpor (2011) recommend that public policies focus on determining and targeting the optimum level of the average official import duty rates, focusing on the identification of the major sources of duty revenue leakage, and substituting sales taxes for tariffs to increase tax revenue sufficiently.

DATA AND METHODOLOGY

This section contains information about the construction of the data series to be used in the estimated model. The original data consists of personal income and property taxes (PIPTAX), import taxes (IMPTAX), cocoa farmers' taxes (CFTAX), domestic goods and services taxes (DGSTAX), a tax reform dummy (TRDUM), and tax revenues from 1980 to 2011. The series are collected from Ghana Statistical Services, the Ministry of Finance, and the Ghana Cocoa Board (COCBOD). The dummy coefficient incorporated with the tax reforms assumes the binary values of 1 and 0 in the equation. 1= tax reform period, and 0 = period of no tax reform. The reason for this is that, with the application of tax reform, any changes in tax revenues (such

as an increase or decrease in the computerization of tax databases in the country) will cause changes in tax revenues. Furthermore, the dummy variable is about the marginal effects in a binary choice model. It is the derivative with respect to the binary variable (computerized tax collection data bases [1995 to 2011] versus non-computerized tax collection databases [1980-1994] as if it were continuous, providing an approximation that is often surprisingly accurate (Greene, & Hensher, 2012).
To investigate the relationship between tax revenues and the drivers of tax revenues the following model is applied:

$$TAXREV = f(PIPTAX, IMPTAX, CFTAX, DGSTAX, TAXDRUM) + ut \quad (1)$$

Where, TAXREV = total tax revenues, and other variables have already been explained.
We investigated our first goal by adopting a generic auto-regressive distributed lLag (ARDL) that looks like the equation below:

$$\Delta y_t = \beta_0 + \Sigma\beta_i \Delta y_{t-i} + \Sigma\gamma_j \Delta X_{1t-j} + \Sigma\delta_k \Delta_{2t-k} + \varphi z_{t-1} + e_t \quad (2)$$

Where, z, the error-correction term, is the Ordinary Least Squares (OLS) residuals series from the long-run cointegrating regression

$$Y_t = a_0 + a_1 X_t + a_2 X_{2t} + v_t \quad (3)$$

The ranges of summation in (2) are from 1 to p, o to q_1, and to q_2 respectively.
Finally, we investigated the second goal by using the following variance decomposition model, a vector auto-regressive (VAR)- a moving average representation.

$$y_{1,t} = \tilde{E}_{1\,1} V_{1,t} + \tilde{E}_{1\,2} V_{2,t} + \tilde{E}_{1\,3} V_{1,t-1} + \tilde{E}_{1\,4} V_{2,t-1} + \ldots \quad (4)$$

$$y_{2,t} = \tilde{E}_{2\,1} V_{1,t} + \tilde{E}_{2\,2} V_{2,t} + \tilde{E}_{2\,3} V_{1,t-1} + \tilde{E}_{2\,4} V_{2,t-1} + \ldots \quad (5)$$

Since the development of the lagged error terms is already known, the only uncertainty concerns the present error terms $v_{1,t}$ and $v_{2,t}$. The second goal is achieved by using MICROFIT software on the VAR system to find the short-term adjustment of the variables to equilibrium and to trace out the system's reaction to a shock (innovation) in one of the variables.

EMPIRICAL RESULTS

The descriptive statistics summarized and presented the essential information contained in the data on the drivers of tax-revenue and total tax revenue in the observed period. It showed that the mean of the dependent variable (total tax revenues) was the largest with C2.132 trillion and standard deviation of 2533 while the tax reform dummy with the mean of C1.715 trillion and standard deviation of 2684, was the most volatile in the series. The cocoa farmers' tax with a mean of C82.47 billion and the standard deviation of 93.37 was the least volatile in the series. Tables 2 and 3 exhibited the estimated correlation matrix for the drivers of Ghanaian tax revenues in the observed period. The mean, mode, and the median measured the central tendency of the variables. Again, Table 1 indicates that the distribution of the variables is not symmetric because the three measures have different values representing the distribution's center of each of the independent variables. Since the mean is the largest of all the three measures (mean, median, and mode), the distribution is positively skewed. If the means were to be the lowest among the three measures, the distribution would be deemed negatively skewed. According to Lind, Marchal, and Wathen (2011), the mean should not be used to represent the data if the distribution were highly skewed. In this study, the distribution is highly skewed because the means of the independent variables were largest of all the three measures. The most frequent component contributor to total revenue (in billions) measured by the mean of

the variables was PIPTAX (609.62), IMPTAX (596.10), DGSTAX (495.73), and CFTAX (82.47). In Table 1, IMPTAX had the highest standard deviation of 837.43 and CFTAX had the lowest standard deviation of 93.37. The PIPTAX and DGSTAX had 811.72 and 492.13 standard deviations respectively. The volatility test using EXCEL at 95% confidence level show that all the drivers of tax-revenues are volatile from the following tests: IMPTAX (837.42> 301.93, PIPTAX (811.72 > 292, DGSTAX 492 > 177.43, and 93.37 > 33.66, respectively. The principal and consistent discovery from this table is that cocoa farmers' tax (CFTAX) has the lowest volatility and import taxes (IMPTAX), has the highest volatility with all the series in the observed period.

Table 1: Descriptive Statistics on the Drivers of Tax-Revenues in Ghana 1980-2011

Statistics	PIPTAX	IMPTAX	CFTAX	DGSTAX
Mean	609.62	596.10	82.47	495.73
Standard error	143.49	148.04	16.51	87.00
Median	265.65	191.15	31.50	402.40
Mode	1.10	N/A	0.00	N/A
Standard Deviation	811.72	837.43	93.37	492.13
Coefficient of Var. (CV)	1.33	1.40	0.99	1.13
Sample variance	658,886.60	701,290.70	8,717.68	242,192.20
Kurtosis	1.95	1.29	0.31	-0.40
Skewness	1.60	1.54	1.15	0.69
Range	3,032.30	2,829.50	316.70	1,762.20
Minimum	0.70	0.30	0.00	1.00
Maximum	3,033.00	2,829.80	316.70	1,763.20
Sum	19,507.90	19,075.30	2,638.90	15,863.40
Observations	32	32	32	32
Confidence level (95%)	292.66**	301.93**	33.66**	177.43**

*Notes: PIPTAX stands for Personal Income Taxes, IMPTAX stands for import taxes, CFTAX stands for Cocoa farmers' taxes, DGSTAX stands for Domestic goods and services taxes. The sample size is 32. **One tailed Significance at the 5 percent level. Data sources from various issues of Ghana Statistical Services, Accra Ghana, ., the Government of Ghana Survey and the Government of Ghana Quarterly Digest of Statistics, Brown (1972) study, African Economic Research Consortium (AERC, 1998), Bank of Ghana (2003), and the World Bank (2003) to collect data. Tax Revenues are in billions of Ghanaian Cedis.*

Table 2 indicates that IMPTAX is highly correlated with PIPTAX (.9818), and DGSTAX is highly correlated with PIPTAX (.8577), IMPTAX (.8337), and CFTAX (.5892). The correlations of the independent variables with total tax revenues are arranged in ascending as CFTAX (0.5205), DGSTAX (0.9049), TRDUM (0.515), PIPTAX (0.9788), and IMPTAX (0.9863), respectively. Table 2 shows that the model has no multicollinearity problem because the drivers of tax-revenues are well-behaved.

Table 2: Pearson Correlation Matrix of the Total Tax Revenues and Drivers of Tax-Revenues in Ghana from 1980-2011

	TAXREV	PIPTAX	IMPTAX	CFTAX	DGSTAX	TRDUM
TAXREV	1.0000					
PIPTAX	0.9788***	1.0000				
	< 0.0001					
IMPTAX	0.9863***	0.9818***	1.0000			
	< 0.0001	< 0.0001				
CFTAX	0.5205**	0.3747**	0.4226**	1.0000		
	0.0023	0.0346	0.0160			
DGSTAX	0.9049***	0.8577***	0.8337***	0.5892***	1.0000	
	< 0.0001	< 0.0001	< 0.0001	< 0.0001		
TRDUM	0.9515***	0.9558***	0.9595***	0.3013*	0.8497***	1.0000
	< 0.0001	< 0.0001	< 0.0001	0.0938	< 0.0001	

*Notes: PIPTAX stands for Personal Income Taxes, IMPTAX stands for import taxes, CFTAX stands for Cocoa farmers' taxes, DGSTAX stands for Domestic goods and services taxes, TAXREV stands for total tax revenues, and TRDUM stands for Tax Dummy (1= tax reform policies after 2001, and 0= Otherwise). *** One tailed significance at the 1 percent level, ** One tailed significance at the 5 percent level, and * One tailed significance at the 10 percent level. There is absence of multicollinearity in the model, implying that the drivers of tax-revenues are well behaved and do not explain each other.*

Table 3 reports the results of the maximum likelihood procedure (not demonstrated in this study) for co-integration analysis proposed by Johansen (1988) and Johansen and Juselius (1990) to assess the degree of integration among the drivers of Ghanaian tax revenues. The Johansen procedure provides a general framework for estimating and testing the existence of multiple co-integrating vectors. The trace test assesses the null hypothesis that the number of co-integrating vectors is less than or equal to *r* as against a general alternative. The maximum eigenvalue test also examines the number of co-integrating vectors versus that number ± 1. Evidence of weak integration would imply that there is no long-run relationship between the drivers of tax revenues and tax revenues in the observed period. The opposite is true. The results in table 1 shows that we are able to reject the null hypothesis of no co-integration among the drivers of tax revenues at least 2 (when r =1) for both eigen values and trace tests when *VAR* is equal (***VAR =2)***. This implies that at least two of the drivers of tax revenues have long-run equilibrium relationships even when they deviate from each other in the short-run.

Table 3: Hypothesis Test Statistics

H_0	H_a	Eigen Value	5% Critical Value	10% Critical Value
r=0	r=1	45.3820[b]	22.1200	18.2450
r≤ 1	r≥ 2	18.4231	15.3478	12.3480
r≤ 2	r≥3	8.4658	11.4530	9.8960
	Conclusion	**R=2**		
H_0	H_A	Trace test	5% critical value	10% critical value
r=0	r≥ 1	74.1929[b]	39.5680	33.8390
r≤ 1	r≥ 2	22.1103	21.3560	19.2385
r≤ 2	r≥3	8.0772	11.8540	9.5456
	Conclusion	**r=2**		

*Notes: r=the number of cointegrating vectors in the model. [b]significant at the 5% level or more. The Johansen (1988) test is used to test the multivariate co-integration. Having r=2 means at least two of the drivers of tax revenues have long-run equilibrium relationships. Johansen's cointegration test for the **VAR=3.** Included in the series are TAXREV- PIPTAX, IMPTAX, CFTAX, DGSTAX and TAXDUM.*

Table 4 shows the results of the ARDL dynamics. The results of Panels A - C attempt to answer the first main purpose of this study (the short-run dynamics of the ARDL. In Panel A, the lags of the drivers of tax revenues (PIPTAX, IMPTAX, CFTAX, and DGSTAX) statistically explained the lags in the Ghanaian tax revenues at the 1% level of significance. However, the lags in the tax dummy (TRDUM) are not statistically significant in explaining the lags in the total tax revenues at the 10% level during the observed period. The coefficient of the error-correction model (ECMt-1) in: Panel A is found to be relatively small (-0.0985) and statistically significant at the 1% level. The numerical explanation is that about 10% of the disequilibria of the previous year's tax revenues adjust back to the long-run equilibrium in the current year.

In Panel B, we find that the lags in tax revenues (ΔTAXREV) are statistically and positively explained by the lags in personal income taxes at the 1% level of significance. However, the lags in cocoa farmers' income taxes (ΔCFTAX), and the lags in the tax reform dummy (ΔTRDUM) statistically and negatively explained the lags in the personal income taxes at the 1% and 5% levels of significance, respectively during the observed period. The coefficient of the error-correction model (ECM_{t-1}) in Panel B is found to be relatively small (-0.1680) and statistically insignificant even at the 10% level.

Table 4: Short-Run Autoregressive Distributed Lag Model Dynamics

Panel A: Lags in Ghanian Tax Revenues				
Regressor.	Coefficient	Standard error	T-Ratio	[Prob. of not.]
Δ $PIPTAX_2$	0.6283	0.1587	3.96***	[0.0005]
Δ$IMPTAX_1$	1.6933	0.1841	9.20***	[0.0001]
Δ$CFTAX_1$	2.6303	0.4052	6.49***	[0.0001]
Δ$DGS\ TAX_2$	0.8257	0.1269	6.51***	[0.0001]
Δ$TRDUM_1$	0.0531	0.0369	1.44	[0.1626]
Constant Δ	21.9338	28.0983	0.78	[0.4421]
Ecm (-1)	-0.0985	0.0450	-2.19**	[0.0132]
Panel B: Lags in Personal Income Taxes				
Δ $TAXREV_1$	0.5988	0.1512	3.96***	[0.0005]
Δ $IMPTAX_1$	-0.3988	0.3623	-1.10	[0.2811]
Δ $CFTAX_2$	-2.4395	0.4257	-5.73***	[0.0001]
Δ $DGSTAX_2$	-0.1984	0.1970	-1.01	[0.3231]
Δ $TRDUM_1$	-0.0727	0.0346	-2.10**	[0.0456]
Constant Δ	-4.8446	2.7739	-1.75*	[0.0578]
Ecm (-1)	-0.1680	0.1272	-1.32	[0.2280]
Panel C: Import Taxes				
Δ $TAXREV_1$	0.4518	0.0591	7.64***	[0.0001]
Δ $PIPTAX_2$	-0.1116	0.0511	-2.18**	[0.0145]
Δ $CFTAX_2$	-0.8218	0.2480	-3.31***	[0.0072]
Δ $DGSTAX_2$	-0.4765	0.0506	-9.42***	[0.0001]
Δ $TRDUM_1$	0.0089	0.0197	0.45	[0.6563]
Constant Δ	5.0803	2.2340	2.27**	[0.0187]
Ecm (-1)	-0.1243	0.0234	-5.31***	[0.0001]
Panel D: Lags in Coco Farmer Income Taxes				
Δ $Taxrev_1$	0.2351	0.0362	6.49***	[0.0001]
Δ $Piptax_2$	-0.2288	0.0399	-5.73***	[0.0001]
Δ $Imptax_1$	-0.2753	0.0999	-2.76**	[0.0105]
Δ $Dgstax_1$	-0.0992	0.0583	-1.70	[0.1009]
Δ $Trdum_2$	-0.0366	0.0089	-4.09***	[0.0003]
Constant Δ	-3.1526	1.0985	-2.87***	[0.0009]
Ecm (-1)	-0.8257	0.0815	-10.13***	[0.0001]
Panel E: Domestic Goods and Services Taxes				
Δ $Taxrev_1$	0.7504	0.1153	6.51***	[0.0001]
Δ $Piptax_2$	-0.1245	0.0520	-2.39**	[0.0235]
Δ $Imptax_2$	-0.8540	0.0765	-11.16***	[0.0001]
Δ $Cftax_2$	-1.0091	0.4932	-2.05**	[0.0165]
Δ $Trdum_1$	0.0333	0.0360	0.92	[0.3638]
Constant Δ	5.2556	3.0090	1.75*	[0.0578]
Ecm (-1)	-0.3380	0.1585	-2.13**	[0.0110]
Panel F: Lags in Tax Reform				
Δ $Taxrev_1$	1.3874	0.9853	1.41	[0.1616]
Δ $Piptax_2$	-1.9944	0.9500	-2.10**	[0.0256]
Δ $Imptax_2$	0.8707	1.9342	0.45	[0.6563]
Δ $Cftax_2$	-10.7019	2.4171	-4.43***	[0.0001]
Δ $Dgstax_1$	0.9568	1.0351	0.92	[0.3638]
Constant Δ	-137.3064	51.4560	-2.67**	[0.0108]
Ecm (-1)	-0.2568	0.0590	-4.35***	[0.0001]

*Panel A: Notes: Adjusted R^2 =0.99, Akaike information Criterion =-164.9256, Durbin-Watson =2.202. Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (2, 1, 1, 2, 1) was selected on the Akaike Information Criterion. Dependent variable was Δ in REVTAX-. Panel C: Notes: Adjusted R^2 =0.960, Akaike information Criterion =-76.8856, Durbin-Watson =2.216, Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (1, 2, 2, 1, 1) was selected on the Akaike Information Criterion. Dependent variable was Δ in IMPTAX. Panel B: Notes: Adjusted R^2 =0.98, Akaike information Criterion =-152.8856, Durbin-Watson =1.565. Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (1, 1, 2, 2, 1) was selected on the Akaike Information Criterion. Dependent variable was Δ in PIPTAX.. Panel D: Notes: Adjusted R^2 =0.89, Akaike information Criterion =-156.8856, Durbin-Watson =1.886. Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (1, 2, 1, 1, 2) was selected on the Akaike Information Criterion. Dependent variable was Δ in CFTAX. Panel E: Notes: Adjusted R^2 =0.96 Akaike information Criterion =-132.4437, Durbin-Watson =1.935. Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (1, 2, 2, 2, 1) was selected on the Akaike Information Criterion. Dependent variable was Δ in DGSTAX. Panel F: Notes: Adjusted R^2 =0.96Akaike information Criterion =-132.4437, Durbin-Watson =1.821. Error-correction representation for the selected autoregressive distributed lag (ARDL) model. The ARDL model (1, 1, 2, 2, 1) was selected on the Akaike Information Criterion. Dependent variable was Δ in TRDUM. In all panels *** indicates two tailed significance at the 1% level with critical value of ± 2.78. ** indicates two-tailed significance at the 5% level with critical value of ± 2.06, * indicates significance at the 10% level with two-tailed with critical value of ± 1.71.*

In Panel C, the lags in tax revenue (ΔTAXREV) statistically and positively explains import taxes at the 1% level of significance. However, the lags in cocoa farmers' income taxes (ΔCFTAX) and the lags in domestic

goods and services taxes (ΔDGSTAX) statistically and negatively explained the lags in import taxes at the 1% level of significance. The lags in personal income taxes (ΔPIPTAX) also statistically and negatively explain total revenues at the 5% level of significance. The coefficient of the error-correction model (ECM_{t-1}) in Panel C is found to be relatively small (-0.1245) and statistically significant at the 1% level. The numerical explanation is that 12.43% of the disequilibria of the previous year's import taxes adjust back to the long-run equilibrium in the current year. In Panel D, the lags in tax revenue (ΔTAXREV) statistically and positively explains the lags in cocoa farmers' income taxes at the 1% level of significance. However, the lags in personal income taxes (ΔPIPTAX) and tax reform dummy (ΔTRDUM) statistically and negatively explain the lags in cocoa farmers' income taxes at the 1% level of significance. The lags in import taxes (ΔIMPTAX) also statistically and negatively explain the lags in cocoa farmers' income at the 5% level of significance. The coefficient of the error-correction model (ECM_{t-1}) in Panel D is found to be relatively big (-0.8257) and statistically significant at the 1% level. Numerically, 83% of the disequilibria of cocoa farmers' income taxes in the previous year adjust back to the long-run equilibrium in the current year. In Panel E, the lags in tax revenue (ΔTAXREV) statistically and positively explains the lags in domestic goods and services taxes (ΔDGSTAX) at the 1% level of significance.

However, the lags in import taxes (ΔIMPTAX) statistically and negatively explain the lags in domestic goods and services taxes at the 1% level of significance. In addition, the lags in personal income taxes (ΔPIPTAX) and cocoa farmers' income taxes (ΔCFTAX) statistically and negatively explain the lags in domestic goods and services (ΔDGSTAX) at the 5% level of significance. The coefficient of the error-correction model (ECM_{t-1}) in Panel E, is found to be relatively big (-0.3380) and statistically significant at the 5% level. Numerically, 34% of the disequilibria of the previous year's domestic goods and services taxes adjust back to the long-run equilibrium in the current year. Finally, in Panel F, the lags in cocoa farmers' income taxes (ΔCFTAX) statistically and negatively explain the lags in tax reform dummy (ΔTRDUM). However, the lags in personal income taxes (ΔPIPTAX) statistically and negatively explain the lags in tax reform dummy (TRDUM). The coefficient of the error-correction model (ECM_{t-1}) in Panel F, is found to be relatively small (-0.2568) and statistically significant at the 1% level.

To further test for the second goal of our study variance decomposition of the drivers of tax revenues (a variant of the innovation accounting technique) is used together with the changing inter-temporal nature of these relationships. The VAR system of the drivers of tax revenues is shocked internally and externally and the forecast variance of each of the drivers of tax revenues is partitioned (Finn & Hodgson, 2005). Table 5 is read similarly to the variance-covariance matrix. By observing the main diagonal, we determine the extent to which each drivers of tax revenues is endogenously determined, because this represents how much of the drivers of tax revenues' own variance is explained by movements in its own shock over the forecast horizon (Amoateng & Deshkovski, 2011).

Conversely, the off-diagonals represent exogeneity from the point of view of the other drivers of tax revenues. In Table 5, with the order of VAR=4, we observe that the cocoa farmers' income taxes (CFTAX) are the most endogenous driver of tax revenues in the VAR system in the observed period. This driver explains its own variance after four years by 66% and with marginal exogenous influences of 12.11%, 8.86%, 5.16%, 4.39%, and 3.34% from TAXREV, TRDUM, PIPTAX, DGSTAX, and IMPTAX, respectively. We also observe that domestic goods and services taxes (DGSTAX) are the second most endogenous driver of tax revenues in the VAR system during the observed period. This driver explains its own variance after four years 43.45% and with marginal exogenous influences of 18.36%, 17.04%, 9.11%, 7.05%, and 4.99% from IMPTAX, TAXREV, CFTAX, PIPTAX, and TRDUM, respectively. Furthermore, we observe that the tax reform dummy (TRDUM) is the third most endogenous driver of tax revenues in the VAR system during the observed period. It explains its own variance after four years by 42% and with marginal exogenous influences of 21.80%, 17.09%, 9.63%, 5.86%, and 3.92% from CFTAX, PIPTAX, TAXREV, DGSTAX, and IMPTAX, respectively. The fourth; fifth; and sixth most endogenous drivers of

tax revenues are IMPTAX, PIPTAX, and TAXREV, respectively. The least endogenous variable in the VAR system is the tax revenues during the observed period.

Table 5: Shows the Variance Decomposition Analysis

Period in Years	TAXREV%	PIPTAX%	IMPTAX%	CFTAX%	DGSTAX%	TRDUM%
1	97.20	0.00	2.09	0.61	0.10	0.00
2	71.80	3.17	13.25	8.25	2.58	0.95
3	52.90	12.48	20.40	8.71	4.21	1.30
4	**30.40**[6]	16.11	29.33	13.94	6.89	3.33
1	6.60	86.49	1.78	3.78	1.15	0.20
2	10.17	70.30	4.93	9.04	4.16	1.40
3	18.05	55.17	6.65	12.15	5.68	2.30
4	28.48	**34.30**[5]	7.37	19.72	7.02	3.11
1	1.01	0.00	98.16	0.10	0.73	0.00
2	3.58	0.44	90.37	1.23	3.08	0.30
3	7.21	1.89	78.93	3.44	6.87	1.66
4	19.85	7.70	**36.57**[4]	11.08	14.71	10.09
1	1.33	0.77	0.45	96.35	0.15	0.95
2	5.88	2.14	1.02	85.19	1.09	4.68
3	9.34	4.80	3.11	70.86	3.98	7.91
4	12.11	5.16	3.34	**66.14**[1]	4.39	8.86
1	0.59	0.10	3.47	0.00	95.84	0.00
2	6.28	1.97	6.71	2.49	80.98	1.57
3	11.31	4.51	12.80	6.79	61.39	3.20
4	17.04	7.05	18.36	9.11	**43.45**[2]	4.99
1	0.61	1.19	0.00	1.96	0.20	96.04
2	1.84	3.35	0.39	5.14	1.16	88.12
3	4.00	12.87	1.60	16.80	3.33	61.40
4	9.63	17.09	3.92	21.80	5.86	**41.70**[3]

Notes: The columns and rows may not add to 100% because of rounding. Orthogonized forecast error variance decomposition analysis (unrestricted vector autoregressive model) order of VAR=4. Percent of forecast error variance of innovation in the ranking of the most dependent variables in the system aftershocks are shown in the upper case. The figures in bold tell us about each driver explains its own variance (both external and internal shocks) after 4 years.

CONCLUSIONS, DISCUSSION, LIMITATIONS, AND POLICY RECOMMENDATIONS

The principal and consistent discovery from this study is that cocoa farmers' tax (CFTAX) has the lowest volatility and import taxes (IMPTAX), has the highest volatility with all the series in the observed period. Increases in the volatility of the drivers of tax-revenue continue to bring about heightened discrepancies in the government revenues and spending, leading to chronic budget deficits in Ghana and many transitional economies. Policy makers should design tax collection processes that are eliable and effective. Cocoa farmers' tax (CFTAX) designed by Cocoa Marketing Board (COBOD) is reliable and effective because of enforcement and compliance. The estimated cointegrating relationships identify at least two long-run vectors for the drivers of tax revenues. The implication of this finding is that at least two of the drivers of tax revenues are expected to come back to long-run equilibrium relationships after short-term disturbances in the observed period. We consistently find that the lags in tax revenues positively and significantly explain the lags in the drivers of tax revenues, with the exception of the lags in the tax reform dummy. Also, we find that cocoa farmers' income taxes are the quickest drivers of tax revenues to adjust to long-run equilibrium in the current year. Cocoa farmers' income taxes continue to remain the largest contributor and most reliable source of tax revenues in Ghana (Ocansey, 2010; Asare, 1987). Import taxes are slowest drivers of tax revenues to adjust to long-run equilibrium in the current year because the collection process is riddled with loopholes, bribery and corruption**.**

Interestingly, the tax reform dummy is fairly quick to adjust to long-run equilibrium in the current year after short-run disturbances. Tax reforms in the form of technological innovations to enhance tax collection processes, public disclosure and accountability of personal taxes, and measures to reduce bribery and corruption are increasing over time but key drivers of tax-revenues such as import tax (IMPTAX), personal

income tax (PIPTAX) and domestic good and services tax (DGSTAX) are not designed to enforcement and compliance measures. The forecast error variance decompositions reveal that cocoa farmers' income taxes are the strongest endogenous variable in the VAR system exogenous driver of tax revenues, and play a dominant role in Ghanaian tax revenues during the observed period. The dominance of cocoa farmers' income taxes in total Ghanaian tax revenues in the long-run relationships is supported using weak exogeneity tests, which indicate that cocoa farmers' income taxes do not adjust to long-run disequilibrium. In contrast, personal income taxes are weakly exogenous and adjust back to long-run disequilibrium.

The limitation of this study is the data used. Data collected on taxes prior to 1994 to the present might contain errors because they were manually collected. From 1994 to the present, records keeping and reporting on taxes has been more accurate because of the increased use of new technologies/computers to collect and analyze data. We could not find reliable data from 2012 to 2015 because of the slow data recording process. The heavy reliance on cocoa farmers' income taxes, which are in steady decline, will require the government to diversify its tax base to generate enough tax revenues to cover growing government expenditures. However, the large underground economy, which is riddled with non-compliance, with tax collection, reduces tax revenues, causes the tax equity problems, and threatens the legitimacy of the entire tax system. Since tax revenue increase option has become elusive to policymakers, the hardline option is to gradually eliminate government expenditures in the areas of colonial delicacies such as free fuel, chauffeurs for government officials (ministers and members of parliament etc), excessive per diems from the president to other government officials and many more, just to mention but few. Another important limitation of our study is that there must be qualitative research approach that uses surveys to find from the ever growing informal sector why citizens under report their true incomes and what are the enforcement and compliance mechanisms in place to make citizens pay their fair share of the tax burden.

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