CENTRAL BANK of BELIZE

Tipping Point: The Efficiency and Sufficiency of the Tax Structure in Belize

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Authors' Note

This paper was presented at the Research Review Seminar in Trinidad and Tobago in June 2018 and at the 50th Annual Monetary Studies Conference in Barbados in November 2018.

The views expressed are those of the authors and do not reflect those of the Central Bank of Belize.

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Abstract

Belize has struggled with budget deficits in its attempt to boost growth by balancing spending on the provision of goods and services for a growing population, development projects, and debt servicing. The resulting financing pressures have been matched by short-term revenue mobilization goals without adequately assessing the long-term collection capacity of the tax system. Therefore, assessing the performance of the tax system in Belize, particularly its mobilization capacity, is of critical interest.

This paper examines the fiscal revenue performance by ascertaining the efficiency and sufficiency of the prevailing tax system, using buoyancy, elasticity, and tax capacity/effort indicators. Quarterly data from 2000-2017 are used to estimate buoyancy and elasticity of tax revenues, using the Dynamic Ordinary Least Square (DOLS) for the buoyancy coefficients and the Divisia Index approach (DI) for the elasticity measure. Empirical findings from Pooled and Fixed Effects OLS models are used to determine the optimal tax capacity/effort from a panel dataset on tax revenue for 60 developing countries over four decades (1977-2016). Countries are further divided into four classifications to determine if optimal levels differ based on income group. The level of responsiveness of tax revenue to GDP and institutional factors coming out of this study will be beneficial for tax planning and fiscal projections in the present Belizean context.

1. Introduction

Taxation is the largest source of revenue for most governments in developing countries. Belize is no exception. Therefore, ensuring the efficiency of the current tax structure and its ability to optimally raise and collect taxes are strategically important for economic development (Ricciuti et al., 2016). Obtaining the desired amount of tax revenues by maximizing the tax capacity of a country is essential, given the need to provide goods and services, such as adequate healthcare, education and infrastructure, to the general public. However, governments must ensure that raising revenues for growth-enhancing expenditure programs and debt obligations do not stifle economic growth or increase income inequality. Unfortunately, the political emphasis has leaned towards meeting short-term expenditure and revenue goals rather than long-term developmental needs and the collection of sufficient revenue in a sustainable and balanced manner. The World Bank has proposed a long-term solution to increase the efficiency and effectiveness of a tax system using a three-prong approach based on maximizing a country's tax capacity, instituting a sound and balanced tax system, and incorporating tools and techniques to improve revenue analysis and forecasting (Le et al., 2016). It is therefore important to assess the performance of Belize's revenue systems and tax capacity/effort by using key analytical tools, performance measures and benchmarks.

This study seeks to fill this knowledge gap by estimating buoyancy and elasticity measures to gauge the efficiency of tax revenues and by calculating Belize's tax capacity and tax effort to ascertain the sufficiency of the tax system. The analysis and findings of this study will provide a starting point to address such questions as:

- Does Belize's revenue move in line with output and therefore support fiscal sustainability?
- Is more effort required to keep tax mobilization in line with economic growth?
- Has Belize reached its tipping point—can we increase our overall tax revenue by implementing new taxes or raising current tax rates—or have we reached our tax capacity?

Over recent years, there have been multiple technical consultations conducted on Belize's tax system and its main revenue earners. The main thrust of these studies was to determine the strengths and weaknesses of the tax system in order to identify areas for improvement, devise practical solutions to reform the existing tax system and address the problem areas unique to each tax category (see Cambridge Resource International Inc., 2015; 2016).

Section 2 of this paper provides an overview of Belize's tax structure, its historical performance on the major categories that generate the majority of tax collections, as well as definitions of keys concepts used. Section 3 summarizes alternative methodologies and describes the techniques used to estimate tax buoyancy and elasticity measures, along with tax capacity and effort. Section 4 presents and discusses results of this study, and Section 5 concludes the paper.

2. Overview

2.1 Trends in Taxation

Table 1: Tax Revenue and Expenditure Ratios - Belize

Year	TR/GDP	GE/GDP	TR/GE	Year	TR/GDP	GE/GDP	TR/GE
1998	18.8	25.7	73.4	**2008**	22.5	27.7	81.2
1999	17.5	29.4	59.5	**2009**	21.6	29.0	74.4
2000	17.2	32.6	52.9	**2010**	23.1	29.2	79.1
2001	18.6	33.8	55.1	**2011**	22.4	28.2	79.4
2002	19.3	31.8	60.7	**2012**	22.1	28.7	76.9
2003	19.0	31.7	60.1	**2013**	23.2	28.6	81.2
2004	19.3	30.6	63.1	**2014**	23.4	32.3	72.7
2005	20.5	30.7	66.9	**2015**	24.8	36.5	67.9
2006	21.1	26.6	79.3	**2016**	25.1	31.8	78.9
2007	22.4	30.9	72.7	**2017**	25.4	31.4	80.9

Source: Central Bank of Belize and Ministry of Finance

TR/GDP: ratio of tax revenue to GDP

GE/GDP: ratio of expenditure to GDP

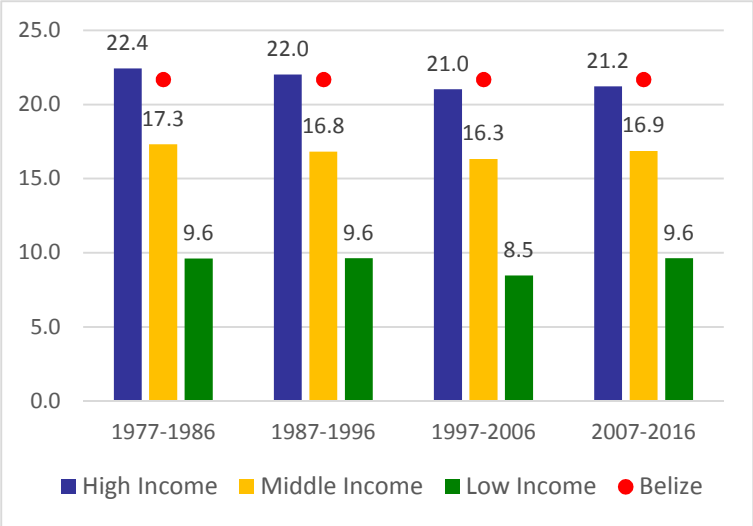
TR/GE: ratio of tax revenue to expenditure

Belize has undertaken several tax reforms aimed at increasing the efficiency and transparency of tax collection, creating incentives for private investment, broadening the tax base and ensuring equitable taxation (Appendix 1). On average, the tax system has contributed 80.0% of the Government's fiscal revenues over the last 20 years. Furthermore, the share of tax revenue as a percentage of GDP, the simplest indicator of tax effort in literature, increased from 18.8% in 1998 to 25.4% in 2017. In terms of revenue collection, Belize is well above the average of our middle-income peer group[1] (Figures 1 and 2). However, expenditure as a percentage of GDP has

[1] 16.7% average for middle income group compared to an average of 21.7% revenue to GDP for Belize during 1998 -2017.

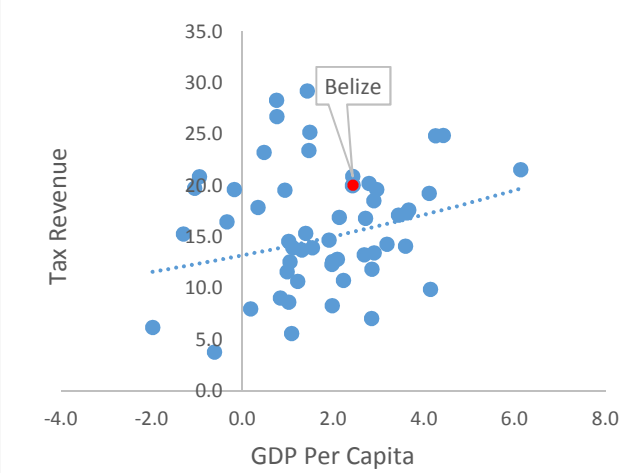
persistently outstripped revenues, showing the deviation between what the country has actually collected against what the country desires to collect (Cyan et al., 2013). Although the tax to expenditure ratio has significantly improved from 1998, the financing gap remains material (Table 1).

Figure 1: Tax Revenue (as % of GDP) by Income Groups



Source: Authors' Calculations

Figure 2: Tax Revenue (as % of GDP) and Income Levels



Source: Authors' Calculations

2.2 Tax Structure

The tax structure in Belize is broadly comprised of direct and indirect taxes and has consistently yielded revenues in the range of 21.0% to 25.0% of GDP in the last decade. Of this, around 70.0% was raised through indirect taxes and 30.0% came from direct taxes. At present, the main revenue-raising taxes are Personal Income Tax (PAYE), Business Tax, General Sales Tax (GST), and Import Duty. Over the last five years, these taxes accounted for 76.1% of total tax revenue with PAYE, import duty, business tax and GST accounting for 9.2%, 17.1%, 18.6% and 31.3%, respectively. The aforementioned tax categories will be elaborated on further in the study and used to calculate tax buoyancy and elasticity for Belize.

Table 2: Tax Contribution to GDP

	2000	2002	2004	2006	2008	2010	2012	2014	2016	2017
Personal Income Tax (PAYE)	1.0	1.2	1.4	1.5	1.8	1.8	1.6	2.1	2.4	2.5
Import Duty	3.7	4.0	3.5	3.4	3.8	4.5	4.7	4.2	3.9	2.7
Sales Tax/GST	5.2	4.6	5.3	6.1	6.8	6.6	6.4	7.5	7.9	7.7
Business Tax	3.0	2.7	3.0	3.9	4.0	4.7	4.3	4.5	4.4	4.4

2.2(i) Personal Income Tax

Personal Income Tax in Belize is levied according to the new Income and Business Tax Act of 1998 and is essentially a pay-as-you-earn (PAYE) system designed to be progressive. The personal income tax levied on formal sector employees is the most stable revenue earner, despite the legislative change in 1998 that modified the income threshold (refer to Appendix 1). Prior to 1998, the Income Tax legislation of 1924 taxed individual income at a graduated marginal rate ranging from 15.0% to 45.0% and a number of deductions were available. In an effort to make the tax simple to administrate and equitable, the new Income and Business Tax Act 1998 replaced the graduated rate structure with a flat rate and an income threshold. As a result, all individual income in excess of $20,000 per year is taxed at a rate of 25.0%. The annual threshold of $20,000 was set to exempt the poor. From 2014 to 2017, PAYE's contribution to total tax revenues increased to 9.3% from the average of 7.4% recorded between 2002 and 2013. The ensuing growth was underpinned by the cumulative 17.0% negotiated wage increase to public servants, which resulted in more persons falling within the taxable bracket. PAYE's contribution to GDP has ranged from 1.0% to 2.5% (Table 2).

2.2(ii) Business Tax

Most countries charge corporate tax on the profit of businesses and companies; Belize upheld this practice until 1998 when the corporate tax was abolished, as most businesses were filing losses and not paying taxes as a result. All businesses in Belize are now taxed on gross receipts rather than profits, leading to a compliance rate of more than 90.0% according to the Income Tax Department, as of 2014. The main attraction of this tax is its ease of administration and minimal compliance costs, despite the different rates applied to different types of businesses (from 0.75% to 25.0%). Similar to the Personal Income Tax, there are basic exemptions for Business Tax in order to avoid unfair taxation on the employed or self-employed. In the case of Trade and Business Taxes, a threshold was initially set at $54,000 per year and $20,000 per year for professional or vocational activities. In 2005, the trade and business threshold was increased to $75,000 with an aim to make it more equitable in application and to strengthen revenue collection. Interest received from Treasury bills, debentures, and bonds issued by or under the authority of the Government of Belize, Export Processing Zone (EPZ) sales, winnings from lottery

less than $1,500 and rental receipts of less than $800 per month are all exempt from the payment of Business Tax.

Total collection of Business Tax has steadily increased with its contribution to GDP ranging from 2.7% in 2002 to 4.4% in 2017. In 2017, this tax accounted for 17.9% of total tax revenues, making it the second highest contributor in financing government expenditure.

2.2(iii) General Sales Tax

Taxes on the consumption of goods and services has transitioned from a broad-based Value Added Tax (VAT) to a less broad-based Sales Tax and, currently, to a General Sales Tax (GST). In 1996, the Government introduced the VAT at a rate of 15.0%, while reducing the custom duties on goods imported from the Caribbean countries. This tax was a broad-based consumption tax. The VAT was abolished in the 1999 reforms and replaced with a single-stage Sales Tax at a rate of 12.0% levied on beverages, tobacco products and fuel, and 8.0% on all other goods and services. The Sales Tax was applied to goods produced in Belize for domestic consumption and on the provision of services as well as imported goods and a variety of goods that were previously exempted under the VAT. In 2004 and 2005[2], the rates were revised and the list of goods subject to the tax was expanded. In 2005, as part of a reform initiative to enhance the simplicity, equity and collection of taxes and to mitigate any negative impact on the productive sector, the Sales Tax was replaced with a consumption-type value-added tax called the General Sales Tax at a rate of 10.0%; which was increased to 12.5% in 2010. At the same time, two minor taxes[3] were also repealed.

The GST was designed to bring greater buoyancy to the tax revenue and to eliminate the negative effects of cascading. Thus, it is collected at the point of importation and on business transactions when goods change hands or when services are performed. It contains many of the features of the VAT, including an in-put/out-put tax mechanism and an invoicing mechanism. The GST carries the 12.5% uniform rate on taxable items, while a number of goods and services are zero-rated[4] (0.0%). In addition, certain supplies and imports are exempted[5] from taxation. Since its inception, its coverage has been modified, including the widening of the list of zero-rated items.

[2] In 2004, the rates were increased by one percentage point each with the exception of telecommunication goods and services that remained at 8.0%; and in 2005, the 13.0% rate was further increased to 14.0% (IDB, 2016).
[3] Entertainment tax and a stamp duty on receipts
[4] GST is charged at a zero rate throughout the production and distribution chain; therefore, the price to the final consumer will contain no element of GST. However, the input taxes are recoverable. A list of zero-rated supplies are found in the GST Act.
[5] No GST is charged at the retail stage. Instead, taxes are collected in the early stage of the production and distribution chain, which is included in the price of the goods/services to consumers. Persons with exempt inputs

During the life of the Sales Tax (1999-2005), its contribution to GDP averaged 5.1% and accounted for 26.8% of total tax revenues. After 2005, with the introduction of the GST, collections rose to 6.1% of GDP and has steadily increased, peaking at 7.9% of GDP by 2016 (see Table 2). Compared to the Sales Tax, the GST accounts for 29.7% of total tax revenues. Although the Sales Tax was less effective than the GST in terms of revenue collection, they are both considered, in their own time period, the main source of revenue to the Government of Belize.

2.2(iv) Import Duty

Import Duty is calculated under the Custom and Excise Act and covers goods entering Belize[6]. The current tariffs in Belize are based on the Harmonized Commodity Description and Coding System developed and maintained by the World Customs Organization (IDB, 2016) and on CARICOM's Common External Tariff. Import duty is calculated on Cost, Insurance and Freight (CIF), and rates range from 0.0% to 100.0%, with the majority of commodities subject to a rate of 20.0%. The amount charged is based on the transaction value, which is derived from the value stated on the invoice, receipt or proof of purchase. Similar to other taxes, the Import Duty Act was often amended[7] to stimulate foreign and domestic investments. In 2016, to be consistent with the World Trade Organization (WTO) requirements, the tax base was amended. This implied the removal of import duties and revenue replacement duties (RRD) from imported goods. However, to compensate for the loss of this revenue stream, the Government of Belize expanded the coverage of other taxes (mainly the GST and Excise Duty). This measure reduced the revenues collected from this important source, as its share to total tax revenue fell from 22.4% in 2015 to 10.7% in 2017. As a direct consequence, its contribution to GDP fell 4.1% (on average) up to 2015 to 2.7% by the end of 2017 (see Table 2).

In general, as can be seen in Table 2, revenues from GST accounted for the highest percentage contribution to GDP, followed by revenues from the Business Tax. Import duty remained a very important source of tax revenue until 2016 when the Government amended the tax base to be consistent with the requirements of the WTO. Meanwhile, the contribution of Personal Income Tax increased throughout the period.

cannot register for GST or reclaim any input taxes related to those inputs. A list of exempted supplies are found in the GST Act.

[6] Not all goods imported into Belize are classified as chargeable goods. Imports by Non-Governmental organizations, governmental institutions, embassies and donations for religious organizations are free from duty. The Minister may exempt any person from the payment of the whole or any portion of the duties.

[7] Refer to Appendix 1 for the list of amendments.

2.3 Tax Buoyancy and Tax Elasticity

The primary purpose of the tax system is to raise the revenue needed by government to provide public goods and services to the populace. Therefore, the development of an effective and efficient tax collecting system to optimally raise this revenue is important for the development of the economy. Tax buoyancy and tax elasticity are two important measures to assess the efficiency of a country's tax system. Equally, the tax capacity and effort is an apt and enduring indicator of the sufficiency of government revenues. Tax capacity (i.e. predicated taxes) represents the maximum tax revenue that a country can collect, given its economic, social, institutional, and demographic characteristics; whereas, tax effort is the relation between the actual revenue and tax capacity.

Leuthold and N'Guessan (1986) state that tax buoyancy is an estimate of the responsiveness of tax receipts to economic growth. This crude measure reflects both discretionary changes and automatic revenue growth but does not distinguish between the two. Mansfield (1972) defines tax buoyancy as the total response of tax revenue to changes in income. A tax is buoyant if one percent increase in national income increases revenues by one percent or more. According to Koatsa and NChake (n.d.), a buoyancy value greater than one implies that the discretionary changes are improving tax collections, while a buoyancy value less than one implies that discretionary changes are ineffective. One important aspect of tax buoyancy is that it varies from year to year; therefore, it is advisable to measure buoyancy over a period of at least five years.

According to Mansfield (1972), tax elasticity measures the automatic response of revenue to income changes exclusive of the effects of discretionary changes. In other words, it calculates what the revenue would have been if there were no changes in the tax law, tax rates or tax base (Haughton, 1998). Since elasticity controls for automatic revenue changes, according to Leuthold and N'Guessan (1986), it is considered the preferred method over buoyancy to measure tax responsiveness. However, it is not easy to estimate the effect of the discretionary change in tax policy.

An elasticity coefficient of one indicates that both revenue and income have a similar growth; a coefficient of more than one indicates that the tax revenue growth exceeds income growth; a coefficient of less than one shows that the income growth exceeds tax revenue growth. Mansfield (1972) highlights that a high elasticity is ideal, especially for developing countries, since it allows the government to finance development expenditure without the need for politically difficult decisions to increase tax rates that may be socially harmful to the masses. Indraratna (1991) adds that the benefit of an elastic tax system (a coefficient greater than one) is the provision of resources for government consumption and capital formation. He defines tax elasticity as the built-in response of revenue to changes in income, assuming an unchanged tax structure.

2.4 Tax Capacity and Tax Effort

Actual tax revenues as a share of GDP is one of the most commonly used measures of tax effort. Le, Moreno-Dodson and Bayraktar (2012) refer to tax capacity as the predicted tax-to-GDP ratio that can be estimated empirically. They stress the importance of considering the country's specific socio-economic factors to obtain a more accurate measure of tax capacity. Meanwhile, tax effort is an index of the ratio between the share of the actual tax collection in GDP and taxable capacity. In other words, tax effort is an index of how effectively a country collects taxes using its available tax instruments relative to the expected or forecasted tax collection. A country can have a high tax effort index (above one) when it efficiently utilizes the tax base to increase tax revenues, and a low tax effort when it still has a potential to raise revenue.

Trotman-Dickenson (1996) defines tax capacity of a country as the proportion of the national income that is above the subsistence level. That is, tax capacity is determined as a certain percentage of national income that can be absorbed in taxation without producing harmful effects on the economy. The first step in assessing the taxable capacity is to determine the subsistence level, as it represents a country's minimum income required to sustain its population and maintain intact the productive capacity of the economy. According to Bird and Martinez-Vazquez (2004), tax effort is simply the tax revenue as a percentage of GDP.

3. Methodology

3.1 Methodological Framework

The methodological framework employed in this study is an econometric approach, particularly the Ordinary Least Square (OLS) analysis. Dynamic OLS (DOLS) is used to calculate buoyancy estimates, and the Divisia Index approach is used to adjust the buoyancy estimates in order to obtain the elasticity measures. Both approaches utilize time series data for Belize over an 18-year time span. A Pooled OLS model is used as the starting point for calculating tax capacity; then, the Hausman Test is applied to determine the most appropriate model for the panel data analysis. Once the appropriate model has been selected for the overall sample, the estimation technique is applied to statistics for Belize. The initial choice of panel data was driven by econometric efficiency and the ease of uncovering dynamic relationships (Hausman and Taylor, 1981). A practical issue when using panel data is to determine if a Random or Fixed Effects model should be used. Each model is advantageous in its own way. The Random Effects model takes into

consideration unsystematic deviations across entities thought to be uncorrelated with other components of the model, while the Fixed Effects model would control for omitted variables correlated with explanatory variables in the model (Woolridge, 2013). For this study, a Fixed Effects model was preferred since it has the power to reduce specification errors, such as omitted variable bias and collinearity, by controlling for the unobserved time invariant heterogeneity with country-level data (Hsiao, 2006).

3.2 Tax Buoyancy and Tax Elasticity

3.2(i) Alternative Methodologies

Several methods are utilized in literature to measure buoyancy and elasticity. The preferred method used to remove the discretionary changes is the Proportionate Adjustment method, since it does not require disaggregated data on tax, but instead it requires the use of budget estimates of tax yield arising out of discretionary changes (Sen, n.d.). This method adjusts a historical tax data time series to a particular year's tax structure on the assumption that the particular tax structure is maintained throughout the period under consideration (Indraratna, 2003). The second method is the Constant Rate Structure method. Although considered the most accurate, this method is rarely used for analytical purposes as the procedure is extremely cumbersome, and relies heavily on the availability of disaggregated data on the effective tax rates, as well as on the changing composition of the tax bases (Sen, n.d.; Bilquees, 2004; Choudhry, 1979). The Dummy Variable captures the discretionary changes in the tax rate as well as the tax structure; however, it is not recommended when discretionary changes have been made frequently in the past as it reduces the degrees of freedom and the efficiency of the regression estimates (Sen, n.d.). Lastly, the Divisia Index approach (the methodology employed in this study) is not demanding in terms of data requirements since it relies mainly on actual tax collection and tax base measures at aggregate levels. Choudhry (1979) discusses this approach: First, a formula is derived that generates an index representing the revenue impact of discretionary tax measures (DTMs). Secondly, the growth rate of this index is divided by the tax base (this measures the growth rate of tax revenue resulting from DTMs in terms of one percent increase in the tax base). Finally, the tax elasticity is calculated by subtracting this ratio from the tax buoyancy. A number of authors have employed this methodology (Table 3).

Table 3: Tax Buoyancy and Tax Elasticity Empirical Studies

Study/Country Selection	Model	Key findings	Strengths/weaknesses
Twerefou et al. Ghana, 1970-2007	Dummy Variable Approach and Ordinary Least Square (OLS)	The overall tax system was buoyant and elastic in the long-run, with buoyancy exceeding the elasticity. In the short-run, it was the reverse. The buoyancy coefficient of the tax-to-base was greater than the base-to-income buoyancy coefficient, indicating that there is potential revenue in the economy which is untaxed.	No precise definition of the tax bases, which was a limitation to the tax data set.
Gillani (1986) Pakistan, 1971-1983	Divisia Index and the Proportional Adjustment Methods	The built-in elasticity of the Pakistan's tax system was greater than unity and higher than buoyancy. The role of discretionary changes was not very substantial in raising additional revenue.	Excessive dependence on unstable sources of revenue.
Hamlet (2013) Dominica, St. Lucia and Antigua and Barbuda, 1980-2010	Divisia Index Method and DOLS	Dominica, Antigua and Barbuda, and St. Lucia possess buoyant but inelastic tax revenue structure. They rely heavily on discretionary policy for effective tax revenue generation.	Reforms conducted within these countries were very effective. Small tax base.
Wolswijk (2007) Netherlands, 1970-2005		Short-term elasticities are often lower than long-term ones when taxes are subdued.	
Milwood (2011) Jamaica, 1998-2010	Divisia Index Approach	Growth in total revenue over the period was through the use of discretionary measures. However, elasticity was less than unity	
Hug (2012) Bangladesh, 1980-2011	Econometric Technique	Overall tax elasticity is very low. Most of the growth in revenue has been achieved through discretionary changes instead of automatic growth.	Tax evasion is high.

Source: Authors' Compilation

3.2(ii) Data and Description of Variables

For the calculation of tax buoyancy and elasticity, this paper focuses on four revenue categories—PAYE, import duties, Business Tax and General Sales Tax, including total revenue. Quarterly time-series data—2000q1 to 2017q4—for the selected taxes were used, along with data on their respective bases—GDP, non-agriculture GDP and imports for Belize. Data on GDP, imports and consumption expenditure were sourced from the Statistical Institute of Belize, while taxation

information was obtained from the Ministry of Finance and the Central Bank of Belize. The main categories of taxes along with their relevant bases are presented in Table 4.

Table 4: Tax Categories and Corresponding Proxy Tax Base

Total Revenue	GDP at market prices
Direct Taxes	GDP at market prices
Indirect Taxes	GDP at market prices
Import Duties	Imports
Business Tax	GDP at basic prices
General Sales Tax	Non-agriculture GDP, Imports
PAYE	Non-agriculture GDP

3.2(iii) Model Specification

Buoyancy Estimation

To estimate both the short-run (instantaneous) and long-run (equilibrium) buoyancy and elasticities of tax revenue with respect to the corresponding tax base, the time series data in log form were tested for unit roots using the Augmented Dickey-Fuller test (ADF). The results signal that all variables were of order one I(1) (Appendix 2). Since the levels of tax revenue and their respective bases were not stationary, using the standard approach to estimate the long-run tax elasticities in levels would result in biased estimates and inconsistent standard errors. The DOLS corrects this coefficient bias and provides an adjustment for possible autocorrelation and endogeneity issues by adding q leads and q lags of the first difference of the independent variables (Stock and Watson, 1993). Wolswijk (2013) for Netherlands, Sobel and Holcombe (1996) for the United States, Hamlet (2013) for ECCB and Milwood (2011) for Jamaica used this method to obtain tax buoyancy and elasticity coefficients. Furthermore, the Newey-West correction (Newey and West, 1987) was applied to reduce inconsistency of the standard error estimates. The long-run equilibrium can be expressed by the log level relation between revenues ($rev_{t,i}$) and their respective base in log levels ($base_{t,i}$) with the leads and lags in the change of the log tax bases (γliΔlnbasei t+l) controlling for a constant (α). The corresponding elasticity measures the revenue response to a 1.0% change in the respective tax base.

$$ln\ (\text{rev}_{i,t}) = \alpha + \beta ln(base_{i,t}) + \sum \gamma li \Delta \ln base_{\ i,t} + l\ + \varepsilon_t$$

After assessing the long-term relationship, residuals from the long-term equations were tested for stationarity. Results confirm the existence of co-integrating relationships (Appendix 2). Next, the short-run elasticities and the speed of adjustment parameters were estimated for each tax instrument by means of an error correction model, which is the lagged value of the estimated

residuals from the long-run equation. The adequacy of the model was tested with diagnostic checks, while evidence of serial correlation or heteroscedasticity was taken as a sign of "persistence" of tax growth rate and an additional lagged dependent or independent variable was added. In the final estimation, obsolete lags were eliminated to obtain a more precise model. The coefficient obtained on the error correction model will reveal the distance in percentage between the actual and equilibrium value that is closed each quarter. The final specification of our short-run regression reads:

$$\Delta ln(rev_{t,i}) = \alpha + \theta \Delta ln(base_{t,i}) + \phi et\text{-}1 + \varepsilon_t$$

where et-1 is the lagged residual from the estimation of equation (1). Thus, the dynamics of tax revenue is determined by the short-run elasticity (θ) and the error correction term (ϕ).

Elasticity Estimation

There are four main methods of estimating elasticity of tax revenue: i) Constant Rate Structure method, ii) Dummy Variable method, iii) Proportional Adjustment method and iv) the Divisia Index method. The many tax reforms over the years eliminate the use of the Dummy Variable method. Both the Constant Rate and the Proportional Adjustment methods share the drawback of being too data intensive—the former needing detailed data on effective tax rates and changing tax bases, and the latter requiring information on the revenue impact of discretionary tax changes and the frequency of these changes. As mentioned before, this study will use the Divisia Index to estimate elasticity coefficients as developed by Choudhry (1979). It is an ideal method when facing data constraints, as the method requires only historical data, and no information is needed on the tax yields resulting from discretionary changes in the budget year. Despite its theoretical and intuitive appeal, the Divisia Index tends to overestimate (underestimate) the positive (negative) revenue effects of tax measures, as well as produce unsatisfactory results in the case of overly large revenue effects (Choudhry, 1979).

The premise of using the Divisia Index to map discretionary tax changes stemmed from the shared characteristics between the effect of technical change on total productivity and the effect of discretionary tax measures on the tax yield. The relationship between factor inputs and output depicted in the production function is similarly mirrored in the relationship between tax yield and the tax base, which can be captured in an aggregate tax function. Just as changes in inputs lead to movements along the production function, and productivity changes lead to shifts in the function, changes in tax bases bring movement along the tax yield curve and discretionary measures lead to shifts over and above those caused by the automatic growth in the bases. If there are no discretionary measures, the tax function remains unaltered. It is this invariance

property of the Divisia Index, contingent on the existence of a continuously differentiable aggregate tax function, which gives this approach its validity and appeal.

Following Choudhry, tax elasticity can be estimated by writing tax revenue (T) as a homogenous function of GDP (x)

$T = \alpha x^{u}$ … … …. … … … … … … … (1)

where T is the tax revenue, x is a proxy base and μ represents the coefficient for buoyancy.

As x rises over time, the tax ratio (T/x) remains constant or rises as the value of u equals or surpasses unity. Using the continuously differentiable aggregate tax function at each point in time, equation (1) can be rewritten as:

$T(t) = f[xi(t), ...xk(t); t]$ … …. … … … … … … … (2)

where T is the aggregate tax yield, x is proxy base for k categories and t represents the time variable proxy for discretionary tax measures.

Taking the logarithmic of the tax function and differentiating with respect to time yields, the effect of discretionary tax change at time (t) seen in equation (3).

$$\frac{f_t(t)}{f(t)} = \frac{\dot{T}}{\mathrm{T(t)}} - \sum_{1}^{k} \frac{f_i(t)x_i(t)}{f(t)} \frac{\dot{x}_i(t)}{x_i(t)}$$

… … … … (3)

Setting:

$$\frac{f_t(t)}{f(t)} = \frac{\dot{D}(t)}{D(t)} \quad \text{and} \quad \frac{f_i(t)x_i(t)}{f(t)} = \beta_i(t)$$

where D(t) = Divisia Index of discretionary tax changes, equation (3) can be rewritten as:

$$\frac{\dot{D}(t)}{\dot{D}(t)} = \frac{\dot{T}(t)}{T(t)} - \sum_{1}^{k} \beta_i(t) \frac{\dot{x}_i(t)}{x_i(t)}$$

… … … … (4)

Integrating equation (4) over the time interval (0,n) we get the index of discretionary tax revenue:

$$\frac{D(n)}{D(0)} = \left[\frac{\mathrm{T(n)}}{\mathrm{T(0)}}\right] exp\left(-\sum_{1}^{k}\int_{0}^{n}\beta_i(t)\frac{\dot{x}_i}{x_i(t)}dt\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots (5)$$

Normalizing equation (5) by setting D(0) =1, D(n) becomes the index of revenue growth due to discretionary tax measures at time (n). The fluctuating B_i(t) is replaced by a constant $\hat{B}_i$(t), which is a form of the weighted average of $\hat{B}_i$(t), where the weights are the ratios of the instantaneous rates of growth of the bases to their average rates of growth in time interval (0,n) (Choudhry, 1979). Taking the logarithm:

.

$$log\ D(n) = log\left(\frac{T(n)}{T(0)}\right) - \sum_{1}^{k}\tilde{\beta}_i\ \log\left(\frac{x_{i(n)}}{x_i(0)}\right) \quad \ldots \quad \ldots \quad \ldots \quad \ldots (6)$$

Log D(n) is the index of discretionary tax measures which is adjusted by the following formula to obtain elasticity estimates.

$$\hat{\mathrm{r}} = \mu - \frac{\log D(n)}{\log\left[{}^{x(n)}\!/_{x(0)}\right]} \quad \ldots \quad \ldots \quad \ldots \quad \ldots (7)$$

Where r is the tax elasticity, subject to the limitation of over or under-estimation, μ is tax buoyancy obtained by regressing tax revenue on respective tax base.

3.3 Tax Capacity and Tax Effort

3.3(i) Alternative Methodologies

In terms of computing the tax capacity and effort of countries, the following three approaches can be used: i) the level of expenditure indicator, ii) the stochastic frontier analysis model and iii) the traditional regression approach. The expenditure approach is a simple indicator of total revenues to expenditure that reveals the deviation between what is actually collected by the government and what it needs to collect based on its financing gap (Cyan et al., 2013). The stochastic frontier analysis allows the estimation of the level of inefficiency in revenue mobilization. It is a two-step approach where, firstly, the taxation possibility frontier is mapped,

and, secondly, the time varying inefficiency in tax collections is measured using administrative and institutional variables (Alfirman, 2003; Cyan et al., 2013; and Pessino and Fenochietto, 2010). In the traditional regression approach, tax capacity is the predicted tax-to-GDP ratio based on the estimates generated from a regression framework employing structural economic and institutional factors. Numerous papers have utilized this traditional approach (Table 5).

Table 5: Tax Capacity and Tax Effort Empirical Studies

Study/Country Selection	Model	Key findings	Strengths/Weaknesses
Gupta (2007) Developing Countries, 25 years	Fixed Effect	Institutional and governance quality is conserved as one of the most essential factors determining the adequacy of tax collection	Countries that depend on taxing goods and services as their primary source of tax revenue tend to have poorer revenue performance.
Le et al. (2012) Developed and developing countries, 1994-2009	Fixed Effects	Developing countries have more limitations to expand the scope for taxation. Countries with low level of actual tax collection and low tax effort may have more room to increase tax revenues without causing major economic distortions or costs. Low-income countries with a low level of tax collection but high tax effort have less opportunity to increase tax revenues without possibly creating distortions.	Taxable capacity and tax efforts present significant deviations across countries, income groups and regions.
Bird et al. (2004)	Traditional Regression Approach	A more encompassing and legitimate state is an essential precondition for more adequate tax system in developing countries.	In determining tax effort not only does supply factor (tax handles) matter, but also the responsiveness of government to the citizen demands are significant (demand factor).
Eltony (2002) Arab Countries, 1990-2008	Fixed Effects	The main determinants of the tax share in the GDP for the Arab countries are the per capita income, the share of agriculture in GDP and the share of mining in GDP. Some Arab countries have substantially increased their tax effort in recent years, while others have experienced marked declines.	

Source: Authors' Compilation

3.3(ii) Data and Description of Variables

For the calculation of tax capacity, the strongly balanced panel dataset includes 60 developing countries from high to low income groups and spans the period from 1977-2016. Given the extensive time period of data coverage, the panel approach aptly befits this study. The preliminary list of developing countries was garnered from a similar study on tax collection and effort by the World Bank, specifically Le et al. (2012). Additional countries were added that have similar economic structures to Belize. The full country sample is located in Appendix 3.

To prevent biased estimates and enhance time dimensionality, the data were averaged across five-year periods as opposed to using annual figures (Dollar and Kraay, 2003). Statistics were obtained from the World Development Indicators (WDI) of the World Bank 2018, unless stated otherwise.

For the purposes of this paper, tax revenue refers to compulsory transfers to the government for public purposes; however, refunds and corrections of erroneously collected tax revenue are treated as negative revenue (World Bank, 2018). Existing studies have used tax/fiscal revenues as a share of GDP as the measure of tax capacity from which tax effort is derived. This ratio is standardized and relatively effortless to collect for a large sample of countries over an extended period of time, thereby offering itself for cross-country comparison. The shortfall of this revenue ratio is the inability to differentiate between the effectiveness and impartiality dimensions of the governments to collect taxes (Ricciuti et al., 2016). Additionally, due to the presence of informal cross-border trade and the shadow economy, GDP estimates may not fully capture the full scope of economic activity in developing countries. This inevitable statistical shortcoming has the potential to impact the tax-to-GDP ratio. Regardless of this drawback, tax revenue as a share of GDP will be used as the primary dependent variable to estimate the tax capacity for the selected sample of countries, where after the technique will be applied to also estimate this indicator for Belize. GDP per capita growth (GDPPCG) will be used as the explanatory variable since it most likely depicts the level of income in an economy. Other control variables are required to diminish the probability of omitted variable bias that would taint the final empirical results. These include: trade, value added of the agricultural (AGR) and manufacturing (MANU) sectors, population growth (POP), government expenditure (EXPEN), government debt (DEBT), and inequality (GINI). The first four variables take into account the current social and macroeconomic climate and control for the likely correlation with other growth-enhancing policies. Government expenditure and debt provide a gauge of whether government spending is directed toward investment or consumption. Inequality considers the possible relationship with other human development policies that may impact tax collection and compliance. These control variables are similar to those used in Tanzi (1987), Grigorian and Davoodi (2007), Fenochietto and Pessino (2010), and others. Variable definitions and summary statistics can be found in Appendix 4. It must be noted that data availability ultimately determined the variables selected.

3.3(iii) Model Specification

As previously discussed, OLS analysis will be applied on five-year panel averages using data obtained from 60 developing countries including Belize. In both models, the dependent variable (***TC***$_{i,t}$**)** is tax revenue as a share of GDP—the proxy to be used to estimate tax capacity.

The following Pooled OLS model serves as the baseline estimation:

$$TC_{i,t} = \alpha_0 + \alpha_1 GDPPCG_{i,t} + \alpha_2 TRADE_{i,t} + \alpha_3 AGR_{i,t} + \alpha_4 MANU_{i,t}$$

$$+ \alpha_5 POP_{i,t} + \alpha_6 EXPEN_{i,t} + \alpha_7 DEBT_{,t} \alpha_8 GINI_{i,t} + \varepsilon_{i,t}$$

where ***i*** represents the specific country, ***t*** is the time period of a five-year average, and **ε** is the disturbance term.

Thereafter, a Fixed Effects model is employed to control for endogeneity and other factors that were not accounted for in the base model and that may arise from the unobserved invariant heterogeneity present in country groups of similar economic structure.

The Fixed Effects regression is computed using the following equation:

$$TC_{i,t} = \beta_0 + \beta_1 GDPPCG_{i,t} + \beta_2 TRADE_{i,t} + \beta_3 AGR_{i,t} + \beta_4 MANU_{i,t}$$

$$+ \beta_5 POP_{i,t} + \beta_6 EXPEN_{i,t} + \beta_7 DEBT_{i,t} + \beta_8 GINI_{i,t} + \eta_{i,t} + \varepsilon_{i,t}$$

where ***i*** represents a specific country, ***t*** is the time period of a five-year average, **η** denotes an unobservable country effect, and **ε** is the disturbance term.

It is assumed that tax effort links an economy to its tax system; consequently, tax effort will be computed once the tax capacity has been estimated. Tax capacity will be calculated using country statistics and the estimated coefficients from the equations above, while tax effort will be the ratio of actual tax revenues to the predicted taxes (tax capacity) of a country. These computations will be carried out for the entire sample including Belize.

4. Results and Discussion

4.1 Tax Buoyancy and Tax Elasticity

According to the Divisia Index, overall tax revenue grew by 1.2% over the period 2000 to 2017, with the sub-components, direct and indirect taxes growing in tandem by 1.3% and 1.2%, respectively. The results show that discretionary tax measures enhanced revenue and had a positive impact on the growth of total taxes (Table 6). The discretionary tax changes over the period produced additional revenue growth of approximately 0.5% in total tax revenue. For the other tax types, discretionary changes also had a significant and positive impact, except for import duties, where discretionary tax measures narrowed the base over the recent years.

Table 6: Decomposition of Tax Growth (2000-2017)

	Discretionary Growth	**Automatic Growth**	**Total Growth**
Total Revenue	**0.5**	**0.7**	**1.2**
Indirect Taxes	*0.5*	*0.7*	*1.2*
Direct Taxes	*0.7*	*0.6*	*1.3*
General Sales Tax	0.8	0.5	1.3
Import Duties	0.0	0.4	0.4
PAYE	0.9	1.0	1.9
Business Tax	0.8	0.2	1.0

Table 6 also highlights automatic growth, which is obtained when discretionary revenue is subtracted from total tax growth. For total tax revenue, automatic growth had the larger impact on growth as the automatic built-in response to growth of the bases contributed 0.7% to overall tax revenue growth, compared to the 0.5% from discretionary changes. This highlights the capacity of Belize's economy to raise revenue independently, which is very important for a small developing country. Total growth in the remaining tax categories was due to an almost equal contribution stemming from both automatic growth and discretionary influence, except for import duties, where automatic growth far outstripped the contribution from discretionary growth. Choudhry (1979) propounded in his study that if discretionary tax changes are to increase revenue, then one should expect that the elasticity of revenue will be smaller than buoyancy and the reverse should also hold true. This observation is evident in Table 7.

Following the Divisia methodology, the buoyancy is obtained by estimating the tax function $T = ax^{\mu}$ (refer to Eqn 1) using the DOLS model. The buoyancy coefficients reveal that total tax revenue and the selected tax categories for Belize are buoyant. Similarly, buoyancy estimates

for total tax revenue were garnered for Jamaica[8] (1.09), Dominica[9] (2.67), Antigua & Barbuda (1.82) and St. Lucia (1.74). The buoyancy for Belize's total tax revenue was estimated at 1.65, with buoyancy higher for direct taxes (1.94) than indirect taxes (1.25), which could reflect the more progressive nature of income and business taxes due to the varying personal relief brackets in case of the former and basic exemption thresholds and varying rates amongst business sectors in case of the latter.

Table 7: Tax Buoyancy and Tax Elasticity Estimates

Tax	Relevant Base	Long run Buoyancy	Long run Elasticity	Short run Buoyancy	Short Run Elasticity	Speed of Adjustment
Total Tax Revenue	GDP at market prices	1.65	1.77	0.43	0.56	-0.13
Indirect Taxes	*GDP at market prices*	*1.25*	*1.37*			
Direct Taxes	*GDP at market prices*	*1.94*	*1.89*			
Business Tax	GDP at basic prices	1.40	1.21	0.78	0.67	-0.86
PAYE	Non-agriculture GDP	1.95	1.77	0.98	0.80	-0.10
Sales Tax	Non-agriculture GDP	1.70	1.63	0.52	0.50	-0.38
Sales Tax	Imports	1.23	1.08	0.25	0.10	-0.35
Import duties	Imports	0.99	1.36	0.40	0.80	-0.19

See Appendix 4 for DOLS results and ecm diagnostics

PAYE and Sales Tax recorded the highest buoyancy estimates of 1.95 and 1.70, respectively, while imports trailed with a buoyancy coefficient of 0.99.

According to the Divisia Index methodology, the elasticity estimates are obtained by adjusting buoyancy using the index of discretionary growth. Choudhry (1979) posited that the size of the elasticity coefficient is influenced by several factors, including the progressive nature of a tax, the distribution of income and the structure of the tax base. Furthermore, economic growth and discretionary changes can affect these aforementioned factors and thus exert an effect on tax elasticity size and in turn affect the tax ratio. The overall tax revenue and the selected tax categories studied were all elastic. Elasticity of total tax revenue was 1.77, a larger estimate than buoyancy (1.65) revealing that Belize's overall tax system is more elastic than buoyant. This result aligned with Belize's rising tax ratio and as Choudhry (1979) highlighted, a country with a tax elasticity that exceeds unity, should display a rising trend in tax ratio. Belize has experienced a consistent rise in its tax ratio over the years, signalling a healthy revenue performance for a country with no major resources (Cambridge Resources International Inc., 2016).

[8] Milwood, 2011
[9] Hamlet, 2013

Looking at the sub-components of total tax reveals that the elasticity for direct taxes (1.89) was bigger than for indirect taxes (1.37). For direct taxes, the effect of discretionary movements had a slightly bigger effect at enhancing revenues, which was evident in its larger buoyancy over elasticity measure. The discretionary changes were aimed at increasing the compliance, base structure and progressivity of these taxes by lowering the business and self-employed threshold exemptions and increasing the income tax relief threshold, even as the rate shifted from a variable one to a fixed flat rate of 25%. The discretionary changes provide the reader with a deeper insight of the contribution of these taxes to the overall buoyancy and elasticity of the tax system (highlighted in Section 2 and outlined in Appendix 1). The elasticities for PAYE and Business Tax were 1.77 and 1.21, respectively. In regards to indirect taxes, while discretionary changes have positively impacted revenue growth, automatic built-in tax growth has exerted a larger effect. This has largely been due to the fiscal adjustments to import duties—the lowering of certain import duty rates and substitution of the excise tax on several major import items in an effort to align with WTO rules. This shift reduced the revenue earned from import duties and raised the revenue earned from excise duties. Discretionary measures on GST have been generally positive (Appendix 1), but the intensity of their impact has been tempered by the extensive exemptions and zero-rated goods and services that reduced the base and affected the size of the elasticity of this indirect tax category. The long-run elasticities for GST and import duties stood at 1.63 and 1.33, respectively, implying that GST and import duty revenue increase by around 1.63% and 1.33% for every 1% increase in their respective base (GDP and imports).

Although long-run elasticities are deemed more relevant to policy in Belize's case, short-run buoyancies and elasticities were included to gauge the impact of tax measures in a given period (Table 7). In contrast to the long-run elasticity that measures the growth of revenue based on the long-run growth of its tax base, the short-run elasticity reveals the immediate change of revenue if the tax base changes by 1%. Results for these elasticities are distinctly lower than their long-run counterparts, with total tax revenue's short-run elasticity estimated at 0.56 compared to its long-run elasticity of 1.77. This would signify low volatility in overall tax revenue and its various components. Without further investigation, it cannot be definitively concluded as other factors can affect the short-run elasticity by delaying the adjustment of tax revenue to tax base changes, such as lags in collection, refund payments, delays in payment and loss-carry forward regulations of business tax. The error correction term for total tax revenues stood at -0.13, highlighting that 13.0% of the disequilibrium is corrected in a given period following deviation from the long-run equilibrium. Business Tax had the highest speed of adjustment (86.0%) and PAYE displayed the lowest speed (10.0%).

The findings of this study are compared with those done for other countries measuring long-run elasticities. Hamlet (2013) found Dominica's tax revenue to be elastic (1.78), but St. Lucia's and Antigua's to be inelastic (0.83 and 0.87, respectively), even as their systems were buoyant. Milwood (2011) concluded that Jamaica's overall tax revenue was marginally inelastic (0.95); however, customs duty and consumption taxes, the two major taxes that were investigated, were found to be elastic. Gillani (1986), also using the Divisia index, found the tax system for Pakistan to be elastic (1.25), and Waryoba (2018) in his recent study on Tanzania's tax system, found overall tax revenues to be more elastic than buoyant. Regarding short-run elasticities, Moreno and Bolevar (2014) found that in all tax categories investigated for Venezuela, the short-run elasticities were below their long-run elasticities, and Bilquees (2004) found short-term elasticities to be much lower and inelastic than long-term elasticities for Pakistan given the lags in collection.

4.2 Tax Capacity and Tax Effort

The panel regression results for tax capacity using data from developing countries are presented in Table 8. The first column in the table presents the results of the Pooled OLS model specification, which was used as the baseline. Due to the likelihood of endogeneity and unobserved heterogeneity ensuing from the use of panel data, a supplemental Fixed Effects model was selected instead of a Random Effects model[10]. The results are presented in column 2.

[10] The Hausman test had a p-value of 0.005.

Table 8: Determinants of Tax Revenues

Dependent Variable:	Pooled OLS	Fixed Effects
Tax Revenue (% of GDP)	(1)	(2)
Constant	-1.590	-12.57
	(3.989)	(7.054)
GDP Per Capita Growth	-0.0300	0.0858***
	(0.147)	(0.121)
Trade	0.0237**	-0.00581**
	(0.0103)	(0.0225)
Agriculture	-0.0114*	0.0298*
	(0.0402)	(0.0772)
Manufacturing	-0.0496*	-0.119*
	(0.0698)	(0.109)
Population Growth	-2.331***	0.460*
	(0.702)	(0.653)
Government Expenditure	0.472***	0.180***
	(0.0875)	(0.151)
Government Debt	0.0416*	0.0662***
	(0.0234)	(0.0117)
Inequality	-0.246***	-0.531***
	(0.0713)	(0.137)
N	298	298
R^2	0.225	0.586
adj. R^2	0.204	0.601
F	18.11	7.179
Standard errors in parentheses	* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$	

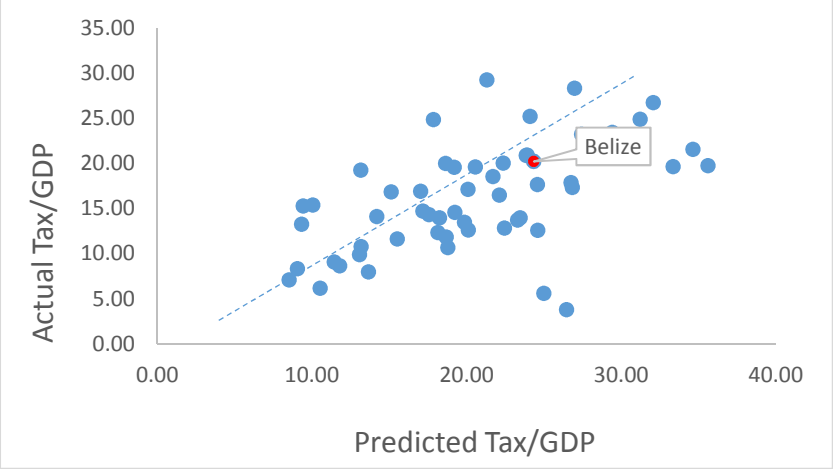
Column 1 presents the estimated coefficients that are mostly statistically significant and have the expected signs, albeit low explanatory power. Of note is the inverse relationship and statistical insignificance of tax revenues and economic development (proxied by GDP per capita growth). It is likely that endogeneity resulting from unobserved heterogeneity may be present, which would explain why the primary variable of interest was negative and not significant. Once these shortcomings were controlled for, the model's explanatory power improved, and the results were more robust (as indicated in Column 2).

In general, the results were consistent with other policy-based studies on factors affecting tax revenue (Column 2); additionally, the estimated coefficients had the expected signs and were all significant. The variables, particularly GDP per capita growth, government expenditure and debt, were statistically significant and reflected the expected positive relationship with taxes. Based on the estimated parameters, the model indicates that a 1% increase in GDP per capita growth leads to a 9% increase in tax revenues. These results are consistent with Tanzi (1987) who postulates that greater economic development demands higher public expenditure, so it is expected that higher tax capacity levels are necessary to garner these funds. On the other hand, the impact of trade openness (proxied by trade) on taxes will require further probing as its relationship was ambiguous (Gupta, 2007). With increased trade, the expectation is that higher growth will enable

more taxes to be collected owing to a broader base. Alternatively, when a country opens its economy with the intention to stimulate increased trade, tax revenues tend to diminish on account of greater economic distortions, such a fiscal incentives and tax concessions (Fenochietto and Pessino, 2010). Oddly enough, this is the case with the selected sample indicating that as trade rises, tax revenues could remain muted or decline by 0.5%. Likewise, the impact of agriculture and manufacturing on tax revenues are similar, in that as the share in the economy grows, the difficulty in raising and collecting taxes escalates due to the nature of the industry. These findings are similar to Gupta (2007), whereby if a large part of the agricultural sector is subsistence-based, then that sector can be difficult or politically infeasible to tax. Moreover, growth in population broadens the tax base, which should positively impact tax revenues. Lastly, as income becomes better distributed, tax collection and compliance should improve. This inverse, albeit significant, relationship is corroborated by parallel studies from Bird et al. (2005) and Cyan et al. (2013). These relationships with tax revenues are in line with the final results listed in Table 8. It would have been ideal to control for institutional-type variables, such as corruption, government instability, and tax evasion, as these may significantly affect revenue performance (Le et al., 2012); however, unavailability of data prevented this.

The estimated coefficients from column 2 in Table 8 were used to compute the predicted value of tax collection (tax capacity) for the selected sample including Belize. Thereafter, a measure of tax effort was estimated, which is the ratio of actual tax revenues to predicted taxes. The full list of fitted values for tax capacity and tax effort for each country included in this study is reported in Appendix 3.4. The World Bank considers a “high tax effort” when a tax effort index is greater than 1, and a “low tax effort” when the tax effort index is less than 1 (Le et al., 2012). Figure 3 displays the country averages of actual and predicted taxes as a share of GDP. For the countries along the line, actual taxes are exceedingly close in value to the predicted taxes. A minimal number of countries are considered to have a high tax effort and exceed their tax capacity (the ones above the 45° line). Belize is located below the unitary tax effort line, indicating that the country is collecting less than its maximum allotment of taxes, and there may be scope to improve collection efforts.

Figure 3: Tax Revenue Indicators



Source: Authors' Calculations

Countries can be categorized into different groups based on their tax efforts and actual tax collection. Using the tax effort benchmark of 1 and the median tax/GDP ratio of the sample (15.4%), a country is regarded as "low collection" if their tax collection is below the median and the reverse holds true for "high collection". Based on this criteria used in Le et al. (2012), the selected sample are sorted according to the following classifications: "low effort, low collection", "high effort, low collection", "low effort, high collection", "high effort, high collection".

According to prevailing tax literature, the tax effort is expected to be positively correlated with actual tax collections, so higher collections are associated with a higher tax effort and low collections with below-average tax effort (Stotsky and WoldeMariam, 1997), as evident in Table 9, where most countries fall in the category "low effort, low collection". Exceptions to this convention are observed, where several countries, including Belize, fall into the "low effort, high collection" category, which means that these countries have the potential to earn high tax revenue.

A closer look at Belize's case reveals a rising trend in tax effort from 0.83 to 0.90 as a result of an increase in actual tax receipts. Tax collection has been the primary revenue earner for the Government with actual tax collection averaging 20.9% of GDP (World Bank, 2018). The underlying impetus behind this movement has been the diversification of the local economy.

Table 9: Country Classification Based on Tax Efforts and Tax Collection

		TAX EFFORT		
		LOW		HIGH
TAX COLLECTION	LOW	Argentina Bahamas, The Bahrain Bangladesh Brazil Burkina Faso Colombia Congo, Dem. Rep. Congo, Rep. Costa Rica Dominican Republic Ethiopia Guatemala Honduras	India Indonesia Lebanon Mexico Mongolia Oman Paraguay Peru Philippines Sierra Leone Thailand	Albania Armenia
	HIGH	Belarus **Belize** Botswana Chile Croatia Dominica Grenada Hungary Jamaica	Madagascar Malaysia Namibia Nicaragua Poland Slovenia South Africa St. Lucia Uruguay	Azerbaijan Barbados Egypt, Arab Rep. El Salvador Morocco New Zealand Papua New Guinea Trinidad and Tobago Vietnam

In 1977, agriculture and manufacturing contributed almost half of the GDP in Belize. Two decades later, these shares declined significantly to less than 20.5% (Central Bank of Belize Statistical Digest, 2017). With the country's growing population at 366,954 inhabitants and its per capita income at US$4,744.74 in 2016, the wholesale and retail trade sector has become the most dominant subsector in the country (Figures 4 and 5). It is believed that this shift in economic activity has contributed to increased tax collection, as farmers are administratively difficult to tax. As the shares of agriculture and manufacturing to GDP have progressively dwindled, this has led to an increase in the effective taxable base for the Government (Abu-Hammour, 1997). Although high tax collection has been achieved, the low effort is indicative of inefficiencies and policy shortcomings in the tax structure, illustrated in the disparity between tax capacity and actual tax revenues (Figure 6).

Figure 4: Economic Growth by Sector – 1977

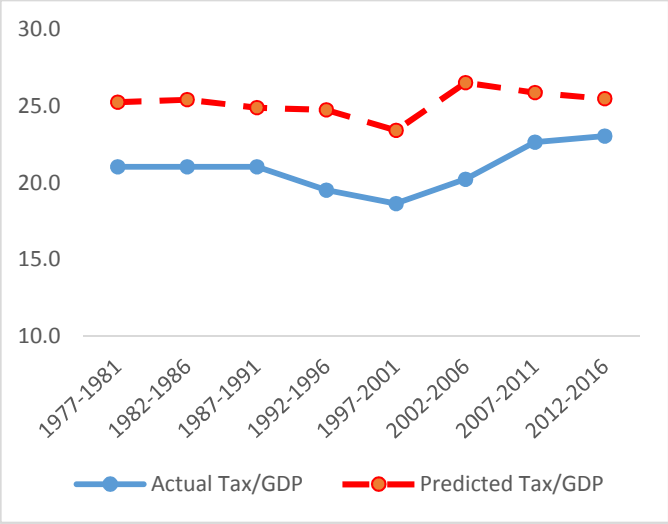
Source: Authors' Calculations

Figure 5: Economic Growth by Sector – 2016

Source: Authors' Calculations

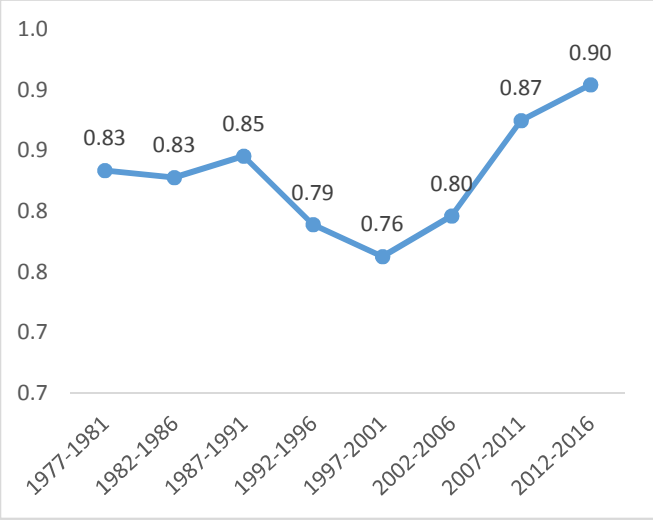
The tax capacity for Belize was estimated at 23.9%, and actual tax collection has always been lower than the tax capacity. The period of 1997-2001 represented the lowest collection point as the impact of several policy changes came to fruition. Prior to 1997, the country reformed its tax structure and experienced its most stable collection period. In 1998, the Government underwent a retrenchment exercise, thereby significantly reducing the taxable population. Furthermore, the Government shifted from the broader-based VAT to a narrower-based Sales Tax in 1999, which reduced tax revenues even more during this five-year period.

Figure 6: Actual and Predicted Tax – Belize



Source: Authors' Calculations

Figure 7: Tax Effort- Belize



Source: Authors' Calculations

While Belize has comparatively high tax collections, its low average tax effort of 0.83 points to some potential to bridge the gap between actual tax revenues and its potential taxable capacity. Since 2007, the country has made greater strides in improving tax effort and closing the gap of 4.3% of GDP between actual and predicted tax levels vis a vis broadening the tax base, increasing the efficiency of tax administration and reducing tax evasion practices. Additionally, through the Government's commitment to meeting the international tax compliance standards such as the Base Erosion and Profit Sharing project, the expectation is to reduce harmful tax practices that encourage preferential treatment for offshore sectors.

5. Conclusion

A primary function of any government is to provide goods and services, to develop the socio-economic infrastructure of the country, and to encourage economic growth and development for the benefit of the populace. Taxation is pivotal in raising the funds to accomplish these goals, and governments are charged with the responsibilities to spend these monies wisely.

This study investigated the performance of Belize's revenue systems using tax buoyancy, elasticity and tax capacity/effort measures. Using the Divisia approach, it was found that revenue growth was affected by the combined contribution of discretionary tax changes and automatic growth of the bases. Belize's buoyancy and long-run tax revenue elasticity was estimated at 1.65 and 1.76, respectively, indicating that overall tax revenue responds favorably to changes in GDP without the need for frequent tax policy changes to keep the tax-to-GDP ratio steady over the medium term. This responsiveness to macroeconomic developments is critical to the country's fiscal sustainability. Belize's above unity long-run buoyancy and elasticity indicators are reflected in its tax ratio trend. The tax revenue to GDP ratio has increased by 2.5% over the past 20 years to 25.4% of GDP in 2017 and compares favorably relative to similar economies.

To gain a deeper understanding of Belize tax revenue performance and place it within an international context, a panel data analysis using 60 countries was conducted to obtain measures for Belize's tax capacity and tax effort. Results revealed that structural factors such as GDP per capita growth, trade openness, and government expenditure/debt were statistically significant and notable determinants of revenue performance. While Belize's actual tax collection was above many of its peers, it has remained below its average tax capacity of 23.9% of GDP. Since tax effort is a function of tax collection, Belize's tax effort indicator averaged 0.83, slightly below 1, which is the benchmark that signals a "high effort" tax system. Classified as "low effort", Belize has some scope to increase tax revenues without overshooting its taxable capacity and tipping

point beyond, which diminishing returns to taxation would be experienced. Due care must be made in striving to bridge this gap, since Belize has already achieved high tax collection.

Therefore, Belize should not mobilize tax through the implementation of new taxes or rate hikes but, rather, through the elimination of tax distortions and the moderation of government expenditure. It is clear that curtailing governance-related inefficiencies and tax policy shortcomings that exist have the potential to produce significant and long-lasting economic enhancements for the country. Tax reforms should aim to strike a balance between tax efficiency and effectiveness, create equity among taxpayers, and simplify the administrative processes. Gains can be made from administrative measures that do not include increases in the current tax rates but, rather, a more pinpointed focus on efforts such as reducing compliance costs and encouraging investment. Further, concerted efforts must be made to eliminate tax evasion/avoidance, similar to the objectives of the Base Erosion and Profit Sharing project. These measures will increase the efficacy of Belize's tax structure. Strengthening the tax collection mechanism is the most viable option if the country's policymakers desire to boost tax revenue performance without minimizing social justice.

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Appendix

Appendix 1:

Major Tax Reforms in Belize, 1981-2008

1987/1988	**-** Reduction of Corporate Tax on public companies with majority government shareholding to 35.0% - Introduction of Withholding Tax at a rate of 25.0%
1989/1990	- Exemption of Income Tax on gratuities and annual income less than seven thousand - Increase Personal allowance and the allowance for wife and children - Exempt the Belize Tourist Board from Income Tax and Stamp Duty - Introduction of a Tax Holiday of no more than 10 years to export enterprises and not more than 25 years to Agro-Industry, Food processing, Mariculture and manufacturing enterprises - Exemption of income tax, withholding tax, capital gain tax or any new corporate tax on the newly established Export Processing Zone (EPZ)
1991/1992	- Increase the Income Tax deductible up to $400 for every child.
1993/1994	- Introduction of a Stamp Duty on airline tickets of $25.00 when the fare does not exceed $250.00 and $30.00 when the fare exceeds $250.00 - Reduction of Stamp duty on imported goods from 14.0% to 12.0% - Increase Custom Duty on spirit imports - Increase Excise Duty on locally-produced rum from $18.00 to $34.00 - Introduction of Gross Receipt Tax at the rate of 1.0% on every self-employed person, firm or company and at the rate of 2.0% on every professional - Exemption of Taxes and Duties on Mollejon Hydroelectric project - Income tax for persons earning less than $10,400 was abolished - Increase basic deductions to $10,400 from persons whose gross income is less than $25,00 and $8,000 from persons whose gross income in more than $25,000 - Increase the penalty to 1.5% on arrears of income tax - Introduction of a Withholding Tax on gross contract payments
1995/1996	- Introduction of Value Added Tax (VAT) at the rate of 15.0% - Introduction of Import Tax - Gross Receipts Tax was repealed - Export Duty on goods was abolished. - An agreement was signed with the Governments of the Member States of the Caribbean Community for the avoidance of double taxation and the prevention of fiscal evasion with respect to taxes on income, profits or gains and capital gains and for the encouragement of regional trade and investment. - Reduction of Excise Duty on locally-produced rum, cigarettes and aerated waters
1997/1998	- Introduction of an accommodation Tax at the rate of 7.0% - Customs and Excise duties on goods was reduced by 5.0% - Establishment of a Revenue Advisory Board to advice on simplification of the existing tax structure to ensure equity, neutrality and transparency.

	- Persons with earnings less than $20,000 were exempted from the payment of Income Tax - Increase basic Income tax allowance to $19,600 - Corporate Income Tax was abolished and replaced by a Business Tax on all self-employed persons, companies and other entities with receipts of more than $54,000 at a rate ranging from 0.75% to 25.0%
1999/2000	- VAT was repealed and replaced by Sales Tax at a rate of 12% on beverage, tobacco products and fuel, and 8% on all other goods and services.
2001/2002	- Introduction of Environmental Tax (ad valorem tax) on import goods at the rate of 1.0% - Duty exemption of a maximum of 2 years for small and medium enterprises
2003/2004	- Customs Duties on certain staple foods and basic necessities, musical instruments and accessories, records, tapes and other recorded media, was abolished - Exempted Sales Tax on certain basic household goods - Income and business tax was amended to provide a more equitable application of business tax and strengthen the framework for collections
2005/2006	- Business Tax threshold was increased to $75,000 per annum where such receipts are the only source of income - Business Tax was increased on trade, professionals, Banks, Public Investment Companies (PIC), realtor agents' commission and casino earnings - Environmental Tax was increased on vehicles over 4 cylinders to 5.0% and to 2.0% any other imports - Excise Tax was increased on rum, tobacco, beer and aerated water - Introduction of the General Sales Tax (GST) at a standard rate of 10.0% to replace the Sales Tax. - Exempted companies engaged in petroleum operations from Business Tax, but subject to an Income Tax rate of 40.0% on their chargeable income
2007/2008	- Exported goods and services and the supply of goods to the Commercial Free Zone (CFZ) and the Export Processing Zone (EPZ) were zero rated along with a limited list of unprocessed foods. -The list of zero-rated items was expanded to include household appliances and some medical items. - Revenue Replacement Duty (RRD) on aviation spirit, other motor spirit, jet fuel, diesel oil was repealed and replaced by flat taxes per gallon - RRD on fertilizer was abolished - Levy Excise Duty on locally refined fuel products - Tariffs for feed concentrate for poultry, cattle, and pig were removed - Duties levied on goods imported for educational or charitable purposes, by small licensed hotels to improve their properties, farm machinery and vans up to 18 seats imported by small licensed tour operators, were reduced. - Petroleum surcharge on revenues derived from petroleum operations when the price exceeds US$90/bbl. on the world market - Business Tax rate was increased on telecommunication to 24.5% and PIC to 12.0%
2009/2010	- Exemption of Income Tax on persons earning less than $26,000 per annum - Increase Business Tax rate on electricity supply to 6.5%

	- Excise Duty on locally extracted crude oil of $1.00 per barrel - Import Duty on school supplies, agricultural supplies, vitamins and certain basic household goods was removed - Increase the rate of GST from 10% to 12.5%. - Imposition of a Social Fee on imports of fuel (10.0%) and all other goods/services (1.5%) into an EPZ - Exempt GST on electricity consumption up to $200 - The list of zero-rated items was expanded - Increased Environmental Tax on aviation spirit, premium and regular gasoline, kerosene, diesel and gas oil to $0.20 per imperial gallon - Business Tax on telecommunication was reduced to 19.0% - Income Tax relief on persons earning not more than $29,000 per annum
2011/2012	-The list of zero-rated items was further expanded to include internet services and fuel. - RRD on cigarettes was reduced - Excise Duty on locally extracted crude oil was increased to $2.00/bbl and on imported fuel an average of $3.15 per imperial gallon - Environmental Tax on CARICOM imports was removed.
2015/2016	- Excise Duty on imported motor spirit, gasoline and diesel was increased - Excise Duty on local beer was adjusted to be the same as that of the other CARICOM countries
2017	- Social Fee on goods and services imported into CFZ at a rate of 10.0% on fuel, 6.0% on fermented beverages, 20.0% on cigarettes and 1.5% on all other goods - Introduction of a departure tax for non-Belizeans of $32.50 - Excise Duty on fuel products - Stamp Duty on foreign exchange permits was increased to 1.75% -Exempt GST on electricity consumption up to $100.00 – down from the previous amount of $200.00 - Environmental Tax on imported goods except for vehicles and fuel was increased to 3.0% ad valorem - Social Fee on cigarettes was reduced to 15.0% -Stamp Duty levied on land transfers

Appendix 2:

Table A2.1 Augmented Dickey-Fuller tests for tax categories (2000Q1-2017Q4)

The table below shows the results from the Augmented Dickey-Fuller (ADF) test on unit roots. Except for GST and business tax that were stationary at level with trend, results for the other tax categories point to tax series being stationary over the entire sample after differencing once.

As to the explanatory variables, all exhibited stationarity after first differencing.

Tax	Level	Level with trend	First difference
Total Revenue	-0.21	-4.60**	-9.31***
Indirect Taxes	0.02	-1.46	-10.57***
Direct Taxes	-1.12	-5.49**	-9.54***
General Sales Tax	-1.6	-4.22**	-7.75***
Business Tax	-3.44	-4.32**	-8.69***
PAYE	-0.56	-1.89	-3.92***
Import Duties	-2.15	-2.11	-9.80***

<10%, **<5%, and *<1%*

Table A2.2 Augmented Dickey-Fuller tests for independent variables (2000q1 – 2017q4)

Base	Level	Level with trend	First difference
Imports	-1.95	-3.11	-3.48***
GDP (basic prices)	-1.41	-2.55	-14.52***
GDP (non-agriculture)	-1.89	-2.33	-14.02***
GDP (market prices)	-1.42	-2.17	-6.23***

Results with intercepts (all significant)

The errors from the long-run equations were also tested for stationarity using the ADF-test, which revealed all were stationary (see table below).

Table A2.3 Augmented Dickey-Fuller tests on residuals from long-term DOLS equations with Newey-West correction

Tax	Level
Business Tax	-6.04***
Import Duties	-3.41***
PAYE	-5.05***
Sales Tax (Non-agriculture GDP Proxy Base)	-3.95***
Sales Tax (Imports Proxy Base)	-8.81***
Total Tax Revenue	-5.11***

Results without intercepts (all significant)

Appendix 3:

Table A3.1 List of Countries

Income Group	Country
High Income	The Bahamas, Bahrain, Barbados, Croatia, Hungary New Zealand, Oman, Poland, Slovenia, St. Kitts and Nevis, Trinidad and Tobago
Middle Income	Albania, Argentina, Armenia, Azerbaijan, Belarus, Belize, Botswana, Brazil, Chile, Colombia, Costa Rica, Rep. Congo, Dominica, Dominican Republic, Arab Rep. Egypt, El Salvador, Grenada, Guatemala, Honduras, India, Indonesia, Jamaica, Lebanon, Malaysia, Mexico, Mongolia, Morocco, Namibia, Nicaragua, Papua New Guinea, Paraguay, Peru, Philippines, South Africa, St. Lucia, Thailand, Uruguay, Vietnam
Low Income	Bangladesh, Burkina Faso, Dem. Rep. Congo, Ethiopia Madagascar, Sierra Leone

Table A3.2 Variable Definitions and Summary Statistics

Variable	Description	Mean	Std. Dev	Min.	Max.	Observations
Tax Revenue (% of GDP)	Tax revenue refers to compulsory transfers to the central government for public purposes; Refunds and corrections of erroneously collected tax revenue are treated as negative revenue (World Bank 2018).	16.487	8.760	1.069	72.852	456
GDP Per Capita Growth (Annual %)	Annual percentage growth rate of GDP per capita based on constant 2010 U.S. dollars. Source: World Bank 2018 WDI	1.772	3.504	-16.265	17.505	456
Trade (% of GDP)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product. Source: World Bank 2018 WDI	76.226	35.953	13.535	245.249	456
Agriculture, value added (% of GDP)	Agriculture value added is the net output of the sector after adding up all outputs and subtracting intermediate inputs. Source: World Bank 2018 WDI	14.693	11.810	0.296	58.669	432
Manufacturing, value added (% of GDP)	Manufacturing value added is the net output of the sector after adding up all outputs and subtracting intermediate inputs. Source: World Bank 2018 WDI	15.439	7.553	0.754	40.665	432
Population Growth (Annual %)	Annual population growth rate is the exponential rate of growth of midyear population, expressed as a percentage. Source: World Bank 2018 WDI	1.604	1.161	-2.022	6.354	456
General Government Final Consumption Expenditure (% of GDP)	General government final consumption expenditure includes all government current expenditures for purchases of goods and services including compensation of employees. Source: World Bank 2018 WDI	14.445	5.244	3.997	32.262	432
Central Government Debt (% of GDP)	Debt (domestic and foreign) is the entire stock of direct government fixed-term contractual obligations that are outstanding on the last day of the fiscal year. Source: World Bank 2018 WDI	59.609	49.307	0.214	283.745	376
Inequality (GINI index)	Gini index measures the extent to which the distribution of income among individuals or households within an economy deviates from a perfectly equal distribution. Source: World Bank 2018 WDI	42.925	10.366	17.250	64.800	376

Table A3.3 Hausman Test Statistics

	-Coefficients-			
	(b) Fixed	**(B) Random**	**(b-B) Difference**	**sqrt(diag(V_b-V_B)) S.E.**
GDP Per Capita Growth	.0857977	.0446887	.041109	.0088776
Trade	-.0005806	.0023033	-.0028839	.0114405
Agriculture	.0298288	-.0150647	.0448935	.0414473
Manufacturing	-.118731	-.015312	-.103419	.0589691
Population Growth	.4602307	-.3114162	.771647	.2513233
Government Expenditure	.180229	.3145417	-.1343126	.0745877
Government Debt	.0661647	.0592562	.0069086	.0043121
Inequality	.5308852	.3157784	.2151068	.1029863
chi2(8)	=(b-B)'[(V_b-V_B)^(-1)](b-B)			
	= 27.70			
P-Value (Prob>chi2)	= 0.0005			
Decision Rule	**Fixed Effects**			

Table A3.4 Tax Indicator by Country

	Actual Tax/GDP	**Predicted tax/GDP**	**Tax Effort**
Albania	13.26	9.32	1.42
Argentina	8.64	11.78	0.73
Armenia	15.28	9.42	1.62
Azerbaijan	15.37	10.05	1.53
Bahamas, The	13.96	23.45	0.60
Bahrain	3.77	26.45	0.14
Bangladesh	7.07	8.51	0.83
Barbados	25.20	24.09	1.05
Belarus	19.74	35.61	0.55
Belize	**20.91**	**23.91**	**0.87**
Botswana	24.90	31.22	0.80
Brazil	12.58	24.60	0.51
Burkina Faso	12.32	18.14	0.68
Chile	17.13	20.09	0.85
Colombia	12.84	22.45	0.57
Congo, Dem. Rep.	6.17	10.52	0.59
Congo, Rep.	11.61	15.50	0.75
Costa Rica	12.60	20.10	0.63
Croatia	21.55	34.63	0.62

Dominica	20.22	24.34	0.83
Dominican Republic	11.85	18.68	0.63
Egypt, Arab Rep.	16.83	15.11	1.11
El Salvador	28.33	26.96	1.05
Ethiopia	8.32	9.05	0.92
Grenada	18.53	21.69	0.85
Guatemala	9.06	11.44	0.79
Honduras	14.57	19.23	0.76
Hungary	23.43	29.41	0.80
India	9.88	13.06	0.76
Indonesia	14.10	14.19	0.99
Jamaica	17.88	26.75	0.67
Lebanon	13.46	19.85	0.68
Madagascar	20.87	23.85	0.87
Malaysia	17.35	26.83	0.65
Mexico	10.66	18.78	0.57
Mongolia	14.30	17.56	0.81
Morocco	20.01	18.64	1.07
Namibia	26.75	32.06	0.83
New Zealand	29.25	21.31	1.37
Nicaragua	16.49	22.10	0.75
Oman	5.59	24.99	0.22
Papua New Guinea	19.57	19.20	1.02
Paraguay	10.77	13.17	0.82
Peru	13.73	23.30	0.59
Philippines	13.96	18.24	0.77
Poland	19.62	20.55	0.95
Sierra Leone	7.98	13.64	0.58
Slovenia	19.63	33.35	0.59
South Africa	23.24	27.43	0.85
St. Kitts and Nevis	17.64	24.57	0.72
St. Lucia	20.04	22.35	0.90
Thailand	14.70	17.17	0.86
Trinidad and Tobago	24.86	17.86	1.39
Uruguay	16.92	17.01	0.99
Vietnam	19.24	13.15	1.46
Latin America & Caribbean	11.66	16.27	0.72
Caribbean Small States	21.33	24.67	0.86

Appendix 4:

Table A4.1 Elasticities of selected revenues

Sales Tax	Non-Agriculture GDP	Imports
long run	*DOLS*	*DOLS*
gdp_{nagri} / imp	**1.70** ***	**1.23** ***
	(0.12)	*(0.13)*
constant$_{LR}$	-2.02 ***	-3.49 ***
	(0.08)	*(0.07)*
short run	*OLS*	*OLS*
Δgdp_{nagri}/ Δimp	**0.52** ***	**0.24** ***
	(0.30)	*(0.11)*
Δ**revt-1**	-0.11	
	0.11	
ecrevt-1	**-0.38****	**-0.35** ***
	(0.10)	*(0.1)*
constant$_{SR}$	0.01**	0.01 ***
	(0.01)	*(0.01)*
ecm diagnostics		
LM (χ^2(2))	0.32	0.86
BPG	0.90	0.77
JB	0.45	0.68

Robust standard errors in parentheses. *, **, *** symbols refer the statistical significance of the p-values at the 10%, 5% and 1% level of the test that the coefficient equals 0. The Swartz criterion was used to provide the lags and leads of first differences of the DOLS regressors (estimates are not presented).

Short-run: pvalues are shown for ecm diagnostics. To test for serial correlation the Breusch-Godfrey Lagrange Multiplier (LM) approach was used as it allows to test for higher than AR(1) orders and is applicable in case of lagged dependent. To test for the null hypothesis of no heteroskedasticity in the residuals the Breusch-Pagan-Godfrey Lagrange Multiplier (LM) approach was utilized. The Jarque-Bera test is performed on the null of normality.

Table A4.2 Elasticities of selected revenues

Business Tax	GDP at Basic Prices	PAYE	Non-Agriculture GDP
long run	*DOLS(NW)*	*long run*	*DOLS(NW)*
gdp_b	**1.40** ***	**gdp_{nagri}**	**1.95** ***
	(0.10)		*(0.06)*
$constant_{LR}$	-9.6 ***	$constant_{LR}$	-11.9 ***
	(0.64)		*(0.23)*
short run	*OLS*	*short run*	*OLS*
Δgdp_b	**0.68** ***	**Δgdp_{nagri}**	**0.98** ***
	(0.15)		*(0.24)*
Δrevt-1	0.17	Δrevt-1	-0.42
	(0.11)		*(0.11)*
ecrevt-1	**-0.86*** **	**ecrevt-1**	**-0.10** ***
	(0.14)		*(0.14)*
$constant_{SR}$	0.01**	$constant_{SR}$	0.01 ***
	(0.01)		*(0.01)*
ecm diagnostics		*ecm diagnostics*	
LM (χ^2(2))	0.17	LM (χ^2(2))	0.46
BPG	0.51	BPG	0.22
JB	0.51	JB	0.17

Robust standard errors in parentheses. *, **, *** symbols refer the statistical significance of the p-values at the 10%, 5% and 1% level of the test that the coefficient equals 0. The Swartz criterion was used to provide the lags and leads of first differences of the DOLS regressors (estimates are not presented).

Short-run: pvalues are shown for ecm diagnostics. To test for serial correlation the Breusch-Godfrey Lagrange Multiplier (LM) approach was used as it allows to test for higher than AR(1) orders and is applicable in case of lagged dependent. To test for the null hypothesis of no heteroskedasticity in the residuals the Breusch-Pagan-Godfrey Lagrange Multiplier (LM) approach was utilized. The Jarque-Bera test is performed on the null of normality.

Table A4.3 Elasticities of selected revenues

Import Duties	Imports	Total Tax Revenue	GDP at Market prices
long run	*DOLS(NW)*	*long run*	*DOLS(NW)*
gdp_b	**0.99** ***	**gdp_{nagri}**	**1.64** ***
	(0.02)		*(0.002)*
$constant_{LR}$	-1.96 ***	$constant_{LR}$	-5.4 ***
	(0.10)		*(0.02)*
short run	*OLS*	*short run*	*OLS*
Δgdp_b	**0.36** ***	**Δgdp_{nagri}**	**0.43** ***
	(0.09)		*(0.14)*
Δrevt-1		Δrevt-1	-0.12
			(0.09)
ecrevt-1	**-0.30*** **	**ecrevt-1**	**-0.13** ***
	(0.07)		*(0.06)*
$constant_{SR}$	0.01**	$constant_{SR}$	0.004 ***
	(0.01)		*(0.01)*
ecm diagnostics		*ecm diagnostics*	
LM (χ^2(2))	0.28	LM (χ^2(2))	0.19
BPG	0.52	BPG	0.23
JB	0.32	JB	0.75

Robust standard errors in parentheses. *, **, *** symbols refer the statistical significance of the p-values at the 10%, 5% and 1% level of the test that the coefficient equals 0. The Swartz criterion was used to provide the lags and leads of first differences of the DOLS regressors (estimates are not presented).

Short-run: pvalues are shown for ecm diagnostics. To test for serial correlation the Breusch-Godfrey Lagrange Multiplier (LM) approach was used as it allows to test for higher than AR(1) orders and is applicable in case of lagged dependent. To test for the null hypothesis of no heteroskedasticity in the residuals the Breusch-Pagan-Godfrey Lagrange Multiplier (LM) approach was utilized. The Jarque-Bera test is performed on the null of normality.