The Effects of Fiscal Policy on Output in Belize

By Emory Ford

Master of Science

Applied Economics

University of the West of England

Faculty of Business and Law

2013

Abstract

This study examines the dynamic effects of taxes and government spending on output in Belize. This was accomplished using a SVAR framework following Blanchard and Perotti's (2002) identification methodology on data spanning from the second quarter of 1997 to the fourth quarter of 2012. The principal finds are that fiscal policy is conducted in a pro-cyclical manner and has non-Keynesian effects on output in Belize. Although taxes and government spending have Keynesian like signage, the fiscal multipliers are less than one, implying that taxes and government spending partially crowd out other components of aggregate demand. The key policy implication is that the Government of Belize should remain fiscally prudent when faced with cyclical downturns, if an expansionary fiscal stance raises debt management concerns.

Acknowledgement

I would like to acknowledge the Central Bank of Belize for their support throughout this process. I am also grateful to my dissertation supervisor, Dr. Yanhui Zhu, who provided me with valuable guidance and encouragement along the way. I am also thankful to all those persons who have assisted me in completing this work.

Table of Contents

List of Tables

List of Figures

1. Introduction

There has been a renewed interest in the use of fiscal policy as a stabilising tool since the onset of the recent Global Financial Crisis. As conventional monetary policy tools in advanced countries lost their ability to effectively stimulate aggregate demand when policy rates reached their lower bound, public officials actively turned to fiscal policy to stimulate real economic activity. In Belize, interest rates remained sticky downwards and the contagion effects of the crisis caused real output to stagnate in 2009. Amidst the concern of a protracted period of low growth, Keynesian style rescue fiscal packages were sought after by the public and promised by policy makers to dampen the adverse effects of the crisis. Given the high levels of public debt in Belize, deficit-driven spending, financed by debt or taxes, would have worsened an already strained fiscal position. It is therefore critical to analyse the effects of tax and Government spending measures on real output to determine the potential of fiscal policy to boost aggregate demand during economic downturns.

In the theoretical and empirical literature, there is a lack of consensus with regards to the true effects of fiscal policy on macroeconomic variables. From a theoretical perspective, non-Keynesians believe that fiscal policy has little, if any, effects on overall economic activity. They argue that the economy is able to regulate itself and advocate a *laissez-faire* approach to address temporary states of disequilibrium. In their view, an increase in government spending merely displaces an almost equal amount of real private spending. By contrast, Keynes (1935) rejected Say's 'law of markets' and instead, recommended active fiscal intervention to smoothen business cycle fluctuations. Thus, Keynesians urge the use of fiscal policy to stimulate aggregate demand during downturns. The Keynesian multiplier hypothesis predicts that if the

government increases deficit spending or implements a tax cut during economic downturns, aggregate spending will rise by a value that is greater than the original value of the additional expenditure or tax cut. On the empirical side, researchers have produced evidence that fiscal policy both crowds out and crowds in private spending.

This paper fills the research gap in two ways. First, it is the only study that has analysed the dynamic effects of fiscal policy on GDP for Belize, using a structuralized vector autoregressive (SVAR) approach. Second, it is one of the few studies that have been carried out focusing on the effects of fiscal policy on economic activity of a developing country. To my knowledge, no other empirical research has been conducted on Belize that has focused solely on the effects of fiscal policy. The only related empirical study was conducted by Hausman and Klinger (2007). They analysed the dynamics of economic growth in Belize, using their growth diagnostic framework and concluded that access to finance acts as a binding constraint on economic growth in Belize. To bypass this growth constraint, they recommended that Belize institutionalize fiscal discipline. In their view, fiscal sustainability is the 'key' to reducing the cost of finance for both the public and private sectors. Other recent studies on fiscal policy developments in Belize are primarily of a qualitative nature and emphasise the need for effective debt sustainability management in Belize; see for instance Glenday and Shuka, 2006; Sahay, 2005.

The purpose of this study is to provide an empirical analysis of the effects of fiscal policy on output using Belizean data. It answers the question how effective the fiscal policy is in stimulating aggregate demand in Belize. This is accomplished using a SVAR framework that follows the identification scheme developed by Blanchard and Perotti (2002).

The principal findings of this dissertation are that fiscal policy is generally conducted in a pro-cyclical manner and has non-Keynesian effects on output in Belize. Although taxes and government spending have Keynesian like signage, the fiscal multipliers are less than one, implying that government taxes and spending crowd out other components of aggregate expenditure. Consequently, an incremental unit increase in government spending, financed by taxes or debt, would result in less than an incremental unit increase in aggregate income. Hence, deficit-driven government spending is unable to effectively stimulate aggregate demand during recessionary times in the medium-run. The key policy implication is that the Government of Belize should remain fiscally prudent when faced with cyclical downturns, if an expansionary fiscal stance would lead to unsustainable debt levels. This finding strongly supports Hausman and Klinger's (2007) recommendation that the Government of Belize musk seek creative ways to finance growth-enhancing investments, while satisfying its inter-temporal budget constraint. In addition, the findings are consistent with other studies that found fiscal multipliers in developing countries to be less than one; see for instance Ilzetzki, Mendoza, and Végh, 2010.

The rest of this dissertation is divided into five sections. Section 2 comprises the literature review, which features a synthesis of the theoretical, empirical, and methodological literature related to this study. Section 3 presents the data used in this study, the data transformations undertaken and key properties of the data utilizing various statistical approaches. Section 4 details the methodology employed focusing, in particular, on the specification of the unrestricted VAR model and the identification of the SVAR model, using the Blanchard and Perotti (2002) approach. Section 5 features

the main results along with robustness checks of the SVAR model employed and a discussion of the study's policy implications. Section 6 concludes.

2. Literature Review

This study utilizes a structural VAR approach, following Blanchard and Perotti's (2002) identification methodology, to investigate the dynamic effects of fiscal policy in Belize. Blanchard and Perotti (2002) estimated a three-variable structuralised VAR consisting of quarterly values of taxes, spending and GDP using U.S. post-war data for two benchmark models. In the first, they assumed that the variables followed a deterministic path, allowing for exogenous linear and quadratic variables. In the second, they assumed stochastic trends by taking the first difference of each variable then subtracted a changing mean. Their results showed that a positive shock to spending yields a positive response to output, while a positive shock to taxes resulted in a negative effect. However, upon extending their model to account for components of aggregate spending, Blanchard and Perotti (2002) obtained evidence of non-monotonic responses to fiscal impulses. In particular, they found that private investment was crowded out by increases in both taxes and government spending - a non-Keynesian response. However, in line with conventional thinking, private consumption was crowded out by taxation and crowded in by government spending - a Keynesian response.

2.1. Theoretical perspective

The macroeconomic effectiveness of fiscal policy to stabilize business cycles is ultimately determined by the magnitude of its effect on output. However, the theoretical literature is inconsistent with regards to the true effects of fiscal policy on the real economy. The literature is generally divided along two major schools of economic thought. More specifically, the effects of fiscal policy on aggregate demand can be described as having either non-Keynesian or Keynesian effects.

Essentially, non-Keynesians argue that, given flexible prices and a constant money supply, an increase in real government expenditure, financed either by taxes or bonds, crowds out the private sector and results in little, if any, increase in total spending. Proponents argue that an increase in government spending, financed by either taxes or domestic debt, merely constitutes a resource transfer from the private sector to Government and results in a lower stock of productive capital in the long-run. Thus, an increase in deficit-driven spending by the public sector leads to a displacement of private expenditure and does not result in an increase in aggregate demand. This implies that the steady-state government spending multiplier is near zero as increases in government demand erase an almost equal amount of private demand.

Classical doctrines emphasise that effective demand could not be deficient or excessive (Spencer and Yohe, 1970). Thus, any incremental increase in deficit-driven government spending only results in changes in relative prices, causing a re-distribution of the same level of real output. This view is embodied in Say's Law, which posits that 'supply creates its own demand' for the production of all goods and services in the economy (Keynes, 1935). In a market economy, the aggregate supply of goods and services is determined strictly by supply side factors such as (i) the behaviour of profit maximising producers, (ii) competitive labour markets, (iii) the existing stock of capital goods and (iv) the state of technology (Spencer and Yohe, 1970).

In conventional neo-classical models, such as those of Robert Solow (1956), the natural growth rate of the economy does not depend on the rate of capital accumulation (like in Keynesian models), but rather on the growth rate of the labour force and the state of technology. Thus, fiscal policy can only affect the rate of growth on the transitional growth path that is associated with movement from an initial capital stock towards the

steady state. In other words, fiscal policy can only affect the level of output in the economy and can hardly influence its steady state growth rate (Easterly and Rebelo, 1993).

The method of financing an increase in government spending plays a key role in determining the channel of the crowding-out effects (Spencer and Yohe, 1970). A debt-financed increase in government expenditure may indirectly lead to a contraction in private consumption and investment through three price channels, that is, (i) real interest rates, (ii) real wages and (iii) price levels. In a closed economy, a debt-financed increase in government expenditure may have the indirect consequence of increasing domestic interest rates, barring any counteractive monetary policy measures. Higher interest rates would reduce private consumption as savings rates rise and lower private investments as the marginal efficiency of capital assets falls owing to higher capital costs (Keynes, 1935). Meanwhile, an increase in government expenditure on labour could drive up real wages which would, in turn, result in a contraction in private employment (Malley and Moutous, 1996). Furthermore, additional government spending could drive up the prices of goods and services in markets they compete in, displacing real private spending that would have otherwise occurred.

On the other hand, a tax-financed increase in government expenditure is believed to displace or substitute private consumption (Carlson and Spencer, 1975). Under this view, an increase in taxes forces the private sector to forego present consumption, while saving rates remain constant. As a consequence, the increase in government consumption that is financed by additional taxation merely substitutes for private consumption. Thus, a tax-financed increase in government spending has no effect on total spending.

Under an alternative framework, the Ricardian equivalence theorem holds that budget deficits and taxation have equivalent effects on the economy. It stresses that a cut in current taxes to stimulate aggregate spending leads to higher future taxes that have the same present value as the initial tax cut to meet future debt service payment costs (Barro, 1989). Thus, a decrease in public savings is matched by an increase in private savings and results in no change in national savings. Barro (1974, p. 1116) argues that "fiscal effects involving changes in the relative amounts of tax and debt finance for a given amount of public expenditure would have no effect on aggregate demand, interest rates, and capital formation".

Ironically, Keynes (1935) provided other reasons why an expansionary fiscal programme may retard private investment. He noted that in an economic climate where there is some form of 'confused psychology', a fiscal expansion may adversely affect the 'confidence' of the private sector, which then leads to an increase in liquidity-preference or diminishes the marginal efficiency of capital without monetary policy intervention. He also recognized that part of any increase in net public investment spending would be lost to the rest of the world in an open economy. Furthermore, Keynes (1935) suggested that the marginal propensity to consume is not homogenous across 'all levels of employment' such that as a 'rule' the marginal propensity to consume falls as real income rises. Since a large portion of any increase in aggregate income would accrue to the entrepreneurial class, who have a lower marginal propensity to consume than the rest of the 'community', the fiscal multiplier would have a weaker effect, following an increase in government spending.

By contrast, Keynes (1935) urged the use of fiscal policy to stabilise fluctuations in aggregate income during downturns. Keynes (1935) argued that governments should

increase deficit spending and lower taxes to boost effective demand during recessions. Thus, Keynesian economics emphasise that an increase in deficit spending during recessionary times leads to an increase in aggregate demand and a reduction in unemployment. The Keynesian multiplier process predicts that an increase in government expenditure or a decrease in the tax rate leads to repeated rounds of increased spending by the private sector, resulting in an expansion of total spending. The increase in aggregate spending over time should be at least equal to the initial increase in net investment. Thus, when there is an incremental increase in government spending during a period of economic slack, aggregate income is expected to rise by an amount that is larger than the size of the initial increment of government spending. Furthermore, the size of fiscal multipliers is believed to be even larger during recessionary times, especially when monetary policy rates reached their lower bound; see for example, Auerbach and Gorodnichenko, 2011.

In endogenous growth models, such as those by Barro (1990) and King and Rebelo (1990), long-term growth can be generated without relying on exogenous factors. In these models, investment in human and physical capital does influence long-term growth and thus, fiscal policy can influence the level of output and the long-run growth rate (Kneller, Bleaney, and Gemmell, 1999). In his endogenous model, Barro (1990) asserts that the composition of productive expenditure in aggregate spending affects the growth and savings rates. He contends that for a given share of government spending per GDP, an increase in productive spending increases the growth and savings rates, whereas an increase in non-productive spending decreases them.

On the other hand, if the share of government spending per output is held constant, an increase in the marginal tax rate lowers the growth and savings rate. Kneller, Bleaney

and Gemmell (1999) clarified that productive expenditures financed by non-distortionary taxes enhance growth rates, while those financed by distortionary taxes have an ambiguous effect. Furthermore, non-productive expenditures financed by distortionary taxes are predicted to have a negative impact on growth but no discernible impact when a non-distortionary tax is used. Similarly, King and Rebelo (1990) concluded that for small developing economies with mobile capital, national taxation policies can lead to either 'development traps' or 'growth miracles'.

2.2. Methodological approach

Econometricians have employed several methodological approaches to study the dynamic effects of fiscal policy on output. Modern techniques to investigate this research question include the use of dynamic general stochastic equilibrium (DSGE) models with adaptations to account for a government sector (see Barro 1989; Barro, 1981; Hall 1980), univariate autoregressive models (see Ramey and Shapiro, 1998), vector autoregressive models (see Blanchard and Perotti, 2002) and simple regression techniques (see Romer and Romer, 2007). Whereas the application of the univariate autoregressive models and simple regression techniques have been largely ignored in the literature to analyse the dynamic effects of fiscal policy on output due to omitted variable bias, VAR modelling has gained popularity over DSGE modelling since the late 1990's due to its ease of use and its requirement of fewer identifying restrictions, as suggested earlier by Sims (1980). For instance, in their study of output responses to fiscal policy, Auerbach and Gorodnichenk (2011, p. 3) explained that they preferred using the SVAR approach over DSGE modelling since "it is difficult to model slack in the economy and potentially non-clearing markets in a DSGE framework without imposing strong assumptions".

Blanchard and Perotti (2002) contended that the VAR approach is better suited to study the effects of fiscal policy rather than monetary policy, for which VAR techniques were created and advancements in applications were initially developed[1]. Since econometricians seek to determine the effect of policy changes through dynamic responses of surprised, one-off innovations to the macroeconomic variables of interest within the VAR framework, Blanchard and Perotti (2002) suggested that fiscal policy variables are more likely to be exogenous to output shocks than monetary variables. Furthermore, unlike in monetary studies, fiscal studies can take advantage of lags in making decisions and in implementing fiscal policy measures. This eliminates the need to consider the impact of discretionary fiscal decisions by policy makers to unexpected contemporaneous shocks to output. This is achieved by using high frequency data, such as quarterly time series of fiscal variables along with other quarterly macroeconomic variables of interest (like output, interest rates and prices). Cognizant of the aforementioned advantages of utilizing the SVAR approach over other empirical methods, the SVAR approach was chosen to conduct this study.

In line with the advantages they cited of using SVAR models in analysing the dynamic effects of fiscal policy, Blanchard and Perotti (2002) developed an identification methodology that was based on 'institutional information about the tax and transfer systems and timing of tax collections to construct the automatic response of fiscal policy to economic activity' (Blanchard and Perotti, 2002 p. 1330). The identification scheme was subsequently extended in Perotti (2004) to take into account the effects of inflation and interest rates. Identification is accomplished by constructing elasticities of output

[1] The VAR approach to conduct macroeconomic analysis and forecast was first recommended by Sims (1980) and applied to studying the macroeconomic effects of monetary variables. In the early stages, VAR techniques were advanced in monetary studies, for example in Mihov and Bernanke, 1995 which extends earlier work by Bernanke and Blinder, 1992, Strongin, 1992 and Christiano, Eichenbaum and Evans, 1994.

to fiscal variables in the system and also by imposing restrictions based on the expected automatic effects of output on macroeconomic variables that make up the system. This approach is used to construct the benchmark model for this study and is the most extensively used method of identifying fiscal shocks in the literature to date, for example see Guy and Belgrave, 2012; Mendoza and Végh, 2009; de Castro and Hernández de Cos, 2008.

To my knowledge, there are three other alternative strategies of identifying fiscal policy shocks in the empirical literature. First, the recursive method, which was introduced by Sims (1980), was later applied to identify fiscal shocks in semi-structural VAR frameworks by Favero (2002) and Fatás and Mihov (2001). However, a major criticism of this approach is that the Choleski ordering of the variables may lead to improbable assumptions regarding the causal interplay of the variables within the VAR model (Perotti 2004). As a consequence, the empirical results obtained may differ solely based on ordering of the variables. This outcome is unsatisfactory to researchers, especially when there is a lack of theoretical justification for which variable should be ordered first.

Second, Ramey and Shapiro (1998) used the 'narrative approach' to analyse the effects of exogenous innovations to government spending utilizing three large military build-ups in the post-World War II era on select macroeconomic variables. In their study, the events of interest consisted of the Korean War, the Vietnam War and the Carter-Reagan build-up. These events were represented by dummy variables that took the value of one in the quarters of 1950:3, 1965:1, and 1980:1, matching the period of the large increase in military spending. Ramey and Shapiro's (1998) identifying assumptions were extended in studies by Burnside, Eichenbaum, and Fisher (2004) and Edelberg,

Eichenbaum and Fisher (1999). On the other hand, Romer and Romer (2009)[2] used the 'narrative approach' to identify exogenous tax changes between 1947 and 2006, filtering out revenue changes owing to automatic effects and other factors that are correlated with movements in economic activity. The main advantage of the narrative approach is that it allows the researcher to define and identify truly exogenous and unanticipated events. However, other 'substantial fiscal shocks', fitting outside the researchers defined interest may be overlooked. For instance, Perotti (2004) identified that there were significant increases in U.S. Government expenditure four quarters before the build-up of sizeable military spending, which Ramey and Shapiro (1998) ignored when setting their start date of the Korean War shock to 1950:3.

Third, Papa (2005), Canova and Pappa (2007), Mountford and Uhlig (2009) and later Dungey and Fry (2009) used an identification strategy in which they directly imposed 'sign restrictions' on fiscal variables and restricted fiscal shocks to be orthogonal with other shocks, following the methodology of Canova and De Nicolo (2002). For example, Mountford and Uhlig (2009) restricted fiscal shocks to be orthogonal with business cycle shocks and monetary policy shocks. They defined a business cycle shock as a shock in which output, consumption, non-residential investment and government revenue are jointly positively correlated. The sign of the impulse responses of a government spending shock and of a government revenue shock were restricted to be positive for the first four quarters of the time horizon, including the quarter of the initial impact. For a monetary policy shock, they imposed a positive sign on the impulse responses of interest rates and a negative sign on the impulse responses of adjusted reserves and prices, following earlier applications in monetary studies by Uhlig (2005).

[2] This effort builds on earlier work done by Romer and Romer (1989) in which they identified monetary policy shocks using a similar non-statistical procedure.

The main advantages of utilizing the sign restrictions approach are that the restrictions are based on economic theory rather than being atheoretical like the recursive approach; monetary policy is directly taken into account; fiscal disturbances are precisely defined; and, there are no endogeneity issues with respect to imposing delay restrictions as in the recursive approach (Canova and Pappa, 2007). However, Perotti (2004) pointed out two key disadvantages of using the sign restrictions approach. First, there is an inability to identify exactly when a shock occurs based on the persistence requirement imposed in defining a fiscal shock. Second, at times, the sign restrictions may be overly powerful, masking other plausible casual dynamic interrelations among the variables.

2.3. Empirical findings

Broadly speaking, there is a lack of consensus in the empirical literature on the size of fiscal multipliers, the crowding out (crowding in) effects of fiscal policy shocks, and the response of the private consumption and investment to shocks to government expenditure (Papa, 2005). Whereas conventional wisdom predicts that tax cuts and increases in government spending raises aggregate demand, some recent studies[3] produced empirical evidence of expansionary fiscal consolidations, such as those by Afonso, 2006; Alesina and Ardagna, 1998 and Giavazzi, Jappelli, and Pagano, 1998, which extended earlier pioneering work by Giavazzi and Pagano, 1990. The later first found empirical evidence of expansionary fiscal contractions in stabilization efforts undertaken by Denmark and Ireland in 1980's, particularly when spending cuts were large and persistent.

[3] See Afonso (2006) for a comprehensive review of studies from 1990-2006.

More specifically, the empirical evidence is inconsistent with regards to the observed effect of a shock to taxes on economic growth, regardless of the identification method used in identifying fiscal shocks or the level of development of the country being studied. The pioneering studies that focused on the U.S. mostly found that in response to a positive tax shock output behaved in a Keynesian like manner, regardless of the identification method used. In particular, they found that a positive shock to taxes causes output to fall (Mountford and Uhlig, 2009; Romer and Romer, 2009; Blanchard and Perroti, 2002) and investments to contract (Mountford and Uhlig, 2009; Blanchard and Perroti, 2002).

However, in a comparative analysis of four different identification methodologies, Caldara and Kamps (2008) obtained inconsistent results. Conventional outcomes depended on the method of identification used for U.S. data over the period 1955-2006. For instance, they concluded that a positive shock to taxes has a distortionary effect on output when using the sign restriction approach but a non-distortionary response when using the recursive and Blanchard and Perotti (2002) methods. They attributed the difference in results to the size of automatic stabilizers estimated or calibrated for alternative identification approaches.

The empirical outcome of studies analysing OECD countries also varied across Keynesian and non-Keynesian lines. For example, Perotti (2004) obtained mixed results in his analysis of the effects of net taxes on GDP for five OECD countries, namely Australia, Canada, West Germany, United Kingdom and United States. He obtained non-Keynesian effects of a tax cut on output for the U.S. in one subsample and the same for Canada in another. With regards to Europe, the signage of the effects of a shock to taxes on output was also ambiguous. For instance, Biau and Girard (2005) observed a weakly

negative response of output to a shock to taxes for France, while de Castro and Hernández de Cos (2008) obtained a positive effect in the short-term but ultimately a Keynesian response in the medium-term for Spain. Giordano et al. (2007) found that positive innovations to net revenues have negligible effects on macro-variables for Italy. Ravnik and Žilić (2011) found that a positive shock to revenue initially crowds out industrial production for Croatia on impact as expected but later exerts an unexpected positive effect on economic activity after three months elapsed.

Similarly, studies that focused on Latin American and Caribbean countries also showed mixed results among alternative identification schemes. For instance, de Paiva et al. (2011) found that a positive shock to public revenue crowds out output for Brazil, Chile and Mexico using the sign restriction approach, whereas Restrepo and Rincón (2006) found a transitory negative effect on output for Chile and no effect for Colombia using the Blanchard and Perotti (2002) approach. For the Caribbean, Guy and Belgrave (2012) applied the Blanchard and Perotti (2002) SVAR approach to analyse the impacts of fiscal policy for Barbados, Guyana, Jamaica and Trinidad and Tobago. They found that a positive shock to taxes crowds in output, particularly for Jamaica. In their view, this counterintuitive outcome reveals that these governments tend to spend lump sum tax receipts in a manner that increases private consumption and private investment.

Turning to government spending, most studies report that a positive one-off innovation to government expenditure induces a positive effect on aggregate demand in support of Keynesian views (Caldara and Kamps, 2008). However, some researchers have found a non-monotonic response to government expenditure when investigating the impulse response of one-off innovations to government spending on components of aggregate spending. In these studies, the impact of shocks to fiscal policy on aggregate demand

hinges on the response of private savings to changes in taxes and government spending. Thus, an increase in government spending may be offset by a compensating increase in private savings as larger budget deficits induces higher interest rates and negative wealth effects. Accordingly, some studies show a non-Keynesian response to a shock to government spending on private consumption (Blanchard and Perotti, 2004), on private investment (Blanchard and Perotti, 2004; Blanchard and Perotti, 2002), and on residential and non-residential investment (Mountford and Uhlig, 2009).

The impact of fiscal policy on macroeconomic variables depends on country specific factors as well as the composition of taxes (distortionary vs. non-distortionary components) and government spending (productive vs. non-productive shares). Given the lack of theoretical and empirical consensus in economics regarding the effect of fiscal policy on economic activity, the only way to determine the true macroeconomic effects of a country's fiscal policy is by empirical analysis.

3. Data

This study uses three variables that span from the second quarter of 1997 to the fourth quarter of 2012. In the following subsections, I discuss how the variables were constructed and show their composition. Thereafter, key statistical properties of the data were examined. In particular, a correlation analysis was conducted to determine the alignment of fiscal policy with business cycles. Shocks to taxes and government spending over the sample period were also examined using a statistical approach.

3.1. Construction of variables

The first variable is tax revenue, hereafter referred to as 'taxes'. It consists of compulsory transfers received by the Central Government that include the sum of taxes on (i) income and profits, (ii) property, (iii) goods and services and (iv) international trade and transactions.

The second variable is government spending, hereafter referred to as 'spending'. It is defined as the sum of Central Government's expenditure on goods and services plus capital expenditure and net lending. This series provides quarterly estimates of government's final consumption of goods and services, as well as, expenditure on gross capital formation in absence of government consumption and investment data extracted from the national accounts. The data on taxes and government spending were obtained from the Central Bank of Belize (the Bank) who extracts the data from the Central Government's monthly statement of operations that is recorded on a cash basis. The Bank uses this information to analyse the operations of Belize's Central Government that is published in various economic reports. The data is also made available in aggregate form in their statistical publication. The monthly data that were obtained from the Bank were aggregated to construct the quarterly series of taxes and spending as defined herein[4].

The third time series is quarterly GDP in 2000 prices obtained from the Statistical Institute of Belize (SIB).

In other similar studies, taxes and spending are defined somewhat differently. With regards to taxes, Blanchard and Perotti (2002) added contributions for social insurance to taxes then subtracted net transfer payments to persons and net interest paid by

[4] The monthly data was grossed into quarterly data to match the periodicity of the quarterly GDP series.

government. In this study, pension payments to government workers as well as interest payments on domestic and foreign liabilities are excluded from spending.

Blanchard and Perotti (2002) constructed their spending variable using capital and current purchases of goods and services obtained from quarterly national accounts. I used capital expenditure and government spending on goods and services from the Ministry of Finance's cash records. The question has been raised whether the use of cash instead of accrual data leads to different outcomes when analysing the effects of fiscal policy in VAR studies[5]. Most of the related studies extract data from treasury accounts, which is usually recorded on a cash basis (Perotti, 2004). For example, Giordano *et al*., 2007 used an identical approach to estimate government consumption and investment for Italy, as done here. Moreover, they found no significant difference on the effect of GDP when they substituted government consumption cash data for national accounts data in their study.

Thereafter, taxes and spending were converted to real terms. Whereas the GDP was obtained from source in constant dollars, taxes and government spending were in current dollars. Hence, the two later series were converted to constant terms based on February 2000 prices in line with the base year of the GDP series. The inflation adjustment was accomplished by deflating both series using Belize's Quarterly Consumer Price Index (CPI) in the absence of the quarterly GDP deflators. The CPI index is based on February 2011 prices and was obtained from the SIB[6].

[5] See Perotti (2004) for a full discussion on this matter.
[6] The GDP implicit price deflator would have been preferred but this is unavailable since the SIB does not compute quarterly GDP in current prices.

All three time series were then decomposed into their unobserved seasonal and non-seasonal components[7]. Seasonal adjustment was accomplished using a ratio to moving average-multiplicative method in EVIEWS 7. Finally, all three series were converted to logs and entered into the VAR as logarithms of real quarterly per capita[8] equivalents. This facilitates interpretation of the impulse responses as shares of GDP (Blanchard and Perotti, 2002).

3.2. Composition of taxes and spending terms

Government spending exceeded tax revenues by 1.8% of GDP on average over the sample period as shown in Table 1. Tax revenues averaged 18.9% of GDP, of which, taxes on goods and services plus taxes on international trade and transactions accounted for more than two-thirds of total tax revenues. At 13.2% of GDP, almost two-thirds of Government spending went on consumption goods and services. Expenditure on capital items averaged 7.5% of GDP over the sample period.

Table 1: Average Shares of Real Taxes and Spending in GDP

Taxes	**18.9**
Income and profits	5.3
Property	0.2
Goods and services	6.8
International trade and transactions	6.7
Spending	**20.7**
Final consumption	13.2
Capital expenditure	7.5

3.3. Correlation analysis

A simple correlation analysis between fiscal policy variables and output can provide insights on how fiscal policy behaved over business cycles during the sample period. Standard Keynesian theory suggests that fiscal policy should be counter-cyclical. If

[7] This procedure was done by other researchers in similar studies such as in de Castro and Hernández de Cos (2008) and Blanchard and Perotti (2002).
[8] The population statistics were obtained from the SIB.

fiscal policy is counter-cyclical, one should observe a positive correlation between taxes and output and a negative correlation between spending and output. This outcome implies that the Government reduces taxes and increases spending during bad times and the reverse would be true during good times. In contrast, if the correlation between taxes and output and spending and output are both positive, then fiscal policy is pro-cyclical. This means that taxes and spending are decreased during bad times and increased during good times. If correlations between fiscal variables are virtually zero, this implies that fiscal policy is practically neutral over the business cycle in line with Barro's (1979) tax-smoothing model (Talvi and Végh, 2005).

The correlation analysis revealed a significantly strong positive association between GDP and taxes with a correlation coefficient of 0.94 at a 1% level of significance, as shown in Table A-2. The sub-components of taxes also exhibited highly positive correlation coefficients with output ranging from 0.87 to 0.65 at the 1% level of significance. In contrast, the association between spending and output was positive but much weaker with a correlation coefficient of 0.48 at a 1% level of significance. Further analysis of the sub-components of spending reveals that the correlation between government consumption and output was positive and high while, the strength of co-movement between expenditure on capital items was negative and weak at a 10% level of confidence.

The results indicate that taxes and spending tend to increase in good times and decrease in bad times, though government expenditure on capital goods was weakly counter-cyclical over the period. Thus, fiscal policy outcomes in Belize are pro-cyclical[9] in behaviour as government spending shares of GDP rises during good times and falls

[9] The results were confirmed using a parsimonious OLS model of quarterly GDP on quarterly taxes and quarterly spending with constant and deterministic terms.

during bad times. Pro-cyclical fiscal policy is viewed as sub–optimal since it reinforces macro-instability. This finding is consistent with reported pro-cyclical fiscal behaviour for developing countries (Talvi and Végh, 2005), and in particular for Latin America (Gavin et al., 1996) and select Caribbean countries (Guy, K., and Belgrave, A. 2012).

The public finance literature provides several explanations for the inability of governments to maintain stable GDP shares of taxes and spending across business cycles. An in-exhaustive list includes: (i) binding credit constraints – whereby sovereign risk rises due to excessive borrowing during up-turns, making it difficult to borrow during down turns (Gavin et al, 2006); (ii) a volatile tax base – whereby large fluctuations in the tax base make it difficult for public authorities in developing countries to conduct 'tax smoothing behaviour' because fiscal surpluses are wasted and spent due to political pressure from agents instead of used to extinguish accumulated debt (Talvi and Végh, 2005); (iii) an agency problem – which occurs when governments appropriate part of tax revenues for unproductive public consumption or political rents (Alesina, Campante, and Tabellini, 2008).

3.4. Examination of fiscal shocks

An analysis of the data reveals several episodes of large variations in government revenues and spending. Table 2 summarises large changes in real taxes and spending over the sample period. In general, tax revenues were less volatile than expenditure on public consumption and investment items, since shocks to taxes were smaller and less frequent than shocks to spending.

The largest shocks to taxes were between two and three standard deviations in size. There were four instances of shocks to taxes within this range that occurred in 1999:2, 2008:4, 2009:2 and 2011:3. Whereas the first two episodes entailed large decreases in

tax collections, the last two reflected large increases in tax revenues. In 1999:2, tax collections contracted steeply due to the implementation of a tax regime with a lower burden that took effect on 1 April 1999 when a 15% value added tax was repealed and replaced by a lower sales tax. The new sales tax regime levied 12% on alcohol, tobacco, and fuel, 8% on all other goods and services and 0% on items that were exempted (Central Bank of Belize, 1999). Meanwhile in 2008:4, the adverse effects of the global financial crisis reached Belize's shores, causing tax collections on income and profits as well as on goods and services to contract steeply. In contrast, tax collections soared in 2009:2 in response to a 25% increase in the rate of the gross sales tax from 10% to 12% and larger takes from petroleum exports owing to rising prices (Central Bank of Belize Quarterly Review, 2009).

Table 2: Large Changes in Real Taxes and Spending

1 std. < Δ taxes < 2 std.			1 std. < Δ spending < 2 std.	
1999:1	11.4		1999:1	28.5
1999:3	9.5		1999:2	(31.2)
2001:1	7.8		2000:4	32.0
2004:1	14.4		2001:3	25.6
2004:4	(7.6)		2001:4	(31.6)
2005:2	7.9		2002:1	38.5
2006:4	9.1		2002:3	31.7
2007:2	11.3		2004:2	(29.0)
2007:3	(8.6)		2005:1	35.1
2008:1	9.2		2005:2	(44.6)
2010:1	9.8		2007:1	36.1
2010:4	11.1		2007:2	(36.8)
2011:2	(13.8)		2007:4	29.2
2011:4	(10.4)		2008:2	(30.0)
			2008:4	27.6
			2009:2	(32.1)
			2012:1	28.2
			2012:2	(33.3)
2 std. < Δ taxes < 3 std.			2 std. < Δ spending < 3 std.	
1999:2	(17.6)		2000:1	46.0
2008:4	(18.6)		2000:2	(54.5)
2009:2	18.9		2002:2	(52.5)
2011:3	19.5			

Notes: One standard deviation for changes in taxes and spending are $7.5mn and $22.1mn, respectively. Values are in millions of Belize dollars.

The upswing in 2011:3 was partly due to automatic tax adjustments, owing to a modest rebound in economic activity and higher tax yields on petroleum exports. Smaller changes that were one to two standard deviations in size largely reflected timing differences in lumpy tax collections, modest changes in tax administration over the period and automatic responses of tax collections in line with business cycles.

Large spending changes reflected ad hoc patterns in capital spending and, to a lesser extent, uneven purchases of goods and services. Interestingly, nine of ten reductions in spending that were greater than one standard deviation in size occurred in the second quarter of the year. These were primarily attributable to reductions in capital expenditure and partly reflected advance or retroactive payments on public investment projects before the end of the fiscal year, owing to the lack of an effective multi-year budgeting framework and public investment programme.

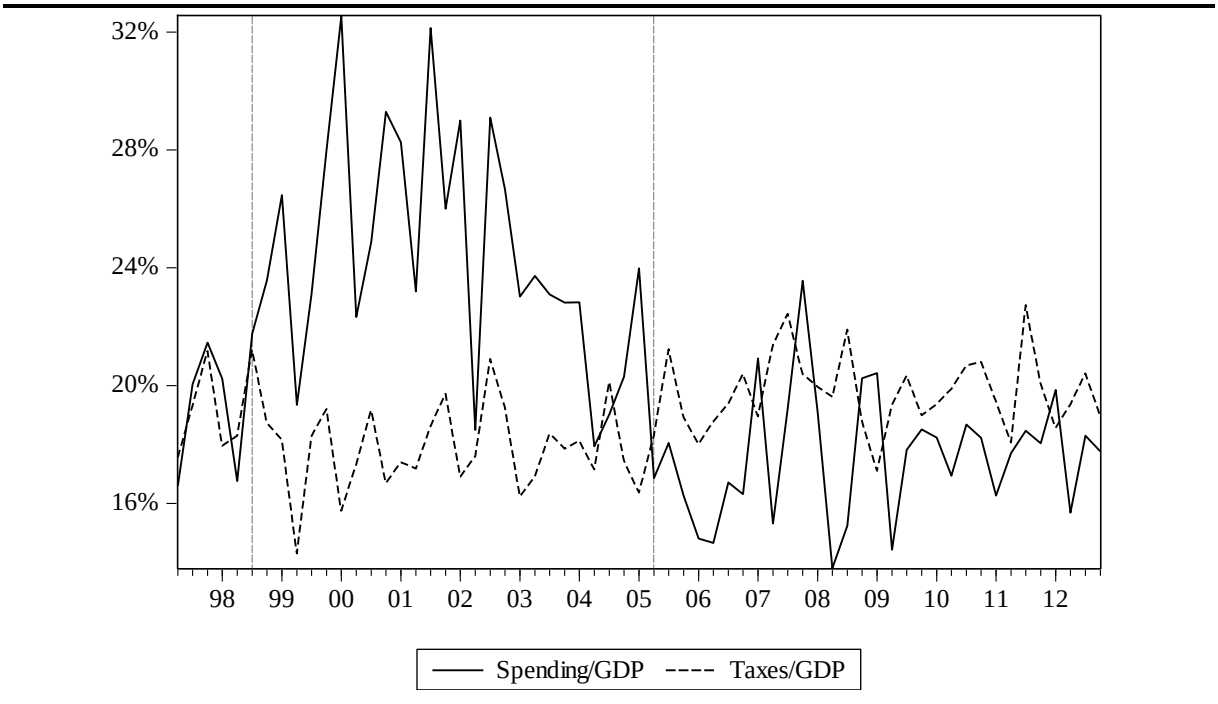
3.5. *Fiscal stance*

A plot of real taxes and spending as shares of real GDP reveals three distinct stances of fiscal policy over the sample period, as shown in Figure 1. In the first phase that spanned from 1997:2 to 1998:2, the Government of Belize's fiscal stance was virtually neutral as changes in government taxes closely followed changes in government spending. In the second phase, which began in 1998:3 and ended in 2005:2, the fiscal stance was expansionary as spending exceeded tax revenues by sizeable margins on a quarterly basis. During this period, financing was augmented from various unsustainable sources. Primarily, these included: (i) borrowings from external commercial creditors on burdensome terms and (ii) capital revenue proceeds stemming

from the privatization of public companies[10] and sale of crown lands, as shown in Figure A-1. With regards to the latter, the IMF's Article IV consultation reported that the Government had sold out all the 'public enterprises' to improve the provision of their services by end of 2003 (IMF, 2004).

The excessive borrowings from commercial creditors abroad led to a rapid accumulation of public debt. The ratio of outstanding debt to GDP had ballooned from 38.7% in 1997:4 to 87.3% in 2005:4 (Central Bank of Belize Annual Report, 2006; Central Bank of Belize Annual Report, 1999) and resulted in an unsustainable debt position. Being highly vulnerable to macroeconomic shocks and faced with high rollover risks, Belize restructured its external debt with commercial creditors in February 2007 to alleviate its looming solvency problem and escape debt distress.

Figure 1: Real Taxes and Spending as Shares of Real GDP



[10] The privatization programme included the sale of shares in the Belize Electricity Limited in 1999, the Belize Water Sewerage Limited in 2001 and the Port Authority of Belize in 2002.

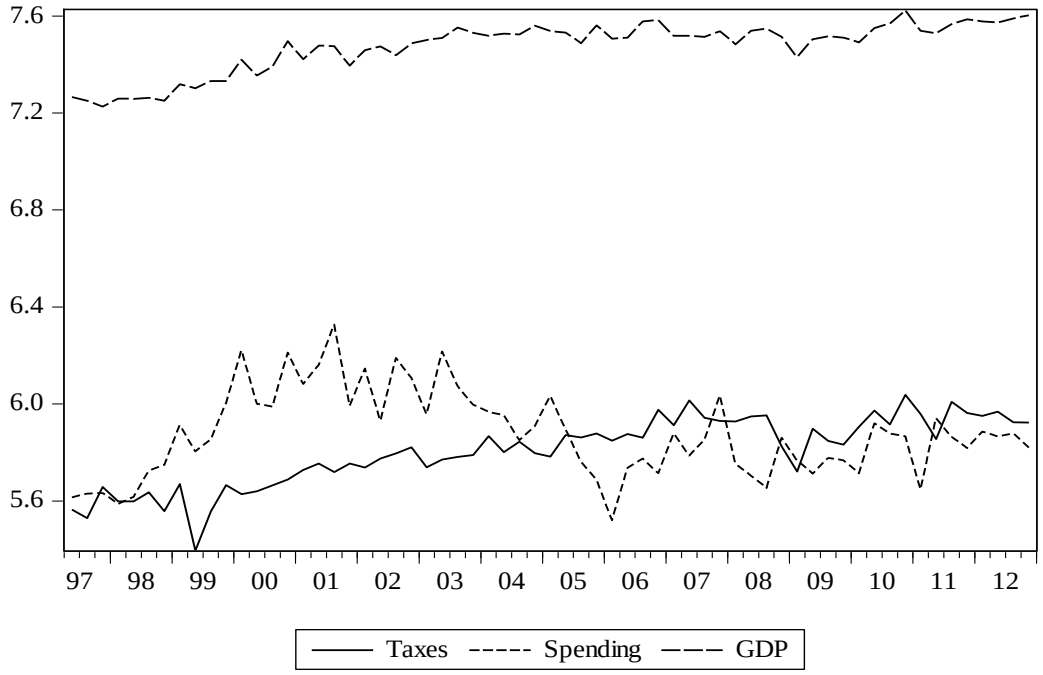
The difficult public sector cash flow position forced a contractionary fiscal stance in the third phase, during which the Government sought to remain solvent by increasing its primary surplus to reduce its debt-to-GDP level. Fiscal consolidation was also necessary to restore confidence and to regain future access to international capital markets. Except for four quarters[11], GDP shares of tax revenues exceeded GDP shares of government spending from 2005:3 to 2012:4. Fiscal consolidation was achieved not only by reducing government expenditures but also by increasing marginal tax rates. The shift policy in stance contributed to a marked difference in real growth rates. Whereas real GDP grew by an annual average of 7.0% from 1998-2004 during the expansionary period, Belize's real GDP growth rate declined to 2.8%, on average, from 2005-2012 when fiscal policy tightened.

3.6. Testing for unit roots

From a visual inspection of the plot of the three series over the sample period in Figure 2, it is unclear whether the variables have unit root(s). The variables were therefore pre-tested for the presence of unit root(s) to determine whether the series are stationary or difference-stationary to avoid spurious regression. Statistical inferences drawn from regressions with non-stationary variables can lead to erroneous conclusions. By convention, a vector error correction (VEC) model is more appropriate for a system containing random variables that are integrated to the order, I(1), with cointegrating relationship(s). Furthermore, the presence of unit roots in a VAR system can make model stability tests as well as Granger causality tests unreliable.

[11] Those periods are 2007Q1, 2008Q4, 2009Q1 and 2012Q1.

Figure 2: Logs of Seasonally Adjusted GDP, Taxes and Spending in Real per Capita Terms



Formal unit root tests were conducted using the Augmented Dickey-Fuller (1979) and Phillips-Perron (1988) tests that includes no constant and no trend, with constant but no trend and with constant and trend. For the former, I choose to use the automatic lag length selection using a Schwarz Information Criterion (SIC) that used a maximum lag length of 10, while for the latter the default Kernel spectrum estimation method using the Andrews bandwidth was chosen. These methods were applied to all three time series. Table A-3 shows that taxes and spending are stationary with a constant and deterministic time trend at levels within the conventional level of significance. In contrast, both tests indicated that the GDP series was stationary at first differences.

It has been shown that the OLS estimator is consistent when a VAR has some unit roots equal to one but with fewer unit roots than variables , "as long as the innovations in the VAR have enough moments and a zero mean, conditional on past values" of the dependent variables (Sims, Stock and Watson, 1990 pp. 113-114). This important finding eliminates the need to impose a cointegrating relationship or employ a vector

error correction model on the original data when the researcher's interest is not in drawing inferences about intercepts or about linear combinations of coefficients. Since the focus of this study is to analyse the dynamic interactions of random shocks or innovations to fiscal variables on output, the benchmark VAR model is estimated with all the variables untransformed at levels in line with the recommendation of Sims, Stock and Watson (1990). Similar studies also used the results of Sims, Stock and Watson (1990) to estimate VARs with the variables entering in levels, see for example Giordano, *et al.* (2007) and de Castro and Hernández de Cos (2008). Additionally, this modern approach eliminates concerns about the low power of the unit root tests, their sensitivity to structural breaks in the data as well as other pre-test biases associated with the traditional approach.

4. Methodology

4.1. Specification of unrestricted VAR model

The key to avoid spurious regression in VAR models is to add a sufficient number of autoregressive lags. Therefore, the process of determining the number of lagged values to include in the VAR model is an integral part of specifying a stable VAR model. Incorrectly specifying the lag length of a VAR model can result in inconsistent impulse responses and variance decompositions (Braun and Mittink, 1993). Whereas over-fitting the model may lead to inefficiency, under-fitting the model may cause some dynamics in the system to be unrealized. Several methods and tests were used to identify the true lag length of the unrestricted VAR model with constant and trend.

Akaike's information criterion (AIC) and Schwarz's information criterion (SIC) from the VAR system were analysed to identify the appropriate lag length. Table 3 shows the AIC and SIC for representations of unrestricted VAR(m) models with orders of m = 1, ...,6 with constant and linear deterministic terms. The preferred VAR(m) model would have the lowest information criterion.

The information criterion obtained through this method offers mixed results. Based on the AIC one should choose 3 lags, whereas the SIC suggests an order of 1 lag length. As observed here, Lütkepohl (1999) found that the SIC criteria typically identifies the most parsimonious model while, in contrast, the AIC chooses the model with the largest lag length and asymptotically overestimates the true order.

Table 3: AIC and SIC Values for VAR

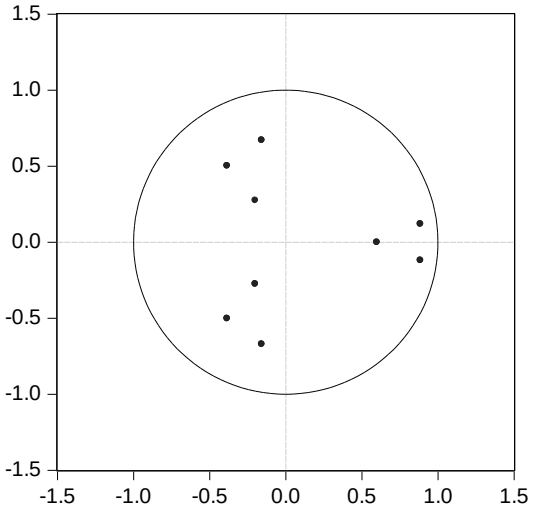
Lag length	**1**	**2**	**3**	**4**	**5**	**6**
AIC	-7.590	-7.530	-7.671*	-7.547	-7.293	-7.354
SIC	-7.076*	-6.699	-6.519	-6.068	-5.481	-5.203

Notes: * indicates lag order selected by the criterion.

Due to the inconsistent findings, a lag length criteria test was conducted. The result is presented in Table A-4. It shows that three of five criteria (LR, SCE and AIC) indicated an optimal lag order of 3, while two criteria (SIC and HQN) supported an order of 2. Furthermore, a lag exclusion Wald test was conducted to verify whether three lags was suitable for the unrestricted VAR model. The χ^2 statistic for the joint significance of all endogenous variables in the VAR at three lag lengths was jointly significant at the 1% level of significance, confirming that three lag lengths is optimal, as shown in Table A-5.

The stability of the model was then tested using the AR roots graph. The estimated VAR(3) is stable if the inverse roots of the modulus are less than one and lie inside the unit circle. If the VAR is not stable, then the results of the impulse analysis will not be valid. There should be 9 roots in the graph, equalling the number of endogenous variables, 3, in the VAR multiplied by the number of lags, 3. The test verifies that no roots lie outside the unit circle. This implies that the unrestricted VAR model with an order of three lags is stable and fit to conduct impulse response analysis. Figure 2 shows the graphical representation of the inverse roots of the characteristic AR polynomial.

Figure 2: AR Roots Graph



Since it is assumed that all the variables in the VAR(3) are endogenous, the validity of this assumption was tested using the pairwise Granger causality tests. The χ^2 statistic for joint significance of the lagged endogenous variables in all three equations revealed that I cannot reject the null hypothesis that the variables in the system can be treated as exogenous at a 10% level of significance. However, if any variable is found to be strictly exogenous, then the restrictions in the identification scheme should restrict the ability of the exogenous variable to react to innovations of other variables in the model.

Several diagnostic tests on the residuals for the VAR(3) model were conducted. Three autocorrelation tests namely, the pairwise cross-correlograms test, the Portmanteau Autocorrelation Test and the autocorrelation LM Test, revealed that that there are no issues with serial autocorrelation in the stable VAR(3) model. Furthermore, the null hypothesis that the residuals were normal using the Cholesky factorization matrix with taxes ordered first was not rejected. Similarly, the results of the White Heteroskedasticity Test with no cross terms under the null of no heteroskedasticity or (no misspecification) for the joint significance of the regressors showed favourably that I cannot reject the null of no misspecification at the 10% level of significance.

4.2. Identification of SVAR

The reduced form VAR, which expresses each variable as a linear function of its own lags, the lags of other variables within the system and a serially uncorrelated error term, can be written as

$$Z_t = A(L)Z_{t-1} + U_t, \quad U_t \sim N(0, \sigma_t^2) \tag{1}$$

where $Z_t \equiv (t_t, g_t, y_t)$ is a three-dimensional vector of endogenous variables consisting of quarterly values of taxes, government spending and output in log levels of real per capita equivalents. The matrix $A(L)$ is a matrix consisting of quarterly autoregressive

polynomials with three lags. Blanchard and Perotti (2002) suggested that it is suitable to account for quarterly dependence of the coefficients owing to the presence of seasonal patterns in tax collections in response to fluctuations in economic activity. $U_t \equiv (u_t^t, u_t^g, u_t^y)$ is a three dimensional vector containing the reduced form residuals of taxes, spending and output that is identically independent, normally distributed with zero mean and constant variances. The observed (or reduced form) residual were obtained from estimating the unrestricted VAR(3) model with constant and trend[12] terms as described in the previous section.

The reduced form residuals of the t_t and g_t equations, u_t^t and u_t^g, can be viewed as linear combinations of three types of shocks (Perotti, 2004). These are combinations of the automatic response of taxes and spending to innovations in output; the systematic discretionary response of fiscal policy decisions on output; and, random discretionary shocks to fiscal policies (Perotti, 2004). As Perotti (2004) noted, the latter are the structural fiscal shocks that are uncorrelated with other innovations and are utilized when estimating the impulse responses to innovations of taxes and spending. The reduced-form residuals can be represented as

$$u_t^t = a_1 u_t^y + a_2 e_t^g + e_t^t \tag{2}$$

$$u_t^g = b_1 u_t^y + b_2 e_t^t + e_t^g \tag{3}$$

$$u_t^y = c_1 u_t^t + c_2 u_t^g + e_t^y \tag{4}$$

where e_t^t, e_t^g and e_t^x are mutually uncorrelated structural shocks[13]; and e_t^t and e_t^g are the structural fiscal shocks of government taxes and expenditure with $\text{cov}(e_t^t, e_t^g) = 0$. Equation (2) defines unexpected movements in taxes within a quarter, t_t, as the sum of

[12] As standard, constant and trend terms are left out of the representation to simplify the notation.
[13] Structural shocks are shocks that are not responsive to economic events (Hann, 2011).

responses to structural shocks to GDP, spending and taxes, captured by $a_1 u_t^y$, $a_2 e_t^g$ and e_t^t, respectively. Equation (3) denotes unexpected movements in spending within a quarter, u_t^g, as the sum of the responses to structural shocks to output, taxes and government spending represented by $b_1 u_t^y$, $b_2 e_t^t$ and e_t^g, respectively. Equation (4) defines the unexpected movements in output within a quarter, u_t^y, as responses to unexpected movements in taxes, $c_1 u_t^t$, government spending, $c_2 u_t^g$, and other unexpected shocks to economic activity, e_t^y.

Three steps are used to identify the system of equations above (Blanchard and Perotti, 2002). In the first step, they used institutional information on taxes, transfers and spending to construct the coefficients a_1 and b_1. These coefficients capture both the automatic effects of economic activity on taxes and spending as well as any discretionary adjustment made to fiscal policy in response to shocks within a given quarter. However, Blanchard and Perotti (2002) reasonably assumed that governments are unable to identify and respond to any shock all within the same quarter. As a result, the parameters are taken to capture only automatic responses of taxes and spending to changes in output when using quarterly data.

Blanchard and Perotti (2002) proposed that these automatic responses can be captured through elasticities of output to taxes and spending. The quarterly elasticity of taxes with respect to output can be written as

$$\mathrm{a}_1 = \sum_{i=4}^{4} \eta_{T_i B_i} \eta_{B_i X} \frac{\tilde{T}_i}{\tilde{T}}, \tag{5}$$

where $\eta_{T_i B_i}$ represents the elasticity of taxes of type i to their tax base; and $\eta_{B_i X}$ represents the elasticity of the tax base to output. Furthermore, $\tilde{T}_i$ means the ith category of actual tax revenue, where $i = 4$; and $\tilde{T} = \sum_i^4 \tilde{T}$denotes total tax revenues;

and $\frac{\tilde{T}_i}{\tilde{T}}$ equals the weighted share of the ith category of actual tax revenue to total tax revenues.

To estimate the elasticity of taxes to output, however, I used the least squares method adopted by de Castro and Hernández de Cos (2008) using the four components of tax revenues. Those categories of taxes are: (i) income and profits, IP, (ii) property, P, (iii) goods and services, GS, and (iv) international trade and transactions, ITT. Since the ith category of taxes was found to be I(1) and co-integrated with output, the elasticity for each category of tax was computed using an error correction model, as specified in de Castro and Hernández de Cos (2008). Formally, the model can be written as

$$\begin{aligned}\Delta \mathrm{Ln}\left(\mathrm{B}_{\mathrm{t}}^{\mathrm{i}}\right) = \gamma + \mu\left(Ln\left(B_{t-1}^{i}\right) - \lambda Ln(Y_{T-1}) - \phi - \delta t\right) + \varepsilon_i \Delta Ln(Y_t) \\ + \sum_{j=1}^{k} \varphi_j \Delta Ln\left(Y_{t-j}\right) + \sum_{j=1}^{k} v_j \Delta Ln\left(\mathrm{B}_{\mathrm{t-j}}^{\mathrm{i}}\right) + \eta_t\end{aligned} \tag{6}$$

where B_i is the relevant tax base for the ith tax category; λ is the error correcting coefficient that shows the correction of ΔB_i to the co-integrating error. The term ε_i represents the value of the short-term contemporaneous elasticity of the ith tax category on output. Using this method, the elasticity on output for taxes, a_1, can be expressed as

$$\mathrm{a}_1 = \sum_{i=1}^{n=4} e_{t,i,y} \times \frac{\tilde{T}_i}{\tilde{T}}, \tag{7}$$

Table 4 below shows that the quarterly tax elasticity to output, a_1, is 0.496. This measure of revenue responsiveness to income means that a one percent increase in quarterly GDP, *ceteris paribus*, increases tax revenues within a given quarter by approximately 0.5%. This value is much smaller than Blanchard and Perotti's (2002) benchmark average value of 2.08 for the US over the quarterly period 1947:1 to 1999:4

but similar to the value of 0.62 computed by de Castro and Hernández de Cos (2008) (2008) for Spain, covering the period 1980:1-2004:4. Blanchard and Perotti (2002) tested the robustness of their model with alternative values of net tax elasticity and found that while the shapes of the impulse responses of GDP to a tax shock were similar, the size of the multipliers varied significantly. Thus, it is important to note it is being assumed that the tax elasticity to output is invariant across the horizon while, in fact, it changes over time.

From a theoretical perspective, the elasticity-spending hypothesis suggests that larger tax elasticities are favoured to smaller ones, since the former leads to greater revenue collection as economic activity grows which, in turn, translates into larger government spending over time. A more responsive tax system tends to suppress 'fiscal illusion', which describes the belief by policy makers that they must increase the tax rate in order to raise tax revenues.

Table 4: Elasticity of Taxes to Output

$\varepsilon_{t\,IP,y} = 0.424$
$\varepsilon_{t\,P,y} = 2.364$
$\varepsilon_{t\,GS,y} = 0.793$
$\varepsilon_{t\,ITT,y} = 0.206$
$\varepsilon_{t\,\tilde{T},y} = 0.496$

With regards to the impact of government spending on output, Blanchard and Perotti (2002) observed that it is difficult to identify any automatic feedback mechanism from quarterly economic activity to quarterly government spending all within the same quarter due to decision making and implementation lags. Therefore, following Blanchard and Perotti (2002), I will assume that the response of the spending residual to the output structural residual is zero, that is, $b_1 = 0$.

The second step is to generate the cyclically adjusted reduced-form tax and spending residuals, represented as

(8) $$u_t^{t,CA} \equiv u_t^t - a_1 u_t^y = a_2 e_t^g + e_t^t$$

(9) $$u_t^{g,CA} \equiv u_t^g - b_1 u_t^y \equiv u_t^g = b_2 e_t^t + e_t^g$$

when $b_1 = 0$. Since $u_t^{t,CA}$ and $u_t^{g,CA}$ are not correlated with e_t^y, these are used as instruments to estimate c_1 and c_2 in an instrumental variable regression of u_t^y on u_t^t and u_t^g using a generalised method of moment estimator.

The third step is to estimate a_2 and b_2. However, simultaneous changes in taxes and spending outcomes present difficulties in identifying whether taxes are responding to spending decisions or whether spending is responding to tax decisions. Since there is no theoretical or empirical rationale for a particular ordering, both scenarios are estimated. First, it is assumed that tax decisions come first, implying that government spending responds to changes in taxes decisions, that is, $a_2 = 0, b_2 \neq 0$. Second, it is assumed that spending decisions comes first, meaning that taxes respond to spending decisions, that is, $a_2 \neq 0, b_2 = 0$.

Table 5 shows the estimated contemporaneous coefficients for both scenarios, that is, when taxes are ordered first and when spending is ordered first. Except for the contemporaneous effect of taxes on GDP, c_1, all other parameters had the expected sign. The positive sign on c_1 implies counter-intuitively that a positive shock to taxes leads to an increase in output within the same quarter. However, c_1 was not statistically different from zero at the conventional level of significance. In contrast, the contemporaneous effect of spending on GDP, c_2, had the expected sign and was highly significant at the 1 percent level of significance. This outcome implies that a one

percent shock to government spending would lead to a 0.09% increase in output within the same quarter.

Table 5: Estimated Contemporaneous Coefficients

	c_1	c_2	b_2	a_2
coefficient	0.0742	0.0938	-0.2655	-0.0611
t-stat	0.8021	4.2481	-0.9861	-0.9861
p-value	0.4258	0.0001	0.3281	0.3281

The identification of the orthogonal (structural) components of the error terms can be expressed in matrix notation as

$$AU_t = BE_t$$

$$\begin{bmatrix} 1 & 0 & -a_1 \\ 0 & 1 & -b_1 \\ -c_1 & -c_2 & 1 \end{bmatrix} \begin{bmatrix} u_t^t \\ u_t^g \\ u_t^y \end{bmatrix} = \begin{bmatrix} 1 & a_2 & 0 \\ b_2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^t \\ e_t^g \\ e_t^y \end{bmatrix} \quad (10)$$

where A and B are square 3 x 3 matrices estimated by maximum likelihood; $U_t \equiv \left[u_t^t, u_t^g, u_t^x\right]$ is a vector of reduced form residuals; and, $E_t \equiv \left[e_t^t, e_t^g, e_t^y\right]$ is a vector consisting of unobserved structural innovations. It is assumed that the structural innovations are orthonormal, meaning that its covariance matrix is an identity matrix, $E = [e_t e_t'] = I$.

Utilizing the coefficient parameters above, the short-run identifying restrictions when $a_2 = 0, b_2 \neq 0$ can be written as

$$\begin{aligned} u_t^t &= 0.495845u_t^y + e_t^t \\ u_t^g &= -0.2655e_t^t + e_t^g \\ u_t^y &= 0.074185u_t^t + 0.093814u_t^g + e_t^y \end{aligned} \quad (11)$$

And when $b_2 = 0, a_2 \neq 0$

$$\begin{aligned} u_t^t &= 0.495845u_t^y + \text{-}0.061079e_t^g + e_t^t \\ u_t^g &= e_t^g \\ u_t^y &= 0.074185u_t^t + 0.093814u_t^g + e_t^y \end{aligned} \quad (12)$$

The identifying restrictions were then written in text form and then the structural factorization matrices were estimated by maximum likelihood under the assumption

that the innovations are multivariate normal. The estimated free parameters were all statistically significant from zero and the reported p-value of the chi-square statistic for the LR test for over-identification led me to reject that the model was overly identified.

Thereafter, the impulse responses were estimated. For the response standard errors, I used the Monte Carlo standard errors set at 500 repetitions, as in Blanchard and Perotti (2002). The impulse definition chosen was the Generalized Impulse Response Functions (GIRFs)[14] developed by Koop et al. (1996) for non-linear models and later specified by Pesaran and Shin (1998) for liner models. The impulse response analysis was carried out for the two alternative ordering assumptions, that is, $a_2 = 0$ and $b_2 = 0$.

[14] Unlike traditional orthogonalized impulse responses such as the Cheloski method of identification, the GIRF in linear multivariate VAR models is preferred because it is invariant to ordering of variables in the VAR system (Koop et al., 1996, Pesaran and Shinn, 1998).

5. Results

The results for the trivariate structuralized VAR model are presented in Figures 3-5. The GIRFs traces the response to generalized one standard deviation innovations to the residual of each variable onto the other endogenous variables in the SVAR over a horizon of three years. The solid line on the graphs gives the point estimate of the GIRFs, conditional on the definition and history of the variables in the model as well as the state of the economy at the time of the shock. The time profile of the generalized impulse responses tend to zero as $n \to \infty$ (Pesaran and Smith, 1998). The broken lines represent one standard error bands about the impulse responses. As standard in similar studies, the threshold of significance occurs where zero does not fall within the two one-standard error bands of the GIRFs. Note that the impulse responses represent only a one-time shock of revenue and spending to output and not an average response over a period of time (Blanchard and Perotti, 2002).

The results confirm that the interpretations of the GIRFs are virtually identical whether tax decisions or spending decisions are ordered first. This result is common in similar studies[15] due to the low correlation between the cyclically adjusted tax and spending innovations. Whereas Blanchard and Perotti (2002) obtained a low negative correlation of -0.09 between cyclically adjusted taxes and spending innovations, I obtained a correlation coefficient of similar magnitude equalling -0.13 for this sample. For expository ease, the results presented below will focus only on the GIRFs when taxes are ordered first.

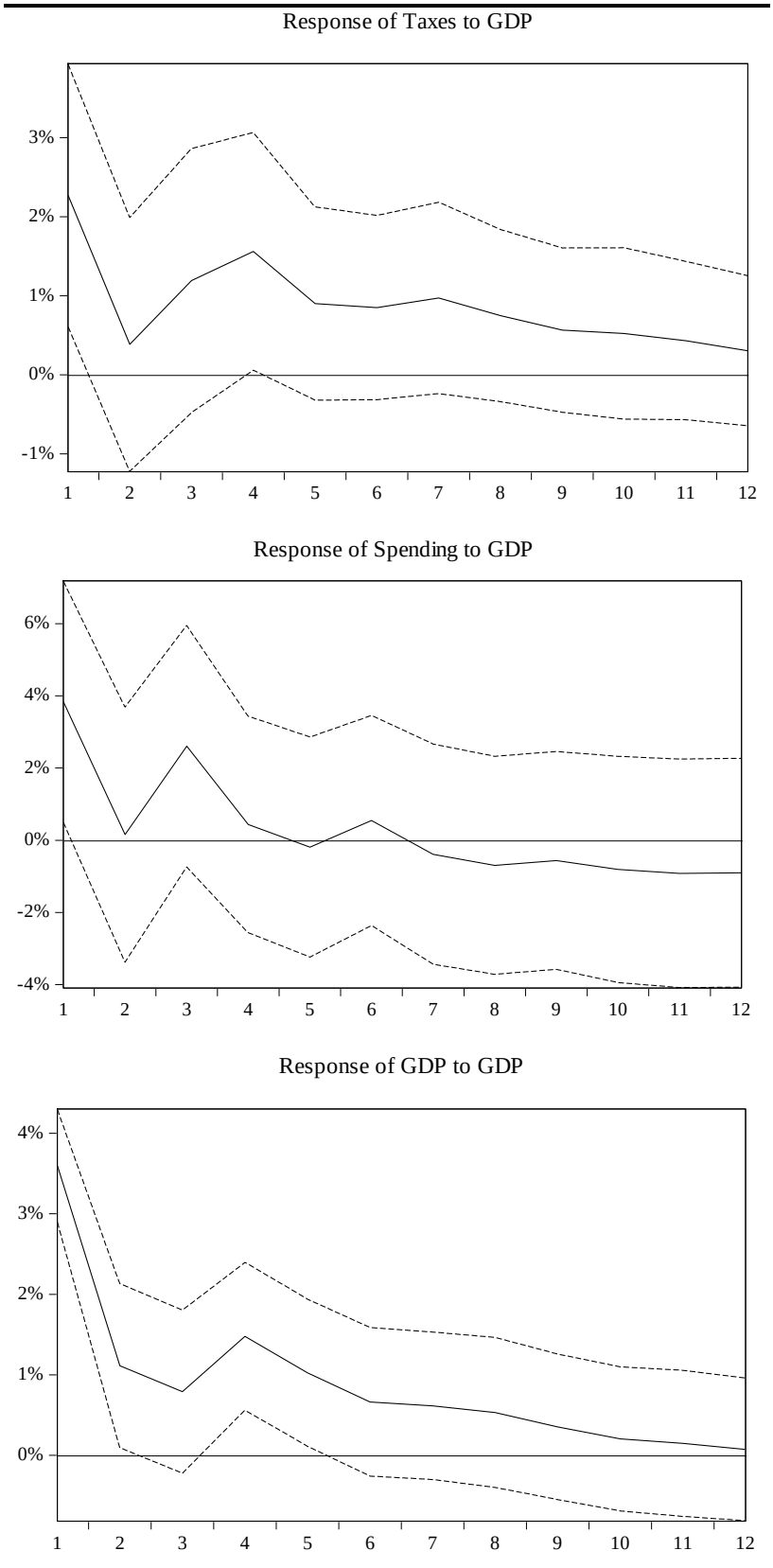
[15] See for example Blanchard and Perotti (2002) and Giordano (2007)

5.1. The effects of shocks on output

Figure 3 shows the generalized impulse responses to one standard error shock to the output equation at time t on expected values of the endogenous variables in the SVAR at time t + n. As expected, a positive shock to output increases tax revenues and government spending over the medium term, though the generalized impulse responses are not statistically significant, except on impact. In response to a shock to output, taxes rise by 2.3% and peak on impact, as shown under 'Response of Taxes to GDP'. Subsequently, it contracts steeply to 0.3% in the second quarter. Taxes then rise to 1.6% in the fourth quarter and subside thereafter to 0.3% at the end of the three-year horizon. The response of taxes is smaller on impact when compared to the response of spending to innovations to output.

Under 'Response of Spending to GDP', government expenditure rises by 3.8% on impact but declines quickly to a 0.2 percentage point increase in the second quarter. Spending then rises in third quarter and contracts again in the fourth. Thereafter, government spending contracts by a quarterly average of -0.5% over the next two years. Although the generalized impulse response of taxes and spending to a shock to output closely 'mimicked' each other, the magnitude of response of taxes was always larger except on impact. Consequently, the accumulated response of taxes, at 10.7%, is larger than that of spending, at 3.1%, over the three-year horizon, as shown in Table A-7. The larger impact on taxes is attributable to the automatic response of taxes to income. By contrast, it is hard to identify any automatic response that would cause government spending to rise in response to an unexpected positive shock to output.

Figure 3: Response to a GDP Shock



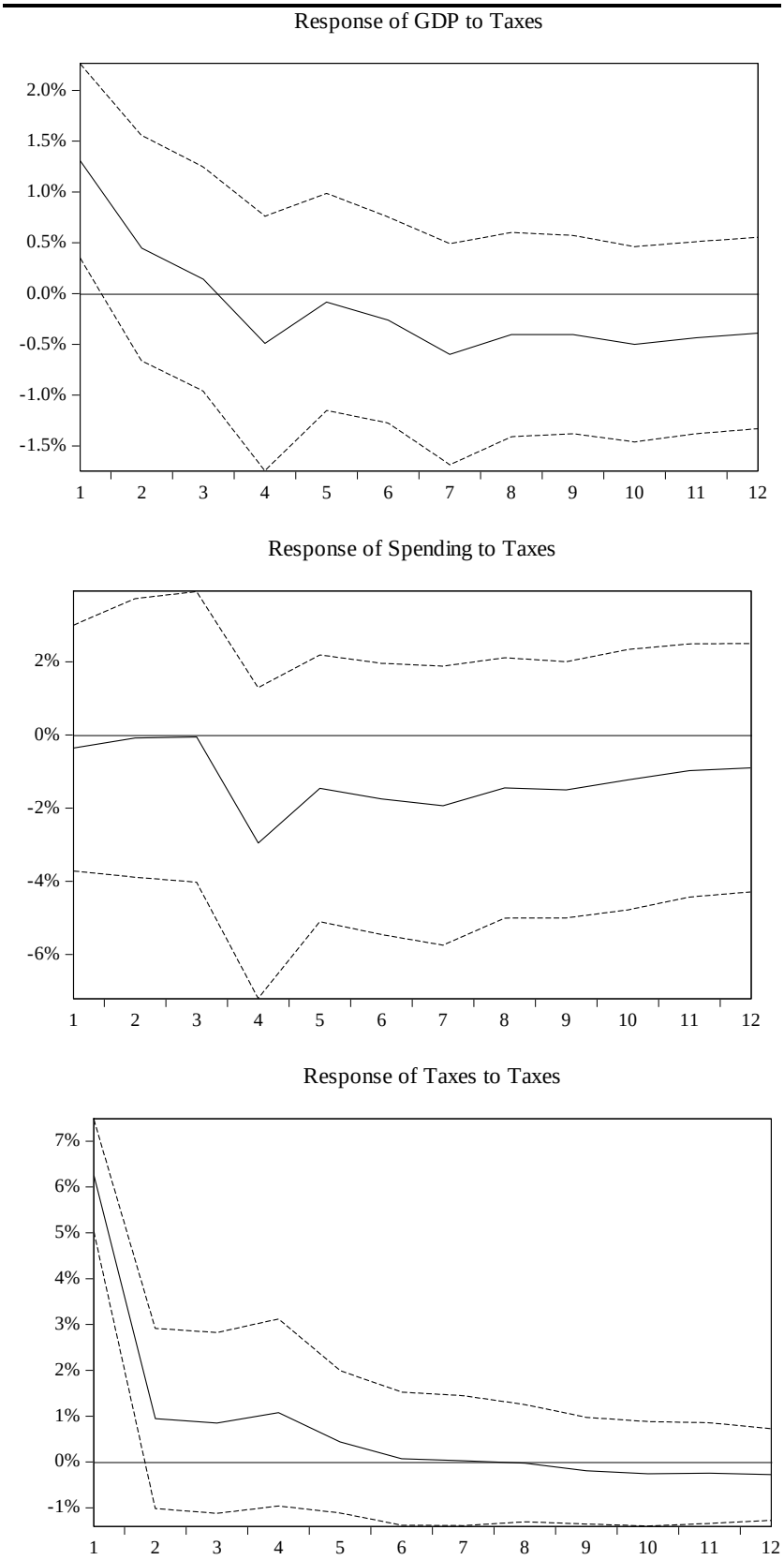
5.2. The effects of shocks on taxes

An unanticipated generalized one standard deviation innovation to taxes causes output to rise by a statistically significant margin of 1.3% on impact as shown in Figure 4 under 'The Response of GDP to Taxes'. This significant positive impact is only transient, as the effects on output after one quarter become insignificant, decline, turn negative in the fourth quarter and then remain negative for the rest of the horizon. The traced effects reach a trough seven quarters out where the contractionary impact peaks at -0.6% of GDP.

Furthermore, a positive shock to taxes has no statistically significant effect on government spending, since the one standard deviation bands include zero for the entire horizon, as shown under 'The Response of Spending to Tax' in Figure 4. This may be explained by 'a deficit-reducing tax increase' behaviour aimed at stabilizing or reducing the public debt to GDP level (Caldara and Kamps, 2008). More specifically, the Government tends to raise taxes in Belize to ameliorate budget deficits and pay down debt incurred in previous periods (deficit-driven tax changes), rather than say, raise taxes to increase public investment expenditure in future periods to boost economic activity (spending-driven tax changes). Thus, a positive shock to taxes do not lead to greater government spending in the short-run but results in an increase in government savings to reduce public debt accumulated in previous periods whilst dampening aggregate demand in the process.

The cumulative tax multiplier, which measures the accumulated change in output over the accumulated change of taxes over a three-year period, is -0.19, as shown in Table A-8. This implies that over a three-year period a one-dollar increase in taxes reduces GDP by nineteen cents. Under 'Response of Taxes to Taxes', it is shown that tax revenues

Figure 4: Response to a Tax Shock



increase by a statistically significant 6.3% on impact and then grow on average by 1.0% for the next three quarters. Thereafter, the growth rate declines further, turning negative eight quarters out and then contracts for the rest of the horizon as the unexpected tax hike eventually slows economic activity.

5.3. *The effects of shocks on government spending*

Under the assumption of perfect foresight, an unanticipated generalized one standard deviation positive shock to government spending causes output to rise over the entire horizon, as shown under the 'Response of GDP to Spending' in Figure 5. Output rises by 1.1% on impact, falls to near zero in the second quarter and then rises, reaching slightly above its initial effect in the fourth quarter where it peaks at 1.2% and completes a one-year cyclical trend. The response of output to spending then persists, averaging 0.7% over the next eight quarters. Except on impact, the response of GDP was not statistically significant for virtually the entire horizon.

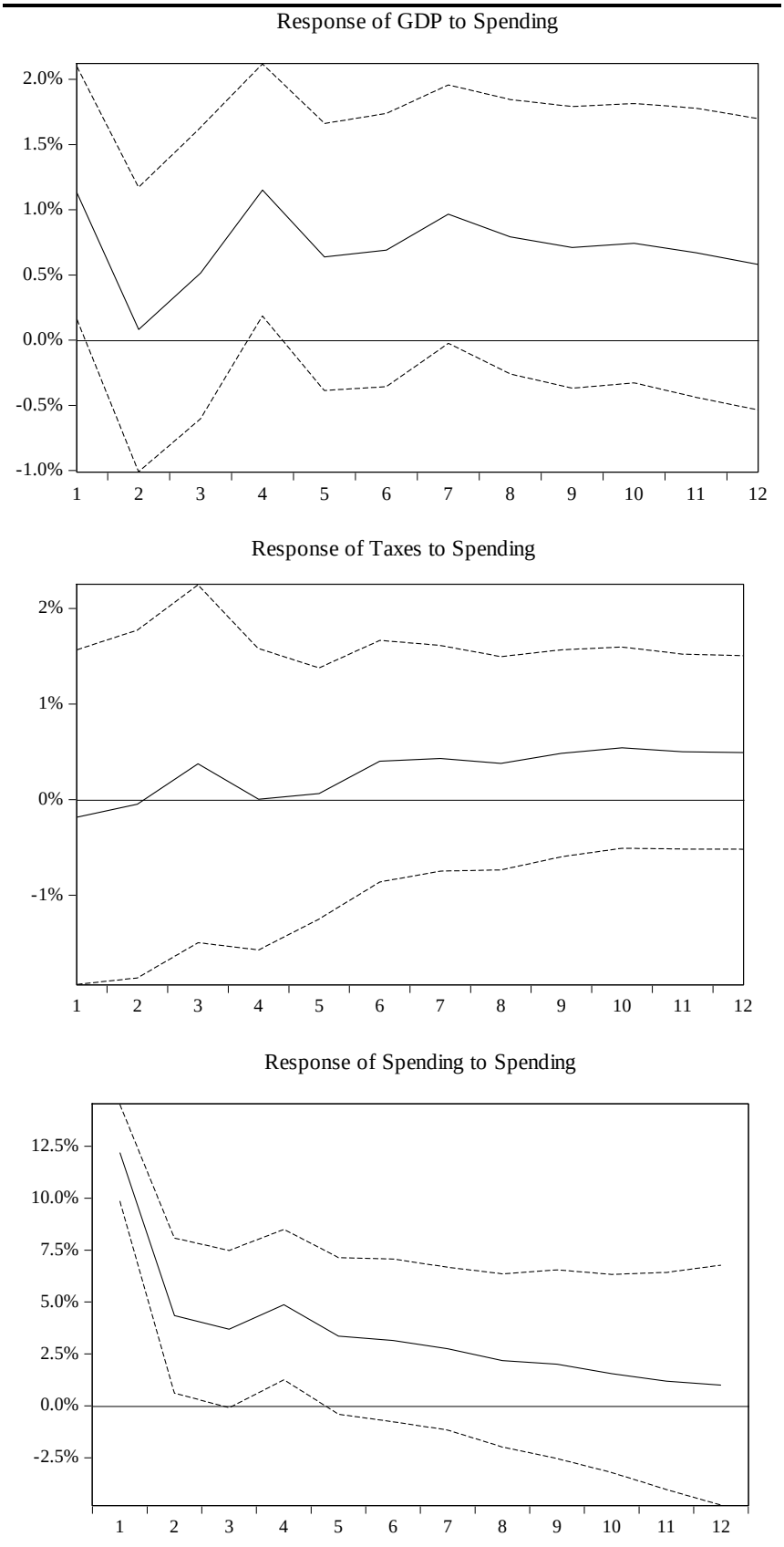
In contrast, the trace effects of the accumulated response of GDP to spending were virtually significant for eight quarters, providing a greater level of confidence in the computation of the spending multiplier. The cumulative multiplier rises from 0.09 on impact to 0.20 at the end of three-year horizon. This implies that a one-dollar increase in government spending leads to a twenty-cent increase in GDP over twelve quarters. Four-fifths of the initial expenditure crowds out other components of GDP because of the displacement of private spending by Government spending and leakages on imports associated with consumer or Government propensities to spend (Spencer and Yohe, 1970).

Government spending has no significant statistical effect on tax revenues, as seen under 'Response of Taxes to Spending' in Figure 5. From a Keynesian perspective, an increase

in government spending should lead to an expansion in output and, in turn, an increase in tax receipts through the automatic stabilizers of the tax system. However, this outcome reinforces the crowding out effects of increased deficit spending on other components of GDP in Belize. If the Government increases spending, financed by domestic debt, without realizing a commensurate increase in taxes to dampen private sector demand, imports will grow faster than exports causing net exports to fall, *ceteris paribus*. Consequently, the current account on the balance of payments will deteriorate and the foreign currency reserves will decline. This explanation is consistent with the predictions of the twin deficit hypothesis, which is plausible in highly open economies facing persistent increases in government spending (Corsetti and Müller, 2006). Furthermore, a one-off innovation to government spending would lead to larger future budget deficits, since persistent increases in spending will not produce sufficient taxes to offset the additions to total spending over time.

Lastly, a shock to spending induces spending in subsequent periods, as shown under 'Response of Spending on Spending' in Figure 5. The effect of a shock to spending leads to a relatively large 12.2% increase in spending on impact, followed by a sharp decrease to almost one-third of its initial value in the second quarter. It remains positive across time and significant for up to five quarters.

Figure 5: Response to a Spending Shock



5.4. Robustness check

Several robustness tests were conducted to assess the structural validity of the benchmark model. The alternative model specifications included: (i) an assumption that the variables followed a stochastic trend when first differenced with a constant but no trend term; (ii) an assumption that the variables followed a stochastic trend at levels with a constant but no trend term; and, (iii) an alternative identification scheme using the Cholesky or recursive ordering method.

Blanchard and Perotti (2002) found that the size and persistence of the dynamic effects of output varied in response to shocks to fiscal variables when time trends were treated as deterministic or stochastic. To determine whether my model was similarly affected by the inclusion of a deterministic trend, I tested the stability of the model assuming that the variables follow a purely random path. This was accomplished by entering the variables in the SVAR in first differences modelled with two lags and a constant.

The alternative model specification produced different results. First, the contemporaneous effects of the fiscal variables were smaller when first differenced. Second, the dynamic effects of the fiscal variables were tempered due to the added restrictions as predicted by Sims, Stock and Watson (1990). Third, unlike Blanchard and Perotti (2002), I found that the sign and magnitude of the effects of a tax increase was different under alternative specifications. Whereas a tax increase had an accumulated negative effect on output when the variables were assumed to have a deterministic trend at levels, a tax increase had an accumulated positive effect on output when first differenced without a trend term, see Table A-9. Fourth, like Blanchard and Perotti (2002), a shock to spending increased output under both specifications but the effect was weaker under a stochastic trend. For this sample, the cumulative spending multiplier fell from 0.20 under a deterministic trend to 0.09 under a stochastic trend after twelve quarters, see Table A-10.

When the variables were entered in the SVAR model at levels without a time trend a tax increase had a positive effect on output while the size of the cumulative spending multiplier was smaller than that obtained from the benchmark model, see Table A-9 and A-10. This result is unsurprising since both unit root tests showed that taxes and spending were stationary when modelled with a constant and trend, see Table A-3. When no trend is included all three variables would have a unit root, violating Sims, Stock and Watson's (1990) pre-condition that there exist fewer unit roots than variables in the VAR. Consequently, the model is sensitive to the inclusion of a time trend.

I also checked to see if the results obtained relied on the identification methodology employed in constructing the benchmark model. To this end, I used the standard Choleski scheme which imposes a recursive ordering of the variables to identify the fiscal shocks. This method attributes all of the effects of the innovation of the variables in the system to the variable that is ordered first. The variables were ordered in two different ways. First, output was ordered first as in Favero (2002), modelled with constant and trend terms. This model assumes that fiscal policy shocks do not have a contemporaneous effect on output. Second, spending was ordered first as in Fatás and Mihov (2001), modelled with constant and trend terms. In this case, it is assumed that all the contemporaneous effects of the system are attributed to government spending.

The results show that the benchmark results relied on the assumptions of the identification methodology used, as found by others such as Caldara and Kamps, 2008. When output was ordered first, a positive one standard deviation shock to taxes caused output to fall as expected. However, when spending was ordered first, a positive shock

to taxes caused output to rise unexpectedly over the three-year horizon, see Table A-9. In both cases, positive shocks to government spending increased output.

In summary, the results of the SVAR model employed in this study rely crucially on the assumption that the variables follow a deterministic path and on the assumptions of the identification methodology used.

5.5. Discussion

This paper investigates whether fiscal policy in Belize can be used to stimulate aggregate demand during economic downturns. The major finding is that fiscal policy is not effective in smoothing business cycles in Belize. Although the tax and spending cumulative multipliers have Keynesian signage, they are less than one which indicates that government spending partially crowds out other components of GDP. It implies that the use of counter-cyclical fiscal policy to alleviate recessions must be carefully orchestrated, since a temporary increase in government spending would lead to persistently larger budget deficits over the medium-term. Deficit-driven spending, financed by either taxes or debt, must be undertaken cautiously since an expansionary fiscal stance may heighten public debt management and public debt sustainability concerns, elevate exchange rate risks and reduce confidence in both fiscal and monetary authorities.

From a Keynesian perspective, fiscal multipliers should be greater than one. This implies, for example, that an incremental increase in government spending should result in more than a one to one increase in total spending. However, Spilimbergo, Symansky and Shindler, 2009, argue that as a rule of thumb, fiscal multipliers for small open economies should be 0.5 or less. They also observed that cross country VAR analyses of low income countries typically provide low estimates of fiscal multipliers ranging from negative to 0.5, partly owing to high public debt levels. Fiscal multipliers are small if leakages on imports are large, monetary conditions are not accommodative to fiscal expansions and stimulus spending leads to unsustainable debt levels

(Spilimbergo, Symansky and Shindler, 2009)[16]. Characteristically, Belize is a highly open economy with a ratio of trade (imports plus exports of goods) to GDP of 92.7% in 2012[17]; theoretically, monetary policy is not accommodative to fiscal expansions owing to the presence of a fixed exchange regime, and; the public debt level exceeds comfort thresholds at a debt-to-GDP ratio of 64.4% in 2012[18] (Central Bank of Belize, 2012). Thus, the fiscal multiplier is expected to be smaller than one.

Recent empirical evidence has supported the view above. Using the same Blanchard and Perotti (2002) identification strategy, Ilzetzki, Mendoza and Végh (2010) found a cumulative long-run multiplier of 0.18 for a sub-group of twenty-four developing countries, while that for a sub-group of high-income countries was 0.8. More recently, Guy and Belgrave (2012) found positive cumulative government expenditure multipliers of 0.20 and 0.30 after 24 quarters for Barbados and Jamaica but negative ones for Trinidad and Tobago and Guyana over the same period. Thus, the empirical evidence in the literature of fiscal multipliers for small developing countries with high debt levels is consistent with my findings for Belize.

The results also provide some key insights into the effect of debt-finance spending, balanced budget spending and fiscal consolidation on output in Belize. For a small open economy like Belize with an underdeveloped domestic capital market, an incremental increase in government spending would most likely be financed by external debt instead of domestic taxation. This would lead to an accumulation of external debt and higher current account deficits. Government borrowing from abroad would not cause

[16] There are other factors that determine the size of fiscal multipliers such as exchange rate flexibility (Ilzetzki, Mendoza and Végh, 2010), financial development, institutional factors, state of the economy and fiscal instrument used.
[17] Ilzetzki, Mendoza and Végh, 2010 classified a country as 'open' when this ratio exceeds 60%.
[18] Although debt thresholds for fiscal policy are country specific, public debt levels at 60% of GDP is used as a reference point to be concerned about fiscal sustainability (International Monetary Fund, 2011).

real market interest rates to rise for the private sector unless it raises sovereign risks. This is because the size of official borrowings would be too small to influence world market rates. Thus, in Belize's case, there is a lower likelihood that an incremental increase in Government spending would crowd out domestic investment in the short run and reduce the stock of productive capital in the long run. However, persistent current account deficits would cause the stock of net domestic assets to decline and the stock of non-resident claims to rise over time. Consequently, leakages for increases in government spending in Belize, financed by external borrowings, would likely occur by way of importation of goods and services and debt service re-payments.

Given my results, the balanced-budget multiplier, defined as the sum of the spending and tax multipliers, is equal to 0.01. This implies that an increase in government spending that is financed by raising taxes, as represented by the balanced-budget multiplier, yields only a small positive effect on GDP. It suggests that the Government should opt to raise taxes over cutting expenditure given that the tax multiplier is smaller than the spending multiplier, and thereby having a smaller contractionary effect on output when considering fiscal consolidation. However, both multipliers are close in absolute value so the advantage of using one instrument over the other may be ambiguous.

Rather than frontloading drastic fiscal austerity measures, fiscal consolidation should be undertaken smoothly and gradually. This approach cushions the harmful macroeconomic effects of slowing aggregate demand, particularly for countries facing economic downturns with high risk premiums or high levels of sovereign debt like Belize (Batini, Callegari, and Melina, 2012). During a recession, the cost of fiscal consolidation would be relatively lower in terms of lost employment and output

compared to economies with multipliers that are greater than one. Lastly, the effects of fiscal policy on output peak early, that is, within the first year of implementation.

This study features several limitations. Stock and Watson (2001) warns that while small VARs such as the three-variable one employed here may be useful as benchmarks, they may be unstable and therefore unsuitable for forecasting. However, several model stability checks provided support that the underlying model was stable. Fatás and Mihov (2001) suggested that in addition to the three variables used here that one should also include the implicit GDP deflator and an interest rate variable to comprise a minimal set of macroeconomic variables for the study of the dynamic effects of fiscal policy changes. Testing for the presence of an omitted variable bias is compounded by data constraints since, in fact, no quarterly GDP deflator is computed for Belize and no suitable monetary policy interest rate variable exists due to an underdeveloped capital market. Furthermore, GDP is not computed on a quarterly basis using the expenditure approach, so I was unable to analyse the impact of fiscal variables on GDP components as typically done in similar studies. Thus, future research can focus on analysing the dynamic relationship between other fiscal policy variables and other macroeconomic series of interest to further the understanding of the transmission mechanism of fiscal policy in Belize as the data set expands and other macroeconomic variables of interest become available.

6. Conclusion

This paper sets out to investigate the dynamic effects of discretionary fiscal policy on output in Belize. It found that conventional fiscal policy is conducted in a pro-cyclical manner in Belize. Furthermore, the tax elasticity of output is small at 0.5. The contemporaneous effects of government spending are positive but small at 0.09. An increase in spending was found to have a weak positive effect on output while an increase in taxes had a weak negative effect. Since the fiscal multipliers are less than one, it is concluded that fiscal policy has an overall non-Keynesian effect on output in Belize.

The impulse analysis provides several key implications for fiscal policy in Belize. It suggests that fiscal policy is not very effective in stimulating aggregate demand in the medium run during recessionary times. Furthermore, the balanced budget multiplier implies that a balanced budget expansionary fiscal shock will produce only a small positive e ffect on economic activity. Consequently, Government must be judicious in raising taxes to fund expenditure activities; especially when those activities are geared towards consumption rather that public investment activities. With regards to speed of fiscal impact, the effects of a shock to taxes are larger on impact and peak earlier than spending, although both peak within the first year of implementation. Turning to size of impact, the cumulative impact of a shock to spending on output is larger than that of a tax cut over a three-year period, although both multipliers are close in absolute value.

Appendix

Table A-1: Descriptive Statistics

	GDP	Taxes	Taxes on				Spending	Spending on	
			Goods & Services	Income & Profits	Int. Trade	Property		Consump-tion	Capital Expend.
Mean	513,095	97,434	35,378	28,081	33,111	864	103,617	67,693	35,925
Median	533,000	100,731	37,791	24,062	33,641	746	10,7867	66,928	28,941
Maximum	711,100	136,027	51,810	53,107	42,504	2163	14,5632	96,744	87,481
Minimum	302,000	53,884	12,212	9,719	25,022	218	57,053	40,134	13,610
Std. Dev.	108,279	23,785	10,797	11,615	4,614	473	21,215	15,623	18,797

Notes: All values are in thousands of Belize dollars. N = 63.

Table A-2: Correlation between Fiscal Variables and GDP

Fiscal Variable	Correlation with GDP
Taxes	0.940 (21.469)***
Taxes on goods and services	0.886 (14.934)***
Taxes on income and profits	0.877 (14.235)***
Taxes on international trade	0.497 (4.472)***
Taxes on property	0.653 (6.740)***
Spending	0.480 (4.271)***
Goods, services, salaries and wages	0.907 (16.793)***
Capital expenditure	-0.212 (-1.695)*

Notes: Values in parenthesis are t-statistics. *** Denotes that the correlation is statistically significant at the 1% level or greater. * Denotes that the correlation is statistically significant at the 10% level or greater. N=63.

Table A-3: Unit Root Tests

Variable	Unit Root Tests	
	ADF	PP
Taxes		
with intercept	-1.390	-2.147
	0.581	*0.228*
with trend and intercept	-5.107	-5.33
	*0.001****	*0.000****
with no trend and intercept	1.215	1.113
	0.941	*0.930*
Spending		
with intercept	-2.50	-3.403267
	0.120	*0.015***
with trend and intercept	-3.680	-3.478301
	*0.031***	*0.051****
with no trend and intercept	0.342	0.261
	0.781	*0.759*
GDP		
with intercept	-2.267	-1.758
	0.186	*0.398*
with trend and intercept	-3.148	-2.831
	0.105	*0.192*
with no trend and intercept	2.179	1.881
	0.993	*0.985*
Δ GDP		
with intercept	-9.330	-13.625
	*0.000****	*0.000****
with trend and intercept	-9.450	-14.991
	*0.000****	*0.000****
with no trend and intercept	-8.777	-11.600
	*0.000****	*0.000****

Notes: The italicized values represent the reported t-statistics. *,** and *** indicate significance at the 1 percent, 5 percent and 10 percent level of significance, respectively.

Table A-4: VAR Lag Order Selection Criteria Test

Lag	LogL	LR	FPE	AIC	SC	HQ
1	238.9879	57.33243	1.01e-07	-7.592810	-7.064623*	-7.386627*
2	246.6441	13.23606	1.06e-07	-7.547256	-6.702156	-7.217363
3	258.9441	20.01358*	9.59e-08*	-7.659121*	-6.497109	-7.205518
4	264.6284	8.670949	1.09e-07	-7.546724	-6.067799	-6.969412

Notes: * indicates lag order selected by the criterion. N=59.

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table A-5: VAR Lag Exclusion Wald Tests

	Taxes	Spending	GDP	Joint
Lag 1	1.214169	7.838623	6.459713	18.78032
	[0.749608]	[0.049467]	[0.091265]	[0.027127]*
Lag 2	1.959638	4.630998	1.962510	7.499562
	[0.580826]	[0.200899]	[0.580224]	[0.585254]
Lag 3	2.259582	7.828100	12.94456	22.37304
	[0.520308]	[0.049701]	[0.004758]	[0.007769]*

Notes: Numbers in [ ] are p-values. N=60. * indicates statistical significance at conventional levels.

Table A-6: Impulse Responses to Generalized One Standard Deviation Innovations to Taxes, Spending and Output

		1 qrt.	4 qrt.	8 qrt.	12 qrt.	peak	
Shock to taxes	Taxes	0.0625	0.0108	-0.0003	-0.0028	0.0625	(1)
	Spending	-0.0036	-0.0295	-0.0145	-0.0090	-0.0295	(4)
	GDP	0.0130	-0.0049	-0.0040	-0.0039	0.0130	(1)
Shock to spending	Taxes	-0.002	0.0003	0.0038	0.0049	0.0054	(10)
	Spending	0.1219	0.0487	0.0218	0.0100	0.1219	(10)
	GDP	0.0113	0.0115	0.0079	0.0058	0.0115	(4)
Shock to GDP	Taxes	0.0227	0.0156	0.0075	0.0030	0.0227	(1)
	Spending	0.0383	0.0044	-0.0069	-0.0090	0.0383	(1)
	GDP	0.0360	0.0148	0.0053	0.0008	0.0360	(1)

Notes: Values in parenthesis represent the quarters in which the responses peaked.

Table A-7: Accumulated Responses to Generalized One Standard Deviation Innovations to Taxes, Spending and Output

		1 qtr.	4 qtr.	8 qtr.	12 qtr.
Shock to taxes	Taxes	0.0625	0.0913	0.0963	0.0867
	Spending	-0.0036	-0.0345	-0.1004	-0.1465
	GDP	0.0130	0.0140	0.0006	-0.0167
Shock to spending	Taxes	-0.0018	0.0015	0.0142	0.0344
	Spending	0.1219	0.2510	0.3655	0.4230
	GDP	0.0113	0.0288	0.0597	0.0867
Shock to GDP	Taxes	0.0227	0.0541	0.0888	0.1070
	Spending	0.0383	0.0703	0.0630	0.0312
	GDP	0.0360	0.0698	0.0981	0.1059

Table A-8: Cumulative Multipliers

	1 qtr.	4 qtr.	8 qtr.	12 qtr.
Taxes	20.9%	15.4%	0.6%	-19.3%
Spending	9.3%	11.5%	16.3%	20.5%

Figure A-1: Non-tax Financing

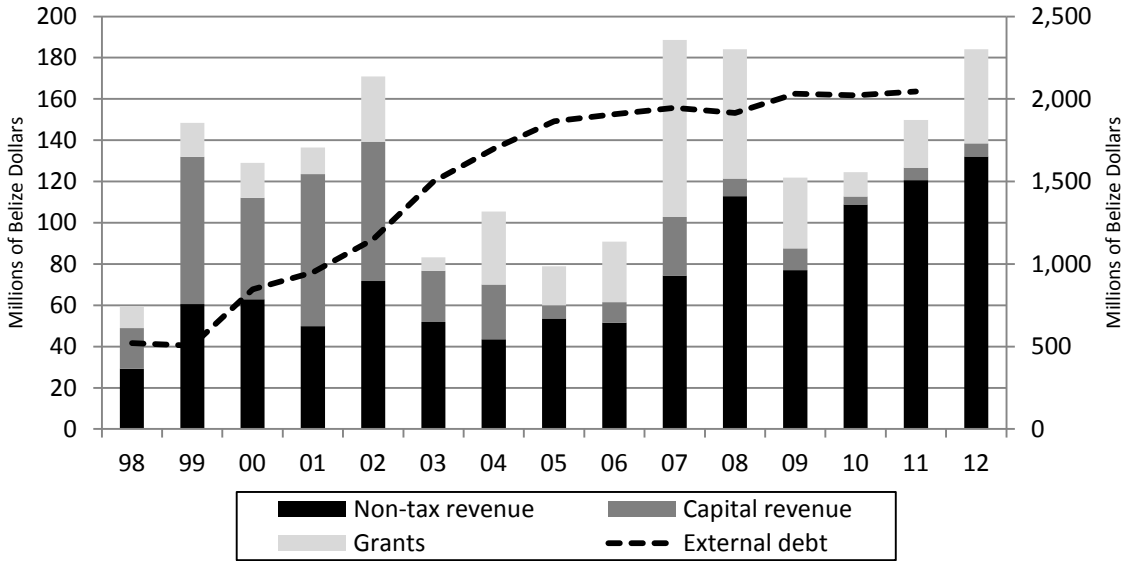


Figure A-2: Graphical Representation of Accumulated Responses

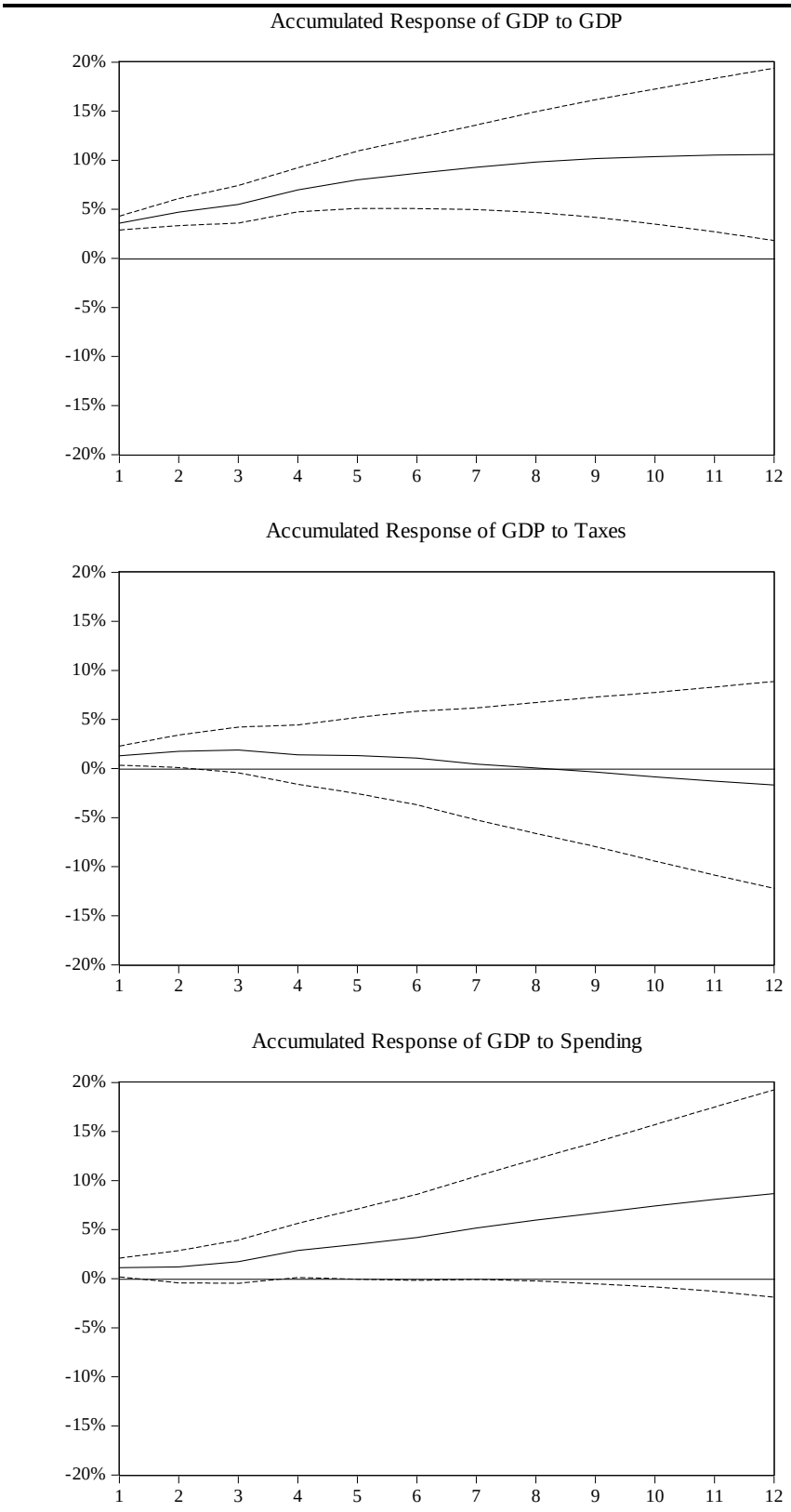


Table A-9: Accumulated Responses to Generalized One Standard Deviation Innovations to Taxes, Spending and Output for Robustness Tests

		1 qtr.	4 qtr.	8 qtr.	12 qtr.
	First Differences with constant and no trend term				
Shock to taxes	Taxes	0.0671	0.0407	0.0348	0.0350
	Spending	0.0009	0.0020	0.0114	0.0098
	GDP	0.0151	0.0085	0.0108	0.0106
Shock to spending	Taxes	0.0005	0.0001	0.0015	0.0017
	Spending	0.1274	0.0786	0.0710	0.0719
	GDP	0.0137	0.0086	0.0063	0.0063
	Levels with constant and no trend term				
Shock to taxes	Taxes	0.0633	0.1111	0.1533	0.1811
	Spending	-0.0008	-0.0123	-0.0580	-0.1065
	GDP	0.0152	0.0353	0.0543	0.0648
Shock to spending	Taxes	-0.0004	-0.0005	0.0026	0.0163
	Spending	0.1213	0.2449	0.3501	0.4094
	GDP	0.0124	0.0262	0.0480	0.0706
	Choleski ordering with output first				
Shock to taxes	Taxes	0.0583	0.0769	0.0688	0.0513
	Spending	-0.0188	-0.0644	-0.1323	-0.1693
	GDP	0.0000	-0.0121	-0.0376	-0.0592
Shock to spending	Taxes	0.0000	-0.0039	-0.0033	0.0092
	Spending	0.1142	0.2338	0.3472	0.4133
	GDP	0.0000	0.0053	0.0246	0.0473
	Choleski ordering with spending first				
Shock to taxes	Taxes	0.0633	0.1110	0.1534	0.1812
	Spending	0.0000	-0.0107	-0.0556	-0.1037
	GDP	0.0153	0.0355	0.0547	0.0653
Shock to spending	Taxes	0.0633	0.1110	0.1534	0.1812
	Spending	0.1213	0.2449	0.3501	0.4094
	GDP	0.0124	0.0262	0.0480	0.0706

Table A-10: Cumulative Spending Multipliers for Robustness Tests

	1 qtr.	4 qtr.	8 qtr.	12 qtr.
First differences without trend term	0.11	0.11	0.09	0.09
Levels with constant and no trend term	0.10	0.11	0.14	0.17
First differences without trend term	0.0	0.02	0.07	0.11
Choleski ordering with spending first	0.10	0.11	0.14	0.17

References

Alesina, A., Campante, F. R., and Tabellini, G. (2008) Why Is Fiscal Policy Often Procyclical?. *Journal of the European Economic Association* [online]. 6 (5), pp. 1006-1036. [Accessed 03 June 2013].

Auerbach, A. J., and Gorodnichenko, Y. (2010) Measuring the Output Responses to Fiscal Policy. *National Bureau of Economic Research* [online]. w16311. [Accessed 05 June 2013].

Barro R. J. (1974) Are Government Bonds Net Wealth?. *Journal of Political Economy* [online]. 82 (6), pp. 1095-1117. [Accessed 20 July 2013].

Barro, R. J. (1979) On the Determination of the Public Debt. *The Journal of Political Economy* [online]. 87 (5), pp. 940-971. [Accessed 05 June 2013].

Barro, R. J. (1989). The Ricardian Approach to Budget Deficits. *The Journal of Economic Perspectives* [online]. 3 (2), pp. 37-54. [Accessed 20 July 2013].

Barro, R. (1990) Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy* [online]. 98 (S5), pp. 103-125. [Accessed 01 July 2013].

Batini, N., Callegari, G., and Melina, G. (2012) Successful Austerity in the United States, Europe and Japan. *IMF Working Paper* [online]. WP/12/190. [Accessed 10 January 2011].

Bernanke, B. S., & Mihov, I. (1995) Measuring Monetary Policy. *National Bureau of Economic Research* [online]. w5145. [Accessed 01 June 2013].

Blanchard, O., and Perotti, R. (2002) An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics* [online]. 117(4), pp. 1329-1368. [Accessed 03 March 2013].

Biau, O., and Girard, É. (2005) Politique Budgétaire et Dynamique Économique en France. L'approche Var Structurel. *Revue Économique* [online]. 56 (3), pp. 755-764. [Accessed 03 July 2013].

Braun, P. A., & Mittnik, S. (1993). Misspecifications in Vector Autoregressions and Their Effects on Impulse Responses and Variance Decompositions. *Journal of Econometrics* [online]. 59 (3), pp. 319-341. [Accessed 17 May 2013].

Caldara, D. and Kamps, C. (2008) *What Are the Effects of Fiscal Policy Shocks? A Var-Based Comparative Analysis* [online]. Germany: European Central Bank. (Working Paper Series No. 877). Available from: http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp877.pdf [Accessed 1 June 2013].

Canova, F., and De Nicolo, G. (1995) Stock Returns and Real Activity: A Structural Approach. *European Economic Review* [online]. 39 (5), pp. 981-1015. [Accessed 03 July 2013].

Canova, F., and Pappa, E. (2007) Price Differentials in Monetary Unions: The Role of Fiscal Shocks. *The Economic Journal* [online]. 117 (520), pp. 713-737. [Accessed 02 July 2013].

Carlson, K. N. and Spencer R. W. (1975). *Crowding Out and Its Critics* [online]. Federal Reserve Bank of St. Louis. Available from: https://research.stlouisfed.org/publications/review/75/12/Crowding_Dec1975.pdf [Accessed 05 June 2013].

Central Bank of Belize (2009) *Central Bank of Belize Quarterly Review June 2009* [online]. Belize: Central Bank of Belize. Available from: https://www.centralbank.org.bz/publications-research/economic-publications/quarterly-reviews [Accessed 01 May 2013] .

Central Bank of Belize (1999) *Central Bank of Belize Eighteenth Annual Report and Accounts 1999* [online]. Belize: Central Bank of Belize. Available from: https://www.centralbank.org.bz/publications-research/economic-publications/annual-reports [Accessed 01 May 2013].

Central Bank of Belize (2006) *Central Bank of Belize Twenty-fifth Annual Report & Statement of Accounts 2006* [online]. Belize: Central Bank of Belize. Available from: https://www.centralbank.org.bz/publications-research/economic-publications/annual-reports [Accessed 01 May 2013].

Central Bank of Belize (2012) *2012 Annual Report and Statement of Accounts* [online]. Belize: Central Bank of Belize. Available from: https://www.centralbank.org.bz/publications-research/economic-publications/annual-reports [Accessed 12 June 2013].

Cochrane, J. H. (1991) A Critique of the Application of Unit Root Tests. *Journal of Economic Dynamics and Control* [online]. 15 (2), pp. 275-284. [Accessed 15 May 2013].

Corsetti, G., and Müller, G. J. (2006) Twin Deficits: Squaring Theory, Evidence and Common Sense. *Economic Policy* [online]. 21 (48), pp. 597-638. [Accessed 11 July 2013].

de Castro, F. and Hernández de Cos, P. (2008) The Economic Effects of Fiscal Policy: The Case of Spain. *Journal of Macroeconomics* [online], 30 (3), pp. 1005-1028. [Accessed 02 May, 2013].

de Paiva Fonseca, H. V., Carvalho, D. B., and da Silva, M. E. A. *The Dynamic Effects of Fiscal Shocks in Latin American Countries* [online]. Available from: http://anpec.org.br/encontro/2011/inscricao/arquivos/292-b528ac4ad67decf75cfe32b9eff74470.pdf [Accessed 06 June 2013].

Dungey, M., and Fry, R. (2009) The Identification of Fiscal and Monetary Policy in a Structural VAR. *Economic Modelling* [online]. 26 (6), pp. 1147-1160. [Accessed 06 June 2013].

Burnside, C., Eichenbaum, M., and Fisher, J. D. (2004) Fiscal Shocks and Their Consequences. *Journal of Economic Theory* [online]. 115 (1), pp. 89-117. [Accessed 03 July 2013].

Easterly, W., and Rebelo, S. (1993) Fiscal Policy and Economic Growth. *Journal of Monetary Economics* [online]. 32 (3), 417-458. [Accessed 02 July 2013].

Edelberg, W., Eichenbaum, M., and Fisher, J. D. (1999). Understanding the Effects of a Shock to Government Purchases. *Review of Economic Dynamics* [online]. 2 (1), pp. 166-206. [Accessed 01 July 2013].

Fatás, A., and Mihov, I. (2001) *The Effects of Fiscal Policy on Consumption and Employment: Theory and Evidence* [online]. Available from: http://www.insead.edu/facultyresearch/faculty/personal/imihov/documents/FPandConsumptionAug2001.pdf [Accessed 11 June, 2013].

Fatás, A., & Mihov, I. (2003) The Case for Restricting Fiscal Policy Discretion. *The Quarterly Journal of Economics* [online]. 118 (4), pp. 1419-1447. [Accessed 12 June 2013].

Favero, C. (2002) How do European Monetary and Fiscal Authorities Behave?. *IGIER* [online]. Working Paper No. 214. [Accessed 12 June, 2013].

Gavin, M., and Perotti, R. (1997) Fiscal Policy in Latin America. *NBER Macroeconomics Annual 1997* [online]. 12, pp. 11-72. [Accessed 22 June, 2013].

Giordano, R., Momigliano, S., Neri, S., and Perotti, R. (2007) The Effects of Fiscal Policy in Italy: Evidence from a VAR Model. *European Journal of Political Economy* [online], 23 (3), pp. 707-733. [Accessed 06 May, 2013].

Giavazzi, F., Jappelli, T., and Pagano, M. (1998). *Searching for Non-Keynesian Effects of Fiscal Policy.* Available from: ftp://ftp.igier.unibocconi.it/wp/1998/136.pdf [Accessed 05 June 2013].

Glenday, G., and Shukla, G. P. (2006). Belize: A Review of Public Expenditures. *Inter-American Development Bank* (online). No. 21038. Available from: http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=831589 [Accessed 01 August 2013].

Guy, K., and Belgrave, A. (2012) Fiscal Multiplier in Microstates: Evidence from the Caribbean. *International Advances in Economic Research* [online]. 18 (1), pp. 74-86. [Accessed 02 July 2013].

Hausmann, R., & Klinger, B. (2007) Growth Diagnostic: Belize. *Center for International Development, Harvard University* [online]. Available from: http://www.hks.harvard.edu/fs/drodrik/Growth%20diagnostics%20papers/Belize%20Growth_Hausmann&Klinger.pdf [Accessed 18 July 2013].

Ilzetzki, E., Mendoza, E. G., and Végh, C. A. (2010) How Big (Small?) are Fiscal Multipliers?. National Bureau of Economic Research [online]. w16479. [Accessed 10 June 2013].

International Monetary Fund (1995) *Guidelines for Fiscal Adjustment* [online]. Washington, D.C.: Fiscal Affairs Department International Monetary Fund (Pamphlet Series No. 49 1995). [Accessed 05 July 2013].

International Monetary Fund (2004) *Belize: 2003 Article IV Consultation—Staff Report* [online]. Washington D.C.: International Monetary Fund. (IMF Country Report No. 04/102) [Accessed 25 April 2013].

International Monetary Fund (2011) *Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis* [online]. Washington D.C.: International Monetary Fund. [Accessed 25 April 2013].

Keynes, J.M. (1935) *The General Theory of Employment, Interest and Money*. Australia. Col Choat. Project Gutenberg of Australia eBooks [online]. Available from: http://gutenberg.net.au/ebooks03/0300071h/0-index.html [Accessed July 3 2013].

King, R. G., & Rebelo, S. (1990) Public Policy and Economic Growth: Developing Neoclassical Implications. *National Bureau of Economic Research* (online). w3338. [Accessed 04 June 2013].

Kneller, R., Bleaney, M. F., and Gemmell, N. (1999) Fiscal Policy and Growth: Evidence from OECD countries. *Journal of Public Economics* [online]. 74 (2), 171-190. [Accessed 12 June 2013].

Koop, G., Pesaran, M. H., and Potter, S. M. (1996) Impulse Response Analysis in Nonlinear Multivariate Models. *Journal of Econometrics* [online]. 74 (1), pp. 119-147. [Accessed 06 June 2013].

Lütkepohl, H. (1999) Vector Autoregressive Analysis. *Quantification and Simulation of Economic Processes* [online]. SFB 373 Papers. Available from: http://edoc.hu-berlin.de/series/sfb-373-papers/1999-31/PDF/31.pdf [Accessed April 05 2013].

Mountford, A., and Uhlig, H. (2009) What Are the Effects of Fiscal Policy Shocks?. *Journal of Applied Econometrics* [online]. 24 (6), pp. 960-992. [Accessed 04 June 2013].

Pappa, E. (2005) *New-Keynesian or RBC transmission? The Effects of Fiscal Shocks in Labour Markets* [online]. London: LSE Research Online. Discussion Paper Series No.

5313. Available from: http://eprints.lse.ac.uk/524/1/CEPR-DP5313[1].pdf [Accessed 02 July 2013].

Pesaran, H. H., and Shin, Y. (1998) Generalized Impulse Response Analysis in Linear Multivariate Models. *Economics Letters* [online]. 58 (1), pp. 17-29. [Accessed 12 June 2013].

Pesaran, M. H., and Smith, R. P. (1998) Structural Analysis of Cointegrating VARs. *Journal of Economic Surveys* [online]. 12 (5), pp. 471-505. [Accessed 05 May 2013].

Ramey, V. A., & Shapiro, M. D. (1998) Costly Capital Reallocation and the Effects of Government Spending. *Carnegie-Rochester Conference Series on Public Policy* [online]. 48, pp. 145-194. [Accessed 08 July 2013].

Ravnik, R., and Žilić, I. (2011) The Use of SVAR Analysis in Determining the Effects of Fiscal Shocks in Croatia. *Financial Theory and Practice* [online]. 35 (1), pp. 25-58. [Accessed 07 April 2013].

Restrepo, J., and Rincón, H. (2006) *Identifying Fiscal Policy Shocks in Chile and Colombia* [online]. Chile: Central Bank of Chile (Working Paper No. 370). Available from: http://www.bcentral.cl/estudios/documentos-trabajo/pdf/dtbc370.pdf [Accessed 12 May 2013].

Romer, C. D., and Romer, D. H. (2009) *A Narrative Analysis of Post-war Tax Changes* [online]. University of California, Berkeley. Available from: http://emlab.berkeley.edu/users/dromer/papers/nadraft609.pdf [Accessed 01 June 2013].

Perotti, R. (2004) Estimating the Effects of Fiscal Policy in OECD Countries. *IGIER* [online]. Working Paper No. 276. [Accessed 14 June, 2013].

Sahay, R. (2005). Stabilization, Debt, and Fiscal Policy in the Caribbean. *International Monetary Fund* (online). WP/05/26. [Accessed 01 August, 2013].

Sims, C. A. (1980) Macroeconomics and Reality. *Econometrica* [online], 48 (1), pp. 1-48. [Accessed 07 June, 2013].

Sims, C. A., Stock, J. H., and Watson, M. W. (1990). Inference in Linear Time Series Models with Some Unit Roots. *Econometrica: Journal of the Econometric Society* [online]. 58 (1) pp. 113-144. [Accessed 02 May, 2013].

Solow, R. M. (1956) A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics* [online]. 70(1), pp. 65-94. [Accessed 02 May, 2013].

Swisher IV, S. N. (2010) *The Response of Output to Fiscal Policy in a VAR Framework: Two Alternatives for Identifying Shocks*. University of Wisconsin-Madison. Available from:

https://mywebspace.wisc.edu/sswisher/web/documents/Swisher_880.pdf [Accessed 15 May 2013].

Spencer, R. W., and Yohe, W. P. (1970) The Crowding Out of Private Expenditures by Fiscal Policy Actions. *Federal Reserve Bank of St. Louis Review* [online]. 52, pp. 12-24. [Accessed 05 June 2013].

Spilimbergo, A., Schindler, M., and Symansky, S. A. (2009) Fiscal multipliers. *IMF Staff Position Note* [online]. SPN/09/11. [Accessed 14 May 2013].

Talvi, E., and Végh, C. A. (2005). Tax Base Variability and Procyclical Fiscal Policy in Developing Countries. *Journal of Development Economics* [online]. 78 (1), pp. 156-190. [Accessed 15 April 2013].