ESSAYS ON
TAX SMOOTHING AND FISCAL POLICY SUSTAINABILITY
IN INDONESIA

A dissertation submitted for the degree of

Doctor of Philosophy (PhD) in Economics

by

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April, 2016

Declaration

I hereby declare that this submission is my own work and the contents contained in the dissertation are my research works conducted under my supervisors—Professor Geoffrey Kingston and Professor Lance Fisher, Department of Economics at Macquarie University.

To the best of my knowledge, this dissertation does not contain materials previously published and written by another person, nor substantial proportions of material which have been accepted for the award of any other degree diploma at any other educational institution.

I also certify that all sources used and any help received in producing this thesis have been acknowledged.

Rudi Kurniawan
April, 2016
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Acknowledgement

First and foremost, I would like to express my gratitude to my supervisor, Professor Geoffrey Kingston who competently and patiently guided me but, at the same time, granted me the freedom to explore the topics I was interested. In addition, I would like to thank my co-supervisor, Professor Lance Fisher, for his constructive discussions, suggestions and comments.

I would like to thank you my sponsor, the Directorate General of Higher Education, Ministry of National Education, Republic of Indonesia, for providing me with doctorate study scholarship, and my employer in Indonesia, Padjadjaran University, for the support and assistance throughout my study.

I also would like to thank you the Faculty of Business and Economics at Macquarie University for generous support for my studies and research. Among the staff at the faculty, thanks are due in particular to Agnieszka Baginska, Kaleen Heng, Laura Billington, Helen Boneham, Jee Young and Lin Bai for all their efficient help with various matters over the years.

Finally, I would like to express my deepest gratitude to my wife, Meity Anita Dewi, for her incessant loving support, attention and encouragements. To her, I dedicate this dissertation

Abstract

This thesis deals with two related issues of fiscal policy optimality and fiscal policy sustainability in Indonesia. In Chapter 2, I examined whether fiscal policy has been optimal based on the tax smoothing hypothesis. In Chapter 3 and 4, I performed two different fiscal policy sustainability analyses. In Chapter 3 analysis is based on the government intertemporal budget constraint (IBC) approach, while in Chapter 4 analysis is based on Bohn's Model Based Sustainability (MBS) approach. In general, I found that fiscal policy in Indonesia since 1970s has been optimal and sustainable, at least in the intertemporal dimension.

Contents

List of Tables

List of Figures

Chapter 1
Introduction

1.1 General Remarks

Fiscal deficits are common features in both developed and developing countries. One of the possible reasons for the existence of fiscal deficit is tax smoothing. According to tax smoothing theory, the optimal fiscal policy is to keep the tax rates relatively constant over time and cope with temporary increases in expenditure by running fiscal deficits and issuing public debt for financing the deficits. Temporary increasing tax rates may be socially wasteful because the distortive costs of taxation increase more than proportionally with any increase in tax rates. By preventing the need for future tax increases, the government may contribute to minimising the distortions to allocative efficiency caused by the tax system.

Closely related to tax smoothing is the issue of fiscal policy sustainability. A sustainable fiscal policy is the one that is designed to avoid the need for major adjustments in the future. Once the government runs into unsustainable fiscal policy, as characterised by persistent large fiscal deficits, corrective measures have to be implemented, including adjustments in the tax rate. Therefore, the sustainability of fiscal policy is important for optimal fiscal policy.

This dissertation deals with the issues of optimal fiscal policy and fiscal sustainability in Indonesia by examining time series of some key fiscal variables to ascertain: (1) whether the fiscal policy has been optimal, e.g. whether it is consistent with tax smoothing theory, and; (2) whether the fiscal policy has been sustainable.

It is expected that a responsible government designs an optimal fiscal policy and keeps fiscal policy sustainable. This thesis finds that Indonesian fiscal policy since 1970 has indeed been responsible, at least in the intertemporal dimension.

1.2 Dissertation Outline

This dissertation consists of three essays related to fiscal policy, namely tax smoothing and fiscal policy sustainability.

The first essay is entitled "**Tax Smoothing: Tests on Indonesian Data**". I examine the evidence for tax smoothing behaviour in Indonesia. The tax smoothing hypothesis was initially proposed by Barro (1979) and recently has been well established in the literature on fiscal policy. According to the tax smoothing hypothesis, since taxes are distorting so that the timing of taxes will matter, and it will be desirable to smooth tax rates over time, financing any temporary spending or shock to the tax base by creating public debt. As such, tax smoothing implies that the tax rate will follow a random walk and, hence, changes in the tax rate will be unpredictable. Based on a battery of unit root tests, I find that the tax rate follows a random walk. Furthermore, based on univariate autoregressions and vector autoregressions I also find that tax rate changes are unpredictable, either by its own lagged values or by lagged values of other variables in the system. These results lead to a conclusion that fiscal behaviour in Indonesia during the sample period is consistent with tax smoothing.

The second essay is entitled "**Sustainability of Fiscal Policy and the Revenue-Expenditure Nexus: The Experience of Indonesia**". I examine the sustainability of the Indonesia fiscal policy and the dynamics of government revenue and expenditure in controlling the size of the deficit using an annual sample period from 1970 to 2010. The literature on fiscal policy sustainability is mainly interested with whether or not the government's intertemporal solvency constraint is violated. As initially proposed by Hamilton and Flavin (1986), stationarity of the budget deficit and debt is consistent with the government's intertemporal budget constraint. Trehan and Walsh (1988, 1991) and Quintos (1995) argue that this is equivalent with the existence of stationarity in both government revenue and expenditure. Meanwhile, others have addressed this issue of fiscal policy sustainability by examining the cointegration relationship between government revenues and expenditures using the cointegration methodology, in the case where government revenue and expenditure are not stationary. The cointegration between revenue and expenditure has been considered as evidence that the intertemporal budget constraint has been respected (Hakkio and Rush,1991; Wu, 1998; Martin, 2000; Cunado et al, 2004).

Related to fiscal policy sustainability is the issue of causal relation between government's expenditure and revenue, or the "revenue-expenditure nexus". The examination of the relationship between government's revenue and expenditure may shed additional light on the dynamics of budgetary process as well as the adjustment towards the long-run budgetary equilibrium. The results show that the government's public debt, overall budget deficit, revenue and expenditure (as ratio to GDP) are all stationary, favouring the conclusion of sustainable fiscal policy in Indonesia during the sample period. Furthermore, I also find that causality runs positively from revenue to expenditure, implying that the decision to spend depends on revenue and that higher revenue would result in higher expenditure. These results support the tax-and-spend hypothesis as proposed by Friedman (1978).

The third paper is entitled "**Does Indonesia pursue a sustainable fiscal policy?**" I examine the sustainability of Indonesian fiscal policy by looking at how the primary balance-to-GDP ratio has responded to variations of the debt-to-GDP ratio, as suggested by Bohn's (1998) Model Based Sustainability approach. This approach is motivated by dissatisfaction with most of the literature that use unit root and cointegration tests in combination with the intertemporal budget constraint. It is argued that unit root or cointegration tests have low power in rejecting the null hypothesis of a unit root from near-unit-root alternatives. Furthermore, Bohn (2005) shows that the consistency with the intertemporal budget constraint (IBC) is not a sufficient condition for debt stationary. It is possible to satisfy the IBC while simultaneously having a mildly explosive path of debt-to-GDP ratios. Using a data set covering the period 1990 – 2010 and controlling for measures of cyclical variations in GDP and temporary government expenditure, I find a significantly positive response of the primary balance-to-GDP ratio to variations in the debt-to-GDP ratio, and that response has been stable since 2000. Moreover, I also find that the debt-to-GDP ratio tends to be mean-reverting due to a nominal growth dividend. These results suggest that the government have significant and strong fiscal response to changes in debt-to-GDP ratio and that the stability of debt-to-GDP ratio is dependent on the growth rate of the economy.

1.3 Fiscal Policy in Indonesia

Fiscal policy is concerned with policy towards public spending, taxation, and borrowing. This section gives some background on fiscal policy in Indonesia, to complement the formal statistical tests in later chapters. It focuses on central government policy during the last four decades.

In the late 1960s when Soeharto's New Order regime came to power, replacing the Soekarno's Old Order regime and its shambolic economic policy (Kuncoro, 2004). It identified the failure of fiscal control as a major contributor for the economic disintegration of the early 1960s (Asher and Booth, 1992). During the Old Order regime, huge budget deficits were financed by excessive money creation which eventually ignited hyperinflation in the mid-1960s. To stabilise the economy, the New Order government adopted a "balanced budget" fiscal policy where domestic financing of the budget deficit in the form of domestic debt or through money creation is forbidden. The deficit was to be financed only by foreign aid and loans. Since the foreign aid and loans were recorded as the government's development revenue the then budget made balanced. Due to the inflexible nature of the balanced budget, the New Order government was able to maintain macroeconomic stability successfully. Wheninflation increased as a result of a booming period, such as an oil bonanza, the fiscal response was stiff, ensuring excessive inflation did not occur (Hill, 2000; Thee, 2002; Rosengard 2004).

In the 1970s Indonesia benefited from two world's oil booms, in 1973/74 and in 1978/79. The windfall revenues from the oil taxes paid by the foreign oil companies operating in Indonesia greatly increased the domestic (non-aid) revenues of the government budget and led to a further increase in government savings. Hence, the government was able to allocate greater proportion of development expenditure to be financed by government savings instead of foreign aid. The government was also able to expand its overhead through an equally rapid increase of the routine budget (Kuntjoro-jakti, 1988). The rapid growth in oil revenues, unfortunately, made efforts to collect non-oil domestic revenues, such as income and sales tax, less urgent. Dependence on oil tax revenues continued to increase such that by 1980, non-oil tax revenues accounted for less than 30 per cent of total tax revenues and only 25 per cent of total budget revenues (Asher and Booth, 1992; Fane, 1999; Kuncoro, 2004). Ironically the budget deficit did not decline during oil booms. The budget deficit continued to increase and spurred an equally rapidly rising foreign debt to close the budget gap.

The 1980s saw two consecutive collapses of world's oil prices in 1982 to early 1986 which ended the windfall of oil revenues. When the oil prices began to drop in 1982, the government was forced to restrain its expenditures, both routine and development expenditures, including the deferral of several large-scale public sector projects (Thee, 2002). The government recognised that it could no longer rely on revenues from oil and the effort to intensify the collection of non-oil taxes became a top priority. In order to increase revenues from non-oil taxes, the government launched a major tax reform in late 1983 comprising a new income tax law which entered into force on 1 January 1984 and a Value Added Tax (VAT) law which was made effective on 1 April 1985 (Gillis, 1985; Kuncoro, 2004). The tax reform had successfully increase the importance of revenues from non-oil tax. Between 1984 and 1989, government revenues from non-oil sources rose from 34 per cent of total domestic revenues to 59 per cent (Mackie and Sjahrir, 1989). Between 1986 and 1996, real GDP grew by an average annual rate of 7.7 per cent (Fane, 1999). Even the 1986-

87 fall in oil prices, from US$28 per barrel to US$10 per barrel, was not especially disruptive to the government budget. Budget surpluses during this period were positive at around 13.1 per cent of GDP. Public debt was a manageable 25 per cent of GDP (Blöndalet al, 2009).

This benign fiscal environment changed with the Asia Financial Crisis (AFC) of 1997-98. During the crisis period, the rupiah lost about four-fifth of its value from a pre-crisis rate of about 2,500 rupiah per US dollar to around 17,500 per US dollar by January 1998 and the economy contracted over 13 per cent (or 15 per cent in per capita terms) in 1998 (Hill, 2007). The dramatic depreciation of rupiah during the crisis quickly translated into banking crisis due to currency and maturity mismatches in banks' balance sheets combined with protracted bank runs as market confidence in banking sector worsening following the closure of 16 small and deeply insolvent private banks in 1 November 1997 (Nasution, 1998; Pangestu, 2003).

On the fiscal side, the AFC had left a sharp increase in public debt in 2000 which reflects expensive cost of restructuring and recapitalising the collapsing banking system, and a widening budget deficit due to the need to provide fiscal stimulus to the crisis-hit domestic economy in 1997-1999. The government had to borrow heavily from IMF in order to stabilise the exchange rate, finance the domestic budget deficit and provide a social safety net. As a result, by the end of 1998, the ratio of public indebtedness to GDP rose to about 58 per cent from around 38 per cent of GDP in 1997. Furthermore, the collapse of banking system in the aftermath of the Asian financial crisis forced the government, in accordance with the IMF recommendation, to undertake a program of banking restructuring and recapitalisation from 1998 to 2000. This program was expensive and necessitated the government to issue bonds (estimated at about Rp600 trillion). The depreciation of the rupiah also increased the local currency value of the pre-existing government debt, which was owed predominantly to external official creditors. As a result, public indebtedness climbed to 85 per cent of GDP in 1999 and reached its peak at 89 per cent of GDP in 2000 (Pangestu, 2003; Kuncoro, 2004; Ministry of Finance, 2010; World Bank, 2014). Therefore, the issue of fiscal sustainability and debt management was becoming a serious concern among scholars and policy makers during that time. As noted by Thee (2003), there was a danger that a growing fiscal deficit will spiral out of control in the next few years as the interest of and subsequently principal of government bonds issued since 1997/98 fall due in 2004. The government took important measures to lessen the burden of the budget, including requesting for a rescheduling of repayments of principal and interest of its foreign debts, and refinancing and stretching out amortisation of domestic debt.

This century has seen gradual and uneven recovery of the Indonesian economy from the crisis. Since 2000, the fiscal deficit had been consistently maintained below 3 per cent of GDP and this, combined with stronger economic growth, lower interest rate and modest sales of nationalised distress assets, helped the public debt-to-GDP ratio to consistently decline since 2001 (Hill, 2007; Sangsubhan and Basri, 2012). There have also been further reforms on the budgetary side. In 2000, the government changed the format of budget by adopting the international standard of the Government Financial Statistics (GFS) for its budget report. The fiscal year also changed from 1 April to 31 March in subsequent year, to 1 January through 31 December. Moreover, the current budget system also introduced financing items that apprise sources of financing government spending, such as privatisation, government debt and foreign loans which before were all simply treated as “development revenue” in order to balance the budget. In 2001, the government introduced “balancing funds” into the budget to anticipate the decentralisation of authority to local governments. In 2003, there was a conscious effort to imitate the Maastricht fiscal rule by enacting The State Finances Law No. 17/2003 which caps the budget deficit to 3 per cent of GDP, and accumulated public debt to less than 60 per cent of GDP. These fiscal rules helped to reinforce the already favourable fiscal outcomes. Indonesia’s public debt continued to decline and in 2008 reached about 33 per cent of GDP.

In 2008, the Global Financial Crisis (GFC), which stemmed from the sub-prime mortgage crisis in the U.S., impacted the Indonesian economy through the international trade channel (Basri and Rahardja, 2010). The fourth quarter of 2008 saw exports growth fell to only about 1.82 per cent, the lowest since 1986, which led to a decline in economic growth from 6.1 per cent to 5.2 per cent on yearly basis (Titiheruw et al., 2009). The world economic slowdown since the early 2008 threatened to confine government revenues while raising the fiscal deficit. The government responded this situation by taking various policy measures to increase, especially, tax revenues, in terms of tax compliance intensification, broadening tax base, modernisation of tax administration and tax enforcement. Accordingly, government revenue increased significantly 38.6 per cent which was pretty higher than the 2007 revenue growth of 11 per cent. Meanwhile, tax revenues were up 34.2 per cent to 108.1 per cent of the Revised 2008 budget, well ahead of the 2007 tax revenue growth of 20 per cent. Government expenditure also increased due to implementation of various price stabilisation programs which aimed to mitigate the adverse impact of the GFC. Expenditure growth was 30 per cent well above the 2007 growth of 13.6 per cent with spending on subsidies increasing by 83.3 per cent, mostly subsidies for fuel and electricity. Through these developments in revenues and expenditures, fiscal deficit in 2008 came to only 0.1 per cent of GDP (Rp4.2 trillion), far below the Revised 2008 budget of 2.1 per cent of GDP (Rp51.3 trillion). Meanwhile, the public debt-to-GDP ratio decreased to 33.2 per cent of GDP.

In 2009, with downward revision to Indonesia's economic growth to 4.0-4.7 per cent, the government enacted a counter-cyclical fiscal stimulus package worth about Rp73.3 trillion (or around US$6.4 billion, or equivalent to 1.5 per cent of GDP). The package contained three major categories: income tax cuts (personal income tax from 35 to 30 percent and corporate income tax from 30 to 28 per cent), waivers of tax and import duties, and subsidies and government expenditures. The aim of the fiscal stimulus was to stimulate spending by households and corporations in order to softening the adverse impact of the GFC. This fiscal stimulus, especially the tax cuts, along with other good policies in monetary, banking and financial sectors, and also some luck, had proven to be able to make the adverse impact of GFC on Indonesian economy relatively limited compared to other countries in the region, including Singapore, Malaysia and Thailand. Indeed, in 2009, when the global economy recorded negative growth, Indonesia grew by 4.5 per cent which was the third fastest growing G-20 country after China and India (Basri and Rahardja, 2011; Sangsubhan and Basri, 2012; Basri, 2013). Impressively, amidst the GFC, the government was still able to maintain a low budget deficit of 1.6 per cent of GDP while the public debt-to-GDP ratio fell to 28.3 per cent.

Recently, in the wake of the GFC, fiscal policy has been directed to provide stimulus to the economy while keeping fiscal sustainability. On the revenue side, policies were aimed at extending revenue sources, particularly in taxation. On the expenditure side, the policies were focused on efforts to stimulate the economy. One crucial issue, related to the quality of government expenditure, is to create more fiscal space by relocating items in the government budget, such as subsidies for fuel, to productive sectors (Basri and Rahardja, 2011; Howes and Davies, 2014). In financing the budget deficit, the government used non-debt and debt financing both from domestic and foreign sources. However, the priority is the financing from domestic sources and seek to reduce dependence on foreign financing. This policy has been carried out while continuously reducing the debt-to-GDP ratio, to ensure fiscal sustainability. In 2010, the debt-to-GDP has further decreased to 26.1 per cent. By 2014, the debt-to-GDP ratio was estimated to have fallen to 24.7 per cent of GDP (Ministry of Finance, 2015).

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Chapter 2

Tax Smoothing: Tests on Indonesian Data

2.1 Introduction

This paper tests for tax smoothing behaviour in Indonesia. According to the tax smoothing model, the government smooths the tax rate by spreading the burden of raising distortionary taxes over time in order to minimise the implied welfare losses (or excess burden) from taxation for a given path of government spending. Accordingly, temporary changes in government spending and output will result in budget imbalances (surplus or deficit) and public debt should serve as a buffer against the necessity of temporarily changing tax rates. Prescott (1977) pioneered the normative theory and Barro (1979, 1981) argue that tax smoothing is also a positive theory of public debt management.

In a stochastic economy with an incomplete securities market, tax smoothing means that the tax rate approximates a random walk and, hence, changes in the tax rate are unpredictable (Barro, 1981; Kingston, 1984; Kingston and Layton, 1986; Kingston, 1991; Strazicich 1996, 1997, 2002). In this paper, I examine these two implications of tax smoothing for the case of Indonesia. First, I test the random walk behaviour of the tax rate by performing unit root tests. I find that the tax rate is nonstationary, a necessary condition for it to follow a random walk. Second, I test whether changes in tax rate are predictable. For this purpose, changes in the tax rate are regressed on a vector of lagged variables, including changes in government expenditure and growth of real output. The results suggest that changes in the tax rate are unpredictable by its own lags and also by lags of government expenditure changes and growth of real GDP. These results suggest tax smoothing by the government.

2.2 More on Public Finance in Indonesia

According to Blöndal et al., (2009), and as explained previously, Indonesia has historically maintained a responsible and conservative fiscal policy, focusing on sustaining aggregate fiscal discipline. In the years prior to the Asian financial crisis 1997/98, the budget had a moderate surplus (1-3 per cent of GDP) and public debt was relatively low (25 per cent of GDP). In 1997/98, the Asian financial crisis hit Indonesia's economy severely. The economy declined by over 13 per cent of GDP in 1998, followed by negligible growth in 1999. In the immediate aftermath of the crisis, and again as mentioned previously, government debt increased dramatically and reached almost 100 per cent of GDP in 1999, reflecting the cost of providing liquidity and eventually the take-over of the collapsing banking system. Most of the increase stemmed from the domestic public debt, which had hitherto been negligible. Nonetheless, fiscal policy continued on a responsible and conservative track and acted as an anchor for the whole economy. Even during the height of the fiscal crisis, budget deficits were maintained at modest levels (reaching a high of 2.5 per cent of GDP in 1999). This situation was the result of major expenditure cuts – largely in public investment and other development expenditures – to offset lower levels of revenue and rising interest expenditures to finance the growing level of debt.

In recent years, fiscal policy in Indonesia has been characterized by low deficits and declining debt ratios. Since 2000, fiscal deficits were rarely greater than 2 percent of GDP and debt levels have come down substantially, reaching about 27 percent of GDP in 2010.

This situation reflects the steadily improving economic performance as well as the proceeds from the sale of assets taken over during the crisis.

As described in Hill (2000), the structure of government's revenue during the New Order regime (1967-1998) was characterized by the alternating relative importance of the three main aggregates, i.e. oil and gas revenue, non-oil domestic revenue (NODR, consisting of tax and non-tax revenues), and foreign aid (or foreign borrowing, which was treated as revenue, i.e. development revenue). The New Order government adopted a "dynamic balanced budget rule" in which all current ("routine") expenditures and a portion of capital ("investment") expenditures were financed domestic revenues which consist of tax and non-tax revenues, and the balance of capital expenditures were financed by foreign loans (or also called as foreign aid due to its concessional feature). There was no domestic public debt. However, since foreign aid was counted as revenue, i.e. "development revenue", the balanced budget adhered to by the government was actually a budget deficit financed by foreign aid.

In the late 1960s foreign aid made important contributions, providing 25 to 30 percent of revenue. Meanwhile, oil and gas contributed 10 to 20 percent of the total, with the remaining 50 to 60 percent coming from NODR. The oil boom in 1970s altered these relative contributions. From 1974/75 to 1985/86, revenues from oil and gas became the dominant source of the total domestic revenues, ranging from 54 to about 71 percent. This implied that the revenue from oil and gas almost doubled from 27 percent of the total in 1971 to 54 percent in 1974, increasing still further to reach its peak contribution of 71 per cent in 1981. In the same period, the share of foreign aid fell to less than 20 percent, and during the early 1980s it was as low as 12 to 13 percent of the government's total revenue.

During the oil boom of the 1970s, foreign aid contributed an increasingly small percentage of the development budget, from 70 to 75 per cent of the total amount around 1970, declining to as little as 25 per cent in 1974 and again in 1980 – 82. However, by the late 1980s the contribution of foreign aid had risen to about 70 per cent (with a high of 81.6 per cent in 1988), before falling again to less than 50 per cent in the early 1990s following a decade of strong growth.

Relying on oil and gas made the government's revenue affected significantly by the fluctuations of world oil price. By 1986, during the low point in international oil prices, the share of oil and gas in the government domestic revenue drastically fell to about 30 per cent, less than one-half of that of its maximum in 1981. Not just that, even nominal value of oil revenues fell sharply, from about Rp13 trillion in 1985 to just Rp6.7 trillion in 1986. The government responded by both increasing the reliance on foreign aid and curtailing expenditures. Foreign aid revenue rose sharply, from Rp3.6 trillion in 1985 to Rp5.8 trillion in 1986 and about Rp10 trillion in 1988. As a share of government revenue the increase was sharper still, from about 15 per cent to about 25 per cent and 30 per cent respectively.

The prospect of declining oil sector taxes because of the oil market collapse in the mid-1980s, together with an increasing recognition of the weaknesses in domestic tax laws, had motivated the government to seriously implement a comprehensive tax reforms. In 1984-85 the government introduced tax reforms to produce a more efficient, buoyant and "clean" tax system, including introduction of a value added tax (VAT), the outsourcing of customs services, and substantial modification of direct taxes. As a result, real NODR, particularly tax, increased substantially after 1984.

Over the 1974-84 periods NODR rose by some 86 per cent, whereas the increase from 1984 to 1992 was over 200 per cent. Particularly, sharp increases occurred in the mid-1980s, with the introduction of VAT, and from the late 1980s, with further reforms and much more vigorous implementation. Since 1988 the revenue from tax has been the dominant source of the government's domestic revenue.

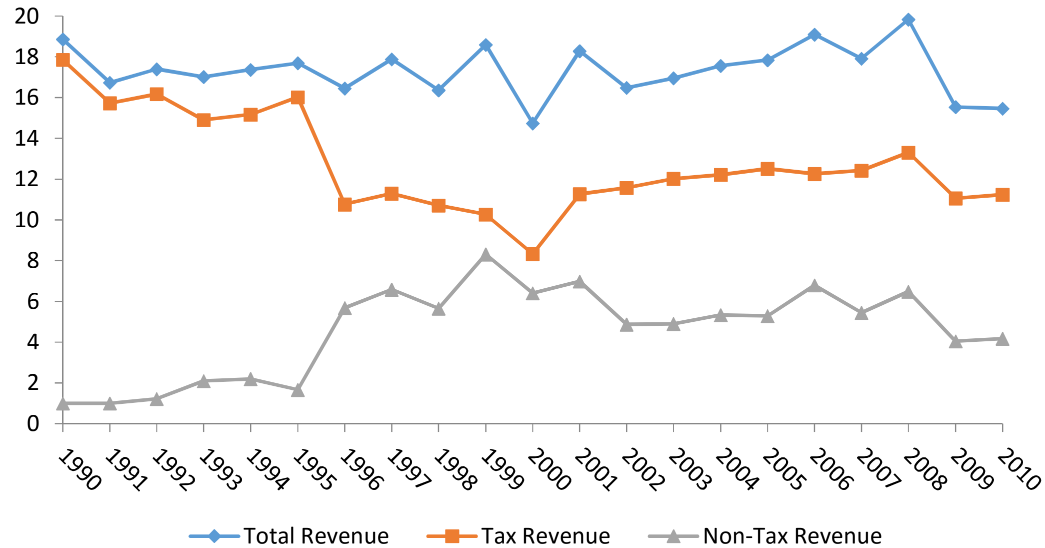
As the oil production is projected to decline, increasing the buoyancy of non-oil and gas tax revenue has become a key element in fiscal adjustment strategy in Indonesia. This serves not only to increase revenue, but also to lessen dependence on volatile oil and gas receipts. The government seeks to raise tax revenue further by intensifying tax collection, arguing that Indonesia's tax ratio at 11.2 percent of GDP is low compared to peers; 15.7 percent in Malaysia, 15.2 percent in Thailand and 12.2 percent in the Philippines. Improved tax administration has played important role in this regard, especially in the field of personal income tax which is heavily dependent on a small number of taxpayers. For example, in 2007, nearly 60per cent of personal income tax revenues came from only 1per cent of taxpayers.

Figure 2-1 displays the development of government total revenue, tax revenue and non-tax revenue (as a ratio to GDP) during the last two decades; 1990-2010. During that period, the revenue ratio averaged 17.3 percent of GDP. As can be seen the revenue fell sharply to 14.8 percent of GDP in 2000 following the drastic downturn in economic activity. The revenue ratio began recovering from 2002 onward and peaked at about 20 percent of GDP in 2008, before declining sharply to 16 percent in 2009. Meanwhile, during 1990-2010 the tax ratio was averaged at 12.7 percent of GDP. In 1990-2000, the tax ratio followed a declining trend and then began to increase in 2001.

Figure 2-2 shows the shares of tax and non-tax revenues in the government total current revenue. The contribution of tax revenue is dominant such that the average share of tax revenue during 1990 – 2010 was about 73 percent of total current revenue. During 1995-1999 the tax ratio showed a declining trend, and starting to rise again to account for 72.7 percent of GDP in 2010.

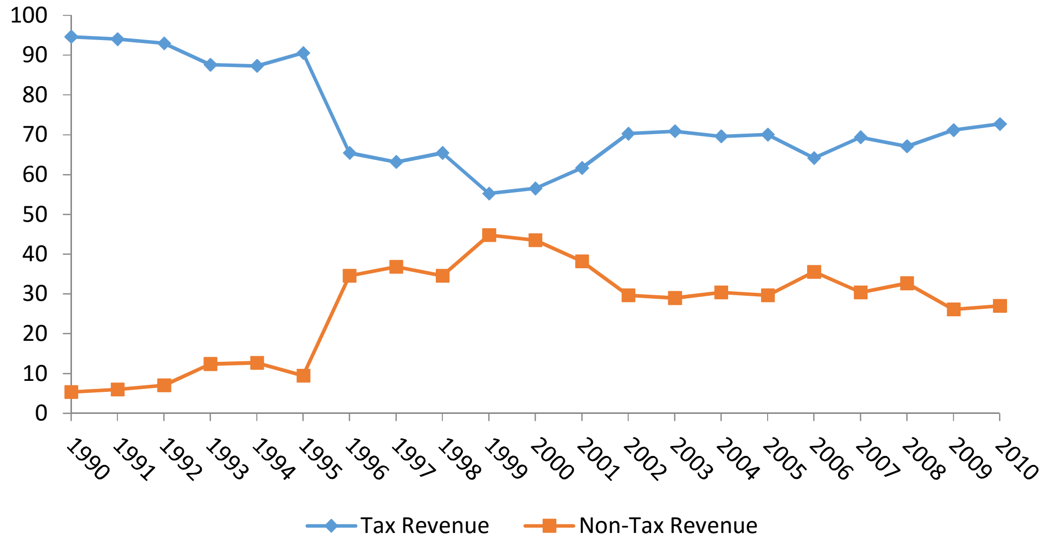
Figure 2-1

Government Revenue (% GDP)



Source: Asian Development Bank

Figure 2-2
Tax and Non-Tax Revenues (% Current Revenue)



Source: Asian Development Bank

2.3 Literature on Tax Smoothing in Industrial Countries

There have been many attempts to test the implication of the tax smoothing hypothesis by using different approaches, primarily in industrial countries. The results are mixed. Some studies test the hypothesis by checking the random walk behaviour of tax rates and predictability of changes in tax rates. For instance, Barro's (1979, 1981) positive theory of tax smoothing portends that marginal tax rates series will be martingales. In Barro (1981), he uses average tax rates (tax receipts relative to GNP) as a proxy for marginal rates in the United States and finds that the average tax rates are random walks. Moreover, he also finds little explanatory power for tax-rate changes from changes in government spending and growth of real output, implying that changes in tax rates would be unpredictable based on current information. These findings are consistent with tax smoothing behaviour.

Kingston (1984) complements Barro's tax smoothing theory with stochastic microeconomic foundations. The theoretical results suggest that the marginal collection cost of an income tax is a martingale and that the marginal rate of income tax is in general a supermartingale, which approximates a simple martingale insofar as marginal tax rates are "predictable" and "small". Tests based on a U.S. series of actual marginal income tax rates 1913 – 1975 accept the hypothesis of random walk behaviour in collection costs, and reject the parallel hypothesis on tax rates.

Sahasakul (1986) finds evidence against the tax smoothing hypotheses for United States. He tests the hypothesis for the United States between 1937 – 1982 by relating the current marginal tax rate to his measures of permanent and transitory components of the government expenditure rate and some other variables. He finds evidence that tax rate responds significantly not only to the permanent government expenditure rate but also to the transitory component and the general price level, and a time trend.

Kingston and Layton (1986) test the tax smoothing hypothesis for Australia between 1949/50 – 1980/81. They build a tax smoothing model that combines simplicity with applicability to a small open economy. They find that the marginal rate of income tax on average male weekly earnings is a random walk, and that its changes cannot be predicted by a vector of forcing variables which includes changes in government spending and growth of real output. These results confirm tax smoothing hypothesis. Moreover, since they also find some evidence against random-walk behaviour of average tax rates, public sector outlays and receipts as percentage of GDP, and average male weekly earnings, they conclude that their failure to reject the tax smoothing hypothesis is probably not just a statistical artefact.

More recent studies use a different approach to test the tax smoothing hypothesis. Rather than examining the random walk behaviour and the predictability of tax rate changes, they test the hypothesis by examining whether the fiscal deficit is informative about future changes in government expenditures. The government sets the budget surplus equal to expected changes in government expenditure. When expenditure is expected to increase, the government runs a budget surplus, and when expenditure is expected to fall, the government runs a budget deficit. For examples, Huang and Lin (1993) and Ghosh (1995) examine the time series properties of North American data using the vector autoregression technique, and find that increases in the budget surplus signal future increases in government expenditure, which is evidence in favour of tax smoothing. In contrast, Olekalns (1997) finds for Australian post-World War II data that the budget surplus has been too volatile to be fully consistent with tax smoothing. Olekalns and Crosby (1998) examine long-run data covering all of the twentieth and some of the nineteenth centuries for Australia, the United Kingdom, and the United States and find that tax smoothing is accepted only for the United States.

Fisher and Kingston (2005) take issue with the Ghosh approach, for two interrelated reasons. First, Ghosh's theoretical development proceeds in terms of "trend" GDP: shocks to government noninterest outlays are the only ones modelled. Accordingly, Ghosh assumes the tax base follows a smooth deterministic trend. However, when he turns to empirical implementation, Ghosh deflates outlays and other quantities by actual GDP, which is not smooth. What is described as "government expenditure" is actually the ratio of government spending to GDP. In this way, shocks to government expenditure are conflated with shocks to the tax base. Second, as the "fiscal surplus"—in fact the ratio of the fiscal surplus to GDP—is used to predict future increases in "government expenditure"—in fact the ratio of government expenditure to GDP—the Ghosh predictive regressions involve to some extent an autoregression. To the extent GDP is autocorrelated, Ghosh's procedure stacks the deck towards accepting the hypothesis that, under tax smoothing, fiscal surpluses help predict future rises in government expenditure. In other words, there is a risk of misreading spurious correlations as support for the tax smoothing hypothesis.

Fisher and Kingston show that under consumption smoothing together with tax smoothing, shocks to the tax base are signalled by private saving. As a consequence, future rises in the ratio of government expenditure to GDP are signalled by a composite of the fiscal surplus and private saving, not the fiscal surplus alone. Similarly, the fiscal surplus is not a sufficient statistic for future rises in real government spending.

As it turns out, in the case of the United States over the period 1947-2000, the fiscal surplus is much more informative for future rises in government spending than private saving, and this fact constitutes support for Ghosh's approach (Fisher and Kingston, 2005). However, the comparative unimportance of private saving as a signalling variable in the US during the last quarter of the 20th century might not be true for other times and places. Notably, GDP is much more volatile in developing countries than industrial economies. For example, whereas the annualised standard deviation of real output about a Hodrick-Prescott trend over the period 1970 to 1994 is 2.10 per cent in the case of the United States, the corresponding figure for Indonesia is 7.77 per cent (Talvi and Végh, 2005; Table A1).

2.4 Literature on Tax Smoothing in Developing Countries

Notwithstanding the doubts just expressed about Ghosh's analysis, it underpins two of the most substantial contributions to the literature on tax smoothing in developing countries: Cashin et al. (1998) and Cashin et al. (1999). These studies apply the Ghosh approach to India, Pakistan and Sri Lanka.

A motivation for looking beyond tests for random walks is that taxes could follow a random walk if rates were determined by a random political process (Cashin et al., 1998, 1999). However, beginning with the pioneering study of Barro (1981), tests for random walks in tax rates have mostly test as well for random walks in the relevant forcing variables, i.e., government expenditure and the tax base. Moreover, these checks typically do find some predictability of changes in the forcing variables. So the evidence for tax-smoothing behaviour by governments appears not to be a spurious result arising from random walks in the forcing variables. Indeed, tests on Indonesian data, reported below, include ones that reject random-walk behaviour in government spending and GDP in Indonesia.

Cashin et al. (1998, 1999) pose the interesting question of what differentiates fiscal policy in developing countries--in particular India, Sri Lanka and Pakistan--from fiscal policy in industrial countries. They give two answers to this question. First, in the case of Pakistan and Sri Lanka, they find evidence for "financial repression" whereby deposit rates at domestic financial institutions are capped, and making deposits at foreign financial institutions is prohibited. This policy lowers domestic real interest rates, enabling governments to borrow cheaply. It also makes close substitutes for domestic money less attractive, facilitating revenue raising via the inflation tax. However, Cashin et al. (1998, 1999) do not link their discussion of financial repression to their formal tests for tax smoothing. Second, they compare and contrast the rate of time preference of governments in industrial and developing countries. In more detail they begin by run cointegrating regressions with the surplus relative to GDP as the dependent variable, and tax receipts relative to GDP as the independent variable. Following Ghosh (1995), Cashin et al. (1998, 1999) explain that the estimated cointegrating parameter, if it exists, can be interpreted as the government's time preference factor. In the case of India over the period 1951-2 to 1996-

97, the cointegrating parameter is estimated to be 1.4. The corresponding estimate for Pakistan, 1956-95, is 1.2. In the case of Sri Lanka it turns out that there is no cointegrating parameter. In the case of the US, Canada and Australia, by contrast, the cointegrating parameters lie between 0.9 and 1.0. In this way, it seems that the governments of India and Pakistan have been more impatient than those of the US, Canada and Australia. Perhaps this observation generalises to other developing economies.

The notion that public sectors in developing countries are relatively impatient is broadly consistent with the tax-smoothing study of Talvi and Végh (2005). They find that fiscal policy has been pro-cyclical in 36 developing countries. That is, public spending has risen in booms and fallen in slumps; moreover, taxes have been cut in booms and raised in slumps. This pro-cyclical behaviour is absent from governments in G7 countries. Talvi and Végh (2005) build a tax-smoothing model in which rent-seeking behaviour makes it difficult for governments to run surpluses during boom times, contrary to the relevant prescription of tax smoothing theory, which assumes that governments act in the public interest. The Talvi and Végh (2005) model rationalises the fact that government consumption rises during booms. It also says that taxes are cut during booms, to limit wasteful spending rises. The opposite behaviour occurs during slumps because governments chronically fail during boom times to build up the fiscal headroom during boom times required for slumps to be ridden out in the way prescribed by tax smoothing theory--and also Keynesian theory, for that matter.

Pro-cyclical fiscal policy might also be interpreted as reflecting imperfect capital markets in developing countries. However, no tax-smoothing model deals explicitly with that. More generally, there are a number of other studies of tax-smoothing behaviour in developing countries apart from the three just discussed, but none comes close in terms of thoroughness or sophistication.

2.5 Theoretical Framework

In this section I derive the condition for optimal taxation, building on Kingston and Layton (1986). Consider a two-period economy with zero time preference and perfect foresight. In the domestic economy, labour n_t is the only factor of production, and related to the output y_t according to the following production function:

$$y_t = \theta_t n_t \tag{1}$$

where θ_t is exogenous but variable, with $0 < \theta_0 \neq \theta_1$, and $t = 0,1$. This implies that one period is a slump period and the other is one of boom. The production function (1) has constant returns to labour which implies that real wage will equal the marginal and average product of labour, namely θ_t, so that the wage bill [$= \theta_t n_t$], which is the labour income, exhausts output. In this economy, factor income [$= \theta_t n_t$] is taxed according to

$$\begin{aligned} &T_t = \tau_t y_t - h_t \\ &h_t \geq 0 \\ &\tau_t \leq \tfrac{1}{2} \end{aligned} \tag{2}$$

where T_t, h_t, and τ_t are respectively tax payments, exogenously-determined government transfers and the marginal income tax rate. The revenue-maximising tax rate turns out to be $\frac{1}{2}$ (see below), therefore the restriction $\tau_t \leq \frac{1}{2}$.

The representative agent has an instantaneous utility function of linear-quadratic form $c_t - \frac{1}{2} n_t^2$ where c_t denotes domestic private consumption, of domestic and/or imported products. Beginning-of-period domestic private asset holdings, $a_t \, (t = 0,1,2)$ are such that initial assets, a_0 are predetermined, current assets a_1 are a decision variable, and terminal assets a_2 are zero. Assets are claims on the domestic government and/or on foreign entities with real interest rate of r_t .

The representative private domestic agent chooses values of $c_t, n_t\ (t=0,1)$ and a_1 that maximize welfare subject to resource constraint as follows:

$$\begin{aligned}&\max \sum_{t=0}^{1} (c_t - \tfrac{1}{2} n_t^2)\\&\text{subject to}\\&h_t + (1-\tau_t)\theta_t n_t + (1+r_t)a_t - (c_t + a_{t+1}) = 0\end{aligned} \tag{3}$$

Using $\lambda_t\ (t=0,1)$ as the multiplier for the constraints, the first-order-necessary conditions for an interior optimum are:

$$\lambda_t = 1 \tag{4}$$

$$n_t = \theta_t (1-\tau_t) \tag{5}$$

$$r_1 = 0 \tag{6}$$

Equation (6) is consistent with the assumption of a world of zero time preference. Equation (1) and (5) suggest that output is positively related to productivity and negatively to taxes, such that

$$y_t = \theta_t^2 (1-\tau_t) \tag{7}$$

Lifetime private consumption is given by inherited assets *plus* lifetime disposable income:

$$\sum_{t=0}^{1} c_t = a_0 + \sum_{t=0}^{1} [\theta^2 (1-\tau_t)^2 + h_t] \tag{8}$$

The government seeks "benevolent" (welfare maximising) finance of its exogenous purchases of goods and service, g_t, plus exogenous transfers h_t . Although debt finance is available, lump-sum taxation is not, so that tax policy must settle for second best. Beginning-of-period public debt, b_t, is such that initial debt, b_0, is predetermined and terminal debt, b_2, is zero. Holders are domestic and/or foreign residents. Public and private debt instruments are perfect substitutes, so the government borrows at the prevailing real interest rate of zero.

The government's problem is to choose values of τ_t and b_1 that solve the following problem:

$$\begin{aligned} &\max\left\{a_0+\sum_{t=0}^{1}\left[\tfrac{1}{2}\theta_t^2(1-\tau_t)^2+h_t\right]\right\} \\ &\text{subject to} \\ &\tau_t\theta_t^2(1-\tau_t)+b_{t+1}-(b_t+g_t+h_t)=0 \end{aligned} \tag{9}$$

According to equation (9), the government's objective function is the agent's indirect life time utility function, or "value function".

Let μ_t be the multipliers to the constraints in (9). The first-order necessary conditions for an interior optimum are

$$\mu_t=1+\frac{\tau_t}{1-2\tau_t} \tag{10}$$

$$\mu_0=\mu_1 \tag{11}$$

The shadow price (10) has two interpretations. First, from (9) and (10) it follows that μ_t can be interpreted as one plus the one-period marginal efficiency cost of income taxation. Second, the Envelope Theorem implies that μ_t measures also the life time domestic cost of an exogenous unit increase in foreign-held public debt. Meanwhile, in the case of domestic debt, since "I owe it to ourselves", then the shadow price is the lesser amount, namely $\frac{\tau_t}{(1-2\tau_t)}$. Equations (10) and (11) together imply that:

$$\tau_0 = \tau_1 \ [= \tau^*] \tag{12}$$

According to equation (12), the optimal tax rate will be *ex ante* (or expectedly) constant over time and that the current tax rate is an unbiased predictor of future tax rates.

Moving from perfect foresight to explicit uncertainty, equation (12) can be expressed as follows:

$$E(\tau_{t+1} \mid \Omega_t) = \tau_t \tag{13}$$

where Ω_t is the information relevant to tax smoothing available at time *t*.

Equation (13) suggests that in order the fiscal policy to be optimal, the tax rate τ_t should be a martingale, i.e. a stochastic process in which the conditional expectation of a future value of a random variable, given current information set, is the current value of the variable. Accordingly, if Ω_t built on the past history of τ_t then

$$E(\tau_{t+1} \mid \tau_t, \tau_{t-1}, \cdots) = \tau_t \tag{14}$$

or, equivalently

$$E(\tau_{t+1} - \tau_t \mid \tau_t, \tau_{t+1}, \cdots) = 0 \tag{15}$$

The martingale property applies to a random walk since all changes of a variable following a random walk without drift have zero mean. In fact, a martingale is a more general stochastic process than a random walk because in the case of a martingale the changes of a level of a variable are given by a random variable which, although it must have zero mean, need not have constant variance. Nor need the changes be independent.

A random walk is a stochastic process where the changes of level are given by the addition of a random variable which exhibits a zero mean and a constant variance, and where there is zero correlation between observations. This is given formally as

$$\tau_t = \tau_{t-1} + \varepsilon_t \tag{16}$$

or

$$\Delta\tau_t = \varepsilon_t \tag{17}$$

where ε_t is a term that is independent and identically distributed with mean 0 and variance σ^2, or $\varepsilon_t \sim i.i.d(0,\sigma^2)$. The random walk model (16) implies that τ_t is nonstationary with a unit root and that the coefficient on τ_{t-1} is equal to one[1].

Equation (17) implies that changes in the tax rate variable will be statistically independent to lagged information. However, tax rates may also behave as an unpredictable random walk for reasons other than tax smoothing. As discussed above, changes in government spending and output could individually, or in combination, cause the tax rate to behave as an unpredictable random walk. Accordingly, to further examine the null hypothesis of tax smoothing, and to look for evidence of an alternative hypothesis, the first-differenced tax rate is regressed on lagged values of itself, the ratio of government expenditure to output, and the growth rate of real GDP. A caveat is that whereas the theoretical model assumes that personal income taxes are the sole component of the tax base, in reality there are other components too.

[1] If uncertainty is modelled formally, as in Kingston (1984), we get $E_{t-1}\tau_t \leq \tau_{t-1}$, allowing some combination of $\beta_0 \leq 0$ and $\beta_1 \leq 1$. Departures from a pure random walk are small to the extent tax rates are small and the volatility of tax rates is small.

2.6 Data and Methodology

2.6.1 Data

Data on the tax rate (τ_t) will be examined for the period 1970-2010. The tax rate τ_t is calculated as annual central government tax revenue divided by annual Gross Domestic Product (GDP). Data are obtained from the *Economic Key Indicators* published on-line by the Asian Development Bank and IMF's International Financial Statistics.

2.6.2 Unit root tests

The random walk model (16) implies that τ_t is nonstationary with a unit root and that the coefficient on τ_{t-1} is equal to one. Therefore, I examine the random walk implication of tax smoothing by testing the null hypothesis of a unit root in the tax rate τ_t series. If the null hypothesis is rejected, then tax smoothing is rejected. For this purpose, I employ a battery of unit root tests. First, I use the conventional unit root tests of the Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests. Second, to account for the possibility of a structural break in the time series, I also perform the Zivot-Andrews unit root test.

2.6.2.1 The ADF test

The ADF unit root test is based on the OLS estimation results from a suitably specified regression equation. The generalized form of the ADF test for unit roots is given by:

$$\Delta\tau_t = \alpha_0 + \gamma\tau_{t-1} + a_2 t + \sum_{i=1}^{p}\beta_i \Delta\tau_{t-i} + u_t \tag{18}$$

where $\Delta\tau_t$ is the first differences of the tax rate, α_0 is a constant, and t is a deterministic time trend. The lag of $\Delta\tau_{t-i}\ (i = 1 \cdots p)$ is added to control for serial correlation in error terms

u_t, with the lag length of *p*. The null hypothesis in ADF test is $H_0 : \gamma = 0$ and the alternative hypothesis is $H_a : \gamma < 0$. If $\gamma = 0$ then τ_t follows a pure random walk. The null hypothesis that τ_t is a random walk can be rejected if the absolute value of *t*-statistic from estimation is greater than the corresponding critical value provided by MacKinnon (1991).

2.6.2.2 The Phillips-Perron unit root test

Phillips and Perron (1988) argue that the ADF type tests have the problem of not having correct statistics when autocorrelation and heterogeneity are present in the error terms. Phillips-Perron unit root test incorporates an alternative of nonparametric method of controlling for serial correlation when testing for a unit root by estimating the non-augmented Dickey-Fuller test equation and modifying the test statistic so that its asymptotic distribution is unaffected by serial correlation. The PP test then entails estimating the following equation:

$$\Delta\tau_t = \alpha_0 + \beta t + \gamma\tau_{t-1} + u_t \tag{19}$$

where the possibility of the autocorrelation in u_t and non-constant variance $\sigma_u^2 \neq \sigma^2$ is allowed. Under the null hypothesis of unit root, it is tested if $\gamma = 0$, while under alternative $\gamma < 1$. Test statistics for γ is thus corrected to this particular properties of the error term. The Phillips-Perron statistic is given by:

$$\tilde{t}_\alpha = t_\alpha \left(\frac{\gamma_0}{f_0} \right)^{\frac{1}{2}} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2 f_0^{\frac{1}{2}} s} \tag{20}$$

where $\hat{\alpha}$ is the estimate, t_α is the *t*-ratio of α, $se(\hat{\alpha})$ is coefficient standard error, *s* is the standard error of the test regression, γ_0 is a consistent estimate of the error variance in the standard Dickey-Fuller test equation[2], and f_0 is an estimator of the residual spectrum at frequency zero. The asymptotic distribution of the PP modified *t*-ratio is the same as that of the ADF statistic.

2.6.2.3 The KPSS unit root test

Both ADF and PP tests suffer from a low power when β in (16) and (17) are close to unity, especially in the small samples. Hence, ADF and PP might fail to reject the null hypothesis of unit root when it actually exists. To elude this problem, Kwiatkowski *et al*. (1992) introduced an alternative test for unit roots, e.g. KPSS test, which adopts stationary as the null hypothesis. The KPSS statistic is a Lagrange multiplier (LM) statistic based on the residuals from OLS regressions of a time series in question on exogenous variables x_t :

$$\tau_t = x_t^{'}\delta + u_t \tag{21}$$

The associated KPSS LM statistic is given by:

$$KPSS = \sum_{t=1}^{T} \frac{S_t^2}{T^2 f_0} \tag{22}$$

where $S_t = \sum_{s=1}^{t} \hat{u}_s$ is a cumulative residual function based on the residuals from (18), f_0 is an estimator of the residual spectrum at frequency zero and *T* is the sample size. This statistic is compared with the critical values in Kwiatkowski et al. (1992).

2.6.2.4 The Zivot-Andrews (ZA) unit root test

A well know problem with the conventional unit root tests—such as the ADF and PP, is that they do not take into account for the possibility of a structural break in the time series. Perron (1989, 1990) shows that the conventional tests could fail to reject the unit root hypothesis of

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[2] Calculated as $\frac{(T-k)s^2}{T}$ where *k* is the number of regressors.

non-stationarity because the ability to reject a unit root decreases when the stationary alternative is true and a structural break is ignored. In order to deal with this problem, Perron proposed allowing for a known or exogenous breakpoint in the Augmented Dickey-Fuller (ADF) unit root tests, based on the knowledge of the data.

Later, Zivot and Andrews (1992) argue that determining the breakpoint exogenously could lead to an over rejection the unit root hypothesis. Therefore, they develop a variation of Perron's original unit root test in which the exact time of the breakpoint is endogenously determined. The ZA unit root test is a sequential test which utilizes the full sample and uses a different dummy variable for each possible breakpoint. The breakpoint is chosen where the *t*-statistic from ADF unit root test is at minimum (most negative). Consequently, a breakpoint will be chosen where the evidence is least favourable for the unit root null hypothesis.

As highlighted by Glynn et al. (2007), there are at least two advantages from allowing possible structural break in testing for the unit root hypothesis. First, it prevents yielding a test result which is biased towards non-rejection of the unit root hypothesis. Second, since this procedure can identify when the possible presence of structural break-point occurred, then it would provide valuable information for analysing whether a structural break on a certain variable is associated with a particular government policy, economic crises, war, regime shifts or other factors.

The most general form of the ZA unit root test, which is called Model C that allows for one-time changes in both the mean and the slope of the time series, can be presented by the following equation:

$$\Delta\tau_t = c + \alpha\tau_{t-1} + \beta t + \gamma DU_t + \theta DT_t + \sum_{j=1}^{k} d_j \Delta\tau_{t-j} + \varepsilon_t \qquad (23)$$

where DU =1 and $DT = t\text{-}TB$ if $t > TB$ and zero otherwise. This tests the null hypothesis of a unit root against the alternative hypothesis of a trend stationary with one time break (TB) in the intercept and slope of the trend function at an unknown point in time. For this, different regressions are run for $TB = 2, 3, \cdots, T-1$, where T is the number of observation adjusted for lost data due to differencing and lag length k. The lag length is selected according to the procedure suggested by Perron (1989).

A break point in the ZA unit root test is chosen that gives the least favourable result for the null hypothesis and the most weight to the trend-stationary alternative. The result is accomplished by choosing the minimum t-statistic on the Dickey-Fuller statistic out of $T\text{-}2$ regressions.

The other two alternative forms of the ZA test are: (1) Model A which allows a break in the intercept (DU) only, and; (2) Model B which allows a break in the slope (DT) only. Following the lead of Perron (1997), most studies report estimates for either models A and C. In more recent studies, Sen (2003) shows that the loss in test power is considerable when the correct model is model C and researchers erroneously assume that the break point occurs according to model A. On the other hand, the loss of power is minimal if the correct model is model A but one erroneously use model C.

2.6.3 Predictability of Tax Rate Changes

The next implication of tax smoothing is that tax rate changes $\Delta\tau_t$ are unpredictable. Based on our model, this implies that tax rate changes cannot be predicted either by its own lagged values or by lagged values of other variables, which includes the ratio of government expenditure Δg_t and growth of real output θ_t (as a proxy for productivity). As discussed before, government expenditure and productivity are the forcing variables that influence the tax rate. Moreover, in the VAR system, I can also examine the predictability of changes in government expenditure Δg_t and changes in output Δy_t .

2.6.3.1 Univariate Autoregression (AR)

To begin with, I test whether tax rate changes $\Delta\tau_t$ is predictable by its own lagged values by estimating the following AR model:

$$\Delta\tau_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i \Delta\tau_{t-i} + u_t \tag{24}$$

Based on (24), the test is carried out by employing the *F* test under the null hypothesis that $\alpha_1 = \alpha_2 = ... = \alpha_k = 0$, that is $\Delta\tau_t$ are unpredictable by its own lagged values. The *F*-statistic is given by:

$$\frac{R^2/(k-1)}{(1-R^2)/(n-k)} \tag{25}$$

where *n* being the number of observations and *k* being the number of variables involved. If the *F*-statistic is less than the critical values, then I can infer that there is no statistical evidence that any of the independent variables help to explain τ_t and, hence, τ_t should not be predictable (Wooldridge, 2009: 152-153).

2.6.3.2 Vector Autoregression (VAR)

To further know whether tax rate changes $\Delta\tau_t$ are predictable, I perform a VAR analysis and examine the predictability using *F* test and block exogeneity Wald test. In a VAR model, all variables in the system are assumed to be endogenous, with each written as a linear function of its own lagged values and the lagged values of all other variables in the system. As such, I can also check the predictability of all other variables in the system, e.g. the predictability of Δg_t and Δy_t, and make comparison. As noted by Barro (1981), tests for the unpredictability of tax rate changes are most interesting in an environment where some future changes in relevant variables are forecastable.

A VAR system with lag order *p* is as follows:

$$\mathbf{Z_t} = \boldsymbol{\alpha} + \boldsymbol{\Phi}_1\mathbf{Z_{t-1}} + \boldsymbol{\Phi}_2\mathbf{Z_{t-2}} + ...\boldsymbol{\Phi}_\mathbf{p}\mathbf{Z_{t-p}} + \mathbf{u_t} \tag{26}$$

where $\mathbf{Z_t} = [\Delta\tau_t, \Delta g_t, \Delta y_t]'$ is a vector of endogenous variables in the model, $\boldsymbol{\alpha}$ is a vector of constants, $\boldsymbol{\Phi}_\mathbf{i}$ (*i*= 1,2,..., *p*) are *k*-dimensional quadratic coefficients matrices, and u_t represents the *k*-dimensional vector of residual. The VAR system (23), assuming that the lag length is 2, can be written explicitly as follows:

$$\begin{aligned}\begin{pmatrix}\Delta\tau_t\\ \Delta g_t\\ \Delta y_t\end{pmatrix} &= \begin{pmatrix}a_{10}\\ a_{20}\\ a_{30}\end{pmatrix} + \begin{pmatrix}b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix}\begin{pmatrix}\Delta\tau_{t-1}\\ \Delta g_{t-1}\\ \Delta y_{t-1}\end{pmatrix}\\ &\quad + \begin{pmatrix}c_{11} & c_{12} & c_{13}\\ c_{21} & c_{22} & c_{23}\\ c_{31} & c_{32} & c_{33}\end{pmatrix}\begin{pmatrix}\Delta\tau_{t-2}\\ \Delta g_{t-2}\\ \Delta y_{t-2}\end{pmatrix} + \begin{pmatrix}e_1\\ e_2\\ e_3\end{pmatrix}\end{aligned} \tag{27}$$

The tax rate changes $\Delta\tau_t$ equation can be written as follows:

$$\begin{aligned}\Delta\tau_t = a_{10} &+ \alpha_1\Delta\tau_{t-1} + \alpha_2\Delta\tau_{t-2} + \beta_1\Delta g_{t-1} + \beta_2\Delta g_{t-2}\\ &+ \varphi_1\Delta y_{t-1} + \varphi_2\Delta y_{t-2} + e_1\end{aligned} \tag{28}$$

where the coefficients for lags of $\Delta\tau_t$, Δg_t and Δy_t have been changed to be α, β and φ respectively for simplicity.

Based on the estimated VAR, predictability of variables in the system is examined by applying the *F* test and block exogeneity Wald test. The *F* test is a joint test that is used for testing the null hypothesis that none of the explanatory lagged variables in a particular equation in the VAR system has significant influence on the dependent variable; all coefficients are simultaneously zero (Greene, 2011; Wooldridge, 2008). For example, for the following tax rate changes $\Delta\tau_t$ equation with order of *p*

$$\Delta\tau_t = \delta + \sum_{i=1}^{p} \alpha_i \Delta\tau_{t-i} + \sum_{i=1}^{p} \beta_i \Delta g_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta y_{t-i} + u_t \qquad (29)$$

the null hypothesis to be tested is:

$$\mathrm{H}_0 : \sum_{i=1}^{p} \alpha_i = \sum_{i=1}^{p} \beta_i = \sum_{i=1}^{p} \varphi_i = 0 \qquad (30)$$

If the null hypothesis cannot be rejected then there is no evidence that any of the explanatory lagged variables have significant influence on $\Delta\tau_t$ and, hence, I can conclude that $\Delta\tau_t$ is unpredictable.

A block-exogeneity Wald test is used for testing whether each block of lagged variables in each equation in the VAR system can, either individually or jointly, significantly influence each of the dependent variables. This is done by restricting all the coefficients in each block of lagged variables to zero. For example, the null hypothesis for individual block exogeneity test in $\Delta\tau_t$ equation is:

$$\mathrm{H}_0 : \sum_{i=1}^{p} \beta_i = 0 \text{ or } \sum_{i=1}^{p} \varphi_i = 0 \qquad (31)$$

where $\sum_{i=1}^{p}\beta_i$ is the block of coefficients of lagged Δg_t and $\sum_{i=1}^{p}\varphi_i$ is the block of coefficients of lagged Δy_t. Meanwhile, the joint (or all) block exogeneity test is:

$$\mathrm{H}_0 : \sum_{i=1}^{p}\beta_i = \sum_{i=1}^{p}\varphi_i = 0 \qquad (32)$$

I used the Wald test for testing the joint significance of each block of lagged endogenous variables in each equation of the VAR model and also for joint significance of all blocks of lagged endogenous variables in each equation of the model. The Wald test is based on the likelihood ratio statistic:

$$(T-c)(\log|\mathbf{\Sigma_r}|-\log|\mathbf{\Sigma_u}|) \qquad (33)$$

where $\mathbf{\Sigma_r}$ and $\mathbf{\Sigma_u}$ are the variance/covariance matrices of the restricted and unrestricted systems, respectively. This statistic follows a Chi-square distribution with degree of freedom equal to 2*p*, where *p* is the lag order of $\mathbf{Z_t}$, *T* is the number of observations and *c* is the number of parameters estimated in each equation of the unrestricted system.

2.7 Results

2.7.1 Unit root tests

In Table 2-1, I presents the results of the ADF, PP and KPSS unit root tests for tax rate τ_t variable. For the ADF test, the method of Perron (1989) is adopted to endogenously determined the optimal lag length of the augmented terms $\Delta\tau_{t-i}$ (i = 1, 2, … p). Starting with a maximum lag length of p = 4, the *t*-statistic of the coefficient β_i in (18) is examined for significance at the 10 percent level in an asymptotic normal distribution, where the absolute value of *t*-test is 1.645. If the *t*-statistic is not significant, the last lagged term is dropped from the regression, and the procedure is repeated for p = 3 and so on, until the significant t-statistic is found. If there is no significant t-statistic then the test is simply performed without lag. For the PP and KPSS test, the bandwidth parameter (which acts as a truncation lag in the covariance weighting) in the Bartlett kernel spectral estimation is selected based on the Newey-West bandwidth selection method.

As can be readily seen in Table 2-1, the results of both the ADF and PP tests, either with constant and trend or with constant only, suggest that the null hypothesis of unit root in the tax rate τ_t series cannot be rejected since both the ADF and PP test statistics are not more negative than the critical MacKinnon values, either at the 5 or 10 percent levels. As such, it can be concluded that τ_t is nonstationary, that being a necessary condition for a random walk.

Table 2-1
The ADF, PP and KPSS Unit Root Tests for the Tax Rate

	ADF test		**PP test**	
	With Trend	No Trend	With Trend	No Trend
t-stats.	-2.973 (0)	-1.952 (0)	2.960	2.012
Critical Values				
1% level	-4.205	-3.606	-4.205	-3.606
5% level	-3.527	-2.937	-3.527	-2.937
10% level	-3.195	-2.607	-3.195	-2.607
KPSS test				
	With Trend	No Trend		
LM Stats.	0.139**	0.328		
Critical Values				
1% level	0.216	0.739		
5% level	0.146	0.463		
10% level	0.119	0.347		

Note: Numbers in parentheses denote lag order, ** = significant at 5per cent level.

The results of KPSS tests are ambiguous since the null hypothesis of stationarity for the tax rate τ_t can be rejected at the 10 percent level if the trend is included in the test equation, but cannot be rejected if the trend is excluded. However, because the trend is significant then I prefer the result from the test equation that includes the trend (the details can be seen in Appendix). The KPSS test results therefore back up the results obtained from the ADF and PP tests that the tax rate τ_t is nonstationary.

To complete the analysis, I further perform the ZA unit root tests for the tax rate series. The results for model A and model C are reported in Table 2-2. The results of the ZA unit root tests support the results of conventional unit root tests in Table 2-1. As can be seen in Table 2-2, the null hypothesis of unit root cannot be rejected either by model A or by model C since the test statistics are not more negative than the critical values at any level of significance.

Table 2-2
The Zivot-Andrews Unit Root Test for the Tax Rate

Test Model	Lags	Test Statistics	Break Year	Critical Values		
				1%	5%	10%
Model A	0	-3.760	1996	-5.34	-4.80	-4.58
Model C	0	-3.663	1996	-5.57	-5.08	-4.82

In addition, the ZA tests identify endogenously the single most significant structural break in the tax rate series. The results of both model A and model C suggest that the structural break point is at year 1996, which is relatively close to the start of the Asian economic crisis that began to severely hit Indonesia in mid-1997.

As a summary, based on the results of a battery of unit root tests, I find evidence that the tax rate is nonstationary, suggesting that the tax rate follows a random walk. This result is consistent with the tax smoothing hypothesis.

2.7.2 Predictability of tax rate changes

2.7.2.1 Autoregression Results

As discussed before, tax smoothing implies that changes in the tax rates should be unpredictable. In Table 2-3, I shows the results of autoregression of tax rate changes $\Delta\tau_t$, which provide evidence on whether changes in tax rate are predictable by its own lagged values. The autoregression model is estimated with lag order of 1, 2, 3 and 4. Based on Akaike Information Criterion (AIC) statistics, the model with only one lag is the best specification. However, in order to have richer information on the predictability of tax rate changes, results of estimation using two, three and four lags are also presented.

Table 2-3
Tax Rate Autoregressions

	Number of Lags in autoregressions			
Coefficient	Lag 4	Lag 3	Lag 2	Lag 1
α_0	-0.129	-0.072	-0.018	0.032
	(-0.450)	(-0.255)	(-0.066)	(0.119)
α_1	-0.257	-0.224	-0.183	-0.198
	(-1.466)	(-1.316)	(-1.100)	(-1.233)
α_2	0.108	0.144	0.135	
	(0.601)	(0.828)	(0.793)	
α_3	0.139	0.158		
	(0.789)	(0.918)		
α_4	0.001			
	(0.008)			
F-stat.	0.820	1.076	1.140	1.520
Prob. (*F*-stat.)	(0.522)	(0.373)	(0.331)	(0.225)

Note: Numbers in parentheses are *t*-statistics

As can be seen in Table 2-3, the values of *F*-tests obtained from all alternative lag lengths of autoregressions are not significant at the 5 per cent level or lower. Therefore, the null hypothesis of zero coefficients for the lagged values of tax rate changes cannot be rejected and it can be concluded that tax rate changes $\Delta\tau_t$ cannot be predicted by its own lagged values during the sample period.

2.7.2.2 Vector autoregression Results

2.7.2.2.1 The F-test

In Table 2-4, I summarises the results of vector autoregression (VAR) estimations, which provide evidence on whether $\Delta\tau_t$ can be predicted not only by its own lagged values but also by lagged values of changes in government expenditure Δg_t and real GDP growth Δy_t. Moreover, Table 2-4 also provides evidence on predictability of Δg_t and Δy_t. To determine the optimal lag lengths of the VAR model, I initially estimate a VAR with maximum lag length of 4. The results from the test for lag length criteria show that the optimal lag length chosen by the LR test, the FPE, the AIC /criterion, and the HQ criterion are all 2 (for details, see Appendix). However, in order to have more insights about the predictability of the variables, I also present the results from all lag structures (lag 1 to lag 4).

The results of VAR for tax rate changes $\Delta\tau_t$ equation, i.e. where $\Delta\tau_t$ is the dependent variable, suggest that the null hypothesis of zero coefficients for all lagged variables in the equation cannot be rejected, since the *F*-statistics of 1.393, 0.836, 1.040 and 0.770 for VAR with lag order of 1, 2, 3 and 4 respectively are not significant even at 10 percent level. Hence, it can be concluded that tax rate changes are not predictable by all of lagged variables during the sample period.

As for government expenditure changes Δg_t equation, the results indicate some predictive power. The *F*-statistics of 3.148, 3.301 and 2.746 for VAR with the lag order of 1, 2, and 3 respectively are significant at 5 percent level. For lag order of 4, the *F*-statistic of 1.910 is significant at the 10 percent level.

Table 2-4
Vector Autoregressions

Dependent Variables	Lag order in VAR	R^2	*F*-stat.	DW
$\Delta\tau_t$	1	0.107	1.393	1.948
	2	0.139	0.836	2.039
	3	0.257	1.040	2.079
	4	0.257	0.770	1.961
Δg_t	1	0.227	3.418**	1.835
	2	0.390	3.301**	1.837
	3	0.478	2.746**	1.864
	4	0.499	1.910*	1.935
Δy_t	1	0.174	2.450*	2.229
	2	0.574	6.972***	1.876
	3	0.605	4.592***	2.172
	4	0.654	3.625***	2.191

Note: ** = significance at 5per cent level, *** = significance at 1per cent level

The results for real GDP growth Δy_t equation also indicate some predictive power. The *F*-statistic of 2.450 for VAR with lag order of 1 is significant at 10 percent level, while the *F*-statistics of 6.972, 4.592 and 3.625 for VAR with lag order of 2, 3 and 4 respectively are significant at the 5 percent level.

2.7.2.2.2 Block exogeneity test

In Table 2-5, I presents the results of block exogeneity tests based on VAR with lag order of 2, which is the best specification as discussed above. Table 2-5 includes three parts. The first part reports the result of testing whether I can exclude the blocks of lags of Δg_t and Δy_t from tax rate changes $\Delta\tau_t$ equation, either jointly or separately. Similarly, the next part reports the result of testing for the equations of Δg_t and Δy_t. Each part of Table 2-5 consists of five columns. The first column lists the dependent variables. The second column lists the independent variables which will be excluded from the equation. The next columns are the value of Chi-squared, degrees of freedom (df) and probability values. The last row in each part of Table 2-5 reports the joint statistics of the two variables excluded from the equation.

Table 2-5
Block Exogeneity Wald Test

Dependent Variable	Excluded Variables	Chi-sqr.	df	*P*-value
$\Delta\tau_t$	Δg_t	1.238	2	0.538
	Δy_t	1.918	2	0.383
	all	2.815	4	0.589
Δg_t	$\Delta\tau_t$	0.383	2	0.826
	Δy_t	6.291	2	0.043
	all	6.545	4	0.162
Δy_t	$\Delta\tau_t$	30.955	2	0.000
	Δg_t	14.998	2	0.001
	all	32.257	4	0.000

Notes: The reported Chi-square statistics are from the estimated VAR with lag order of 2. The term “all” refers to the exclusion of lags of all variables other than the lags of the dependent variable.

The first part of Table 2-5 suggests that the null hypothesis of excluding lags of Δg_t and Δy_t from $\Delta\tau_t$ equation cannot be rejected, either jointly or separately. The values of Chi-squared 1.238 (with probability = 0.5380) and 1.918 (with probability = 0.383) for Δg_t and Δy_t respectively are not significant, suggesting that the block of lags of each of the two variables can be excluded from $\Delta\tau_t$ equation separately. Meanwhile, the Chi-squared of 2.815 (with probability = 0.589) for "all", which is a joint test, is also not significant, suggesting that the block of lags of Δg_t and Δy_t can be jointly excluded from $\Delta\tau_t$ equation. These results suggest that $\Delta\tau_t$ is unpredictable by Δg_t and Δy_t, either individually or jointly.

The second part of Table 2-5 shows that the blocks of lags of $\Delta\tau_t$ and Δy_t can be jointly excluded from Δg_t equation, since the joint Chi-squared test of 0.162 with *P*-value of 0.162 is not significant at 5 percent level or lower. This suggests that Δg_t cannot be predicted jointly by $\Delta\tau_t$ and Δy_t. However, separately, the blocks of lags of Δy_t has significant explanatory power in predicting Δg_t.

Finally, the last part of Table 2-5 tells that I can reject the null hypothesis of excluding the blocks of lags of $\Delta\tau_t$ and .Δg_t. from output growth Δy_t equation, either jointly or individually. The Chi-squared statistics for each and for all of the blocks of regressors are highly significant at the 1 percent level. Hence, Δy_t is endogenous in the system and is predictable.

2.8 Conclusion

Following a history of recent fiscal policy in Indonesia, this paper examines Indonesian tax rate data to ascertain whether there is an evidence of tax smoothing. For that purpose, two tests were performed. First, random walk behaviour of the tax rate was examined by undertaking a battery of unit root tests. The null hypothesis of a unit root cannot be rejected, indicating that the tax rate is nonstationary and, hence, consistent with a random walk.

Second, the predictability of the tax rate is examined by regressing changes in the tax rate on its own lagged values and also lagged of changes in the tax rate, changes in the government expenditure ratio to GDP, and growth of real output. They are found to be not significant in predicting changes in the tax rate. Taken together the present evidence seems to be consistent with the tax smoothing hypothesis since the tax rate series displays random walk behaviour and is unpredictable. Therefore, the present empirical study provides support to this theory.

Discussions of fiscal policy in Indonesia have often emphasised inefficiencies, such as unwillingness to lower barriers to imports (Fane, 1999) and ongoing fuel subsidies (Hill, 2000). Tax smoothing theory hypothesises that governments set tax rates in an intertemporally efficient way. That Indonesian fiscal policy appears to have been efficient in this particular dimension, at least over the period 1970 to 2010, represents an interesting counterweight to previous discussions of efficiency in static settings.

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Appendix

Unit Root Tests

Null Hypothesis: TR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on t-statistic, lagpval=0.1, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.973437	0.1521
Test critical values:	1%	-4.205004	
	5%	-3.526609	
	10%	-3.194611	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1971-2010
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.252478	0.084911	-2.973437	0.0052
C	4.847992	1.491031	3.251437	0.0025
@TREND(1970)	-0.058358	0.022796	-2.560075	0.0147

R-squared	0.227930	Mean dependent var	0.045500
Adjusted R-squared	0.186197	S.D. dependent var	1.673544
S.E. of regression	1.509721	Akaike info criterion	3.733766
Sum squared resid	84.33258	Schwarz criterion	3.860432
Log likelihood	-71.67532	Hannan-Quinn criter.	3.779564
F-statistic	5.461559	Durbin-Watson stat	2.394450
Prob(F-statistic)	0.008349		

Note: TR = Tax Rate

Null Hypothesis: TR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on t-statistic, lagpval=0.1, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.952431	0.3059
Test critical values:	1% level	-3.605593	
	5% level	-2.936942	
	10% level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1971-2010
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.161008	0.082465	-1.952431	0.0583
C	2.345171	1.205256	1.945788	0.0591

R-squared	0.091170	Mean dependent var	0.045500
Adjusted R-squared	0.067253	S.D. dependent var	1.673544
S.E. of regression	1.616289	Akaike info criterion	3.846849
Sum squared resid	99.27080	Schwarz criterion	3.931293
Log likelihood	-74.93698	Hannan-Quinn criter.	3.877381
F-statistic	3.811987	Durbin-Watson stat	2.232680
Prob(F-statistic)	0.058283		

Note: TR = Tax Rate

Null Hypothesis: TR has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.959554	0.1559
Test critical values:	1per cent level	-4.205004	
	5per cent level	-3.526609	
	10per cent level	-3.194611	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.108314
HAC corrected variance (Bartlett kernel)	1.661322

Phillips-Perron Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1971-2010
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.252478	0.084911	-2.973437	0.0052
C	4.847992	1.491031	3.251437	0.0025
@TREND(1970)	-0.058358	0.022796	-2.560075	0.0147

R-squared	0.227930	Mean dependent var	0.045500
Adjusted R-squared	0.186197	S.D. dependent var	1.673544
S.E. of regression	1.509721	Akaike info criterion	3.733766
Sum squared resid	84.33258	Schwarz criterion	3.860432
Log likelihood	-71.67532	Hannan-Quinn criter.	3.779564
F-statistic	5.461559	Durbin-Watson stat	2.394450
Prob(F-statistic)	0.008349		

Note: TR = Tax Rate

Null Hypothesis: TR has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.011712	0.2808
Test critical values:	1per cent level	-3.605593	
	5per cent level	-2.936942	
	10per cent level	-2.606857	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.481770
HAC corrected variance (Bartlett kernel)	2.717357

Phillips-Perron Test Equation
Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1971-2010
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TR(-1)	-0.161008	0.082465	-1.952431	0.0583
C	2.345171	1.205256	1.945788	0.0591

R-squared	0.091170	Mean dependent var	0.045500
Adjusted R-squared	0.067253	S.D. dependent var	1.673544
S.E. of regression	1.616289	Akaike info criterion	3.846849
Sum squared resid	99.27080	Schwarz criterion	3.931293
Log likelihood	-74.93698	Hannan-Quinn criter.	3.877381
F-statistic	3.811987	Durbin-Watson stat	2.232680
Prob(F-statistic)	0.058283		

Note: TR = Tax Rate

Null Hypothesis: TR is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.139128
Asymptotic critical values*:	1per cent level	0.216000
	5per cent level	0.146000
	10per cent level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	7.722127
HAC corrected variance (Bartlett kernel)	25.29371

KPSS Test Equation
Dependent Variable: TR
Method: Least Squares
Sample: 1970-2010
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.51878	0.873915	18.90205	0.0000
@TREND(1970)	-0.115500	0.037607	-3.071212	0.0039

R-squared	0.194753	Mean dependent var	14.20878
Adjusted R-squared	0.174106	S.D. dependent var	3.135204
S.E. of regression	2.849234	Akaike info criterion	4.979528
Sum squared resid	316.6072	Schwarz criterion	5.063117
Log likelihood	-100.0803	Hannan-Quinn criter.	5.009966
F-statistic	9.432345	Durbin-Watson stat	0.348274
Prob(F-statistic)	0.003874		

Note: TR = Tax Rate

Null Hypothesis: TR is stationary
Exogenous: Constant
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.328493
Asymptotic critical values*:	1per cent level	0.739000
	5per cent level	0.463000
	10per cent level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	9.589762
HAC corrected variance (Bartlett kernel)	41.07989

KPSS Test Equation
Dependent Variable: TR
Method: Least Squares
Sample: 1970-2010
Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.20878	0.489637	29.01903	0.0000

R-squared	0.000000	Mean dependent var	14.20878
Adjusted R-squared	0.000000	S.D. dependent var	3.135204
S.E. of regression	3.135204	Akaike info criterion	5.147354
Sum squared resid	393.1802	Schwarz criterion	5.189148
Log likelihood	-104.5207	Hannan-Quinn criter.	5.162573
Durbin-Watson stat	0.278020		

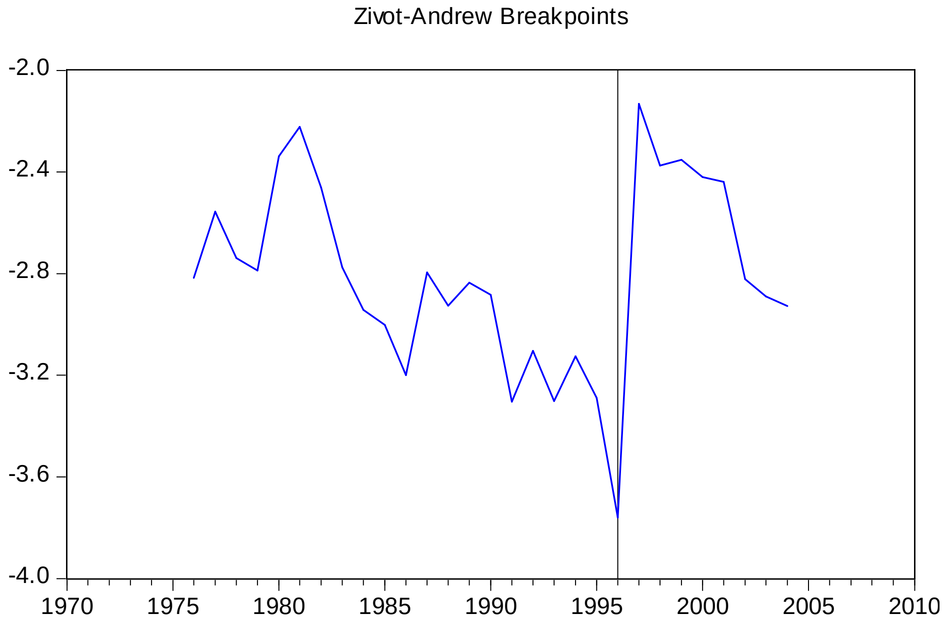
Note: TR = Tax Rate

Zivot-Andrews Unit Root Test: Model A

Sample: 1970-2010
Included observations: 41
Null Hypothesis: Y has a unit root with a structural
break in the intercept
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1996

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-3.760491	0.028692
1per cent critical value:	-5.34	
5per cent critical value:	-4.93	
10per cent critical value:	-4.58	

* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process

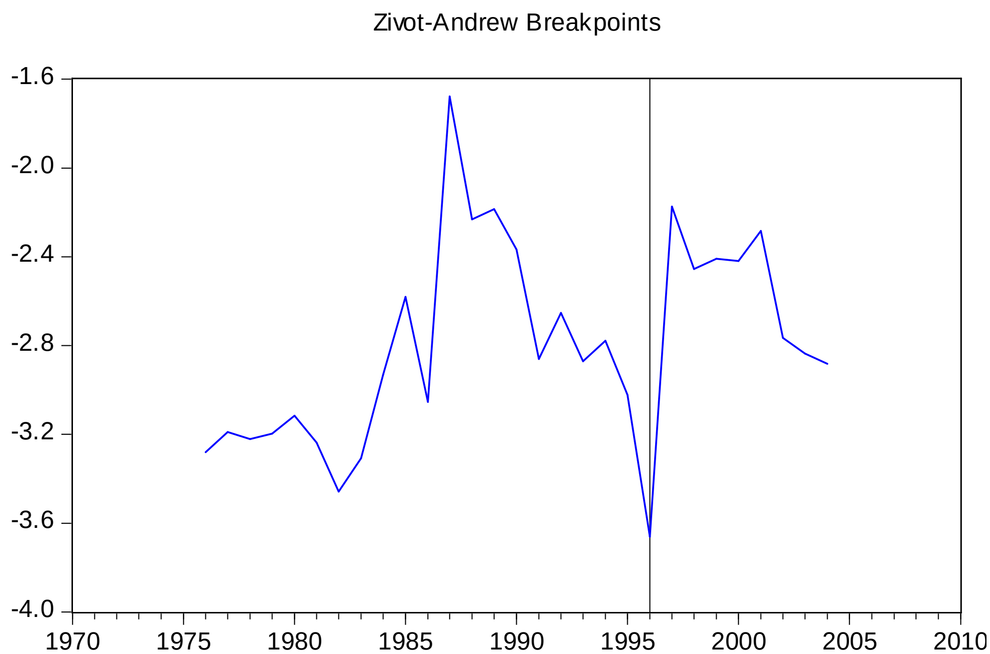


Zivot-Andrews Unit Root Test: Model C

Sample: 1970-2010
Included observations: 41
Null Hypothesis: Y has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1996

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-3.662503	0.002206
1per cent critical value:	-5.57	
5per cent critical value:	-5.08	
10per cent critical value:	-4.82	

* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process



Autoregressions

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1972-2010
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031915	0.268805	0.118729	0.9061
D(TR(-1))	-0.197977	0.160583	-1.232862	0.2254

R-squared	0.039459	Mean dependent var	0.023590
Adjusted R-squared	0.013498	S.D. dependent var	1.689599
S.E. of regression	1.678157	Akaike info criterion	3.923190
Sum squared resid	104.1998	Schwarz criterion	4.008501
Log likelihood	-74.50220	Hannan-Quinn criter.	3.953799
F-statistic	1.519949	Durbin-Watson stat	1.952687
Prob(F-statistic)	0.225403		

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1973-2010
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018071	0.275449	-0.065606	0.9481
D(TR(-1))	-0.182708	0.166050	-1.100317	0.2787
D(TR(-2))	0.134511	0.169679	0.792737	0.4333

R-squared	0.061157	Mean dependent var	-0.007895
Adjusted R-squared	0.007509	S.D. dependent var	1.700646
S.E. of regression	1.694249	Akaike info criterion	3.968013
Sum squared resid	100.4668	Schwarz criterion	4.097296
Log likelihood	-72.39224	Hannan-Quinn criter.	4.014010
F-statistic	1.139962	Durbin-Watson stat	2.059464
Prob(F-statistic)	0.331419		

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1974-2010
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.071690	0.280884	-0.255229	0.8001
D(TR(-1))	-0.223765	0.170062	-1.315782	0.1973
D(TR(-2))	0.143923	0.173780	0.828194	0.4135
D(TR(-3))	0.158212	0.172266	0.918418	0.3651

R-squared	0.089123	Mean dependent var	-0.044324
Adjusted R-squared	0.006316	S.D. dependent var	1.709006
S.E. of regression	1.703601	Akaike info criterion	4.005171
Sum squared resid	95.77447	Schwarz criterion	4.179325
Log likelihood	-70.09567	Hannan-Quinn criter.	4.066569
F-statistic	1.076271	Durbin-Watson stat	2.018381
Prob(F-statistic)	0.372576		

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1975-2010
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.129048	0.286473	-0.450470	0.6555
D(TR(-1))	-0.256910	0.175241	-1.466040	0.1527
D(TR(-2))	0.107977	0.179725	0.600792	0.5523
D(TR(-3))	0.139415	0.176792	0.788581	0.4363
D(TR(-4))	0.001389	0.175782	0.007905	0.9937

R-squared	0.095679	Mean dependent var	-0.102500
Adjusted R-squared	-0.021008	S.D. dependent var	1.695686
S.E. of regression	1.713405	Akaike info criterion	4.043088
Sum squared resid	91.00844	Schwarz criterion	4.263021
Log likelihood	-67.77559	Hannan-Quinn criter.	4.119851
F-statistic	0.819962	Durbin-Watson stat	2.046724
Prob(F-statistic)	0.522376		

Vector Autoregressions

VAR Lag Order Selection Criteria
Endogenous variables: D(TR) D(GE) GROWTH
Exogenous variables: C
Sample: 1970-2010
Included observations: 36

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-237.9514	NA	130.6603	13.38619	13.51815*	13.43225
1	-227.9490	17.78211	123.9194	13.33050	13.85834	13.51473
2	-209.0464	30.45408*	72.36860*	12.78036*	13.70408	13.10276*
3	-204.1215	7.113769	93.51181	13.00675	14.32635	13.46733
4	-197.9748	7.854162	116.0413	13.16527	14.88074	13.76401

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5per cent level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Vector Autoregression Estimates
Sample (adjusted): 1972-2010
Included observations: 39 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(TR)	D(GE)	GROWTH
D(TR(-1))	-0.130781	-0.002713	0.502998
	(0.20137)	(0.23424)	(0.42042)
	[-0.64945]	[-0.01158]	[1.19642]
D(GE(-1))	-0.118608	-0.470676	-0.399014
	(0.16062)	(0.18684)	(0.33534)
	[-0.73842]	[-2.51913]	[-1.18986]
GROWTH(-1)	0.098600	0.017399	0.325929
	(0.07468)	(0.08687)	(0.15591)
	[1.32033]	[0.20030]	[2.09048]
C	-0.520234	0.010835	3.828944
	(0.50212)	(0.58408)	(1.04832)
	[-1.03607]	[0.01855]	[3.65246]
R-squared	0.106648	0.226586	0.173548
Adj. R-squared	0.030075	0.160293	0.102709
Sum sq. resids	96.91106	131.1289	422.4135
S.E. equation	1.663997	1.935598	3.474040
F-statistic	1.392767	3.417966	2.449902
Log likelihood	-73.08813	-78.98468	-101.7959
Akaike AIC	3.953237	4.255625	5.425428
Schwarz SC	4.123859	4.426246	5.596050
Mean dependent	0.023590	0.064872	5.665258
S.D. dependent	1.689599	2.112280	3.667484
Determinant resid covariance (dof adj.)		80.76649	
Determinant resid covariance		58.37696	
Log likelihood		-245.3208	
Akaike information criterion		13.19594	
Schwarz criterion		13.70780	

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1972-2010
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.520234	0.502124	-1.036066	0.3073
D(TR(-1))	-0.130781	0.201373	-0.649447	0.5203
D(GE(-1))	-0.118608	0.160624	-0.738421	0.4652
GROWTH(-1)	0.098600	0.074678	1.320332	0.1953

R-squared	0.106648	Mean dependent var	0.023590
Adjusted R-squared	0.030075	S.D. dependent var	1.689599
S.E. of regression	1.663997	Akaike info criterion	3.953237
Sum squared resid	96.91106	Schwarz criterion	4.123859
Log likelihood	-73.08813	Hannan-Quinn criter.	4.014455
F-statistic	1.392767	Durbin-Watson stat	1.947986
Prob(F-statistic)	0.261214		

Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1972 2010
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.010835	0.584082	0.018550	0.9853
D(TR(-1))	-0.002713	0.234242	-0.011583	0.9908
D(GE(-1))	-0.470676	0.186841	-2.519128	0.0165
GROWTH(-1)	0.017399	0.086867	0.200296	0.8424

R-squared	0.226586	Mean dependent var	0.064872
Adjusted R-squared	0.160293	S.D. dependent var	2.112280
S.E. of regression	1.935598	Akaike info criterion	4.255625
Sum squared resid	131.1289	Schwarz criterion	4.426246
Log likelihood	-78.98468	Hannan-Quinn criter.	4.316842
F-statistic	3.417966	Durbin-Watson stat	1.834555
Prob(F-statistic)	0.027773		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: GROWTH
Method: Least Squares
Sample (adjusted): 1972-2010
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.828944	1.048319	3.652462	0.0008
D(TR(-1))	0.502998	0.420420	1.196418	0.2396
D(GE(-1))	-0.399014	0.335345	-1.189864	0.2421
GROWTH(-1)	0.325929	0.155911	2.090483	0.0439

R-squared	0.173548	Mean dependent var	5.665258
Adjusted R-squared	0.102709	S.D. dependent var	3.667484
S.E. of regression	3.474040	Akaike info criterion	5.425428
Sum squared resid	422.4135	Schwarz criterion	5.596050
Log likelihood	-101.7959	Hannan-Quinn criter.	5.486646
F-statistic	2.449902	Durbin-Watson stat	2.228670
Prob(F-statistic)	0.079808		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Vector Autoregression Estimates
Sample (adjusted): 1973-2010
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(TR)	D(GE)	GROWTH
D(TR(-1))	-0.169521	-0.130780	0.827918
	(0.21559)	(0.22756)	(0.32969)
	[-0.78632]	[-0.57470]	[2.51120]
D(TR(-2))	-0.035186	0.031679	1.748193
	(0.21613)	(0.22814)	(0.33052)
	[-0.16280]	[0.13886]	[5.28915]
D(GE(-1))	-0.032284	-0.350474	-0.702648
	(0.18966)	(0.20019)	(0.29003)
	[-0.17022]	[-1.75071]	[-2.42264]
D(GE(-2))	0.175752	0.188669	-1.117059
	(0.19311)	(0.20384)	(0.29532)
	[0.91010]	[0.92558]	[-3.78252]
GROWTH(-1)	0.106914	-0.048071	0.177163
	(0.08573)	(0.09049)	(0.13111)
	[1.24708]	[-0.53121]	[1.35130]
GROWTH(-2)	0.016034	0.221117	-0.152877
	(0.08392)	(0.08858)	(0.12834)
	[0.19106]	[2.49617]	[-1.19120]
C	-0.726525	-0.967949	5.536327
	(0.63834)	(0.67379)	(0.97619)
	[-1.13814]	[-1.43656]	[5.67135]
R-squared	0.139302	0.389815	0.574373
Adj. R-squared	-0.027285	0.271715	0.491994
Sum sq. resids	92.10440	102.6186	215.3984
S.E. equation	1.723691	1.819417	2.635970
F-statistic	0.836210	3.300710	6.972291
Log likelihood	-70.74106	-72.79489	-86.88283
Akaike AIC	4.091635	4.199731	4.941201
Schwarz SC	4.393295	4.501391	5.242862
Mean dependent	-0.007895	0.034474	5.606922
S.D. dependent	1.700646	2.131971	3.698332
Determinant resid covariance (dof adj.)		40.18513	
Determinant resid covariance		21.81723	
Log likelihood		-220.3303	
Akaike information criterion		12.70159	
Schwarz criterion		13.60658	

Note:TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1973-2010
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.726525	0.638344	-1.138141	0.2638
D(TR(-1))	-0.169521	0.215588	-0.786319	0.4377
D(TR(-2))	-0.035186	0.216134	-0.162800	0.8717
D(GE(-1))	-0.032284	0.189657	-0.170221	0.8659
D(GE(-2))	0.175752	0.193114	0.910096	0.3698
GROWTH(-1)	0.106914	0.085731	1.247082	0.2217
GROWTH(-2)	0.016034	0.083922	0.191055	0.8497

R-squared	0.139302	Mean dependent var	-0.007895
Adjusted R-squared	-0.027285	S.D. dependent var	1.700646
S.E. of regression	1.723691	Akaike info criterion	4.091635
Sum squared resid	92.10440	Schwarz criterion	4.393295
Log likelihood	-70.74106	Hannan-Quinn criter.	4.198963
F-statistic	0.836210	Durbin-Watson stat	2.039269
Prob(F-statistic)	0.551460		

Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1973 2010
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.967949	0.673794	-1.436565	0.1609
D(TR(-1))	-0.130780	0.227561	-0.574705	0.5696
D(TR(-2))	0.031679	0.228137	0.138859	0.8905
D(GE(-1))	-0.350474	0.200190	-1.750710	0.0899
D(GE(-2))	0.188669	0.203839	0.925578	0.3618
GROWTH(-1)	-0.048071	0.090493	-0.531212	0.5991
GROWTH(-2)	0.221117	0.088582	2.496174	0.0181

R-squared	0.389815	Mean dependent var	0.034474
Adjusted R-squared	0.271715	S.D. dependent var	2.131971
S.E. of regression	1.819417	Akaike info criterion	4.199731
Sum squared resid	102.6186	Schwarz criterion	4.501391
Log likelihood	-72.79489	Hannan-Quinn criter.	4.307059
F-statistic	3.300710	Durbin-Watson stat	1.836677
Prob(F-statistic)	0.012516		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: GROWTH
Method: Least Squares
Sample (adjusted): 1973 2010
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.536327	0.976193	5.671346	0.0000
D(TR(-1))	0.827918	0.329690	2.511205	0.0175
D(TR(-2))	1.748193	0.330524	5.289154	0.0000
D(GE(-1))	-0.702648	0.290035	-2.422636	0.0214
D(GE(-2))	-1.117059	0.295322	-3.782516	0.0007
GROWTH(-1)	0.177163	0.131106	1.351303	0.1864
GROWTH(-2)	-0.152877	0.128338	-1.191201	0.2426

R-squared	0.574373	Mean dependent var	5.606922
Adjusted R-squared	0.491994	S.D. dependent var	3.698332
S.E. of regression	2.635970	Akaike info criterion	4.941201
Sum squared resid	215.3984	Schwarz criterion	5.242862
Log likelihood	-86.88283	Hannan-Quinn criter.	5.048530
F-statistic	6.972291	Durbin-Watson stat	1.875706
Prob(F-statistic)	0.000093		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Vector Autoregression Estimates
Sample (adjusted): 1974 2010
Included observations: 37 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(TR)	D(GE)	GROWTH
D(TR(-1))	-0.297465	-0.291585	0.873231
	(0.22804)	(0.24108)	(0.35847)
	[-1.30445]	[-1.20950]	[2.43601]
D(TR(-2))	0.034297	0.015384	1.634753
	(0.23787)	(0.25148)	(0.37393)
	[0.14418]	[0.06117]	[4.37185]
D(TR(-3))	0.062140	-0.139987	-0.050287
	(0.30748)	(0.32507)	(0.48335)
	[0.20209]	[-0.43064]	[-0.10404]
D(GE(-1))	0.134493	-0.174004	-0.914501
	(0.22448)	(0.23732)	(0.35288)
	[0.59913]	[-0.73320]	[-2.59156]
D(GE(-2))	0.270198	0.388955	-1.121348
	(0.23559)	(0.24907)	(0.37034)
	[1.14689]	[1.56165]	[-3.02787]
D(GE(-3))	0.061665	0.267590	0.195482
	(0.23773)	(0.25132)	(0.37370)
	[0.25939]	[1.06472]	[0.52310]
GROWTH(-1)	0.092257	-5.10E-05	0.179531
	(0.12274)	(0.12976)	(0.19295)
	[0.75162]	[-0.00039]	[0.93046]
GROWTH(-2)	0.094168	0.303278	-0.197705
	(0.09156)	(0.09680)	(0.14393)
	[1.02845]	[3.13307]	[-1.37359]
GROWTH(-3)	-0.185219	-0.160327	0.153801
	(0.09499)	(0.10042)	(0.14931)
	[-1.94998]	[-1.59661]	[1.03005]
C	-0.107854	-0.893407	4.798143
	(0.92841)	(0.98150)	(1.45942)
	[-0.11617]	[-0.91024]	[3.28770]
R-squared	0.257489	0.477873	0.604834
Adj. R-squared	0.009986	0.303830	0.473112
Sum sq. resids	78.07150	87.25632	192.9192
S.E. equation	1.700452	1.797697	2.673042
F-statistic	1.040347	2.745726	4.591749
Log likelihood	-66.31481	-68.37247	-83.05077
Akaike AIC	4.125125	4.236350	5.029771
Schwarz SC	4.560508	4.671733	5.465154
Mean dependent	-0.044324	0.007027	5.494168
S.D. dependent	1.709006	2.154562	3.682534
Determinant resid covariance (dof adj.)		41.80963	
Determinant resid covariance		16.24660	
Log likelihood		-209.0780	
Akaike information criterion		12.92314	
Schwarz criterion		14.22929	

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1974 2010
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.107854	0.928409	-0.116171	0.9084
D(TR(-1))	-0.297465	0.228039	-1.304448	0.2031
D(TR(-2))	0.034297	0.237873	0.144184	0.8864
D(TR(-3))	0.062140	0.307482	0.202095	0.8414
D(GE(-1))	0.134493	0.224482	0.599128	0.5541
D(GE(-2))	0.270198	0.235593	1.146886	0.2615
D(GE(-3))	0.061665	0.237728	0.259395	0.7973
GROWTH(-1)	0.092257	0.122744	0.751623	0.4588
GROWTH(-2)	0.094168	0.091563	1.028450	0.3129
GROWTH(-3)	-0.185219	0.094985	-1.949975	0.0616

R-squared	0.257489	Mean dependent var	-0.044324
Adjusted R-squared	0.009986	S.D. dependent var	1.709006
S.E. of regression	1.700452	Akaike info criterion	4.125125
Sum squared resid	78.07150	Schwarz criterion	4.560508
Log likelihood	-66.31481	Hannan-Quinn criter.	4.278618
F-statistic	1.040347	Durbin-Watson stat	2.079429
Prob(F-statistic)	0.435141		

Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1974-2010
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.893407	0.981503	-0.910244	0.3707
D(TR(-1))	-0.291585	0.241080	-1.209496	0.2370
D(TR(-2))	0.015384	0.251477	0.061175	0.9517
D(TR(-3))	-0.139987	0.325066	-0.430642	0.6701
D(GE(-1))	-0.174004	0.237320	-0.733204	0.4698
D(GE(-2))	0.388955	0.249066	1.561654	0.1300
D(GE(-3))	0.267590	0.251323	1.064723	0.2964
GROWTH(-1)	-5.10E-05	0.129763	-0.000393	0.9997
GROWTH(-2)	0.303278	0.096799	3.133072	0.0041
GROWTH(-3)	-0.160327	0.100418	-1.596608	0.1220

R-squared	0.477873	Mean dependent var	0.007027
Adjusted R-squared	0.303830	S.D. dependent var	2.154562
S.E. of regression	1.797697	Akaike info criterion	4.236350
Sum squared resid	87.25632	Schwarz criterion	4.671733
Log likelihood	-68.37247	Hannan-Quinn criter.	4.389843
F-statistic	2.745726	Durbin-Watson stat	1.863814
Prob(F-statistic)	0.020344		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Dependent Variable: GROWTH
Method: Least Squares
Sample (adjusted): 1974-2010
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.798143	1.459421	3.287702	0.0028
D(TR(-1))	0.873231	0.358467	2.436011	0.0217
D(TR(-2))	1.634753	0.373928	4.371845	0.0002
D(TR(-3))	-0.050287	0.483349	-0.104039	0.9179
D(GE(-1))	-0.914501	0.352877	-2.591560	0.0152
D(GE(-2))	-1.121348	0.370343	-3.027866	0.0054
D(GE(-3))	0.195482	0.373699	0.523098	0.6052
GROWTH(-1)	0.179531	0.192949	0.930459	0.3604
GROWTH(-2)	-0.197705	0.143933	-1.373592	0.1809
GROWTH(-3)	0.153801	0.149313	1.030052	0.3121

R-squared	0.604834	Mean dependent var	5.494168
Adjusted R-squared	0.473112	S.D. dependent var	3.682534
S.E. of regression	2.673042	Akaike info criterion	5.029771
Sum squared resid	192.9192	Schwarz criterion	5.465154
Log likelihood	-83.05077	Hannan-Quinn criter.	5.183264
F-statistic	4.591749	Durbin-Watson stat	2.172449
Prob(F-statistic)	0.000965		

Note: TR = Tax Rate, GE = Government Expenditure, GROWTH = real GDP Growth Rate

Vector Autoregression Estimates
Sample (adjusted): 1975-2010
Included observations: 36 after adjustments, Standard errors in ( ) & t-statistics in [ ]

	D(TR)	D(GE)	GROWTH
D(TR(-1))	-0.348628	-0.272500	1.013148
	(0.24798)	(0.26665)	(0.37723)
	[-1.40589]	[-1.02195]	[2.68575]
D(TR(-2))	-0.035277	0.084527	1.870539
	(0.27230)	(0.29280)	(0.41423)
	[-0.12955]	[0.28868]	[4.51569]
D(TR(-3))	0.076454	-0.109052	0.120563
	(0.33853)	(0.36402)	(0.51498)
	[0.22584]	[-0.29958]	[0.23411]
D(TR(-4))	-0.093767	0.050875	0.293628
	(0.33060)	(0.35549)	(0.50291)
	[-0.28363]	[0.14311]	[0.58385]
D(GE(-1))	0.126263	-0.131192	-1.010643
	(0.24313)	(0.26143)	(0.36985)
	[0.51933]	[-0.50182]	[-2.73257]
D(GE(-2))	0.368372	0.341121	-1.600821
	(0.30101)	(0.32367)	(0.45791)
	[1.22378]	[1.05390]	[-3.49596]
D(GE(-3))	0.053974	0.113756	0.007877
	(0.30007)	(0.32266)	(0.45648)
	[0.17987]	[0.35255]	[0.01726]
D(GE(-4))	-0.069440	-0.197538	0.165107
	(0.25881)	(0.27829)	(0.39371)
	[-0.26830]	[-0.70981]	[0.41937]
GROWTH(-1)	0.092516	-0.003822	0.059914
	(0.13752)	(0.14787)	(0.20919)
	[0.67276]	[-0.02585]	[0.28640]
GROWTH(-2)	0.112965	0.274341	-0.279430
	(0.13485)	(0.14500)	(0.20513)
	[0.83773]	[1.89201]	[-1.36219]
GROWTH(-3)	-0.160332	-0.204740	0.094136
	(0.11251)	(0.12098)	(0.17116)
	[-1.42500]	[-1.69228]	[0.54999]
GROWTH(-4)	-0.078178	0.048474	0.210965
	(0.10883)	(0.11703)	(0.16556)
	[-0.71834]	[0.41422]	[1.27427]
C	0.054464	-0.695747	5.037051
	(1.16939)	(1.25744)	(1.77892)
	[0.04657]	[-0.55330]	[2.83153]
R-squared	0.286602	0.499174	0.654131
Adj. R-squared	-0.085606	0.237873	0.473678
Sum sq. resids	71.79448	83.01233	166.1420
S.E. equation	1.766776	1.899798	2.687669
F-statistic	0.770004	1.910341	3.624935
Log likelihood	-63.50698	-66.12025	-78.60962
Akaike AIC	4.250388	4.395569	5.089423
Schwarz SC	4.822214	4.967396	5.661250

Dependent Variable: D(TR)
Method: Least Squares
Sample (adjusted): 1975-2010
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.054464	1.169395	0.046574	0.9633
D(TR(-1))	-0.348628	0.247977	-1.405888	0.1731
D(TR(-2))	-0.035277	0.272300	-0.129552	0.8980
D(TR(-3))	0.076454	0.338532	0.225840	0.8233
D(TR(-4))	-0.093767	0.330598	-0.283628	0.7792
D(GE(-1))	0.126263	0.243127	0.519329	0.6085
D(GE(-2))	0.368372	0.301011	1.223782	0.2334
D(GE(-3))	0.053974	0.300071	0.179870	0.8588
D(GE(-4))	-0.069440	0.258809	-0.268304	0.7909
GROWTH(-1)	0.092516	0.137517	0.672759	0.5078
GROWTH(-2)	0.112965	0.134847	0.837727	0.4108
GROWTH(-3)	-0.160332	0.112513	-1.425000	0.1676
GROWTH(-4)	-0.078178	0.108831	-0.718339	0.4798

R-squared	0.286602	Mean dependent var	-0.102500
Adjusted R-squared	-0.085606	S.D. dependent var	1.695686
S.E. of regression	1.766776	Akaike info criterion	4.250388
Sum squared resid	71.79448	Schwarz criterion	4.822214
Log likelihood	-63.50698	Hannan-Quinn criter.	4.449971
F-statistic	0.770004	Durbin-Watson stat	1.961336
Prob(F-statistic)	0.673862		

Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1975-2010
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.695747	1.257439	-0.553305	0.5854
D(TR(-1))	-0.272500	0.266648	-1.021946	0.3174
D(TR(-2))	0.084527	0.292802	0.288683	0.7754
D(TR(-3))	-0.109052	0.364020	-0.299577	0.7672
D(TR(-4))	0.050875	0.355489	0.143112	0.8874
D(GE(-1))	-0.131192	0.261432	-0.501819	0.6206
D(GE(-2))	0.341121	0.323674	1.053902	0.3029
D(GE(-3))	0.113756	0.322663	0.352553	0.7276
D(GE(-4))	-0.197538	0.278295	-0.709814	0.4850
GROWTH(-1)	-0.003822	0.147871	-0.025850	0.9796
GROWTH(-2)	0.274341	0.145000	1.892012	0.0711
GROWTH(-3)	-0.204740	0.120985	-1.692279	0.1041
GROWTH(-4)	0.048474	0.117025	0.414216	0.6826

R-squared	0.499174	Mean dependent var	-0.025000
Adjusted R-squared	0.237873	S.D. dependent var	2.176174
S.E. of regression	1.899798	Akaike info criterion	4.395569
Sum squared resid	83.01233	Schwarz criterion	4.967396
Log likelihood	-66.12025	Hannan-Quinn criter.	4.595152
F-statistic	1.910341	Durbin-Watson stat	1.935354
Prob(F-statistic)	0.088085		

Dependent Variable: GROWTH
Method: Least Squares
Sample (adjusted): 1975 2010
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.037051	1.778916	2.831529	0.0095
D(TR(-1))	1.013148	0.377230	2.685755	0.0132
D(TR(-2))	1.870539	0.414231	4.515694	0.0002
D(TR(-3))	0.120563	0.514984	0.234110	0.8170
D(TR(-4))	0.293628	0.502915	0.583852	0.5650
D(GE(-1))	-1.010643	0.369851	-2.732566	0.0119
D(GE(-2))	-1.600821	0.457906	-3.495958	0.0019
D(GE(-3))	0.007877	0.456476	0.017256	0.9864
D(GE(-4))	0.165107	0.393707	0.419365	0.6788
GROWTH(-1)	0.059914	0.209195	0.286403	0.7771
GROWTH(-2)	-0.279430	0.205133	-1.362188	0.1863
GROWTH(-3)	0.094136	0.171158	0.549994	0.5876
GROWTH(-4)	0.210965	0.165557	1.274272	0.2153

R-squared	0.654131	Mean dependent var	5.417465
Adjusted R-squared	0.473678	S.D. dependent var	3.704674
S.E. of regression	2.687669	Akaike info criterion	5.089423
Sum squared resid	166.1420	Schwarz criterion	5.661250
Log likelihood	-78.60962	Hannan-Quinn criter.	5.289006
F-statistic	3.624935	Durbin-Watson stat	2.191336
Prob(F-statistic)	0.003885		

VAR Granger Causality/Block Exogeneity Wald Tests
Sample: 1970 2010
Included observations: 38

Dependent variable: D(TR)

Excluded	Chi-sq	df	Prob.
D(GE)	1.238382	2	0.5384
GROWTH	1.918146	2	0.3832
All	2.814558	4	0.5893

Dependent variable: D(GE)

Excluded	Chi-sq	df	Prob.
D(TR)	0.382730	2	0.8258
GROWTH	6.291395	2	0.0430
All	6.545359	4	0.1620

Dependent variable: GROWTH

Excluded	Chi-sq	df	Prob.
D(TR)	30.95500	2	0.0000
D(GE)	14.99790	2	0.0006
All	32.25738	4	0.0000

Chapter 3

Sustainability of Fiscal Policy and the Revenue-Expenditure Nexus: The Case of Indonesia

3.1 Introduction

A sustainable fiscal policy, according to Blanchard et al. (1990), is the one that can be continued indefinitely with a stable government debt-to-GDP ratio. In this sense, a persistent and large budget deficit leading to a rapid increase in the public debt to GDP ratio is a symptom of an unsustainable fiscal policy (Burger, 2005). When the market realises that the higher debt servicing costs will make it more difficult for the government to meet its budget constraint, it will be increasingly difficult for the government to sell its debt, which will increase the risk of monetizing the deficit or debt default.

Fiscal policy sustainability is a recurrent issue and it has received much attention lately following the recent global financial and economic crisis since mid-2007. In response to the crisis, many industrial countries have adopted countercyclical fiscal policy by introducing fiscal stimulus through increasing expenditure and lowering taxes. Over 2009 – 2010, fiscal stimulus packages averaging about 4 per cent of GDP have been implemented by the G-20 countries (IMF, 2009). The purpose is to generate economic activities during the economic slowdown and, hence, preventing the economies from falling further. It is widely believed that fiscal stimulus packages have made a significance contribution to the economic recovery (Adam et al., 2010; Bevan 2010; Hur et al. 2010). However, while such a fiscal activism has helped to alleviate the adverse impacts of the crisis, in the process it may lead to increases in fiscal deficits and public debts, which raises concern about fiscal sustainability.

According to the IMF (2009), as a result of countercyclical fiscal measures, it is expected that fiscal balances of member nations will be weaker by almost 6 percentage points of GDP and government debt will rise by 14 percentage points of GDP in 2009 in G-20 countries. Tanzi (2010) argues that the stimulus packages contributed to the perception that the fiscal deterioration created by the crisis would not be cyclical but long lasting and would have major consequences for the role that governments would play in the economy in years to come.

The apparent fiscal sustainability of Indonesia is interesting because it is a developing economy, with attendant fiscal weaknesses such as fuel subsidies, yet appears to have been relatively free of the fiscal myopia that has plagued much of the developing world. For example, India and Pakistan appear to have "back-loaded" much of their tax collections (Cashin et al., 1998 and 1999). Similarly, chronic incapacity to run surpluses during times of peace and prosperity together with efforts to run sustainable fiscal policies appears to have induced developing countries to run pro-cyclical fiscal policies (Talvi and Végh, 2005). By maintaining prudence in the intertemporal dimension, Indonesia has been an exception to the rule for developing countries. This paper uses recent econometric tools to characterise the distinctive sustainability of Indonesian fiscal policy.

In more detail, the aim of this paper is twofold. Firstly, it tests for the sustainability of fiscal policy in Indonesia. Since the Asian financial crisis 1997/98, the Indonesian government has implemented various fiscal consolidation measures in order to pursue fiscal sustainability, while also seeking to provide fiscal stimulus to support economic growth. The budget deficit has been consistently maintained below 3 per cent of GDP since 2000, and the public debt to GDP ratio has consistently declined since 2001. Hence, Indonesia entered the recent global economic crisis which started in mid-2007 in better fiscal condition than many Asian countries, or even the US and Europe. This looks like fiscal policy in Indonesia has been sustainable. However, I am interested in checking the sustainability formally, and in doing so I test the time series properties of the variables of interest derived from the government intertemporal budget constraint (IBC).

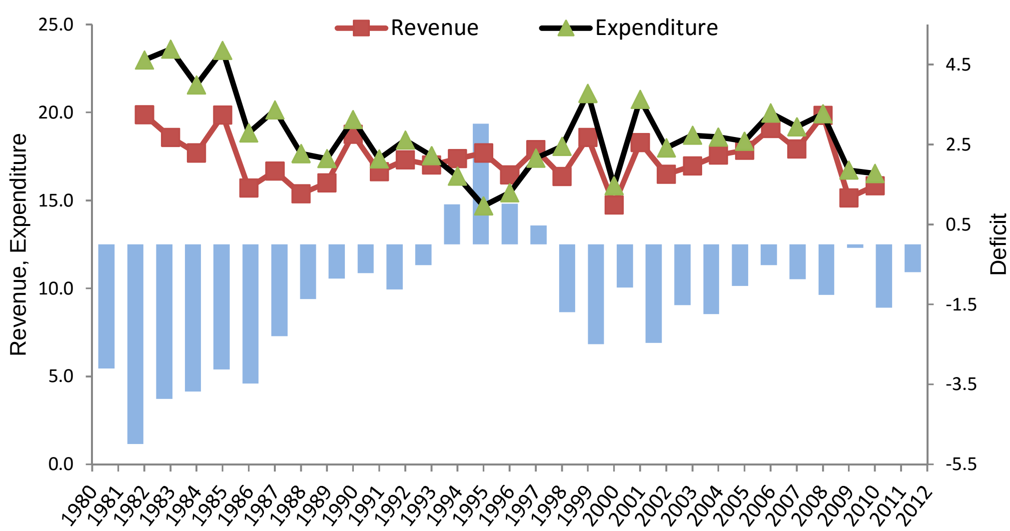
Secondly, this paper aims to test the causal relationship between government revenue and expenditure. As described in Burger (2005), the cause of fiscal policy unsustainability lies in the difference between the levels (and not the composition) of expenditure and revenue, namely the budget deficit. This implies that the direct cure for an unsustainable fiscal policy is to control budget deficit. Accordingly, a number of theoretical studies have developed several approaches to control the budget deficit, including the causality hypothesis between government revenue and expenditure which specifies whether government should control the budgetary deficit by adjusting expenditure, or by adjusting revenue, or by employing both corrective measures simultaneously. For instance, if the causality extends from revenue to expenditure, a deficit can be more effectively controlled by adjusting expenditure than by adjusting revenue as an increase in revenue would trigger an increase in expenditure and, therefore, not lead to a reduction of deficit in subsequent period (Martin et al., 2004). To test the causality relationship between revenue and expenditure I utilise the Granger causality/Block exogeneity Wald test based on the results from a vector autoregression (VAR) model. To determine whether the causality is positive and negative, I complement the causality test with the generalised impulse response analysis.

3.2 Overview of Public Finance in Indonesia

3.2.1 Revenue, expenditure and deficit

Figure 3-1 shows the development in government revenue, expenditure, and overall fiscal balance ratios to GDP in Indonesia from 1982-2010. During this sample period, government revenue and expenditure to GDP ratios fluctuated, averaging 17.3 and 18.7 per cent of GDP respectively, while the average budget deficit was 1.4 per cent of GDP. There was a period of budget surplus in 1994-1997, or four years before Indonesia became mired in an economic crisis (1997/98).

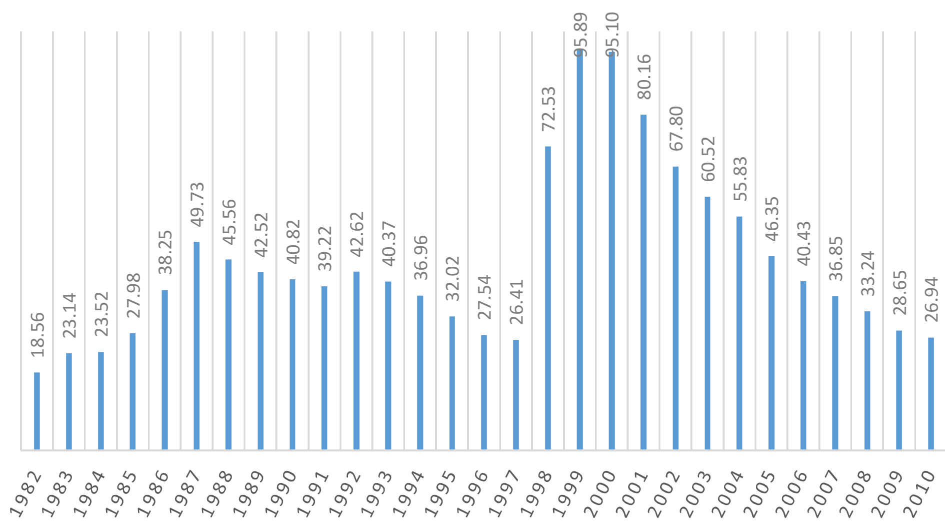
Figure 3-1
Revenue, Expenditure and Fiscal Balance (% GDP)



Source: Asian Development Bank

The public debt to GDP ratio (see Figure 3-2) ranges from 18.56 per cent in 1982 to 95.90 per cent in 1999 averaged 44.67 per cent. In 1982-1996, the period before the Asian financial crisis, the average of public debt to GDP ratio is 35.25 per cent with an increasing trend during 1982-1987 and a decreasing trend during 1987-1997. Following the Asian crisis, the debt to GDP ratio increased rapidly from 26.4 percent of GDP in 1997 to reach its peak at 95.9 percent of GDP in 1999. This rapid increased in debt to GDP ratio can be attributed to the cost of providing liquidity and eventually the take-over of the collapsing banking system. Since 2001, the debt to GDP ratio has consistently decreased. In 2010, the debt to GDP ratio reached 27 per cent of GDP.

Figure 3-2
Public Debt (% GDP)



Source: International Monetary Fund

During 1982-1995, the ratio of government expenditure to GDP fluctuated, with a declining trend. On average, the government expenditure to GDP ratio was 19.3 percent of GDP, with the highest 23.6 per cent in 1983 and the lowest 14.7 per cent in 1995. The government revenue to GDP ratio also fluctuated, but was relatively stable compared to expenditure. The average government revenue to GDP ratio was 17.5 per cent, with the highest ratio being 19.9 per cent in 1983 and the lowest ever, 15.4 per cent of GDP in 1988. As a result, the overall budget was in deficit, albeit with a declining trend. The average budget deficit was 1.8 per cent of GDP. The largest budget deficit was 5 per cent of GDP in 1983 (see Figure 3.1). The declining trend in the budget deficit during 1982 – 1995 reflects the fact that the fiscal policy was responsible and conservative with a strong willingness to pursue fiscal consolidation. In fact, during 1994-1997, four years prior to the Asian economic crisis, Indonesia recorded a moderate budget surplus of 1-3 per cent of GDP (average of 1.4 per cent of GDP).

In 1997/98, the Asia financial crisis severely hit Indonesia's economy. The economy shrank by over 13 per cent of GDP in 1998. Public debt increased dramatically in 1997 and 1998 and reached almost 100 per cent of GDP in 1999 (see Figure 3-2), which can be attributed to the cost of providing liquidity and eventually the take-over of the collapsing banking system. Nevertheless, fiscal policy continued on a responsible and conservative track and acted as anchor for the whole economy (Blöndal et al., 2009). Even during the height of the fiscal crisis (1998-1999), deficits were modest, reaching a high of 1.69 per cent of GDP in 1998 and 2.5 per cent of GDP in 1999. In fact, the prudent budget policy is generally seen as having been instrumental in the economic recovery. This situation was the result of major expenditure cuts—largely in public investment and other development expenditures—to offset lower levels of revenue and raising interest expenditures to finance the growing level of public debt. In 2000, in spite less favourable economic and political developments, the government brought the fiscal deficit under control quickly. The fiscal deficit had fallen to less than 2 per cent of GDP by 2000, and it has remained there for most years since (Hill and Shiraishi, 2007).

Since 2001, the focus of the government's fiscal policy has been to promote fiscal consolidation and reduce government debt gradually in order to achieve fiscal sustainability. As a result of the overall macroeconomic situation and current policy challenges, since 2006, the government has also focused fiscal policy on providing a modest degree of stimulus to the overall economy, within the constraints of the government's overall fiscal situation.

During 2001-2005 the fiscal policy was mainly oriented toward fiscal consolidation as reflected by a declining trend in the budget deficit to GDP ratio. As shown in Figure 3-1, while the revenue and expenditure to GDP ratios fluctuated, the budget deficit gradually declined from 2.5 per cent of GDP in 2001 to 0.5 per cent of GDP in 2005. The fiscal conservatism during this period can be attributed to: (i) the adoption of the IMF-supported stabilization programme under which the government was required to consolidate its budget by bringing down the deficit, and (ii) the adoption of the fiscal rule based on the government regulation No. 23/2003, which caps the fiscal deficit at 3 per cent of GDP and accumulated debt at 60 per cent of GDP.

Fiscal consolidation and solid economic growth helped to reduce the ratio of public debt to GDP ratio. In 2001, the public debt to GDP decreased to about 80 per cent of GDP as compared to 95 per cent of GDP in 2000. Since then, the debt to GDP ratio consistently declined. In 2005, the debt to GDP reached the level of 46 per cent of GDP. Some important measures undertaken to enhance fiscal consolidation included: (1) continued tax and custom reforms to increase revenue and lessen dependence on volatile oil and gas receipts, and (2) streamlined expenditures, including limitations on fuel subsidies. Once fiscal consolidation was achieved in 2005, the government could afford a pro-growth fiscal policy.

During 2006 – 2009, an increasing trend in the budget deficit suggests that the fiscal policy was mainly oriented towards fiscal stimulus, while still consistently maintaining longer run fiscal sustainability. In this period, government revenue and expenditure respectively averaged 17.5 and 18.5 per cent of GDP. Meanwhile, the budget deficit increased from 0.9 per cent of GDP in 2006 to 1.58 per cent of GDP in 2009, averaging 0.1 per cent of GDP. Fiscal stimulus was aimed at supporting economic growth and then at preventing economic slowdown following the global financial crisis that started in 2008. Fiscal stimulus was introduced in forms of: (1) various tax and non-tax fiscal incentives (such as reduction in personal and corporate income tax rates, import duty waivers for raw materials and capital goods, and diesel and electricity subsidies) aimed at raising production activities and investment; (2) transfer payment aimed at maintaining households' purchasing power; (3) increased expenditures on both government consumption and investment aimed at strengthening the real sector, job creation and mitigation of job losses, and (4) increasing the education budget. Meanwhile, the debt to GDP ratio has decreased from 40 per cent in 2006 to 27 per cent in 2010, which is lower than the original target of 40 per cent of GDP by the end of 2009.

In summary, fiscal policy in Indonesia during the sample period has been responsible and conservative, aimed at balancing between fiscal consolidation and fiscal stimulus concerns. The trend in conservative policymaking has been officially confirmed in the government regulation No. 2003 which caps the fiscal deficit at 3 per cent of GDP and accumulated debt at 60 per cent of GDP. After the 1997/98 economic crisis, the budget deficit has been consistently maintained below 3 per cent of GDP and the public debt to GDP ratio has consistently declined since 2001 to reach 27 per cent of GDP in 2009.

3.2.2 Government debt structure

In general, the instruments of the Indonesian central government debt can be classified into two broad categories: loans and government securities (Surat Berharga Negara or SBN). Government loans consists of external/foreign loans and, since 2010, domestic loans. Government securities consist of government debt securities and government shari'a securities. Since most of government securities are issued in the domestic market, they can be considered to represent domestic debt. As shown in Table 3-1, the outstanding government securities have become to be larger than external loan since 1999. This is in line with government's determination to reduce its dependence on foreign loans in budget deficit financing and to develop domestic government securities market in order to mobilise domestic financial resources.

3.2.2.1 External Loans

External loans are mainly arisen from bilateral and multilateral donors/creditors. Other sources of external loan are export credit facility, leasing and commercial loans. External loans have also been recognised as foreign aid or foreign assistance due to their concessional and long term nature and their grant element. As noted by Chowdhury and Sugema (2005), financing the fiscal gap was the clearest objective in obtaining external loans

Based on their design, external loans from bilateral and multilateral creditors can be in the form of project loans and program loans. Project loans means external loans utilised to finance certain activity by the state ministry/institution, including loans forwarded to local government and/or state-owned enterprise that stipulate certain requirements. Meanwhile, program loans means loans obtained in cash in which its drawdown stipulates certain mutually-agreed conditions.

Table 3-1
Central Government Debt Outstanding (IDR Trillion), 1998-2013

	Loans				
Year	External	Domestic	Total Loans	**Securities**	**Total**
1998	452.54	-	452.54	100.00	1,005.09
1999	438.26	-	438.26	501.57	1,378.10
2000	582.60	-	582.60	651.68	1,816.88
2001	612.52	-	612.52	660.65	1,885.70
2002	569.84	-	569.84	655.31	1,795.00
2003	583.30	-	583.30	648.75	1,815.34
2004	637.18	-	637.18	662.32	1,936.69
2005	620.22	-	620.22	693.08	1,933.51
2006	559.43	-	559.43	742.73	1,861.59
2007	586.36	-	586.36	803.06	1,975.77
2008	730.25	-	730.25	906.50	2,366.99
2009	611.20	-	611.20	979.46	2,201.85
2010	616.86	0.39	617.25	1,064.40	2,298.91
2011	620.28	1.01	621.29	1,187.66	2,430.24
2012	614.81	1.80	616.61	1,361.10	2,594.31
2013	712.17	2.27	714.44	1,661.05	3,089.94

Source: Ministry of Finance, Republic of Indonesia
Note: the currency of denomination of the external debt was predominantly US dollars.

During the New Order era (1966-1998) and until 2007, the distribution of external loans was coordinated through two consortiums of groups of creditor countries and multilateral agencies, namely the Inter-Governmental Group on Indonesia (IGGI), from 1966-1991, and the Consultative Group on Indonesia (CGI), from 1992-2007. The IGGI was established in 1966 and was chaired by the Minister of Development Cooperation of the Netherlands. The IGGI carried out annual informal reviews of Indonesia's development needs and coordinated annual development aid flows intended to meet those needs. In March 1992, the IGGI was disbanded at the request of the Indonesian government due to political reasons. The Indonesian government at that time argued that the IGGI had been utilised by the Netherlands as an instrument of intimidation in order to meddle with Indonesia's domestic affairs that were irrelevant to the purposes of loans provided by the IGGI, particularly those related to human right issues following the Dili incident case in East Timor on 12 November 1992 (Vos, 2001; INFID, 2007; Azis, 2008).

In April 1992 the Consultative Group on Indonesia (CGI) was established to replace the IGGI and it was co-chaired by the Indonesian Coordinating Minister of Economic Affairs and the World Bank respectively. In February 2007 the CGI was also disbanded, again at the request of the Indonesian government. As stated by the Finance Minister at that time, Sri Mulyani Indrawati, the CGI was no longer needed as Indonesia's main creditors were practically only three: the World Bank, the Asian Development Bank and Japan. It is also emphasized that Indonesia since then prefers to arrange external loan agreements through G-to-G negotiations rather than through round table, multilateral negotiations (INFID, 2007; Winters, 2010). As can be seen in Table 3-2. During 1997-2010, the biggest three creditors:

Japan, the World Bank and the Asian Development Bank have together provided about 70 per cent of the total external loans for the Indonesian central government.

3.2.2.2 Domestic loans

Domestic loans are any loans obtained from domestic lenders (possibly with conditions). Lenders of domestic loan are the state-owned banks, local government-owned banks, and local governments that have budget surpluses (Republik Indonesia, 2008). Domestic loan use is currently, based on the Medium-Term National Development Plan 2015-2019, limited to the financing of defence and security sectors. In line with its objective to support the empowerment of domestic industry and self-sufficiency in financing, domestic loans can be utilized for other sectors' financing (Ministry of Finance, 2015). In Table 3-1, it can be seen that outstanding domestic loans since 2010 are very much smaller than external loans.

3.2.2.3 Government securities

The first time the government issued domestic debt in the form of government bonds, was in 1998, in the aftermath of the Asian Financial Crisis (1997-98). Initially, public domestic debt was issued in the form of government bonds for the purpose of bank restructuring and recapitalisation program. Two types of government bonds were issued at that time, namely recapitalisation bonds for the commercial banks, and repayment bonds to Bank Indonesia (Pangestu 2003). During 1998-2000, the government issued a total of Rp 643.8 trillion of government bonds. By the end of 2000, the bond holders (national banks that had been recapitalised by the government) started to trade these bonds, which initiated the development of the government securities domestic market.

In December 2002, based on the Law No. 24/2002, the government began issuing government securities directly on the market for the purpose of: (1) financing the state budget deficit; (2) covering short-term cash shortages arising from mismatch between receipts and expenditures in the State Treasury Account within one fiscal year, and; (3) managing the public debt portfolio. In 2005, government securities has become more important instrument of budget deficit financing compared to foreign loans.

Nowadays, government securities consist of government debt securities (Surat Utang Negara, also known as Government Bonds or T-bonds), Treasury Notes (Surat Perbendaharaan Negara, i.e. T-bills), Government Islamic Securities (Sukuk) and Islamic Treasury Notes (Islamic T-bills). Government Bonds are issued for tenors of more than 12 months, with variable rates or fixed coupons. Treasury Notes are issued for a maximum tenor of 12 months with interest paid under the discount system. Meanwhile, Sukuk and Islamic T-bills are respectively long-term and short-term securities issued by the government based on Shari'a, or Islamic, principles. Based on tradability, government securities include tradable and non-tradable securities, and based on currency denomination including rupiah and foreign exchange denominated securities.

As can be seen in Table 3-3, outstanding tradable government securities are dominated by rupiah denominated securities, particularly in forms of bonds with fixed and variable rates. It also can be seen that the proportion of bonds with fixed rates tend to increase while the proportion of variable rates bonds is in the contrary.

Table 3-2

Central Government External Loan Outstanding by Creditors (USD Million), 1997-2010

	Japan		ADB		World Bank		Others		
Year	Nominal	% Total	Nominal	% Total	Nominal	% Total	Nominal	% Total	Total
1997	19.17	37.50	5.22	10.21	10.83	21.19	15.90	31.10	51.12
1998	22.03	39.07	6.13	10.87	11.32	20.07	16.91	29.99	56.39
1999	26.00	42.12	7.21	11.68	12.09	19.59	16.43	26.62	61.73
2000	24.16	39.54	7.67	12.55	12.42	20.33	16.85	27.58	61.10
2001	21.88	37.15	8.04	13.65	12.17	20.66	16.81	28.54	58.90
2002	24.97	39.17	8.65	13.57	11.53	18.09	18.59	29.17	63.74
2003	28.38	41.18	8.77	12.73	10.67	15.48	21.09	30.61	68.91
2004	28.64	41.76	9.04	13.18	9.90	14.43	21.01	30.63	68.59
2005	25.58	40.55	9.16	14.52	9.11	14.44	19.24	30.50	63.09
2006	24.47	39.46	9.41	15.17	8.74	14.09	19.40	31.28	62.02
2007	24.63	39.57	10.18	16.35	8.37	13.45	19.07	30.63	62.25
2008	29.61	44.40	10.87	16.30	8.96	13.44	17.25	25.87	66.69
2009	27.61	42.52	10.89	16.77	10.10	15.56	16.33	25.15	64.93
2010	30.49	44.77	11.15	16.37	11.37	16.70	15.09	22.16	68.10

Source: Ministry of Finance, Republic of Indonesia

Table 3-3
Government Securities Outstanding (IDR billion or stated otherwise), December 2007 – December 2013

	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12
A. Tradable	543,680	648,335	724,898	803,191	919,236	1,085,173
1. Rupiah Denominated	477,747	525,695	581,748	641,215	723,606	820,266
a. Government Debt Securities (SUN)	477,747	520,995	570,215	615,498	684,618	757,231
1) T-Bill	4,169	10,012	24,700	29,795	29,900	22,820
2) Zero-coupon bond	10,500	11,491	8,686	2,512	2,512	1,263
3) Fixed Rate Bond	294,453	352,558	393,543	440,396	517,142	610,393
4) Variable Rate Bond	168,625	145,934	143,286	142,795	135,063	122,755
b. Government Islamic Securities (SBSN)	0	4,700	11,533	25,717	38,988	63,035
1) Fixed Rate Islamic Bond	0	4,700	11,533	25,717	37,668	62,840
3) T-Bill Shari'a	0	0			1,320	195
2. Foreign Currency Denominated	65,933	122,640	143,150	161,976	195,630	264,907
a. Government bond (million USD)	7,000	11,200	14,200	16,200	18,700	22,950
b. Islamic bond (million USD)	0	0	650	650	1,650	2,650
c. Government bond (million JPY)	0	0	35,000	95,000	95,000	155,000
B. Non-Tradable	259,404	258,160	254,561	261,215	268,419	275,927
a. Promissory note to central bank	259,404	258,160	251,875	248,432	244,636	240,144
c. Government Islamic Securities	0	0	2,686	12,783	23,783	35,783
TOTAL GOVERNMENT SECURITIES	803,084	906,495	979,459	1,064,406	1,187,655	1,361,101
Exchange rates assumption						
IDR/USD	9,149	10,950	9,400	8,991	9,068	9,670
IDR/JPY			101.70	110.29	116.80	111.97

Source: Ministry of Finance, Republic of Indonesia

3.3 Literature Review

3.3.1 Fiscal policy sustainability concept

Since the seminal paper of Hamilton and Flavin (1986), fiscal sustainability analyses have mostly started with a representative agent model in which the government must satisfy an intertemporal budget constraint (IBC) and, in every period, a static budget constraint (Chalk and Hemming, 2000). Within this framework, fiscal policy is considered to be sustainable if the expected present value of all future primary surpluses equals the current level of public debt. The IBC can be derived from a budget identity that links the primary balance to revenue, expenditure and public debt as follows:

$$\begin{aligned} B_t - B_{t-1} &= r_t B_{t-1} + G_t - T_t \\ B_t &= (1+r_t)B_{t-1} + G_t - T_t \\ B_t &= (1+r_t)B_{t-1} - S_t \end{aligned} \tag{1}$$

where G_t is primary government expenditures (i.e., government expenditures excluding interest payments), B_t is the stock of debt at the end of period, T_t is the government revenues, r_t is the one-period (average) interest rate on government debt issued at the end of last period, and $r_t B_{t-1}$ is interest payments made in the current period. According to (1), government budget deficit $G_t - T_t + r_t B_{t-1}$ must be financed by issuing new debt, and that the size of the current government debt is equal to the accumulation of the current and past budget deficits. Since (1) should hold in each period, then

$$B_{t+1} - B_t = r_{t+1} B_t - S_{t+1} \tag{2}$$

Solving (2) for B_t, the stock of debt at time t is equal to

$$B_t = \frac{B_{t+1}}{1+r_{t+1}} + \frac{S_{t+1}}{1+r_{t+1}} \tag{3}$$

To derive the intertemporal budget constraint, equation (2) is iterated $k-1$ periods forward as follows:

$$\begin{aligned}
B_{t+1} &= \frac{B_{t+2}}{1+r_{t+2}} + \frac{S_{t+2}}{1+r_{t+2}} \\
B_{t+2} &= \frac{B_{t+3}}{1+r_{t+3}} + \frac{S_{t+3}}{1+r_{t+3}} \\
&\cdots \\
B_{t+k-2} &= \frac{B_{t+k-1}}{1+r_{t+k-1}} + \frac{S_{t+k-1}}{1+r_{t+k-1}} \\
B_{t+k-1} &= \frac{B_{t+k}}{1+r_{t+k}} + \frac{S_{t+k}}{1+r_{t+k}}
\end{aligned} \tag{4}$$

Recursively substitute B_{t+k-1} into B_{t+k-2}, B_{t+k-2} into B_{t+k-3}, etc,…, to get

$$\begin{aligned}
B_t &= \frac{B_{t+1}}{1+r_{t+1}} + \frac{S_{t+1}}{1+r_{t+1}} \\
&= \frac{B_{t+k}}{(1+r_{t+k})\times(1+r_{t+k-1})\times\cdots\times(1+r_{t+2})\times(1+r_{t+1})} \\
&\quad + \frac{S_{t+k}}{(1+r_{t+k})\times(1+r_{t+k-1})\times\cdots\times(1+r_{t+2})\times(1+r_{t+1})} \\
&\quad + \cdots + \frac{S_{t+2}}{(1+r_{t+2})\times(1+r_{t+1})} + \frac{S_{t+1}}{(1+r_{t+1})}
\end{aligned} \tag{5}$$

Assuming that the real interest rate us constant and positive over time $(r_{t+k} = r > 0)$, summing up the terms in equation (5) for infinite periods forward, the general representation of the stock of debt B_t is equal to present value of the future debt stock and the sum of the discounted primary budget balance

$$B_t = \frac{B_{t+k}}{(1+r)^k} + \sum_{k=1}^{\infty} \frac{S_{t+k}}{(1+r)^k} \tag{6}$$

According to equation (6), the initial stock of debt B_t should be equal to the sum of the discounted primary balance and the present value of the future debt stock. Taking expectations, I can rewrite equation (6) as follows:

$$B_t = \lim_{k \to \infty} E_t \frac{B_{t+k}}{(1+r)^k} + E_t \sum_{k=1}^{\infty} \frac{S_{t+k}}{(1+r)^k} \tag{7}$$

A necessary and sufficient condition for fiscal policy sustainability is that as $k \to \infty$ then the expected present value of future debt stock should converge to zero:

$$\lim_{k \to \infty} E_t \frac{B_{t+k}}{(1+r)^k} = 0 \tag{8}$$

Equation (8) is known as the transversality condition, which implies a no-Ponzi game[1] and states that the growth rate of public debt should not be larger than the interest rate. If the transversality condition is satisfied then the intertemporal budget constraint (IBC) is:

$$B_t = E_t \sum_{k=1}^{\infty} \frac{S_{t+k}}{(1+r)^k} \tag{9}$$

which states that the government that is faced with the transversality condition will have to achieve future primary surpluses whose present value adds up to current value of the stock of public debt.

[1] A Ponzi Game is a situation in which an economy borrows funds continuously by issuing a new debt. In this way the economy is rolling over it indefinitely without eventually retiring it. It happens when an economy is spending more than it is earning and public spending thus permanently exceeds tax revenue (Romer, 2011).

3.3.2 Tests of fiscal sustainability

Many studies have tested fiscal policy sustainability for various countries since the early 1980s, when most countries experienced high levels of government debt and primary deficit. Two methods, based on the intertemporal budget constraint, appear to be worth pursuing. One method is to test past fiscal data to see if government debt and/or deficits follow a stationary process, along the lines suggested by the pioneer Hamilton and Flavin (1986). The other is to implement cointegration tests of government revenues and expenditures, following Trehan and Walsh (1988), Hakkio and Rush (1991), and Bohn (1998, 2005).

The work by Hamilton and Flavin (1986) is the first important contribution to testing for fiscal sustainability. Assuming constant real interest rates, they argue that a sufficient condition for fiscal sustainability is that the primary balance, and therefore that public debt stock, is a stationary series. Hamilton and Flavin derive a testable equation based on (7) as follows:

$$B_t = \sum_{k=1}^{\infty} \frac{1}{(1+r)^k} E_t\left(T_{t+k} - G_{t+k}\right) + A_0(1+r)^t + \varepsilon_t \qquad (10)$$

where $A_0 = E_t\left[\lim_{k\to\infty} \frac{1}{(1+r)^k} B_{t+k}\right]$ and ε_t is an error term. The IBC, or fiscal sustainability condition, is satisfied if $A_0 = 0$, which assumed to be true if the public debt stock B_t and the primary surplus $R_t - G_t$ follow stochastic stationary processes. If $A_0 > 0$ then B_t will not be stationary, implying that public debt at time *t* cannot be paid back by expected future surpluses.

Trehan and Walsh (1988) argue that if the debt stock B_t and primary deficits S_t are integrated of order one I(1), and if real interest rates are constant, a necessary and sufficient condition for fiscal sustainability is that debt and primary fiscal balances are cointegrated, with a (1, *r*) vector of cointegration. This can be seen by rewriting the government budget equation (1) as follows:

$$\begin{aligned} B_t - B_{t-1} &= G_t + r_t B_{t-1} - T_t \\ \Delta B_t &= r_t B_{t-1} + S_t \end{aligned} \tag{11}$$

If B_t is an I(1) process then the change in debt $\Delta B_t = B_t - B_{t-1}$ must be stationary by definition. This implies that the overall balance $(r_t B_{t-1} + S_t)$ is stationary, and that if the interest rate is constant, B_t and S_t are cointegrated with a cointegrating vector (1, *r*). In short, if cointegration tests suggest that debt and primary fiscal balances are cointegrated then fiscal policy is sustainable (Chalk and Hemming 2000). In their later paper, Trehan and Walsh (1991) suggest that, if interest rates are not constant, then an alternative way to assess fiscal sustainability is to test the stationarity of the overall government deficit, i.e. the deficit including interest payments. They argue that stationarity of the overall deficit is a sufficient condition for intertemporal budget balance, given positive (not necessarily constant) real interest rates.

Hakkio and Rush (1991) reformulated equation (2) with total government expenditure (i.e. government expenditure including interest payments) on the left hand side as follows

$$GG_t = G_t + rB_{t-1} = T_t + \sum_{k=1}^{\infty} \frac{1}{(1+r)^{k+1}} (\Delta T_{t+k} - \Delta G_{t+k}) + \lim_{k\to\infty} \frac{1}{(1+r)^{k+1}} B_{t+k} \tag{12}$$

where $GG_t = G_t + rB_{t-1}$ is total government expenditures. If revenues T_t and expenditures G_t are integrated of order one, or I(1), so that ΔT_t and ΔG_t are stationary, then

$$GG_t = \alpha + T_t + \lim_{k\to\infty} \frac{1}{(1+r)^{k+1}} B_{t+k} + \varepsilon_t \tag{13}$$

Assuming that $\lim_{k\to\infty} \frac{1}{(1+r)^{k+1}} B_{t+k} = 0$ leads to the following test equation

$$T_t = \alpha + \beta GG_t + \varepsilon_t \tag{14}$$

Given that GG_t and T_t are both I(1), Hakkio and Rush (1991) define cointegration between government revenue and government expenditure as a necessary condition for the IBC, thus fiscal sustainability, to hold. Moreover, they also argue that $0 < \beta \leq 1$ is a necessary condition for the term in equation (10) to zero.

3.3.3 Revenue-expenditure nexus

The literature on public finance offers four competing alternative hypotheses regarding the causal relationship between government revenue and expenditure. Literature surveys among others, include Ewing and Payne (1998), Darrat (2002), Payne (2003), Narayan (2005), Dalena and Magazzino (2012) and Elyasi and Rahimi (2012).

First, the tax-and-spend hypothesis—advocated by Friedman (1978) and Buchanan and Wagner (1977)—suggests a unidirectional causality running from revenue to expenditure, e.g. changes in government revenues would lead to changes in government expenditures. According to Friedman (1978), the unidirectional causality from revenue to expenditure is positive, which implies that increasing revenue will simply lead to more expenditure. Reducing taxes could even reduce budget deficits. Buchanan and Wagner (1977) argue, by contrast, that an increase in revenue will reduce the deficits. According to Buchanan and Wagner, increasing government revenue will result in decreasing expenditure. Their argument is built on an assumption that the public suffer from fiscal illusion whereby a reduction in taxes will make the public perceive that the cost of government programs has fallen and, hence, demand more programs from the government. The increase in demand, if undertaken, will result in higher government expenditure and, consequently, a higher budget deficit. To reduce government expenditures, Buchanan and Wagner favour limiting the ability of the government to resort to deficit financing. In short, increasing revenue is the appropriate way to reduce the budget deficit.

Second, the spend-and-tax hypothesis—advocated by Barro (1979) and Peacock and Wiseman (1979)—suggests a unidirectional causality running from government expenditure to revenues, that changes in government expenditure would only lead to changes in government revenue. According to Peacock and Wiseman (1979), temporary increases in government expenditures due to “crises” can lead to permanent increases in government revenues. Meanwhile, Barro (1979), based on Ricardian equivalence proposition, suggests that government borrowing undertaken today will lead to an increased tax liability in the future. Thus, under the Ricardian equivalence government expenditure is fully capitalised by the public in recognition of these increased future tax liabilities.

Third, the tax-and-spend and spend-and-tax hypothesis (or the fiscal synchronisation hypothesis)—as proposed by Musgrave (1966) and Meltzer and Richard (1981)—suggests a bidirectional causality between government revenues and expenditures. According to this hypothesis, the revenue and expenditure decisions are made simultaneously by analysing costs and benefits of alternative government programs.

Finally, the institutional separation hypothesis—advocated by Wildavsky (1988) and Baghestani and McNown (1994)—suggests the possibility of independence determination of revenues and expenditures due to institutional separation of allocation and taxation functions of government. Therefore, this view precludes unidirectional causation from revenue to spending or from spending to revenue.

3.4 Data and Methodology

3.4.1 Data

I use annual data on government debt stock, government expenditure, government revenue, and government budget deficit covering the period 1982 - 2010. All variables are scaled to GDP. While controlling for GDP, this treatment also alleviates the question of whether variables should be in nominal or real terms. The data for government revenue, expenditure, deficit, and GDP are collected from the *Key Indicators for Asia and the Pacific* published by Asian Development Bank (ADB)[2], while the data for public debt stock are taken from the Historical Public Debt Data Base published by the Fiscal Affair Department of International Monetary Funds (IMF)[3].

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[2] http://www.adb.org/publications/series/key-indicators-for-asia-and-the-pacific
[3] http://www.imf.org/external/datamapper/index.php?db=DEBT

3.4.2 Sustainability test

As argued by Trehan and Walsh (1988, 1991), the stationarity of the overall budget deficit is a sufficient condition for a sustainable fiscal policy, and this condition is equivalent with the existence of stationarity in both the government revenue and expenditure. Therefore, I start the fiscal policy sustainability analysis by testing the stationarity of the government revenue and expenditure. If both government revenue and expenditure are I(0), then the budget deficit is also I(0), and it can be concluded that the transversality condition is satisfied, and therefore that fiscal policy is sustainable. If either revenue or expenditure is I(0), while the other is I(1), the transversality cannot be satisfied and therefore fiscal policy is unsustainable. If both government revenue and expenditure are I(1), the test for sustainability should be proceeded to cointegration test between the two variables. Stationarity of the overall budget deficit requires that revenue and expenditure be cointegrated with cointegrating vector (1, -β), where $\beta = 1$. If $0 < \beta < 1$ then the overall budget deficit will be I(1), hence fiscal policy is unsustainable.

I apply two types of unit root test. The first type includes the conventional unit root tests of Augmented Dickey-Fuller (ADF) test, the Phillips-Perron (PP) test, and Kwiatkowski, Phillips, Schmidt and Shin (KPSS). These conventional unit root tests are well-known for their bias towards nonrejection of the null hypothesis of nonstationarity (or unit root) in the presence of structural breaks and low power of near-integrated process (Perron 1989). Meanwhile, the KPSS stationary test suffers from size distortions in the presence of structural breaks and tends to over-reject the true null hypothesis of stationarity (Lee, Huang, and Shin 1997). The second type of unit root used allows for a break in the series and is the Zivot and Andrews' (1992) unit root test (ZA test).

3.4.2.1 Conventional stationarity tests

The ADF test for checking stationarity properties of a time series variable, for instance y_t, involves the estimation of alternative specifications of the following general equation:

$$\Delta y_t = \alpha_0 + \alpha_1 T + \beta y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \qquad (15)$$

where α_0 is a constant, Δ denotes the difference operator, T denotes the time trend, and ε_t is the error term assumed to be covariance stationary. The null hypothesis of the ADF test is that the variable y_t is a nonstationary $(H_0 : \beta = 0)$ which is rejected if β is significantly negative $(H_a : \beta < 0)$. If the calculated ADF statistic is higher than McKinnon's critical values, then the hull hypothesis is not rejected and the series is nonstationary or not integrated of order zero I(0). Alternatively, rejection of the null hypothesis implies stationarity.

The PP unit root test involves estimating a non-augmented version of regression (15); i.e., without the lagged difference terms. The PP unit root test uses a non-parametric method to control for serial correlation under the null hypothesis. The null and alternative hypotheses in PP test are the same as in the ADF test. However, PP unit root test is based on its own statistic and corresponding distribution (Phillips 1987; Phillips and Perron 1988).

Finally, the KPSS uses a similar (though parametric) autocorrelation correction to the PP but assumes that the observed time series can be decomposed into the sum of a deterministic trend, a random walk and a stationary error term. It thus tests the null hypothesis of trend stationarity corresponding to the hypothesis that the variance of the random walk equals zero

(Kwiatkowski et al. 1992). I consider using the KPSS test as a complement for the ADF and PP tests.

3.4.2.2 Zivot-Andrews stationarity test with a structural break

The Zivot and Andrews' (1992) unit root test (ZA test) is a variation of Perron's (1989) original test. The difference is that in the ZA test the break in a time series is estimated endogenously, rather than exogenously determined. There are three alternative models of the ZA test in relation with three possible ways that a break can appear in a time series: (1) Model A which permits a one-time change in the level (intercept) of the series; (2) Model B, which allows for a one-time changes in the slope of the trend function, and; (3) Model C, which combines one-time changes in the level and the slope of the trend function of the series. I use Model C which is less restrictive and is the most comprehensive compared to Model A and Model B. Moreover, Perron (1997) argues that most macroeconomic time series can be adequately modelled using either model A or model C. However, as suggested by Sen (2003), if model A is used when in fact the break occurs according to model C then there will be a substantial loss in test power. Meanwhile, if the break is characterised according to model A, but model C is used, then the loss in power is minor. Therefore, model C is superior to model A. Model C of the ZA unit root test is as follows:

$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \varphi DU_t + \gamma DT + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad (16)$$

where DU_t is an indicator dummy variable for a mean shift occurring at each possible break-date (*TB*) and DT_t is corresponding trend shift variable. Formally, $DU_t = 1$ if $t > TB$ and $DU_t = 0$ if otherwise. Meanwhile $DT_t = t - TB$ if $t > TB$ and $DT_t = 0$ if otherwise. The null hypothesis is $\alpha = 0$, which implies that y_t contains a unit root with a drift that excludes any structural break. The alternative hypothesis is $\alpha < 0$ which implies that the series is a trend stationary process with a one-time break occurring at an unknown point in time.

The ZA test identifies endogenously the point of the single most significant break-date (TB) in every time series being examined. Specifically, the ZA test considers every point as potential break-date and runs a regression for every possible break-date sequentially. From among all possible break-dates, the ZA test selects as its choice of break-date which minimises the one-sided t-statistic for testing $\alpha = 0$. The knowledge about the break point is central for accurate evaluation of any programs or events that bring about structural change.

3.4.3 Revenue and expenditure causality test

3.4.3.1 Granger causality/Block exogeneity Wald test

To test the causality between government revenue and expenditure I follow the intuitive notion of a variable's forecasting ability due to Granger (1969, 1980): if a variable, or group of variables, x_t is found to be helpful for predicting another variable, or group of variables, y_t then x_t is said to Granger-cause y_t; otherwise it is said to fail to Granger-cause y_t. Hence, Granger causality is not the same as "systemic forcing", which is the usual (common sense) definition of causality. Granger causality has to be interpreted as a forecast, whether one thing happens before another thing does and helps predict it (Hamilton, 1994).

The Granger causality test involves estimating the vector autoregression (VAR) system which in general can be written as:

$$y_t = c + \sum_{i=1}^{p} \mathbf{\Phi}_i \mathbf{y}_{t\text{-}i} + \varepsilon_t,\ t = 1, 2, \cdots, T \tag{17}$$

where $\mathbf{y}_t = (y_{1t}, y_{2t}, \cdots, y_{mt})'$ is a $(m \times 1)$ vector of jointly determined endogenous variables, $\mathbf{\Phi}_i$ is $(m \times m)$ coefficient matrices, *p* is order of lag, and ε_t is a $(m \times 1)$ vector of innovations and is a white noise process. For the purpose of this paper, $\mathbf{y}_t = [gr_t, ge_t]'$ where gr_t is the government revenue to GDP ratio and ge_t is the government expenditure to GDP ratio.

Based on the VAR, the Granger causality between revenue and expenditure can be tested by applying the Block exogeneity Wald test (Enders, 2009). This test detects whether the lags of one variable can Granger cause any other variables in the VAR system. The null hypothesis is that all lags of one variable can be excluded from each equation in the VAR system. The test statistic is

$$(T - 3p - 1)(\log|\Sigma_{re}| - \log|\Sigma_{un}|) \sim \chi^2(2p) \tag{18}$$

where *T* is the number of observation, Σ_{re} is the variance/covariance matrix of the restricted system, Σ_{un} is the variance/covariance matrix of the unrestricted VAR system, and *p* is the number of lags of the variable that is excluded from the VAR system.

Based on the Granger causality/Block exogeneity Wald test, I can obtain the information about the direction of causality between variables, but I do not know whether the causality is negative or positive. To answer this question I analyse the impulse-response function, that is a function that measures the time profile of the effect of shocks at given point in time on the (expected) future values of variables in a dynamic system (Pesaran and Shin, 1998).

3.4.3.2 Impulse response analysis

To check whether the causality between revenue and expenditure is positive or negative, I employ the generalised impulse response function (GIR), which originally proposed by Koop et al. (1996) and further developed by Pesaran and Shin (1998) for linear multivariate models. To calculate impulse responses I need the vector moving average representation of (13) which simply is:

$$\mathbf{y}_t = \sum_{i=0}^{\infty} \mathbf{A}_i \varepsilon_{t-i}, \; t = 1, 2, \cdots, T \tag{19}$$

where $\mathbf{A}_i$ is an $(m \times m)$ coefficient matrix which can be calculated recursively by using

$$\mathbf{A}_i = \sum_{i=1}^{p} \mathbf{\Phi}_p \mathbf{A}_{i-p}, \; i = 1, 2, ... \tag{20}$$

with $\mathbf{A}_0 = \mathbf{I}_\mathrm{m}$ and $\mathbf{A}_i = 0$ for $i < 1$.

The impulse-response function of y_t can be formally defined as

$$GIR_y(n, \mathbf{h}, \mathbf{Z}_{t-1}) = E(\mathbf{y}_{t+n} \,|\, \varepsilon_t = h, \mathbf{Z}_{t-1}) - E(\mathbf{y}_{t+n} \,|\, \mathbf{Z}_{t-1}) \tag{21}$$

where n is the number of time periods ahead, $\mathbf{h} = (h_1, \cdots, h_m)'$ is $(m \times 1)$ vector of the size of shock to variable k, $\mathbf{Z}_{t-1}$ is the known history of the economy from the past up to time $t-1$. According to equation (17), the generalised impulse response for the vector $\mathbf{y}_t$, n period ahead, is the difference of the expected value of $\mathbf{y}_{t+m}$ when taking the shock $\mathbf{h}$ into account.

The choice of vector of shocks $\mathbf{h}$ is crucial to the properties of the impulse response function. Sims (1980) suggests to use the orthogonalised impulse response (OIR) by identifying $\mathbf{h}$

through using the Cholesky decomposition of $\Sigma = PP'$, where $\mathbf{P}$ is $(m \times m)$ lower triangular matrix. In this context, the orthogonalised impulse response function for a unit shock is

$$OIR_j(n) = \mathbf{A}_n \mathbf{P} \mathbf{e}_j,\ n = 0, 1, 2, \cdots \tag{22}$$

where $\mathbf{e}_j$ is an $(m \times 1)$ selection vector with unity as its *j*-th element and zero elsewhere. The OIR function is critised because the results depend on the orthogonality assumption and they differ with ordering choice.

The generalised impulse response function developed by Koop et al. (1996) and Pesaran and Shin (1998) uses (17) directly by introducing a shock to only one element of ε_t, says the *j*-th element, and integrating out the effects of other shock using an assumed or the historically observed distribution of the errors. In this case, the generalised impulse response can be written as

$$GIR_y(n, h_j, \mathbf{Z}_{t-1}) = E(\mathbf{y}_{t+n} \mid \varepsilon_{jt} = h_j, \mathbf{Z}_{t-1}) - E(\mathbf{y}_{t+n} \mid \mathbf{Z}_{t-1}) \tag{23}$$

If the errors are correlated, a shock to one error will be associated with changes in the other errors. Assuming Gaussian innovations, $\varepsilon_t \sim N(0, \mathbf{\Sigma})$, the conditional expectation of the shock equals:

$$E(\varepsilon_t \mid \varepsilon_{jt} = h_j) = (\sigma_{1j}, \sigma_{2j}, \cdots, \sigma_{mj})' \sigma_{jj}^{-1} h_j = \mathbf{\Sigma} \mathbf{e}_j \sigma_{jj}^{-1} h_j \tag{24}$$

where $\mathbf{e}_j$ is an $(m \times 1)$ selection vector with unity as its *j*-th element and zero elsewhere. Equation (20) gives the predictive shock in each error given a shock to ε_{jt} based on the typical correlation observed historically between the errors.

By setting $h_j = \sqrt{\sigma_{ij}}$ in (20), i.e. measuring the shock by one standard deviation, the GIR function that measures the effect of a one standard error shock to the *j*th equation at time *t* on expected values of y at time $t+n$ is given by

$$GIR_{ij}(n) = \sigma_{jj}^{-\frac{1}{2}} \mathbf{A}_n \mathbf{\Sigma} \mathbf{e}_j \qquad (25)$$

These impulse responses can be uniquely estimated and take full account of the historical patterns of correlation observed amongst the different shocks. Unlike the OIR function, the results from GIR function are invariant to the ordering of the variables in the VAR.

3.5 Empirical results

3.5.1 Sustainability testing

The sustainability testing is started by testing for the stationarity of the government revenue and expenditure variables. The results from the ADF, PP, and KPSS tests are reported in Table 3-4. The time trend is not included in both the ADF and PP tests since it was found insignificant when included. For the government revenue, the results from both the ADF and PP tests suggest that the null hypothesis of nonstationarity can strongly be rejected at the 1 per cent significance level. The *t*-statistic values of the ADF and PP tests are -5.703 and -5.791 respectively, which are larger than the absolute value of the 1 per cent critical value of -3.689. Meanwhile, the KPSS test results suggest that the null hypothesis of stationarity cannot be rejected even at the 10 per cent significance level (see the Appendix for details).

Table 3-4
The ADF, PP and KPSS Unit Root Tests for Government Revenue and Expenditure

	ADF Test			**PP Test**			**KPSS Test**		
Variables	C	T	*t*-stat.	C	T	*t*-stat.	C	T	LM-stat.
Revenue	Yes	No	-5.703*** (0.000)	Yes	No	-5.791*** (0.000)	Yes	No	0.082
Expenditure	Yes	No	-3.515** (0.015)	Yes	No	-3.390** (0.020)	Yes	No	0.272

Notes: For the ADF and PP tests, C = constant, T = time trend. The decision whether to include C and/or T in the tests is dictated by their significance. For the ADF, lag length is selected based on Akaike Information Criterion (AIC). For the PP and KPSS test, the lag truncation for Bartlett-Kernel suggested by the method of Newey-West (1987). The signs **** and ** denote rejection of the null hypothesis at the 1 and 5 per cent level of significance respectively..

For the government expenditure variable, the null hypothesis of nonstationarity can be rejected at 5 per cent significance level by both ADF and PP tests. The *t*-statistic values of the ADF and PP tests are respectively -3.515 and -3.390. Their absolute values are larger than the absolute value of the critical value of -2.972. Meanwhile, the KPSS test does not reject the null hypothesis of stationarity.

Based on the ADF, PP, and KPSS tests, both government revenue and expenditure, as ratios to GDP, are stationary. This is consistent with the hypothesis that fiscal policy in Indonesia during the sample period was sustainable, notwithstanding the crisis of 1997/98.

Regarding the previous results, it is interesting to further test for the stationarity of the overall budget deficit and debt ratios. The results are presented in Table 3-5. For the debt ratio, the results of unit root tests are ambiguous. The ADF test suggests that the null hypothesis of a unit root can be rejected, but only at a low significance level of 10 per cent. Meanwhile, the PP test suggests that the debt ratio series is nonstationary as the null hypothesis of a unit root cannot be rejected even at 10 per cent significance level. On the other hand, the KPSS test decisively asserts that the debt ratio is stationary as the null hypothesis of stationarity cannot be rejected even at the 10 per cent significance level.

The results for the total deficit-to-GDP ratio show that the null hypothesis of a unit root can be rejected by both the ADF and the PP tests, but only at a low significance level of 10 per cent. Meanwhile, the KPSS test can only uphold the null hypothesis of stationarity at the 10 per cent significance level.

Table 3-5
The ADF, PP and KPSS Unit Root Tests for Debt and Deficit

Variable	**ADF Test**				**PP Test**			**KPSS Test**		
	C	T	Lag	*t*-stat.	C	T	*t*-stat.	C	T	LM-stat.
Debt	Yes	No	1	-2.755*	Yes	No	-0.711 (2)	Yes	No	0.211 (3)
Deficit	No	No	0	-1.783*	No	No	-1.724*(3)	Yes	Yes	0.131* (4)

Notes: For the ADF and PP tests, C = constant, T = time trend. The decision whether to include C and/or T in the tests is dictated by their significance in test equations. The lag length in the ADF test is selected based on Akaike Information Criterion (AIC). The numbers in the brackets are the *p*-values of the corresponding *t*-statistics. For the PP and KPSS tests, the numbers in the bracket denote the lag truncation for Bartlett-Kernel suggested by the method of Newey-West (1987). In the KPSS test, The null hypothesis of stationarity is rejected if the test statistics exceed the critical values. The sign * denotes rejection of the null hypothesis at the 10 per cent level of significance.

The conflicting results and low power of the conventional unit root tests in the case of debt and deficit variables might due to the presence of structural breaks in the data. As can be seen in Figure 3-1, there is an indication of a structural break in the time series of both the debt and total deficit variables. This break is most probably corresponded to the financial crisis of 1997 – 1998. To account for the structural break in the time series data, I proceed by testing unit root for debt ratio and total deficit ratio using the Zivot-Andrews unit root test. The results are reported in Table 3-6. The table also shows the time when the break occurred. As can be seen, the results of Zivot-Andrews unit root test indicate that both the debt and total deficit variables are stationary during the sample period as the null hypothesis of unit root can be rejected at the 1 per cent significance level. Moreover, the Zivot-Andrews test suggests that the structural break for both debt ratio and total deficit ratio occur in the year 1998, which is the year when the country experienced significant economic turmoil.

Table 3-6
The Zivot- Andrews Unit Root Tests for Debt and Deficit

Variable	Break	c	β	φ	γ	α	Lag	Verdict
Debt	1998	0.244 (7.201)	-0.002 (-0.600)	0.400 (8.964)	-0.035 (-7.020)	-0.627*** (-10.478)	1	Stationary
Deficit	1998	-0.0531 (-5.467)	0.0048 (5.472)	-0.0415 (-5.451)	-0.0037 (-3.693)	-1.060*** (-6.186)	0	Stationary

Note: Numbers in parentheses are *t*-statistics. Critical values for the test ($\alpha = 0$) at the 1, 5 and 10 percent are respectively -5.57, -5.08 and 4.82. The sign *** denotes statistical significance at the 1 per cent level of significance.

In summary, the results from the unit root tests show that both government revenue and expenditure are stationary, or are I(0). This is consistent with the hypothesis that fiscal policy in Indonesia during the sample period has been sustainable, a conclusion supported by the facts that both total deficit and public debt time series are also stationary.

3.5.2 Granger causality test

Granger causality tests can shed light on the theory discussed in Section 3.3.3. I perform a Granger causality test using the data in levels. The following unrestricted VAR system, expressed explicitly, is estimated:

$$gr_t = \alpha_0 + \alpha_1 gr_{t-1} + \cdots + \alpha_p gr_{t-p} + \beta_1 ge_{t-1} + \cdots + \beta_p ge_{t-p} + \varepsilon_t \quad (26)$$

$$ge_t = \alpha_0 + \alpha_1 ge_{t-1} + \cdots + \alpha_p ge_{t-p} + \beta_1 gr_{t-1} + \cdots + \beta_p gr_{t-p} + \mu_t \quad (27)$$

where gr_t is the ratio of government revenue to GDP at time *t* and ge_t is the ratio of government outlays to GDP at time *t*. As the first step, I check for the optimal lag order to be used for the VAR model and then test the usual properties of the residuals after the estimation. Table 3-7 shows that the entire lag order selection criteria, consisting of the likelihood ratio (LR), Akaike information criterion (AIC), Schwartz criterion (SC), and Hannan-Quinn criterion (HQ), recommend (in case of the small sample) a lag order of 1 while estimating an unrestricted VAR system up to a maximum lag order of 4. Therefore, in the next step I apply a Granger causality test based on a VAR specification with lag of 1. The VAR estimation results are presented in Table 3-8.

The VAR model broadly satisfies standard requirements. As shown by Figure 3-3, all the inverse roots of AR characteristic polynomials lie inside the unit circle, indicating that the VAR model is stable.

Table 3-7
VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	145.970	NA	3.41E-08	-11.518	-11.420	-11.491
1	155.513	16.797*	2.20E-08*	-11.961*	-11.669*	-11.880*
2	156.642	1.806	2.79E-08	-11.731	-11.244	-11.596
3	158.276	2.353	3.43E-08	-11.542	-10.860	-11.353
4	161.685	4.363	3.73E-08	-11.495	-10.617	-11.251

Notes: Endogenous variables are *gr* and *ge*. Sample: 1982 – 2010 (25 observations). * indicates lag order selected by the criterion.

Table 3-8
VAR Estimates

	Dependent Variable	
	gr_t	ge_t
gr_{t-1}	-0.023 (-0.090)	-0.681 (-2.028)
ge_{t-1}	-0.043 (-0.259)	0.707 (3.287)
C	0.184 (5.541)	0.171 (3.971)
R-squared	0.008	0.303
Adj. R-squared	-0.071	0.247
F-statistic	0.099	5.440

Note: Sample (adjusted): 1983-2010. Included observations: 28 after adjustments. The *t*-statistics in ()

Figure 3-3
Inverse Roots of AR Polynomial

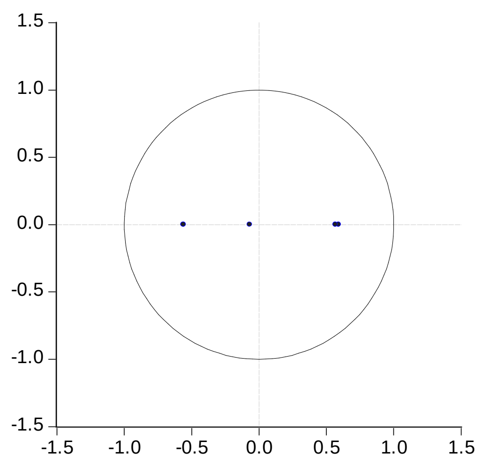


Table 3-9 and Table 3-10 show the results from the VAR residual normality test and the VAR residual correlation Lagrange Multiplier (LM) test, respectively. With the data from Table 3-9, I cannot reject the null hypothesis of normality properties, since *p*-values are 0.990 for skewness, 0.349 for kurtosis, and 0.712 for the Jarque-Bera test. This provides some support for the hypothesis that residuals from the VAR model have a normal distribution. Table 3-10 shows that I also cannot reject the null hypothesis of no autocorrelation up to lag 4, since p-values are 0.304, 0.609, 0.503, and 0.406 respectively. These normality and autocorrelation tests give support to the assumption of our model about white noise residuals.

Table 3-9
VAR Residual Normality Test

Component	Skewness	Chi-sq	df	*p*-value
1	0.049	0.011	1	0.915
2	-0.042	0.008	1	0.927
Joint		0.020	2	0.990

Component	Kurtosis	Chi-sq	df	*p*-value
1	1.767	1.772	1	0.183
2	2.464	0.335	1	0.563
Joint		2.108	2	0.349

Component	Jarque-Bera	df	Prob.	
1	1.784	2	0.410	
2	0.344	2	0.842	
Joint	2.128	4	0.712	

Table 3-10
VAR Residual Serial Correlation LM Test

Lags	LM-Statistic	*p*-value
1	4.838	0.304
2	2.702	0.609
3	3.339	0.503
4	3.997	0.406

Note: *p*-value from chi-square with 4 df.

Table 3-11 shows the result of Granger causality test based on the previously specified VAR model. The Granger causality/block exogeneity Wald test suggests that I can reject the null hypothesis of excluding revenue in the expenditure equation at 5 per cent significance level due to the fact that χ^2 = 4.11 with *p*-value = 0.043. Therefore, revenue Granger causes expenditure.

Table 3-11
Granger Causality/Block Exogeneity Wald Test

Dependent variable	Excluded	Chi-sq.	df	*p*-value
gr_t	ge_t	0.0669	1	0.7959
ge_t	gr_t	4.1149	1	0.0425

Note: Sample: 1982-2010, Included observations: 28

On the contrary, I cannot reject the null hypothesis of excluding the expenditure in the revenue equation because *p*-value = 0.799 for the χ^2 = 0.067 is larger than the 10 per cent significance level. Based on the Granger causality test results I conclude that there exists a unidirectional causality running from revenue to expenditure. This empirical result is in line with other papers such as Narayan (2005) for Indonesia, Singapore, Sri Lanka, and Nepal; Narayan and Narayan (2006) for El Salvador, Haiti, Chile and Venezuela; Wolde-Rufael

(2008) for Ethiopia, Ghana, Kenya, Nigeria, Mali and Zambia. Preliminary indications from Table 3-8 are the revenue rises have a negative effect on expenditure. To investigate this question further, I proceed to an impulse-response analysis.

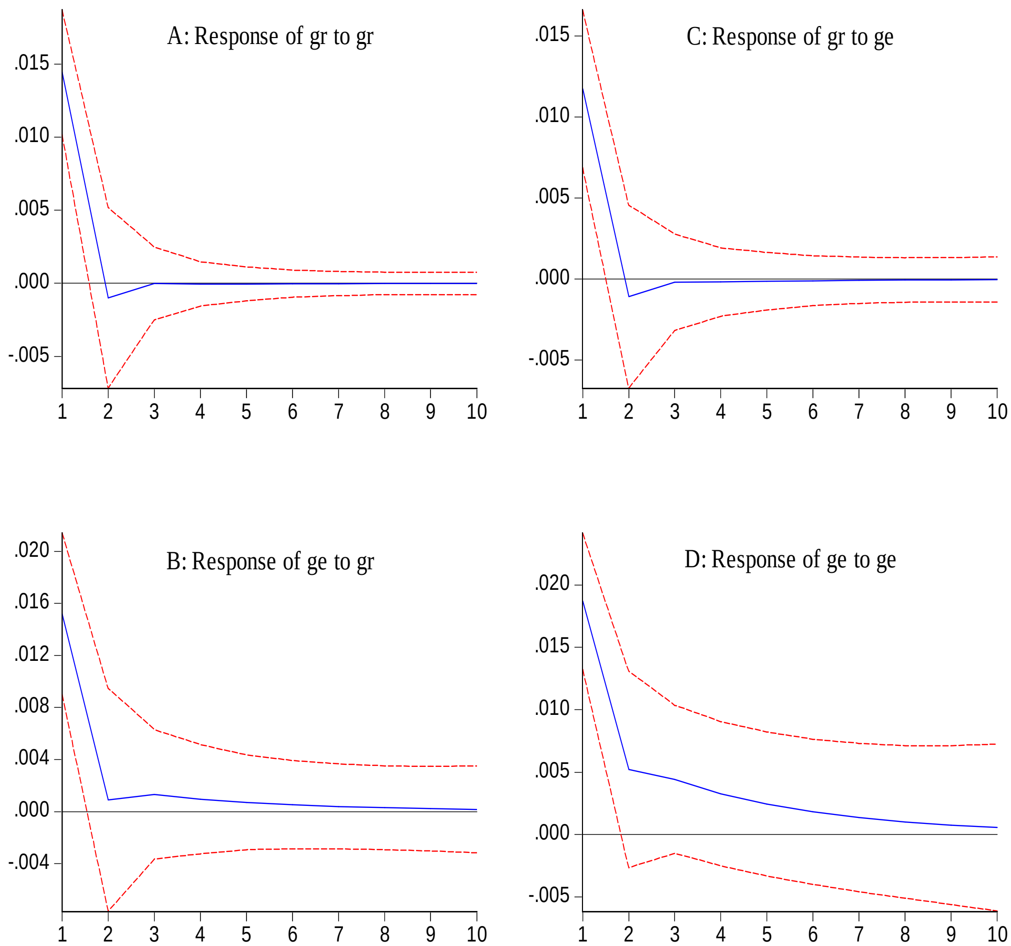
3.5.3 Generalised impulse response

Figure 3-4 exhibits the graphical representation of the asymptotic generalised impulse response function. Since I use a VAR model with 2 endogenous variables then I have 4 different graphical representations of impulse response functions: Panel A, B, C, and D. Each panel shows the dynamic response of each variable to a one standard deviation shock on itself and other variable. In each panel, the horizontal axis presents the four years following the shock, while the vertical axis measures the yearly impact of the shock on each endogenous variable.

Firstly, Panel A and B respectively show that a shock in revenue significantly leads to higher revenue and higher expenditure in the short run, but I can observe that the effect of revenue on expenditure is seemed to be stronger. As can be seen in Panel B, the effect of revenue on expenditure is always positive after the first period, while Panel A shows that the effect on revenue becomes slightly negative after the first period. The fact that a shock in revenue significantly affects expenditure supports the results of the causality test.

Next, Panel C and D respectively show that a shock to expenditure significantly leads to higher expenditure and higher revenue in the short run. The positive effect of revenue on expenditure (Panel B) seems to be stronger than the effect of expenditure on revenue (Panel C). Therefore, I conclude that expenditure does not Granger cause revenue.

Figure 3-4
Generalised Impulse Response



(Response to generalised one S.D. Innovations ±2 S.E).

The results of the generalised impulse responses confirm the previous causality test that there is a unidirectional causality running from revenue to expenditure. Moreover, the impulse responses show that the causality is positive. This suggests that fiscal authorities in Indonesia behave in accordance with Friedman's (1978) tax and spend hypothesis, since an increase in revenue would result in even higher expenditure. Since the effect of a shock to revenue on expenditure is stronger than the effect on revenue then an increase in revenue would also result in a worsening of budget deficit. Therefore, increasing revenue may not be a viable way to curtail the government deficit. Curtailing the government deficit should probably be performed *via* reducing expenditure rather than increasing revenue.

3.6 Conclusion

I have examined the sustainability of fiscal policy in Indonesia. After highlighting the development in some major fiscal variables—i.e. revenue, expenditure, deficit and debt—I used the intertemporal budget constraint (IBC) framework to study the issue. The empirical findings from testing the stationarity properties of the variables above suggest that both the government revenue and expenditure are stationary in levels which implies that the transversality condition is satisfied and, therefore, the fiscal policy during the sample period was sustainable, notwithstanding the crisis of 1997/98. The stationarity properties of deficit and public debt also give support to this conclusion. I then proceed to the causality test and impulse response analysis to see the dynamic relationship between government revenue and expenditure.

From the causality test and impulse responses I find that there is a positive unidirectional causality from revenue to expenditure, which is consistent with tax and spend hypothesis advocated by Friedman (1978). This finding indicates that raising revenue would be followed by higher expenditure, therefore leading to a worsening of the budget deficit. Of course, one way to control the budget deficit, and hence avoiding an exploding debt to GDP ratio, is by boosting government revenue while restraining expenditure such that expenditure grows at a lower rate than revenue.

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Appendix

Government Revenue Ratio (GR)

Null Hypothesis: GR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on AIC, MAXLAG=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.702852	0.0001
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GR)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GR(-1)	-1.068920	0.187436	-5.702852	0.0000
C	0.184042	0.032635	5.639377	0.0000

R-squared	0.555727	Mean dependent var	-0.001443
Adjusted R-squared	0.538639	S.D. dependent var	0.020879
S.E. of regression	0.014182	Akaike info criterion	-5.604950
Sum squared resid	0.005229	Schwarz criterion	-5.509793
Log likelihood	80.46931	Hannan-Quinn criter.	-5.575860
F-statistic	32.52253	Durbin-Watson stat	2.036603
Prob(F-statistic)	0.000005		

Null Hypothesis: GR has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.791372	0.0001
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000187
HAC corrected variance (Bartlett kernel)	0.000154

Phillips-Perron Test Equation
Dependent Variable: D(GR)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GR(-1)	-1.068920	0.187436	-5.702852	0.0000
C	0.184042	0.032635	5.639377	0.0000

R-squared	0.555727	Mean dependent var	-0.001443
Adjusted R-squared	0.538639	S.D. dependent var	0.020879
S.E. of regression	0.014182	Akaike info criterion	-5.604950
Sum squared resid	0.005229	Schwarz criterion	-5.509793
Log likelihood	80.46931	Hannan-Quinn criter.	-5.575860
F-statistic	32.52253	Durbin-Watson stat	2.036603
Prob(F-statistic)	0.000005		

Null Hypothesis: GR is stationary
Exogenous: Constant
Bandwidth: 0 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.082347
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000205
HAC corrected variance (Bartlett kernel)	0.000205

KPSS Test Equation
Dependent Variable: GR
Method: Least Squares
Sample: 1982 2010
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.173003	0.002706	63.93386	0.0000

R-squared	0.000000	Mean dependent var	0.173003
Adjusted R-squared	0.000000	S.D. dependent var	0.014572
S.E. of regression	0.014572	Akaike info criterion	-5.585539
Sum squared resid	0.005946	Schwarz criterion	-5.538391
Log likelihood	81.99031	Hannan-Quinn criter.	-5.570772
Durbin-Watson stat	1.989455		

Government Expenditure Ratio (GE)

Null Hypothesis: GE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on AIC, MAXLAG=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.514939	0.0150
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE(-1)	-0.588484	0.167424	-3.514939	0.0016
C	0.108138	0.031642	3.417505	0.0021

R-squared	0.322119	Mean dependent var	-0.002304
Adjusted R-squared	0.296046	S.D. dependent var	0.023585
S.E. of regression	0.019789	Akaike info criterion	-4.938681
Sum squared resid	0.010181	Schwarz criterion	-4.843524
Log likelihood	71.14154	Hannan-Quinn criter.	-4.909591
F-statistic	12.35480	Durbin-Watson stat	2.487598
Prob(F-statistic)	0.001633		

Null Hypothesis: GE has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.390001	0.0200
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000364
HAC corrected variance (Bartlett kernel)	0.000253

Phillips-Perron Test Equation
Dependent Variable: D(GE)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE(-1)	-0.588484	0.167424	-3.514939	0.0016
C	0.108138	0.031642	3.417505	0.0021

R-squared	0.322119	Mean dependent var	-0.002304
Adjusted R-squared	0.296046	S.D. dependent var	0.023585
S.E. of regression	0.019789	Akaike info criterion	-4.938681
Sum squared resid	0.010181	Schwarz criterion	-4.843524
Log likelihood	71.14154	Hannan-Quinn criter.	-4.909591
F-statistic	12.35480	Durbin-Watson stat	2.487598
Prob(F-statistic)	0.001633		

Null Hypothesis: GE is stationary
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.272333
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000498
HAC corrected variance (Bartlett kernel)	0.001031

KPSS Test Equation
Dependent Variable: GE
Method: Least Squares
Sample: 1982 2010
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.186900	0.004219	44.30035	0.0000

R-squared	0.000000	Mean dependent var	0.186900
Adjusted R-squared	0.000000	S.D. dependent var	0.022720
S.E. of regression	0.022720	Akaike info criterion	-4.697301
Sum squared resid	0.014453	Schwarz criterion	-4.650153
Log likelihood	69.11086	Hannan-Quinn criter.	-4.682535
Durbin-Watson stat	1.049448		

Debt Ratio (DR)

Null Hypothesis: **DR** has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on AIC, MAXLAG=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.754747	0.0783
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DR)
Method: Least Squares
Sample (adjusted): 1984 2010
Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DR(-1)	-0.264633	0.096064	-2.754747	0.0110
D(DR(-1))	0.568418	0.163772	3.470784	0.0020
C	0.121799	0.048015	2.536675	0.0181

R-squared	0.396392	Mean dependent var	0.001407
Adjusted R-squared	0.346091	S.D. dependent var	0.118678
S.E. of regression	0.095968	Akaike info criterion	-1.745159
Sum squared resid	0.221038	Schwarz criterion	-1.601178
Log likelihood	26.55965	Hannan-Quinn criter.	-1.702346
F-statistic	7.880441	Durbin-Watson stat	1.809774
Prob(F-statistic)	0.002339		

Null Hypothesis: **DR** has a unit root
Exogenous: None
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.710823	0.3997
Test critical values:	1% level	-2.650145	
	5% level	-1.953381	
	10% level	-1.609798	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.013014
HAC corrected variance (Bartlett kernel)	0.020528

Phillips-Perron Test Equation
Dependent Variable: D(DR)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DR(-1)	-0.023963	0.044257	-0.541442	0.5926

R-squared	0.010067	Mean dependent var	0.002993
Adjusted R-squared	0.010067	S.D. dependent var	0.116761
S.E. of regression	0.116172	Akaike info criterion	-1.432433
Sum squared resid	0.364389	Schwarz criterion	-1.384854
Log likelihood	21.05406	Hannan-Quinn criter.	-1.417888
Durbin-Watson stat	1.075395		

Null Hypothesis: DR is stationary
Exogenous: Constant
Bandwidth: 3 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.210646
Asymptotic critical values*:	1% level	0.739000
	5% level	0.463000
	10% level	0.347000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.040530
HAC corrected variance (Bartlett kernel)	0.111898

KPSS Test Equation
Dependent Variable: DR
Method: Least Squares
Sample: 1982 2010
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.446728	0.038046	11.74178	0.0000

R-squared	0.000000	Mean dependent var	0.446728
Adjusted R-squared	0.000000	S.D. dependent var	0.204884
S.E. of regression	0.204884	Akaike info criterion	-0.298872
Sum squared resid	1.175368	Schwarz criterion	-0.251724
Log likelihood	5.333639	Hannan-Quinn criter.	-0.284105
Durbin-Watson stat	0.313387		

Deficit Ratio (DEFICIT)

Null Hypothesis: DEFICIT has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on AIC, MAXLAG=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.782946	0.0712
Test critical values:	1% level	-2.650145	
	5% level	-1.953381	
	10% level	-1.609798	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DEFICIT)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEFICIT(-1)	-0.166931	0.093627	-1.782946	0.0858

R-squared	0.099980	Mean dependent var	0.000861
Adjusted R-squared	0.099980	S.D. dependent var	0.011329
S.E. of regression	0.010748	Akaike info criterion	-6.193202
Sum squared resid	0.003119	Schwarz criterion	-6.145624
Log likelihood	87.70483	Hannan-Quinn criter.	-6.178657
Durbin-Watson stat	2.043704		

Null Hypothesis: DEFICIT has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.724153	0.0801
Test critical values:	1% level	-2.650145	
	5% level	-1.953381	
	10% level	-1.609798	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000111
HAC corrected variance (Bartlett kernel)	9.46E-05

Phillips-Perron Test Equation
Dependent Variable: D(DEFICIT)
Method: Least Squares
Sample (adjusted): 1983 2010
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEFICIT(-1)	-0.166931	0.093627	-1.782946	0.0858

R-squared	0.099980	Mean dependent var	0.000861
Adjusted R-squared	0.099980	S.D. dependent var	0.011329
S.E. of regression	0.010748	Akaike info criterion	-6.193202
Sum squared resid	0.003119	Schwarz criterion	-6.145624
Log likelihood	87.70483	Hannan-Quinn criter.	-6.178657
Durbin-Watson stat	2.043704		

Null Hypothesis: DEFICIT is stationary
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West using Bartlett kernel)

		LM-Stat.
Kwiatkowski-Phillips-Schmidt-Shin test statistic		0.131079
Asymptotic critical values*:	1% level	0.216000
	5% level	0.146000
	10% level	0.119000

*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1)

Residual variance (no correction)	0.000210
HAC corrected variance (Bartlett kernel)	0.000621

KPSS Test Equation
Dependent Variable: DEFICIT
Method: Least Squares
Sample: 1982 2010
Included observations: 29

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.026086	0.005436	-4.798564	0.0001
@TREND(1982)	0.000871	0.000333	2.613667	0.0145

R-squared	0.201921	Mean dependent var	-0.013890
Adjusted R-squared	0.172363	S.D. dependent var	0.016508
S.E. of regression	0.015018	Akaike info criterion	-5.492687
Sum squared resid	0.006089	Schwarz criterion	-5.398390
Log likelihood	81.64396	Hannan-Quinn criter.	-5.463154
F-statistic	6.831254	Durbin-Watson stat	0.569062
Prob(F-statistic)	0.014467		

The Zivot-Andrews Unit Root Test for Debt Ratio (DR)

Zivot-Andrews Unit Root Test
Sample: 1982 2010
Included observations: 29
Null Hypothesis: DR has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 1 (maximum lags: 4)
Chosen break point: 1998

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-10.47811	2.16E-12
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

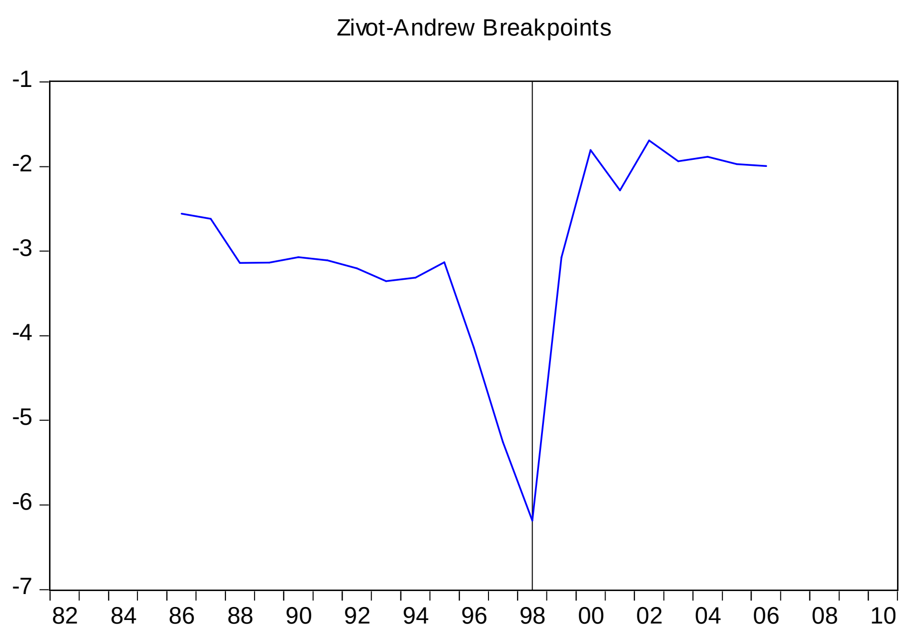
* Probability values are calculated from a standard t-distribution
and do not take into account the breakpoint selection process

The Zivot-Andrews Unit Root Test for DEFICIT

Zivot-Andrews Unit Root Test
Sample: 1982-2010
Included observations: 29
Null Hypothesis: DEFICIT has a unit root with a structural
break in both the intercept and trend
Chosen lag length: 0 (maximum lags: 4)
Chosen break point: 1998

	t-Statistic	Prob. *
Zivot-Andrews test statistic	-6.185572	0.000344
1% critical value:	-5.57	
5% critical value:	-5.08	
10% critical value:	-4.82	

* Probability values are calculated from a standard t-distribution and do not take into account the breakpoint selection process



Chapter 4

Does Indonesia Pursue Sustainable Fiscal Policy?

4.1 Introduction

Fiscal policy sustainability is a prerequisite to stable growth of the economy. Unsustainable fiscal policy, characterised by persistent budget deficits and rapid debt accumulation, may neither be an instrument nor effective in stabilising economy, and even may lead to economic crisis. In this light, a number of empirically based methods have been developed to assess whether or not a country fiscal policy is following a sustainable path.

In the traditional approach, fiscal policy sustainability is assessed by checking if fiscal policy is in compliance with the government's intertemporal budget constraint (IBC), or, in other words, if the transversality condition is satisfied. Two common methods for doing this are by testing the stationarity properties of key fiscal variables such as debt stock, budget deficit, government revenue, and expenditure, or by testing the cointegration of government revenue and expenditure. Prominent references in this stream are, among others, Hamilton and Flavin (1986), Wilcox (1989), Trehan and Walsh (1988), Trehan and Walsh (1991), and Quintos (1995). The essence of the approach is to investigate whether debt is stable, declining or increasing over time, or to check if government revenue and expenditure are drifting too far apart so as to destabilise debt dynamics and the fiscal deficit.

However, such time series methods of testing fiscal policy sustainability have been subject to criticism. For example, Bohn (1995) argues that the traditional approach is *ad hoc* for it makes debatable assumption about discount rates and future states of nature. Moreover, it is empirically difficult to reject a unit root in real debt and in the debt to GDP ratio, especially in small time series samples. Therefore, even if debt to GDP ratio is declining, the difficulty of rejecting a unit root does not allow us to get insight whether the decline is due to luck (e.g. high economic growth) or policy design.

This paper aims to assess the sustainability of the Indonesian fiscal policy in the spirit of the model based sustainability (MBS) approach proposed by Bohn (1995, 1998, 2005). Using this approach enables us to answer the following questions: How do governments react to the accumulation of debt? Do they take corrective measures when the debt-to-GDP ratio starts rising or do they let the debt grow? According to the MBS approach, a positive and statistically significant response of the primary balance to an increase in the (lagged) stock of debt (both as a ratio to GDP) in a "fiscal reaction function" constitutes a sufficient condition for fiscal policy sustainability. The argument for this is that in response to an increase in the size of outstanding debt stock policymakers adopt measures to increase revenues and/or cut expenditures to raise the primary surplus in order to keep the debt-to-GDP ratio from exploding.

4.2 Literature Review

4.2.1 Ad hoc sustainability approach

In the traditional approach, fiscal policy is considered sustainable if it satisfies the government's intertemporal budget constraint (IBC), wherein the current stock of public debt is matched by an excess of future primary surpluses over primary deficits in present value terms. The IBC can be derived from the standard budget identity, which can be expressed in terms of ratios to GDP as follows:

$$\begin{aligned} d_t &= (1+r_t)d_{t-1} + (\tau_t - g_t) \\ &= (1+r_t)d_{t-1} + s_t \end{aligned} \tag{1}$$

where, d_t is the stock of government debt at the end of the period, τ_t is public revenue, and g_t is primary public expenditure (e.g. expenditure excluding interest payments), and $s_t = g_t - \tau_t$ is the primary budget balance. Meanwhile, $r_t = \frac{1+i_t}{1+y_t} - 1$ where i_t is the nominal interest rate on government debt d_t and y_t is the nominal GDP growth rate[1]. Equation (1) says that debt-to-GDP ratio increases if the government runs a deficit and, at the same time, the nominal interest rate exceeds nominal GDP growth. The literature usually assumes that i_t and y_t are constant, so that (1) can be rewritten as:

$$d_t = (1+r)d_{t-1} + s_t \tag{2}$$

Iterating (2) forward to infinity and taking expectation yields:

$$d_t^* = \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} E_t(s_{t+j}) + \lim_{j\to\infty} \frac{1}{(1+r)^j} E_t(d_{t+j}) \tag{3}$$

[1] Although i_t and y_t are defined as the nominal interest rate and the nominal growth rate respectively, however, given that the inflation rate will cancel out in the ratio, they can also shed light on the real interest rate and the real growth rate.

where $d_t^* = (1+r_t)d_{t-1}$. Based on (3), the IBC is fulfilled if and only if the sum of discounted primary surpluses equals the current stock of debt, which implies that the debt-to-GDP ratio goes to zero at infinity:

$$d_t^* = \sum_{j=0}^{\infty} \frac{1}{(1+r)^j} E_t(s_{t+j}) \tag{4}$$

$$\lim_{j\to\infty} \frac{1}{(1+r)^j} E_t(d_{t+j}) = 0 \tag{5}$$

Equation (5) is known as the transversality condition, which rules out Ponzi games[2]. A fiscal policy that leads to an explosive debt to GDP ratio with the debt growing over time at a faster rate than the economy is not sustainable.

Earlier papers like Hamilton and Flavin (1986), Trehan and Walsh (1991), Hakkio and Rush (1991), and Quintos (1995), which study the US economy, along with more recent papers which study other economies, assess the sustainability of fiscal policy by checking the consistency of the current fiscal policy with the IBC, and are generally based on either univariate time series analyses such as unit root tests and/or cointegration tests[3].

Time series analysis of fiscal policy sustainability has been subject to criticism. On empirical grounds, such time series analyses are not easy to implement because they typically need

[2] A Ponzi game is a situation under which a government may engage in debt roll-over schemes by financing interest payments through the issue of new debt (Bartolini and Cottarelli, 1991).

[3] Adopting an intertemporal budget constraint approach, Hamilton and Flavin (1986) tested historical series of present values of public deficit and debt for stationarity. Trehan and Walsh (1988) extended this work by showing that satisfying the intertemporal budget constraint is equivalent to the condition that government expenditures (inclusive of interest payments) are cointegrated with government revenue. Hakkio and Rush (1991) and Quintos (1995) tested the cointegration of expenditures and revenues for U.S. data and found that the intertemporal budget constraint was validated for long periods but there were some break points which signalled sub-periods during which this condition did not hold (Correia et al. 2008).

relatively long time series of data that are seldom available in the fiscal area, especially as regards public debt. Moreover, the power of unit root tests tends to be low (especially in small samples) in distinguishing between situations in which fiscal policy may be close to being sustainable and when it is unsustainable (Adams, Ferrarini, and Park (2010)). On the other hand, Bohn (2005) asserts that stationary and cointegration tests are misplaced as a test of fiscal policy sustainability because in an infinite sample any order of integration of debt is consistent with the transversality condition and this implies that intertemporal budget constraint is always satisfied.

On conceptual grounds, Bohn (2005) argues that fiscal policy sustainability according to IBC (equation 4) is a flawed definition for it needs assumptions about the discount rate future debt at a fixed “safe” rate[4] and, hence, is only a very limited concept of sustainability, or *ad hoc*. The *ad hoc* IBC ignores the probability distribution of fiscal variables and the discount factor across different states of nature, therefore it ignores uncertainty. When the uncertainty is taken into account, some policies that do not satisfy IBC in the form (4) are, nevertheless, sustainable, or *vice versa*.

Moreover, the time series analyses do not explicitly identify which fiscal policies that underlie the data. As a result, they do not shed much light on the kinds of fiscal policies that might deliver sustainability, or identify why sustainability may not have held in the past.

[4]The interest rate of the discount factor is usually proxied by the realised or average return on a government bond.

4.2.2 Model-Based Sustainability approach

Bohn (1995) propose an alternative concept of Model-Based Sustainability (MBS) which allows for the optimizing behaviour of lenders in a general equilibrium stochastic setting. Here, the ability of the government to borrow depends on the lender's willingness to lend, and accordingly different assumptions about the behaviour of lenders lead to different conclusions about fiscal policy sustainability. Therefore, rather than using a fixed discount factor, Bohn uses a discount factor that depends on the lender's marginal rate of substitution in consumption, which may vary over time and across states of nature, hence, consistent with uncertainty. Moreover, this implies a non-zero correlation between the discount rate and the primary balance and debt. Assuming that potential lenders are infinitely lived optimising agents and that financial markets are complete, Bohn demonstrates that the IBC takes the following form:

$$d_t^* = \sum_{j=0}^{\infty} \frac{\beta^j u'(C_{t+j})}{u'(C_t)} E_t(s_t) + \lim_{j\to\infty} \frac{\beta^j u'(C_{t+j})}{u'(C_t)} E_t(d_{t+j}) \tag{6}$$

where E_t is the expectation operator C_{t+j} is aggregate consumption, $u(.)$ is the utility function of the representative agent, β^j is the rate of consumer's time preference, and the primary balance s_{t+j} and aggregate consumption C_{t+j} vary across different states of the world. The terms of $\frac{u'(C_{t+j})}{u'(C_t)}$ is the lender's marginal rate of substitution between consumption in two adjacent time periods and $\frac{\beta^j u'(C_{t+j})}{u'(C_t)}$ is the pricing kernel for discounting state-contingent claims on period $t+j$. Based on (6), the conditions for fiscal policy sustainability are:

$$d_t^* = \sum_{j=0}^{\infty} \frac{\beta^j u'(C_{t+j})}{u'(C_t)} E_t(s_t) \tag{7}$$

$$\lim_{j\to\infty} \frac{\beta^j u'(C_{t+j})}{u'(C_t)} E_t(d_{t+j}) = 0 \tag{8}$$

The above sustainability conditions (equation 7 and 8) are derived from optimizing lender behaviour. As in the *ad hoc* sustainability approach, equations (7) and (8) respectively assert that an initial debt must be backed by the present value of future primary surpluses and that the transversality condition must be satisfied. However, (7) and (8) differ from the *ad hoc* condition (4) and (5) because the discount factor now depends on the lenders' marginal rate of substitution that may vary over time and across states of nature, hence consistent with uncertainty, and is generally different from $\frac{1}{(1+r)^j}$. According to the MBS approach, conditions (4) and (5) in the *ad hoc* approach are just special cases of (7) and (8) respectively, that is if I assume that there is no uncertainty, lenders are risk neutral (instead of risk averse), and zero covariance of the discounting factor $\frac{\beta^j u'(C_{t+j})}{u'(C_t)}$ with primary surplus and with debt.

4.2.3 Fiscal reaction function

Based on the MBS, Bohn (1998, 2005) proposes an alternative approach to assess fiscal policy sustainability without being forced to estimate a general equilibrium model and to specify private agents' preferences. Specifically, his Proposition 1 implies that sustainability of fiscal policy can be tested by estimating a policy rule (or a reaction function) for the primary balance-to-GDP ratio as follows:

$$s_t = \rho d_{t-1} + \alpha \mathbf{Z}_t + \varepsilon_t = \rho d_{t-1} + \mu_t \qquad (9)$$

where s_t is the primary balance-to-GDP ratio, d_t is the debt-to-GDP ratio, $\mu_t = \alpha \mathbf{Z}_t + \varepsilon$ is a composite of other determinants of the primary balance, and ε_t is the residual which is $i.i.d. \sim (0, \sigma)$. The coefficient ρ can be called a fiscal response (or reaction) coefficient since it gives the response of the primary balance-to-GDP ratio to an increase in the debt-to-GDP ratio. Bohn (1998, 2005) argues that if μ is bounded as share of GDP and if the present value of GDP is finite, then a significant and strictly positive response of d_{t-1} to s_t (e.g. $\rho > 0$) is consistent with conditions (7) and (8), and constitutes a sufficient condition for fiscal policy sustainability. The intuitive reasoning behind this argument is that debt-to-GDP ratio will be mean-reverting if policymakers take corrective action by raising the primary balance-to-GDP ratio in response to an increase in the debt-to- GDP ratio.

The essence of the proof is that debt is reduced by a factor of $(1-\rho)^n$ after *n* period relative to Ponzi scheme. Hence, $\dfrac{\beta^j u'(C_{t+j})}{u'(C_t)} E_t(d_{t+j}) \approx (1-\rho)^n . d^* \to 0$ for any (small) $\rho > 0$ is consistent with the condition (8).

In the spirit of Barro's (1979) tax smoothing theory, Bohn (1998, 2005) suggests incorporating a measure of temporary government expenditure $(GVAR_t)$ and a business cycle indicator $(YVAR_t)$ as other determinants of primary balance in $\mathbf{Z}_t$. According to tax smoothing theory, either a temporary increase in government expenditure or a temporary declines in income (i.e. in the tax base) would result in a higher than normal budget deficit.

4.2.4 Debt dynamics

While acknowledging that the non-stationary of debt-to-GDP ratio is an indication of an unsustainable fiscal policy, Bohn (1998) argues that the standard traditional unit root tests of the debt-to-GDP ratio, such as Dickey-Fuller and Phillips-Perron tests, are misspecified because these tests suffer from omitted variable bias and, hence, can lead to erroneous conclusions when used to evaluate debt dynamics. Specifically, there are two reasons for this failure. First, if $(r-\rho)$ is strictly below zero, but not much below zero, it would be difficult to reject the unit root (or nonstationary) null hypothesis. Second, unit root tests are misspecified because they ignore the systematic components of other determinants of the primary surplus in $\mathbf{Z}_t$. As the result, unit root tests produce inconsistent estimates due to omitted variable bias (Bohn, 1998; Piergallini and Postigliola, 2012).

As an alternative test, to check if the debt dynamics follows a mean-reverting process, the budget identity equation (1) and the primary balance equation (9) can be combined to obtain a dynamic equation of the debt-to-GDP ratio as follows:

$$\begin{aligned} d_t &= (1+r)d_{t-1} - (\rho d_{t-1} + \boldsymbol{\alpha}\mathbf{Z}_t + \varepsilon_t) \\ \Delta d_t &= (r-\rho)d_{t-1} + \boldsymbol{\beta}\mathbf{Z}_t + u_t \end{aligned} \qquad (10)$$

where $\boldsymbol{\beta} = -\boldsymbol{\alpha}$ and $u_t = -\varepsilon_t$. According to (10), the change in the debt to GDP ratio depends on the lagged level and the nondebt components. Assuming stationary $\mathbf{Z}_t$, the debt-to-GDP ratio should be a stationary, mean-reverting process if $(r-\rho)<0$, or if $r < \rho$. As mentioned before, standard unit root tests, such as Dickey-Fuller and Phillips Perron unit root tests, can easily fail to detect this mean-reversion process in the deb- GDP-ratio and, hence, leading to a conclusion of unsustainable fiscal policy.

4.2.5 Some empirical studies

Bohn (1998) applies the MBS approach to the U.S. federal government data (1916 – 1995) using a specification that includes measures of temporary (cyclical) changes in output and public expenditure on the basis of Barro's (1979) tax smoothing theory. The results show that conditional response of the primary deficit to debt (both as a ratio to output) is positive and statistically significant, with the estimates of ρ range from 0.028 to 0.054 in the full sample and five subsample periods. Accordingly, Bohn concludes that despite extended periods of primary deficits, U.S. fiscal policy has historically been sustainable.

In a subsequent work, Bohn (2005) confirms the finding of his previous study over a longer sample period spanning more than 200 years (1792 – 2003) using a variety of specifications. The estimates of ρ are somewhat higher ranging from 0.028 to 0.147 depending on the subsample period and measures of temporary changes in output and government purchases.

Following the work of Bohn (1998), a growing number of studies that have estimated fiscal policy reaction functions for different countries or groups of countries. The review of literature shows differences in terms of dependent variables, non-debt explanatory variables. Regarding the dependent variables, besides using the actual primary balance, some studies also use the cyclical adjusted primary balance as the dependent variable, which is argued to provide better proxy of discretionary fiscal policy. The reason is that changes in cyclical adjusted primary balance reflect merely discretionary fiscal policy since it is corrected for some cyclical behaviour. Examples in this stream are von Hagen et al. (2001), Gali and Perotti (2003), European Commission (2004), and IMF (2004). However, according to Wierts (2007), the relevant issue is that the debt stabilising response of the primary surplus is present either with or without correcting budgetary data for the effects of the cycle.

Regarding the non-debt determinants of the primary surplus, some studies follow Bohn (1998) by incorporating business cycle and temporary government spending as the explanatory variables (for example Valderrama (2005); Mendoza and Ostry (2008); Ghatak and Sánchez-Fung (2007), and; Fincke and Greiner (2010)). Some other studies also introduce various other non-debt explanatory variables. For example, Callen et al. (2003) incorporate four transitory determinants of fiscal policy for the case of emerging markets panel: output gap, CPI inflation rate, oil and non-oil commodity price cycles, and an indicator to capture the years in which a country experienced a debt default or restructuring. Abiad and Ostry (2005) use the output gap to control for the effects of the business cycle; oil and non-oil commodity prices to control for the impact of commodity price movements on the fiscal position of commodity-exporting countries; and CPI inflation to capture possible effects of inflation on the fiscal balance, and the revenue-to-GDP ratio as a proxy for the capacity of a country's fiscal institutions to deliver primary surpluses. Moreover, they also include a number of noneconomic factors that may influence fiscal efforts and a dummy variable that reflects the influence of international financial institutions, e.g. if a country has an IMF-supported program in a given year.

In the following, I take a closer look at several studies that focus on emerging market countries. Abiad and Ostry (2005) estimate fiscal reaction functions using panel data of 31 emerging market countries over 1990-2002. Their results show that primary surpluses in emerging market respond positively to increases in debt at low to moderate levels of debt, indicating a desire to satisfy the intertemporal budget constraint. The values of coefficients range from 0.06 to 0.1 depending on model specifications. Interestingly, they also find that when the debt ratio become sufficiently high (more than 50 per cent of GDP), the primary surplus becomes only marginally responsive to further increases in debt. This suggests that at sufficiently high debt levels emerging market countries respond much more weakly to satisfying government solvency constraint.

Ghatak and Sánchez-Fung (2007) employ the MBS approach to assess fiscal policy sustainability in a sample of developing countries: Peru, the Philippines, South Africa, Thailand, and Venezuela, over the period 1970 – 2000. The results show that fiscal policy does not appear to be sustainable in all countries in the sample because these countries' budget surpluses are not responding positively to increasing debt to GDP ratio as hypothesized by Bohn (1998). In fact, for all countries the fiscal response coefficient ρ is negative and significant for Peru, Thailand and Venezuela, and negative but not significant for the Philippines and South Africa. However, based on the recursive *t*-statistics estimates for the fiscal reaction coefficients they argue that there is an indication of fiscal policy sustainability for the case of Thailand. Even though Thailand's primary balance did not systematically respond to debt, on average, it has done so from the mid-1980s because the recursive *t*-statistic of the fiscal reaction coefficient increases consistently from the mid-1980s until the end of the sample period.

Mendoza and Ostry (2008) apply MBS to panel data of 56 countries, consisting of 34 emerging market countries and 22 industrial countries, over the period of 1990 – 2005. The results for the full sample of industrial and emerging economies are consistent with the key requirement of the model-based fiscal sustainability test, namely a positive and significant conditional response of primary fiscal balances to changes in government debt.

The results for the panel of industrial economies show a positive and significant response of the primary surplus to debt, ranging from 0.02 to 0.045 depending on model specifications, with a 5 per cent significance level. Therefore Mendoza and Ostry (2008) conclude that Bohn's conclusion that there is substantial evidence in favour of fiscal policy sustainability in the U.S. extends to a panel of 22 industrial countries with data for the period 1970–2005.

The results for the panel of emerging market economies show that the coefficients of fiscal responsiveness are positive and significant, ranging from 0.033 to 0.041. Hence, the fiscal response in emerging market countries varies over a much narrower range than in the case of the industrial countries. Moreover, the coefficients of fiscal responsiveness are estimated with more precision since they are all significant at 1 per cent level.

Furthermore, Mendoza and Ostry (2008) split each country group into subgroups of high-debt and low-debt countries. They find that the marginal response of the primary surplus to debt is significantly weaker when debt levels surpass the sample mean and median for each group. This suggests that when debt get very large, it may be difficult to generate a primary surplus that is sufficient to ensure fiscal policy sustainability.

Fincke and Greiner (2010) apply the MBS for testing sustainability of fiscal policy in selected low- and middle income developing countries of Africa and Latin-America. They estimate the response of primary balance to debt by using the penalised spline estimation technique to take into account that the reaction of the primary surplus to variations in debt need not be constant but may be time-varying. Their results show that Botswana follows a sustainable debt policy during 1978 – 2003, and that country can be considered as an ideal as concerns its debt policy in the sample countries. The estimated parameter for the debt-to-GDP ratio is positive and significant at the 1 per cent level. Meanwhile, the smooth term, which measures the deviation from the mean of the reaction coefficient, shows that the reaction coefficient is steadily increasing until about 1990. This is in accordance with the fact that the debt is significantly reduced and high primary surpluses were achieved. After that, importance of debt reduction has diminished and a falling trend in primary balance supports that development. The declining smooth term displays the reversed image of the increasing debt ratio trend. This reflects that the scope of possible reaction in times of a high debt ratio is smaller, thus the value of smooth term is low. With both, the smooth term and the positive value of the reaction coefficient being significant, it is possible to state that the fiscal response remained positive for the entire sample period. Fincke and Greiner conclude that there is evidence for sustainability of fiscal policy in the case of Botswana.

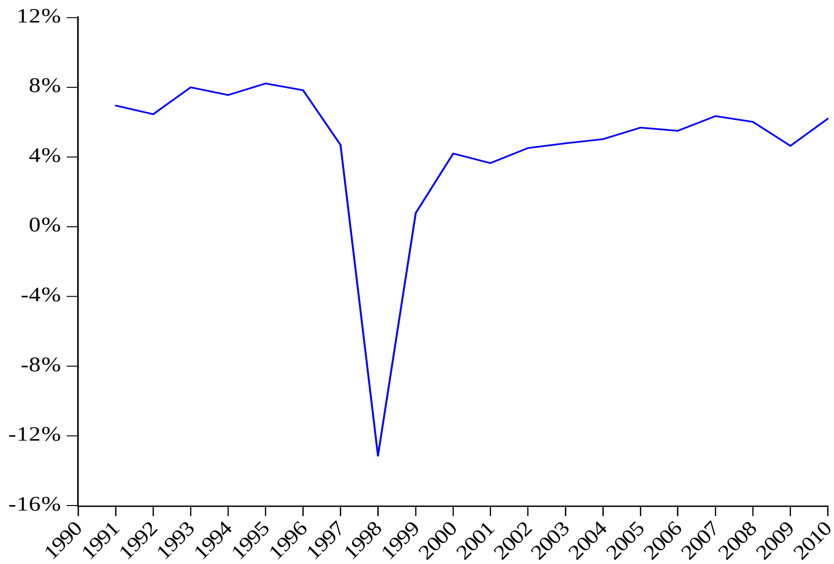
4.3 Overview of Fiscal Development in Indonesia

During 1990 - 1997, Indonesia showed a strong economic performance. Annual economic growth averaged 8 per cent and the overall fiscal balance was in modest surplus since 1992. Inflation was a little higher than the other East Asian economies (close to 10 per cent a year), credit growth was strong, but not perceived as worrisome, and asset prices rose steadily and kept rising until a peak in August 1997.

Meanwhile, public debt was on the decline. Between 1990 and 1997, the debt-to-GDP ratio declined by about 16 per cent of GDP. The main factors behind this were sizeable primary fiscal surpluses and economic growth. Moreover, in 1994 – 1997 the government used privatisation proceeds to repay a large portion of its foreign debt. As can be seen in Figures 4-1, 4-2 and 4-3, during 1990 – 1997 a decreasing trend in the debt to GDP ratio coincided with an increasing trend in the primary surplus to GDP ratio and a steady economic growth about 7 per cent. During this period, sound macroeconomic and fiscal fundamentals did not predict a pending crisis.

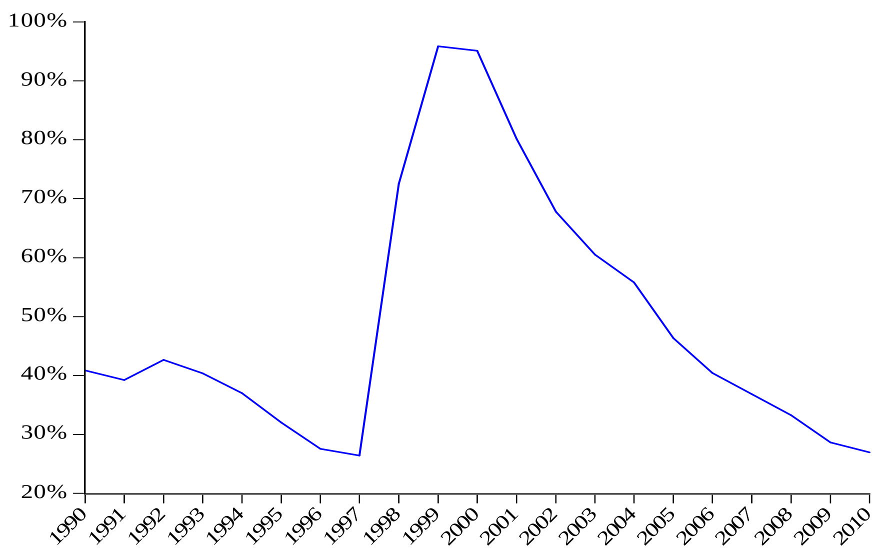
In the mid of 1997, severe Asian financial crisis hit Indonesia together with other neighbouring Asian countries, such as Thailand, South Korea, Malaysia and the Philippines. The major impact of the crisis to the economy is on economic growth, which drops dramatically in 1998 of over 13 per cent. This was the worst decline among the crisis-affected East Asian economies.

Figure 4-1
Economic Growth (%)



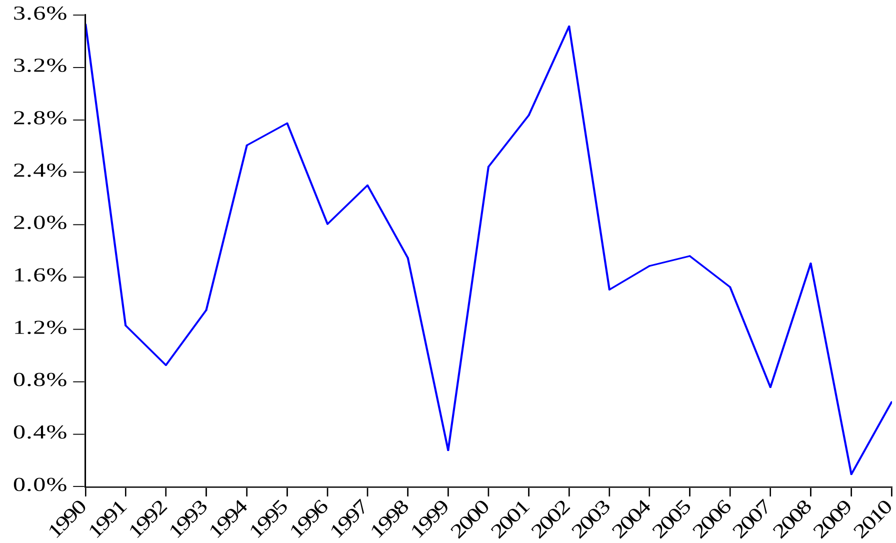
Source: Asian Development Bank

Figure 4-2
Debt (% GDP)



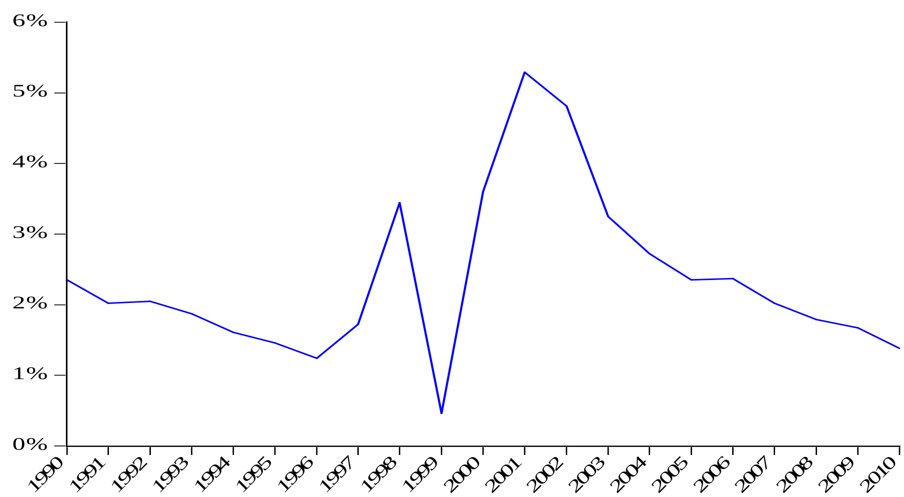
Source: International Monetary Funds

Figure 4-3
Primary Balance (% GDP)



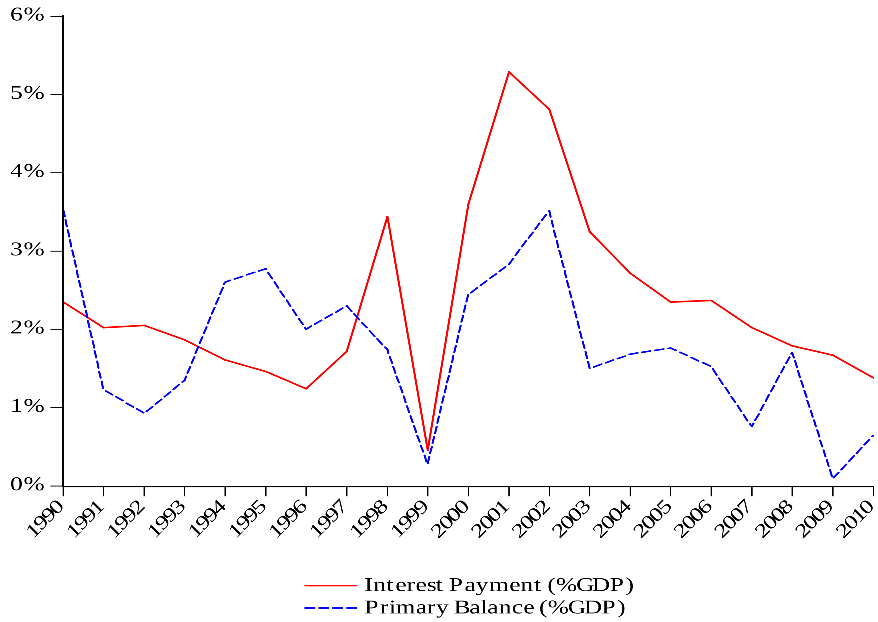
Source: Bank Indonesia

Figure 4-4
Interest Payment (%GDP)



Source: Bank Indonesia

Figure 4-5
Interest Payment and Primary Balance (% GDP)



Source: Bank Indonesia

As shown by Figure 4-2 and 4-3, in the immediate aftermath of the Asian financial crisis, the government faced a rapidly rising debt-to-GDP ratio accompanied by a declining primary balance-to-GDP ratio. The debt-to-GDP ratio increased sharply, from 26 per cent of GDP in 1997 to 73 per cent of GDP in 1998 and then reached its peak of 96 per cent of GDP in 1999. The bulk of public debt accumulation during the crisis period is primarily due to financing state bank recapitalisation and bailing-out of some private banks (detailed discussions are given by Hill (2007) and Sasin (2001). The high real price of foreign currency also helped elevate the debt to GDP ratio during the crisis period, especially in 1998, by increasing the value of US$-denominated debt. However, the overall impact of the real exchange rate during this period is relatively small compared to the fiscal costs of the banking crisis (Pangestu, 2003). Meanwhile, the primary surplus-to-GDP ratio sagged from 2.8 per cent of GDP in 1995 to 0.3 per cent of GDP in 1999, which is the lowest ever during the sample period.

Following the Asian financial crisis, Indonesia managed to bring the fiscal deficit and debt under control in spite of a weakened central government, an ambitious decentralization program, increased pressure to set up social expenditure, and widespread discontent with the International Monetary Fund (IMF) stabilisation program (Hill 2007). As depicted in Figure 4-2 and 4-3, the debt-to-GDP ratio has continuously declined, and the primary balance-to-GDP ratio is always in surplus since 2000. Only in 2009 did the primary balance nearly approach zero per cent of GDP in line with the increase in the budget deficit as set forth in the 2009 fiscal stimulus[5].

The debt to GDP ratio has consistently declined since 2001 (see Figure 4-2). As described in Azis (2008), realizing the mounting fiscal burden and that it emanated largely from the bank bailout policy, the government took a number of steps to ease it, including the following: (1) *Buyback program*, in which the government used the proceeds from privatization and asset sales by IBRA to re-purchase some of the non-matured bonds. This redemption scheme was exercised in 2003, when banks and securities companies that held

[5] Fiscal policy in 2009 focused on delivering a stimulus to the economy during the period of the global economic downturn, while simultaneously maintaining the fiscal sustainability. The fiscal stimulus package approved by the Indonesian Parliament was launched with three key objectives: (i) maintain and/or boost public purchasing power, (ii) bolster corporate/business sector resilience in coping with the global crisis and (iii) create jobs and mitigate the impact of worker lay-offs through labour-intensive infrastructure development policies. This additional stimulus totalled Rp 73.3 trillion was packaged into tax savings and tax subsidies for business and the infrastructure package. This stimulus raised the deficit in the Revised 2009 Budget to 2.4% of GDP from the originally targeted 2009 Budget deficit at 1% of GDP.

recap bonds sold back some of them at higher than the original prices; (2) *Re-profiling debt* in line with the policy goal of adding longer term issues to the secondary market and the limited capacity of government to create a surplus in the short run in the primary balance. The way this was carried out was to first determine each bank's liquidity requirement, and then the government exchanged the bank's holdings of bonds above that level for new bonds that had a longer maturity. However, this scheme applied only to banks that were still in the public sector, prior to divestment; (3) *Debt-switching* which was intended to lengthen the maturity profile of the debt. The main difference between this approach and the reprofiling scheme is that the terms of the bond exchanges were determined by the market, not unilaterally set by the government; (4) *Refinancing matured bonds* by issuing new bonds; and (5) *Reducing government's contingent liabilities* by phasing-out the blanket guarantee program and in other ways. This was to accompany an improving health of the banking sector and strengthened macroeconomic stability that would enable interest rates to decline. With the above schemes, it was expected that the cost of refinancing would become more manageable without putting too much pressure on the government budget.

The overall fiscal outlook improved with the continued primary budget surplus, fiscal consolidation, stronger economic growth, lower interest rates, an appreciation in the rupiah, a renegotiation of debt maturity and—in the aftermath of the tsunami—debt forgiveness (Ishikawa, 2005; IMF, 2005; Azis, 2008). Moreover, a Fiscal Law (Law No. 17) was introduced in 2003, capping the budget deficit at 3 per cent of GDP and public debt at 60 per cent of GDP (OECD 2008). The authorities' medium-term fiscal strategy targets further gradual fiscal consolidation and reductions in public debt. This strategy is based on improvements in tax administration and other base broadening with a reorientation of spending toward development of infrastructure with energy subsidies being phased out (Budina and Tuladhar, 2010)

It should be noted that since the Asian financial crisis the interest payment on debt-to-GDP ratio has always been larger than the primary balance-to-GDP ratio (see Figure 5). This condition implies that the stability of debt-to-GDP ratio, i.e. the fiscal policy sustainability, would be critically affected by nominal interest rate and nominal GDP growth rate. If the nominal interest rate greatly exceeds the nominal GDP growth rate, the outstanding public debt will expand in relation to GDP. In the case of Indonesia, the nominal GDP growth rate has been high (relative to its real counterpart) as a consequence of inflation, while interest payments on public debt have been relatively low. Therefore, public debt in relation to GDP has continued to decline.

4.4 Data and Methodology

4.4.1 Data

I use annual data on government debt stock, primary balance, and government expenditure covering the period 1990 - 2010. All the variables are expressed as a ratio to GDP. The public debt data are taken from the *Historical Public Debt Data Base* published by the Fiscal Affair Department of International Monetary Funds (IMF)[6]. The primary balance and government expenditure data are taken from the *Indonesian Financial Statistics*[7] published by Bank Indonesia.

[6] http://www.imf.org/external/datamapper/index.php?db=DEBT
[7] http://www.bi.go.id/web/en/Statistik/

4.4.2 Methodology

The main hypothesis to be tested is that the government takes corrective actions by adjusting the primary budget balance in response to variations in debt to GDP ratio so as to ensure fiscal sustainability. Hence, the specification of fiscal reaction function to be estimated is:

$$s_t = \alpha_0 + \rho d_{t-1} + \alpha_Y YVAR_t + \alpha_G GVAR_t + \varepsilon_t \qquad (11)$$

where s_t is the primary surplus to GDP ratio, d_t is the debt to GDP ratio, ε_t is an error term which assumed to be $i.i.d.N(0,\sigma^2)$. The parameter of interest in (11) is ρ which is expected to be positive and significant. If so, an increase in the public-debt-to-GDP ratio in the previous period is associated with an increase in the current primary balance-to-GDP ratio. This suggests that the government takes corrective measures to the variations in the level of indebtedness by adjusting the primary balance.

As the other determinants of the primary balance-to-GDP ratio, I use a measure of temporary fluctuations in output (business cycle) $YVAR_t$ and a measure of temporary government expenditure $GVAR_t$. I obtain the variables by using the following formulas:

$$YVAR_t = \frac{y_t - y_t^T}{y_t^T},\ GVAR_t = \frac{g_t - g_t^T}{y_t} \qquad (12)$$

where y_t and g_t are the real GDP and real government expenditure, respectively. The superscript T on each variable denotes the trend value of the corresponding variables, which are obtained by using the Hodrick-Prescott (HP) filter with the smoothing parameter set at 100.

The variable $YGAP_t$ gives the deviation of real GDP from its trend where positive values indicate booms and negative values indicate recessions. Meanwhile, the variable $GGAP_t$ gives the deviation of real public spending from its normal value with positive value indicating expenditures above the normal level and *vice versa*.

To check if the debt-to-GDP ratio series follows a mean-reverting process, which implies sustainability, the following regression is estimated:

$$\Delta d_t = \gamma d_{t-1} + \beta_0 + \beta_Y YVAR_t + \beta_G GVAR_t + e_t \qquad (13)$$

In equation (13), the coefficient γ is expected to be negative and significant, which indicates mean-reversion process in the debt-to-GDP ratio series.

4.5 Results

4.5.1 Fiscal reaction function

Table 4-1 presents the estimates of the fiscal reaction regression (11). The regression is performed using Ordinary Least Squares (OLS) estimation. The goodness-of-fit of the estimated model is relatively high with R^2 = 0.543 and *F*-statistic = 6.327 that is significant at the 1 per cent level. Moreover, the regression results also seem to be robust to various departures from the standard regression assumptions in terms of serial correlation (Durbin-Watson test), non-normality (Jarque-Bera test) and heteroskedasticity (Breusch-Pagan-Godfrey test) of residuals.

Table 4-1
Determinants of Primary Balance-to-GDP Ratio

Variable	Coefficient	Std. Error	*t*-statistic	Prob.
Constant	0.000	0.005	0.1262	0.901
d_{t-1}	0.032	0.009	3.598***	0.002
$YVAR_t$	0.074	0.037	1.972*	0.066
$GVAR_t$	0.021	0.008	2.550**	0.021

R^2 = 0.543	F-stat. = 6.327	Het. (BPG) = 0.272	JB-stat. = 1.587	DW-stat. = 1.965
$\bar{R}^2$ = 0.457	*Prob.* = 0.005	*Prob.* = 0.965	*Prob.* = 0.452	

Notes: Dependent Variable: primary balance to GDP ratio, regression method is OLS, sample (adjusted): 1991-2010, included observations = 20 after adjustments. Het. (BPG) denotes Breusch-Pagan-Godfrey heteroskedasticity test (Chi squared). JB-stat. denotes Jarque-Berra statistic for residual normality test. *, ** and *** indicate statistical significance at the 10, 5 and 1% levels, respectively

The coefficient on the lagged debt-to-GDP ratio ρ is positive and highly significant at the 1 per cent level. This suggests that the government is systematically responding to variations in the debt-to-GDP ratio, so as to ensure fiscal policy sustainability. The value of ρ = 0.032 is close to the one obtained from a broad sample of emerging market economies by Mendoza and Ostry (2008), which in their results ranging between 0.033 to 0.041, depending on model specifications and the definitions of control variables used in estimations. Associated with this positive and significant fiscal reaction, Indonesia's public debt to GDP ratio has decreased to about 27 per cent of GDP in the period under consideration.

The estimated coefficient of business cycle variable $YVAR_t$ is positive but only significant at the 10 per cent level. This could be an indication that fiscal policy in Indonesia over the sample period tends to be acyclical to procyclical since a higher primary balance to GDP ratio is coincided with a higher-than-trend real GDP. As discussed in Budina (2010), several factors adversely affect fiscal policy as a countercyclical tool in Indonesia, including high dependence on revenue from natural resources, narrow and volatile tax bases, low discretionary spending, and problems with budget execution.

The estimated coefficient for temporary public expenditure $GVAR_t$ is positive and significant at 5 per cent level, implying that public expenditure above its trend is associated with higher primary surplus ratio. This can be explained by the orientation of fiscal policy which is aimed at balancing between fiscal consolidation and fiscal stimulus during the sample period. Hence, even when the government expenditure is increasing, the primary surplus is also deliberately increased.

To get further insight about the fiscal responsiveness to indebtedness over time, I estimate the recursive coefficient of the fiscal reaction coefficient ρ. This method can be used to determine if, and when, changes in the estimated ρ values occurred. The recursive procedure involves successively re-estimating the model by adding one observation at a time until the final estimation contains the full set of observations[8]. Plotting the recursive coefficient estimates enables us to see the evolution of the ρ through time as more and more of the sample data are used in the estimation.

[8] I begin the estimation of equation (13) using a minimum sample size of 8 observations and then observations are added one at a time as I move through the sample. Therefore, in all, the recursive estimation involves N – 8 regressions, where N is the number of observations.

Figure 4-6
Recursive Estimates of ρ

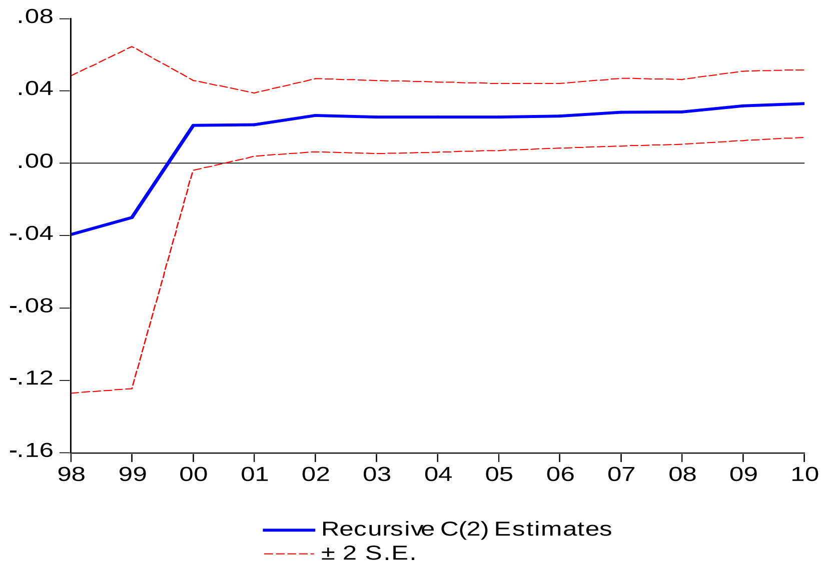


Figure 4-6 displays the recursive coefficient estimates with associated two-standard error confidence intervals for equation (11). As can be seen, the coefficient of fiscal policy response to indebtedness ρ is negative (albeit not significant) and showing a steady increase until 2000. From then on, the time path of the fiscal reaction is positive and remains relatively stable. This is in accordance with Figure 4-2 and 4-3 displaying that the primary balance and the debt have been simultaneously following a declining trend since 2000. This fact reflects the government's commitment to maintain a primary fiscal surplus and to decrease the debt ratio in order to maintain a sustainable fiscal policy.

4.5.2 Debt dynamics

Estimates of debt dynamics regression (13) using OLS are reported in Table 4-2. To deal with autocorrelation and heteroskedasticity problems, robust *t*-statistics are computed using heteroskedasticity and autocorrelation consistent (HAC) covariance matrix (Newey and West, 1987). As can be seen, the coefficient on lagged debt-to-GDP ratio is negatively significant ($\gamma = -0.421$ with robust *t*-statistic = -4.648 significant at 1 per cent level). This implies that the debt-to-GDP ratio follows is mean-reverting and, therefore, supports the conclusion that the fiscal policy during the sample period has been sustainable.

Table 4-2
Determinants of Changes in Debt-to-GDP Ratio

Variable	Coefficient	Std. Error	*t*-statistic	Prob.
Constant	0.206	0.078	2.650***	0.018
d_{t-1}	-0.421	0.091	-4.648***	0.000
$YVAR_t$	-1.252	0.399	-3.138***	0.006
$GVAR_t$	-0.240	0.057	-4.200****	0.000

R^2 = 0.416	F-stat. = 3.793	DW-stat. = 0.766
$\bar{R}^2$ = 0.306	Prob. = 0.031	

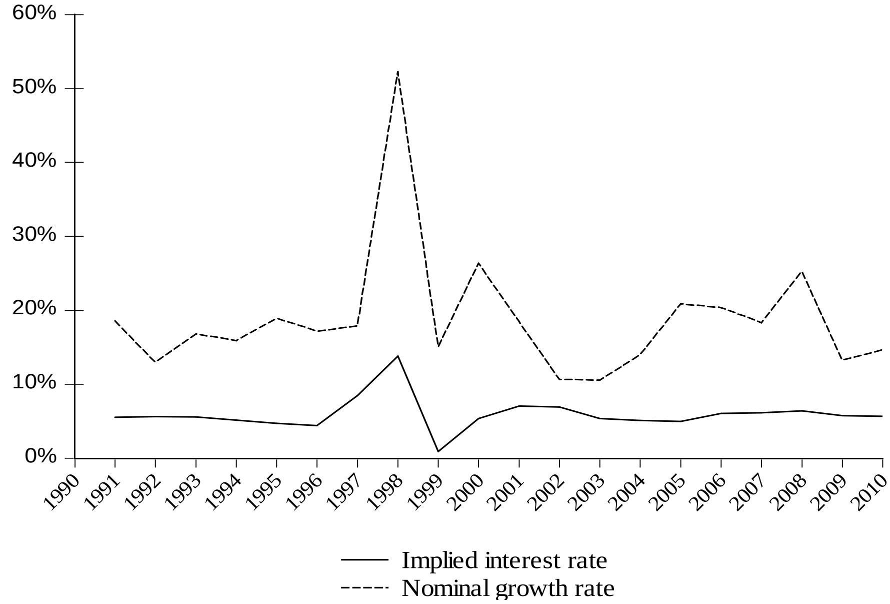
Notes: Dependent Variable: change in debt-to-GDP ratio, regression method is OLS, standard errors and t-statistics are computed using the Newey-West heteroskedasticity and autocorrelation consistent (HAC) method. Sample (adjusted): 1991 - 2010, included observations = 20 after adjustments. *, ** and *** indicate statistical significance at the 10, 5 and 1% levels, respectively.

The coefficient on business cycle $YVAR_t$ is significantly negative ($\gamma = -0.252$ with robust *t*-statistic = -3.138) indicating that a higher-than-trend GDP is associated with a decrease in the change in the debt-to-GDP ratio, which is consistent with the tax smoothing.

The coefficient on temporary government expenditure $GVAR_t$ is significantly negative (-0.240 with robust *t*-statistic = -4.2) suggesting that higher-than-trend government expenditure is on average coincided with declining change in the debt-to-GDP ratio. This may reflect the government's effort to continually decrease the debt-to-GDP ratio even though the government has to increase expenditure.

To explain the mean-reverting process in the debt to GDP ratio, I need to look back at the definition of the coefficient γ on b_{t-1} in equation (13), that is $\gamma = r - \rho$, where r is the nominal interest rate on government debt net of the growth rate of nominal GDP, and ρ is the response of the primary surplus-to-GDP ratio to changes in the debt-to-GDP ratio. With regard to that definition, the debt dynamics is mean-reverting if $(r-\rho)<0$. To get r, I calculate the nominal interest rate on debt i_t as the implied interest rate, i.e. interest paid as percentage of the stock of last year's debt. For the sample period, the average implied interest rate on debt is 5.94 per cent (or 0.0594). Meanwhile, the average nominal GDP growth is about 18.91 per cent (or 0.1891). Therefore, $r = \frac{1+i}{1+y} = \frac{1+0.0594}{1+0.1891} - 1 \approx -0.109$ which is lower than zero. This implies that the condition $(r-\rho)<0$ is satisfied and that the "nominal growth dividend" has exceeded the interest cost on public debt, preventing *per se* the debt-to-GDP ratio from embarking on an unstable path (see Figure 4-7).

Figure 4-7
Implied Interest Rate and Nominal Growth Rate (%)



4.6 Conclusion

This paper examines the sustainability of fiscal policy Indonesia by analysing the responsiveness of the primary budget balance to debt accumulation and the mean-reverting process of the debt-to-GDP ratio, using the approach introduced by Bohn (1998, 2008). Using annual data for the period 1990 – 2010 I estimate a fiscal reaction function and a debt dynamics equation that control for business cycles and temporary government expenditure. The results show that the response of the primary balance to variations in debt is significantly positive, suggesting that the government has systematically responded to decreases in the debt-to-GDP ratio by reducing the primary balance surplus. This implies that fiscal policy has been sustainable. I have also shown that the fiscal response to debt accumulation has been stable since 2000.

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Appendix

Dependent Variable: PB
Method: Least Squares
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000600	0.004754	0.126249	0.9011
DR(-1)	0.032259	0.008966	3.598111	0.0024
YVAR	0.073814	0.037440	1.971507	0.0662
GVAR	0.021249	0.008332	2.550403	0.0214

R-squared	0.542599	Mean dependent var	0.016831
Adjusted R-squared	0.456837	S.D. dependent var	0.008938
S.E. of regression	0.006587	Akaike info criterion	-7.030592
Sum squared resid	0.000694	Schwarz criterion	-6.831446
Log likelihood	74.30592	Hannan-Quinn criter.	-6.991717
F-statistic	6.326758	Durbin-Watson stat	1.965341
Prob(F-statistic)	0.004924		

PB = Primary balance to GDP ratio, DR = Debt to GDP ratio

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.100294	Prob. F(2,14)	0.9052
Obs*R-squared	0.282506	Prob. Chi-Square(2)	0.8683

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 1991 2010
Included observations: 20
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000884	0.005527	-0.159981	0.8752
DR(-1)	0.001974	0.010729	0.183972	0.8567
YVAR	0.010025	0.048054	0.208628	0.8377
GVAR	0.000139	0.009719	0.014260	0.9888
RESID(-1)	-0.025136	0.311879	-0.080597	0.9369
RESID(-2)	-0.155102	0.346365	-0.447799	0.6611

R-squared	0.014125	Mean dependent var	1.65E-18
Adjusted R-squared	-0.337973	S.D. dependent var	0.006045
S.E. of regression	0.006992	Akaike info criterion	-6.844818
Sum squared resid	0.000684	Schwarz criterion	-6.546098
Log likelihood	74.44818	Hannan-Quinn criter.	-6.786505
F-statistic	0.040117	Durbin-Watson stat	1.963414
Prob(F-statistic)	0.998887		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

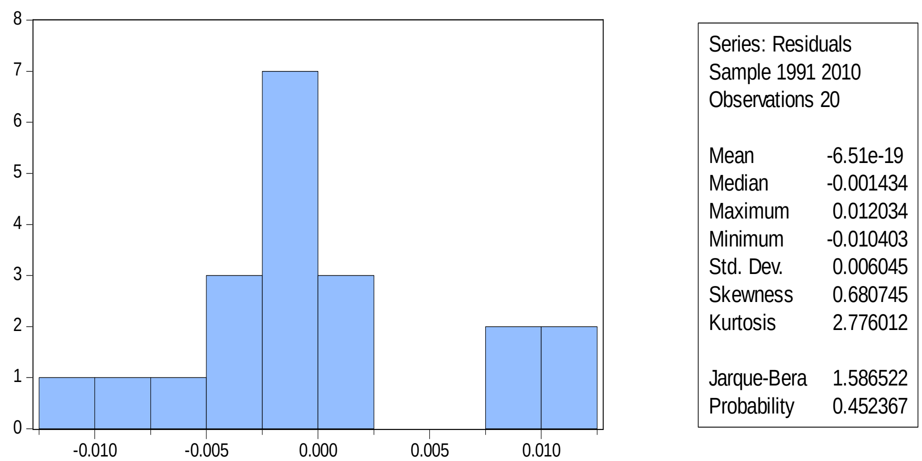
F-statistic	0.073585	Prob. F(3,16)	0.9733
Obs*R-squared	0.272189	Prob. Chi-Square(3)	0.9652
Scaled explained SS	0.154691	Prob. Chi-Square(3)	0.9845

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1991 2010
Included observations: 20

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.07E-05	3.71E-05	1.367549	0.1904
DR(-1)	-3.18E-05	6.99E-05	-0.454423	0.6556
YVAR	-5.92E-05	0.000292	-0.202718	0.8419
GVAR	1.62E-06	6.50E-05	0.024915	0.9804

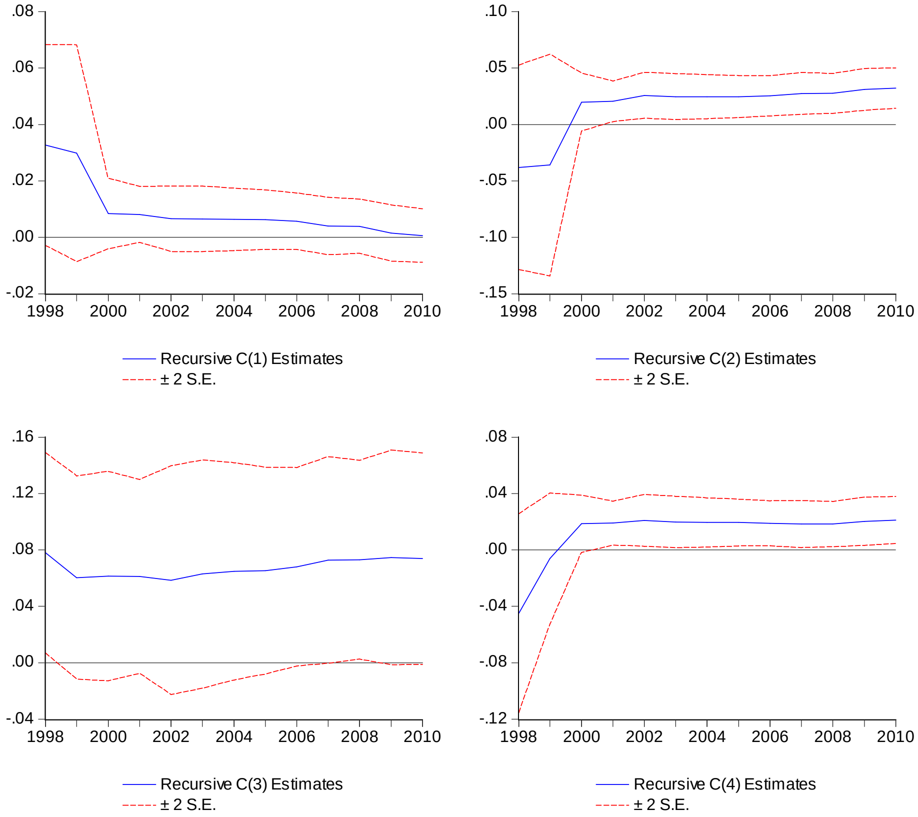
R-squared	0.013609	Mean dependent var	3.47E-05
Adjusted R-squared	-0.171339	S.D. dependent var	4.75E-05
S.E. of regression	5.14E-05	Akaike info criterion	-16.73839
Sum squared resid	4.22E-08	Schwarz criterion	-16.53925
Log likelihood	171.3839	Hannan-Quinn criter.	-16.69952
F-statistic	0.073585	Durbin-Watson stat	2.143936
Prob(F-statistic)	0.973301		

Histogram – Normality test



Recursive Estimates of Equation 11

$$s_t = \alpha_0 + \rho d_{t-1} + \alpha_Y YVAR_t + \alpha_G GVAR_t + \varepsilon_t$$



Debt Dynamics

Dependent Variable: D(DR)
Method: Least Squares
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.205597	0.080022	2.569255	0.0206
DR(-1)	-0.421293	0.150918	-2.791532	0.0131
YVAR	-1.252379	0.630229	-1.987180	0.0643
GVAR	-0.239629	0.140245	-1.708639	0.1068

R-squared	0.415619	Mean dependent var	-0.006942
Adjusted R-squared	0.306048	S.D. dependent var	0.133101
S.E. of regression	0.110878	Akaike info criterion	-1.383920
Sum squared resid	0.196702	Schwarz criterion	-1.184773
Log likelihood	17.83920	Hannan-Quinn criter.	-1.345044
F-statistic	3.793132	Durbin-Watson stat	0.765589
Prob(F-statistic)	0.031423		

Dependent Variable: D(DR)
Method: Least Squares
Sample (adjusted): 1991 2010
Included observations: 20 after adjustments
HAC standard errors & covariance (Prewhitening with lags = 2 from AIC maxlags = 2, Bartlett kernel, Newey-West automatic bandwidth = 1.9968, NW automatic lag length = 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.205597	0.077594	2.649650	0.0175
DR(-1)	-0.421293	0.090641	-4.647922	0.0003
YVAR	-1.252379	0.399054	-3.138369	0.0063
GVAR	-0.239629	0.057048	-4.200464	0.0007

R-squared	0.415619	Mean dependent var	-0.006942
Adjusted R-squared	0.306048	S.D. dependent var	0.133101
S.E. of regression	0.110878	Akaike info criterion	-1.383920
Sum squared resid	0.196702	Schwarz criterion	-1.184773
Log likelihood	17.83920	Hannan-Quinn criter.	-1.345044
F-statistic	3.793132	Durbin-Watson stat	0.765589
Prob(F-statistic)	0.031423		

Chapter 5
Conclusion

In this thesis, I have attempted to deal with two important issues of fiscal policy optimality and fiscal policy sustainability for the case of Indonesia. These two issues are closely interconnected. The optimal fiscal policy, according to the tax smoothing theory, prescribes a near constant tax rate in order to minimise the distortionary costs from taxation (or to maximise welfare). Meanwhile, a sustainable fiscal policy is the one that is expected to ensue in public debts and interest payments being met as they fall due. If fiscal policy is not sustainable, there would be adverse consequences for future government access to capital markets on reasonable terms. Therefore, the sustainability of fiscal policy is important for optimal fiscal policy.

In general, I conclude that fiscal policy in Indonesia since 1970s has been consistent with the optimality criteria of tax smoothing and has also been consistent with sustainability criteria. By pursuing sustainable fiscal policy, the government can keep the tax rates relatively stable and, therefore, contribute to minimising the distortionary costs of taxation.

In Chapter 2, a simple open-economy model showed that the marginal excess burden of taxation should be constant through time. Since the function of tax rates that characterises marginal excess burden is itself constant through time, it follows that those marginal rates too should be constant through time. Although classical, the Chapter 2 model concurs with Keynesian models that large, temporary swings in the tax base call for large countercyclical swings in the tax base. Unlike Keynesian models, however, the Chapter 2 model does require that the government's budget be balanced in present-value terms.

Chapter 2 examined whether fiscal policy in Indonesia has been optimal based on the tax smoothing framework. By performing unit root tests, it is found that the tax rate (as represented by the ratio of tax revenue to GDP) follows a random walk during the sample period. Furthermore, the results from autoregressions and vector autoregressions confirm that tax rate changes are unpredictable either by its own lagged values or by lagged values of other relevant variables (i.e. changes in the government expenditure and economic growth).

In Chapter 3 and 4, I performed two different analyses in order to examine the sustainability of fiscal policy in Indonesia. In Chapter 3, analysis was based on the government intertemporal budget constraint (IBC) which implies that fiscal policy is sustainable if the budget deficit and debt series are stationary and is equivalent with the existence stationarity in both the government revenue and expenditure or, alternatively, a cointegration relationship if both are not stationary. Using a battery of unit root tests, I found that budget deficit and debt ratios, as well as government revenue and expenditure, are all stationary. These findings lead to conclusion that fiscal policy during the sample period is sustainable. Moreover, there is a positive causality running from government revenue to expenditure which implies that the decision to spend depends on revenue and that higher revenue would result in higher expenditure. These results support the tax-and-spend hypothesis as proposed by Friedman (1972).

In Chapter 4, I examined further the sustainability of Indonesian fiscal policy by testing the response of the primary balance-to-GDP ratio to variations of the debt-to-GDP ratio, as suggested by Bohn's (1998) Model Based Sustainability approach. I find evidence of significantly positive response of the primary balance-to-GDP ratio to variations in the debt-to-GDP ratio, and that response has been stable since 2000. Moreover, I also find that the debt-to-GDP ratio tends to be mean-reverting due to a nominal growth dividend. These results suggest a sustainable fiscal policy and the stability of debt-to-GDP ratio is dependent on the growth rate of the economy.

Discussions of fiscal policy in Indonesia have often emphasised inefficiencies, such as unwillingness to lower barriers to imports, and ongoing fuel subsidies. That Indonesian fiscal policy appears to have been efficient in the intertemporal dimension, at least over the period 1970 to 2010, therefore represents a contrast to the views typically expressed in previous discussions of the efficiency of Indonesia's public sector. It also represents a contrasty to typical findings for developing countries other than Indonesia.