Sustainability of Fiscal Policy and Government Revenue-Expenditure Nexus: The Experience of Indonesia

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October 2012

INTERNATIONAL CONFERENCE ON MANAGEMENT, ECONOMICS AND FINANCE (ICMEF 2012) PROCEEDING
15th - 16th OCTOBER 2012. HILTON HOTEL, KUCHING, SARAWAK, MALAYSIA
ISBN: 978-967-5705-09-0. WEBSITE: www.globalresearch.com.my

SUSTAINABILITY OF FISCAL POLICY AND GOVERNMENT REVENUE-EXPENDITURE NEXUS: THE EXPERIENCE OF INDONESIA

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ABSTRACT

This paper empirically examines the issue of fiscal policy sustainability in Indonesia. To do so, we first diagnose the Indonesia's public finance by analysing the evolution of key fiscal indicators—debt, budget deficit, revenue and expenditure—over time. It is found that the fiscal policy in Indonesia has been responsible and conservative. The budget deficit has been maintained below 3 percent of GDP with a decreasing trend in public debt-to-GDP ratio since 2001 to present. We then test the fiscal sustainability based on the government intertemporal budget constraint (IBC) framework using the data set covering the period of 1982 – 2010. The IBC framework requires the stationarity of public debt and total deficit as well as cointegration of government revenues and expenditures. We find that all the variables of interest are stationary, which favouring a conclusion that fiscal policy in Indonesia has been sustainable during the sample period. We proceed by analysing the nexus of the government revenue and expenditure. The results from the Granger causality test and the generalised impulse response function are consistent with the Friedman's (1978) tax-and-spend hypothesis, that government revenue Granger causes government expenditure positively. We also find that a shock in expenditure lead to a worsening budget deficit Therefore, in controlling budget deficit and sustaining fiscal sustainability, the fiscal authorities in Indonesia should pursue robust fiscal policy aimed at raising revenue and controlling expenditure.

Field of Research: *Public finance, fiscal policy sustainability, Causality, Impulse response, Indonesia.*

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1. INTRODUCTION

Sustainable fiscal policy is a key for a stable macroeconomic environment and a sustainable economy. It is related to the issue of whether the government is capable of sustaining a given spending, taxation, and borrowing pattern indefinitely, or whether it will be ultimately constrained to alter those policy settings to satisfy its long run budget constraint (Abdulnasser, 2000). A sustainable fiscal policy, according to Blanchard (1990), is the one that can be continued indefinitely with a stable government debt-to-GDP ratio. Meanwhile, in the government intertemporal budget constraint framework, a fiscal policy is sustainable if the current value of government debt is less than or equals the sum of discounted future government surpluses, implying that the government is not financing its activities through a Ponzi

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scheme (Hamilton and Flavin, 1986). In this sense, a persistently large budget deficit which leading to an ever rising 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, which in turn will cause adverse effects to the economy. Domar (1944) expressed a concern about the importance of fiscal policy sustainability as follows: *"… continuous government borrowing results in an ever rising public debt, the servicing of which will require higher and higher taxes; and that the latter will eventually destroy our economy or result in outright repudiation of the debt".*

The issue of 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 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 percent 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 (Adams 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 IMF (2009), as the result of countercyclical fiscal measures, it is expected that fiscal balances 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 aim of this paper is twofold. Firstly, this paper aims to test for the sustainability of fiscal policy in Indonesia. Since the Asian financial crisis 1997/98, the government has implemented various fiscal consolidation measures in order to pursue fiscal sustainability, while also seeking to provide fiscal stimulus to support economic growth. As the results, the budget deficit has been consistently maintained below 3 percent 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 with better fiscal condition than many Asian countries, or even the US and Europe. This may be an indication that fiscal policy in Indonesia has been sustainable. However, we are interested in checking the sustainability formally, and in doing so we 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

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lead to a reduction of deficit in subsequent period (Martin et al., 2005). To test the causality relationship between revenue and expenditure we 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, we complement the causality test with the generalised impulse response analysis.

2. OVERVIEW OF PUBLIC FINANCE IN INDONESIA

Figure 1 shows the development in government revenue, expenditure, and overall budget deficit ratios to GDP in Indonesia during 1982 – 2010. In this sample period, the government revenue and expenditure to GDP ratios have fluctuated with average of 17.3 and 18.7 percent of GDP respectively, while the average of overall budget deficit is 1.4 percent of GDP. There is a period of budget surplus in 1994 – 1997, four years before Indonesia mired in an economic crisis in 1997/98.

The public debt to GDP ratio (see Figure 2) ranges from 18.56 percent in 1982 to 95.90 percent in 1999, averaged 44.67 percent. In 1982 – 1996, the period before the Asian financial crisis, the average of public debt to GDP ratio is 35.25 percent 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 26.41 percent in 1997 to reach its peak at 95.90 percent 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 has reached 27 percent of GDP.

Figure 1: Revenue, Expenditure, and Deficit (% GDP)

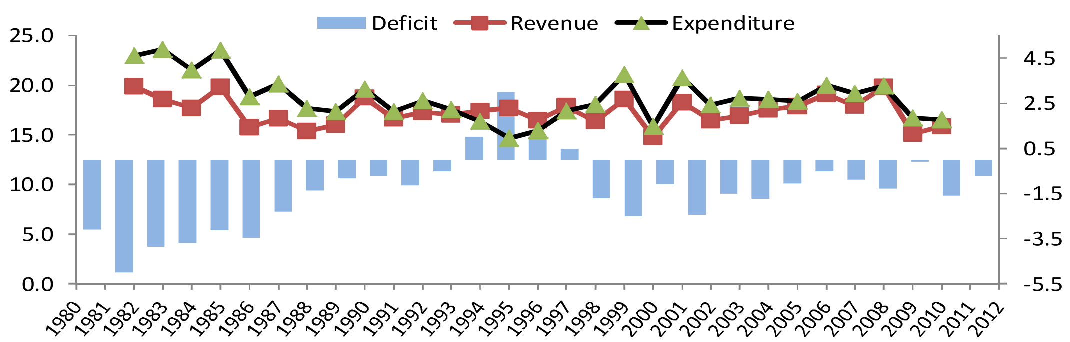

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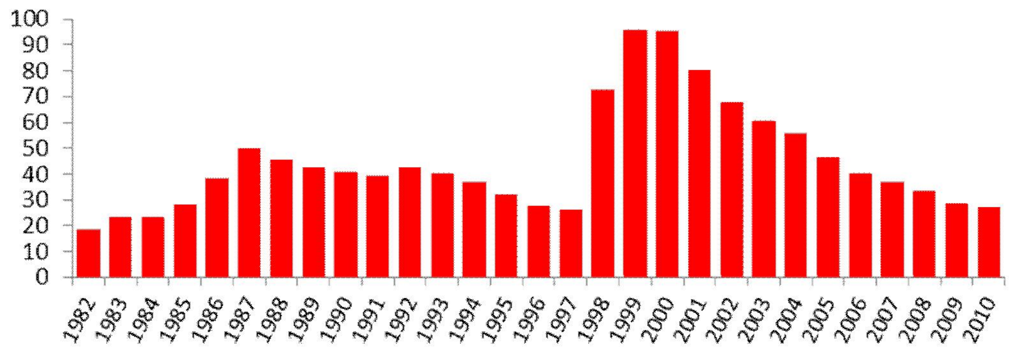
Figure 2: Public Debt (% GDP)



During 1982 – 1995, the ratio of government expenditure to GDP had been fluctuated with a declining trend. On average, the government expenditure to GDP ratio was 19.26 percent of GDP, with the highest 23.59 percent in 1983 and the lowest 14.68 percent in 1995. The government revenue to GDP ratio had also been fluctuated, but relatively more stable compared to the expenditure. The average government revenue to GDP ratio was 17.47 percent, with the highest 19.88 percent in 1983 and the lowest, ever, 15.37 percent of GDP in 1988. As the result, the overall budget deficit on average had been deficit, however with a declining trend. The average budget deficit was 1.79 percent of GDP. The largest budget deficit was 5 percent of GDP in 1983 (see Figure xxx). The declining trend in the budget deficit during 1982 – 1995 reflects 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 percent of GDP (average of 1.4 percent of GDP).

In 1997/98, the Asia financial crisis severely hit the Indonesia's economy. The economy shrank by over 13 percent of GDP in 1998. Public debt increased dramatically in 1998 and reached almost 100 percent of GDP in 1999, 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 percent of GDP in 1998 and 2.5 percent 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 fiscal deficit under control quickly. The fiscal deficit had fallen to less than 2 percent of GDP by 2000, and it has remained there for most years since (Hill and Shirasi, 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.

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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 can be seen in Figure 1, while the revenue and expenditure to GDP ratios were fluctuated, the budget deficit gradually declined from 2.5 percent of GDP in 2001 to 0.5 percent 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 percent of GDP and accumulated debt at 60 percent 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 percent of GDP as compared to 95 percent of GDP in 2000. Since then, the debt to GDP ratio consistently decreases. In 2005, the debt to GDP reached the level of 46 percent of GDP.

Some important measures undertaken to enhance fiscal consolidation included: (1) continued tax and custom reforms to increase revenue, and also to lessen dependence on volatile oil and gas receipts; (2) streamlined expenditures, including limitations on fuel subsidies, and; (3) gradual reduction in government debt. 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 toward fiscal stimulus, while still consistently maintaining longer run fiscal sustainability. In this period, the government revenue and expenditure were respectively averaged on 17.5 and 18.5 percent of GDP. Meanwhile, the budget deficit increased from 0.87 percent of GDP in 2006 to 1.58 percent of GDP in 2009, with average of 0.95 percent of GDP. Fiscal stimulus was aimed at supporting the economic growth and then at preventing economic slowdown following the global financial crisis started that 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, and; (3) increased expenditures on both government consumption and investment aimed at strengthening the real sector, job creation and mitigation of job losses; (4) along with increasing the education budget. Meanwhile, the government keeps managing to reduce the debt to GDP ratio. During this period, the debt to GDP ratio has decreased from 40 percent in 2006 to 27 percent in 2010, which is lower than the original target of 40 percent of GDP by the end of 2009. This achievement has been made possible by lower growth of new debt as compared to economic growth.

In summary, the 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 percent of GDP and accumulated debt at 60 percent of GDP. After the 1997/98 economic crisis, the budget deficit has been consistently maintained below 3 percent of GDP and the public debt to GDP ratio has consistently declined since 2001 to reach 27 percent of GDP in 2010.

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3. LITERATURE REVIEW

3.1 Fiscal policy sustainability concept

Since the seminal paper of Hamilton and Flavin (1986), fiscal sustainability analyses 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 sustainable if the expected present value of all future primary surpluses equals the current level of public debt. The IBC can be derived from an identity of budget constraint that links the primary balance to revenue, expenditure and public debt as the following:

$$\begin{aligned} B_t - B_{t-1} &= G_t - R_t + r_t B_{t-1} \\ B_t &= G_t - R_t + (1+r_t)B_{t-1} \end{aligned} \qquad (1)$$

where G_t is the primary government expenditure (i.e., government expenditure on goods and services excluding interest payments), B_t is the stock of debt at the end of period, GR_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 current period. Equation (1) states that government budget deficit $G_t - GR_t + r_t B_{t-1}$ 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, the intertemporal budget constraint can be obtained by performing recursive iteration as the following:

$$B_t = \sum_{k=1}^{\infty} \frac{1}{\prod_{j=1}^{k}(1+r_{t+j})}(R_{t+k} - G_{t+k}) + \lim_{k\to\infty} \prod_{j-1}^{k} \frac{1}{(1+r_{t+j})} B_{t+k} \qquad (2)$$

Assuming that the interest rate is stationary and then taking expectation in the equation, the IBC can be rewritten as follows:

$$B_t = E_t \sum_{k=1}^{\infty} \frac{R_{t+k} - G_{t+k}}{(1+r)^{k+1}} + \lim_{k\to\infty} E_t \frac{B_{t+k}}{(1+r)^{k+1}} \qquad (3)$$

According to (3), whether fiscal policy is sustainable or not depends on the development of the present value of public debt, i.e. the second term of the right hand side of (3). A sustainable fiscal policy should ensure that the present value of the stock of debt goes to zero in infinity, that is

$$\lim_{k\to\infty} E_t \frac{B_{t+k}}{(1+r)^{k+1}} = 0 \qquad (4)$$

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Equation (4) is known as the transversality condition, which implies a no Ponzi game [1] and stating that the growth rate of public debt should not be larger than the interest rate. If the transversality condition is satisfied, then the IBC becomes:

$$B_t = E_t \sum_{k=1}^{\infty} \frac{R_{t+k} - G_{t+k}}{(1+r)^{k+1}} \qquad (5)$$

This equation says that a fiscal policy is sustainable if the present discounted value of the primary surplus is equal to the current level of public debt. In other words, this solvency condition states that, for a fiscal policy to be sustainable, a government that has debt outstanding will have to run primary budget surpluses in the future. Those surpluses should be large enough to satisfy equation (5).

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 deficit 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, 2008).

The work by Hamilton and Flavin (1986) is a pioneer in testing fiscal policy sustainability. Assuming constant real interest rates, they argue that a sufficient condition [2] for fiscal policy sustainability is that the primary balance, and therefore that public debt stock, is a stationary series. They derive a testable equation based on (2) as follows:

$$B_t = \sum_{k=1}^{\infty} \frac{1}{(1+r)^k} E_t\left(R_{t+k} - G_{t+k}\right) + A_0(1+r)^t + \varepsilon_t \qquad (6)$$

where $A_0 = \lim_{k \to 0} E_t \frac{B_{t+k}}{(1+r)^k}$ and ε_t is an error term. The IBC is satisfied if $A_0 = 0$, which assumed to be true if the public debt stock B_t and the primary surplus $\left(R_t - G_t\right)$ follow a stochastic stationary process. 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 surplus.

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[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 2006).

[2] Sufficient condition means that fiscal policy could be sustainable even if debt is non-stationary.

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Trehan and Walsh (1988) argue that if 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, -1) vector of cointegration. This can be seen by rewriting the government budget equation (1) as follows:

$$\begin{aligned} B_t - B_{t-1} &= G_t + r_t B_{t-1} - T_t \\ \Delta B_t &= r_t B_{t-1} + S_t \end{aligned} \tag{7}$$

In (7), if B_t is a stationary process then the change in debt $\Delta B_t = B_t - B_{t-1}$ must also 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, -1). 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 subsequent paper, Trehan and Walsh (1991) extend their (1998) work by relaxing the constancy of interest rate and suggest that a sufficient condition for fiscal policy sustainability is that the total budget surplus (not the primary surplus) should be I(0), irrespective of the time series properties of the interest rate (Green et al., 2000).

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

$$GG_t = G_t + rB_{t-1} = R_t + \sum_{k=1}^{\infty} \frac{\Delta R_{t+k} - \Delta G_{t+k}}{(1+r)^{k+1}} + \lim_{k \to 0} \frac{B_{t+k}}{(1+r)^{k+1}} \tag{8}$$

where $GG_t = G_t + rB_{t-1}$ is the total government expenditures (i.e. government expenditure on goods and services plus interest payments). If revenues R_t and expenditures G_t are integrated of order one, or I(1), so that ΔR_t and ΔG_t are stationary, then

$$GG_t = \alpha + R_t + \lim_{k \to 0} \frac{B_{t+k}}{(1+r)^{k+1}} + \varepsilon_t \tag{9}$$

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

$$R_t = \alpha + \beta GG_t + \varepsilon_t \tag{10}$$

Given that GG_t and R_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 $0 < \beta \le 1$ is a necessary condition for the term in equation (9) to zero.

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3.3 Government revenue-expenditure nexus

Literature of public finance offers four competing alternative hypotheses regarding the causal relationship between government revenue and expenditure (literature survey, among others, can be seen in Darrat, 1998; Payne, 1998; Moalusi, 2004; Westerlund et. al., 2009; Keho, 2010; Elyasi and Rahimi).

First, the tax-and-spend hypothesis—advocated by Friedman (1978) and Buchanan and Wagner (1978)—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. Therefore, reducing taxes is the appropriate remedy to budget deficit. On the contrary, Buchanan and Wagner (1978) argue that the causality is negative, an increase in revenue as remedy for deficit budgets. On the contrary, Buchanan and Wagner (1978) argue that the causality is negative, that increasing government revenue will result in decreasing expenditure. Their argument is built on an assumption that public suffer from fiscal illusion. According to this assumption, 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, higher budget deficit. To reduce government expenditures, Buchanan and Wagner favour limiting the ability of the government to resort to deficit financing. Therefore, increasing revenue is the appropriate way to reduce budget deficit.

Second, the spend-and-tax hypothesis—advocated by Barro (1974, 1978) and Peacock and Wiseman (1979)—suggests a unidirectional causality running from government expenditure to spending, 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 (1974, 1978), based on Ricardian equivalence proposition, suggests that government borrowing undertaken today will lead to an increased tax liability in the future. Thus, under 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.

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4. DATA AND METHODOLOGY

4.1 Data

We 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 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 Key Indicators for Asia and the Pacific published by Asian Development Bank (ADB) [3], 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) [4].

4.2 Sustainability test

As argued by Trehan and Walsh (1998, 1991), the stationarity of the overall budget deficit is a <u>sufficient</u> condition for a sustainable fiscal policy, and this condition is equivalent with the existence of stationarity in both the government revenue and expenditure. Therefore, we 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 we can conclude 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. The stationarity of overall budget deficit requires that revenue and expenditure be cointegrated with cointegrating vector $(1, -\beta)$, where $\beta = 1$. If $0 < \beta < 1$ then the overall budget deficit will be I(1), hence fiscal policy is unsustainable.

We apply two types of unit root tests. 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 et al, 1997). The second type of unit root used allows for a break in the series and is the Zivot-Andrews (1992) unit root test (ZA test).

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[3] http://www.adb.org/publications/series/key-indicators-for-asia-and-the-pacific

[4] http://www.imf.org/external/datamapper/index.php?db=DEBT

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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:

$$\Delta y_t = \alpha_0 + \alpha_1 T + \beta y_{t-1} + \sum_{j=1}^{k} \delta_j \Delta y_{t-j} + \varepsilon_t \qquad (11)$$

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 (11); 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 with zero variance 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). We consider using the KPSS test as a complement for the ADF and PP tests in which the null hypothesis of KPSS test is that a series is stationary.

4.2.2 Zivot-Andrews stationarity test with a structural break

The Zivot-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. We decide to use Model C which is less restrictive and is the most comprehensive compared to Model A and Model B. Moreover, Perron (1997) argue 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 break is charaterised 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 ZA unit root test is as follows:

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$$\Delta y_t = c + \alpha y_{t-1} + \beta t + \varphi DU_t + \gamma DT + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \qquad (12)$$

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. Meanwhile, 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

4.3 Revenue and expenditure causality test

4.3.1 Granger causality/Block exogeneity Wald test

To test the causality between government revenue and expenditure we follow the intuitive notion of a variable's forecasting ability due to Granger (1969): 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.

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

$$y_t = c + \sum_{i=1}^{p} \mathbf{\Phi}_i \mathbf{y}_{t\text{-}i} + \varepsilon_t, \; t = 1, 2, \ldots, T \qquad (13)$$

where $\mathbf{y}_t = (y_{1t}, y_{2t}, \ldots, y_{mt})'$ 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, 2003). This test detects whether the lags of one variable can

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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

$$(T-3p-1)(\log|\Sigma_{re}|-\log|\Sigma_{un}|) \sim \chi^2(2p) \qquad (14)$$

where *T* is the number of observation, Σ_{re} is variance/covariance matrices of the restricted system, Σ_{un} is variance/covariance matrices 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, we can obtain the information about the direction of causality between variables, but we do not know whether the causality is negative or positive. To answer this question we 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 (Shin and Pesaran, 1998).

4.3.2 Impulse response analysis

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

$$\mathbf{y}_t = \sum_{i=0}^{\infty} \mathbf{A}_i \varepsilon_{t-i},\ t = 1,2,\ldots,T \qquad (15)$$

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

$$\mathbf{A}_i = \sum_{i=1}^{p} \mathbf{\Phi}_p \mathbf{A}_{i-p},\ i = 1,2,\ldots \qquad (16)$$

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

$$GIR_y(n,\mathbf{h},\mathbf{Z}_{t-1}) = E(\mathbf{y}_{t+n} \mid \varepsilon_t = h, \mathbf{Z}_{t-1}) - E(\mathbf{y}_{t+n} \mid \mathbf{Z}_{t-1}) \qquad (17)$$

where *n* is the number of time periods ahead, $\mathbf{h} = (h_1,\ldots,h_m)'$ 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 **h** into account.

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The choice of vector of shocks **h** is crucial to the properties of the impulse response function. Sims (1980) suggests to use the orthogonalised impulse response (OIR) by identifying **h** through using the Cholesky decomposition of $\mathbf{\Sigma} = \mathbf{PP}'$, where **P** is $(m \times m)$ lower triangular matrix. In this context, the orthogonalised impulse response function for a unit shock is

$$OIR_j(n) = \mathbf{A}_n \mathbf{P} \mathbf{e}_j, \; n = 0,1,2,\ldots \quad (18)$$

where $\mathbf{e}_j$ is $(m \times 1)$ 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 Shin and Pesaran (1988) use (17) directly by introducing shock only to one element of ε_t, says the *j*-th element, and integrate 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

$$GIR_y(n, h_j, \mathbf{Z}_{t-1}) = E(\mathbf{y}_{t+n} \mid \varepsilon_{jt} = h_j, \mathbf{Z}_{t-1}) - E(\mathbf{y}_{t+n} \mid \mathbf{Z}_{t-1}) \quad (19)$$

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:

$$E(\varepsilon_t \mid \varepsilon_{jt} = h_j) = (\sigma_{1j}, \sigma_{2j}, \ldots, \sigma_{mj})' \sigma_{jj}^{-1} h_j = \mathbf{\Sigma} \mathbf{e}_j \sigma_{jj}^{-1} h_j \quad (20)$$

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

$$GIR_{ij}(n) = \sigma_{jj}^{-\frac{1}{2}} \mathbf{A}_n \mathbf{\Sigma} \mathbf{e}_j \quad (21)$$

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.

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5. EMPIRICAL RESULTS

5.1 Sustainability test

We start the sustainability test 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 1. 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 we can reject the null hypothesis of nonstationarity at 1 percent 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 1 percent critical value of -3.689. Meanwhile, the KPSS test results suggests the null hypothesis of stationarity cannot be rejected event at 10 percent significance level, and upholds the null hypothesis of stationarity up to 1 percent significance level.

Table 1: Unit Root Tests for Government Revenue and Expenditure

Variables	ADF Test				PP Test			KPSS Test		
	C	T	Lag	*t*-stat.	C	T	*t*-stat.	C	T	LM-stat.
Revenue	Yes	No	0	-5.703 (0.000)	Yes	No	-5.791 (0.000)	Yes	No	0.082 (0)
Expenditure	Yes	No	0	-3.515 (0.015)	Yes	No	-3.390 (0.020)	Yes	No	0.272 (3)

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. The lag length is selected based on Akaike Information Criterion (AIC). The numbers in the brackets are the *p*-values of the corresponding *t*-statistics. For the KPSS test, the numbers in the brackets denote the lag truncation for Bartlett-Kernel suggested by the method of Newey-West (1987). The critical values at 1, 5 and 10 percent levels are respectively 0.739, 0.463 and 0.347.

For the government expenditure variable, the null hypothesis of nonstationarity can be rejected at 5 percent 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 1 critical value of -2.972. Meanwhile, the KPSS test suggests that we cannot reject the null hypothesis of stationarity uphold the null hypothesis of stationarity at 5 percent significance level.

Based on the ADF, PP, and KPSS tests, both government revenue and expenditure, as ratios to GDP, are stationary. This means that the transversality condition is satisfied, therefore we can conclude that fiscal policy in Indonesia during the sample period has been sustainable.

Regarding the previous results, we are interested to test for the stationarity of the overall budget deficit and debt ratio. For the debt ratio, the results of unit root tests are ambiguous. The ADF test suggests that the null of unit root can be rejected, but only at a low significance level of 10 percent. Meanwhile, the PP test suggests that the debt ratio series is nonstationary as the null hypothesis of stationary cannot be rejected even at 10 percent 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 10 percent significance level.

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

Table 1: 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 (0.078)	Yes	No	-0.711 (0.400)	Yes	No	0.211 (3)
Deficit	No	No	0	-1.783 (0.071)	No	No	-1.724 (0.080)	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. The lag length is selected based on Akaike Information Criterion (AIC). The numbers in the brackets are the *p*-values of the corresponding *t*-statistics. For the KPSS test, the numbers in the bracket denote the lag truncation for Bartlett-Kernel suggested by the method of Newey-West (1987). The critical values at 1, 5 and 10 percent levels are respectively 0.739, 0.463 and 0.347.

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 xxx, 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 in 1997 – 1998. To account for the structural break in the time series data, we 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. The table also shows the time when the break occurred.

Table 3: Zivot- Andrews Tests for Unit root for Debt and Deficit (% GDP)

Variable	TB	μ	β	φ	γ	α	Lag	Verdict
Debt	1998	0.2437 (7.2014)	-0.0018 (-0.5996)	0.4001 (8.9641)	-0.0354 (-7.0202)	-0.6266 (-10.4781)	1	Stationary
Deficit	1998	-0.0531 -5.4673	0.0048 5.4718	-0.0415 -5.4511	-0.0037 -3.6932	-1.0603 -6.1856	0	Stationary

Note: Numbers in () and [] are respectively t-statistics and *p*-values

As can be seen in Table 3, the results of Zivot-Andrews unit root test indicate that both the debt and total deficit variables are stationary during the period of observation as the null hypothesis of unit root can be rejected at 1 percent 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 a significance degree of economic turmoil.

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In summary, the results from the unit root tests show that both government revenue and expenditure are stationary, or are I(0). This implies that there exists a long run equilibrium relationship between government revenue and expenditure and that they are not drifting to far apart. Therefore, the transversality conditio is satisfied and we can conclude that fiscal policy in Indonesia during the sample period has been sustainable. This conclusion is supported by the facts that both total deficit and public debt time series are also stationary.

5.2 Granger causality test

Provided that government revenue and expenditure variables are stationary at levels—which implies the existence of long run equilibrium between the two variables—we perform the Granger causality test using the data at levels. The following unrestricted VAR system, expressed explicitly, is estimated:

$$gr_t = \alpha_0 + \alpha_1 gr_{t-1} + \dots + \alpha_p gr_{t-p} + \beta_1 ge_{t-1} + \dots + \beta_p ge_{t-p} + \varepsilon_t \quad (22)$$

$$ge_t = \alpha_0 + \alpha_1 ge_{t-1} + \dots + \alpha_p ge_{t-p} + \beta_1 gr_{t-1} + \dots + \beta_p gr_{t-p} + \mu_t \quad (23)$$

As the first step, we 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 4 shows that the entire lag order selection criteria, consisting of the likelihood ratio (LR), Akaike information criterion (AIC), Schwartz criterion (SC), and Hannan-Quin 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 we apply a Granger causality test based on a VAR specification with lag order of 1. The VAR estimation results are presented in Table 5.

Table 2: 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.

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Table 5: VAR Estimates

	gr	*ge*
gr(-1)	-0.023476	-0.681396
	(0.25945)	(0.33591)
	[-0.09048]	[-2.02852]
ge(-1)	-0.042956	0.706925
	(0.16609)	(0.21503)
	[-0.25864]	[3.28751]
C	0.184217	0.170938
	(0.03324)	(0.04304)
	[5.54139]	[3.97150]
R-squared	0.007828	0.303235
Adj. R-squared	-0.071546	0.247493
F-statistic	0.098623	5.440044
Determinant resid covariance (dof adj.)		2.47E-08
Determinant resid covariance		1.97E-08
Log likelihood		168.9564
Akaike information criterion		-11.63974
Schwarz criterion		-11.35427

Sample (adjusted): 1983 2010
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

The VAR model broadly satisfies standard requirements. As shown by Figure 3, all the inverse roots of AR characteristic polynomials lie inside the unit circle, indicating that the VAR model is stable. Table 6 and Table 7 show the results from the VAR residual normality test and the VAR residual correlation Lagrange Multiplier (LM) test, respectively. With the data from Table 6, we 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 7 shows that we 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.

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Figure 3: Inverse roots of AR polynomial

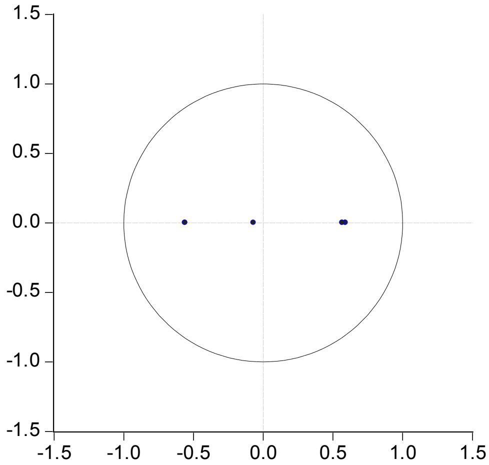

Table 6: VAR Residual Normality Test

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	

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Table 7: VAR Residual Serial Correlation LM Test

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

p-value from chi-square with 4 df.

Table 8 shows the result of Granger causality test based on the previously specified VAR model. The Granger causality block exogeneity Wald test suggests that we cannot reject the null hypothesis of excluding revenue in the expenditure equation at 5 percent significance level due to the fact that χ^2 = 4.11 and *p*-value = 0.043. Therefore, revenue Granger causes expenditure. On the contrary, we can 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 10 percent significance level. Based on the Granger causality test results we conclude that there exists a unidirectional causality running from revenue to expenditure [5]. However, we do not know whether the causality is positive or negative. To answer this question, we then proceed to the impulse-response analysis.

Table 3: 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

5.3 Generalised impulse response

Figure xxx exhibit the graphical representation of the asymptotic generalised impulse response function. Since we use a VAR model with 2 endogenous variables then we 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.

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[5] Our empirical result is, for example, in line with that of Narayan and Narayan (2006) for El Salvador, Haiti, Chile and Venezuela, Narayan (2005) for Indonesia, Singapore, Sri Lanka and Nepal, and with that of Wolde-Rufael (2008) for Ethiopia, Ghana, Kenya, Nigeria, Mali and Zambia.

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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 we 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 is a support for 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 fact that expenditure significantly affects the revenue conflicts with the previous causality test where expenditure does not Granger cause revenue. However, we can observe that the positive effect of revenue on expenditure (Panel B) seems to be stronger than the effect of expenditure on revenue (Panel C). Therefore, we prefer the result from causality test, and conclude that expenditure does not Granger cause revenue.

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 reveals 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 is not a viable way to curtail government deficit. This implies that curtailing the government deficit should probably be performed via a fiscal adjustment by reducing reductions in expenditure rather than increasing revenue.

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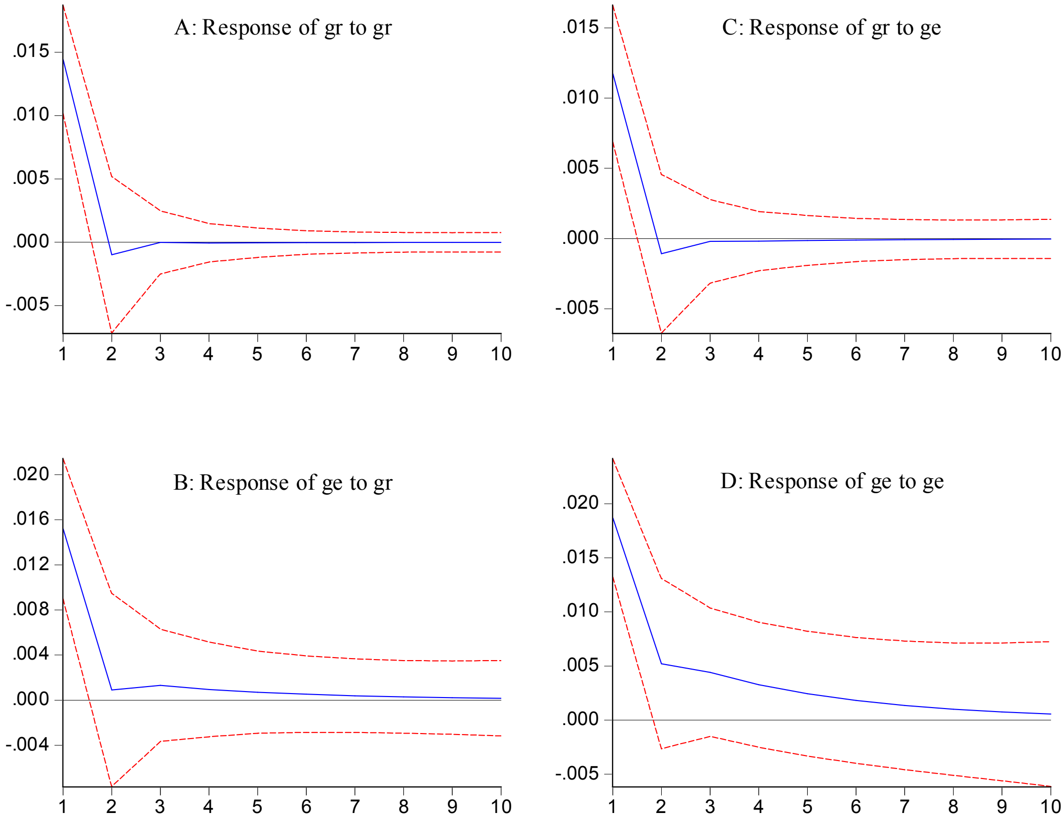
Figure 4: Generalised Impulse Response
Response to Generalised One S.D. Innovations ±2 S.E.



6. CONCLUSION

We have examined the fiscal policy sustainability in Indonesia. After highlighting the development in some major fiscal variables—i.e. revenue, expenditure, deficit and debt—we use the intertemporal budget constraint (IBC) framework to study the issue of fiscal policy sustainability in Indonesia. The empirical findings from testing the stationarity properties of the variables suggest that both the government revenue and expenditure are stationary at level, which implies that the transversality condition is satisfied and, therefore, the fiscal policy during the sample period is sustainable. The stationarity properties of deficit and public debt also give support to this conclusion. We then proceed to the causality test and impulse response analysis to see the dynamic relationship between government revenue and expenditure to identify a viable way to curtail the government budget deficit.

From the causality test and impulse responses we 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 budget deficit. Accordingly, one way to control the budget deficit, and hence

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avoiding exploding debt to GDP ratio, is by boosting government revenue while restraining expenditure such that expenditure grows at a lower rate than revenue. Accordingly, enhancing revenue collection efforts and reforms in public expenditure will be crucial.

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15th - 16th OCTOBER 2012. HILTON HOTEL, KUCHING, SARAWAK, MALAYSIA
ISBN: 978-967-5705-09-0. WEBSITE: www.globalresearch.com.my

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