Fiscal Sustainability in Some ASEAN Countries: Evidence from a Panel Data Analysis

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Abstract

This paper examines the issue of fiscal sustainability for a panel of eight major Southeast Asian (ASEAN) countries for the period of 1989-2017. The paper uses both stationarity and cointegration tests to investigate whether fiscal policy in these countries conforms to the intertemporal budget constraints of their public sectors. Overall, the presence of a long-run relationship between government revenue and expenditure is found but the size of the cointegration slope parameters between revenue and expenditure obtained from the fully modified OLS (FMOLS) and the dynamic ordinary least squares (DOLS) are significant, less than unity, indicating weak form fiscal sustainability. The weak sustainability underscores the need for commitment to longer-term fiscal discipline and justifies the ongoing efforts by the ASEAN countries to strengthen their fiscal positions.

Keywords*: fiscal sustainability, public debt, intertemporal budget constraint, stationary, cointegration, FMOLS and DOLS.*

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1. Introduction

In the context of a society with limited resources, borrowing seems to be a desirable method that allows governments to finance required expenditures. Government borrowing is accepted as long as it is consistent with a sound fiscal policy. Maintaining sustainable fiscal policy has been increasingly important in the scope of economists and policymakers. The main objective of fiscal sustainability is to provide a country with the macroeconomic stability to maintain both its budget deficit and public debt within sustainable limits (Ehrhart and Llorca, 2008). There has been substantial growth in the literature related to fiscal sustainability over the past few years, especially after the financial crisis that began in the United States since 2007 and then quickly spread to the EU and the rest of the world. Negative shocks from the crisis have exposed fiscal vulnerabilities and led to considerable deterioration in the fiscal positions of a number of these countries, in terms of both high budget deficits and rising government debt or even calls to other countries and international organisations for assistance in the form of a bailout. Similarly, Japan's fiscal situation has reached a critical point with gross government debt surpassing 200 percent (OECD, 2013). Based on these reasons, issues relating to fiscal and debt sustainability seem pertinent and important.

Managing fiscal sustainability prospects is also among the key macroeconomic management issues in the ASEAN countries. The ASEAN countries now stand at the center of the most dynamic economic region of the world, and their performance has been part of the Asian 'miracle' that has been well studied by economists and policymakers the world over (Hicklin et al., 1997). However, a unique characteristic of the ASEAN economies most badly damaged by the Asian financial crisis of 1997-1998 (the ASEAN-4: Indonesia, Malaysia, Philippines, and Thailand) was that fiscal policies and public debt levels had been relatively sound leading up to the crisis (see, among others, Makin, 1999 and Eichengreen, 2002). High and persistent fiscal deficits in ASEAN countries have been a matter of concern for policymakers and researchers. As a consequence of reforms, ASEAN countries' fiscal deficits and public debts are decreasing gradually but remain consistently high (see Table 1).

[Insert Table 1 about here]

Assessment of fiscal sustainability is largely dependent on how it is defined. The most common way of assessing a given economy's fiscal position is based on the intertemporal

budget constraint for the public sector, which indicates that a fiscal policy is sustainable when it is expected to generate sufficient net revenues in the future to repay the accumulated debt and its service. On the other hand, a fiscal policy becomes unsustainable if the government intends to finance its future interest expenses by issuing further debt and is unable to generate adequate revenues even via seigniorage. Theoretical approaches that are frequently used in the literature to assess the sustainability of public policies include fiscal indicators analysis and intertemporal budget constraint framework. The original literature on fiscal sustainability based on the constraint approach mostly focused on advanced economies while very few studies on the sustainability of fiscal policies have been done on developing countries. In addition, the main analytical techniques used to analyse the sustainability of public finances have been stationarity tests for the stock of public debt and cointegration tests between government expenditure and government revenue. Such tests have been performed mostly for individual countries, which sometimes poses the problem of relatively short time series. The main advantage of panel unit root tests and panel cointegration analysis is that these methods increase the power of these tests by including new observations by individual time series to the panel. Afonso and Rault (2008) highlighted benefits of using panel data including better properties of the testing procedures in comparison with more basic time series methods.

Most comparable studies have taken into account the possible cross-sectional dependence among countries when investigating the sustainability of public finances for developed countries from the EU, Latin America, and OECD. This study, therefore, adds to the limited literature on developing countries using time series econometric techniques and the inter-temporal government budget constraint framework.

The principal purpose of this paper is to examine the sustainability of fiscal policy in a set of eight ASEAN countries covering the period of 1989-2017 by applying recent advances in the econometrics of non-stationary and cointegration tests. Both the individual and panel approaches in testing sustainability are applied.

The remainder of this paper is organized as follows. The next section reviews theoretical backgrounds, econometric models and empirical literature on fiscal and public debt sustainability. The following section briefly presents some stylized facts of fiscal policy for the ASEAN countries and reports empirical tests and assessment of debt and fiscal sustainability. Finally, Section 4 concludes with an overview of the main findings of the paper along with the policy implications of those findings.

2. Theoretical Framework of Fiscal Sustainability

2.1. The issues of sustainability

Borrowing is an important tool for both governments and private entities to finance investment projects in order to achieve sustainable development, as well as cover short-term imbalances between revenues and expenditures. Government borrowing can also allow fiscal policy to play a countercyclical role over economic cycles[1]. However, high levels of public debt are likely to be deleterious for economic growth and sustainable development (Checherita and Rother, 2010). So far, economic literature has not defined a unique benchmark against which to assess sustainability and various definitions of fiscal sustainability are considered.

According to the IMF, debt sustainability is defined as a situation in which a borrower is expected to be able to continue servicing its debts without an unrealistically large future correction to the balance of income and expenditure. It does not include any of the following scenarios: (i) a situation in which a debt restructuring is already needed (or expected to be needed); (ii) a situation where the borrower keeps on indefinitely accumulating debt faster than its capacity to service these debts is growing (a Ponzi game)[2]; or (iii) a situation in which the borrower lives beyond its means by accumulating debt in the knowledge that a major retrenchment will be needed to service these debts (even if nothing in the external environment changes). The cost of financing is a key factor influencing debt accumulation (i.e., the present value budget constraint) and thus sustainability. Sustainability thus incorporates the concepts of both solvency and liquidity, without making a sharp demarcation between them. Moreover, the assumption of no expectation of major corrections in income or expenditure captures the notion that there are social and political limits to adjustment that determine willingness (as opposed to ability) to pay, which may be especially important in a sovereign context (IMF, 2002, p.4).

According to Adams, Ferrarini and Park (2010), fiscal sustainability is the state wherein the government budget can be smoothly financed without generating explosive increases in public debt (or money supply) over time. When this condition is met, the budget is said to be sustainable and, conversely, when the condition is not met. They also draw an explicit distinction between static fiscal sustainability (when the government can be financed

[1] http://www.un.org/esa/ffd/wp-content/uploads/2016/03/2016-IATF-Chapter2E.pdf

[2] A 'Ponzi game' is named after Charles Ponzi who set up a shell company in 1919 that has no business investment in the United States. He offered investors of the company 40% return in three months by using new investors' money to pay the initial investment to attract more people to invest in his company.

smoothly period by period) and dynamic fiscal sustainability (when the budget does not lead over time to explosive increases in public debt). Put another way, static sustainability refers to the ability of the government to fund its budget period by period (funding liquidity) while dynamic sustainability is concerned with very long-term fiscal solvency. They conclude that both static and dynamic fiscal sustainability are important, and threats to either or both can have implications for macroeconomic and financial stability.

Balassone and Franco (2000) propose a number of different conditions for sustainability, from a non ever-rising tax rate to an intertemporal discounted budget constraint. One of the first definitions of sustainable fiscal policy is that the tax rate should not rise forever. From Domar's model, Balassone and Franco derive a necessary condition for sustainability, namely an ever-growing tax ratio cannot be sustainable; or in other words, sustainability requires a non ever-rising tax ratio.

According to Mendoza and Oviedo (2003), the term fiscal sustainability means that the present value of total government spending equals its revenues. Put in another way, Alvarado et al. (2004) define as fiscally sustainable a situation that satisfies the two following conditions: namely, (i) a country can satisfy its budget constraint and (ii) it does not keep accumulating debt while knowing that a major future adjustment will be needed in order to service its debt. Theoretically, fiscal sustainability implies that the observed net stock of the government's financial liabilities is consistent with fiscal solvency considerations (Mendoza and Oviedo, 2003).

Given the intertemporal budget constraint, Buiter (1985) suggests that a fiscal policy is sustainable if it maintains the ratio of government net worth to GDP at the present level. Similarly, Blanchard et al. (1990) define a sustainable fiscal policy as a policy such that the debt-to-GNP ratio eventually converges back towards its initial level after some excessive variation. In other words, for a fiscal policy to be sustainable, after having accumulated debt in the past, the government must run primary surpluses in the future. Similar definitions are given by Gunter (2003) and Burnside (2003) who define sustainability to mean that a country can meet its current and future debt service obligations in full without recourse to debt relief, rescheduling or accumulation of arrears. Also, Ko and Morita (2015) define government debt as sustainable in so far as the debt hovers at some level.

The definition based on the intertemporal budget constraint is the most widely accepted and most analytical discussions of fiscal sustainability take as their starting point a representative agent model in which the government must satisfy both an intertemporal

budget constraint and, in every period, a static budget constraint. According to Hakkio and Rush (1991), the government budget constraint for a given period t can be written as:

$$G_t + (1 + r_t)B_{t-1} = R_t + B_t \quad (1)$$

where G_t is primary government expenditure which excludes interest payments, R_t is government revenue, B_t is government debt, r_t is the real interest rate and then $(1 + r_t)\, B_{t-1}$ is the interest payment on the debt. The budget constraint implies that the total government expenditure (the left-hand side of Equation 1) must be equal to the government revenue and new borrowings in period *t* (the right-hand side of Equation 1). Rewriting Equation 1, one can get the following equation:

$$B_t - B_{t-1} = G_t - R_t + r_t B_{t-1} \quad (2)$$

in which, $(G_t - R_t)$ is the primary deficit. Assuming that the real interest rate is stationary, with mean *r* and defining $G_t' = G_t + (r_t - r)B_{t-1}$, Equation 2 can be expressed as

$$B_t = (1 + r)B_{t-1} + G_t^{'} - R_t \quad (3)$$

Or alternatively,

$$B_t = \left(\frac{1}{1+r}\right)\left(R_{t+1} - G_{t+1}^{'}\right) + \left(\frac{1}{1+r}\right)B_{t+1} \quad (4)$$

Rewriting Equation 4 for the subsequent periods of $t+1$, $t+2$, $t+3$… and recursively solving that equation leads to the following intertemporal budget constraint[3]:

$$B_t = \sum_{j=1}^{\infty} \frac{R_{t+j} - G_{t+j}^{'}}{(1+r)^j} + \lim_{j \to \infty} \frac{B_{t+j}}{(1+r)^j} \quad (5)$$

As discussed by Hamilton and Flavin (1986) and Hakkio and Rush (1991), the crucial element in the intertemporal budget constraint is the second term of the right-hand side of Equation 5 which must equal to zero in order to rule out the possibility that the government issues new debt to finance its deficit. Following Afonso and Rault (2008), a sustainable fiscal policy should ensure that the present value of the stock of public debt goes to zero in infinity, which implies that debt will not grow faster than the real interest rate. In this case, it presents the absence of Ponzi games and the fulfilment of the intertemporal budget constraint. To achieve such of condition, the government needs to achieve budget primary surpluses with present value equal to the current value of the public debt.

[3] The variables of the present value budget constraint are also defined as a percentage of GDP (see, e.g., Hakkio and Rush, 1991, Goyal et al. 2004; Payne et al. 2008; Afonso and Rault, 2007 and Tronzano, 2013)

2.2. Assessment of fiscal sustainability

There are a number of methods to evaluate fiscal policy sustainability; however a common practice in the literature is basically to look at historical fiscal data to examine if government debt follows a stationary process or if there is cointegration between government revenue and government expenditure.

Based on the Equation 5, two complementary definitions of fiscal sustainability that set the background for empirical testing can be presented:

First, the value of public current debt must be equal to the sum of future primary surpluses:

$$B_t = \sum_{j=1}^{\infty} \frac{1}{(1+r)^j} (R_{t+j} - G'_{t+j}) \tag{6}$$

And second, the present value of public debt must approach zero in infinity:

$$\lim_{j \to \infty} \frac{B_{t+j}}{(1+r)^j} = 0 \tag{7}$$

Based on these above formulations, in order to test empirically the no-Ponzi game condition, it is possible to test the stationarity of the first difference of the stock of public debt using unit root tests. Another approach assessing fiscal policy sustainability is through cointegration tests. The implicit hypothesis concerning the real interest rate, with mean *r*, is also stationarity. We re-use the auxiliary variable $G'_t = G_t + (r_t - r)\, B_{t-1}$, and the additional definition $GG_t = G_t + r_t\, B_{t-1}$, the intertemporal budget constraint can also be written as

$$GG_t - R_t = \sum_{j=1}^{\infty} \frac{1}{(1+r)^{j-1}} (\Delta R_{t+j} - \Delta G'_{t+j}) + \lim_{j \to \infty} \frac{B_{t+j}}{(1+r)^{j+1}} \tag{8}$$

and with the absence of Ponzi games, GG_t and R_t must be cointegrated variables of order one for their first differences to be stationary.

It is assumed that *R* and *G'* are stationary variables at the first difference level. It also means that the series *R* and *G'* in levels are *I(1).* In order to hold the Equation 8, its left-hand side will also have to be stationary. If *GG* and *R* are integrated of order 1, these two variables should be cointegrated with cointegration vector *(1,-1)* for the left-hand side of Equation 8 to be stationary.

Consequently, the sustainability of the intertemporal government budget constraint can be measured by the cointegration regression between government revenue and expenditure as the following equation:

$$R_t = a + bGG_t + u_t \quad (9)$$

This approach enables us to examine the stability of fiscal deficit. If the null of no cointegration, the hypothesis that the two *I(1)* variables are not cointegrated, is rejected, this implies that government revenue and expenditure are cointegrated. In this case, the series of the residual u_t must be stationary and does not contain a unit root.

There are several conclusions concerning the intertemporal budget constraint. Hakkio and Rush (1991) point out that if there is cointegration between government revenue and expenditure with $0 < b \leq 1$, then the condition that prevents a Ponzi game situation is satisfied. In this mode, the value of b is defined as the degree of sustainability. If $0 < b < 1$, we have 'weak' sustainability; meanwhile $b = 1$ presents 'strong' sustainability or sustainability in the strict sense. In economic terms, 'weak' sustainability means that the government responds to the increase in public debt but the adjustments are not equal to the growth of public expenditure. As a result, we may see an unsteady increase of fiscal deficit and public debt. Afonso (2004) also demonstrates that three cases may happen: (i) when there is no cointegration, the fiscal deficit is not sustainable; (ii) when there is cointegration with $b = 1$, the deficit is sustainable and (iii) when there is cointegration with $b < 1$, government expenditures grow faster than government revenues and the deficit may not be sustainable.

However, Quintos (1995) states that $0 < b \leq 1$ would be a necessary and sufficient condition for the fiscal sustainability, and the presence of a cointegration relationship between R_t and GG_t is also a sufficient condition for fiscal sustainability. In this case, the government may spend more than it raises, which will consequently impose high risk of increasing fiscal deficit or having to offer a higher interest rate when it puts its debt on the market. Thus, this situation seems to be not in accordance with the possibility that the government might market its debt in the long-run (Carrion-i-Silvestre, 2014).

2.3. Literature review

Since the early 1990s, there has been an important emergence of empirical literature dealing with the issue of debt sustainability. The econometric literature testing the present value budget constraint focuses on the time series properties of government expenditures and tax revenues, budget deficits and the level of public debt. As mentioned above, the empirical

literature has followed two different approaches to test fiscal sustainability. The first rests mainly on a univariate-based approach or testing stationarity of the various fiscal variables; while the second, a multivariate-based approach employs cointegration techniques and explores the existence of a long-run equilibrium relationship between government revenue and expenditure.

A number of papers have concentrated on the first framework of examining the stationary properties of fiscal balance. Based on this method, if the deficit or public debt series exhibits non-stationarity, subsequent debt will also grow without bound over time which renders fiscal policy unsustainable. A stationary deficit means that the series is reverting to a certain mean over time being in general close zero. If that were the case, then obviously fiscal policy and debt would be sustainable, since deficits will be under control. Hamilton and Flavin (1986) use yearly data for the United States, covering the period 1962-1984 to investigate whether the post-war U.S. deficits are largely consistent with the proposition that the government budget must be balanced in present-value terms. The paper concludes that the hypothesis of a unit root of the deficit and outstanding debt can be rejected for both processes. However, the test results seem to be fairly weak. They reject the null hypothesis of a unit root at 10 percent significant level and employ short time series of only 22 annual observations which may have low power. Trehan and Walsh (1988) also use the annual data for the United States exploiting the period of 1890 - 1986. The paper focuses on the deficit inclusive of interest which is in contrast to recent studies using the deficit exclusive of interest. The empirical results suggest that the government's budget is consistent with intertemporal budget balance. In the next paper of Trehan and Walsh (1991), they test the stationary of public debt and deficits from 1960 to 1984 and draw the similar conclusion of fiscal sustainability. Wilcox (1989) evaluates the sustainability of fiscal policy using the stationary test of public debt between 1960 and 1984. The finding suggests that recent fiscal policy in the United States has not been sustainable which contrasts with those of Hamilton and Flavin (1986).

Within the same framework, the stationary test of deficits and public debt is conducted for other countries to see whether fiscal policy is sustainable or not. For instance, Corsetti and Roubini (1991) verify the fiscal sustainability using a large sample of 18 OECD countries for the period 1960-1989. The results show that among the G-7 countries, public sector solvency seems a serious issue in Italy while does not appear to be a problem in a number of OECD countries such as Germany, Japan, France, the United Kingdom and Canada. The evidence for the United States is mixed. Problems of sustainability of the current path of fiscal policies

are also present in Belgium, Ireland, the Netherlands, and Greece. Buiter and Patel (1992) test the sustainability of public sector debt in India with data for 1971–1989. They contend overall public sector debt was unsustainable irrespective of the alternative interest rate. Uctum and Wickens (1997), using annual data of government debt for the United States and EU countries for the period 1965-1994, find that many countries do not have a sustainable policy.

In the second framework, cointegration tests were used to explore whether there is a long-run relationship between government revenue and expense. If such a relationship exists, this means that the respective government is not spending without bound and is taking into account the amount of revenues it is generating and fiscal policy is sustainable. Hakkio and Rush (1991) use quarterly values for revenues and expenditure, in 1950: II-1988: IV for the United States. The test results show that government spending was growing faster than government revenue. It also supports the hypothesis that deficits have become a problem only in recent years. Liu and Tanner (1995) also conducts the tests for the cointegration of interest-inclusive expenditure and revenue and found that U.S. debt is sustainable. Similarly, using quarterly data covering the period 1947: II-1992: III, Quintos (1995) finds that U.S. debt is sustainable until 1980. The cointegration test is also employed for other economies. Payne (1997) examines the sustainability of budget deficits of the G-7 countries between 1949 and 1994. It is revealed that in the cases of Canada, Italy, the United Kingdom, and the United States cointegration is present between revenues and expenditures. However, the estimated coefficients are significantly less than one which suggests ‘weak’ fiscal sustainability. For France, Japan, and Italy the budget deficits of these countries may not be sustainable due to the lack of cointegration. In order to investigate the causality relationship between Romanian public expenditure and revenue, Stoian (2008) uses the quarterly data from 1991 to 2005. The results reveal that there is a correction mechanism which forces budgetary expenditure and revenue to be in equilibrium over the long term and not to cause large fiscal imbalances. The cointegration test is also applied to assess public debt and fiscal sustainability in developing countries. For example, Bui et al. (2015) perform an analysis of Vietnam’s fiscal and public debt sustainability. The findings demonstrate that no sustainability, as well as potential risk, is reflected by Vietnam public debt and fiscal policy.

The empirical studies show that most of the stationarity analyses in the past were performed for individual countries, resulting in the problem of short time series. Since for many countries available time series are insufficient for the study of many hypotheses of interest, unit root tests are often unable to reject the null hypothesis of no stationarity simply

because the actual mean-reverting behaviour is slow and takes several years to complete (Krajewski et al., 2016). Recent literature deals with the cross-sectional analysis of fiscal sustainability by applying panel data methods that have a number of advantages, as mentioned above. In recent years methods based on panel data are more commonly used to assess fiscal sustainability. Modern panel analyses of cointegration and stationarity have been implemented. For example, Afonso and Rault (2008) apply modern panel cointegration techniques to a structural long-run equation between general government expenditure and revenue. The paper concludes that fiscal policy was sustainable both for the EU15 panel set, and within sub-periods (1970-1991 and 1992-2006). Westerlund and Prohl (2010) use the panel cointegration test on government revenue and expenditure for eight rich OECD countries between 1997: I to 2005: IV. The results reported that the sustainability hypothesis cannot be rejected. Similarly, Campo-Robledo and Melo-Velandia (2011) evaluate the fiscal sustainability hypothesis for eight Latin American countries for the period 1960-2009, including Argentina, Chile, Colombia, Ecuador, Panama, Peru, Paraguay and Uruguay using second generation cointegration panel data models. The empirical evidence shows the weak sustainability of primary deficit for these Latin American countries. Afonso and Jalles (2012) revisit the issue of fiscal sustainability in 18 OECD countries over the period 1970-2010, employing the unit root and cointegration analysis, both country and panel based. They conclude that fiscal policy has been unsustainable for many countries in the sample. In order to assess fiscal sustainability for a selected group of ten Central and Eastern European (CEE) countries in two periods: an inclusive full sample period (1990-2012), and a pre-crisis sub-sample (1990-2008), Krajewski et al. (2016) use the panel stationarity test for public debt and the cointegration test between revenue and total expenditure, inclusive interest payments. They find that both panel stationarity tests and the presence of panel cointegration between revenues and expenditures support the notion of sustainability in CEE countries. However, the estimation results show sustainability only in a weak sense, which may pose a threat to public finances in the futures.

Very few studies on fiscal sustainability apply panel stationarity and cointegration tests for developing Asian countries. First, Lau and Baharumshah (2005) investigate the issue of fiscal sustainability by adopting families of panel unit root tests for a panel of 10 Asian countries including India, Indonesia, Korea, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand for the period 1970-2003. They find favorable evidence of mean-reverting behaviour for the cluster of Asian-10 countries by adopting the commonly used panel unit root technique; while using the series-specific unit root test, they found that

four out of ten countries (Korea, Malaysia, Singapore and Thailand) are stationary, suggesting little evidence of fiscal sustainability in these Asian countries. Then, Adedeji and Thornton (2010) exploit panel unit root and cointegration techniques and employed a dynamic ordinary least squares (DOLS) model to distinguish between 'strong' and 'weak' sustainability for five Asian countries–India, Pakistan, Philippines, Sri Lanka, Thailand–for the period 1974-2001. The results indicate that government revenue and expenditure in a panel of these economies were non-stationary and cointegrated series. However, the cointegration coefficient is significantly less than unity, indicating 'weak' fiscal sustainability and the likelihood that policy measures would be required to put public finances on a more sustainable basis. Syed et al. (2014) explore the issue of sustainability of fiscal policy for ten Asian countries. The pool of 10 countries is further divided into a pool of SAARC countries and a pool of IMT-GT countries[4]. The results of panel cointegration between government revenue and expenditure showed that fiscal policy is sustainable in the case of SAARC countries whereas it is not sustainable in IMT-GT countries. Sharstri et al. (2017) examine sustainability of public finances for five major South Asian economies namely, Bangladesh, India, Nepal, Pakistan, and Sri Lanka for the period 1985-2014. The empirical results demonstrate coherence with intertemporal budget constraint for these countries. However, in view of the weakly sustainable fiscal stance, the results also suggest that these countries, except for Bangladesh, need to reinforce commitments to long-term fiscal discipline.

Table 2 summarizes the conclusions of these papers. Overall, the analysis conducted in this paper is interesting in as much as it increases the empirical evidence focusing on the ASEAN countries. The approach adopted in this paper has not yet been implemented in previous studies in the case of the ASEAN countries.

[Insert Table 2 about here]

3. Empirical Analysis

3.1. Stylised Facts and Data Overview

The sustainability of fiscal policy is evaluated for a sample of eight ASEAN countries: Cambodia, Indonesia, Lao, Malaysia, Myanmar, Philippines, Thailand and Vietnam. The

[4] Although the SAARC includes eight countries, including, Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, but due to scarcity of the data, the authors had to exclude Afghanistan and Nepal. Therefore, henceforth the SAARC* represents all the countries in SAARC except Afghanistan and Nepal. Furthermore, the IMT-GT includes only three countries, that is Indonesia, Malaysia, and Thailand, but the authors added Singapore in this panel in order to increase the number of countries.

research uses annual data drawn from the International Monetary Fund's World Economic Outlook Database. The analysis conducted uses annual time series covering the period 1989-2017 for each of the variables. The countries are selected according to data availability. The variables of government debt, revenue and expenditure are measured in terms of their ratio to nominal GDP. Table 3 reports the list of countries, the corresponding period and summary statistics for these variables.

[Insert Table 3 about here]

The Asian financial crisis of 1997-1998 refers to a macroeconomic shock from capital outflows that subsequently contributed to currency crises experienced by most of the ASEAN countries, including Indonesia, Malaysia, Philippines, and Thailand. In the years after the crisis, overall budget balances measured as a proportion of GDP have deteriorated markedly in the ASEAN economies, turning pre-crisis fiscal surpluses to deficits that remain high by the standards of developed economies (Makin, 2005). All ASEAN countries have posted high and persistent deficits since 2000. Most notably, Malaysia's average budget deficit was 4.3 percent of GDP during 2000-2017, followed by Cambodia of 3.7 percent of GDP, and Lao of 3.5 percent of GDP (ADB, 2018). Government debt increased significantly because ASEAN governments actively deployed fiscal policy as a post-crisis, counter-cyclical measure to boost domestic demand in the context of a global economic slowdown. Accelerated domestic financial liberalization also facilitated issuance of public debt instruments in home markets over this time (Makin, 2005). The highest government debt-to-GDP ratios were recorded in Myanmar in 2001 with 216 percent, Lao in 2002 with 99 percent and Indonesia in 2000 with 87 percent. The average government revenue-to-GDP ratio of eight ASEAN countries was 18.5 percent meanwhile the average government expenditure-to-GDP was recorded at 20.7 percent.

3.2. Testing for individual stationarity

At a first step, the standard augmented Dickey-Fuller (ADF) tests including trend and no trend are used to preliminarily assess the stationarity of the time series of public debt. Using the classic method proposed by Hamilton and Flavin (1986), the time series were run for both levels and first differences. For public debt, both *I(0)* and *I(1),* the tests indicate fiscal sustainability. In the case of *I(1),* Quintos (1995) shows that it is a weak sustainability.

The early and pioneering work on testing for a unit root in time series was done by Dickey and Fuller (Dickey and Fuller 1979). The tests are based on the following set-up:

$$Y_t = \rho Y_{t-1} + u_t \quad (10)$$

where ρ is a parameter to be estimated and the u_t are assumed to be white noise. If $|\rho| \geq 1$, the series is non-stationary and the variance of Y increases with time and approaches infinity. Otherwise, the series is stationary if $|\rho| < 1$.

One of the most popular of these tests is the ADF test which is carried out by estimating Equation 10 after subtracting Y_{t-1} from both sides of the equation to then get the following form:

$$\Delta Y_t = \delta Y_{t-1} + u_t \quad (11)$$

in which $\delta = \rho - 1$. The null hypothesis H_0 is $\delta = 0$ or $\rho = 1$, meaning Y has a unit root or in other words, Y is non-stationary. In contrast, the alternative hypothesis H_1 is $\delta \neq 0$ or $\rho < 1$ which means that Y does not have a unit root or Y is stationary.

[Insert Table 4 about here]

Table 4 presents the results of the ADF tests for individual time series of debt. It can be seen that in most of the cases, government debts are non-stationary with trend and no trend, except Thailand and Malaysia, for which the ADF tests indicate strong sustainability for both cases of deterministic.

According to Hamilton and Flavin (1986), the stationarity of public debt is a sufficient, albeit not necessary, condition for fiscal sustainability. The absence of Ponzi game is still satisfied if debt is integrated of order one. For the further step, it is possible to test for the first differences of the government debt series. Both *I(0)* and *I(1)* of public debt present fiscal sustainability. In the latter case, Quintos (1995) denotes it as a weak sustainability[5]. Table 5 provides the results of individual ADF tests for first differences of government debt.

[Insert Table 5 about here]

[5] Bergman (2001) showed that sufficient condition for government solvency is that government debt is integrated of any finite order.

When it comes to testing government debt at the first difference level, the results are more varied compared to the previous case. There is some evidence for each country showing that the government debt time series are difference-stationary, which suggests fiscal sustainability in a weak sense.

Bohn (2005) provides a formal proof that fiscal policy is sustainable if the time series of public debt is integrated of any infinite order. It means that it is possible to test for public debt being *I(2)* or even *I(3)* and arrive at stationary cases after differencing the available time series a sufficient number of times. However, such an approach appears uncertain for the following two reasons. First, the number of observations may reduce after differencing the time series. In such short samples, as those under consideration, the tests are widely known to have low power, thus it is difficult to draw conclusions based on this method only. Furthermore, since the order of integration is not predetermined, such an approach distorts the final size of the test sequence (Krajewski et al., 2016).

In addition, Neaime (2004) suggests that the stationarity and cointegration-based tests of debt sustainability ideally should employ long time series (say 30–50 annual observations) on various macroeconomic variables. Consequently, instead of further differencing or using a cointegration test for the individual time series, it is better to apply panel-based methods to test for the presence of sustainability for the group of eight ASEAN countries.

3.3. Panel stationarity tests

The first step is to analyse the time series properties of the data to determine the persistence of the revenue, expenditure and public debt series. A number of panel unit root tests advocated by Levin, Lin and Chu (2002) (LLC), Im, Pesaran and Shin (2003) (IPS), Breitung (2000), Maddala and Wu (1999) (ADF Fisher) and Choi (2001) (PP Fisher) are used to test the stationarity of the government debt, revenue and expenditure. Basically, these tests are extensions of the traditional ADF test. In the case of panel data, the ADF test is based on estimating the following equation:

$$\Delta Y_{it} = \delta_i y_{it-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{it-j} + u_{it} \quad \text{(for i = 1, 2, …, N and t = 1, 2, …, T)} \qquad (12)$$

which is basically an extension of Equation 11 across individuals, denoted by subscript i. The LLC and Breitung tests both assume that there is a common unit root process. Under the assumption, the null of H_0: $\delta_i = \delta = 0$ for all i is tested against the alternative hypothesis, H_1: $\delta_i = \delta < 0$ for all i. Based on the null hypothesis, there is a unit root, while under the alternative, there is no unit root.

The IPS and the ADF Fisher and PP Fisher tests all allow the possibility of varying autoregressive processes across individuals, and therefore uses the group-mean of individual t-statistics in statistical inference. The IPS test examines the null of H_0: $\delta_1 = \delta_2 = \ldots = \delta_N = 0$ (each individual time series in the panel contains a unit root) against the alternative H_1: $\delta_i < 0$ for at least one i (at least one of the individual series in the panel is stationary). On the assumption that N cross-section units are independently distributed, the t-statistic can be computed as an average of the individual ADF t-statistics such that

$$\overline{t_{NT}} = \left(\sum_{i=1}^{N} t_{iT_i}(p_i)\right) / \mathrm{N} \qquad (13)$$

Where t_{iT} denotes the i^{th} individual t-statistic for testing $\delta_i = 0$ in each individual ADF regression. In a further step, the above t-bar statistic is standardized so that it converges to a standard normal distribution, as N increases. A key strength of this test is that δ_i is allowed to differ across countries and only a fraction of panel members is required to be stationary under the alternative hypothesis. The IPS test been widely implemented in empirical research due to its rather simple methodology and alternative hypothesis of heterogeneity. This test assumes cross-sectional independence among panel units (except for common time effects), but allows for heterogeneity in the form of individual deterministic effects (constant and/or linear time trend), and heterogeneous serial correlation structure of the error terms.

In the MWC test, the null and alternative hypotheses are as similar as those of the IPS test. If P_i is defined as the asymptotic p-value from any individual unit root test for cross-section i, then under the null of unit root for all N cross-sections, it may have the result that: $P = -2\sum_{i=1}^{N} log(P_i) \rightarrow \chi^2_{2N}$ or P has a χ^2 distribution with $2N$ degrees of freedom.

In addition, Choi (2001) demonstrates that $Z = \frac{1}{\sqrt{N}}\sum_{1=1}^{N} \Phi^{-1}(p_1) \rightarrow N(0,1)$ where Φ denotes the standard normal cumulative distribution function.

In this paper, the estimation procedures incorporate the non-stationary panel unit-root test proposed by Levin, Lin and Chu (2002), Im, Pesaran and Shin (2003), Breitung (2000), Fisher-type tests using ADF and PP tests (Maddala and Wu (1999) and Choi (2001)), conducted for both levels and first differences of government revenue, expenditure and debt. It is also conducted for without and with a time trend. The results from the unit root tests for panel data using a sample of eight ASEAN countries are detailed in Table 6.

[Insert Table 6 about here]

As shown in table 6, for the series of government debt at level, most of the tests, namely IPS, MW and Breitung tests, support the null hypothesis of unit root: i.e. the government debt is non-stationary and possesses a unit root at level. However, the null hypothesis is rejected on the basis of 5% and 1% levels of significance by the LLC and Choi tests respectively. In the case of small *N* and *T*, IPS (1997) suggested that *t*-bar test has better performance. They proposed a cross-sectionally demeaned version of both test to be used in the case where the errors in different regressions contain a common time-specific component. Thus, more evidence shows that government debt in the analysed sample is not an *I(0)* process.

In order to test for the presence of weak sustainability, the application of the same battery of tests to first differences of government debt is repeated. All the tests rejected the null hypothesis at all conventional levels of significance; or in other words, the debt series were difference-stationary, which indicates that fiscal policy in the ASEAN countries was weakly sustainable.

For the variables of government revenue and expenditure, the presence of unit root in these series strongly indicates that the variables are not stationary in levels. To test the order of integration, the panel unit root tests are then applied at first difference. Based on the further tests, the results confirm that the variables are difference-stationary. It can be concluded that the government revenue and expenditure-to-GDP ratios have been found to be integrated of order 1 or *I(1).* All the preceding results lead to examine whether government revenue and expenditure ratios are cointegrated in a panel perspective.

3.4. Panel cointegration test on government revenue and expenditure

Since cointegration tests typically require long samples, it is not feasible to draw conclusions based on individual tests. Instead, it is better to implement a battery of tests for the whole panel, consisting of our group of eight countries. Thus, the next step is to test for existence of a long-run cointegration between government revenue and expenditure in the panel using Pedroni (1999 and 2004) and Kao (1999), who propose a range of statistics that can be used to determine the presence of cointegration in heterogeneous panels. In each case, the *t*-statistics are constructed using the residuals from the following hypothesized cointegrating equation:

$$R_{it} = a_i + b_i GG_{it} + u_{it} \quad \textit{(for } i = 1, 2, \ldots, N \textit{ and } t = 1, 2, \ldots, T\textit{)} \tag{14}$$

Where *a* allows the cointegrating regression to include country-specific fixed effects, *b* is the long-run coefficient, and *u* is a residual term. Under the null hypothesis of no cointegration, the residual u_{it} will be *I(1).* The structure of estimated residual is as follows:

$$u_{it} = \lambda_i u_{it-1} + \mu_{it} \quad \text{or} \quad u_{it} = \lambda_i u_{it-1} + \sum_{j=1}^{p_i} \pi_{ij} \Delta u_{it-j} + v_{it} \qquad (15)$$

where λ_i is the autoregressive coefficient of the residual u_{it} from the Equation (15).

Pedroni (1999) panel cointegration test

Pedroni describes various methods of constructing statistics for testing the null hypothesis of no cointegration $(\lambda_i = 1)$. There are two alternative hypotheses, namely the homogenous alternative, H_1: $(\lambda_i = \lambda) < 1$ for all *i* (in the case of panel cointegration tests based on within-dimension statistics), and the heterogeneous alternative, H_1: $\lambda_i < 1$ for all *i* (in the case of group mean cointegration tests based on between-dimension statistics)

Based on various methods, Pedroni (1999) derives four panel cointegration statistics. The first category of four statistics is classified as panel cointegration statistics, which presume a common value for the unit root coefficient and are based on within-dimension statistics. It includes a variance ratio statistic, a non-parametric Phillips and Perron type ρ-statistic, a non-parametric Phillips and Perron type *t*-statistic, and a Dickey–Fuller type *t*-statistic. The second category of three panel cointegration statistics is defined as group mean panel cointegration statistics, which allow for differences in this parameter and are based on between-dimension statistics. The set includes, in this case, a Phillips and Perron type *ρ*-statistic, a Phillips and Perron type *t*-statistic and finally an Augmented Dickey-Fuller type *t*-statistic. All these statistics are distributed as asymptotically normal.

Kao (1999) panel cointegration test

Kao's residual panel cointegration test is based on the assumption that homogeneous slope coefficients exists across countries (Kao, 1999). Hence, the null hypothesis of no cointegration, H_0: $\rho = 1$, is tested against the alternative hypothesis of stationary residuals, H_1: $\rho < 1$. Kao presents four DF-type statistics. The first two DF statistics are based on assuming strict exogeneity of the regressors with respect to the errors in the equation, while the remaining two allow for endogeneity of the regressors. Kao also proposes an ADF test statistic. The asymptotic distributions of all tests converge to a standard normal distribution *N(0, 1)* and $T \rightarrow \infty$ and $N \rightarrow \infty$.

Table 7 contains the test results of panel cointegration employing Pedroni (1999, 2004) and Kao (1999) for the full period 1989 - 2017.

[Insert Table 7 about here]

First, for testing the cointegration between government revenue and expenditure when neither intercept nor trend was used as deterministic specification, the null hypothesis of no-cointegration was rejected by most of the statistics (10 out of 11 statistics) under the Pedroni test. For the other two cases, the null hypothesis of no cointegration is rejected by the panel *t*- and group *t*- statistics (both are non-parametric) at 5% significance level (except the case of individual intercept, the group PP-statistic rejects the null hypothesis at the 10% significance level). It was also accepted by the ρ-statistic. Pedroni (2004) carried out Monte Carlo simulations and concluded that in short samples (in this case, $T=29$ and $N=8$), panel *t*- and group *t*- statistics generally performed best. Thus, it is possible to conclude that the null hypothesis of no cointegration is rejected by using Pedroni's tests.

According to Gutierrez (2003), the author shows that Kao's test has higher power than Pedroni's tests when a small-*T* number of observations are included in the panel. Consequently, in order to assess the robustness of the findings, Kao's test is also implemented. The conclusion of Kao's test confirmed the existence of a long-run relationship between government revenue and expenditure ratios for the set of ASEAN eight countries at 1% level of significance.

3.5. Estimation of cointegrating relationship

Finally, as the null hypothesis of no cointegration between the series is rejected, the coefficient of the long-run relationship between government revenue and expenditure can be estimated. Quintos (1995) distinguishes between a strong and a weak definition of fiscal sustainability. Assuming that government revenue and expenditure are both *I(1),* strong coefficient *b* is unity. Weak solvency occurs when *b* is less than unity. In the context of revenue and expenditure ratios to GDP, Hakkio and Rush (1991) and Cipollini (2001) argue that only the strong condition is appropriate to assess fiscal sustainability as the weak condition may be satisfied but the government still could have difficulty financing a fiscal deficit if the expenditure-to-GDP ratio continuously exceeds the revenue-to-GDP ratio.

With a view to estimate the parameter *b* in the Equation 14[6], two different methods, the Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Squares (DOLS) are implemented. When the series are non-stationary, specific panel cointegration techniques should be used. In the case of homogeneous and near-homogeneous panels, the cointegration can be estimated by a fully modified (FM) estimator Phillips and Hansen (1990). This method is non-parametric as it employs kernel estimators of the nuisance parameters affecting the asymptotic distribution of the OLS estimator. It addresses the possible issue of endogeneity of the regressors as well as the autocorrelation of residuals. Alternatively, the DOLS procedure, proposed by Kao and Chiang (2000), Mark and Sul (1999, 2003) and Pedroni (2001), is parametric and has the advantage of computing convenience (Bodart et al., 2011). Based on Monte Carlo simulations, Kao and Chiang (2001) concluded that the DOLS outperforms both the OLS and the FMOLS estimators in finite samples in terms of unbiased estimation. The DOLS estimator also has an additional advantage in controlling the endogeneity in the model, as augmentation with the lead and lagged differences of the regressor suppress the endogenous feedback. Thus, the DOLS estimation method provides a robust correction of endogeneity in the explanatory variables. However, this paper applies both FMOLS and DOLS since the cointegrated regression model which was composed of series having a long-term relationship between each other showed deviating results when it was estimated by least squares method. The estimates of the long-run coefficient are reported in the Table 8.

[Insert Table 8 about here]

The results clearly suggest the existence of a long-run cointegrating relationship between government revenue and expenditure that is statistically significant. For all four versions of the estimations, the average of the estimated slopes is 0.889, meaning that, on average, a 1% change in government expenditure leads to a 0.889 % change in government revenue for the considered group of eight ASEAN countries. Note that all these cases point estimates of slope parameters are highly significant. The close values of long-run coefficients for all estimations confirm the robustness of the estimated results

[6] The DOLS procedure involves running the following regression: $R_{it} = a_i + b_i GG_{it} + \sum_{j=-q}^{q} c_{i,t} \Delta GG_{i,t+j} + \varepsilon_{it}$ where $t = 1, \ldots, T$ and $i = 1, \ldots, N$. Equation () includes the leads and lags of ΔGG_{it} in the cointegrating regressions to produce asymptotically unbiased estimators which typically chosen using some info criterion.

Further Wald tests on the model reject both the null hypothesis of $b = 0$ and $b = 1$ at the conventional significant levels. A 1% increase in government expenditure causes government revenue to increase by less than 1%, which implies that although sustainable fiscal positions are feasible, governments in the region spend more than they receive in revenue, suggesting that these governments must be cautious with their public finances. By extension, it also implies that if governments spend at a lower rate compared to their ability to raise revenues in the long-run, so that government revenue and expenditure are one-to-one, then the strong-form sustainability can be confirmed and there would be no cause for alarm about the future course of a fiscal deficit situation.

To sum up, in the case of the panel eight ASEAN countries, the empirical tests show that two non-stationary variables, government revenue and expenditure, are cointegrated and fiscal policy can be judged sustainable only in the weak form. This result appears broadly in accordance with the existing literature on emerging and developing countries.

4. Conclusion and policy implications

4.1. Conclusion

This paper has closely assessed the fiscal sustainability of public finance for eight ASEAN countries including Cambodia, Indonesia, Lao, Malaysia, Myanmar, Philippines, Thailand, and Vietnam by exploiting the data for the period 1989-2017. Starting from the present value borrowing constraint of governments, the study investigates past fiscal data to see if the government debt to GDP follows a stationary process and if there is cointegration between government revenue and government expenditure as a percentage of GDP.

The econometric methods employed in the paper include both time series and panel data techniques, namely (i) individual unit root tests of the government debt of each country; (ii) panel data unit root tests of the government debt and (iii) the panel data cointegration tests proposed by Pedroni (1999, 2004) and Kao (1999). Finally, the FMOLS and DOLS models are also applied to investigate the degree of fiscal sustainability.

Three methods have come to the same conclusion. First, the results from the individual unit root test point to the non-stationarity of the debt series (with the exceptions of Malaysia and Thailand) but stationarity of the first-difference debt for most countries suggesting that the solvency condition would be satisfied in the weak sense. Second, panel unit root tests show that fiscal debt series were difference-stationary, which suggests that fiscal policy in the ASEAN countries was not sustainable in a strong sense for the analysed period. On the basis

of panel cointegration tests, the estimation results show that government revenue and expenditure exhibit common movements in the long run. Nevertheless, the relationship between these variables is not one to one. This condition means that, although there is a long-run relationship, the cointegration coefficient is lower than unity, which means that the governments are spending more than they are collecting. Overall, the evidences provide broad support for a weakly sustainable fiscal policy in line with the recent literature.

The contribution of this paper is twofold. First, it has covered a larger number of emerging and developing countries in Southeast Asia than previous studies in contributing to the empirical literature on fiscal sustainability for ASEAN countries, a topic that has attracted the attention of researchers and economists. Second, from a methodology point of view, a more accurate evaluation of the degree of fiscal sustainability is achieved through the comparison of parameter estimates of the cointegrating vectors obtained from alternative econometric methodologies. The FMOLS and DOLS estimation techniques have been used, which are robust against asymptotic endogeneity and serial correlation. Using both grouped mean and pooled FMOLS and DOLS to estimate the fiscal sustainability of countries, the results reflect consideration about the problem of heterogeneous panel and fill some gaps in previous studies.

This study has several areas for improvement. First, relevant to the intertemporal government budget constraint, the tests of the hypothesis that the fiscal sustainability condition holds in a country is based on historical time-series data. These tests are not designed to link the observed underlying sources of macroeconomic uncertainty with the dynamics of public debt in order to provide short- and long-run, forward-looking measures of sustainable public debt ratios (Mendoza and Oviedo, 2004). Second, it is now well-established that examining time series for the presence of structural breaks is an important component of any empirical analysis. Indeed, the standard unit root tests have serious power distortions in the presence of structural breaks (Afonso, 2007). Consequently, further studies should be undertaken on the sustainability of fiscal policy with fiscal reforms comprising a structural break.

4.2. Policy implications

A number of important policy implications emerge from the empirical analysis. The first and foremost policy message is that weak fiscal sustainability in the aforementioned countries reflects government expenditures systematically higher than government revenues. This results in high and persistent fiscal deficits, and puts upward pressure on the stock of debt. If

fiscal policy were to be conducted in the future as it was in the past, there could still be some problems. In order to reduce the debt to more prudent levels or maintain the debt on a sustainable path, governments require a steady decline in fiscal deficits or primary budget surpluses. To this end, governments could either raise more revenues or moderate their expenditure concurrently. To achieve the first option, revenue reforms could be pursued via increasing tax rates, widening the tax base, and strengthening tax administration, as implemented in a number of countries. For example, Thailand has a range of reform options to gradually strengthen tax revenue, including an increase in the amount of tax revenue collected from the VAT[7]. In Lao, a number of measures to improve revenue collection and broaden the tax base should be implemented, including enforcing compliance of tax and duty exemptions and VAT deductibles, and focusing on large taxpayers and taxes on vehicles, petrol, and luxury goods (ADB, 2018). On the expenditure side, reform efforts should aim at moderating current expenditure, restructuring the spending structure, improving the effectiveness of public expenditure and its allocation. In the Vietnamese current context, with the high level of government expenditure to GDP and the rising proportion of recurrent expenditure[8], it is important to rationalize spending, adjust the diversification of public investments under the principle of fiscal sustainability to boost economic growth, support socioeconomic development, and provide a more effective mechanism for strict control over public expenditure.

The second policy message from the analysis is that ASEAN countries need to improve public debt management. According to the IMF (2018), average public debt in these countries is not projected to decline significantly in the upcoming years due to an increase in investment demands, unexpected rises in interest rates, or sharp currency depreciations, which may severely endanger public debt sustainability in the future. Among the ASEAN countries, the public debt to GDP ratios of Indonesia, Malaysia, and Thailand seem to have stabilized and appear more manageable; meanwhile a high and increasing public debt poses a key risk in Lao[9]. In order to curb the rising public debt, along with fiscal reforms, Lao authorities should strengthen the country's public debt management and establish more

[7] In Thailand, the existing VAT rate of 7 percent is relatively low in comparison with regional peers and other parts of the world.
[8] According to the World Bank (2017), from 2011-2015, Vietnam's total state budget expenditure – including capital outlays financed by off-budget bonds – averaged 29.2 percent. The proportion of recurrent to capital expenditure was 70:30, compared to 65:35 from 2006-10.
[9] According to the IMF (2018), the ratio of public debt to GPD of Lao PDR was projected to rise from 63.58 percent in 2017 to 68.19 percent in 2020 and 69.67 percent in 2023.

transparent loan cycles. Furthermore, growing exposure to rollover, exchange rate, and interest rate risks should be closely monitored in these countries.

Another important policy implication is that regional policymakers should continue to give high priority to improving or adopting fiscal rules. Fiscal rules specify numerical targets for key budgetary aggregates such as annual government deficits, debts or spending. The goal of fiscal rules is to improve fiscal discipline and reduce government deficits and debts. The use of fiscal rules is on average associated with improved fiscal performance (IMF, 2009)[10]. The database of fiscal rules constructed by the IMF (2017) shows that among emerging and developing ASEAN countries, only Indonesia and Malaysia adopt fiscal rules[11].

Last but not least, this paper examines fiscal sustainability using the explicit government debt, the flows of government revenue and expenditure; but it is important to note that the existence of contingent liabilities and fiscal burdens arising from population ageing[12] are likely to add to the vulnerability of the fiscal positions of these ASEAN countries. As a result, the need to rebuild fiscal space to deal with contingent liability shocks remains, given the worsening demographics in future.

[10] In fact, many countries have introduced fiscal rules. The European Union, by Treaty, established fiscal rules in the early 1990s, with the goal of ensuring that all members would maintain sustainable fiscal policies, which specified that countries should keep their government deficits at or below 3 percent of GDP, and that government debt should not exceed 60 percent of GDP. A number of other economies, in Europe and elsewhere, seemed to have found fiscal rules to be helpful in achieving greater budget disciplines. According to the IMF (2017), about 80 countries currently are subject to national or supranational fiscal rules.

[11] Following Schaechter et al. (2012), the database includes all rules with specific numerical targets fixed in legislation, as well as fiscal arrangements for which the targets can be revised but are binding for a minimum of three years. Thus, the medium-term budgetary frameworks or expenditure ceilings that provide multi-year projections are not considered as fiscal rules because they can be changed annually. There are four main types of fiscal rules, namely debt rules, budget balance rules, expenditure rules, or revenue rules according to the aggregate targeted. Debt rules set an explicit limit or target for public debt in percent of GDP. Budget balance rules set a limit on the overall balance (including or net of capital expenditures), the structural or cyclically-adjusted balance, and the balance 'over the cycle'. Expenditure rules set limits on total, primary, or current spending while revenue rules set ceilings on revenues.

[12] According to ASEAN and United Nations data, with the exception of the Philippines, the proportion of people over the age of 65 in ASEAN is expected to triple from 2015 to 2050 (ERIA, 2017).

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Table 1: Overall Budget Deficit and Government Debt in ASEAN Countries from 2000-2017

	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017
Overall Budget Deficit (as percentage of GDP)										
Cambodia	-2.1	-0.7	-8.8	-7.6	-6.8	-6.9	-3.8	-2.6	-2.7	-3.1
Indonesia	-1.1	-0.5	-0.7	-1.1	-1.8	-2.2	-2.1	-2.6	-2.5	-2.9
Lao	-4.6	-4.5	-2.2	-1.6	-1	-5.2	-3.2	-3.8	-4.4	-5.4
Malaysia	-5.5	-3.4	-5.3	-4.7	-4.3	-3.8	-3.4	-3.2	-3.1	-3.0
Myanmar	0.7	n/a	-4.6	-3.8	1.6	-1.4	-1.1	-4.3	-2.6	-5.7
Philippines	-3.7	-2.6	-3.5	-2.0	-2.3	-1.4	-0.6	-0.9	-2.4	-2.2
Thailand	-2.8	0.1	-2.9	-1.6	-2.2	-0.6	-1.8	-1.2	-0.7	n/a
Vietnam	-4.3	-1.0	-2.1	-0.5	-3.4	-5.0	-4.4	-4.3	-4.2	-3.5
Government Debt (as percentage of GDP)										
Cambodia	35.2	36.2	28.7	29.7	31.5	31.6	31.8	30.9	29.1	30.4
Indonesia	87.4	42.6	24.5	23.1	23.0	24.8	24.7	27.5	28.3	28.8
Lao	n/a	75.8	55.1	50.8	55.2	54.3	58.6	58.1	58.4	63.6
Malaysia	32.9	41.4	51.9	52.6	54.6	56.4	56.2	57.9	56.2	54.1
Myanmar	146.6	110.4	49.6	46.1	40.7	33.2	29.9	34.5	35.7	33.6
Philippines	61.1	67.4	49.7	47.5	47.9	45.7	42.1	41.5	39.0	39.9
Thailand	57.8	45.5	39.8	39.1	41.9	42.2	43.3	42.5	41.8	41.9
Vietnam	31.4	36.5	48.1	44.7	48.4	52.0	55.0	57.4	59.9	58.5

Sources: ADB and IMF, 2018

Table 2: Some Empirical Evidence regarding Fiscal Policy Sustainability

Author and date	Country - Period	Data Frequency	Methods	Sustainability
Time Series Study				
Hamilton and Flavin (1985)	U.S. (1962-1984)	Annual	Deficit and public debt stationary	Yes
Trehan and Walsh (1988, 1991)	U.S. (1890-1986 and 1960-1984)	Annual	Deficit and public debt stationary	Yes
Wilcox (1989)	U.S. (1960-1984)	Annual	Public debt stationary	No
Hakkio and Rush (1991)	U.S. (1950: II-1988: IV)	Quarterly	Cointegration	No
Corsetti and Roubini (1991)	18 OECD countries (1960-1989)	Annual	Public debt stationary	Yes for Germany, Japan, France, the United Kingdom and Canada. No for Italy, Belgium, Ireland, the Netherlands, and Greece, etc. Mixed evidence for the U.S.
Buiter and Patel (1992)	India (1971-1989)	Annual	Public debt stationary	No
Liu and Tanner (1995)	U.S. (1950-1989)	Annual		Yes (with breaks in 1982)
Quintos (1995)	U.S. (1947:2-1992:3)	Quarterly	Cointegration	Yes till 1980
Uctum and Wickens (1997)	U.S. and EU (1965-1994)	Annual	Government debt stationary	No for many countries
Payne (1997)	G-7 - 1949-1994	Annual	Cointegration	Yes only for Germany
Stoian (2008)	Romani (1991-2005)	Annual	Cointegration	Yes
Bui et al. (2015)	Vietnam (1990-2013 for debt and 1985-2013 for revenue and expenditure)	Annual	Public debt stationary and cointegration	No
Panel Data Studies				
Lau and Baharumshah (2005)	10 Asian countries (1970-2003)	Annual	Panel stationary	Yes when applying commonly used panel unit root techniques
Afonso and Rault (2008)	15 EU Countries (1970-2006 within sub-	Annual	Panel cointegration	Yes

	periods of 1970-1991 and 1992-2006)			
Westerlund and Prohl (2010)	08 OECD countries (1977Q1-2005Q4)	Quarterly	Panel cointegration	Yes
Adedeji and Thornton (2010)	5 Asia Countries (India, Pakistan, the Philippines, Sri Lanka and Thailand) 1974-2001	Annual	Panel cointegration	Yes (weak sustainability)
Campo-Robledo and Melo-Velandia (2011)	08 Latin American countries: Argentina, Chile, Colombia, Ecuador, Panama, Peru, Paraguay and Uruguay (1960-2009)	Annual.	Panel cointegration	Yes (weak sustainability)
Afonso and Jalles (2012)	18 OECD countries (1970-2010)	Annual	Both time series and panel stationary and cointegration	No for many countries
Syed et al. (2014)	10 Asian countries (1990-2010)	Annual	Panel cointegration	Yes for SAARC countries and No for IMT-GT countries
Krajewski, Mackiewicz and Szymańska (2016)	A selected group of ten Central and Eastern European countries (1990-2012)	Annual	Panel stationarity and cointegration	Yes (weak sustainability)
Sharstri, Giri and Mohapatra (2017)	05 major South Asian countries (1985-2014)	Annual	Panel cointegration	Yes (weak sustainability)

Source: Author's construction

Table 3: Country Coverage and Statistical Summary for Fiscal Variables, 1989-2017

(as percentage of GDP)

Country	No. of observations	Coverage	Mean	Std. dev.	Max	Min.
Government Debt						
Cambodia	22	1996 - 2017	33.03	4.46	43.10	26.99
Indonesia	18	2000 - 2017	39.04	19.25	87.44	22.96
Lao	17	2001 - 2017	66.87	16.74	99.16	50.81
Malaysia	28	1990 - 2017	47.11	11.23	75.18	30.04
Myanmar	20	1998 - 2017	86.88	55.94	216.04	29.91
Philippines	25	1993 - 2017	56.05	10.84	76.08	39.03
Thailand	22	1996 - 2017	43.49	9.19	57.83	15.19
Vietnam	18	2000 - 2017	44.37	9.19	59.94	31.43
Government Revenue						
Cambodia	22	1996 - 2017	13.98	4.46	21.38	8.05
Indonesia	25	1993 - 2017	15.63	1.93	19.45	12.47
Lao	18	2000 - 2017	16.51	3.46	21.41	11.51
Malaysia	28	1990 - 2017	24.48	2.98	31.11	19.61
Myanmar	21	1997 - 2017	13.75	4.62	21.97	8.50
Philippines	29	1989 - 2017	18.52	1.29	21.30	14.49
Thailand	23	1995 - 2017	20.25	1.37	22.31	17.46
Vietnam	20	1998 - 2017	23.79	2.22	27.26	19.63
Government Expenditure						
Cambodia	22	1996 - 2017	17.28	3.75	23.24	12.33
Indonesia	25	1993 - 2017	16.68	2.22	19.51	11.51
Lao	18	2000 - 2017	19.88	3.65	26.10	13.80
Malaysia	28	1990 - 2017	26.73	2.69	33.64	22.52
Myanmar	21	1997 - 2017	17.20	4.12	23.48	12.18
Philippines	29	1989 - 2017	19.58	1.29	21.75	16.18
Thailand	23	1995 - 2017	21.07	2.30	26.47	17.18
Vietnam	20	1998 - 2017	26.85	3.05	31.61	20.34

Source: IMF and ADB (2018)

Table 4: ADF Tests of Government Debt for Individual Countries

Sample: 1989-2017 **Total Number of Observations: 170**				
Deterministic	**Intercept**		**Intercept and Trend**	
	t-stat	**Prob.**	**t-stat**	**Prob.**
Cambodia	-2.070037	0.2575	-2.806384	0.211
Indonesia	-2.292388	0.1856	-2.370906	0.3757
Lao	-2.427962	0.1501	-0.069009	0.9901
Malaysia	-2.802939*	0.0711	-3.989171**	0.0216
Myanmar	-2.335193	0.1745	-1.019114	0.9136
Philippines	-0.965896	0.7476	-1.898383	0.6228
Thailand	-4.132302***	0.0047	-5.943868***	0.0005
Vietnam	0.754756	0.989	-2.569192	0.296

Note: MacKinnon values for rejection of hypothesis of a unit root at 1% level (***), 5% level (**) and 10% level (*).

Table 5: ADF Tests for First Differences of Government Debt for Individual Countries

Sample: 1989-2017 **Total number of observations: 170**				
Deterministic	**Intercept**		**Intercept and trend**	
	t-stat	**Prob.**	**t-stat**	**Prob.**
Cambodia	-3.107579*	0.0422	-3.023599	0.1504
Indonesia	-1.399198	0.5497	-4.273392**	0.0214
Lao	-0.900056	0.7565	-3.789246**	0.0476
Malaysia	-2.811682*	0.0704	-2.98946	0.1538
Myanmar	-4.466258***	0.0035	-5.173999***	0.0037
Philippines	-3.959587***	0.0063	-3.870347**	0.0307
Thailand	-5.812275***	0.0001	-5.007021***	0.0037
Vietnam	-4.399768***	0.0044	-4.533252***	0.0139

Note: MacKinnon values for rejection of hypothesis of a unit root at 1% level (***), 5% level (**) and 10% level (*).

Table 6: Panel Unit Root Test Result of the Fiscal Variables

Sample: 1989 – 2017						
	Level			**First Level Difference**		
	Public Debt	**Revenue**	**Expenditure**	**Public debt**	**Revenue**	**Expenditure**
Intercept						
LLC	-1.62952** (0.0516)	0.51035 (0.6951)	-0.93293 (0.1754)	-3.22932*** (0.0006)	-1.21695 (0.1118)	-4.88557*** (0.0000)
IPS	-0.67103 (0.2511)	0.32519 (0.6275)	-1.21735 (0.1117)	-4.37279*** (0.0000)	-3.91902*** (0.0000)	-5.99765*** (0.0000)
MW-ADF-Fisher Chi-square	20.0159 (0.2195)	12.3304 (0.7209)	22.3212 (0.1331)	50.8125*** (0.0000)	45.0221*** (0.0001)	66.3477*** (0.0000)
Choi-PP-Fisher Chi square	47.0222*** (0.0001)	21.3305 (0.1662)	32.7895*** (0.0079)	87.2074*** (0.0000)	121.538*** (0.0000)	164.287*** (0.0000)
Intercept and Trend						
LLC	-2.00334** (0.0226)	0.62742 (0.7348)	-0.47479 (0.3175)	-2.54335*** (0.0055)	1.26634 (0.8973)	-3.67637*** (0.0001)
IPS	-0.48801 (0.3128)	0.17227 (0.5684)	-0.20073 (0.4205)	-3.79641*** (0.0001)	-1.90820** (0.0282)	-4.50181*** (0.0000)
MW-ADF-Fisher Chi-square	18.1544 (0.3149)	13.3713 (0.6454)	15.2123 (0.5091)	42.3458*** (0.0004)	28.0336** (0.0313)	49.8148*** (0.0000)
Choi-PP-Fisher Chi square	46.5081*** (0.0001)	17.2856 (0.3674)	24.9326* (0.0710)	85.5765*** (0.0000)	97.7951*** (0.0000)	159.881*** (0.0000)
Breitung t -stat	1.17676 (0.8804)	-0.53740 (0.2955)	-0.65223 (0.2571)	-2.28164** (0.0113)	-2.88352*** (0.0020)	-4.25704*** (0.0000)

Note: *, **, *** indicates rejection of the null hypothesis of a unit root at 10%, 5% and 1%, levels of significance. The *p*-values are in c.

Table 7: Panel Cointegration Tests, 1989-2017

Pedroni (1999, 2004) Engle-Granger Based Cointegration Test			
	Panel Statistic		**Group Statistic**
	Statistic	**Weighted Statistic**	**Statistic**
Deterministic Specification: Individual Intercept			
V-statistic	0.631852 (0.2637)	0.672257 (0.2507)	
Rho-statistic	-1.473633* (0.0703)	-1.420397* (0.0777)	-0.345906 (0.3647)
PP-statistic	-2.034499** (0.0210)	-1.868591** (0.0308)	-1.526736* (0.0634)
ADF-statistic	-0.461455 (0.3222)	-0.296649 (0.3834)	0.123717 (0.5492)
Deterministic Specification: Constant & Trend			
V-statistic	0.003391 (0.4986)	-0.165520 (0.5657)	
Rho-statistic	-0.586272 (0.2788)	-0.768135 (0.2212)	0.390816 (0.6520)
PP-statistic	-2.110140** (0.0174)	-2.255461** (0.0121)	-1.990003** (0.0233)
ADF-statistic	-0.309480 (0.3785)	-0.582810 (0.2800)	-0.343685 (0.3655)
Deterministic Specification: No Constant & Trend			
V-statistic	1.604687* (0.0543)	1.004218 (0.1576)	
Rho-statistic	-3.778273*** (0.0001)	-4.283910*** (0.0000)	-1.510270* (0.0655)
PP-statistic	-3.483134*** (0.0002)	-3.796752*** (0.0001)	-3.451615*** (0.0003)
ADF-statistic	-2.642071*** (0.0041)	-3.211381*** (0.0007)	-2.301851** (0.0107)
Kao (1999) Residual Cointegration Test, Ho: No cointegration			
	t-Statistic		
ADF	-2.707225*** (0.0034)		

Note: ***, ** and * indicate 1%, 5% and 10% level of significance respectively. The *p*-values are in parentheses.

Table 8: Estimation of the cointegrating coefficient

Estimation Method	FMOLS		DOLS	
	Pooled	**Grouped**	**Pooled**	**Grouped**
Long-run coefficient	0.89716	0.883913	0.893314	0.88272
t-statistic	77.0236*** (0.0000)	95.73238*** (0.0000)	74.7861*** (0.0000)	86.20750*** (0.0000)
No. of observations	178	178	162	162
R-squared adjusted	0.780352	0.777873	0.845744	0.841067
b = 0	77.02360*** (0.0000)	95.73238*** (0.0000)	74.78610*** (0.0000)	86.20750*** (0.0000)
b = 1	-8.829104*** (0.0000)	-12.57282*** (0.0000)	-8.931473*** (0.0000)	-11.45376*** (0.0000)

Note: ***, ** and * indicate 1%, 5% and 10% level of significance respectively. The *p*-values are in parentheses. Pooled estimation performs FMOLS and DOLS on the pooled sample after removing the deterministic components from both the dependent variable and the regressors. Grouped mean estimation computes the cross-section average of the individual cross section FMOLS and DOLS estimates.

Annex: Data Sources

All data was taken from the International Monetary Fund's World Economic Outlook Database, updated on October 9th, 2018.

- General Government Gross Debt (percent of GDP)
- General Government Revenue (percent of GDP)
- General Government Expenditure (percent of GDP)