The sustainability of fiscal policy: A group-mean panel estimator approach

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Abstract: There has been a rising interest recently on studying sustainability of fiscal policy using panel data. Generally, these kinds of studies will in their last come up with a conclusion that a panel of countries have or haven't a sustainable fiscal policy. To come up with such kind of conclusion, most of those studies implicitly assume that there is a common cointegrated relationship in government revenue and expenditure between countries in their panel data. However there is not much argument could support that necessarily those countries shares a same long run relationship.

This paper employs recently developed techniques, group-mean panel estimator (include group-mean panel FMOLS and DOLS), for investigating the sustainability of fiscal policy in a panel of countries , but without assuming that there must be a common cointegrated relationship in government revenue and expenditure between countries in their panel data. To our knowledge, this is the first paper adopt a group-mean panel estimator to investigate whether countries have a sustainable fiscal policy.

1. Introduction

The concept of fiscal sustainability is closely related to the government's ability to maintain a same set of policies. Burnside (2003) has clearly explained that if a particular combination of fiscal policy would, if indefinitely maintained, lead to insolvency, then we should refer it as unsustainable.

Hamilton and Flavin (1986) may be the two first economists who introduce a systematic way to analyze the sustainability of fiscal policy. To do this, they propose a method to statically test whether a country satisfies its intertemporal budget constraint.[1] To analyze intertemporal budget constraint, Hamilton and Flavin (1986) suggested that if a country could satisfy its intertemporal budget constraint, the fiscal deficit should follow a stationary stochastic process.

Smith and Zin (1988) developed an alternative method to test whether the government's behavior is consistent with its intertemporal budget constraint. They

[1] According to explanation given by Abdullah, Mustafa & Dahalan(2012), the government's budget constraint in theory could be defined with both static and inter-temporal budget constraint. The static budget constraint is satisfied only if the government could to finance its current expenditure with its revenue and new borrowing, and meet or rollover its maturing liabilities. And the inter-temporal budget constraint is often formulated with respect to conditions for solvency, which requires that the present discounted value of future primary budget balances should at least be equal to the value of the outstanding stock of debt.

suggested that cointegration tests could be employed to exam such hypothesis. Wilcox (1989) extended the work of Hamilton and Flavin (1986). He suggested that appears of structure change for the interest payment on debt may make their analysis result misleading.

Hakkio and Rush (1991) work might be considered as the major foundation of pervious technique on study the question. They construct a three step approach to study the question. For a short summary and state more clearly, economists have constructed the idea that fiscal policy is said to be sustainable in economics if the present value of current and future tax revenues cover the present value of current and future government expenditure plus the initial government debt.

Recently, the interest on studying how to investigate whether countries satisfy their intertemporal budget constraint have shifted from mathematical model deriving to statistical method applying. Reason for this happened, may due to the rising interest on using panel data , for example Adedeji and Thornton(2010) using Asia countries' data, Afonso and Rault(2010) using Euro zone data, Westerlund and Prohl(2010) using OECD countries' data, and Ehrhart and Llorca(2008) using six South-Mediterranean countries' data.

The rising interest on using panel data to study the sustainability of fiscal policy may be due to two reasons. One of the reason may result from the rising recognize to the fact that countries' economy is interacted. Euro zone is one of the other areas that have most frequently been studied in the panel context. Antonio Afonso and Rault(2010) in their study give out the reason that although fiscal sustainability is always considered on a country basis and can usually only be restored by changing national fiscal policies, and although there is no single fiscal policy in the EU however in a common monetary policy view point, fiscal policy in the current institutional setting of EMU should be considered a largely national competence and responsibility. Therefore panel sustainability analysis of public finances is relevant in the context of EU countries. Take Asia Pacific countries as another example, countries within Asia Pacific are having more interaction both on labor and product market averagely compare to the interaction between an Asia Pacific and non-Asia Pacific country. Moreover, Asia Pacific countries are relatively less affected by the financial crisis started from 2008. Under the situation that both U.S and Euro have big terrible in their economy, Asia Pacific countries may become the "engine" of the global economy in the not so distant future. Therefore to study them as a whole may become fruitful.

Another important reason for using panel is relatively technical. Panel data is combination of time series and cross section data, by combining time series of cross-section of observations, most of time we could have a larger data set to study topic we couldn’t study before because of the lack of observation. Moreover by combining time series of cross-section of observations, we also gain the opportunity to eliminate disturbance to individual country getting a more accurate result.

However all these advantage we have mentioned is only a part of the picture. In fact, using a traditional Panel method on studying this topic may have varies problems because the panel we are going to analyze could be a Heterogeneous Panel. This paper try to fill the gap in pervious literature that using group mean panel estimators suggested by Pedroni (2001) rather than a pool estimator to estimate the fiscal policy sustainability. To use such an estimator, we accounted some problems a Heterogeneous panel may lead. We will discuss it more later when we try to discuss the panel method in other section. This paper also extends literature in another way by using a new data set that contains countries all over the word which is a data set not have been used in the past. This paper is designed as follow. Section 2 is the theoretical background of how countries could obey their intertemporal budget constraint, Section 3 the methodology of using panel data, Section 4 the empirical results and conclusion in section 5.

2. Theoretical background

According to Hakkio and Rush (1991), the government's one period budget constraint for a given period *t* is

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

where G_t is the primary government expenditure, $r_t$is the real interest rate, $(1 + r_t)B_{t-1}$ is the interest payment on the debt, $R_t$is the government revenue, and $B_t$is the fund raised by issuing new debt. This equation implies that the total expenditure of a government in period t is equal to its total revenue plus issued bond in period t. Equation (1) represents the government's temporal budget constraints in period t and according to Hakkio and Rush (1991) the government's temporal budget constraints should be hold in t + 1, t+2 and so on. Therefore we could solving the equation" forward" and combine to get the government's intertemporal budget constraint:

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

The crucial element in the intertemporal budget constraint is the second term from the right-hand. As discussed more extensively by Hamilton and Flavin(1986), Barro(1987), and McCallum(1984), the limiting value of $\prod_{s=1}^{k} \frac{B_{t+k}}{(1+r_{t+s})}$ must equal to zero in order to rule out the possibility of the government financing its deficit by issuing new debt. If the limit term does not equal to zero, the government is bubble-financing its expenditures, in which old debt that matures is financed by issuing new debt. In other worlds, government is holding a Ponzi scheme.[2]

Through equation (2) we could also see that if the term $\prod_{s=1}^{k} \frac{B_{t+k}}{(1+r_{t+s})}$ from the right-hand side of equation (2) is zero, the present value of the existing stock of public debt will be identical to the present value of future primary surpluses. In an empirical perspective, the equation might become more useful if we could make some more assumption in equation (1). By assuming that the real interest rate is stationary, with mean r, and add rB_{t-1} to both sides of equation (1) then equation (1) could become

$$G_t + (r_t - r)B_{t-1} + (1 + r)B_{t-1} = R_t + B_t \quad (3)$$

Define E_t as:

$$E_t = G_t + (r_t - r)B_{t-1}$$

Then solving equation (3) follow will leads us to:

$$B_{t-1} = \sum_{s=0}^{\infty} \frac{(R_{t+s} - E_{t+s})}{(1+r)^{s+1}} + \lim_{s\to\infty} \frac{B_{t+s}}{(1+r)^{s+1}} \quad (4)$$

As discussed more extensively by Hakkio and Rush (1991), the limiting value of $\frac{B_{t+s}}{(1+r)^{s+1}}$ must equal to zero. Afonso and Rault(2010)give a detailed explanation that if

[2] The “Ponzi scheme” is named after an Italian immigrant Charles Ponzi. In 1919, Charles Ponzi set up a shell company that has no business investment in USA. He give 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.

the limiting value of $\frac{B_{t+s}}{(1+r)^{s+1}}$ equal to zero, it implies that debt will grow no faster than the real interest rate. In other words, it implies that the government is not bubbling finance their debt. To achieve such of condition, the government will need to ensure the present of budget surpluses equal the current value of the public debt.

A usual practice in the literature is to investigate past fiscal data to see if government debt follows a stationary process or to establish if there is cointegration relationship between government revenues and government expenditures.[3]

For the present value budge constrain in equation (4), according to Afonso and Rault(2010) it will be possible to ascertain empirically the absence of Ponzi scheme by testing the stationarity of the first difference of the stock of public debt using unit root tests. It is also possible to assess fiscal policy sustainability through cointegration tests. The implicit hypothesis concerning the real interest rate, with mean r, is also stationarity. Using again the auxiliary variable $E_t = G_t + (r_t - r)B_{t-1}$, and the additional definition of $GG_t = G_t + r_t B_{t-1}$, where GG is the total government spending and is equal to the spending government spending on goods and serveries, transfer payments and interest on the debt , then the intertemporal budget constraint

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[3] Hamilton and Flavin (1986) first used these procedures. See also Trehan and Walsh (1991) and Hakkio and Rush (1991).

could be written as

$$GG_t = \sum_{s=0}^{\infty} \frac{(\Delta R_{t+s} - \Delta E_{t+s})}{(1+r)^{s-1}} + R_t + \lim_{s\to\infty} \frac{B_{t+s}}{(1+r)^{s+1}} \quad (5)$$

and with the no-Ponzi scheme condition, GG_t and R_t must be cointegrated variables of order one for their first differences to be stationary.

Assuming that *R* and *E* in levels are I (1), it implies that the series *R* and *E* are non-stationary variables, and the first differences of them are stationary variables. Then, to hold equation (5), the total government spending will also have to be stationary. If it is possible to conclude that *GG* and *R* are I (1), these two variables should be cointegrated with cointegration vector (1, -1) for the left-hand side of equation (5) to be stationary.

Letting $-\sum_{s=0}^{\infty} \frac{(\Delta R_{t+s} - \Delta E_{t+s})}{(1+r)^{s-1}} = a$, to test the fiscal sustainability than can be achieve by using the following cointegration regression:

$$R_t = a + \beta GG_t + u_t \quad (6)$$

With equation (6), Hakkio and Rush (1991) demonstrate that if *GG* and *R* are non-stationary variables in levels but stationary variable in their first difference, the condition $0 < \beta < 1$ is a sufficient condition for the budget constraint to be obeyed.[4]

[4] When government revenues and expenditures are expressed as a percentage of GDP (or in per capita terms), it is necessary to have $\beta=1$ in order to ensure the government debt to GDP ratio not to diverge in an infinite horizon.

Quintos(1995) have further expand clear that both the null that $\beta \geq 1$ and $\beta \leq 0$ are rejected is the condition of a strongly sustainable fiscal policy and the null that $\beta \geq 1$ is not rejected but $\beta \leq 0$ is rejected the country is say to be having a weakly sustainable fiscal policy.[5]

In our empirical analysis, we will assess the stationarity of government debt, the sufficient condition for fiscal sustainability, and the existence of cointegration between government revenues and expenditures which is a necessary condition for sustainable fiscal policy.

3. Methodology

3a. Group mean estimator

In previous section we have discuss the mathematical mode of testing fiscal policy sustainability, however if one try to make use of panel data in studying sustainability of fiscal policy, varies problems may appears because of its different nature to time series data. One of the serious problems, for all the best we known that have been always neglect, is the problem of heterogeneous panel. The problem of heterogeneous panel is resulted from pervious study's adoption of a pooled estimator.[6]By using a

[5] For detail see Quintos(1995)

pooled estimator they will in fact implicitly assume there is a homogenous relationship between the panel of countries they are studying.

Under the pooled estimator framework, the hypothesis to test a single restriction on slope β_i for all i cross-sectional unit, according to Pedroni (2001) will be $H_0: \beta_i = \beta_0$ against the alternative hypothesis $H_a: \beta_i = \beta_a \neq \beta_0$ implies that if the null is rejected, the slope for all i cross-sectional unit is not equal to the hypothesis value but equal to others value. However that will not necessarily be the real case, in fact quit the contrast, most of the time that may not appear to have a homogenous relationship between countries in a panel. Examples of mechanisms that could leads to such circumstances include differences in definition of government expenditure and revenue between countries, different measurement errors, different political cycle, and different political institution. In the panels' context, it is not hard to imagine that, if some kinds of these factors play a role in the data. There will be significant difference across countries within the panel data, and therefore there will be a high possibility for heterogeneous cointegrating relationships appearing.

Once there is possibility for heterogeneous cointegrating relationships, a more idea estimator, based on Pedroni (2001) argument, should be allow one to test the null hypothesis $H_0: \beta_i = \beta_0$ for all i against the alternative hypothesis $H_a: \beta_i \neq \beta_0$

because there is no reason to believe that, if the cointegrating slopes are not equal to some value, that they necessarily take on some other arbitrary common value. And a group mean estimator would allow us to do so.

In addition, Pedroni(2001)argues that the group mean estimators produce consistent estimates of the average slope under the alternative hypothesis that the slopes are different from one and vary across countries whereas the pooled estimator do not. Pedroni(1995)also suggested that other advantage of a group mean estimators is that the point estimates will have a more useful interpretation when the true cointegrating vectors are heterogeneous. Point estimates for the group mean estimator can be interpreted as the mean value for the cointegrating vectors. However it is not the case for the pooled estimators. Based on these arguments, the conclusion that a panel of countries has a sustainable fiscal policy if one only uses a pooled estimator may not be sufficient.

3b. Group Mean FMOLS and DOLS

In this paper, rather than the Group Mean ordinary least square(GMOLS), we adopt two group mean estimators namely the Group-Mean Fully Modified ordinary least square (Group-Mean FMOLS) and the Group-Mean Dynamics ordinary least square

(Group-Mean DOLS) estimator proposed by Pedroni (2001).[7]

The reasons are, according to Stock (1987), if there are cointegration relationship exists between non-stationary variables we could get a super consistent estimates if we apply the OLS method. The conclusion makes the estimation of cointegrating relationship become easy, therefore become wildly used in the field of empirical study. However, further studies show there are two major disadvantages. First, although OLS will prove super consistent estimate, based on Monte Caro experiment by Banerjee (1986), ignoring short term dynamics will cause a larger limit sample biases. Second, generally the distribution of the OLS estimates is not standard, could easily affected by noise and therefore leads to failure on standard testing procedure.

To avoid these two problems, we follow Phillips and Hansen (1991) suggestion that a non-parametric correction should be used in the OLS (the method they proposed is the method so called FMOLS). Based on Phillips and Hansen (1991), Pedroni (1996, 2000) suggestion, in our case, the Group Mean FMOLS estimator could be constructed as below. Firstly, let $\xi_{it} = (\hat{u}_{it}, \Delta\, GG_{it})'$ be a stationary vector consisting

[7] Fully Modified OLS estimator is one of estimators that been found more appropriate than OLS when try to estimate relationship between variables which are cointegrated, and other estimator that have been include in this field is the DOLS estimator. For more detail on FMOLS see Phillips and Hansen (1990).

of the estimated residuals from the cointegrating regression and the differences in total government expenditure, and let

$$\Omega_i \equiv \lim_{T\to\infty} E\left[T^{-1}\left(\sum_{t=1}^{T}\xi_{it}\right)\left(\sum_{t=1}^{T}\xi_{it}^{'}\right)\right]$$

be the long-run covariance for this vector process.[8] It allow us to decompose the long-run covariance matrix to

$$\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i^{'}$$

Where Ω_i^0 is the contemporaneous covariance and Γ_i is a weighted sum of autocovariances. Make use of the decomposed long-run covariance matrix Group-Mean FMOLS then given as

$$\hat{\beta}_{GFM} = \left(\sum_{t=1}^{T}(GG_{it} - \overline{GG}_i)\, R_{it}^{*} - T\hat{\gamma}_i\right) \times N^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(GG_{it} - \overline{GG}_i)^2\right)^{-1} \quad (7)$$

Where

$$R_{it}^{*} = (R_{it} - \bar{R}_i) - \frac{\widehat{\Omega}_{21i}}{\widehat{\Omega}_{22i}} \bigtriangleup GG_{it}$$

$$\hat{\gamma}_i \equiv \widehat{\Gamma}_{21i} + \widehat{\Omega}_{21i}^{0} - \frac{\widehat{\Omega}_{21i}}{\widehat{\Omega}_{22i}}\left(\widehat{\Gamma}_{22i} + \widehat{\Omega}_{22i}^{0}\right)$$

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8 This long-run covariance matrix is typically estimated using any one of a number of HAC estimators, such as the Newey-West estimator.

Since we could see that in equation (7) the component after the summation over *i* countries is identical to the pooled FMOLS estimator, we then can find out that the group mean FMOLS can be constructed simply as

$$\hat{\beta}_{GFM} = \mathrm{N}^{-1} \sum_{\mathrm{i}=1}^{\mathrm{N}} \hat{\beta}_{FM,i}$$

Where $\hat{\beta}_{FM,i}$ is the pooled FMOLS estimator, for country i in the panel. And the *t*-statistic for the Group Mean FMOLS estimator according to Pedroni(2001) will then can be constructed as

$$t_{\hat{\beta}_{GFM}} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{\beta}_{FM,i}}$$

where

$$t_{\hat{\beta}_{FM,i}} = \left(\hat{\beta}_{FM,i} - \beta_0\right) \left(\hat{\Omega}_{11i}^{-1} \sum_{t=1}^{T} (GG_{it} - \overline{GG}_i)^2\right)^{1/2}$$

Besides FMOLS, there are still different estimators could provide reliable result for the cointegration relationship exists between non-stationary variables. One of them is DOLS proposed by Stock, J, & Watson(1993). [9]

Following Pedroni(2001), a group-mean DOLS estimator then could be constructed as follows. Firstly, begin by adding lead and lagged differences of the regressor in order to control the endogenous feedback effect. According to Pedroni (2001), this

[9] For details of DOLS, see Stock, J, & Watson(1993).

procedure is similar to add nonparametric correction term for s_{it} in terms of $\Delta \mathrm{p}_{\mathrm{it}}$ in the FMOLS procedure. The DOLS regression in a panel setting then could be expressed as

$s_{it} = \alpha_i + \beta_i GG_{it} + \sum_{k=-K_i}^{K_i} \gamma_{ik} \vartriangle GG_{it-k} + \mu_{it}^*$ (8)

From this regression, Pedroni (2001) construct the group-mean panel DOLS estimator as

$$\hat{\beta}_{GD}^* = \left[N^{-1} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} z_{it} z_{it}^{'} \right)^{-1} \left(\sum_{t=1}^{T} Z_{it} \tilde{R}_{it} \right) \right]_1$$

where

z_{it} is the $2(K+1)\times 1$ vector of regressors $z_{it} = (GG_{it} - \overline{GG}_i, \vartriangle GG_{it-K}, \dots, \vartriangle GG_{it+K})$

$\tilde{R}_{it} = R_{it} - \bar{R}_i,$

The subscript 1 outside the brackets indicates that we are only using the first element of the vector to calculate the pooled slope coefficient

Since the component after the summation over the *i* is identical to the pooled DOLS estimator, it implies that the group mean estimator can be constructed simply as $\hat{\beta}_{GD}^* = N^{-1} \sum_{i=1}^{N} \hat{\beta}_{D,i}^*$, where $\hat{\beta}_{D,i}^*$ is the DOLS estimator, for country i in the panel. Using a similar procedure with Group mean FMOLS, if once let $\sigma_i^2 = \lim_{T\to\infty} E[T^{-1}(\sum_{t=1}^{T} \hat{\mu}_{it}^*)^2]$ be the long-run variance of the residuals from the DOLS regression (which can be estimated using standard HAC methods), then the corresponding *t*-statistic for the group mean DOLS estimator can be constructed as

$$t_{\hat{\beta}_{GD}} = N^{-1/2} \sum_{i=1}^{N} t_{\hat{\beta}_{D,i}}$$

where

$$t_{\hat{\beta}_{D,i}} = \left(\hat{\beta}_{D,i} - \beta_0\right)\left(\sigma_i^{-2} \sum_{t=1}^{T} (GG_{it} - \overline{GG}_i)^2\right)^{1/2}$$

4. Data and Results

Results are displayed in table 1-3.The Panel consists of annual observation from 1981 to 2011 of general government revenue and expenditure to GDP ratio in 28 countries all over the world from the IMF data base. One of our reasons for choosing these countries is fiscal policy between countries all over the world are become more and more interacted result by technology and strategy of diplomacy changing. Therefore it could be fruitful to investigate the overall fiscal policy sustainability around the world. We start from trying to use all countries data all over the world but restricted by the quantity of data since we only choose country that has around or larger than 30 observation each of our variables and finally comes up those 28 countries in our data set.

In table 1a and 1b, we have adopted different panel unit root tests because the reason that some of the test assumes common unit root process and the others assumes individual unit root process.

First, we used the test proposed by Im, Pesaran and Shin (2003,) for the reason that the test allows 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 panel data.

In order to have a more accuracy result, we also implement four other panel unit root tests. And among them, Fisher-type tests using ADF and PP tests (Maddala and Wu, 1999, hereafter MW; and Hadri, 2000), is assuming there are individual unit root process and the tests proposed by Levin, Lin and Chu (2002), is assuming there are common unit root process. Table 1 shows summaries of panel unit root tests for general government revenue-to-GDP ratios (Rev), general government expenditure-to-GDP ratio (Exp), the first difference of general government revenue-to-GDP ratios and the first difference of general government expenditure -to-GDP ratios.

Table 1 Panel Unit root test

	Levels		First differences	
	Rev	Exp	Rev	Exp
Levin, Lin & Chu t*	*-1.5359	-0.7913	**-16.527	-14.9708
Im, Pesaran and Shin W-stat	-1.2006	-1.0856	**-19.8029	-18.497
ADF - Fisher Chi-square	63.3602	**74.9383	**430.368	407.039
PP - Fisher Chi-square	*70.4204	**77.5797	**530.06	528.168

*,** indicate reject the null hypothesis in 10% and 5% significant level respectively. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Automatic selection of lags is based on AIC.

In table 1, the results clearly shows that the null hypothesis that general government revenue-to-GDP ratio contains a unit root is accept in 5 percent significant level, but the null hypothesis that the first difference of general government revenue-to-GDP ratio contains a unit root is rejected in 5 percent significant level in all 4 unit root test.

Repeat a similar procedure, Table 2a and b shows summaries of panel data unit root tests for general government expenditure-to-GDP ratios and the first difference of general government expenditure -to-GDP ratios. The table 1 also shows that the null hypothesis that general government expenditure-to-GDP ratio contains a unit root is accept in 5 percent significant level, but the null hypothesis that the first difference of general government expenditure -to-GDP ratio contains a unit root is rejected in 5 percent significant level in all 4 unit root test.

For the cointegration test in step 2, the Pedroni (1999, 2004) cointegration test following the Engle and Granger (1987) residual based method is employed to test whether general government revenue-to-GDP ratio and general government expenditure-to-GDP ratio is cointegrated.

Table 2 Pedroni's cointegration test

Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	1.7903	0.0367**	0.52997	0.2981
Panel rho-Statistic	-3.549767	0.0002**	-2.743946	0.003**
Panel PP-Statistic	-3.834084	0.0001**	-3.316071	0.0005**
Panel ADF-Statistic	-4.019087	0**	-4.295317	0**

Alternative hypothesis: individual AR coefs. (between-dimension)		
	Statistic	Prob.
Group rho-Statistic	-0.61393	0.2696
Group PP-Statistic	-2.213524	0.0134**
Group ADF-Statistic	-3.371099	0.0004**

*,** indicate reject the null hypothesis in 10% and 5% significant level respectively. Automatic selection of lags is based on MAIC.

In table 2, all cointegration tests with assumption that there has a common AR coefficient reject the null hypothesis that general government revenue-to-GDP ratio and general government expenditure-to-GDP ratio is not cointegrated in 5 percent significant level. And for cointegration tests with assumption that there have some individual AR coefficients, two out of three tests reject the null hypothesis that general government revenue-to-GDP ratio and general government expenditure-to-GDP ratio is not cointegrated in 5 percent significant level.

Last but not least, we give out the estimation and testing results of individual country, in table 3a and the panel results in table 3b.[10] Noticed that we have given two versions of panel results in table 3b, one is from the group mean method without time dummies and other is from the group mean method with time dummies since another panel data related issue is short run, cross-sectional dependency. And according to Pedroni(2001), common time dummies could capture certain forms of cross-sectional dependency therefore we also include it in our results.

[10] We use a modified rat program to compute the Group mean Panel estimator in our paper, which is originally programed base on Pedroni (2001).

Table 3a Fiscal Policy's sustainability test (individual countries)

Country	FMOLS	t-stat (β≤0)	t-stat (β≥1)	DOLS	t-stat (β≤0)	t-stat (β≥1)
Bangladesh	-0.03	-0.04	*-1.38	-1.85	-3.52	**-5.42
Bhutan	0.69	**4.91	**-2.18	1.35	**5.92	1.53
Bolivia	1.49	**3.34	1.10	1.48	**8.91	2.91
Botswana	0.10	0.19	*-1.62	-0.67	-0.86	**-2.13
Canada	0.22	**1.85	**-6.52	0.26	**8.74	**-24.79
China	1.08	**19.87	1.48	1.29	**13.14	2.92
Colombia	0.97	**12.43	-0.40	1.03	**37.84	0.94
Comoros	0.79	**7.53	**-1.96	1.00	**8.94	0.00
EG	0.28	**1.90	**-4.97	0.09	0.77	**-7.61
Ethiopia	0.81	**6.37	*-1.46	0.99	**7.19	-0.07
Finland	0.32	**4.24	**-8.92	0.38	**13.70	**-22.10
Ghana	0.67	**4.52	**-2.22	0.68	**3.06	*-1.44
Iceland	-0.61	-2.58	**-6.79	-0.89	*-1.34	**-2.85
Japan	-0.07	-0.76	**-12.28	-0.15	-3.48	**-27.49
Kenya	0.90	**2.85	-0.33	1.38	**4.43	1.22
Lesotho	0.87	**2.92	-0.44	0.89	**4.19	-0.53
Madagascar	0.15	0.54	**-3.06	-1.04	-1.55	**-3.04
Mongolia	0.66	**4.49	**-2.27	0.56	**3.16	**-2.45
Mozambique	0.72	**3.02	-1.18	0.42	0.90	-1.25
Norway	-0.54	-1.82	**-5.21	-1.08	-14.60	**-28.14
SK & N	0.60	**3.74	**-2.44	0.68	**6.42	**-2.99
SV & G	0.36	**1.81	**-3.29	0.14	0.24	*-1.48
Seychelles	0.59	**2.21	*-1.53	0.71	**3.49	*-1.41
Swaziland	0.81	**7.38	**-1.70	0.90	**6.31	-0.70
Sweden	0.59	**4.13	**-2.88	0.68	**21.54	**-10.09
Switzerland	0.73	**3.76	*-1.38	0.98	**7.56	-0.19
Taiwan	0.41	**2.74	**-3.94	0.40	**4.12	**-6.19
United Kingdom	0.33	**1.69	**-3.50	0.55	**8.71	**-7.01

*, ** indicate reject the null hypothesis in 10% and 5% significant level respectively.

Table 3b Fiscal Policy's sustainability test (panel results)

Panel Results	GMFMOLS	t-stat (β≤0)	t-stat (β≥1)	GMDOLS	t-stat (β≤0)	t-stat (β≥1)
Without Time Dummies	0.5	**19.73	**-14.91	0.33	**43.99	**-43.11
With Time Dummies	0.48	**19.61	**-16.46	0.44	**77.68	**-33.81

*, ** indicate reject the null hypothesis in 10% and 5% significant level respectively.

Displayed in table 3a, the results of FMOLS shows that 6 countries have a non-sustainable fiscal policy, 16 countries have a weakly sustainable fiscal policy and only 6 countries have a strongly sustainable fiscal policy in 10 percent significant level. The results from DOLS are similar, it shows that 8 countries have a non-sustainable fiscal policy, 10 countries have a weakly sustainable fiscal policy and only 10 countries have a strongly sustainable fiscal policy in 10 percent significant level. Overall, Group mean methods (either with or without time dummies) show on averagely the panel of countries has a weakly sustainable fiscal policy.

5. Conclusion

Due to the increasing interaction in sustainability of fiscal policies between countries, investigation on the overall fiscal policy sustainability around the world could be fruitful. In previous literature traditional panel method have been applied to study fiscal data with similar reason, however as we have discussed in our pervious section, heterogeneous panel could be an issues of estimation and should be consider when we are testing the hypothesis about sustainability of fiscal policy. Using Group mean FMOLS and DOLS to estimate the fiscal sustainability of countries, our results should be more well consider about the problem of heterogeneous panel and allows us fill the gap in previous studies.

The major results of this article can be summarized as follows. Using different Unit root and cointegration test with varies assumption, this paper provide evidence that different variables used in our estimation are nonstationary and cointegrated as suggested by the theory. Our estimation results shows on averagely countries in our data set have a weakly sustainable fiscal policy.

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