Tax revenue, expenditure, and economic growth: An analysis of long-run relationships

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ABSTRACT

Focusing on the investigation of "long-term" relationship between tax revenue, expenditure, and economic growth, this paper employs the Granger causality test and finds that the linkage between tax revenue and spending is a bi-directional causal correlation. Furthermore, applying Persyn and Westerlund's (2008) co-integration test allows for corroboration of existence of long-run cointegration linkages among outcome of economy and the three variables. In addition, by adopting two-step system generalized method of moments (SGMM) for a dynamic panel of 82 developed and developing countries during 16-year period (2000–2015), this research demonstrates that the impact of tax revenue and spending is substantial and ambiguous, depending on different groups of economies.

1. Introduction

It is widely known that any change in public policy can affect economic activities (Holley, 2011). During the last decades there have been numerous studies that investigated the linkage between public spending or tax revenue and economic growth. Dzhumashev (2014) revealed that relations among public finance, institutional quality, and economic growth are too ambiguous, which needs to be clarified.

Furthermore, despite Barro's (1990) argument that it is equal to public expenditure, tax revenue depends on public expenses. The question, therefore, is "how does tax revenue correlate closely with government expenditure?" In the past two decades, the results seem to be mixed and confusing.

In addition, through the statistics obtained of income per capita, tax revenue, and government expenditure, this research shows different trends of these variables by types of economic groups. While developed countries are likely to collect more taxes, spend less, and maintain the slow speed of growing outcome, developing countries keep spending more and collect less revenue for rapid growth in their economies (see appendix A). Moreover, a marked difference between developed and developing countries lies in the fact that developing countries constitute more than 60% of the world population, but they contribute less than 30% to global GDP (Spence, 2011).

This paper initially attempts to investigate the causal correlation between tax revenue and government spending. The second objective is to evaluate long-run economic growth affected by tax revenue and government expenditure (hereafter termed "public finance factors"). Finally, it is imperative to estimate the level effects of tax revenue and expenditure on economic growth depending on kinds of groups of economies to expand the literature on endogenous economic growth.

Besides the introduction, this paper is structured as follows. The second section discusses the theoretical background and briefly describes previous research findings in the same field. Section 3 presents the empirical dataset and findings, followed by Section 4, which concludes the study and also draws a few implications.

2. Theoretical bases, previous empirical research, and methodologies

Relationship between tax revenue and government spending

The interaction between tax revenue and government spending can be divided into three strands. First, there is a fiscal synchronization hypothesis that confirms the bidirectional causal link between the two variables (Musgrave, 1966; Meltzer & Richard, 1981; Bohn, 1991; Chang & Chiang, 2009). Second, the "spend-tax" hypothesis, which maintains that government expenditure can be a root cause of change in tax revenue (Friedman, 1978; Darrat, 1998; Blackley, 1986). The last strand is reflected through "tax-spend" hypothesis that takes into account the role of

tax revenue in enabling government to lead expenses (Mahdavi & Westerlund, 2008; Hansan et al., 2012). However, most studies examined panel data of high income countries or of merely one country and arrived at main conclusions to justify the three listed hypotheses. For supporting government planners, a question can be posed as to whether there exists a bidirectional causality linkage between tax revenue and expenditure for both developed and developing countries.

To investigate this relationship, this study applies the causality theory suggested by Granger (1969) and sets out to examine the bidirectional causal linkage between tax revenue and government spending in the context of developed and developing countries. The null hypothesis can be formulated as follows:

$$H_0: \beta_i^{(k)} = \beta^{(k)} \; \forall_{i=1,\ldots\ldots N}, \forall_{k=1,\ldots,p}$$

$$H_1: \beta_i^{(k)} \neq \beta_j^{(k)}, k \in \{1, \ldots., p\}, \exists (i,j) \in \{1, \ldots., N\}$$

The corresponding F test is:

$$Z = \frac{(SRR_k - SRR_1)/p(N-1)}{SRR_1/[NT - N(1+p) - p]}$$

The empirical research equation for Granger test is computed as:

$$taxrev_{i,t} = \beta_0 + \sum_{i=0}^{k} \beta_1 gexp_{i,t-1} + \sum_{i=1}^{p} \delta_1 taxrev_{i,t-1} + \varepsilon_i + \vartheta_{i,t} \quad (1)$$

$$gexp_{i,t} = \gamma_0 + \sum_{i=0}^{k} \gamma_1 taxrev_{i,t-1} + \sum_{i=1}^{p} \theta_1 gexp_{i,t-1} + \varepsilon_i + \vartheta_{i,t} \quad (2)$$

where $taxrev_{i,t}$ is the proportion of total tax revenue to gross domestic products (GDP) of country i (i=1,…N) at time t (t=1,…T), $gexp_{i,t}$ denotes the proportion of total government expenditure to GDP, k and p are latencies, ε_i stands for country-characteristic effects, and $\vartheta_{i,t}$ represents the observation error with $E(\vartheta_{i,t}) = 0$.

In addition, short-term tax changes can be different from long-run effects because of a great elasticity of demand curve (Holley, 2011). In the past decade there have been few studies performing a comprehensive analysis of this difference to help policy makers design the appropriate policies in public finance.

Since it helps avoid the bias given the case of regressions from nonstationary variables, multiple studies employed co-integration test to clear up the problem of spurious regression (e.g., McCoskey & Kao, 1999; Bai & Ng, 2004; Pedroni, 2004; Breitung & Pesaran, 2005; Westerlund & Edgerton, 2008; Persyn & Westerlund, 2008).

The following question, therefore, should be determined: "Do cointegration relationships exist among tax revenue, government spending, and long-run economic growth?"

In addition, the error-correction (EC) model is often applied to investigate the long-run relationship between stationary as well as cointegrated variables (Ojede & Yamarik, 2012).

Assuming that *i* represents a country and *t* is time period, the long-run relationship can be represented as below:

$$lrgdp_{i,t} = \alpha_{0,i} + \alpha'_{i,t}X_{i,t} + u_{i,t}, \quad (3)$$

where $lrgdp_{i,t}$ is logarithm of real GDP per capita (dependent variable), $\alpha_{0,i}$ is a country-specific intercept term, $\alpha'_{i,t}$ denotes country-characteristic slope coefficients, *X* indicates the vector of public finance and institutional quality, and $u_{i,t}$ is an error term of country *i* at time *t*.

In case a co-integration linkage exists between $lrgdp_{i,t}$ and *X* variables, and error term $u_{i,t}$ is an I(0) process for all countries *i*, we can re-write the growth equation in terms of an autoregressive distributed lag (ARDL) of order (p,q) as below:

$$lrgdp_{i,t} = \beta_{1,i}lrgdp_{i,t-1} + \beta_{2,i}lrgdp_{i,t-2} + \cdots + \beta_{p,s}lrgdp_{i,t-p} + \sigma'_{0,i}X_{i,t} + \sigma'_{1,i}X_{i,t-1} + \cdots + \sigma'_{q,i}X_{i,t-q} + \varepsilon_i + \vartheta_{i,t}, \quad (3a)$$

where *p* is number of lag of dependent variable, and q is number of lag of independent variables.

Then, we re-design the error-correction model as follows:

$$\Delta lrgdp_{i,t} = \sum_{j=1}^{p-1}\beta_{j,i}\Delta lrgdp_{i,t-j} + \sum_{j=0}^{q-1}\sigma'_{j,i}\,\Delta X_{i,t-j} + \mu_i\left[lrgdp_{i,t-1} - \theta_{0,i} - \theta'_{1,i}X_{i,t}\right] + \vartheta_{i,t} \quad (3b)$$

where $\beta_{j,i}$ and $\sigma_{j,t}$ are short-run coefficients, $\theta_{0,i}$ and $\theta_{1,i}$stand for long-run coefficients, and μ_i represents an adjustment-speed (error-correction term) to the long-run equilibrium.

Definition of public finance and its effect on economic growth

As documented by Barro (1990), Buchanan (1999), Wellisch (2004), Kaul and Conceição (2006), and McGee (2013), tax revenue and expenditure are two major components of public finance. Barro (1990) explained the mode of interaction between government expenditure and taxes with their effects on household spending and income. Moreover, from Barro's (1990) perspective, there might be a too simple social regime, where government collects taxes from income and property only. The limitation of this research is that it does not evaluate the relationship between total tax revenue and total public spending, which articulates the government capability.

In the last decades, two stances have emerged in evaluating growth effect of tax revenue and government expenditure. First, a number of researchers used the endogenous growth model to estimate the impact of tax revenue or expenditure in isolation. Second, they applied the causality or cointegration test to capture the linkage between economic growth and tax structure or share of expenditure.

A few previous investigations indicated that income tax, sale tax, or property tax has full meaning in reducing economic outcome in both developing and developed economies (Lee & Gordon, 2005; Ojede & Yamarik, 2012; Amir et al., 2013, Adkisson & Mohammed, 2014). In addition, Bujang et al. (2013) employed Kao's cointegration test for a panel dataset of 24 developing and 24 developed countries in a 10-year period and mentioned that tax structure and GDP in developing countries do not have the long-run cointegrating linkages, but only in

developed countries do these links exist. Furthermore, Easterly and Rebelo (1993) revealed that income tax increases economic growth, while custom tax reduces it.

Some earlier studies also showed the mixed growth effect of government spending and tax revenue. Barro (1991) performed an empirical study of 98 countries from 1960 to 1985 and noted that the relationship between public spending and economic growth is negative. Furthermore, Hitiris and Posnett (1992) analyzed the data of 20 OECD countries over a 28-year period, demonstrating that when government spends a certain amount on health care, this expense can promote income per capita. Applying OLS, fix effects, and pooled OLS techniques, Kneller et al. (1999) performed an analysis of the dataset of 22 developed countries between 1970 and 1995 and found that government spending positively affects income per capita, whilst taxation exerts a harmful effect on this variable. Cooray (2009) adopted the generalized method of moments to indicate that public spending and quality of governance positively affect economic growth. In addition, Dzhumashev (2014) argued that public expenditure depends on effectiveness of governance as well as level of corruption. How do tax revenue and expenditure afftect economic growth? Do their levels of effects differ considering different kinds of economic groups? The questions are to be tackled in the next sections of this study.

Methodologies

Before running co-integration test, this paper employs the unit root test following HT (1999) and IPS (2003). The Harris-Tzavalis (HT) (1999) test hypothesizes that all panels have the same autoregressive parameter and rho is smaller than 1. It also assumes that the periods of time are fixed, which is similar to the Levin-Lin-Chu test. However, the IPS test does not necessitate balanced data, but requires that T must be at least 5, if the dataset is strongly balanced for the asymptotic normal distribution of Z-t-tilde-bar to hold.

For co-integration test, this study follows Persyn and Westerlund's (2008) proposed technique, developed by Westerlund (2007). This allows for complete check of heterogeneous characteristics of long-run parts of error correction model. The null hypothesis is H_0: $a_i = 0$ for all i, (i= 1,…N) and H1: : $a_i < 0$ for all I, (i= 1,…N). This test uses the G_a and G_t test statistics for checking the null hypothesis for at least one *i*. These statistics start from a weighted average of the individually estimated a_i's and their t-ratio²s respectively. The test also requires that the null hypothesis (H_0) be rejected for accumulating evidence of co-integration of at least one of the cross-sectional units. The P_a and P_t test statistics pool information over all the cross-sectional units to test H_0: $a_i = 0$ for all i, (i= 1,…N) and H1: : $a_i < 0$ for all I, (i= 1,…N). Rejection of H_0 is thus substantial to validate existence of co-integration given the entire panel.

After identifying the co-integration linkages between dependent and independent variables, this paper adopts the two-step system generalized method of moments (SGMM) method for a dynamic panel of the whole sample as well as for

cluster data to determine the levels of effects of tax revenue and government expenditure on economic growth in both developed and developing countries. According to the numerous previous studies, this technique can help achieve more consistent endogenous growth model than fixed effects method (Arrellano & Bond, 1991; Baltagi, 2005; d'Agostino et al., 2012; Sasaki, 2015). Furthermore, endogenous variables always appear in growth models, which causes bias to OLS regression, and using exogenous instruments could help regressors fix this issue (Barro 1990; Acemoglu et al., 2001). Siddiqui and Ahmed (2013) indicated that generalized method of moments (GMM) is an instrumental technique, which handles the endogenous phenomenon as well as the matter of inefficiency in the presence of heteroskedasticity. Owing to the bias of the lagged dependent variable in the right-hand-side, the first-different GMM helps regressors elimilate the bias of fixed effects and unobserved error term effects (Arellanon & Bond, 1991; Roodman, 2009). In addition, Windmeijer (2005) revealed that the two-step GMM procedure obtains consistent and efficient parameters of estimation. This study, therefore, applies two-step SGMM to the dynamic panel data of 38 developed and 44 developing countries in a 16-year period.

In accordance with Barro (1990) and Barro and Sala-i-Martin (1992), the empirical model for estimating degrees of effects of tax revenue and government expenditure on economic growth are as below:

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 taxrev_{i,t} + \alpha_3 infl_{i,t} + \alpha_4 tradeop_{i,t} + \alpha_5 tinv_{i,t} + \alpha_6 topop_{i,t} + \alpha_7 hdi_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t} \quad (4a)$$

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 gexp_{i,t} + \alpha_3 infl_{i,t} + \alpha_4 tradeop_{i,t} + \alpha_5 tinv_{i,t} + \alpha_6 topop_{i,t} + \alpha_7 hdi_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t}, \quad (4b)$$

where, $infl_{i,t}$ is Inflation of country i (i=1,…N) at time t (t=1,…T), $tradeop_{i,t}$ stands for trade openness, $tinv_{i,t}$ represents total investment, $topop_{i,t}$ is total population, and $hdi_{i,t}$ is human development index, surveyed and measured by United Nations Development Program (UNDP).

3. Empirical data and findings

We extract the annual data for the whole sample, which includes 38 developed and 44 developing countries over a 16-year period (2000–2015) (see Appendix B—List of studied countries), and the strong balanced panel data is used for analysis (see Table 1—Description of variables).

Table 1

Description of variables (for the whole sample of 82 developed and developing countries)

Meaning and source	Variable	Obs.	Mean	Std. dev.	Min	Max
Real gross domestic per capita (US dollars) – world bank website (WB) (updated on August 10, 2016)	*rgdp*	1312	16,948.350	19,550.880	194.169	91,593.630
Total tax revenue (% of GDP) – International Monetary Fund (IMF) (updated in April 2016)	*taxrev*	1312	30.561	11.522	8.489	57.435
Total government expenditure (% of GDP) – (IMF) (updated in April 2016)	*gexp*	1312	32.731	11.519	10.529	65.572
Inflation(Consumer annual Price index) – (WB)	*infl*	1312	5.199	7.550	-8.238	168.620
Trade (% of GDP) – (WB)	*tradeop*	1312	82.488	57.468	4.692	439.657
Total domestic investment (% of GDP) – (IMF) (updated in April 2016)	*tinv*	1312	23.586	5.981	8.675	58.151
Total population (People) – (WB)	*topop*	1312	5E+07	1.4E+08	81,131	1.3E+09
Human development index (index) – United Nations development program (UNDP)	*hdi*	1312	0.727	0.150	0.283	0.949

Table 1 shows the big gap between developed and developing countries in real GDP per capita, tax revenue, and expenditure.

Table 2

Correlation matrix (for the whole sample of 82 developed and developing countries)

	lrgdp	taxrev	gexp	infl	tradeop	tinv	topop	hdi
lrgdp	1							
taxrev	0.745***	1						
	0.000							
gexp	0.695***	0.933***	1					
	0.000	0.000						
infl	-0.279***	-0.176***	-0.189***	1				
	0.000	0.000	0.000					
tradeop	0.137***	0.104***	0.059*	-0.017	1			
	0.000	0.000	0.034	0.536				
tinv	-0.036	-0.010	-0.068**	0.174***	0.164***	1		
	0.195	0.705	0.015	0.000	0.000			
topop	-0.155***	-0.193***	-0.136***	0.069**	-0.202***	0.155***	1	
	0.000	0.000	0.000	0.013	0.000	0.000		
hdi	0.862***	0.697***	0.679***	-0.189***	0.142***	0.050*	-0.133***	1
	0.000	0.000	0.000	0.000	0.000	0.068	0.000	

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Through Table 2, it can be observed that tax revenue and expenditure are significantly and strongly correlated with economic growth and that tax revenue and expenditure are closely correlated with each other.

Table 3a

Results of unit root test for a panel with normal data for the whole sample in 2000–2015

Normal	HT test			IPS test		
	rho Statistic	z	p-value	Statistic	p-value	AIC chosen lags average
rgdp	0.904	4.000	1.000	8.270	1.000	0.45
lrgdp	0.935	5.544	1.000	3.136	0.999	0.45
taxrev	0.4871***	-16.778	0.000	-3.679***	0.000	0.50
gexp	0.618***	-10.266	0.000	-4.008***	0.000	0.48
hdi	0.908	4.191	1.000	-0.458	0.324	0.51
infl	0.331***	-24.551	0.000	-12.643***	0.000	0.34
tradeop	0.794	-1.478	0.0697	-1.981**	0.023	0.65
tinv	0.715***	-5.414	0.000	-1.789**	0.0368	0.41
topop	0.989	8.267	1.000	7.724	1.000	1.50
ltopop	0.342***	-20.241	0.000	-3.557***	0.000	1.540

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

The table shows three variables that do not stay significant, including “real income per capita,” “human development indicator,” and “total population.” This finding is underpinned by Bujang et al. (2013), which demands identification of co-integration linkages between non-stationary variables and others.

This study continues by running the unit root test for first different values of variables, noting that all variables stay significant at first differences concerning both HT and IPS test. The variable “total population” is significant after taking the first difference of logarithm using IPS test.

Table 3b

Results of unit root test for a panel with data of first different values for the whole sample in 2000–2015

First difference	HT test			IPS test		
	rho Statistic	z	p-value	Statistic	p-value	AIC chosen lags average
Δ*.rgdp*	0.263***	-25.835	0.000	-12.688***	0.000	0.43
Δ*.lrgdp*	0.295***	-24.326	0.000	-12.517***	0.000	0.39
Δ*.taxrev*	-0.251***	-50.038	0.000	-22.404***	0.000	0.37
Δ*.gexp*	-0.093***	-42.598	0.000	-22.405***	0.000	0.32
Δ*.hdi*	0.194***	-29.074	0.000	-14.013***	0.000	0.23
Δ*.infl*	-0.071***	-41.564	0.000	-31.341***	0.000	0.76
Δ*.tradeop*	-0.114***	-43.586	0.000	-20.248***	0.000	0.38
Δ*.tinv*	-0.110***	-43.375	0.000	-21.673***	0.000	0.41
Δ*.topop*	0.591***	-10.413	0.000	2.045***	0.980	1.37
Δ*.ltopop*	0.366***	-20.993	0.000	-6.039***	0.000	1.28

Note: *p < 0.1, **p < 0.05, ***p < 0.01

Tables 3a and 3b show the evidence of stationarity for all variables; it means that a unit root is absent from the error term in the panel dataset.

Table 4

Pairwise Granger test results

H_0: Government expenditure does not Granger cause tax revenue (dependent variable: *taxrev*)	Obs.	z-Stat	Prob.
gexp → *taxrev*	1312	36.71***	0.000
H_0: Tax revenue does not Granger cause government expenditure (dependent variable: *gexp*)			
taxrev → *gexp*	1312	36.12***	0.000

Note: *p < 0.1, **p < 0.05, ***p < 0.01

Table 5

Westerlund long-run cointegration test: Dependent variable: *lrgdp (*Average AIC selected lag length: 1)

	taxrev - lrgdp			gexp - lrgdp			infl - lrgdp		
Statistic	Value	Z-value	P-value	Value	Z-value	P-value	Value	Z-value	P-value
Gt	-3.357***	-11.281	0.000	-2.610***	-2.863	0.002	-3.425***	-12.050	0.000
Ga	-20.018***	-11.055	0.000	-19.169***	-9.898	0.000	-20.294***	-11.430	0.000
Pt	-22.008***	-3.349	0.000	-16.047	3.594	1.000	-17.625	1.755	0.960
Pa	-14.012***	-7.668	0.000	-9.865*	-1.381	0.084	-12.605***	-5.536	0.000
AIC lead length:		0.55		0.63			0.63		
	tradeop - lrgdp			tinv - lrgdp			hdi - lrgdp		
Statistic	Value	Z-value	P-value	Value	Z-value	P-value	Value	Z-value	P-value
Gt	-2.801***	-5.020	0.000	-3.610***	-14.141	0.000	-3.968***	-18.175	0.000
Ga	-18.042***	-8.364	0.000	-19.987***	-11.012	0.000	-16.905***	-6.817	0.000
Pt	-19.057	0.087	0.535	-21.637***	-2.917	0.002	-24.096***	-5.782	0.000
Pa	-12.740***	-5.739	0.000	-16.441***	-11.351	0.000	-14.605***	-8.567	0.000
AIC lead length:		0.71		0.74			0.63		
	topop - lrgdp								
Statistic	Value	Z-value	P-value						
Gt	-4.912***	-11.281	0.000						
Ga	-13.336***	-11.055	0.000						
Pt	-24.764***	-3.349	0.000						
Pa	-10.743***	-7.668	0.000						
AIC lead length:		0.71							

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 4 indicates that there exists a bi-directional and causal relationship between tax revenue and government, which supports the fiscal synchronization hypothesis that is justified by a few previous studies such as Musgrave (1966), Meltzer and Richard (1981), Bohn (1991), and Chang and Chiang (2009). This result also suggests that policy makers in both developed and developing countries should focus on the important role of total tax revenue and expenditure for larger government budget as well as increasing economic outcomes to develop appropriate fiscal synchronization in these economies.

Before performing regression analysis of

the level effects of tax revenue, expenditure, and economic growth, this research employs co-integration test to avoid bias from non-stationary variables and answer the second research question: "Do co-integration relationships exist among tax revenue, government spending, and long-run econmic growth?"

Co-integration test results:

*H_0: In each pair of variables there exists no long-term co-integration linkage*The co-integration test results indicate that the linkages between tax revenue or expenditure and economic growth are co-integrated. Interestingly, this finding supports not only the line trend graphs discussed earlier (see Appendix A) but also the fiscal synchronization hypothesis confirmed by Chang and Chiang (2009) for the case of 15 OECD countries over the 1992–2006 period.

Furthermore, to overcome the limitation of previous studies that run causality or co-integration test for investigating the correlations among tax revenue, expenditure, and long-run economic growth, this research also seeks to determine the degrees of effects of these two variables on economic growth.

In light of the bias caused by the dynamic characteristic of strong balanced panel data of 82 countries in a 16-year period, this research applies the two-step system generalized method of moments (SGMM) to estimate the level effects of tax revenue and expenditure on economic growth (Baltagi, 2005.) Roodman (2009) noted that SGMM estimation typically includes more instruments, which therefore increases the efficiency of the regression. To apply the SGMM estimation we conduct the Hansen test of over-identifying restrictions to check the null hypothesis that the instrumental variables are exogenous. If the null hypothesis can be rejected, then the SGMM estimation can fix the problem of endogeneity, and the regression will provide results with small bias. In the case of "large N and small T," the Hansen test is appropriate to verify the endogenous phenomenon (Hansen, 1982; Baltagi, 2005). Using dynamic panel data always encounters autocorrelation problems. For this reason we employ Arellano–Bond test to identify the autocorrelation of different error terms; it involves E ($\Delta U_{it}, \Delta U_{it-2} = 0$) (Arellano & Bond, 1991). We also apply two types of unit root test to identify stationary variables before running SGMM for reducing bias from time series data in long-run period. Most variables stay significant at first lag or first differences given HT and IPS unit root tests (see Tables 3a and 3b).

Results two-step system generalized method of moment estimation:

Table 6a

Level effects of tax revenue and government expenditure (for the whole sample of 82 developed and developing countries)

(4a) Dependent variable: lrgdp				(4b) Dependent variable: lrgdp			
	Coef.	z	P>z		Coef.	z	P>z
lrgdp (L1).	0.993***	792.560	0.000	lrgdp (L1).	0.994***	1,059.920	0.000
taxrev	0.001***	8.830	0.000	gexp	-0.0002**	-2.46	0.014
infl	-0.001***	-26.660	0.000	infl	-0.001***	-41.95	0.000
tradeop	0.0003***	8.710	0.000	tradeop	0.0002***	10.130	0.000
tinv	0.004***	31.240	0.000	tinv	0.003***	41.630	0.000
topop	0.000***	4.620	0.000	topop	0.000***	3.670	0.000
hdi	-0.085***	-5.420	0.000	hdi	-0.024***	-2.99	0.003
Number of obs.			1066	Number of obs.			1066
Number of groups			82	Number of groups			82
Number of instruments			77	Number of instruments			80
AR(2)			0.155	AR(2)			0.222
Hansen test			0.194	Hansen test			0.274
Wald chi2(7)			2.E+07	Wald chi2(7)			5.28E+07
Prob > chi2			0.000	Prob > chi2			0.000

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 6b

Level effects of tax revenue and government expenditure (for 44 developing countries)

(4a) Dependent variable: lrgdp				(4b) Dependent variable: lrgdp			
	Coef.	z	P>z		Coef.	z	P>z
lrgdp (L1).	0.93***	873.64	0.000	lrgdp (L1).	1.023***	482.270	0.000
taxrev	0.85***	2.75	0.006	gexp	15.563***	17.270	0.000
infl	-0.76**	-2.06	0.040	infl	-0.239	-0.310	0.756
tradeop	-2.92***	-34.13	0.000	tradeop	-5.214***	-12.020	0.000

(4a) Dependent variable: lrgdp				(4b) Dependent variable: lrgdp			
	Coef.	z	P>z		Coef.	z	P>z
tinv	5.88***	23.30	0.000	tinv	1.258***	5.870	0.000
topop	0.000	0.05	0.962	topop	0.000***	-4.460	0.000
hdi	-24.30***	-64.49	0.000	hdi	-16.145***	-19.660	0.000
Number of obs.			616	Number of obs.			573
Number of groups			44	Number of groups			44
Number of instruments			38	Number of instruments			36
AR(2)			0.1975	AR(2)			0.2035
Hansen test			0.3753	Hansen test			0.231
Wald chi2(7)			4.51E+09	Wald chi2(7)			3.01E+08
Prob > chi2			0.000	Prob > chi2			0.000

Note: *p < 0.1, **p < 0.05, ***p < 0.01

Table 6c

Level effects of tax revenue and government expenditure (for developed countries only)

(4a) Dependent variable: lrgdp				(4b) Dependent variable: lrgdp			
	Coef.	z	P>z		Coef.	z	P>z
lrgdp (L1).	0.969***	162.570	0.000	lrgdp (L1).	0.562***	40.440	0.000
taxrev	0.001***	3.120	0.002	gexp	-0.004***	-12.960	0.000
infl	-0.005***	4.560	0.000	infl	-0.001***	-6.490	0.000
tradeop	0.000***	2.950	0.003	tradeop	0.001***	19.410	0.000
tinv	0.004***	10.030	0.000	tinv	0.004***	32.200	0.000
topop	0.000**	2.320	0.021	topop	0.000*	-1.870	0.061
hdi	0.248***	3.160	0.002	hdi	2.030***	20.450	0.000
Number of obs.			570	Number of obs.			503
Number of groups			38	Number of groups			38
Number of instruments			30	Number of instruments			36
AR(2)			0.81	AR(2)			0.51

(4a) Dependent variable: lrgdp

Coef.	z	P>z
Hansen test		0.32
Wald chi2(7)		2.60E+05
Prob > chi2		0.000

(4b) Dependent variable: lrgdp

Coef.	z	P>z
Hansen test		0.13
Wald chi2(7)		5.66E+04
Prob > chi2		0.000

Note: $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$

Tables 6a, 6b, and 6c show the impacts of total tax revenue (*taxrev)* and total investment (*tinv),* and most of those of total population *(topop)* on economic growth for the three models are positive and significant at 1% level. These findings advocate the studies of Alizadeh et al. (2015), who, by using the error correction model, indicated that tax revenue is crucial in increasing GDP per capita. Applying neo-classical model for 98 countries in a 26-year period, Barro (1991) argued that tax revenue promotes investment and indirectly boosts economic growth. However, inflation, as also suggested, reduces income per capita. Additionally, government expenditure is found to exert a negative effect on economic growth considering both the whole sample and the case of developing countries. These results enrich the literature of Samuelson (1954), Barro (1991), and Edwards (1998).

It is most noteworthy that human development indicator (*hdi*) and government expenditure (*gexp)* for the group of developed countries are different from those for the whole sample and the group of developing countries alone. Increases in these variables lead to improved GDP per capita.

Specifically, in developing countries, human development and trade openness (*tradeop)* are harmful to the wellbeing of these economies. Jenkins (2004) posited that in Vietnam the import value is attributable to a decline in the economic growth rate, while the export value contributes to increased economic growth. On the other hand, while Dumith et al. (2011) found that high human development index gives rise to the physical inactivity in both developed and developing countries, Atkinson (2016) confirmed this finding for developing countries only. Future reasearch shall be conducted for better understanding of the issue with human development index as well as trade openess.

4. Conclusion and limitations

This study applies the Granger pairwise causality test and confirms the synchronization hypothesis that a bi-directional causal relationship exists between tax revenue and expenditure. Second, by employing the Persyn and Westerlund's (2008) test, co-integration liankages are found between the variables tax revenue or expenditure and economic growth in both developed and developing countries. The two-step system generalized method of moments estimation reveals that tax revenue always positively affects economic growth. In constrast, government

expenditure impacts differently on economic growth depending on different kinds of economic groups. Furthermore, there is a big gap between developed and developing countries. For the group of 38 developed countries, substantial evidence is accumulated of more government tax collection yet less spending. Given the case of 44 developing countries, nevertheless, the results verify that governments spend more but impose less tax, which eventually results in more rapid growth. These findings are in support of both "fiscal synchronization" and "spend-tax" hypotheses. On that basis, suitable and effective fiscal policies can be subsequently formulated to promote healthy development of these economies during the coming years.

The first limitation of this research is that no analysis has been performed of the structure of tax revenue as well as components of government expenditure to further capture the role of these variables in an economy. Second, this study could not find out a plausible reason for profound effects of trade openness and human development index on economic growth for both the groups of developed and developing countries, which leaves another gap for future discussions to be held■

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Appendices

Appendix A: Line trend graphs

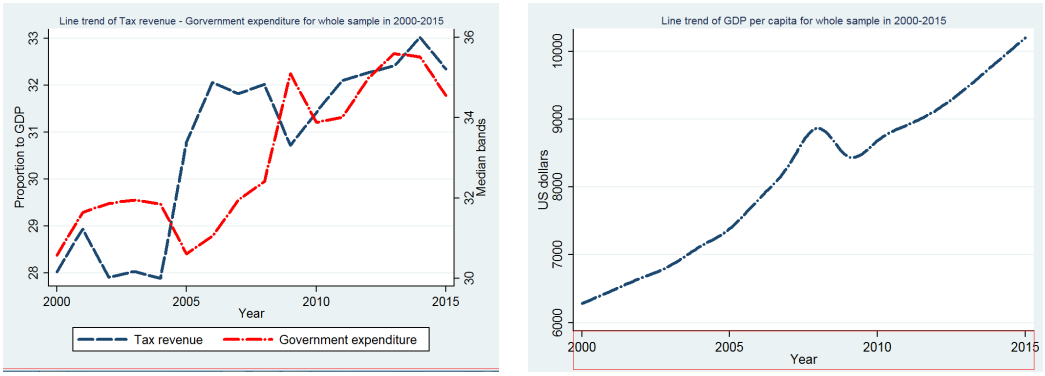

Figure 1. Line trends of tax revenue, government expenditure, and GDP per capita for the whole sample in 2000–2015

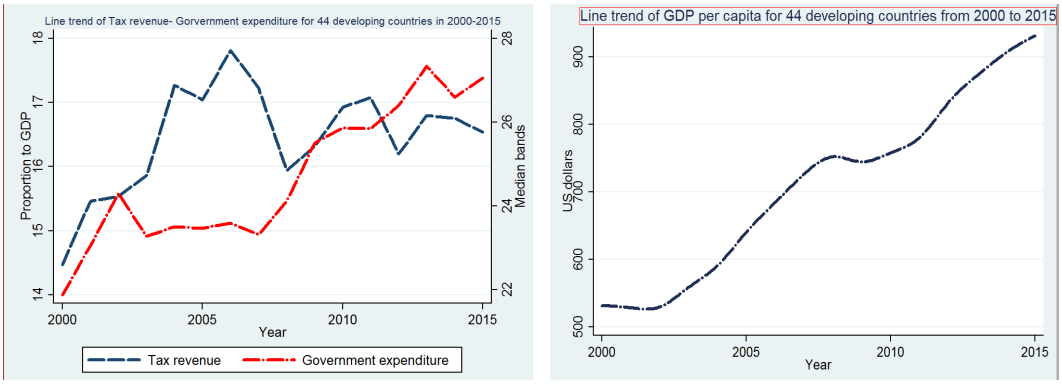

Figure 2. Line trends of tax revenue, government expenditure, and GDP per capita for 44 developing countries in 2000–2015

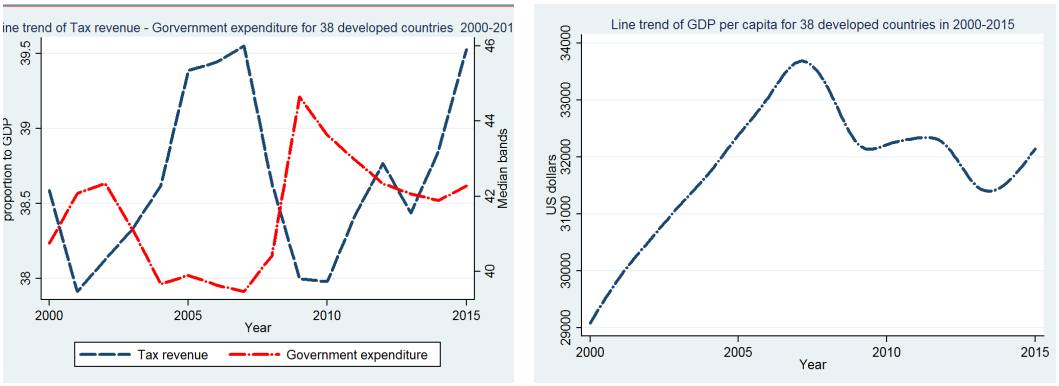

Figure 3. Line trends of tax revenue, government expenditure, GDP per capita for 38 developed countries in 2000–2015

Source: Authors' compilation using the data collected from IMF and WB

Appendix B

Table B

List of studied countries

Developed countries

Ord.	Country	Region(s)	Income group
1	Australia	East Asia and Pacific	High income
2	Austria	Europe and Central Asia	High income
3	Belgium	Europe and Central Asia	High income
4	Canada	North America	High income
5	Chile	Latin America and Caribbean	High income
6	Croatia	Europe and Central Asia	High income
7	Cyprus	Europe and Central Asia	High income
8	Czech Republic	Europe and Central Asia	High income
9	Denmark	Europe and Central Asia	High income
10	Estonia	Europe and Central Asia	High income

11	Finland	Europe and Central Asia	High income
12	France	Europe and Central Asia	High income
13	Germany	Europe and Central Asia	High income
14	Greece	Europe and Central Asia	High income
15	Hungary	Europe and Central Asia	High income
16	Ireland	Europe and Central Asia	High income
17	Italy	Europe and Central Asia	High income
18	Japan	East Asia and Pacific	High income
19	Korea	East Asia and Pacific	High income
20	Latvia	Europe and Central Asia	High income
21	Lithuania	Europe and Central Asia	High income
22	Malta	Middle East and North Africa	High income
23	Netherlands	Europe and Central Asia	High income
24	New Zealand	East Asia and Pacific	High income
25	Norway	Europe and Central Asia	High income
26	Poland	Europe and Central Asia	High income
27	Portugal	Europe and Central Asia	High income
28	Seychelles	Sub-Saharan Africa	High income
29	Singapore	East Asia and Pacific	High income
30	Slovak Republic	Europe and Central Asia	High income
31	Slovenia	Europe and Central Asia	High income
32	Spain	Europe and Central Asia	High income
33	Sweden	Europe and Central Asia	High income
34	Switzerland	Europe and Central Asia	High income
35	Trinidad and Tobago	Latin America and Caribbean	High income
36	United Kingdom	Europe and Central Asia	High income
37	United States	North America	High income
38	Uruguay	Latin America and Caribbean	High income
Developing countries			
1	Armenia	Europe and Central Asia	Lower middle income

2	Bangladesh	South Asia	Lower middle income
3	Belarus	Europe and Central Asia	Upper middle income
4	Belize	Latin America and Caribbean	Upper middle income
5	Benin	Sub-Saharan Africa	Low income
6	Bolivia	Latin America and Caribbean	Lower middle income
7	Brazil	Latin America and Caribbean	Upper middle income
8	Bulgaria	Europe and Central Asia	Upper middle income
9	Cambodia	East Asia and Pacific	Lower middle income
10	Colombia	Latin America and Caribbean	Upper middle income
11	Congo, Rep.	Sub-Saharan Africa	Lower middle income
12	Cote d'Ivoire	Sub-Saharan Africa	Lower middle income
13	Egypt	Middle East and North Africa	Lower middle income
14	El Salvador	Latin America and Caribbean	Lower middle income
15	Ethiopia	Sub-Saharan Africa	Low income
16	Georgia	Europe and Central Asia	Upper middle income
17	Ghana	Sub-Saharan Africa	Lower middle income
18	Guatemala	Latin America and Caribbean	Lower middle income
19	India	South Asia	Lower middle income
20	Indonesia	East Asia and Pacific	Lower middle income
21	Islamic Republic of Iran	Middle East and North Africa	Upper middle income
22	Jamaica	Latin America and Caribbean	Upper middle income
23	Kenya	Sub-Saharan Africa	Lower middle income
24	Kyrgyz Republic	Europe and Central Asia	Lower middle income
25	Madagascar	Sub-Saharan Africa	Low income
26	Malaysia	East Asia and Pacific	Upper middle income
27	Mali	Sub-Saharan Africa	Low income
28	Mauritius	Sub-Saharan Africa	Upper middle income
29	Moldova	Europe and Central Asia	Lower middle income
30	Mongolia	East Asia and Pacific	Lower middle income
31	Namibia	Sub-Saharan Africa	Upper middle income

32	Nepal	South Asia	Low income
33	Pakistan	South Asia	Lower middle income
34	Peru	Latin America and Caribbean	Upper middle income
35	Philippines	East Asia and Pacific	Lower middle income
36	Romania	Europe and Central Asia	Upper middle income
37	Russia	Europe and Central Asia	Upper middle income
38	South Africa	Sub-Saharan Africa	Upper middle income
39	Thailand	East Asia and Pacific	Upper middle income
40	Togo	Sub-Saharan Africa	Low income
41	Tunisia	Middle East and North Africa	Lower middle income
42	Uganda	Sub-Saharan Africa	Low income
43	Ukraine	Europe and Central Asia	Lower middle income
44	Vietnam	East Asia and Pacific	Lower middle income

Source: The World Bank