VNU Journal of Science: Economics and Business, Vol. 34, No. 5E (2018) 39-62

VNU Journal of Science: Economics and Business

Journal homepage: https://js.vnu.edu.vn/EAB

How Does Governance Modify the Relationship between Public Finance and Economic Growth: A Global Analysis

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Received 20 July 2018
Revised 04 December 2018; Accepted 26 December 2018

Abstract: Aiming to investigate the role of governance in modifying the relationship between public finance and economic growth, this study applied a seemingly unrelated regression model for the panel data of 38 developed and 44 developing countries from 1996 to 2016. It is easy to see that this research measures public finance by two parts of the subcomponents: total tax revenue and general government expenditure. We also call governance the "control of corruption indicator". The finding indicates that governance always positively affects the economy. However, when it interacts with public finance, this interaction has a diverse effect on economic growth in developed countries, depending on tax revenue or government expenditure. Nevertheless, in developing countries, this interaction has a beneficial impact on the growth of an economy.

Keywords: Governance, public finance, economic growth, developed and developing countries.

1. Introduction

Some authors have argued that total tax revenue and government expenditure are two major factors that steer both private and public activities, depending on governance and its quality. Until now, governance theories are open to nonstop arguments over the role of government in affecting economic growth, but debate over how governance modifies the relationship between economic growth and public finance is rare. Bird, Martinez-Vazquez, and Torgler (2008) considered tax revenue as a share of GDP and could represent the tax effort or tax capacity of a country [1]. They said that governance positively promotes tax revenue. Dzhumashev (2014) also showed that corruption forces government spending to be more effective [2]. He suggested that increasing levels of corruption may improve economic growth in less developed countries, but it should be detrimental in developed countries due to higher costs of private production. D'Agostino, Dunne, and Pieroni (2012) and Ugur (2014) indicated that corruption suggests weakness of institutional quality, and has a potentially harmful effect on economic growth [3, 4]. Moreover, d'Agostino, Dunne, and Pieroni, (2016) revealed that, although corruption does not directly affect the growth of economies, the interation among corruption, spending on investment and spending on protecting country through military forcesits interaction with spending on investment and military negatively affects economic growth

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https://doi.org/10.25073/2588-1108/vnueab.4165

[5]. In summary, only those countries that maintain a low corruption index achieve high tax revenue, spend less, and maintain the stable growth of their economy. In the last decades, most previous scholars who assessed the crucial role of corruption noted the "greasing or salting" of the wheels of an economy, depending on the different groups of countries. There is little literature that evaluates the way governance modifies public finance before its direct effects on economic activities. Furthermore, the relationship between anti-corruption and other macroeconomic variables is complicated. The role of corruption in an economy depends on government size, as well as the quality of governance, and needs to be clarified [2, 4]. Until now, the question: "How does governance in anti-corruption lead public finance and economic growth?" The answer to this question has become a challenge to economists all over the world.

Additionally, investigating the effects of governance and public finance on economic growth helps this study to indicate that public finance affects economic growth differently depending on government taxes or spending. Otherwise, the effect of the interaction between governance and public finance makes government expenditure become a beneficial factor for economic growth. These findings provide evidence supporting the theory of quality of government as well as public choice theory for both developed and developing countries. The research aims to evaluate the influences of governance on modifying the relationship between public finance and economic growth.

2. Literature review and analytical framework

In the last two decades, most authors have considered public finance as a tool that supports governments in determining the level of spending for providing public goods or services to society. Furthermore, public finance is a technique that can help governments make decisions regarding the level of taxes to charge its citizens for better provision of public goods in the future, as well as a means through which governments can control deficits. Two major components of public finance are tax revenue and government expenditure, as documented by Kaul and Conceição (2006), and McGee (2013) [6, 7]".

Hague and Martin (2004) confirmed that governance stands for the activities of making collective decisions [8]. Therefore, these authors argued that the government's decisions depend on the authority, who has the right to act, rather than the power to do. However, an authority creates its own power so long as people accept that the authority figure has the right to make decisions, so governance may have an important role in the process of governance. Additionally, Dzhumashev (2014) argued that corruption represents the quality of governance and influences an economy's private and public production through its impact on the effectiveness of government spending as well as the control of production costs [2]. In comparison, Ugur (2014) debated that corruption stands for institutional quality and has diverse effects on the income per capita of an economy [4].

Following Dzhumashev (2014) and Ugur (2014)s' argument, this study uses the control of corruption indicator (CCI) extracted from The World Bank's database to evaluate the quality of governance [2, 4]. However, this indicator represents the perception of private, elite governors and foreign investors about the public powers exercised by private firms only. That is also a reason to promote this study by applying another indicator, for example, the corruption perception index - CPI to confirm the reliable results of evaluating the effects of governance. According to Transparency International (TI), we know that this organization collects its CPI from two different types of source: business people's opinion surveys and, assessment scores of a country's performance provided by a group countries'

expert analysis. In addition, both indicators have the same meaning. In a country with a higher index, that area has obtained freedom from corruption. The CCI range is from -2.5 to 2.5. The corruption perception index range is from 1 to 100.

Economic growth plays a crucial role in society and determines the living conditions of people around the world. There is a great deal of literature on economic growth. First, classical economists posit that economic growth depends only on the population (labor force) and physical capital [9]. The simple Cobb-Douglas production function (Y=F(K,L)) was a popular function used in early research to examine economic growth [10].

Neo-classical scholars indicated that growth in economies is created by increasing output or changing GDP per worker [11]. They explained the differences in economic outcomes by applying external factors: human capital, physical capital, and transforming technologies. They designed an economic model, Y=AK^α L^(1-α), where Y is productivity, A denotes technology process, and K and L are physical capital and human capital, respectively."

The limitation of both the classical and neo-classical models, as most scholars have explained, is that in the long run, growth in GDP per capita is driven by exogenous technological change. These theorists did not consider the potential accumulation or dissipation of physical and human capital in the long run.

Mankiw, Romer, and Weil (1992) developed the growth equation following Solow's style [12]:

$$Log\ (Y_{i,t}) - Log\ (Y_{i,0}) = \beta Log(Y_{i,0}) + X_{\alpha} + Z_{\varphi} + \varepsilon_i$$

where $Log\ (Y_{i,t})$ stands for the logarithm of economic growth of country i at time t, X_α is a matrix vector of independent variables, Z_φ denotes the vectors of control variables and ε_i indicates the vector of the unobserved error term. Furthermore, Islam (1995) put the growth model in context of dynamic panel data and designed this above equation as seen below [13]:

$$Log(Y_{i,t}) = bLog(Y_{i,t-1}) + X_{\alpha} + Z_{\varphi} + \mu_i + \vartheta_t + \varepsilon_{i,t,}$$

$$b = (1 + \beta) \rightarrow \beta = (b - 1)$$

Barro and Sala-i-Martin (2004) supposed that a government finances its expenditure for public goods and services with lump-sum taxes and they designed a new production function to measure income as seen as below [14]:

$Y = ALK^{\alpha}G^{1-\alpha}$, where G stands for quantity of public goods

These authors also argued that the total tax revenue collected is τY so the growth account will be: $Y = R.K + \omega.L + \tau.Y$, where τ is the average of the tax rate between $\tau K + \tau L$.

Through this argument, we found that government expenditure tax revenue and give direct effects on both major input factors of the production function: physical capital and labor capital (K & L in above equation); it also has an indirect influence on technology (A) so this debate shows the complicated path of the indirect impact of taxes and expenditure on economic income and needs to be clarified. However, these authors considered the relationship between direct taxes, government expenditure, and economic growth only. In each society, we should examine the links between total tax revenue, general government expenditure and economic growth to support policymakers. In addition, a small group of authors computed the average or five-year average of the GDP per capita growth rate to evaluate the growth level of the economy (Devarajan, Swaroop and Heng-fu, 1996; Kneller, Bleaney and Gemmell, 1999) [15, 16]. In general, most researchers have evaluated economic growth using GDP per capita [5, 17]. This variable indicates the full meaning of capability of an economy, which considers the quantity of human resources. That is the reason why this research uses real GDP per capita to measure economic growth.

Governments play an important role in the organization of society and the law. However,

attaining a balance between income growth and spending always constitutes a big challenge for them. Therefore, the relationship between public finance and economic growth has received much attention in the recent literature. Early contributions to Wagner's proposition/Law emphasize that economic growth results in an expanding government size. Based on this proposition, many scholars have applied causality and co-integration tests to capture the linkage between economic growth and tax structure or share of expenditure only [18]. Another strand of literature has examined the relationships among the subcomponents of tax revenue or government expenditure according to spending objectives and economic growth by adopting the endogenous growth model [18, 5, 19]. Debates over public finance and growth may be still incompletely evaluated. Recently, many scholars and economists have looked for a way to connect public finance with governance quality in explaining the role of government in an economy [3, 4].

Regarding the role of governance quality, Stiglitz (2000) indicated that the government is concerned with all economic activities and devises and maintains a legal framework that covers all transactions within an economy [20]. Hillman (2004) reviewed the existing studies, and revealed that public finance is a tool that helps governments in low-income countries to increase economic growth and to reduce poverty [21]. This author proved that corruption in these countries makes governments ineffective in spending and collecting taxes.

Most previous research investigated the role of corruption or governance in the short-run or long-run relationship between each part of public finance using running regressions with a single regression. In addition, governance and public finance have a complicated link with economic growth. Furthermore, most researchers have used secondary and cross-countries' data. For less bias from cross-countries' data, we should apply the appropriate statistic technique. However, most previous studies have applied the single regression for estimation. To fill in this gap, this study applied seemingly unrelated regressions to determine the role of corruption in modifying the growth effect of total tax revenue and total expenditure. Zellner (1962) confirmed that for less bias by using macro data to estimate with single equation could be fixed with estimation of the parameters of a set of regression equation as seen as below [22]:

$Y_\mu = X_\mu \beta_\mu + U_\mu$, where Y_μ is a Tx1 vector of observation on $\mu' th$ "dependent" variables, X_μ is a Txl_μ matrix with rank of l_μ observation on $l_\mu' th$ "independent" variables, β_μ is a l_μx1 vector of re gression coefficient and U_μ is a Tx1 vector of random error terms, each with mean zero. This system may be written as seen below:

$$\begin{bmatrix} y_1 \\ y_2 \\ . \\ . \\ . \\ y_M \end{bmatrix} = \begin{bmatrix} X_1 & 0 \dots 0 \\ 0 & X_2 \dots 0 \\ . & . \quad . \\ . & . \quad . \\ . & . \quad . \\ 0 & 0 \dots X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ . \\ \beta_M \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ . \\ . \\ . \\ u_M \end{bmatrix}$$

Which can be re-written as below:

$$vec(Y) = \left(\bigoplus_{i=1}^{M} X_i \right) vec(\{\beta_i\} M) + vec(E),$$

where,

$Y = (y_1 \dots . y_M)$,
$E = (\epsilon_1 \dots \epsilon_M)$, $\bigoplus_{i=1,}^{M} X_i =$
$diag\ (X_1 \dots X_M), \{\beta_i\} M$

denotes a set of M vector and vector (X_i) is the vector operator that stacks the columns of a matrix or set vectors. The disturbances, vec (E) in (5) have zero mean and variance-covariance matrix $\sum \oplus IT$, i.e. vec (E) ~ $(0, \sum \oplus IT)$, where $\sum = [\sigma_{i,j}] \in$ RM x M is symmetric positive semidefinite matrix. For simplicity, the data matrix $\bigoplus_{i=1,}^{M} X_i$ is abbreviated to $\bigoplus_i X_i$ and the coefficients $\{\beta_i\} M$ to $\{\beta_i\}. T$. The best linear estimator (BLUE) of $\{\beta_i\}$ can be

obtained by solving the generalized linear least squares problems.

3. Research methods and data

3.1. Research methods

To answer the research question, this paper conducts a regression for the seemingly unrelated regression (SUR) model [22, 23]. This model also verifies the role of governance in modifying the effects between public finance and economic growth. The SUR model can ensure efficient computation with orthogonal regression and it can help this study to reduce bias from cross-countries' data extracted from two financial crises.

In this research, M stands for 3 equations, and μ'th dependent variables are 3 factors such as "tax revenue - *TAXgdp*", "government spending - *GEXgdp*" and "economic growth - *lrgdp*". The l_μ independent variables are "governance - *Gov*, inflation - *infl*, foreign direct investment inflow - *FDI*, and the human development index - *HDI*".

The empirical model and equation for performing the SUR model should be designed as seen below:

$$\begin{bmatrix} TAXgdp_1 \\ GEXgdp_2 \\ . \\ . \\ . \\ lrgdp_M \end{bmatrix} = \begin{bmatrix} Gov_1 & & 0 \dots 0 \\ 0 & inflation_2 & \dots 0 \\ & . \ . \ . & \\ & . \ . \ . & \\ & . \ . \ . & \\ 0 & 0 \dots & Hdi_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ . \\ . \\ . \\ \beta_M \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ . \\ . \\ . \\ u_M \end{bmatrix} \quad (1)$$

$$y_{i,jt} = X_{i,jt}\beta_{i,jt} + u_{i,jt} \quad (2)$$

Where $y_{i,jt}$ are dependent variables, which stand for economic growth *(lrgdp)*, tax revenue *(TAXgdp)*, and government expenditure *(GEXgdp)* of country i at time t, while $X_{i,jt}$ represent the independent variable "Governance - *Gov*" and other control variables such as inflation rate *(infl)*, the ratio of FDI's value per GDP, and HDI.

Conducting SUR and SGMM models helps this study to answer the research question and to fix the endogeneity issue. Blundell and Bond (1998) showed that when the series are closed to a random walk, the system GMM estimation is more robust [24]. In addition, the outcome of economies could be affected by dependent variables with first lag, that indicating the endogenous phenomena. Moreover, auto-correlation with an error term can exist. In each equation, ϵ_{it} can be re-written as below: $\epsilon_{it} = V_i + U_{it}$ and transformed lagged dependent variable that correlates with transformed error term $(U_{it} - \bar{U}_i)$, the $\Delta LRgdp_{it}$ also correlates error term $U_{i,t-1}$. So to solve the endogenous phenomena and auto-correlation, the study has to apply a two-step system generalized method of moments [25]. Baltagi (2005), D'Agostino, Dunne and Pieroni (2012), and Sasaki (2015) indicated that a dynamic panel data technique can help the endogenous growth model be more consistent than the fixed effect model [25, 3, 26]. Furthermore, Acemoglu and Robinson (2001) revealed that endogenous variables always appear in growth models that make OLS regression biased, and using an exogenous instrument could help regressors fix this issue [27]. In addition, Windmeijer (2005) noted that the two-step GMM procedure obtains consistent and efficient parameters of estimation [28].

In accordance with Barro and Sala-i-Martin (1992), the empirical model for estimating degrees of tax revenue and government expenditure on economic growth are expanded as seen below [29]:

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 FDI_{i,t} + \alpha_3 INFL_{i,t} + \alpha_4 HDI_{i,t} + \alpha_5 PUB_{i,t} + \alpha_6 GOV_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t} \quad (3.1)$$

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 FDI_{i,t} + \alpha_3 INFL_{i,t} + \alpha_4 HDI_{i,t} + \alpha_5 PUB_{i,t} + \alpha_6 GOV_{i,t} + \alpha_7 GOV\_PUB_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t} \quad (3.2)$$

Where, $FDI_{i,t}$ stands for foreign direct investment ratio with GDP per capita, $infl_{i,t}$ is the inflation rate of country *i* (i = 1,… N) at time *t* (t = 1,… T), $hdi_{i,t}$ is a human development index, surveyed and measured by the United Nations Development Program (UNDP), $GOV_{i,t}$ stands for governance evaluated by a control of corruption indicator or corruption perception index, $PUB_{i,t}$ represents the two sub variables: total tax revenue - *taxrev* and general government expenditure rate to GDP per capita - *Gexp*, and $GOV\_PUB_{i,t}$ denotes the interaction between governance and each part of the public finance factor.

As we may know, total tax revenue can indicate the total capability of a system of tax collection and general government expenditure denotes fully effective spending of a government, therefore these are the reasons for choosing tax revenue and government spending as public finance variables in our model. Few researchers have evaluated the role of public finance in a growth model. Furthermore, public finance affects production inputs and tax revenue has influences on the investment climate of countries so that we should investigate the link between total tax revenue, general government expenditure, and economic growth in the long run.

To achieve low bias from specification of the error term, this study adds control variables to the above models, including the foreign direct investment rate to GDP per capita representing the investment climate, inflation, and human development index. Nevertheless, to ensure the robustness of estimation, this study also conducts a non-linear correlation test with the null hypothesis of that being between the dependent variable and control variables is a non-linear relationship.

3.1. Research data

To get the second research objective, a "control of corruption" score obtained from Kaufman et al. (2011) measures the "governance" variable. This variable measures perceptions of corruption, conventionally defined as the exercise of public power for private gain. The scores are oriented so that higher values correspond to better outcomes, on a scale from -2.5 to 2.5. A higher index indicates lower corruption or lack of corruption and higher control of corruption. This study collected this data from The World Bank's database - World Governance Indicators (WGI). Since 2002, this examination has taken place annually; therefore, the data from 1997, 1999, and 2001 in this study were added up and divided to get the average [30]. This variable may support the tax system as well as public spending. For a robustness check, we continue to extract the CPI of business, which was evaluated by TI. From 1996 to 2011, they computed the maximum index to be ten, however, from 2012, the computation method of this CPI was changed and now the highest index is 100, which represents the area where corruption is free. Most developing countries lacked the index in 1996 and 1997. This study assumes that the beginning score of this index is the same score in 1998, so this research chooses the nearest index to fill in this missing value for these two years.

Furthermore, we extract the annual data for the whole sample, which includes 38 developed and 44 developing countries over a 21-year period (1996-2016) (See Appendix A1 - List of studied countries).

Due to the reason that instability of economies affects economic activities, we choose the inflation annual index for describing economic status. In this research, FDI's rate to GDP denotes the investment climate and we compute the logarithm of this variable for less bias. This study collects this data from The World Bank's database – WDI.

The human development index is a variable that indicates the quality of human capital in a society. We collect the HDI from the UNDP. The strong balanced panel data is used for analysis (see Table 1).

Table 1 shows the large differences in income per capita between developing and developed countries. The maximum of real GDP per capita can be bigger than the minimum by 490 times. The largest gap between the highest rate of tax revenue or expenditure and its lowest is 7 times. The highest indicator of control of corruption is 2.47, while the lowest is only -1.53. These facts suggest a reason to examine the relationships among these variables in both developed and developing countries.

Table 2 shows that public finance, corruption and economic growth are strongly and significantly correlated, and that tax revenue and expenditure are closely correlated with each other. Additionally, this table also shows that CCI and CPI correlated strongly, so we can use CPI for running robust check of CCI.

To avoid bias from spurious regression as well as co-integration test running, this paper employs the unit root test following Harris-Tzavalis' (HT) (1999) test and Im-Pesaran-Shin (IPS) (2003), which relaxes the assumption of a common rho and does not require a strong balanced panel [31-32]. While the Harris-Tzavalis' (HT) (1999) test hypothesizes that all panels have the same autoregressive parameter and rho is smaller than 1 [31]. It also assumes that the periods are fixed, which is similar to the Levin-Lin-Chu test [33]. 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 (see the results in Lien and Thanh, 2017) [34].

Table 1. Description of variables

Meaning	Variable	Obs	Mean	Std. Dev.	Min	Max
Gross domestic per capita (US. dollars)	rgdp	1721	16593.04	19304.80	186.66	91617.28
Inflow of foreign direct investment value (% of GDP)	FDI	1714	5.52	18.99	-43.46	451.72
Inflation (Consumer annual price index)	INFL	1721	6.85	28.08	-27.63	1058.37
Human development index (index)	HDI	1721	0.74	0.79	0.26	32.83
Total tax revenue (% of GDP)	TAXgdp	1721	30.31	11.65	8.05	57.41
Total government expenditure (% of GDP)	GEXgdp	1721	32.66	11.67	10.03	65.10
Control of corruption indicator	CCI	1721	0.29	1.06	-1.53	2.47
Corruption perception index	CPI	1721	48.26	22.40	10.00	100.00

Source: World bank's database - WDI and WGI, IMF's databsae - GFS , and UNDP's database - HDI.

Table 2. Correlation matrix

	rgdp	FDI	INFL	HDI	TAXgdp	GEXgdp	CCI	CPI
rgdp	1							
FDI	0.05**	1						
	0.03							
INFL	-0.12***	-0.01	1					
	0.00	0.59						
HDI	0.13***	0.01	-0.02	1				
	0.00	0.62	0.37					
TAXgdp	0.66***	0.08***	-0.02	0.14***	1			
	0.00	0.00	0.33	0.00				
GEXgdp	0.57***	0.07***	-0.03	0.13***	0.94***	1		
	0.00	0.00	0.20	0.00	0.00			
CCI	0.87***	0.09***	-0.12***	0.14***	0.65***	0.57***	1	
	0.00	0.00	0.00	0.00	0.00	0.00		
CPI	0.87***	0.07***	-0.12***	0.15***	0.63***	0.54***	0.97***	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Source: World Bank's database - WDI and WGI, IMF's database - GFS , and UNDP's database - HDI.

4. Empirical results

Before running an estimation, this study tries to divide the panel data into two groups: developed and developing countries following the classification of countries by the World Bank on July 1, 2017 [35]. This research also runs the VIF and non-linear regression test for less bias from cross-panel data. Acording to Weisberg (2005), p. 216 we learn that using "collinear predictors can lead to unacceptably variable estimated coefficients compared to problems with no collinearity" [36]. In a mean function:

$$E(Y|X_1 = x_1, X_2 = x_2) = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

suppose $r_{1,2}$ is the sample correlation between x_1 and x_2, and define the:

$SX_iX_j = \sum(x_{ij} - \overline{x_j})^2$ to be the sum of square for the jth term in the mean function. For j=1,2 we so that:

$$Var(\widehat{\beta_j}) = \frac{\sigma^2}{1 - r_{1,2}^2} \frac{1}{SX_iX_j}$$

The variances of $\widehat{\beta_1}$ and $\widehat{\beta_2}$ are minimized if $r_{1,2}^2 = 0$, while $r_{1,2}^2$ is near 1, these variances are greatly inflated, for example if $r_{1,2}^2 = 0.95$, the variance $\widehat{\beta_1}$ *is* 20 times as large as if $r_{1,2}^2 = 0$

VIF_j is called a variance inflation factor and it will be computed by:

$VIF_j = \frac{1}{1-R_j^2}$ (Marquardt, 1970) [37].

Assuming that X_j's could have been sampled to make $R_j^2 = 0$, while keeping SXiXj constant, the VIF represents the increase in variance due to correlation between the predictors and hence, collinearity. In case of that $R_j^2 = (0.95)^2$ VIF should be $1/(1\text{-}0.95^2)$ = 10.256. A rule of thumb is that if $VIF(\widehat{\beta_j})$ >10 then multicollinearity is high (see table in Appendixes A3 and A4).

Table 3. The results of verification of the influence of governance on economic growth in 44 developing countries

	(SUR)	**(SUR)**	**(SUR)**	**(SGMM)**	**(SGMM)**	**(SGMM)**
	lrgdp	lrgdp	lrgdp	lrgdp	lrgdp	lrgdp
FDI	0.064***	0.065***	0.064***	0.093**	0.272***	0.299***
	(3.37)	(3.38)	(3.37)	(2.76)	(9.29)	(10.55)
INFL	-0.0003*	-0.0004*	-0.0003*	-0.0003**	-0.0001*	-0.0002***
	(-0.67)	(-0.98)	(-0.71)	(-2.95)	(-2.48)	(-3.30)
HDI	5.921***	6.007***	5.991***	1.972***	3.145***	2.839***
	(33.36)	(34.36)	(34.64)	(4.66)	(11.02)	(7.71)
TAXgdp	0.030***	0.010**		0.058***	0.027***	
	(6.56)	(2.58)		(13.23)	(6.79)	
GEXgdp	-0.025***		0.013***	-0.014***		0.031***
	(-5.77)		(5.09)	(-4.13)		(6.24)
CCI	0.026***	0.318**	0.008***	0.082***	0.025***	0.021***
	(13.37)	(2.45)	(2.72)	(17.42)	(6.44)	(5.85)
CCI_TAX		0.009*			0.042***	
		(1.86)			(10.20)	
CCI_GEX			0.015***			0.042***
			(7.22)			(9.52)
_cons	2.603***	3.448***	3.016***	1.929***	2.409***	2.387***
	(15.87)	(18.05)	(17.13)	(6.12)	(8.27)	(8.78)
Obs.	893	893	893	851	851	851
N. of groups				44	44	44
N. of instruments				43	43	43
AR2 Test				0.342	0.829	0.977
Hansen test				0.430	0.704	0.557

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

Source: World Bank's database - WDI and WGI, IMF's database - GFS, and UNDP's database - HDI.

The role of governance in modifying the effect between public finance and economic growth in developed countries

Table 3 indicates that governance, and tax revenue, and the interaction between them positively affect economic growth, but government expenditure has a significantly negative effect on economic growth when it stays alone. However, the interaction between governance and government expenditure becomes a beneficial factor for growth. These findings support the "salting" role of corruption in the wheels of an economy [3, 4]. The result also supports d'Agostino, Dunne and Pieroni (2016), who confirmed the direct positive effect of control of corruption on economic growth [5]. Furthermore, we considered the endogenous variables in our SGMM model as "economic growth," because the lag of this variable can affect itself. We then used instrumental variables of "governance" to correct the endogeneity phenomenon [5]. Additionally, to gain effective results from the SUR model, we choose the option "corr" to test the correlation between dependent variables in the system regression and all the test results confirm that the dependent variables such as "economic growth", "tax revenue" and "government expenditure" are correlated. After running the SUR model, which is one of the most useful tools for fixing endogenous phenomenon, this study continues to conduct the correlation matrix of the residual of three dependent variables in three equations of the SUR model. These tests also help this research present the results of the SUR model for only

the main dependent variable "lrgdp" instead of triple dependent variables. This result confirms that the SUR model is an appropriate technique for fixing the variance change of the correlation matrix of residuals (see table in Appendix A2). Through Table 3, this study also confirms that the FDI's rate to GDP is a beneficial factor for growth, while the unstable situation of an economy could be harmful to increase economic outcome.

Table 4. The results of verification of the influence of governance on economic growth in 38 developed countries

	(SUR) *lrgdp*	(SUR) *lrgdp*	(SUR) *lrgdp*	(SGMM) *lrgdp*	(SGMM) *lrgdp*	(SGMM) *lrgdp*
FDI	0.033**	0.031**	0.035**	0.053***	0.060***	0.045***
	(2.32)	(2.17)	(2.41)	(6.26)	(9.24)	(5.38)
INFL	-0.008**	-0.007**	-0.005*	-0.001	-0.001	0.009***
	(-3.11)	(-3.010)	(-2.16)	(-0.55)	(-1.54)	(5.97)
HDI	6.840***	6.857***	6.865***	6.784***	6.974***	7.354***
	(26.39)	(26.50)	(25.04)	(36.41)	(28.34)	(28.22)
TAXgdp	0.011***	0.010***		0.011***	0.008	
	(4.22)	(4.25)		(4.58)	(1.94)	
GEXgdp	-0.001		0.004**	-0.001		0.002*
	(-0.64)		(2.19)	(-0.36)		(1.70)
CCI	0.273***	0.300***	0.007***	0.377***	0.430***	0.011***
	(16.14)	(5.19)	(3.94)	(16.21)	(4.54)	(6.43)
CCI_TAX		-0.001			-0.001	
		(-0.40)			(-0.51)	
CCI_GEX			0.003***			0.004***
			(3.66)			(4.10)
_cons	3.386***	3.353***	3.330***	3.038***	2.901***	2.508***
	(18.16)	(16.93)	(15.91)	(15.68)	(15.03)	(13.55)
Obs.	745	745	745	708	708	671
N. Groups				38	38	38
N. Instruments				37	37	38
AR.2 test				0.778	0.571	0.335
Hansen test				0.506	0.513	0.601

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

Source: World Bank database - WDI and WGI, IMF's database - GFS , and UNDP's database - HDI.

The role of governance in modifying the effect between public finance and economic growth in developed countries

Unlike developing countries, the interaction between governance and tax revenue in developed countries has a negative effect on economic growth without any significance. This finding suggests that policymakers in developed countries should focus on fiscal policy more than anti-corruption policy in taxation to maintain their growth. The other remaining variables have the same influence with developing countries. Tables 3 and 4 presented in this section prove that governance modifies the effects of public finance on economic growth differently according to different group countries. Unlike Imam and Jacobs (2007), this study verifies the role of governance in modifying the link between public finance and economic growth [38]. The findings denote the crucial role of governance in anti-corruption as well as in promoting the economy. Good governance with a high score of control of corruption indicator could increase

the efficiency of government expenditure and encourage the economy.

To ensure the robustness of the model, we continue using other data, which measures the CPI of businesses by Transparency International. The results were consistent with the results of the control of corruption indicator from The World Bank website (see Tables 5 and 6).

We used the CPI developed by Transparency International (TI). The maximum index is 100 and indicates that countries that receive the maximum index, are free of corruption. Tables 3 and 4 show the consistent results of the control of CCI compared to the CPI in Tables 5 and 6.

Table 5. Robustness check of the governance role in 44 developing countries

	(SUR) *lrgdp*	(SUR) *lrgdp*	(SUR) *lrgdp*	(SGMM) *lrgdp*	(SGMM) *lrgdp*	(SGMM) *lrgdp*
TAXgdp	0.031***	0.014***		0.070***	0.039***	0.046***
	(2.16)	(5.19)		(13.91)	(4.10)	(5.46)
GEXgdp	-0.027***		0.014***	-0.016***		
	(-6.11)		(5.28)	(-6.68)		
CPI	0.026***	0.010***	0.007**	0.078***	0.037***	0.046***
	(13.39)	(3.20)	(2.27)	(10.93)	(3.15)	(8.44)
CPI_TAX		0.015***			0.001**	
		(6.66)			(2.06)	
CPI_GEX			0.016***			0.001***
			(7.63)			(4.75)
Obs.	893	893	893	850	851	851
N. of groups				44	44	44
N. of instruments				43	42	43
AR2 Test				0.302	0.149	0.162
Hansen test				0.527	0.609	0.746

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

Source: World Bank's database - WDI and WGI, IMF's databade - GFS , and UNDP's database - HDI.

Table 6. Robustness check of the governance role in 38 developed countries

	(1) lrgdp	(2) lrgdp	(3) lrgdp	(4) lrgdp	(5) lrgdp	(6) lrgdp
TAXgdp	0.011***	0.014**		0.016***	0.020***	
	(4.13)	(2.77)		(4.69)	(2.81)	
GEXgdp	-0.001		0.004**	-0.004**		0.004**
	(-0.26)		(2.62)	(-2.59)		(2.25)
CPI	0.011***	0.013***	0.006***	0.028***	0.036***	0.009***
	(14.49)	(4.74)	(3.89)	(13.39)	(7.60)	(5.04)
CPI_TAX		-0.0001			-0.0002	
		(-0.73)			(-1.62)	
CPI_GEX			0.003***			0.003***
			(3.82)			(4.41)
Obs.	745	745	745	708	708	671
N. of groups				38	38	38
N. of instruments				38	38	38
AR2 Test				0.352	0.199	0.800
Hansen test				0.698	0.375	0.572

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

Source: World Bank's database - WDI and WGI, IMF's databaase - GFS , and UNDP's database - HDI.

Tables 5 and 6 provide a robustness check of the role of governance in modifying the relationship between public finance and economic growth.

Running SUR and SGMM models, this chapter confirms that governance has a positive role in economies. The findings support the "salting of wheels" effects of corruption in an economy. Additionally, the interaction between governance and public finance has a diverse effect on economic growth depending on different groups of countries and kinds of parts of public finance such as tax revenue or government expenditure.

Furthermore, the corruption perception of business data, which is evaluated by TI, was applied; this research provides evidence of a robustness check for the SUR and SGMM models. This result suggests that analysis of the governance effect through seemingly unrelated regression should provide robust results.

4. Conclusion and implication

To investigate the role of governance in modifying the effects of public finance on economic growth, this study conducts both SUR and SGMM models for the strong balanced panel data of 38 developed and 44 developing countries. The findings confirm that governance has both direct and indirect positive effects on economic growth in developed and developing countries. First, this factor is a beneficial factor for the growth of an economy. The result suggests that government in both developed and developing countries should try to improve their governance in anti-corruption for developing their economies. Second, the interaction between this factor and any subcomponent of the public finance could diversely affect the economy. For instance, in developing countries, the interaction between governance and government expenditure supports the government spending effectively. This finding confirms that governments in developing countries should be concerned with anti-corruption policy and fiscal policy to promote their economies. On the other hand, in developed countries, the interaction between governance and tax revenue does not support the government in promoting an economy so the government in these countries should focus their anti-corruption strategies on government spending more to gain the highest efficiency.

Verifying the robustness of the CCI using the CPI that is measured by TI, this research confirms that anti-corruption always plays an important role in increasing the economy in both developed and developing countries. Additionally, to grow their economies, governance in anti-corruption in developing countries has more power than in developed ones.

These findings suggest that policymakers in both developed and developing countries should pay more attention in setting up an appropriate system of corruption control to increase their economies. Furthermore, governments in developed countries need to pay more attention to increase the effectiveness of public spending by using anti-corruption techniques. In contrast, governments in developing countries should focus on increasing the use of a CCI to collect more taxes as well as to spend tax revenue effectively. The research results also support the literature of quality governance to prove the important role of the government to control corruption worldwide.

The confirmation of the "salting" wheels of corruption in both developed and developing economies recommends that the governments worldwide should focus on increasing systems of anti-corruption for raising their economies. Furthermore, the interaction between governance and public finance has a diverse effect on the economy depending on different groups of countries. The findings suggest that developing governments should think about the appropriate tools to set up strong systems to combat corruption. On the other hand, to promote their economies, governments in developed countries should be concerned with the effectiveness of government expenditure using control of corruption techniques.

The limitation is that this study does not investigate the influences of interaction between governance and public finance on economic growth with a cluster of a smaller group of countries. This cluster could help developing governments such as that of Vietnam or other South East Asian countries to handle deficits as well as to grow their economies. Future research should try to bridge this gap.

Furthermore, the compliance of a tax burden could be a major issue in collecting tax revenue; therefore, we may explore its influences in future research to explain how the compliance of tax burden affects tax revenue for increasing the economy.

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Appendicies

Table Appendix A1

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.

Table Appendix A2

Correlation matrix of residuals for 38 developed countries and 44 developing countries:

SUR for 38 developed countries

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lrgdp	745	6	.2513569	0.8511	4257.41	0.0000
TAXgdp	745	5	3.701257	0.8194	7453.04	0.0000
GEXgdp	745	5	4.177244	0.8099	7235.80	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.0331065	.0142703	2.32	0.020	.0051373	.0610758
infl	-.0076849	.0024731	-3.11	0.002	-.012532	-.0028378
hdi	6.840025	.2591959	26.39	0.000	6.33201	7.34804
TAXgdp	.0111689	.0025453	4.39	0.000	.0061802	.0161577
GEXgdp	-.001433	.0022553	-0.64	0.525	-.0058533	.0029873
cci	.2727677	.0168958	16.14	0.000	.2396524	.3058829
_cons	3.385647	.1863912	18.16	0.000	3.020327	3.750967
TAXgdp						
Lgfdi	-.6551942	.2031717	-3.22	0.001	-1.053403	-.256985
infl	.1939679	.0349476	5.55	0.000	.125472	.2624639
hdi	10.575	3.682354	2.87	0.004	3.357716	17.79228
GEXgdp	.881257	.0104636	84.22	0.000	.8607487	.9017654
cci	2.341422	.2283914	10.25	0.000	1.893783	2.789061
_cons	-2.969496	2.673	-1.11	0.267	-8.20848	2.269487
GEXgdp						
Lgfdi	.7219405	.2300198	3.14	0.002	.2711101	1.172771
infl	-.2198511	.0393744	-5.58	0.000	-.2970235	-.1426788
hdi	-11.48478	4.172267	-2.75	0.006	-19.66227	-3.307286
TAXgdp	1.122494	.0133279	84.22	0.000	1.096371	1.148616
cci	-2.637539	.2584228	-10.21	0.000	-3.144038	-2.13104
_cons	3.593673	3.013147	1.19	0.233	-2.311986	9.499332

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	-0.0000	1.0000	
GEXgdp	0.0000	-0.9010	1.0000

Breusch-Pagan test of independence: chi2(3) = 604.764, Pr = 0.0000

lrgdp	745	6	.251371	0.8511	4255.11	0.0000
TAXgdp	745	6	2.599642	0.9109	9953.55	0.0000
GEXgdp	745	6	4.198698	0.8079	5016.19	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.0312671	.014382	2.17	0.030	.0030789	.0594553
infl	-.0073097	.0024287	-3.01	0.003	-.0120699	-.0025495
hdi	6.856703	.258739	26.50	0.000	6.349584	7.363822
TAXgdp	.0104628	.0024597	4.25	0.000	.005642	.0152836
cci	.3000061	.0612996	4.89	0.000	.1798612	.4201511
CCI_TAX	-.0005844	.0014716	-0.40	0.691	-.0034687	.0022998
_cons	3.352926	.1980394	16.93	0.000	2.964776	3.741076
TAXgdp						
Lgfdi	-.0850845	.1417617	-0.60	0.548	-.3629323	.1927633
infl	.106914	.0241204	4.43	0.000	.0596389	.1541891
hdi	5.993027	2.544607	2.36	0.019	1.00569	10.98036
GEXgdp	.5943079	.0120128	49.47	0.000	.5707633	.6178526
cci	-7.575589	.4206901	-18.01	0.000	-8.400127	-6.751052
CCI_TAX	.2270774	.0090027	25.22	0.000	.2094324	.2447223
_cons	8.252239	1.871389	4.41	0.000	4.584384	11.9201
GEXgdp						
Lgfdi	.2000063	.2287393	0.87	0.382	-.2483145	.6483271
infl	-.1867043	.0386461	-4.83	0.000	-.2624493	-.1109594
hdi	-9.139691	4.115719	-2.22	0.026	-17.20635	-1.07303
TAXgdp	1.550292	.0313362	49.47	0.000	1.488875	1.61171
cci	9.943605	.8396113	11.84	0.000	8.297997	11.58921
CCI_TAX	-.3113401	.0197805	-15.74	0.000	-.3501092	-.272571
_cons	-10.12547	3.081394	-3.29	0.001	-16.16489	-4.086049

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	0.0212	1.0000	
GEXgdp	-0.0283	-0.7496	1.0000

Breusch-Pagan test of independence: chi2(3) = 419.593, Pr = 0.0000

lrgdp	745	6	.2583955	0.8426	3989.49	0.0000
TAXgdp	745	7	3.739728	0.8156	4857.68	0.0000
GEXgdp	745	7	3.644439	0.8553	6091.55	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.0348735	.0144757	2.41	0.016	.0065017	.0632452
infl	-.0054406	.0025244	-2.16	0.031	-.0103882	-.0004929
hdi	6.864901	.2741505	25.04	0.000	6.327576	7.402226
GEXgdp	.0035891	.0016406	2.19	0.029	.0003736	.0068046
CCI	.0065837	.0016724	3.94	0.000	.0033058	.0098617
CCI_GEX	.0032528	.0008893	3.66	0.000	.0015099	.0049957
_cons	3.300376	.2074363	15.91	0.000	2.893809	3.706944
TAXgdp						
lrgdp	1.772387	.5072651	3.49	0.000	.7781662	2.766609
Lgfdi	-.7976286	.2001378	-3.99	0.000	-1.189891	-.4053657
infl	.2154794	.0344547	6.25	0.000	.1479495	.2830094
hdi	-.7328055	5.072917	-0.14	0.885	-10.67554	9.209929
GEXgdp	.9505298	.0230297	41.27	0.000	.9053925	.9956672
cci	4.93261	.6913407	7.13	0.000	3.577607	6.287613
CCI_GEX	-.075061	.0153644	-4.89	0.000	-.1051746	-.0449473
_cons	-12.35946	3.230764	-3.83	0.000	-18.69164	-6.027276
GEXgdp						
lrgdp	-.7265615	.4990016	-1.46	0.145	-1.704587	.2514636
Lgfdi	.7275785	.1955084	3.72	0.000	.344389	1.110768
infl	-.2115281	.0334716	-6.32	0.000	-.2771312	-.1459251
hdi	-4.701182	4.940575	-0.95	0.341	-14.38453	4.982167
TAXgdp	.9026602	.0218653	41.28	0.000	.859805	.9455154
cci	-7.839251	.5650131	-13.87	0.000	-8.946657	-6.731846
CCI_GEX	.1421869	.0130216	10.92	0.000	.1166651	.1677087
_cons	12.9668	3.111579	4.17	0.000	6.868221	19.06539

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	-0.0169	1.0000	
GEXgdp	-0.0187	-0.6738	1.0000

Breusch-Pagan test of independence: chi2(3) = 338.715, Pr = 0.0000

SUR for 44 developing countries

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lrgdp	893	6	.4685339	0.7764	3096.86	0.0000
TAXgdp	893	6	3.587883	0.8099	7383.46	0.0000
GEXgdp	893	6	3.67891	0.8048	7251.41	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.064431	.0191104	3.37	0.001	.0269754	.1018867
infl	-.0002787	.000414	-0.67	0.501	-.0010901	.0005328
hdi	5.921206	.1774941	33.36	0.000	5.573324	6.269088
TAXgdp	.0296138	.0045123	6.56	0.000	.0207699	.0384576
GEXgdp	-.0253802	.0044016	-5.77	0.000	-.0340072	-.0167531
ccii	.0261788	.0019582	13.37	0.000	.0223407	.0300169
_cons	2.603074	.1640367	15.87	0.000	2.281567	2.92458
TAXgdp						
Lgfdi	-.0337204	.1418407	-0.24	0.812	-.311723	.2442822
infl	.0049486	.0030532	1.62	0.105	-.0010355	.0109327
hdi	2.714532	1.223234	2.22	0.026	.3170372	5.112028
GEXgdp	.9600978	.0229805	41.78	0.000	.9150569	1.005139
cci	-.5601622	.8805351	-0.64	0.525	-2.285979	1.165655
CCI_GEX	-.0064927	.0303752	-0.21	0.831	-.066027	.0530415
_cons	-3.526537	1.395544	-2.53	0.012	-6.261754	-.7913202
GEXgdp						
Lgfdi	.0426759	.1454339	0.29	0.769	-.2423693	.3277211
infl	-.0045742	.0031382	-1.46	0.145	-.010725	.0015766
hdi	-1.938431	1.263042	-1.53	0.125	-4.413948	.5370862
TAXgdp	1.015931	.0236322	42.99	0.000	.9696123	1.062249
cci	.654158	.8023788	0.82	0.415	-.9184755	2.226792
CCI_TAX	.0035634	.0301257	0.12	0.906	-.0554819	.0626087
_cons	3.640258	1.396074	2.61	0.009	.9040039	6.376512

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	0.0130	1.0000	
GEXgdp	-0.0088	-0.8592	1.0000

Breusch-Pagan test of independence: chi2(3) = 659.475, Pr = 0.0000

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lrgdp	893	6	.4683937	0.7765	3105.53	0.0000
TAXgdp	893	6	3.587891	0.8099	7383.08	0.0000
GEXgdp	893	6	3.67893	0.8048	7251.65	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.0644785	.0190819	3.38	0.001	.0270786	.1018784
infl	-.0004062	.0004133	-0.98	0.326	-.0012163	.0004039
hdi	6.00682	.174817	34.36	0.000	5.664185	6.349455
TAXgdp	.0103338	.0039997	2.58	0.010	.0024946	.018173
cci	.3180012	.1299523	2.45	0.014	.0632994	.5727029
CCI_TAX	.0093396	.0050096	1.86	0.062	-.000479	.0191582
_cons	3.448191	.1910702	18.05	0.000	3.0737	3.822682
TAXgdp						
Lgfdi	-.0336871	.1418407	-0.24	0.812	-.3116898	.2443155
infl	.0049497	.0030532	1.62	0.105	-.0010344	.0109338
hdi	2.69982	1.223239	2.21	0.027	.3023154	5.097324
GEXgdp	.9608666	.0229816	41.81	0.000	.9158235	1.00591
cci	-.579579	.8805922	-0.66	0.510	-2.305508	1.14635
CCI_GEX	-.0052608	.0303773	-0.17	0.863	-.0647991	.0542776
_cons	-3.53233	1.395566	-2.53	0.011	-6.267589	-.7970719
GEXgdp						
Lgfdi	.0426573	.1454339	0.29	0.769	-.2423879	.3277026
infl	-.0045741	.0031382	-1.46	0.145	-.0107249	.0015767
hdi	-1.927533	1.263044	-1.53	0.127	-4.403054	.5479871
TAXgdp	1.01547	.0236326	42.97	0.000	.9691512	1.061789
cci	.6625988	.8023966	0.83	0.409	-.9100697	2.235267
CCI_TAX	.0028225	.0301264	0.09	0.925	-.0562242	.0618692
_cons	3.64046	1.39608	2.61	0.009	.9041938	6.376727

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	0.1725	1.0000	
GEXgdp	-0.1995	-0.8592	1.0000

Breusch-Pagan test of independence: chi2(3) = 721.362, Pr = 0.0000

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
lrgdp	893	6	.4678649	0.7770	3132.41	0.0000
TAXgdp	893	6	3.587827	0.8099	7382.92	0.0000
GEXgdp	893	6	3.678957	0.8048	7251.54	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lrgdp						
Lgfdi	.0641496	.0190494	3.37	0.001	.0268135	.1014857
infl	-.0002945	.000412	-0.71	0.475	-.0011019	.000513
hdi	5.990598	.1729538	34.64	0.000	5.651615	6.329581
GEXgdp	.0133195	.0026145	5.09	0.000	.0081953	.0184438
CCI	.0082022	.0030159	2.72	0.007	.0022911	.0141134
CCI_GEX	.0153971	.0021314	7.22	0.000	.0112196	.0195746
_cons	3.015644	.1759994	17.13	0.000	2.670692	3.360597
TAXgdp						
Lgfdi	-.0334336	.1418402	-0.24	0.814	-.3114353	.2445681
infl	.0049603	.0030531	1.62	0.104	-.0010238	.0109443
hdi	2.667598	1.222385	2.18	0.029	.2717674	5.063428
GEXgdp	.958643	.0227495	42.14	0.000	.9140547	1.003231
cci	-.4707982	.8662463	-0.54	0.587	-2.16861	1.227013
CCI_GEX	-.0087847	.0299355	-0.29	0.769	-.0674572	.0498879
_cons	-3.446044	1.389953	-2.48	0.013	-6.170303	-.7217861
GEXgdp						
Lgfdi	.0424099	.1454335	0.29	0.771	-.2426345	.3274542
infl	-.0045874	.0031382	-1.46	0.144	-.0107381	.0015633
hdi	-1.90338	1.262585	-1.51	0.132	-4.378001	.5712401
TAXgdp	1.017173	.0235008	43.28	0.000	.9711119	1.063233
cci	.5862943	.7947104	0.74	0.461	-.9713095	2.143898
CCI_TAX	.0054679	.0298765	0.18	0.855	-.0530889	.0640248
_cons	3.579437	1.393295	2.57	0.010	.84863	6.310244

Correlation matrix of residuals:

	lrgdp	TAXgdp	GEXgdp
lrgdp	1.0000		
TAXgdp	0.2353	1.0000	
GEXgdp	-0.2021	-0.8592	1.0000

Breusch-Pagan test of independence: chi2(3) = 745.179, Pr = 0.0000

Table Appendix A3

Results of variance inflation factor test (VIF[1])

$$E(Y|X_1 = x_1, X_2 = x_2) = \beta_0 + \beta_1 x_1 + \beta_2 x_2$$

$$Var(\hat{\beta_j}) = \frac{\sigma^2}{1 - r_{1,2}^2} \frac{1}{SX_i X_j}$$

Variable	VIF	1/VIF
taxrev	9.87	0.101328
gexp	8.49	0.117754
cci	1.79	0.559274
hdi	1.02	0.975995
infl	1.02	0.979163
fdigdp	1.01	0.990824
Mean VIF	3.87	

Variable	VIF	1/VIF
taxrev	10.01	0.099910
gexp	8.58	0.116517
cpi	1.74	0.574334
hdi	1.03	0.974455
infl	1.02	0.976808
fdigdp	1.01	0.991847
Mean VIF	3.90	

Except TAXgdp that have VIF >10, other remaining variances are smaller than 10, hence we can confirm that among economic growth, tax revenue and control of corruption close correlation exists.

[1] VIF is a variance inflation factor, which was developed by Marquardt (1970).

Table Appendix A4

Results of non-linear test with H_0: Between these two variables non-linear correlation exists. All results have rejected the null hypotheses.

- FDI - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0027229	.0013688	1.99	0.047	.00004	.0054057

- INFL - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	-.0104765	.0039966	-2.62	0.009	-.0183098	-.0026433

- HDI - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	1.338315	.449079	2.98	0.003	.4581368	2.218494

- TAXgdp - Lrdgp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0443692	.0129751	3.42	0.001	.0189383	.0698

- GEXgdp - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	-.0350107	.0146615	-2.39	0.017	-.0637467	-.0062747

- CCI - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.6309926	.3168192	1.99	0.046	.0100384	1.251947

- CPI - Lrgdp

lrgdp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_nl_1	.0135514	.00745	1.82	0.069	-.0010503	.0281531