



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

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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.

Dzhamashev (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, its interaction with spending on investment and military negatively affects economic growth [5]. In summary, only those countries that maintain a low corruption index achieve high tax revenue, spend less, and

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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, 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, $Y = AK^\alpha L^{1-\alpha}$, 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]:

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

where $\text{Log}(Y_{i,t})$ 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]:

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

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

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 (see Azam et al., 2015; d'Agostino, Dunne and Pieroni, 2016; Ramírez, Díaz and Bedoya, 2017) [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 (d'Agostino, Dunne, and Pieroni, 2012; Ugur, 2014) [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 $T \times 1$ vector of observation on μ 'th "dependent" variables, X_{μ} is a $T \times l_{\mu}$ matrix with rank of l_{μ} observation on l_{μ} 'th "independent" variables, β_{μ} is a $l_{\mu} \times 1$ vector of regression coefficient and U_{μ} is a $T \times 1$ vector of random error terms, each with mean zero. This system may be written as seen below:

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

Which can be re-written as below:

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

where,

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

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, $\text{vec}(E)$ in (5) have zero mean and variance-covariance matrix $\sum \bigoplus IT$, i.e. $\text{vec}(E) \sim (0, \sum \bigoplus IT)$, where $\sum = [\sigma_{ij}] \in RM \times M$ 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 - *ifnl*, 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:

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 foreign direct investment value per GDP (*FDI*), and human development index (*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].

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

$$y_{i,jt} = X_{i,jt}\beta_{i,jt} + u_{i,jt} \tag{2}$$

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 $U_{i,t-1}$ (Baltagi, 2005) [25]. So to solve the endogenous phenomena and auto-correlation, the study has to apply a two-step system generalized method of moments estimation (Baltagi, 2005) [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 [1]:

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 FDI_{i,t} + \alpha_3 INFL_{i,t} + \alpha_4 HDI_{i,t} + \alpha_5 PUB_{i,t} + \alpha_6 GOV_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t} \quad (7.1)$$

$$lrgdp_{i,t} = \alpha_0 + \alpha_1 lrgdp_{i,t-1} + \alpha_2 FDI_{i,t} + \alpha_3 INFL_{i,t} + \alpha_4 HDI_{i,t} + \alpha_5 PUB_{i,t} + \alpha_6 GOV_{i,t} + \alpha_7 GOV_PUB_{i,t} + \varepsilon_{i,t} + \vartheta_{i,t} \quad (7.2)$$

Where, $FDI_{i,t}$ stands for foreign direct investment ratio with GDP per capita, $infl_{i,t}$ is the inflation rate of country i ($i = 1, \dots, N$) at time t ($t = 1, \dots, T$), $hdi_{i,t}$ 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.

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 [29]. 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 human development index (HDI) from the UNDP (see Table 3.1).

The strong balanced panel data is used for analysis (see Table 3.1 - Description of variables).

Table 3.1 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 3.1. 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 3.2. 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.

Table 3.2 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.

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 [30-31]. While the Harris-Tzavalis' (HT) (1999) test hypothesizes that all panels have the same autoregressive parameter and rho is smaller than 1 [30]. It also assumes that the periods are fixed, which is similar to the Levin-Lin-Chu test [32]. 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 $Z - \bar{t}$ to hold (see the results in Lien and Thanh, 2017) [33].

3.2. 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 [34]. This research also runs the VIF and non-linear regression test for less bias from cross-panel data (see table in Appendixes A3 and A4).

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

Table 4.1. The results of verification of the influence of governance on economic growth in 44 developing countries

	(SUR) lrgdp	(SUR) lrgdp	(SUR) lrgdp	(SGMM) lrgdp	(SGMM) lrgdp	(SGMM) lrgdp
FDI	0.064*** (3.37)	0.065*** (3.38)	0.064*** (3.37)	0.093** (2.76)	0.272*** (9.29)	0.299*** (10.55)
INFL	-0.0003* (-0.67)	-0.0004* (-0.98)	-0.0003* (-0.71)	-0.0003** (-2.95)	-0.0001* (-2.48)	-0.0002*** (-3.30)
HDI	5.921*** (33.36)	6.007*** (34.36)	5.991*** (34.64)	1.972*** (4.66)	3.145*** (11.02)	2.839*** (7.71)
TAXgdp	0.030*** (6.56)	0.010** (2.58)		0.058*** (13.23)	0.027*** (6.79)	
GEXgdp	-0.025*** (-5.77)		0.013*** (5.09)	-0.014*** (-4.13)		0.031*** (6.24)
CCI	0.026*** (13.37)	0.318** (2.45)	0.008*** (2.72)	0.082*** (17.42)	0.025*** (6.44)	0.021*** (5.85)
CCI_TAX		0.009* (1.86)			0.042*** (10.20)	

CCI_GEX			0.015*** (7.22)			0.042*** (9.52)
_cons	2.603*** (15.87)	3.448*** (18.05)	3.016*** (17.13)	1.929*** (6.12)	2.409*** (8.27)	2.387*** (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.

Table 4.1 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 (see table in Appendix A2). Through Table 4.1, this study also confirms that the foreign direct investment rate to GDP (FDI) is a beneficial factor for growth, while the unstable situation of an economy could be harmful to increase economic outcome.

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

Table 4.2. The results of verification of the influence of governance on economic growth in 38 developed countries

	(SUR) <i>lrgdp</i>	(SUR) <i>lrgdp</i>	(SUR) <i>lrgdp</i>	(SGMM) <i>lrgdp</i>	(SGMM) <i>lrgdp</i>	(SGMM) <i>lrgdp</i>
FDI	0.033** (2.32)	0.031** (2.17)	0.035** (2.41)	0.053*** (6.26)	0.060*** (9.24)	0.045*** (5.38)
INFL	-0.008** (-3.11)	-0.007** (-3.010)	-0.005* (-2.16)	-0.001 (-0.55)	-0.001 (-1.54)	0.009*** (5.97)
HDI	6.840*** (26.39)	6.857*** (26.50)	6.865*** (25.04)	6.784*** (36.41)	6.974*** (28.34)	7.354*** (28.22)
TAXgdp	0.011*** (4.22)	0.010*** (4.25)		0.011*** (4.58)	0.008 (1.94)	
GEXgdp	-0.001 (-0.64)		0.004** (2.19)	-0.001 (-0.36)		0.002* (1.70)
CCI	0.273*** (16.14)	0.300*** (5.19)	0.007*** (3.94)	0.377*** (16.21)	0.430*** (4.54)	0.011*** (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.

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. Both Tables 4.1 and 4.2 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 [35]. 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 4.3 and 4.4).

Table 4.3. Robustness check of the governance role in 44 developing countries

	(SUR)	(SUR)	(SUR)	(SGMM)	(SGMM)	(SGMM)
	<i>lrgdp</i>	<i>lrgdp</i>	<i>lrgdp</i>	<i>lrgdp</i>	<i>lrgdp</i>	<i>lrgdp</i>
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 database - GFS, and UNDP's database - HDI.

Table 4.4. Robustness check of the governance role in 38 developed countries

	(1)	(2)	(3)	(4)	(5)	(6)
	lrgdp	lrgdp	lrgdp	lrgdp	lrgdp	lrgdp
TAXgdp	0.011*** (4.13)	0.014** (2.77)		0.016*** (4.69)	0.020*** (2.81)	
GEXgdp	-0.001 (-0.26)		0.004** (2.62)	-0.004** (-2.59)		0.004** (2.25)
CPI	0.011*** (14.49)	0.013*** (4.74)	0.006*** (3.89)	0.028*** (13.39)	0.036*** (7.60)	0.009*** (5.04)
CPI_TAX		-0.0001 (-0.73)			-0.0002 (-1.62)	
CPI_GEX			0.003*** (3.82)			0.003*** (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 database - GFS, and UNDP's database - HDI.

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 4.1 and 4.2 show the consistent results of the control of CCI compared to the CPI in Tables 4.3 and 4.4. Tables 4.3 and 4.4 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 Transparency International, 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 concern the

anti-corruption policy with 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 Transparency International, 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
<hr/>			
Developing countries			
<hr/>			
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:

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.

SUR for 38 developed countries

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

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

Correlation matrix of residuals:

	<i>lrgdp</i>	<i>TAXgdp</i>	<i>GEXgdp</i>
<i>lrgdp</i>	1.0000		
<i>TAXgdp</i>	-0.0000	1.0000	
<i>GEXgdp</i>	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: $\chi^2(3) = 419.593$, Pr = 0.0000

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
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
<hr/>						
Correlation matrix of residuals:						
	lrgdp	TAXgdp	GEXgdp			
lrgdp	1.0000					
TAXgdp	-0.0169	1.0000				
GEXgdp	-0.0187	-0.6738	1.0000			
<hr/>						
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 (VIF¹)

According to Weisberg (2005), p. 216 we learn that using “collinear predictors can lead to unacceptably variable estimated coefficients compared to problems with no collinearity” [62]. 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:

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

$$Var(\bar{\beta}_j) = \frac{\sigma^2}{1 - r_{1,2}^2} \frac{1}{SX_i X_j}$$

The variances of $\bar{\beta}_1$ and $\bar{\beta}_2$ 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 $\bar{\beta}_1$ 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:

$$VIF_j = \frac{1}{1 - R_j^2} \text{ (Marquardt, 1970) [61].}$$

Assuming that X_j 's could have been sampled to make $R_j^2 = 0$, while keeping $SX_i X_j$ 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 $1/(1-0.95^2) = 10.256$. A rule of thumb is that if $VIF(\bar{\beta}_j) > 10$ then multicollinearity is high.

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	

¹ VIF is a variance inflation factor, which was developed by Marquardt (1970) [61].

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.

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