

Article

Role of Governance in Debt-Growth Relationship: Evidence from Panel Data Estimations

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Abstract: This paper provides an empirical analysis of the relationship between debt and national output mediated by a measure of the quality of state governance. Using WGI's dataset of 106 countries for the period 1996–2015, the paper analyzes the mediated effect of governance on debt-growth relationship. For this purpose, we use the fixed effect (LSDV) and system GMM estimation technique in order to overcome the possible problem of endogeneity. Results show the non-linear pattern between public debt and economic growth via governance. Although, public debt has negative impact on economic growth, but the results are statistically positive and significant when public debt is interacted with governance, which confirms that governance is a channel by which public debt influences economic growth. Moreover, we calculate the threshold of governance which shows that the public debt has positive impact on economic growth when the governance level is higher than the threshold and adversely affects the economic growth in the case of low level of governance than threshold. Evidence from this study reveals the fact that governance plays a mediating role in debt-growth relationship as there is a pattern of complementarity between public debt and governance: the higher the level of governance, the lesser the adverse effect of public debt on economic growth.

Keywords: public debt; governance; economic growth; system GMM estimator



Citation: Abbas, Q.; Junqing, L.; Ramzan, M.; Fatima, S. Role of Governance in Debt-Growth Relationship: Evidence from Panel Data Estimations. *Sustainability* **2021**, *13*, 5954. <https://doi.org/10.3390/su13115954>

Academic Editors: Bruce Morley and Antonio M. López Hernandez

Received: 20 April 2021
Accepted: 20 May 2021
Published: 25 May 2021

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1. Introduction

The recent economic crisis has produced a sharp rise in public debt levels across the globe. The rise in public debt levels greatly influenced the determinants of economic growth and demanded many researchers and governments to seek out this phenomenon [1]. According to a report of IMF (2016), the impact of public debt on economic growth is widespread worldwide and even in some advanced countries, debt-growth ratio has surpassed 50 percent while in some countries such as Japan, Greece and Italy, this ratio is more than 100 percent. Many countries, particularly developing and underdeveloped countries, face a fiscal deficit and fragile growth due to continued growth in debt level.

Most studies show a non-linear negative impact of public debt on economic growth, which conforms to neo-classical and endogenous growth models [2,3]. Several previous studies report that higher level of debt affects not only capital accumulation, but GDP growth as well through increased interest rates and higher future taxes [4,5], high inflation ratio and an increased degree of ambiguity in future policies. Over the years, the level of public debt has become an ongoing political debate not only for developing countries but also for emerging economies. Public debt has been demonstrated to have an adverse effect on growth and this negative impact sometimes becomes so significant that GDP growth becomes negative. Moreover, the authors propose a minimum threshold for the level of debt and suggest that countries remain below this value. High government debt limits the possibilities of counter-cyclical fiscal policies and therefore higher volatility as well as reducing future growth. As a result, public debt undermines macroeconomic stability.

Continuous growth has been a key objective of all governments and to achieve sustainable growth, governments must control the level of public debt. Consequently, researchers are interested in examining the debt levels and its effects on different economies. As described by [6], the key objective for governments is to achieve sustainable growth and researchers consider that public debt is the necessary condition for sustainable growth. Countries face the problem of attaining and maintaining sustainable debt levels compatible with sustainable growth. In terms of sustainability, it may be argued that growth based on short-term public debt, rather than long-term productivity, is unsustainable. Hence, worries about the build-up of sovereign debt and countries face debt overhang. Moreover, debt overhang continues to be a major threat to many advanced and developing economies [7]. Additionally, some studies illustrate that, in developing countries, debt-growth ratio does not depend solely on debt size. Furthermore, institutional quality and policies play a major role in the relationship of these two. Against this background, few studies, such as [8–10], demonstrate that quality of policies and institutions are required to foster investment, sustainable growth and get rid of high debt.

In 1989, the World Bank used the term ‘good governance’. Since then, it has been used and applied in numerous fields of study. Over the past few years, the quality of governance has played a critical role in economic growth. This phenomenon has been supported by many international organizations such as the World Bank, the United Nations, the Organization for Economic Cooperation and Development, the International Monetary Fund and the Asia-Pacific Economic Cooperation Conference. Good governance is considered to be an essential condition for promoting the country’s competitiveness and improving individuals’ life quality. Good governance encourages investment by protecting property rights, accountability controls the corruption, and effective regulation sustains competition [11]. There is, therefore, a consensus that good governance makes it possible to manage the debt efficiently and effectively by adopting sound fiscal and monetary policies. As such, good governance is a key tool for economic development. Governance has become a major field of research for measuring its impact on economic growth in recent times [12].

Traditional economic research concentrates solely on the factors linked to economic growth and debt, however, after exploring the non-economic factors and their role in economic growth, attention begins to increase. Non-economic factors such as institutional quality play a significant role in debt accumulation [13]. Some recent studies demonstrate that public debt is a function of corruption [6]; taking this into account, authors of [14] study the relationship between governance and public debt, and outcomes demonstrated the reason behind high debt ratio is poor governance. To sum up, poor governance has serious implications for economic growth and rationale for higher public debt ratios.

In this paper, our main objective is to study debt-growth with an emphasis on the role of governance. Our main contribution has been to analyze the intermediation effect of governance and calculate its threshold value of economic growth and debt relationship. This study is useful for policymakers to understand the intermediation effect of governance and its utility in the choice of debt to growth ratio, enhancing growth ratio and economic stability.

For this purpose, we estimate the balanced data from the panel of 106 countries covering the period 1996–2015. We start our estimation using fixed effects (least square dummy variable) estimation methodology and then we employ system GMM (generalized method of moments) estimation technique. The system GMM method is widely used to address a possible endogeneity problem such as inverse causality, omitted variables bias and simultaneity biasedness problem. The results of our estimates confirm the negative impact of public debt on economic growth. Moreover, the intensity of this negative effect is lower when countries have higher level of good governance and vice versa in case of poor governance. To be more precise, the higher the level of governance, the less the public debt will adversely affect economic growth. Additionally, we find the threshold level of governance above which public debt tends to positively impact on economic

growth. Countries that have poor governance or a low level of governance must improve governance quality to deal with the negative effects of public debt.

The main limitation in our research is that governance and public debt are jointly endogenous with economic growth. This may cause biases in our estimation resulting from simultaneity or reverse causality. To deal with this problem, previous literature has pointed out several remedies and there is still debate about which technique is the most appropriate. In our paper, we used annual data as well as 3 years of averaged data of the sampled countries.

The paper presentation is as follows: the theoretical basis is described in Section 2. Section 3 provides model, estimation approach and the data. Results and key findings are outlined in Section 4. The final section concludes the research and discusses a number of policy implications.

2. Theoretical Basis

2.1. Public Debt and Economic Growth

Public debt has a destructive effect on economic growth suggested by the classical economists like Smith [15], Mill [16] and Ricardo [17]. The Ricardian equivalence explains that the consumption of an individual or a family is based on the lifetime present value of their after-tax income. Moreover, this theory indicates that the public spending, whether financed by taxation or borrowing, is equal. Under this scenario, the government's decision to reduce taxes to boost the economy means that individuals save more by buying the bonds. Thus, as Ricardo pointed out, government indebtedness has a neutral impact on economic growth. Although, Keynesian macroeconomic model of investment saving–liquidity preference and money supply (IS–LM) describes that if the increase in public debt prompted by deficit-financed, fiscal policy increases the level of income, and the transaction demands for money and prices, then this causes higher interest rate on public bonds due to a fixed money supply. In accordance with Keynesian theory, if the private sector considers public bonds to be a net asset, the deficit will further exacerbate private spending, transaction demand, interest rates, and prices. The effects of expansionary fiscal policy on capital formation can be reinforced by accelerated effects and thus boost economic growth. On the other hand, monetarists argued that the macroeconomic effect of the financed debt drives out private investment by raising interest rates. As a result, public debt will therefore have an adverse effect on economic growth. Moreover, the theory of debt overhang suggests that if future debt increased beyond the country's repayment capacity, the projected debt servicing costs will discourage domestic and foreign investment, and thereby hinder economic growth [18].

The conventional view on the debt-growth relationship indicates that, in the short term, public debt exerts a positive influence on growth by driving aggregate demand [19]. However, some previous studies have pointed to a negative debt-growth relationship and contradict the Ricardian equilibrium [20–22]. However, a few studies support the Barro idea of Ricardian equivalency [23,24]. Additionally, there are some studies with mixed results [25]. Nonetheless, this issue has yet to be resolved, but beyond this conventional view, in recent times, researchers mostly examined the debt-growth relationship through various channels.

Some studies suggest that high public debt is very harmful in the long run. A country with higher indebtedness level not only has to pay long-term interest but also faces the sovereign risk [26–29]. Other studies examine the channel of tax increases distorted by high government debt [4,5]. Higher indebtedness leads to inflation [30–32]. However, authors of [33] follow the path of declining public spending on infrastructure. High levels of debt can limit discretionary counter-cyclical policies, consequently leading to greater volatility in the economy, thus reduction in growth [34]. High indebtedness has an extreme case when it affects the banking sector and creates monetary crisis, which leads to economic instability [35].

2.2. Governance and Economic Growth

Governance is comprised of traditions and institutes through which authority of a state is exerted. Governance includes how governments are selected, monitored and replaced; the governments' capacity to effectively develop and implement sound policies, and respect for citizens and the state with regard to the institutions that govern economic and social interaction between citizens and state. Since the late 1990s, governance has been an important part of international organizations. The WGI is a widely used tool to measure the governance. It is comprised of six dimensions of governance as given in the World Bank WGI database. Based on the definition of governance provided by WGI, many economists agree that good governance plays an important role in the analysis of the performance across countries [36]. Good governance is an important factor in growing the economy [37,38]. Despite this, a number of publications suggest the importance of governance and the necessary institutional conditions. Some researchers consider governance a forecast of growth [39] and the government institutions play a significant part in economic growth [40,41]. Some authors refer to effective institutions in formulating the long-term growth, showing that countries with weaker institutions face a crisis and stagnation [42].

Economic growth is directly and indirectly linked to governance [43,44]. Good governance promotes economic growth and undermines income inequity. Good governance has gained a lot of importance in recent decades. This importance is growing globally, particularly for developing countries in order to attract more investment and sustainable growth [45]. Poor institutional quality leads to poor political and economic activities that do not encourage the productive activities [40]. As mentioned by [46], economic development not only increases the economic resources but also helps to build institutions. They also include that institutions are the basis to have low corruption, rule of law, etc. Similarly, it can be seen that developed countries are politically more stable than developing or poor countries [47].

Moreover, all six dimensions given by WGI seem to be correlated with each other and can affect each other. For example, the authors in [48] show that poor governance has an adverse effect on investment. The ineffectiveness of government, weakness of the law and political instability are directly related to corruption, which ultimately make it worse for investment. In addition, economists briefly discuss how these variables are interrelated and affect each other. The weakness in rule of law causes corruption and adversely affects the economy. Poor regulatory quality and poor government policies increase bribery by restricting competition. Therefore, property rights will be less protected and people will feel unprotected against the rule of law because they think their tax money is not well spent [49].

2.3. Economic Growth, Debt and Governance

Political economics theory and research show that a certain degree of positive indebtedness is important to the performance of an economy. Thus, earlier research has identified two reasons for this positive influence: one is the fluctuating role of public debt as advocated by Barro [4] while the second reason is the wealth redistributive role of public debt as described by [50,51]. Nevertheless, countries with good governance can take advantage of this beneficial aspect. Good governance is regarded as a prerequisite for growth in the economy [39,40]. The work of North [40] describes the significance of institutions, and emphasizes on institutional quality results in encouraging higher investment that leads to economic growth. Moreover, quality institutes prevent distortion activities and reduce uncertainty. Corruption is seen as a factor distorting economic activities by reducing private and foreign direct investment, thereby reducing economic growth [52].

Most researchers analyze debt-governance relationship through political and institutional factors. Governance helps to accumulate public debt [53]. The authors of [54,55] developed the debt theory which stipulates that under same economic conditions, different countries pursue different levels of public debt because of policy decisions and agreements.

Among the six dimensions of governance presented by Kaufmann, some of the preceding publications address the factor of corruption; for example, the studies of [6,56–60] posit that corruption results in adversely affecting growth. Corruption affects the economy through improper application of government resources, in this case, the government finances mainly through borrowing, resulting in a higher interest rate and burden on the economy. Some public investment can be diverted from their purpose by corrupt individuals [61] as due to these rent-seeking activities, the government invests most of the public expenditure in sectors which are not of importance to the public, such as highways, rather than schools and hospitals [62].

Other than corruption, some earlier publications also account for the impacts of other dimensions of governance on public debt. According to [63], other dimensions of governance might be correlated with one another, improving that rule of law reduces the harms of corruption and protects property rights. Voice and Accountability can enhance a nation's borrowing authority through its integrity [64] and it has a positive relationship with growth [63], as well as improving the ability of debt forgiveness [65]. Political institutions play an important role in financial stability [66,67]. Political stability not only improves the legal system of the economy by making the given contracts awarded valid, but also improves the overall macroeconomic stability [68]. Efficient and effective institutions and political stability not only reduce output volatility, but also improve the real GDP growth and reduce the likelihood of a sovereign debt crisis [69]. Moreover, an efficient and effective regulatory system is a key driver of economic performance [46]. The quality of regulation lies in the framework of good governance. The smooth functioning of a regulatory system strengthens investor confidence by balancing the accountability, transparency and consistency [70]. In addition, weak government effectiveness underpins corruption that ultimately affects the macroeconomic stability [71].

On the whole, the invaluable literature implies that governance influences the level of public debt and overall macroeconomic stability. All the six dimensions of governance are somewhat correlated to each other. Weak governance inclines the public debt level through the rent-seeking activities and allocation of government spending.

The objective of this study is to fulfill the gap in previous literature by checking the mediation role of governance in debt-growth relationship. Taking this into account, we explore quality of governance, whether it is high or low and how this impacts the debt-growth relationship or not.

3. The Model, Estimation Approach and Data

3.1. The Model

In this study, the model begins with a neoclassical growth model. To represent aggregate production function, the neoclassical growth model is considered to be an important framework:

$$Y = f(K, L) \quad (1)$$

where Y indicates total production, K indicates capital stock and L represents labor. As the existence of heterogeneity across countries and the analysis of this production function show the different steady states, the concept of convergence arises. According to this model, poor countries grow faster to move to steady-state than countries with higher values because of high return to capital [72,73]. There are different variables to underpin the convergence such as debt hang theory which suggests that if a debt burden of a country is so large that it is impossible to repay, then this divergence dissuades current investment. Consequently, this slows the economic growth and makes it difficult for the economy to recover. As underpinned by [74], debt-growth relationship is explained as inverted U-shaped. However, as discussed by [75], we add the public debt (D) into our model. Here, D is the public debt to GDP ratio. Equation (1) takes the form $Y = f(K, L, D)$. Evidence from cross-country analysis shows that, at the time, some developing countries are growing more rapidly by taking the advantage of catching up, while at the same time, other developing

countries are growing slowly. The model specification below measures how public debt affects economic growth:

$$y_{it} = \alpha + \beta_{it} + \gamma X_{it} + \rho_{it} + \varepsilon_{it} \quad (2)$$

where α , β and γ are the coefficients of elasticity. Governance is one of the reasons countries have different growth levels [76]. In the previous literature, researchers seek the direct linkage between governance and growth. Results show that governance and economic growth are positively correlated [77–79]. Different authors well documented governance influence on economic growth and their analytical framework shows the growth regression equation. In our analysis, following [80], we measure debt-growth relationship by taking governance as a mediating variable. Moreover, we use all six governance indicators as explained by WGI, whereas they use only one indicator of governance (control of corruption). We also use the expression of interaction between debt and governance to measure the marginal effect. After induction of governance variable, our model transforms into the following form:

$$\ln y_{it} = \beta_0 + \beta_1 \ln \text{debt}_{it} + \beta_2 \text{gov}_{it} + \beta_3 \ln \text{debt}_{it} \times \text{gov}_{it} + \gamma X_{it} + \rho_{it} + \varepsilon_{it} \quad (3)$$

where i represents countries involved in our study and t is the timeframe. In our analysis ($i = 1, \dots, 106$ and $t = 1996, \dots, 2015$), whereas, gov_{it} is the set of governance variable, ρ_{it} represents country's specific fixed effects and ε_{it} denotes error term. In our analysis, vector X_{it} comprises of a set of control variables such as total factor productivity (TFP); inflation; government size and exports (EXP). TFP contributes positively to economic growth [81] whereas exports of country raise productivity, and hence contributes positively to economic growth [75]. Inflation is measured by GDP deflator and has an adverse effect on economic growth [82]. Government size is the government consumption expenditure and it also has a negative effect on economic growth [72]. As our main goal is to measure the mediating role of governance in debt-growth relationship, therefore, the marginal impact of public debt can be computed from the equation below:

$$\frac{\partial \ln y_{it}}{\partial \ln \text{debt}_{it}} = \beta_1 + \beta_3 \text{gov}_{it} \quad (4)$$

The preceding equation clearly demonstrates that the marginal impact of public debt on economic growth depends on governance. This means marginal effect between countries is not homogeneous, but is dependent on a country's governance. In the countries where governance level is low (bad), the marginal effect seems to be worsening. Moreover, this negative effect decreases in countries where the level of governance is high (good).

3.2. Estimation Approach

3.2.1. Panel Unit Root Test

In this study, we start with panel unit root tests in order to identify the issue of heterogeneity because the main difference between times series and panel data is heterogeneity. In time series, the heterogeneity is considered a problem as the unit root is tested in a given model for a given individual or country. As far as the panel is concerned, this heterogeneity must be checked. For this purpose, we employ MW-augmented Dickey–Fuller and MW-PP unit root tests for panel data.

3.2.2. Static Panel Least Square Dummy Variable and System GMM Estimations

In our current article, we use the sample of 106 economies worldwide covering the period 1996–2015 in order to study the impact of public debt on economic growth. Our main contribution is incorporating interaction term between public debt and the governance in order to show that the relationship between these two variables is conditioned by the quality of governance. According to previous literature, since ordinary least square (OLS) estimation is likely to be a source of biasedness, if there exists simultaneity, growth can generate the problem of endogeneity, since economic growth affects some explanatory

variables such as governance. Conversely, without simultaneity, OLS estimation is efficient and consistent. In case where simultaneity is present, then (2SLS) instrumental variables techniques and generalized method of moments (GMM) are used. These two estimators are considered to be more consistent and efficient. This simultaneity produces biased results and can be corrected using various econometric models. To address this problem, the Hausman [83] test is widely applied. We perform this test by selecting alternate estimation techniques rather than OLS. We first perform the Hausman test to verify the appropriate alternative between fixed and random effect. FE seems to be more appropriate than RE. In addition, the previous literature suggests that we cannot rely solely on the FE method because the problem of endogeneity may still exist, such as public debt may be related to residuals and the unobserved country-specific factors. Thus, based on previous literature, we conclude that GMM estimation technique is appropriate for dealing with the problem of endogeneity.

Hence, we use both the GMM in first difference developed by Arellano and Bond [84] and GMM in system developed by Blundell and Bond [85]. GMM in first difference has widely been used in dynamic panel data estimation. This estimation technique applies the first difference and an appropriate level of their lagged value. The specific effects eliminate in this way. However, the GMM in first difference becomes inappropriate in case of a small number of observations in time series and the process can be improved by applying system GMM [84]. The system GMM is considered as being more efficient compared to first difference GMM. The system GMM estimation not only eliminates a country's specific effect but also controls the problem of endogeneity by using lagged values of dependent variables.

We use the Sargan [86] test to verify the validity of over-identification of instrument, testing the validity of null hypothesis whether the error term is correlated. It is suggested that GMM is an appropriate estimation technique to solve the common problems in growth model, especially, by using the first difference to remove time-invariant country-specific effects. Running the system GMM attains the following equation form:

$$\ln y_{it} = \alpha_i + \beta \ln y_{i,t-1} + \delta X_{it} + \vartheta_i + \varepsilon_{it} \quad (5)$$

The Equation (5) takes the below form for GMM in difference:

$$\ln y_{it} - \ln y_{i,t-1} = \alpha_i + \beta (\ln y_{i,t-1} - \ln y_{i,t-2}) + \delta (X_{it} - X_{i,t-1}) + (\vartheta_i - \vartheta_{i-1}) + (\varepsilon_{it} - \varepsilon_{i,t-1}) \quad (6)$$

GMM in difference estimation allows us to exclude country-specific effects and introduce the new error term [84]. The new error term supports the assumption that the error term ε_{it} has no correlation and the predictors are exogenous. In our analysis, we use two-step system GMM estimation to better understand short-term effect.

3.3. The Data

The data used in this study are drawn from the database of the World Bank, IMF, PINN World Table (version 9.1) and Worldwide Governance Indicators. Depending on availability, it comprises the period from 1996 until 2015 for 106 countries (list of countries is shown in Appendix A (Table A1). In addition, for robustness checking, we also use International Country Risk Guide (ICRG) dataset. The definitions and sources of data, and descriptive statistics are presented in Tables 1 and 2 respectively. The dependent variable in this paper is per capita GDP. Public debt is the independent variable and is defined as the central government debt (which represents over 90% of total government debt).

Table 1. Definitions and data sources of variables.

Variables	Description	Data Source
Y _{i,t}	It represents the real GDP per capita.	WDI
DEBT	It represents public debt to GDP ratio. Here, debt means the general government gross debt.	IMF
GOV	We use all six measures of governance and make a composite index ranging from 0–10. This dataset consists of 100 points distributed among 12 variables on the basis of social and political factors, each variable has different points. Out of 12 variables, 5 variables have 12 points such as government stability, socioeconomic conditions, investment profile, internal conflicts and external conflict; 6 variables have 6 points such as corruption, military in politics, religious tensions, law and order, ethnic tensions and democratic accountability, whereas bureaucracy quality has 4 points. If the commutative value is less than 50%, it means high risk. Greater the value, lower the risk. We make a composite index ranging from 0–10.	WDI (World Governance Indicators)
ICRG	International Country Risk Guide dataset (ICRG)	International Country Risk Guide dataset (ICRG)
TFP	Refers to total factor productivity.	PINN WORLD TABLE 9.1
INF	Refers to inflation, which is measured as the annual rate of change in GDP deflator.	WDI
GS	Refers to general government spending as a share of GDP.	PINN WORLD TABLE 9.1
EXP	Refers to total exports presented as share of GDP.	PINN WORLD TABLE 9.1

Table 2. Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP	2120	13,555.75	18,148.56	112.8494	119,225.4
PUBLIC DEBT	2120	0.5589	0.4050	0.0006	3.4267
TFP	2120	0.6343	0.2533	0.0986	1.9926
INFLATION	2120	8.2680	27.5666	−31.5959	779.4702
GOVERNMENT SIZE	2120	0.0764	0.0764	0.0166	0.6949
EXPORTS	2120	0.3058	0.3058	0.0016	2.5675
GOVERNANCE	2120	1.8706	1.8706	1.21	9.01
ICRG	1840	6.9673	1.2591	3.1920	9.4670

Notes: Missing values are replaced by mean value.

The governance dataset consists of 6 variables: voice and accountability, political stability and violence, government effectiveness, rule of law, regulatory quality, and control of corruption as described by [87]. The governance dataset variables are defined on a −2.5 to 2.5 scale; greater values correspond to better governance. Previous literature shows that some authors use different ways to create index for governance. Some authors use the governance variables without any modification as given by Worldwide Governance Indicators [13,14,88]. To deal with the issue of causality, for example, authors in [89] use the simple average of the six indicators of governance to modify a new index. Whereas some authors use percentile rank to index governance variable ranges from 0 to 1, better value means better the quality of governance [90]. Some authors, such as [11], use statistical method of principal component factor analysis (PCA) for constructing a composite governance index. In this paper, we construct a percentile rank with index ranges from 0–10 by using all six indicators of governance. For this purpose, first of all, we take the mean of all six measures of governance and then we add 2.5 in mean value and multiply it with 2.

The descriptive statistics of variables used in this analysis is provided in Table 2. Governance and ICRG variables are ranging from 1.2 to 9.01 and 3.192 to 9.467 respectively. For governance value, greater value means quality of governance is better and lower value

means vice versa. For ICRG variable, if the value is less than 50%, it means the country is at high risk. Ranging from 61–70% means moderate risk, from 71–80% means low risk. If value exceeds 80%, this shows very low risk. Moreover, while we use ICRG variable, 14 countries are not included in the analysis because of the unavailability of the data, and therefore, the number of countries becomes 92. The debt to GDP ratio has a mean of 0.5589, therefore, it seems that the gap between the minimum and maximum value of debt to GDP ratio is very large. The distortion of debt to GDP ratio therefore varies considerably. The correlation matrix for variables used in our estimation is provided in Appendix A (Tables A2 and A3).

4. Results and Discussion

4.1. Results of Panel Unit Root Test

The results of panel unit root test suggest that all the variables are non-stationary in their level and they become stationary at first difference in both MW (ADF) test and MW (PP) test. The null hypothesis in both cases is all panels contain unit roots; our results reject the null hypothesis and accept the alternate hypothesis of at least one panel is stationary. Therefore, from the results in Table 3, we conclude that all series of variables is stationary at first difference.

Table 3. Panel unit root test results.

Variables	ADF				PP			
	at Level		at First Difference		at Level		at First Difference	
	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.	Statistic	Prob.
Y	83.1710	1.0000	618.3302	0.0000	60.6679	1.0000	760.9305	0.0000
debt	215.3464	0.4231	589.1298	0.0000	200.9820	0.6957	931.1289	0.0000
gov	151.3765	0.9994	278.0759	0.0016	163.5261	0.8862	240.6634	0.0086
tfp	138.9459	1.0000	372.4569	0.0000	57.8912	1.0000	430.4834	0.0000
inf	108.6041	1.0000	823.2310	0.0000	138.8481	1.0000	1197.9083	0.0000
gs	210.3000	0.5201	1086.6427	0.0000	238.6427	0.2210	2020.2153	0.0000
exp	218.9263	0.3222	1104.1247	0.0000	138.8481	1.0000	2075.0177	0.0000

4.2. LSDV and System GMM Results

The objective of this paper is to study the relationship between public debt and economic growth conditioned by governance in sample countries. In our analysis, we adopt a step-wise method to treat the potential endogenous problem. Firstly, we apply lags on right-hand variables, then incorporate the FE through our regression and then we apply the IV approach as this approach is useful in addressing the endogeneity problem. Although, the IV approach is useful for treating the endogeneity problem but the main problem with IV approach is to find the suitable instruments associated with the exogenous variables and are not associated with the error terms. At the end, we use the system GMM estimation to check robustness of our results. In applying the system GMM estimator, different lags can be applied in order to measure the causality. Results are different with different lags [91]. The main reason behind using more than one lag is there might be serial correlation error term still remaining. That is, the Arellano–Bond AR-2 is rejecting the null hypothesis of second order serial correlation of the first differenced error term. In this scenario, the better idea is to include further lags of the dependent variable. In applying system GMM estimator, higher order autoregressive lags can capture the serial correlation in the error. This problem can be solved by using deeper lags as instrument. First of all, we apply the lags of one to four years on the dependent variable depending on the significant values.

Table 4 provides results for the effect of governance on debt-growth nexus using static panel LSDV in first two columns and two-step system GMM in last two columns. In column 1, public debt and governance are included and the results show that public debt has negative and significant impact on economic growth, while governance also has negative and significant impact on economic growth because in our model, most of the countries have low level of governance.

Table 4. Estimate results of Panel LSDV and two-step system GMM: effects of public debt on GDP growth (1996–2015).

	1	2	3	4
Yit	FE	FE	GMM	GMM
yit−1			0.9033 *** (0.0047)	0.9283 *** (0.0079)
yit−2			−0.1588 *** (0.0057)	−0.1857 *** (0.0070)
yit−3			0.1213 *** (0.0032)	0.2203 *** (0.0068)
yit−4			−0.0293 *** (0.0035)	−0.1314 *** (0.0073)
Gov	−0.1085 *** (0.0248)	−0.0372 (0.0253)	−0.0262 *** (0.0013)	0.0232 *** (0.0030)
Debt	−0.2863 *** (0.0199)	−0.7448 *** (0.0515)	−0.2028 *** (0.0043)	−0.3318 *** (0.0088)
debt × gov		0.0910 *** (0.0095)		0.0395 *** (0.0014)
Tfp	0.9432 *** (0.0587)	0.8593 *** (0.0579)	0.0866 *** (0.0110)	0.1361 *** (0.0128)
Inf	−0.1216 *** (0.0097)	−0.1104 *** (0.0095)	0.0228 *** (0.0009)	0.0244 *** (0.0009)
Gs	0.2222 *** (0.0440)	0.1942 *** (0.0430)	−0.0686 *** (0.0057)	−0.0296 *** (0.0107)
Exp	0.5629 *** (0.0292)	0.5381 *** (0.0286)	0.1649 *** (0.0057)	0.1648 *** (0.0097)
Constant	10.7785 *** (0.1777)	10.2764 *** (0.1811)	1.5592 *** (0.0429)	1.4957 *** (0.0577)
Observations	1925	1925	1366	1366
R-squared	0.4112	0.4398		
Number of countries	106	106	106	106
Sargan test			103.7508	100.9895
p-value			1.0000	0.8029
First-order serial correlation			−4.38	−4.3769
p-value			0.0000	0.0000
Second-order serial correlation			−0.56519	0.72125
p-value			0.5719	0.4708

Notes: First two columns provide the results of LSDV and last two columns provide the results of dynamic two-step system GMM mean to estimate the effect of public debt on GDP growth using WGI's dataset. *** is significant at the 1% level.

These findings conform to previous literature, such as [92–94], whereas [38,95,96] report the adverse effect of bad governance. Column 2 provides the interaction term between public debt and economic growth. Our findings show that the public debt is a function of governance. A country's debt level is accumulated at the governance level and public debt has a negative effect on economic growth; these results are consistent with previous studies. The overall effect is determined by the Equation (4), which shows that public debt and economic growth has a negative and significant relationship when the

threshold value of governance is below 8.18. Similarly, debt has positive influence when the value of a country's governance is higher than the threshold value.

In Table 4, columns 3 and 4 provide the results of dynamic system GMM estimation used in this paper as a benchmark for checking the robustness of FE estimation. Column 3 presents results without interactive term. In column 3, public debt and governance coefficients are negative and significant which show the consistency with previous studies as we explained earlier. Column 4 presents the results of interaction term between public debt and economic growth; the result shows that the debt negatively impacts economic growth when a country has low governance level and debt boosts a country's growth when governance level is high. The threshold level of debt from negative to positive is 8.4. This shows that debt-growth relationship is negative when the governance value is below 8.4; similarly, a positive and significant relationship whenever a country's governance value is above 8.4. Moreover, if we take the estimation results of column 4, we can calculate the critical and marginal values of each country in the sample as countries across have different levels of governance. According to the results of two-step system GMM, if all other things are unchanged, the marginal effect can be calculated as $(-0.3318 + 0.0395 \times \text{gov})$. On the basis of mean, minimum and maximum value of governance, we calculate the marginal effect becomes -0.1183 , -0.2840 and 0.0241 respectively. This shows that the extent to which marginal effects change between countries is dependent on the level of governance.

Moreover, in our analysis, we conduct the Sargan–Hansen test of over-identifying restrictions and the Arellano–Bond test for zero autocorrelation in first-difference test of autocorrelation to check the validity of instruments. Results of Sargan–Hansen test clearly show that we cannot reject the null hypothesis as p -value is a long way away from the indicated problems with the instruments. Therefore, this supports the validity of these instrument variables. Moreover, Arellano–Bond test indicates that the first order is serially correlated and is rejected while the output result of second order shows that there is no serial correlation.

4.3. Robustness Check

This section reports the robustness of our estimation results.

4.3.1. Using Alternate Proxy of Governance Variable

First, we include ICRG dataset that can be used as a proxy of governance as it is used in most of the previous literature, for example [11,97]. Table 5 provides estimation results of alternate proxy use for governance variable. We use the ICRG dataset as a proxy to measure governance. These results can be seen to be almost identical to the results of estimation using WGI dataset. It can be seen from estimation results presented in Table 4 that there is consistency in our main results which confirms intermediating role of governance in debt-growth relationship. Our estimation results show that public debt is positively impacting economic growth due to higher (good) level of governance.

Moreover, the threshold value separating negative and positive impact of public debt is calculated using Equation (4). In case of static panel LSDV estimation, the threshold is 8.76 and in case of two-step system GMM, the value of threshold is 8.74. This means that governance level needs to be higher if public debt is to positively affect economic growth. As two-step system GMM is a benchmark in this paper, we consider the results of two-step system GMM. Hence the estimation results using ICRG show that if all other things remain unchanged, an increase of one point in the level of governance leads to an increase in GDP per capita by (slope = $-0.5797 + 0.063 \times \text{gov}$). Therefore, the minimum threshold level (gov = 8.74) is required for public debt to be positive.

Table 5. Robustness test: estimate results of Panel LSDV, and two-step system GMM estimates: effects of public debt on GDP growth (1996–2015).

	1	2	3	4
Yit	FE	FE	GMM	GMM
yit−1			0.8582 *** (0.0068)	0.8354 *** (0.0099)
yit−2			−0.1086 *** (0.0064)	−0.1169 *** (0.0071)
yit−3			0.0909 *** (0.0038)	0.1998 *** (0.0056)
yit−4			−0.0223 *** (0.0071)	−0.0865 *** (0.0092)
Icrg	−0.1800 *** (0.0234)	−0.0775 *** (0.0258)	0.0193 *** (0.0051)	0.0948 *** (0.0078)
Debt	−0.2628 *** (0.0203)	−1.1201 *** (0.1016)	−0.1789 *** (0.0068)	−0.5797 *** (0.0287)
debt × icrg		0.1278 *** (0.0149)		0.0663 *** (0.0036)
Tfp	0.9332 *** (0.0639)	0.8314 *** (0.0635)	0.1248 *** (0.0180)	0.1418 *** (0.0403)
Inf	−0.0991 *** (0.0101)	−0.0880 *** (0.0099)	0.0184 *** (0.0011)	0.0196 *** (0.0012)
Gs	0.2231 *** (0.0504)	0.1542 *** (0.0499)	−0.0835 *** (0.0092)	−0.0868 *** (0.0189)
Exp	0.7095 *** (0.0340)	0.6916 *** (0.0333)	0.2967 *** (0.0092)	0.3240 *** (0.0107)
Constant	11.6922 *** (0.1960)	10.7954 *** (0.2181)	1.6490 *** (0.0958)	1.1037 *** (0.1450)
Observations	1665	1665	1181	1181
R-squared	0.4512	0.4760		
Number of countries	92	92	92	92
Sargan test			90.28598	87.73857
p-value			1.0000	0.9678
First-order serial correlation			−4.1098	−4.0877
p-value			0.0000	0.0000
Second-order serial correlation			−1.2407	1.2407
p-value			0.2147	0.7400

Notes: First two columns provide the results of LSDV and last two columns provide the results of dynamic two-step system GMM mean to estimate the effect of public debt on GDP growth using ICRG dataset. *** is significant at the 1% level.

Similarly, as in the previous section, the validity of instrument variables is checked by Sargan–Hansen test of over-identifying restrictions and the Arellano–Bond test for zero autocorrelation in first-difference test of autocorrelation. Results of Sargan–Hansen test clearly support the validity of instruments and Arellano–Bond test indicates that the first order AR is serially correlated and is rejected but the second order AR cannot be rejected. The results suggest that the impact of public debt on economic growth depends on the governance level in sample countries. Countries with higher governance level experience lesser adverse effect of public debt.

4.3.2. Using 3-Years Non-Overlapping Averaged Estimates to Verify Our Results (in Case of WGIs as Proxy of Governance Variable)

We use the averaged variables to measure the long-run effects. For this purpose, we use a three-year averaged model. We averaged our model of 20 years into 7 non-overlapping periods; first six periods consist of 3-years non-overlapping periods while the last period consists of 2-years non-overlapping period. Table 6 provides the estimation results of three-year averaged model using WGIs dataset as a proxy to measure governance. The results are consistent and validate our estimation results as presented in full sample (see Table 4).

Table 6. Robustness test: 3-years non-overlapping averaged estimates of Panel LSDV and two-step system GMM estimates: effects of public debt on GDP growth (1996–2015).

	1	2	3	4
Yit	FE	FE	GMM	GMM
yit−1			0.7321 *** (0.0161)	0.6948 *** (0.0165)
yit−2			−0.0207 (0.0180)	−0.0239 (0.0185)
yit−3			−0.1668 *** (0.0149)	−0.1198 *** (0.0119)
gov	−0.1590 *** (0.0480)	−0.0782 (0.0477)	0.0563 *** (0.0150)	0.1067 *** (0.0152)
debt	−0.2967 *** (0.0357)	−0.8605 *** (0.0892)	−0.1060 *** (0.0136)	−0.3373 *** (0.0287)
debt × gov		0.1099 *** (0.0160)		0.0393 *** (0.0037)
tfp	1.2606 *** (0.1860)	1.1578 *** (0.1798)	0.0837 (0.0517)	0.1583 *** (0.0420)
Inf	−0.2124 *** (0.0193)	−0.1929 *** (0.0188)	0.0107 *** (0.0025)	0.0113 *** (0.0023)
Gs	0.8129 * (0.4328)	0.7186 * (0.4170)	−0.7836 *** (0.1215)	−0.6288 *** (0.0927)
Exp	0.6579 *** (0.0569)	0.6197 *** (0.0551)	0.0577 *** (0.0133)	0.0554 *** (0.0099)
Constant	9.4842 *** (0.2977)	9.0775 *** (0.2928)	3.7954 *** (0.1031)	3.3903 *** (0.1111)
Observations	699	699	292	292
R-squared	0.4304	0.4726		
Number of countries	106	106	104	104
Sargan test			75.57759	80.52486
p-value			0.2471	0.3395
First-order serial correlation			−3.8804	−3.7042
p-value			0.0001	0.0002
Second-order serial correlation			0.0002	0.63576
p-value			0.3278	0.5249

Notes: First two columns provide 3-years averaged results of LSDV and last two columns provide the results of dynamic two-step system GMM mean to estimate the effect of public debt on GDP growth using WGIs dataset. *** and * are significant at the 1% and 10% levels respectively.

4.3.3. Using 3-Years Non-Overlapping Averaged Estimates to Verify Our Results (in Case of ICRG as Proxy for Governance Variable)

In this section, we check robustness by averaging variables to measure the long-run effects. For this purpose, we use a three-year averaged model. We averaged our model of 20 years into 7 non-overlapping periods; same as done in the previous section; first six periods consist of 3-years non-overlapping periods while the last period consists of 2-years non-overlapping period. Table 7 provides the estimation results of three-year averaged model using ICRG dataset as a proxy to measure governance. In this case, estimation results are consistent with full sample.

Table 7. Robustness test: 3-years non-overlapping averaged estimates of Panel LSDV and two-step system GMM estimation: effects of public debt on GDP growth (1996–2015).

	1	2	3	4
Yit	FE	FE	GMM	GMM
yit−1			0.7399 *** (0.0120)	0.7289 *** (0.0052)
yit−2			−0.0648 *** (0.0134)	−0.0729 *** (0.0073)
yit−3			−0.1770 *** (0.0116)	−0.1355 *** (0.0057)
icrg	−0.3486 *** (0.0447)	−0.1738 *** (0.0472)	−0.0657 *** (0.0101)	0.0464 *** (0.0108)
debt	−0.2124 *** (0.0358)	−1.5974 *** (0.1707)	−0.1113 *** (0.0074)	−0.5856 *** (0.0274)
debt × icrg		0.2034 *** (0.0246)		0.0696 *** (0.0039)
tfp	1.9257 *** (0.2272)	1.5851 *** (0.2182)	0.1193 *** (0.0365)	0.2014 *** (0.0226)
Inf	−0.0063 *** (0.0009)	−0.0051 *** (0.0009)	0.0033 *** (0.0005)	0.0041 *** (0.0003)
gs	0.8055 (0.5719)	0.3220 (0.5425)	−1.1293 *** (0.0980)	−1.0163 *** (0.0476)
exp	1.6085 *** (0.1937)	1.7933 *** (0.1840)	0.0658 *** (0.0215)	0.0836 *** (0.0235)
Constant	9.0311 *** (0.3664)	8.0914 *** (0.3638)	4.9180 *** (0.1255)	3.8786 *** (0.0966)
Observations	642	642	274	274
R-squared	0.3736	0.4438		
Number of countries	92	92	92	92
Sargan test			76.15548	78.99773
p-value			0.3162	0.4789
First-order serial correlation			−3.9963	−4.0437
p-value			0.0001	0.0001
Second-order serial correlation			1.4445	1.0019
p-value			0.1486	0.3164

Notes: First two columns provide 3-years averaged results of LSDV and last two columns provide results of dynamic two-step system GMM mean to estimate the effect of public debt on GDP growth using ICRG dataset. *** is significant at the 1% level.

5. Conclusions

Previous literature unveiled the fact that public debt adversely affects economic growth after a certain debt threshold level. Furthermore, the importance of governance in stimulating economic growth cannot be ignored. In this context, we examine the intermediating effect of governance on the debt-growth relationship. We use the sample of 106 countries during the period 1996–2015 for our empirical estimation. Previous studies suggest that other

regressors are considered to be endogenous with GDP growth. To deal with specific effect and endogeneity, we employ the system GMM in our empirical estimation. Moreover, the autocorrelation is tested by using Arellano and Bond correlation test.

Our empirical findings show the nonlinear pattern between debt-growth relationships in the presence of governance. Although, Public debt has negative effect on economic growth but our results show that the interaction term between public debt and economic growth is significant and positive which reveals that after a certain threshold value of governance the adverse effect of public debt turns to be positive. Also, when we use the ICRG dataset as a proxy to measure the governance, the results show the same nonlinear pattern as the results when we used WGI's dataset as a proxy to measure the governance variable. Moreover, for robustness checking of our results, we used the 3 years averaged data for both proxies of governance variable. In both cases, our results show a nonlinear pattern which indicated the consistency of our results in this paper.

These results suggest that poor governance accumulate the public debt means that poor governance magnifies the effect of debt on economic growth. So, we can say good governance is important in order to use the public debt in an efficient and effective way and governance is significant intermediating variable in debt-growth relationship.

In sum, good governance is important to lessen the adverse effect of public debt and make the good use of public debt in development of a country. The developing and underdeveloped countries are suffering badly to higher level of public debt because these countries are facing poor quality of state governance. Poor quality of state governance worsens the adverse effect of debt. So, the governments seeking to reduce the adverse effect of public debt need to improve the quality of governance. Countries facing the adverse effect of public debt need to improve the governance quality to encourage investment; reduce the corruption level, effective use of government spending; improve the competition in market and collection of revenues and taxes, effective regulations to enhance the competitiveness. In this way, country's competitiveness can be improved which results in improving the individuals' life quality.

The impact of public debt on economic growth can be described through different channels. One of them is present sanitary crisis which has increased the debt level at very high values. The policy makers especially in developing countries need to consider this channel for future research. Moreover, considering the non-linearity and threshold regression can also be useful for future research by using the recent data especially during the pandemic time when the debt level is increased in many countries.

Author Contributions: Data curation, Q.A.; formal analysis, Q.A. and M.R.; funding acquisition, L.J.; supervision, L.J.; methodology, M.R.; software, Q.A. and M.R.; review and editing, S.F. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Tianjin "131" innovative talent team project: Nankai university 100 young academic leaders (Team) Training support program, Tianjin philosophy and social sciences foundation key projects (2019), China.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data used in this study is available upon request from the corresponding author.

Acknowledgments: We would like to acknowledge Nankai University, Tianjin, China for administrative and moral support. We are also grateful to the editor and anonymous referees for their valuable comments and suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. List of Countries.

Angola	Croatia	Ireland	Namibia	Slovenia
Argentina	Cyprus	Italy	Netherlands	South Africa
Armenia	Czech Republic	Japan	New Zealand	Spain
Australia	Denmark	Jordan	Nicaragua	Sri Lanka
Austria	Ecuador	Kazakhstan	Niger	Sweden
Bahrain	Equatorial Guinea	Kenya	Nigeria	Switzerland
Barbados	Estonia	Korea, Rep.	Norway	Tajikistan
Belgium	Fiji	Kuwait	Panama	Tanzania
Benin	Finland	Kyrgyz Republic	Paraguay	Thailand
Bolivia	France	Lao PDR	Peru	Togo
Botswana	Gabon	Lesotho	Philippines	Tunisia
Brazil	Germany	Lithuania	Poland	Turkey
Bulgaria	Greece	Luxembourg	Portugal	Ukraine
Burkina Faso	Guatemala	Malaysia	Romania	United Kingdom
Burundi	Honduras	Malta	Russian Fed.	United States
Cameroon	Hong Kong	Mauritania	Rwanda	Uruguay
Canada	Hungary	Mauritius	Saudi Arabia	Venezuela, RB
Chile	Iceland	Mexico	Senegal	Zimbabwe
China	India	Moldova	Serbia	
Colombia	Indonesia	Mongolia	Sierra Leone	
Costa Rica	Iran, Islamic Rep.	Morocco	Singapore	
Côte d'Ivoire	Iraq	Mozambique	Slovak Republic	

Notes: Barbados, Benin, Burundi, Equatorial Guinea, Fiji, Kyrgyz Republic, Lao PDR, Lesotho, Mauritania, Mauritius, Moldova, Panama, Rwanda and Tajikistan are not included in analysis using ICRG dataset because of unavailability of dataset.

Table A2. Correlation matrix 1.

Variables	GDP	DEBT	TFP	INF	GS	EXP	GOV
GDP	1.0000						
DEBT	0.0252	1.0000					
TFP	0.6179	−0.0718	1.0000				
INF	−0.1300	0.0604	−0.1020	1.0000			
GS	−0.0237	0.0250	−0.1492	0.1003	1.0000		
EXP	0.5267	−0.0963	0.3799	−0.0665	0.0869	1.0000	
GOV	0.7070	−0.0541	0.7155	−0.1877	−0.0423	0.4878	1.0000

Notes: This correlation matrix is between variables when using WGI dataset as a proxy for governance variable and missing values are replaced by mean value.

Table A3. Correlation matrix 2.

Variables	GDP	DEBT	TFP	INF	GS	EXP	ICRG
GDP	1.0000						
DEBT	0.0566	1.0000					
TFP	0.6384	−0.0182	1.0000				
INF	−0.1269	0.0497	−0.0807	1.0000			
GS	−0.1050	−0.0088	−0.1209	0.0861	1.0000		
EXP	−0.4813	−0.0802	0.3656	−0.0565	−0.0235	1.0000	
ICRG	0.6515	−0.0603	0.6457	−0.1571	0.0592	0.4435	1.0000

Notes: This correlation matrix is between variables when using ICRG dataset as a proxy for governance variable and missing values are replaced by mean value.

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