The impact of local government debts on economic growth in China: From the perspectives of general obligation bonds and revenue bonds

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Abstract Since the financial crisis of 2008, the Chinese government has implemented a series of fiscal policies to stimulate local investment and economic development, with bond issuance being one of the key measures. Beginning in 2015, local government revenue bonds were introduced alongside the long-standing general obligation bonds. Notably, the issuance of these bonds saw a significant increase following the 2019 pandemic, aimed at injecting funds into profitable major projects to stimulate local economic recovery. This research aims to verify the relationship between local government debt and economic development by investigating the impact of bond stock on economic growth across 31 provinces in China. Utilizing panel data from 2015 to 2022 and employing the system GMM testing methodology, the analysis reveals that a 1% increase in the stock of general obligation bonds in the previous year leads to a 0.039% increase in GDP in the current year. In contrast, a 1% increase in the stock of revenue bonds corresponds to a 0.066% decrease in GDP. The findings underscore the importance of general obligation bonds in fostering economic growth, while highlighting that the stock of revenue bonds may not only fail to promote economic recovery but could also bring about certain negative effects. The results emphasize the imperative of prudent management of government revenue bonds and the urgent need for further research to address the effectiveness of expanding their issuance and its implications for economic growth. Properly managing these bonds is crucial to ensuring that fiscal policies achieve their intended economic outcomes without inadvertently causing harm.

Keywords: economic growth, general obligation bond, revenue bond, system GMM

1. Introduction

In the aftermath of the 2008 financial crisis, lingering repercussions continue to cast a shadow on the global economy. The profound impact of the COVID-19 pandemic has exacerbated the deceleration and, in some cases, recessionary trends in the economic growth of numerous regions worldwide (Dieppe, 2021). To mitigate adverse effects and promote economic development, the Chinese government has implemented proactive fiscal policies. For instance, the constant issuance of local government bonds has been carried out to stabilize steady economic growth (Jiang & Dai, 2021). These measures necessitate the collaboration of local governments, leading to a continuous escalation of local government debt (LGD). Concurrently, with the ongoing development of urbanization in China, the government has introduced a people-oriented new type of urbanization, demanding heightened infrastructure that aligns with the needs of the populace and urbanization (Qi et al., 2020). Consequently, fiscal expenditures have been on the rise.

Government debt can be seen as a unique form of fiscal revenue (Reis, 2022). When the government’s fiscal revenue is insufficient to meet the needs of urban construction and industrial development, the government resorts to borrowing to increase fiscal revenue, stimulating economic growth (Hilton, 2021). In China, general obligation bonds (GOBs) and revenue bonds (RBs) are two common types of LGBs issued by local governments. GOBs derive their financial support from the unwavering trust, financial stability, and revenue-raising authority of the government entity responsible for their issuance. These bonds are typically used to fund essential public projects such as schools, infrastructure, or other community facilities. The repayment of general obligation bonds relies on the government’s ability to raise taxes and generate revenue from its general funds. On the other hand, RBs are specifically tied to the income generated by a particular project or facility. Unlike GOBs, RBs are not typically backed by the government’s taxing authority. Instead, they are supported by the revenue streams generated by the project for which the bonds were issued.
According to the Ministry of Finance, as of the end of February 2023, local outstanding debt reached CNY 36.2 trillion in China, with GOBs accounting for 40.6% and RBs accounting for 59.4%. This represents a substantial increase from the CNY 16.47 trillion recorded at the end of 2017, with GOB accounting for 61.2% and RB accounting for 38.8%. Notably, the scale of LGBs, particularly in the form of revenue bonds, has grown rapidly, posing increasing risks and garnering increasing attention from both societal and academic circles (Bordo & Duca, 2021). This practice is not surprising given that governments worldwide have consistently resorted to debt financing to address budgetary deficits, obtaining funds either from domestic or external markets. The primary motivation for such borrowing stems from the imperative to narrow the disparity between investment and savings (Likita, 2010). In instances where there is an inadequacy of savings to meet the actual investment requirements, governments must actively intervene to bridge this gap. Developing countries often grapple with a cycle of low productivity, diminished savings, and restricted income, resulting in a dearth of internal capital formation (Adedopo et al., 2007). However, the servicing of principal loan amounts and interest obligations contributes to the accumulation of debts.

The fundamental relationship between LGD and regional economic growth can be summarized in three points: (1) Local borrowing can address fiscal deficits, thereby stimulating economic growth, while also posing the risk of amplifying fiscal strains that may impede economic progress (Rangarajan & Srivastava, 2005). The differential impact depends on the direction and efficiency of fund utilization, as well as the debt-bearing capacity of local governments (Lv, 2015). (2) If LGD is within a reasonable range, people's livelihoods can improve, and they can respond to crises (Cecchetti et al., 2011). However, if local government funds are abused and exceed reasonable limits, they can intensify fiscal pressure, crowd out private investment, and shift from a positive to a negative corrective role in addressing market failures (Cao & Zhang, 2020). (3) Different regions with varying levels of development will experience different effects of LGD due to differences in fund utilization direction, fund utilization efficiency, and regional debt repayment capacity (Guan & Fan, 2020). Prior relevant studies have indicated that the stimulating effect on regional economic growth tends to slow down as the scale of LGD expands. For instance, Cheng and Gong (2014) noted that when LGD reaches the international cautionary threshold of 60% or more, it may even impede local development in China. Additionally, China's regional development exhibits significant imbalances, leading LGD to have varying impacts on regional economic growth. With the increase in per capita urban investment bond balances, the national per capita GDP also increases. Eastern provinces, which have higher economic development levels and greater debt repayment capacity, contrast with central and western provinces, which have lower economic development levels and relatively lower debt repayment capacity.

The synthesis of literature findings revealed a varied landscape concerning the impact of government debt on economic growth. While some studies have indicated a positive correlation with economic growth, others have revealed a negative association (Murungi & Okiro, 2018). According to the analysis put forth by Kregel (1994), an upward trend in government spending relative to national income offers the government an opportunity to adjust and refine fiscal policy strategies. This adaptability allows for increased inputs during economic downturns, furnishing a dependable impetus for the reinstatement of full employment. Deng et al. (2013) argue that a significant relationship exists between the magnitude of national debt and the trajectory of economic growth, underscoring the importance of maintaining a prudent level of deficit and national debt. Barta (2018) called for cautions against the excessive issuance of public debt, as it may curtail labor and investment intentions, thereby negatively influencing the accumulation of social capital. There is controversy regarding the effects of LGD on regional economic growth, which can be broadly categorized into three types: positive promotion, negative hindrance, and nonlinear relationships.

The first mainstream viewpoint posits that LGD plays a positive role in promoting regional economic growth. Keynes (1936) managed demand to regulate the economy, and government debt is considered one of the crucial means for public demand management. An increase in government debt is seen as beneficial for demand management and stimulating economic growth. Keynes' postulation on public debt has undergone nuanced refinement and extension by a plethora of adherents within the Keynesian school of economic thought. Alvin Hansen (1939), the "American Keynesian," advanced the notion that upon reaching a certain threshold of social productivity, the government impacts circulation value to latent savings through indebtedness. By directing these funds into domains such as education and health, the government ostensibly returns savings to the populace, thereby augmenting overall societal wealth. Hansen's contribution extended the Keynesian perspective from its customary focus on short-term, cyclical, and transitory aspects to encompass long-term, secular, and enduring dimensions. This extension gave rise to the influential "long-term stagnation theory," positing that a perpetual deficiency in demand may persist, and thus, if deficit spending can stimulate investment in the short term, it is equally efficacious in the long term. According to the exposition by British economist Coddington (1976), Keynesian economic policy embodies three principal attributes: the argument in favor of intentional and countercyclical fiscal strategies, the purposeful increase in budgetary shortfalls, and the assertion that government outlays do not supplant private expenditure.

Maluei (2015) applied a dataset of Kenya from 1970 to 2014 and contended that government debt represents a dual impact, internally enhancing consumption and investment along with societal wealth, while externally causing wealth reduction due to the outflow of principal and interest beyond domestic boundaries. Swamy (2015) noted a positive impact on debt resulting from trade openness, final consumption, expenditure, and gross fixed capital formation. Conversely, a negative influence on debt was observed in response to population growth, inflation, government expenditure, foreign direct investment, and savings through indebtedness. By directing these funds into domains such as education and health, the government adherents within the Keynesian school of economic thought. Alvin Hansen (1939), the "American Keynesian," advanced the notion that upon reaching a certain threshold of social productivity, the government impacts circulation value to latent savings through indebtedness. By directing these funds into domains such as education and health, the government ostensibly returns savings to the populace, thereby augmenting overall societal wealth. Hansen's contribution extended the Keynesian perspective from its customary focus on short-term, cyclical, and transitory aspects to encompass long-term, secular, and enduring dimensions. This extension gave rise to the influential "long-term stagnation theory," positing that a perpetual deficiency in demand may persist, and thus, if deficit spending can stimulate investment in the short term, it is equally efficacious in the long term. According to the exposition by British economist Coddington (1976), Keynesian economic policy embodies three principal attributes: the argument in favor of intentional and countercyclical fiscal strategies, the purposeful increase in budgetary shortfalls, and the assertion that government outlays do not supplant private expenditure.

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Another viewpoint, supported by many theories, contends that government debt issuance is a primary means to offset fiscal deficits and that debt repayment will increase fiscal deficits. Adam Smith suggested that excessive government debt would increase taxation, and an overly heavy tax burden could lead merchants and factories to transfer monetary capital to countries with lighter tax burdens, causing losses to the nation. Ricardo (1951) adhered to the "harmful theory of public debt", stating in his book Principles of Political Economy and Taxation that the effect of government debt on the economy is not solely the transfer of interest payments but rather the adverse consequence of public debt exerting pressure on the existing capital. Moreover, he contended that the government, by resorting to debt rather than taxation to finance its expenditures, creates an illusion of economic prosperity, as the public bears a lesser tax burden for servicing debt interest, resulting in a wasteful allocation of resources. While certain government debts exhibit manageable characteristics, others prove to be less tenable, as exemplified by the Greek government debt crisis that unfolded in 2009. Pegkas (2018) explored the nuanced relationship between general government debt and economic growth in Greece from 1970 to 2016, employing threshold models to uncover potential threshold effects. The findings supported a negative correlation between general government debt and economic growth. The ensuing economic repercussions elicited widespread criticism and societal discontent toward the recovery plan, primarily due to escalating unemployment rates, deterioration of public services, and a decline in real income. These adverse outcomes were attributed to governmental policies encompassing expenditure strategies, institutional closures and mergers, and public service staff layoffs (Markantonatuo, 2013).

Checherita-Westphal and Rother (2010) investigated the typical repercussions of government debt on the growth of per capita GDP in a study encompassing 12 euro area countries over nearly four decades, starting in 1970. Their analysis revealed a nonlinear relationship between debt and growth, demonstrating a critical threshold at approximately 90-100% of GDP. Past this point, the government debt-to-GDP ratio was found to have a detrimental impact on long-term economic growth. In a parallel context, the United States of America grappled with a burgeoning national debt that surpassed 100% of its gross domestic product. The genesis of the U.S. debt predicament traces back to 1970, characterized by a surge in government expenditure unaccompanied by a proportional increase in tax collection (Thornton, 2012). Calderón and Fuentes (2013) assessed the inhibitory impact of public debt on economic growth and the potential mitigating role of economic policies across various countries from 1970 to 2010. Their analysis revealed a consistently negative and robust association between public debt levels and economic growth. Wu (2014) unveiled noteworthy regional variations by explaining that certain regions exhibit debt-to-Gross Regional Product (GRP) ratios proximate to critical debt thresholds, covering the period 2010-2012 for 30 Chinese regions. Swamy (2015) explored the intricate connection between government debt and economic growth by encompassing diverse country groupings and incorporating considerations of economic, political, and regional variations based on a substantial dataset. The nonmonotonic connection suggested that an increase of 10 percentage points in the debt-to-GDP ratio is associated with an average growth decrease spanning from 2 to 23 basis points.

Elom-Obed et al. (2017) undertook an examination of the repercussions of escalating public debt on Zambia’s economic growth between 1980 and 2008. The findings substantiated a long-term negative association between public debt and economic growth, demonstrating the effects of crowding-out and debt overhang phenomena. Larkey et al. (2018) conducted research using data from 50 African countries spanning the period from 1980 to 2015 to examine the influence of public debt on economic growth. By utilizing both ordinary least squares estimation and the generalized method of moment estimation, their analysis revealed a nonlinear negative relationship between public debt and economic growth. Baidoo et al. (2021) employed an autoregressive distributed lag model with annual time series data spanning from 1980 to 2017 for Ghana and revealed a deleterious influence of government debt on economic growth. Utilizing macroeconomic data spanning the period 2000 to 2020, Tang (2022) proposed that LGD in China has surpassed a reasonable threshold, resulting in a pronounced crowding-out effect of debt expansion on the real economy, extending beyond jurisdictional boundaries with notable spatial spillover effects.

In addition, some experts and scholars have summarized the long-term economic effects of debt, suggesting that governments should control LGD within a reasonable range and not endlessly expand debt for economic growth. By analyzing the relationship between LGD and economic growth, scholars have found that LGD should be controlled before reaching a balance or turning point, although there is no final conclusion on what this balance point is. For instance, Mencinger et al. (2014) conducted an in-depth exploration of the transmission pathways that elucidate the short-term ramifications of public debt on economic growth. The result inferred that for ‘old’ EU member states, the debt-to-GDP turning point, where the positive effect of accumulated public debt shifts to a negative effect, falls within the range of 80% to 94%, whereas for ‘new’ EU member states, the turning points range between 53% and 54%. Mao and Huang (2018) argued that if the debt level has
not reached a threshold, local government borrowing will have a significant positive effect, promoting economic development. However, if the debt level surpasses the threshold, the negative effects of local government borrowing predominate, slowing down or even inhibiting economic growth.

Zhao et al. (2019) explored the correlation between LGD and regional economic growth in China, revealing the substantial impact of spatial agglomeration on regional economic growth. They noted that once the magnitude of LGD surpasses a specific threshold, economic growth experiences suppression due to the displacement of private investment and the decrease in public expenditure. Chen and Li (2019) empirically investigated the government debt and economic growth of 30 provinces and municipalities in China from 1995 to 2010, where governmental fiscal constraints were absent, and a discernible inverted U-shaped relationship manifested between them. Under conditions of governmental debt constraints, there is an observable decrease in the economic growth rate concomitant with the progressive escalation of government debt. Hilton (2021) used annual time-series data spanning from 1978 to 2018, and the findings indicated an absence of a short-term causal association between public debt and GDP; however, unidirectional Granger causality emerges from public debt to GDP in the long term. Yu (2023) employed a methodological amalgamation of theoretical exploration and empirical investigation to scrutinize the intricate relationship between LGD and economic growth in Chinese provinces, positing that the effect of LGD on economic growth experiences initial enhancement followed by suppression.

In essence, the influence of debt on the economy is significantly contingent upon the historical stage in which different countries or regions find themselves. Moreover, numerous scholars have postulated the existence of an optimal debt-to-GDP ratio, emphasizing a threshold beyond which the deleterious effects of debt become pronounced (Mencinger et al., 2014; Swamy, 2015; Zhao et al., 2019; Pegkas, 2019; Tang, 2022). Notably, China’s annual debt ceiling continues to increase (China Electronic Local Government Bond Market Access, 2024), posing concerns despite the apparent moderation of new debt within a seemingly rational range. This perpetual expansion of the debt ceiling is unlikely to be a sustainable solution. Furthermore, the landscape of China’s LGD has undergone significant structural adjustments in recent years, with a gradual reduction in the proportion of GOB and a corresponding dominance of RB. However, there is currently a dearth of research indicating whether this transition will yield discernible benefits for long-term economic development. The effectiveness of this shift in promoting sustained economic growth remains an open question that warrants further investigation.

2. Materials and Methods

2.1. Research scope

Given the importance of LGD and the disparities among previous research results regarding the impact of LGD on economic growth, this study strives to address the research gap that has focused on the economic impact of GOB and RB in China. Based on data availability, the research objects include 31 provincial regions (23 provinces, 4 municipalities, and 4 autonomous regions) in China. Panel data across provincial regions over the period from 2015 to 2023 are selected, considering that China commenced the issuance of RB in 2015. To investigate whether LGD plays a predominant role in promoting economic growth in China, this study utilizes the stocks of GOB and RB by local governments as proxy indicators for the two main types of LGD to establish a model to analyze the impact of LGD on regional economic growth. A distinctive feature of this study lies in its unique time frame, choice of variables, selected countries, and empirical methodology, setting it apart from existing research. The anticipated outcomes are poised to offer guidance for governmental initiatives within the domain of local debt governance. Notably, because RB issuance commenced only in 2015, despite achieving a remarkable exponential increase in scale within a few short years, empirical studies examining the relationship between LDSB and economic growth in China are scarce. Hence, this study aims to contribute valuable insights to enrich the literature in this domain.

Considering the current situation, only provincial governments, the four directly administered municipalities, and the governments of planned single-city districts are qualified to issue LGBs. The selected research sample for this study includes 31 Chinese provincial-level regions from 2015 to 2023, encompassing provinces, autonomous regions, and directly administered municipalities. The dependent variable used is GDP (100 million RMB yuan). The key explanatory variables, the stock of local government general bonds (100 million RMB yuan) and the stock of revenue bonds (100 million RMB yuan), are derived from the China Local Government Bond Information Disclosure Platform. The intricate relationships between LGD and macroeconomic variables give rise to potential endogeneity challenges in empirical modeling. This calls for a judicious selection of estimation models, with consideration of advanced econometric techniques, to ensure robust and unbiased estimates of the impact on overall economic growth. Acknowledging these complexities, the control variables used in this study are as follows: social capital stock (CS) is proxied by the total fixed asset investment of the whole society (100 million RMB), human capital level (HC) is proxied by total employment (10 thousand), education (EDU) is proxied by total expenditure on education (100 million RMB), tax income is proxied by general public budget revenue (100 million RMB), and foreign trade (FT) is proxied by total import and export volume (100 million RMB). The descriptive statistics for each variable are presented in Table 1.
2.2. Model Specification

Due to the different units of measurement for various types of data, the logarithmic form of the equation is employed to linearize the model, thereby avoiding estimation biases arising from unit discrepancies.

\[
\log(Y_{it}) = a_0 + a_1 \log(Y_{i,t-1}) + a_2 \log(GOB_{it}) + a_3 \log(RB_{it}) + b_1 \log(CS_{it}) + b_2 \log(HC_{it}) + b_3 \log(EDU_{it}) + b_4 \log(TA_{it}) + \varepsilon_{it}
\]  

(1)

where \(Y_{it}\) represents GDP, \(Y_{i,t-1}\) is the lagged form, \(GOB_{it}\) denotes general obligation bonds, \(RB_{it}\) represents revenue bonds, \(CS_{it}\) stands for foreign direct investment, and \(HC_{it}\), \(EDU_{it}\), and \(\varepsilon\) are error terms. The theoretical expectation is that the regression coefficients \(a_1\) and \(a_2\) are positive, suggesting that the stocks of GOBs and RBs contribute positively to economic growth. However, given the escalating debt levels and the gradual slowdown in economic growth in China, this paper holds that the stocks of the two bonds may not necessarily have a positive impact on economic growth. Therefore, no predictions are made regarding the positive or negative coefficients of the two core variables. The inclusion of social capital stock (\(CS_{it}\)) and human capital level (\(HC_{it}\)) in the model accounts for their impact on macroeconomic stability. Additionally, education levels are critical because they contribute to human capital formation, innovation, and productivity growth, all of which are essential for sustained economic progress. Taxation policies directly influence investment decisions, consumption patterns, and overall economic activity, making them crucial factors to consider in any economic analysis. Additionally, foreign trade plays a significant role in shaping a country’s economic trajectory, impacting its export competitiveness, import dependency, and overall integration into the global economy. Considering that education (\(EDU_{i,t}\)), taxation (\(TA_{i,t}\)), and foreign trade (\(FT_{i,t}\)) all have an impact on a country’s economic development, these variables are included in the model to control for errors and ensure a comprehensive analysis of economic dynamics. \(u_{it}\) is composed of a country-specific effect \(\varepsilon_{i,t}\). Table 2 presents the correlations between variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. dev.</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
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<td>25416.81</td>
<td>1043</td>
<td>129118.6</td>
<td>N=31, T=8</td>
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<tr>
<td>gob</td>
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<td>456.1064</td>
<td>0</td>
<td>2329</td>
<td>N=31, T=8</td>
</tr>
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<td>5063</td>
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<tr>
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<td>16134.57</td>
<td>1295.68</td>
<td>64731.66</td>
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<tr>
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<td>2981.203</td>
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<td>18363</td>
<td>N=31, T=8</td>
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<tr>
<td>ft</td>
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<td>2416.064</td>
<td>3.10532</td>
<td>12795.7</td>
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Source: Calculated by the author.

### Table 1 Descriptive statistics of the variables.

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Source: Calculated by the author.

Table 2 Correlation test results.

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<th>lhc</th>
<th>ledu</th>
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<tr>
<td>lb</td>
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<td>0.599***</td>
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<td>lcs</td>
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<td>0.701***</td>
<td>0.715***</td>
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<tr>
<td>lhc</td>
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<td>0.745***</td>
<td>0.676***</td>
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<td>0.766***</td>
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<tr>
<td>lta</td>
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<tr>
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<td>0.700***</td>
<td>0.698***</td>
<td>0.731**</td>
<td>0.817**</td>
<td>0.919***</td>
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</table>

Source: Calculated by the author.

This study employs dynamic panel analysis, for which commonly available estimation methods include the difference GMM and system GMM. First, different GMMs are used to remove the unobserved specific effect from the panel data; however, this leads to a weak instrument problem. Blondell and Bond (1998) opted for system GMM, which encompasses a set of orthogonality conditions that are strategically enforced to secure reliable parameter estimates, particularly in the presence of endogeneity and unobserved individual-country effects. Using the system GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998), the relationship between LGD and GDP fluctuations across US states from 2015 to 2022 is examined. This approach amalgamates regression in first differences with regression in levels within a unified analytical framework, frequently applied in recent economic studies (e.g., Boukhatem, 2016; Acheampong, 2018), and is selected for
several reasons. First, it incorporates fixed provincial-level effects to control for unobservable, time-invariant idiosyncratic variations. Second, given the dynamic nature of the process of generating dependent variables (DV), with current values influenced by past values, system GMM includes lagged DVs to prevent autocorrelation bias (Davis & Haltiwanger, 1992; Kirchhoff & Phillips, 1988). Finally, considering the potential endogeneity of infrastructure investments, system GMM uses lagged differences in endogenous variables as instruments to address this issue.

\[ \log(Y_{it}) = \alpha_0 + \alpha_1 \log(Y_{it-1}) + \alpha_2 \log(Y_{it-2}) + \beta_1 \log(GOB_{it-1}) + \beta_2 \log(RB_{it-1}) + X'_{it} \gamma + \nu_i + \epsilon_{it} \]  

(2)

The Stata command xtabond2 (Roodman, 2009a) is employed to estimate Eq. (2) using the system GMM. Here,\( Y_{it} \) represents the GDP indicator in province i and year t. \( GOB_{it-1} \) and \( RB_{it-1} \) denote one-period lagged values of GOB and RB, respectively. \( X'_{it} \) is a matrix of control variables, and \( \epsilon_{it} \) are vectors of province fixed effects. The error term, \( \epsilon_{it} \), captures idiosyncratic factors. Parameters \( \beta_1 \) and \( \beta_2 \) capture the short-term impacts of GOB and RB, respectively, in year t-1. Throughout the estimation process, lagged level variables function as instruments in the first-differenced regression, whereas lagged first-differenced variables serve as instruments in the original level regression. Essentially, the system GMM estimator entails the estimation of a system of equations to accommodate these methodological nuances:

\[ \begin{pmatrix} y_{it} \\ \Delta y_{it} \end{pmatrix} = \alpha' \begin{pmatrix} y_{it} \\ \Delta y_{it} \end{pmatrix} + \beta' \begin{pmatrix} X_{it} \\ \Delta X_{it} \end{pmatrix} + \begin{pmatrix} \Delta u_{it} \end{pmatrix} \]  

(3)

It is assumed that the transitory errors are serially uncorrelated and that the initial conditions \( y_{i1} \) are predetermined:

\[ E(\epsilon_{it}\epsilon_{is}) = 0 \text{ for } t \neq s \]  

(4)

\[ E(\epsilon_{it}\epsilon_{i2}) = 0 \text{ for } t \geq 2 \]  

(5)

This implies the moment restrictions (5) and (6) proposed by Arellano and Bond (1991):

\[ E(y_{it-s}\Delta\epsilon_{it}) = 0 \text{ for } t=3, \ldots, T \text{ and } s \geq 2 \]  

(6)

\[ E(X_{it-s}\Delta\epsilon_{it}) = 0 \text{ for } t=3, \ldots, T \text{ and } s \geq 2 \]  

(7)

Given the assumption of independence between the differences in the explanatory variables on the right-hand side of Eq. (1) and the unobservable individual-specific effects, additional moment conditions are incorporated for the level component within the integrated system GMM framework (Blundell & Bond, 1998).

\[ E[\Delta y_{it-s}(\nu_i + \epsilon_{it})] = 0 \text{ for } s=1, t=3, \ldots, T \]  

(8)

\[ E[\Delta X_{it-s}(\nu_i + \epsilon_{it})] = 0 \text{ for } s=1, t=3, \ldots, T \]  

(9)

To assess the validity and feasibility of the GMM estimation results, Bond et al. (2002) proposed a straightforward test method: if the GMM estimates lie between the fixed effects estimates and the mixed OLS estimates, then the GMM estimation is considered reliable and effective. The consistency of the system GMM estimator also hinges upon the adequacy of lagged values of the explanatory variables as appropriate instruments to effectively manage endogeneity and unobserved individual-specific effects. Consistent with the approaches outlined by Arellano and Bond (1991) and Arellano and Bover (1995), the validity of instruments is assessed through several specification tests, namely, the Hansen J-test (Hansen, 1982) of overidentification and tests for second-order residual autocorrelation (Arellano & Bond, 1991).

3. Results and Discussion

This section aims to outline a panel data model suitable for examining the interplay between LGD and GDP growth across 31 provincial regions in China. The model considers variables expressed in logarithms: “lgdp” denotes the logarithm of real GDP, “lgb” is the logarithm of government obligation bond stock in RMB yuan, “lrb” signifies the logarithm of revenue bond stock in RMB yuan, “lcs” is the logarithm of capital stock, “lhc” denotes the logarithm of human capital, “ledu” is the logarithm of expenditure in education, “lta” stands for the logarithm of tax income, and “lft” represents the logarithm of foreign trade. The analysis spans the period from 2015 to 2022, yielding a total of 248 observations across the 31 groups. The author employs balanced panel model estimations using the Stata econometric package. The primary findings are summarized in Table 3.

Table 3 presents the outcomes of four dynamic panel data estimations. The first column designates the dependent variable as the logarithm of GDP, while the explanatory variables, control variables, and test results are listed below. The second column presents the OLS estimation results of the dynamic panel data, which demonstrate significant coefficients for the logarithm of GOB and RB, and the logarithm of GOB exhibits an anticipated positive sign with an R2 of 0.9914. Conversely, the logarithm of RB yields a negative coefficient, contrary to expectations. Moving to the third column, the FE estimation shows coefficients with the expected signs but fail to attain statistical significance for RB, yielding an R2 of 0.9586.
The purpose of conducting OLS and FE estimations is to establish the upper and lower bounds of the GMM estimates. Because $Y_{i,t-1}$ is positively correlated with the composite error term, OLS estimation tends to lead to an upward bias in lagged coefficients. In contrast, in dynamic panel data models using fixed effects estimation where intragroup differencing transforms are performed, due to the positive correlation between $Y_{i,t}$ and $e_{i,t}$ after differencing, there is a negative correlation between intragroup differences in $Y_{i,t-1}$ and the error term, resulting in a severe downward bias in lagged coefficients.

<table>
<thead>
<tr>
<th>Dependent variable: lgpdp</th>
<th>OLS</th>
<th>FE</th>
<th>DIF-GMM</th>
<th>SYS-GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td>lgpdp.L1</td>
<td>0.9808294***</td>
<td>0.8501146***</td>
<td>0.7061097***</td>
<td>0.923321***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>lgob</td>
<td>0.0094518*</td>
<td>0.0169681**</td>
<td>0.0265048</td>
<td>0.0390572***</td>
</tr>
<tr>
<td></td>
<td>(0.055)</td>
<td>(0.011)</td>
<td>(0.372)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>lrb</td>
<td>-0.0104342**</td>
<td>0.0052915</td>
<td>0.0586764</td>
<td>-0.0658978***</td>
</tr>
<tr>
<td></td>
<td>(0.043)</td>
<td>(0.435)</td>
<td>(0.163)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>lcs</td>
<td>0.003123</td>
<td>0.0652496***</td>
<td>0.1450296</td>
<td>0.0460221</td>
</tr>
<tr>
<td></td>
<td>(0.698)</td>
<td>(0.435)</td>
<td>(0.369)</td>
<td>(0.450)</td>
</tr>
<tr>
<td>lhc</td>
<td>-0.0139307</td>
<td>0.0160731</td>
<td>1.101925</td>
<td>-0.085115</td>
</tr>
<tr>
<td></td>
<td>(0.431)</td>
<td>(0.805)</td>
<td>(0.159)</td>
<td>(0.293)</td>
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<tr>
<td>ledu</td>
<td>0.0102798</td>
<td>0.0850332**</td>
<td>0.1613472</td>
<td>0.0622093</td>
</tr>
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<td>(0.503)</td>
<td>(0.037)</td>
<td>(0.439)</td>
<td>(0.282)</td>
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<tr>
<td>lta</td>
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<td>0.0252289</td>
<td>0.1321186</td>
<td>-0.0598224</td>
</tr>
<tr>
<td></td>
<td>(0.911)</td>
<td>(0.212)</td>
<td>(0.253)</td>
<td>(0.252)</td>
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<tr>
<td>lift</td>
<td>0.0049053</td>
<td>0.0599934***</td>
<td>0.3026509***</td>
<td>0.053916**</td>
</tr>
<tr>
<td></td>
<td>(0.334)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>R2</td>
<td>0.9914</td>
<td>0.9586</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR(1) Prob &gt; Z=</td>
<td></td>
<td></td>
<td></td>
<td>0.304</td>
</tr>
<tr>
<td>AR(2) Prob &gt; Z=</td>
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<td></td>
<td></td>
<td>0.685</td>
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<td></td>
<td></td>
<td>0.111</td>
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<tr>
<td>Hansen test of overid</td>
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<td>215</td>
<td>155</td>
<td>186</td>
</tr>
</tbody>
</table>

Source: Calculated by the author.

The fourth column depicts the difference GMM estimation results, where the coefficients demonstrate the expected signs but lack statistical significance. The results from the difference GMM estimation, as presented in the fourth column, indicate that while the lagged dependent variable exhibits the expected sign, the remaining explanatory variables do not demonstrate the anticipated significance. The consistency of GMM estimators (difference GMM and system DMM) critically depends on whether various assumptions are met. According to the autocorrelation tests of the error term, the first-order difference of the error term should exhibit first-order autocorrelation but not second-order autocorrelation. However, in the difference GMM estimation results, both the first-order and second-order serial autocorrelations of the error term are not significant. The Sargan test does not reject the null hypothesis, thereby failing to reject the null hypothesis, which means that the model specification does not sufficiently support the overall validity of the instruments. Moreover, the coefficient of $log(Y_{i,t-1})$ in the difference GMM estimation exceeds the upper and lower bounds of the OLS and FE estimations. Therefore, it can be concluded that the estimation results of the difference GMM are not robust.

Subsequent estimation using system GMM in two stages, depicted in the fifth column, indicates that all the coefficients of the explanatory variables exhibit the expected signs and are statistically significant. The estimation results confirm the significant importance of foreign trade for GDP growth. Moreover, the coefficients of the lagged logarithm of capital stock, human capital, education expenditure, and taxation display the anticipated sign, although they lack statistical significance. While first-order autocorrelation is not rejected, second-order autocorrelation is found to be not significant ($p>0.1$). The Hansen J test confirms the correct specification of the model and the overall validity of the instruments. Consequently, the system GMM estimates in two stages are deemed preferable and more appropriate than those of previous methods, thus offering a potential model for elucidating the impact of the financial sector on economic growth. Overall, the estimated system GMM in two stages proves to be the most suitable model, indicating a positive relationship between GDP and lagged GDP, as well as between GDP and GOB, alongside a negative association with RB. Specifically, the estimated values indicate...
system GMM indicates that a 1% increase in the stock of GOB in the previous year will lead to a 0.039% increase in GDP in the current year, while a 1% increase in the stock of RB will correspond to a 0.066% decrease in GDP.

To summarize, the empirical findings underscore the significance of the LGD and its substantial impact on economic growth and development. The logarithm of GOB exhibits a theoretically anticipated sign and reveals significance across all estimation methods except in difference GMM estimation, indicating its influence on GDP. This is possibly due to the issuance and management of GOB have become relatively well-established (Malhota et al., 2022) and the fact that expanding government spending can stimulate demand and boost economic activities (Taher, 2017; Wang, 2019; Alagba & Idowu, 2019). Therefore, concerted efforts to expand the issuance volume of the GOB will bolster economic activities, thereby enhancing the welfare of the population. Furthermore, the study highlights the potential negative impact of relatively new RBs on economic growth, which aligns with the results of previous studies (Elom-Obet et al., 2017; Pegkas, 2018; Zhao et al., 2019), who suggested that high stock of LGD might discourage investment and economic efficiency, potentially offsetting the benefits of fiscal policies. Ultimately, the question of whether to continue expanding the stock of RB and how to effectively manage these special bonds has become an urgent issue in need of resolution.

4. Conclusions

Emerging evidence highlights the declining economic growth of China, which was previously recognized as one of the most economically promising major powers globally (Hamnett, 2018). Consequently, policymakers may consider that the issuance of government bonds can stimulate public infrastructure investments and thus drive economic growth. However, the findings suggest that such incentives may not effectively facilitate economic growth; instead, the increasing issuance of RB may contribute to economic losses. Conversely, the stock of GOB plays a crucial role in generating economic growth momentum. These results underscore the importance of carefully evaluating the costs and benefits of LGDs, recognizing that they entail trade-offs and may not serve as a panacea for all economic recessions. Policymakers should avoid the assumption that investing in profitable infrastructure projects will automatically drive economic development but should prudently examine and assess the impact of bond issuance on the economy, involving the rational and efficient allocation of funds to appropriate sectors.

Several limitations of the empirical analysis warrant consideration and provide avenues for future research. First, due to the relatively short history of RB issuance in China, this study could only access and analyze annual data since 2015. Additionally, the generalizability of the results to other subnational levels or countries requires further exploration, considering potential variations in the impact of bond issuance. Finally, the Ministry of Finance in China should pay closer attention to relevant data on government bonds and extend the precision of the data and time span to obtain more accurate results.

Ethical considerations

Not applicable.

Conflict of interest

The authors declare no conflicts of interest.

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