Local government debt and regional economic growth in China

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Received 21 October 2019
Revised 21 October 2019
Accepted 21 October 2019

Abstract

Purpose – With China's economic growth slowing down and the growth rate of fiscal revenue decreasing, the pressure on local government debts is further increasing. Under this background, it is of great significance to clarify the relation between local government debts and China's economic growth in order to give full play to the positive role of local debts in stabling growth. The paper aims to discuss this issue.

Design/methodology/approach – Therefore, this paper explores the impact of Chinese local government debt on economic growth from theoretical and empirical aspects, respectively, and compares the regional differences between different debts and economic growth dynamics.

Findings – In the theoretical model part, this paper constructs a three-sector dynamic game model, under the two circumstances of whether local government is subject to debt constraints, and examines the relation between local government debt and economic growth and other variables through numerical simulation. Research shows that when the government is not constrained by debt, there is an inverted "U" relation between government debt and economic growth. When the government is constrained by debt, the economic growth rate gradually decreases as the government debt increases.

Originality/value – In the theoretical analysis part, this paper tries to estimate the amount of local debts under different calibers and examines the impact of different types of local government debts on China's economic growth and their regional differences. The results show that excessive accumulation of government hidden debts in the eastern region is not conducive to economic growth, while explicit debts in the central and western regions significantly contribute to local economic growth. The results of empirical analysis are basically consistent with the predictions of the theoretical model.

Keywords Economic growth, Regional differences, Local government debts

Paper type Research paper

1. Introduction

The debt of local governments has always been one of the most important problems plaguing China's economy. Although the central government and local governments at all levels have strengthened the supervision and risk management of local debts since the comprehensive audit of local debts in 2010, the scale of local debts is still expanding rapidly and various disguised debt financing methods are frequently introduced. As of the end of 2012, governmental debt of 36 local governments at their respective levels had a balance of 3.8 trillion yuan, an increase of 12.94 percent compared with 2010[1]. In addition, affected by the problem of concentrated maturity of debts, local governments are facing greater pressure to repay debts. By the end of June 2013, 1.86 trillion yuan (17 percent) of the debts for which the local governments are responsible would be due in 2015. At the end of 2014, in

JEL Classification — E17, H63, H74

Shiyi Chen thanks the supports from National Science Fund for Distinguished Young Scholars (71525006), Cheung Kong Scholars Program and Shanghai Leading Talent Project. Wang Li thanks the supports from National Natural Science Foundation (71603056), Humanities and Social Sciences Projects of Ministry of Education (16YJC790093) and Fundamental Research Funds for the Central Universities (2017ECNU-HLYT015). The authors bear all the responsibility for the paper.

China Political Economy
Vol. 2 No. 2, 2019
pp. 330-353
Emerald Publishing Limited
2516-1652
DOI 10.1108/CPE-10-2019-0028

nine provinces, nine provincial capitals and nine counties that were selected by the National Audit Office for examination, their debt balance for which they were liable increased by 46 percent compared with that at the end of June 2013[2]. In addition, the slowdown of economic growth and the downside real estate market further weakened the comprehensive financial resources of the local governments, and forced them into a Ponzi scheme where policies were tied up and old debts were repaid with new debts. It is precisely because of the complex local government debt problem and economic slowdown that Moody's, an international rating agency, announced that its outlook for China's local governments in 2016 was negative[3]. The local debt problem has once again received widespread attention from all walks of life.

The discussion on the relation between local government debt and regional economic growth in China is of great significance, especially under the background of relatively high downward pressure in the current economy and the widening difference between the growth rate of fiscal expenditure and revenue, and balancing well between local government debt and economic growth will help to handle the relation between debt management and steady growth, while preventing debt risks. Existing literature shows that there are some uncertainties about the impact of government debt on economic growth: on the one hand, government debt can promote economic growth through capital accumulation and productivity improvement (Pattillo *et al.*, 2004); on the other hand, government debt can squeeze out investment through tax (Barro, 1979), interest rate (Baldacci and Kumar, 2010) and inflation (Cochrane, 2011), thus hindering the improvement of economy and productivity. In China, local government debt funds have played an active role in making up for the shortage of local financial resources in crises and natural disasters responses, improving people's livelihood and protecting the ecological environment[4]. For example, in response to the Asian financial crisis in 1998 and the international financial crisis in 2008, local governments in China raised funds in various ways, including government debt refinancing, bonds issued by the Ministry of Finance on behalf of local governments and financing platform companies, which provided financial support for local economic development. By the end of 2012, 92.14 percent of debt funds were spent on areas such as transportation, urban construction, land acquisition and storage, education, science, culture, health, agriculture, forestry, water conservancy, ecological construction, environmental protection and affordable housing. The input of these debt funds has accelerated the construction of infrastructure such as highways, railways and airports and municipal projects such as rail transit, roads and bridges[5]. Therefore, from this perspective, local government debt in China has played a part in promoting economic growth. However, some scholars believe that investment in China is too much and the excessive supply of funds may not be beneficial to its economy[6]. The fiscal and tax competition among regions and the performance evaluation system based on GDP drive local governments to over-debt, and the existence of performance programs and wasteful practices have reduced the efficiency of resource allocation (Gong *et al.*, 2011). In addition, the government's poor management in debt financing process, poor asset quality and weak solvency of some financing platforms may also limit the government's role in promoting economic growth. For this reason, the following questions arise naturally: Has the local government debt expenditure really played a role in promoting China's regional economic growth? If so, is there a turning point in the impact of government debt on economic growth, and does excessive government debt hinder economic growth? If there is such a turning point, then the current debt-dependent local investment model will no longer be sustainable, and reasonable government debt and public investment management policies are of crucial importance. In addition, since there are differences in economic development, population structure and policy formulation among different regions, does the impact of government debt on economic growth differ among regions? Do different government debts, such as explicit local government debts,

state debt of local state-owned enterprises and urban investment debts, have different impact on economic growth? This paper will try to answer the above questions and propose economic development policy recommendations with local characteristics based on different types of government debts.

2. Literature review

At present, foreign research on local government debt has formed a relatively mature theoretical system. Most of the literature is mainly analyzed from the perspective of public finance, fiscal federalism and constitutional economics. Cranford, Hildreth, Zorn and others acknowledged the important role of local government debt in financing public goods and economy based on the traditional public finance theory. Hildreth and Zorn recognized the positive role of government debt in public expenditure by examining the development of municipal debt market in the USA since 1980 and making a detailed analysis of several major events in the debt market in combination with relevant economic and social conditions (Hildreth and Zornt, 2005). Unlike Hildreth and Zorn, Wildasin emphasized the soft budget constraints under the federal fiscal system. He believes that under the federal financial system, there exist divergent interests between the central government and the local government, and the result of the game between the central government and the local government is likely to be that the central government bears part or even all of the debt burden for the local government due to political pressure or other reasons. Moreover, the more developed a region's economy is, the more remarkable the phenomenon of "too big to fail" will be, and the more likely the government is to become over-indebted (Wildasin, 2004). Similarly, scholars such as Hildreth and Miller (2002) also emphasized the influence of local economic development level on the government's debt capacity. In addition, some scholars, such as Persson, carried out analysis from the perspective of constitutional economics. They believe that the higher the mobility of the population in a region and the more acute the aging problem of the population, the more likely the residents are to pass on the cost of debt. Therefore, the greater impulse of local governments to be in debt may have adverse effects on the economy (Persson and Tabellini, 2000). It can be seen that under the framework of constitutional economics and fiscal federalism, the redistribution effect of debts and political conflicts play a fairly crucial role. Therefore, the median voter model taking these factors into account has been widely used in the study on foreign local government debts. For example, Wang *et al.* analyzed the decision of local government's optimal public expenditure with given debt and tax costs by establishing a median voter model. In addition, Wang (2008) further analyzed variables such as public sector investment, borrowing costs and economic growth and derived an inverted "U" relation between debt and economic growth.

Chinese researchers also expressed different views on the relation between local government debt and economic growth. Their research takes three kinds of perspectives. First is the spending perspective. Some researchers regarded government debt as a form of spending and they recognized the contribution of government debt to economic growth (Jia and Guo, 2011; Hu and Xu, 2011). Private investors shy away from direct investment in infrastructure projects which usually require huge spending and produce remarkable externalities. Therefore, the researchers believed that using government debt to finance investment in public goods and capital would benefit long-term economic growth and improve fiscal standing of governments. However, as some researchers pointed out, given the system of fiscal decentralization, local governments have the impulse to over-leverage because of cross-regional fiscal competition and GDP-centered political assessment. Yet, politically-motivated projects and wasteful behavior undermine efficiency of resources allocation. Meanwhile, interests of local governments are closely intertwined with the local economy (Feng and Li, 2005; Gong *et al.*, 2011). Second is the risk perspective.

Researchers including Liu, Yu, Han and Jia emphasized risks brought by local governments' contingent debt and hidden debt as well as their impact on the economy. Liu and Yu (2002) believed that contingent debt risks are more outstanding with lower-level governments with more fragile economic foundation. According to Han *et al.* (2005), due to uncertainties associated with fiscal revenue or investment returns of Chinese Governments, the key to debt recognition lied with understanding and measuring credit risks; research on safety margins of debt size carried great importance for growth of the real economy and financial market. Jia (2011) pointed out that invisible debt of local governments resulted in not only economic losses when debt chains fall apart in some places, but also social and even political risks. Third (Liu, 2010) is the micro-entity perspective. Liu pointed out that under the current system, over-leveraging by local governments is very likely to lead to future tax hikes. This will not only make it more difficult to start and operate business, but also put a dent on resident income and employment, thus distorting investment and consumption structure, and hampering economic growth. Liu and Zhang (2010) and Liu (2010) held the view that land-oriented fiscal policies bring maximum benefits to governments but clearly generate negative externalities. Higher housing prices increase living costs for residents and reduce their social welfare, hindering long-run economic growth and stability (Liu and Zhang, 2010).

However, due to lack of theoretical tools and data availability, domestic studies on the relation between local government debts and regional economic growth are confined to descriptive analysis or summary, and are yet to form a theoretical system. Then the question is: could we make use of the theoretical framework or basic model created by foreign researchers? Obviously, this is not feasible. For instance, the median voter model is developed based on the electoral system of federalist nations. The model prescribes that the government aims to minimize the political costs, or expected net loss in votes (Hettich and Winer, 1984). This is different from what we see in China where local governments are obsessed with GDP targets. Furthermore, when there is a high level of district heterogeneity, the median voter model can hardly offer a sound reflection of median preferences. The model also has a questionable assumption that the government always represents interests of median voters (Holcombe, 1989), which is hard to qualify.

In China, there have been limited empirical studies on the relation between local government debt and regional economic growth. Besides, most of the relevant studies, whether in China or abroad, overlook regional heterogeneity. Since different regions vary in terms of economic development, demographic features, government preferences and policies, understanding regional differences is important for developing more reasonable policies.

Therefore, on the basis of previous studies, this paper will first construct a three-sector dynamic game model including individuals, enterprises and government, and investigate the relation between local debt and economic growth through numerical simulation. Then, in the empirical analysis part, we use the estimated explicit debt of local governments, state-owned debt of local state-owned enterprises and the sum of these two kinds of debts as the proxy variables of local government debts to examine the impact of local government debts on economic growth in the eastern and central and western regions and their differences.

Compared with previous studies, this paper tries to contribute new insights in that: First, it attempts to achieve a breakthrough in theoretical research. This paper studies the relation between local government debt and economic growth by constructing a three-sector dynamic game model, which is of great reference significance to the formation of a new theoretical system for the study of local government debt in China. Second, in the theoretical model, this paper examines the relation between debt and such variables as consumption and economic growth based on whether the local government is subject to debt constraints, and pays special attention to comparing the characteristics of regional differences.

Third, in the empirical analysis, the paper estimates the debt amount of local governments under different statistical standards, and uses the debt data under these statistical standards as proxy variables of local debt in the empirical model to examine the impact of debt on economic growth in eastern, central and western regions, so as to better understand the dynamic relation between different debts and economic growth.

The remaining structure of this paper is as follows: the second part is the construction of theoretical model, which respectively discusses the dynamic relation between debt and economic growth according to whether debt constraints work or not; the third part will numerically simulate the equilibrium path of each variable under different debt constraints and the relation between debt and economic growth; the fourth part is empirical analysis, which uses the estimated explicit debt of local governments, state-owned debt of local SOEs and urban investment debts as proxy variables of local government debts to examine the influence and difference of local government debts on economic growth in eastern and central and western regions. The fifth part is the conclusion.

3. Theoretical model

This section will build a two-stage dynamic game model including the government, enterprises and individuals. In the first stage, the government chooses the optimal government expenditure in order to maximize its own interests. The government here is no longer a benevolent planner, but a government with maximizing GDP as its goal. At the second stage, households and enterprises make the optimal consumption and production decisions with given government expenditure. The second stage shows that the consumption and production decisions of households and enterprises are the functions of government expenditure. A smart government has predicted at the first stage how its expenditure decisions will affect the behavior of households and enterprises, and makes its actual expenditure decisions of this stage with the knowledge of this influence, so as to align the final consumption and production behavior with the consumption and production behavior to achieve the GDP target.

First, this paper will examine the actors at the second stage: this paper assumes that there are N enterprises and L individuals in this economy.

3.1 Enterprises

We assume that the number of enterprises in the economy, N, is large enough, so each enterprise's decision on capital investment will not affect the total capital of the whole society. We define the production function of the enterprise i as (the subscript t is omitted in the following analysis):

$$Y_i = F\left(K_i, L_i\frac{G}{K}\right) = AK_i^{\alpha}L_i^{1-\alpha}\left(\frac{G}{K}\right)^{1-\alpha}, \tag{1}$$

where K_i and L_i are the capital and labor input of the enterprise, G is the public capital expenditure decided by the government at the first stage, K is the total capital of the whole society and $F(\cdot)$ is a neoclassical production function. We introduce public capital expenditure in the form of stock rather than flow, which is more in line with reality (Barro and Sala-i-Martin, 2004). The production function shows the externality and crowding-out (competitive and exclusive) characteristics of public expenditure: the increase of government expenditure will increase the marginal productivity of private capital and labor input; the services obtained by each producer (G/K) will decrease as the total social capital increases, so (G/K) can be used to reflect the degree of crawding out.

We divide both sides of (1) by labor input to derive its intensive form:

$$y_i = f\left(k_i, \frac{G}{K}\right) = Ak_i^{\alpha}\left(\frac{G}{K}\right)^{1-\alpha}, \tag{2}$$

where $y_i = (Y_i/L_i)$, $k_i = (K_i/L_i)$, $f(\cdot)$, which are also neoclassical production functions.

Set the interest rate as r, the wage rate as w and the government tax rate as τ (the tax rate in this model τ is an exogenous variable for all subjects because it is difficult for the local government to freely set the tax rate), and assume no capital depreciation. The enterprise chooses k_i, L_i to maximize the profit function with given r, w, τ, G, K:

$$L_i\left((1-\tau)f\left(k_i, \frac{G}{K}\right) - w - rk_i\right). \tag{3}$$

According to the equilibrium conditions, we get the marginal output of capital and labor as follows:

$$r = (1-\tau)\alpha Ak^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha}, \tag{4}$$

$$w = (1-\tau)(1-\alpha)Ak^{\alpha}\left(\frac{G}{K}\right)^{1-\alpha}. \tag{5}$$

3.2 Individuals

Assuming that there is a representative individual with infinite life, the utility function of each period is a monotonically increasing concave function ($c^{1-\sigma} - 1/1-\sigma$), in which per capita consumption is c and the elasticity of substitution of marginal utility is σ. And k is set as the per capita capital stock. In order to simplify the model, assume that there is no population growth, and the budget constraint of the representative individual is:

$$\dot{k} = (rk + w) - c. \tag{6}$$

At the same time, in order to exclude individuals from playing Ponzi games, the following conditions apply:

$$\lim_{t \to 0} k \exp\left(-\int_0^t r(v)dv\right) \geqslant 0. \tag{7}$$

The representative individual will choose consumption and capital stock to maximize the present value of his lifetime utility $\int_0^{\infty}(c^{1-\sigma} - 1/1-\sigma)e^{-\rho t}dt$ under the constraints of (6) and (7), and the given interest rate r and wage rate w, of which ρ is the discount factor.

The present value Hamiltonian function is defined as:

$$J = u(c) + \lambda(w + rk - c), \tag{8}$$

where λ is the present value of Hamiltonian multiplier, representing the shadow price of capital.

The first-order condition is:

$$u'(c) = \lambda, \tag{9}$$

$$\dot{k} = w + rk - c, \tag{10}$$

$$\dot{\lambda} = -\lambda r + \lambda\rho. \tag{11}$$

The transversality condition:

$$\lim_{t\to\infty} \lambda k e^{-\rho t} = 0. \tag{12}$$

Among them, Equation (9) means that the marginal utility of consumption is equal to the shadow price of capital, Equation (10) is the cumulative function of capital, Equation (11) is an Euler's equation and Equation (12) means that the present value of capital is zero in the long run.

Based on the first-order conditions of Equations (9)–(12) and corporate problems, we conclude that under the given government expenditure G and tax rate τ, the optimal capital and consumption path are as follows:

$$\gamma_c = \frac{\dot{c}}{c} = \frac{1}{\sigma}\left((1-\tau)\alpha A k^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha} - \rho\right), \tag{13}$$

$$\gamma_k = \frac{\dot{k}}{k} = (1-\tau)Ak^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha} - \frac{c}{k}. \tag{14}$$

The path of change in per capita output can be found by differentiating the two sides of $\ln y = \ln f(k, (G/K))$ with respect to t:

$$\gamma_y = (2\alpha-1)\gamma_k + (1-\alpha)\gamma_g = (2\alpha-1)\left((1-\tau)Ak^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha} - \frac{c}{k}\right) + (1-\alpha)\frac{\dot{G}}{G}. \tag{15}$$

Assume $\gamma_c = 0$ and $\gamma_k = 0$, we can also obtain the two trajectories, i.e., $\dot{c} = 0$ and $\dot{k} = 0$, which divide the phase diagram in Figure 1 into four regions, CC' is the stable arm, and A is the

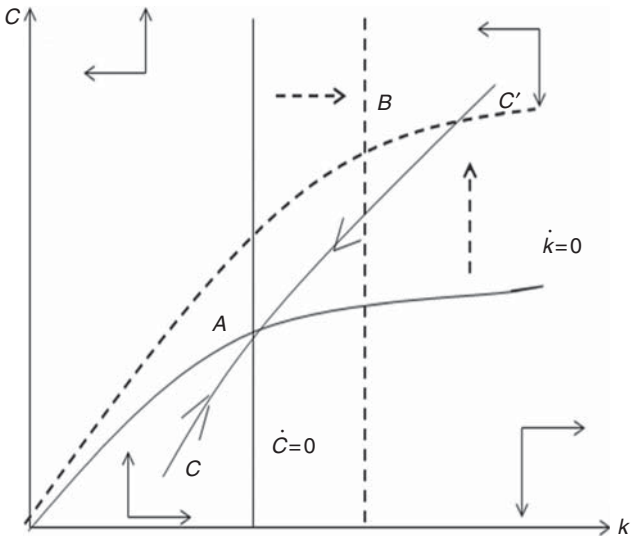


Figure 1.
Phase diagram analysis

stable equilibrium point. When (G/K) increases, the curve $\dot{c} = 0$ moves to the right and $\dot{k} = 0$ moves up, and the economy will reach a new stable equilibrium B (the intersection point of dashed lines, as shown in the figure). The per capita capital and consumption in the new stable state are higher than the initial stable equilibrium point. Thus, when (G/K) increases, it will be conducive to slowing down the economic slowdown caused by the decline of marginal productivity of capital.

So far, all the second-stage decision variables are obtained: the equilibrium paths of per capita consumption, per capita capital stock and per capita output are functions of the government expenditure path $G(t)$. Next, we will discuss the behavior of the government, which is the main actor at the first stage, in making the optimal decision under the given reaction functions of Equations (13)–(15).

3.3 The government

The government in this economy is self-benefiting, and its goal is to maximize the growth rate of per capita output. For the convenience of analysis, we set the dual problem of maximizing the economic growth rate as the goal of the self-benefiting government: with the given initial per capita output level y_0, make the per capita output level reach y_1 in the shortest possible time. Set B as the total amount of debt, Y as the total output of the economy, G as public capital expenditure, C_p as transfer expenditure, T_0 as higher-level fiscal transfer payments, with their corresponding lowercase letters representing the per capita value of variables, h as the debt interest, and θ as the service efficiency and of debt funds ($0 \leqslant \theta \leqslant 1$), and then we obtain the total form of government budget constraints as follows:

$$\theta\dot{B} + \tau Y + T_0 = hB(t-1) + \dot{G} + C_P. \tag{16}$$

For per capital:

$$\theta\dot{b} + \tau y + t_0 = hb(t-1) + \dot{g} + c_P. \tag{17}$$

Since in China, local debts cannot be used for interest expenses $hb(t-1)$ and transfer expenditure c_P, we can only use tax revenue to repay them. We assume that φ_0 ($\varphi_0 < 1$) of the total tax revenue is used for interest expenses and transfer expenditure, namely:

$$hb(t-1) + c_P = \phi_0 \tau y. \tag{18}$$

Substituting Equation (18) into Equation (17), we obtain:

$$\theta\dot{b} = \dot{g} - (1-\phi_0)\tau y - t_0. \tag{19}$$

Assume that the maximum amount of debt per capita that the government can borrow is $\overline{b}$, and we will continue the discussion according to whether the debt required by the government $\dot{b}$ reaches $\overline{b}$ make the optimal decisions (i.e. whether the debt ceiling constraint is tight). It is worth noting that, in reality, it is easier for the economically developed eastern region to borrow funds, so the eastern region has a larger $\overline{b}$ and is prone to loose debt constraints, while the central region and especially the western region face smaller $\overline{b}$ and tighter debt constraints are more common due to lower and unstable fiscal revenues.

3.3.1 Scenario 1: $\dot{b} \leqslant \overline{b}$. Because the amount of debt $\dot{b}$, the government needs to borrow for an optimal decision is less than or equal to $\overline{b}$, the government can always borrow

enough funds to make an optimal decision. Therefore, by solving the government equation:

$$\min_{G_t} \int_0^T dt, \tag{20}$$

$$s.t. y(0) = y_0, y(T) = y_1, \tag{21}$$

$$\dot{y} = (2\alpha - 1)\left((1-\tau)Ak^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha} - \frac{c}{k}\right)y + (1-\alpha)\frac{\dot{G}}{G}y. \tag{22}$$

We can obtain the relation between government expenditure and various economic variables:

$$\begin{aligned}&(2a-1)\left((1-\tau)AK^{\alpha-1}\left(\frac{G}{K}\right)^{-\alpha}(1-\alpha)\frac{1}{K}\right)y + (\alpha-1)\left(\frac{G}{G^2}\right)y : \\ &= (\alpha-1)\left(\frac{y}{G}\right)\left((2\alpha-1)\left((1-\tau)AK^{\alpha-1}\left(\frac{G}{K}\right)^{1-\alpha} - \frac{c}{k}\right) + (1-\alpha)\frac{\dot{G}}{G}\right) + (1-\alpha)\left(\frac{\dot{y}}{G} - \frac{y\dot{G}}{G^2}\right).\end{aligned} \tag{23}$$

Because the government can always borrow the desired amount of debt to meet its budget constraints, through the government budget constraint Equation (19), we can obtain the balanced per capita debt path (at this time, the debt path is passively determined by the balanced government expenditure path, per capita capital path, etc.):

$$\dot{b} = \frac{1}{\theta}\left(\dot{g} - \left(1-\phi_0\right)\tau y - t_0\right). \tag{24}$$

3.3.2 Scenario 2: $\dot{b} > \overline{b}$. In this scenario, the government cannot borrow enough funds for its optimal expenditure, but the phase diagram analysis shows that G is conducive to improving the steady state per capita consumption and capital level, so the government has the motivation to make its own debt level reach $\overline{b}$. Set b_0 as the initial per capita debt level, the debt balance for period t is:

$$b(t) = b_0 + \overline{b}t. \tag{25}$$

Substituting Equation (25) into the government's budget constraint, we obtain the expenditure path as follows:

$$\dot{g} = \tau y + t_0 + (\theta - (t-1)h)\overline{b} - c_P - hb_0. \tag{26}$$

To simplify the problem, we set A as 1 in the following analysis, and assume the central government's transfer payments to local governments $t_0 = 0$ and local consumer spending $c_P = 0$.

4. Numerical simulation

4.1 Parameterization

Due to the complexity of the theoretical model in this paper, we cannot get an analytical solution. Therefore, we will examine the relation between debt and variables such as

economic growth and subject behavior through numerical simulation. The model parameters are assigned according to the actual situation in China, where the capital share α is 0.6 based on the data of Jun and Yuan (2003). For the elasticity of substitution of marginal utility σ, since we do not have valid data to estimate it, we set it at 1.5 (Xixi and Liutang, 2007) based on experience. The choice of discount rate for consumption ρ takes into the consideration the interest rate of one-year treasury bonds in China, and is set at 0.04. The local tax rate τ is 0.14 based on Beijing's 2010 tax rate. In addition, Xixi and Liutang (2007) also adopted the same tax rate in their paper. Thus, the value of parameter τ is reasonable. Debt interest θ takes into consideration the one-year loan interest rate, and is set at 0.064. The service efficiency of debt funds θ is set at 0.9. In addition, we assign initial values to per capita consumption c, per capita capital k, per capita output y, per capita public capital expenditure g and per capita debt b to place them on the equilibrium path. Specifically, the initial values of per capita consumption, per capita capital, per capita output and per capita public capital expenditure are selected with reference to Beijing's actual per capita consumption, actual per capita output, actual per capita capital formation and actual government per capita budget expenditure data in 2010[7].

4.2 Numerical simulation and analysis

4.2.1 Scenario 1: $\dot{b} \leqslant \overline{b}$. Figure 2 shows the equilibrium change path of each variable and the relation between per capita debt and the equilibrium economic growth rate under China's economic parameters when the government is not affected by debt constrains. It is found that per capita output shows a U-shaped trend in such situation, that is, it decreases at the beginning of the period and then increases gradually, while per capita consumption shows an inverted U-shaped trend (Figure 2 (a) and (b)). The possible reason is that when debt constraints do not work, the regional fiscal and tax competition and GDP-based performance evaluation system drive local governments to borrow and invest more, and excessive public investment (see Figure 2(c)) crowds out private investment, which decreases per capita output in the short term. However, with the positive externalities of public investment, such as increasing private capital and the marginal productivity of labor, per capita output shows an upward trend in the long run. In addition, the inverted U-shaped path of per capita consumption depends on the interaction of two factors: on the one hand, due to the income effect, per capita consumption increases with the increase of income and decreases with the decrease of income, i.e., per capita consumption has the same variation with per capita income; on the other hand, since a debt-ridden government ultimately needs to use its tax revenues to repay debt obligations, which increases the future tax burden on residents, reduces their future disposable income and lowers the per capita consumption level. Meanwhile, the relatively high debt constraint ceilings in these regions are possibly at the expense of the inflated prices of land and house property, which will further increase the future living cost of residents and prompt them to increase current consumption and reduce future consumption expenditures. Such effect can be termed as "the tax-and-cost effect." Figure 2(b) shows that when debt constraints do not work, the tax-and-cost effect becomes prominent due to excessive debt, and per capita consumption shows a downward U-shaped trend. Figure 2(d) reflects the relation between per capita debt level and economic growth rate in equilibrium. Due to the existence of crowding out effect and the decline of per capita output in the short term, the output growth rate is negative at the beginning and then as the positive externalities of public investment appear, the per capita output growth rate and per capita debt level show positively monotonic relation when the latter is relatively low. However, the positive externalities of public investment merely play a role of slowing down the decline of marginal productivity, and the ultimate decline in the marginal productivity of factors makes the economic growth rate decrease as the per capita debt level increases.

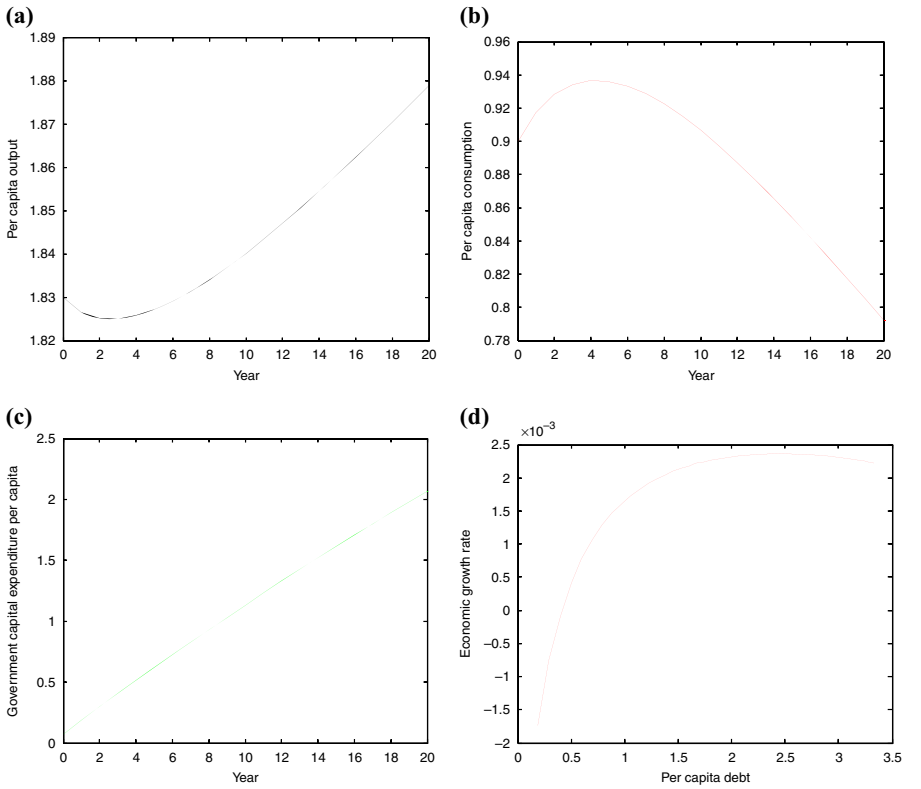
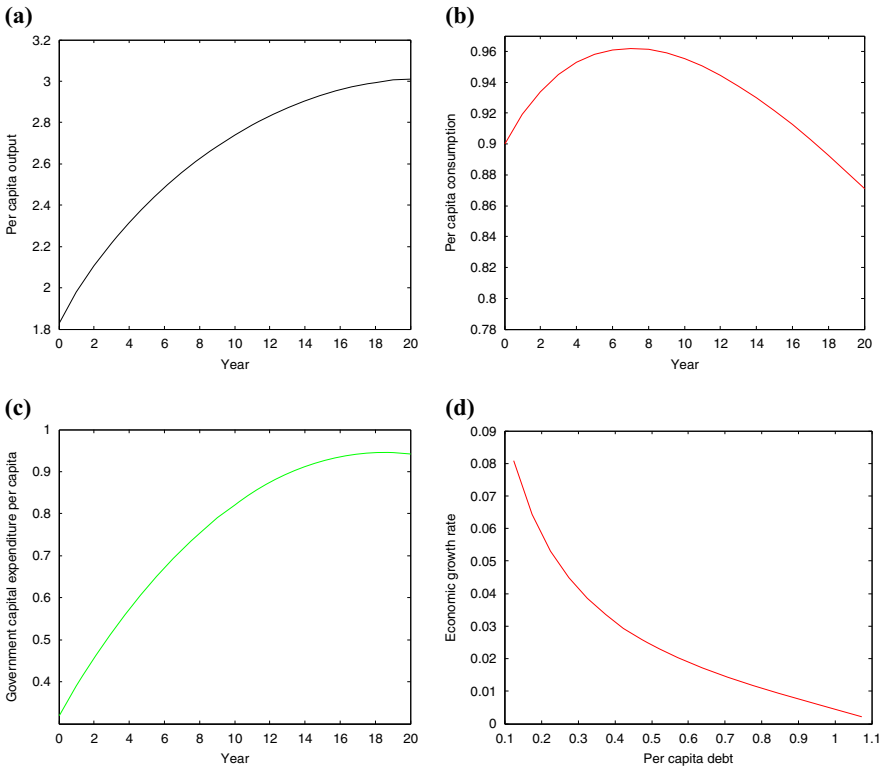


Figure 2.
The equilibrium path of variables without debt constraints

Notes: (a) Per capita output, year: the variation of per capita output; (b) per capita consumption, year: the variation of per capita consumption; (c) government capital expenditure per capita, year: the variation of government capital expenditure per capita; (d) economic growth rate, per capita debt: per capita debt and economic growth rate

That is, when the government is not constrained by debt, there exists an inverted U-shaped relation between the per capita output growth rate and per capita debt level.

4.2.2 Scenario 2: $\dot{b} > \overline{b}$. Figure 3 shows the equilibrium change path of each variable and the relation between per capita debt and the equilibrium economic growth rate when government debt constraints play a role under Chinese economic parameters. It is found that per capita output increases with time and the U-shaped trajectory in scenario 1 does not appear (Figure 3(a)). The possible reason is that due to debt constraints, local governments are unable to raise enough capital to maximize their interests, while limited public capital expenditures (Figure 3(c)) have little crowding out effect on private investment, so the externalities of public investment, such as increasing private capital and the marginal productivity of labor, become the main driving force behind the increase of per capita output; although the variation of per capita consumption also presents a U-shaped path for being affected by the tax-and-cost effect (Figure 3(b)), it is found that when the government is not constrained by debt, per capita consumption begins to decline rapidly in the fourth period, but when the government is constrained by debt, per capita consumption only declines slightly in the seventh period. This indicates that limited debt financing has reduced the future tax burden and living cost pressure on residents to some



Notes: (a) Per capita output, year: the variation of per capita output; (b) per capita consumption, year: the variation of per capita consumption; (c) government capital expenditure per capita, year: the variation of government capital expenditure per capita; (d) economic growth rate, per capita debt: per capita debt and economic growth rate

Figure 3.
The equilibrium path of variables with debt constraints

extent; unlike the scenario where debt constraints exist, the absence of crowding out effect allows the economy to achieve a relatively high growth rate in the short term, so the growth of per capita output does not experience the same rising phase as when the government is not constrained by debt, and the final decline of the marginal productivity of factors has led to a downward trend in the economic growth rate (Figure 3 (d)), i.e., when the government is bound by debt, the per capita output growth rate and per capita debt level are negatively monotonic[8].

It is worth mentioning that many scholars in China have studied the crowding out effect of debt and public investment. Ziyin and Wei (2003) and Shenglong and Angang (2010) and other scholars confirmed the positive effect of debt or public investment on private investment and the economy. Xixi and Liutang, Yong and Mingming (2011) and other scholars supported the existence of this effect. Xixi and Liutang believed that the crowding out effect of debt was prominent in China's economy. However, different from the views of these scholars, through the above comparative analysis, this paper considers that the crowding out effect of local debt differs from region to region, which is more obvious in regions that are not constrained by debt due to excessive government debt and investment. And it is precisely because of such effect that the per capita output growth rate of those

regions will experience a rising phase with the emergence of the positive externalities of public investment when the debt level is low.

5. Empirical analysis of the impact of local government debt on China's economic growth

5.1 Empirical model and data sources

5.1.1 Empirical model. The simulation results of the theoretical model show that there is an inverted U-shaped relation between the per capita output growth rate and per capita debt level when there are no debt constraints, and the two are negatively and monotonically correlated when there are debt constraints. In reality, the eastern region is relatively economically developed with stable fiscal revenues, and local governments have relatively high debt ceilings. Therefore, governments there are less likely to be subject to debt constraints, and there may be an inverted U-shaped relation between per capita debt and the economic growth rate in the eastern region. Similarly, governments are more likely to face debt restrictions and there may be a monotonically decreasing correlation between per capita debt and the economic growth rate in the central and western region. To verify this hypothesis, this section will introduce the variable of debt based on the basic economic growth model of such scholars as Barro, and examine the differences between the eastern region and the central and western region in the impact of local government debt on economic growth. The basic measurement model is as follows:

$$\gamma_{i,t} = c + \beta_1 \cdot \ln debt_{i,t-1} + \beta_2 \cdot \ln debt^2_{i,t-1} + \delta \cdot X_{i,t-1} + \alpha_i + \varepsilon_{i,t}.$$

In this model, the subscript i refers to the region, t time, α unobservable individual heterogeneity and ε the random interference term. To be consistent with the theoretical model, the dependent variable, i.e., the economic growth rate, is measured by the per capita real GDP growth rate and for the independent variable local government debt, this paper also adopts the per capita real form correspondingly: ln *debt* and ln $debt^2$ represent, respectively, the logarithm of per capita real debt and the square of this logarithm, the coefficient and significance of the two demand priority attention in the empirical analysis. X refers to a series of control variables, including the main factors affecting China's economic growth that have been identified in existing literature: ln *gdppercapita*, the logarithm of per capita real GDP, which usually lags one period in the model to control the convergence effect of economic growth; *trade*, the ratio of total import and export to GDP, which is used to reflect the degree of a country's trade openness; *fdi*, the ratio of foreign direct investment to GDP, which is used together with *trade* in some literature to reflect the openness of an economy; ln *government*, the logarithm of per capita real fiscal expenditure, which is used to control the impact of government size on economic growth (this paper deducts expenditures in science, education, culture and health, which are mainly public, from public finance expenditures); *govconsumption*, the ratio of governmental consumption to GDP; and ln *humancapital*, the logarithm of the number of students enrolled in colleges and universities out of every 1,000 people in the population, which is used to measure human capital investment (Ming and Zhao, 2009)[9]. It should be noted that in order to alleviate the issue of endogenous simultaneity[10], this paper adopts a method similar with that of Ming and Zhao (2009), which lags one period for all explanatory variables.

5.1.2 Data sources and processing. This paper uses the panel data samples of 30 provinces and municipalities in China from 1995 to 2010[11] and divides them into two sub-samples, the eastern region and the central and western region, to conduct empirical analysis[12].

The raw data involved in this paper include GDP (at selected year's price), GDP index, year-on-year CPI, the exchange rate, total export-import volume, foreign direct investment (US$ denominated), government fiscal expenditures, expenditures in science, education, culture and health, and gross fixed capital formation, the number of students enrolled in colleges and universities, etc., which are sourced from *China Statistical Yearbook* and *China Compendium of Statistics* (regional data). Among them, the data of foreign direct investment are denominated in RMB through exchange rate adjustment.

The acquisition and estimation of local government debt data is a major difficulty in the empirical analysis of this pape, because relevant data differ among scholars or institutions. For example, at the end of 2010, the National Audit Office divided local government debt into three categories, i.e., local governments' direct debt (debt that will be repaid by government fiscal revenue), debt for which local governments issue official guarantees, and other related debt[13], while two scholars, Sun Tao and Zhang Xiaojing, believed that local government debt in China was mainly the debt of local governments borrowed at home and abroad through local trust and investment institutions and the debt of local SOEs guaranteed by government finance. This paper mainly refers to the statistical standard proposed by Sun Tao and Zhang Xiaojing, and estimates the data of three categories of local government debt. All data are extracted from *China Statistical Yearbook* and the database *Wind*. The first category is explicit local government debt. This paper first totals up the debt revenues of local governments, including those from the principal of cashed securities (1995–1997), state bond-turned loans (1998–2010), issuance of local government bonds with the Ministry of Finance as agent (1995–2001) and loans abroad (1995–2001), to obtain data on newly-added local debt each year in each region; then, obtains data on current-year debt expenditure based on the expenditure of local governments, including purchases of securities (1995–1997), debt interest (1998–2008) and repayment of the capital and interest of government bonds (2009–2010); and, finally, subtracts the current year's debt expenditure from the annual newly-added local government debt to obtain the net value added of local government debt each year, which are totaled up to obtain the balance or stock of local debt. Since such debt can be clearly confirmed by law or contracts, it can be termed as "the explicit debt of local governments." The second category is the total state debt of local SOEs, which is obtained by multiplying the total national assets of local SOEs from 1997 to 2010 and their corresponding asset-liability ratios. *China Finance Yearbook* also provides the total liabilities of state-owned industrial production enterprises in various regions from 1995 to 1997, and estimates the state debt of local SOEs based on the ratio of two 1997 figures. The third category is the data of city investment debt issued by city investment companies. This paper aggregates city investment debt issued by all city investment companies from 1995 to 2010 based on the provinces where these companies are located and obtains the scale of city investment debt issued in each province each year. Although the second and third categories of debt are not legally or contractually recognized as government debt, local governments often assume them out of public interest or political pressure once local SOEs or city investment companies are unable to repay them. Therefore, from this perspective, the two categories of debt can be regarded as the implicit debt of local governments.

Figure 4 shows the variation of local government debt in China to some extent. It is found that since 2008, both the explicit local government debt on the one hand and the state debt of local SOEs and city investment debt on the other have accelerated their growth. By 2010, China's explicit local government debt increased by 1.4 times, while the scale of city investment debt increased by nearly three times. In the empirical analysis below, this paper uses explicit debt, implicit debt and the sum of all debt estimated in this paper as the proxy variables of local government debt to examine the relation between local government debt and regional economic growth. To be consistent with the theoretical model, all debt data have been adjusted to actual values based on 2005-based CPI data.

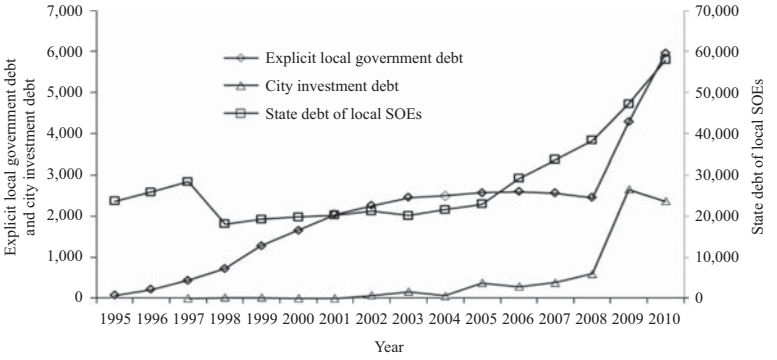


Figure 4.
The variation of various types of debts in China from 1995 to 2010 (unit: 100 million)

5.2 Empirical results and analysis

Tables I–IV provide the estimates of Equation (1) (Model 1) and related robustness test results (Model 2–5) under different statistical standards on debt. Because whether the estimation of panel data is made by the mixed model, fixed effect model or random effect model is based on whether the individual effect exists and the unobservable individual heterogeneity is related to explanatory variables, this paper conducts the *F*-test and the Hausman test for each regression model and finds that at the 10 percent significance level, most results of the *F*-test reject the null hypothesis, i.e., "no individual effect," which means that the fixed effect model is prior to the mixed model; likewise, most results of the Hausman test also reject the null hypothesis i.e., "unobservable individual heterogeneity is not related to explanatory variables," which means the fixed effect model is prior to the random effect model. Therefore, Tables I–IV only provide the estimation results of the fixed effect. For regression models that do not reject the null hypothesis, this paper also examines the estimation results of the mixed and random models and finds that the significance of key variables is basically unchanged, which also proves the robustness of the estimation results in this paper.

5.2.1 The impact of local government debt on economic growth in the eastern region. This paper first examines the estimation results of Equation (1) using the samples from the eastern region in Tables I–IV and finds that when the sum of two types of implicit debt (state debt of SOEs and city investment debt) and the state debt of SOEs are used as the proxy variables of local government debt (Tables I and II), the coefficient before per capita debt is positive, the coefficient before its quadratic term is negative, and both coefficients are significant at the significance level of 10 percent. This indicates that in the eastern region, there is reversed U-shaped relation between the implicit debt of local governments and economic growth, i.e., when the per capita debt level is low, the appropriate increase of debt may be beneficial to growth; when the level exceeds a certain threshold, the increase of per capita debt level may not be conducive to growth. When the estimated explicit debt of various regions is used as the proxy variable of local government debt (Table III), it is found that the variable, per capita debt and the coefficient before its quadratic term are not significant. The possible reason is that the estimated explicit debt is only a small fraction of the total debt (including implicit debt) of the eastern region, which is relatively high, and such explicit debt does not have significant impact on the economy there. When the sum of explicit debt and implicit debt is used as the proxy variable of local government debt (Table IV), the regression results still reveal a reversed U-shaped relation between local debt and economic growth in the eastern region, and the results are quite stable.

Table I.
Local government debt (implicit debt) and regional economic growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Eastern region					
ln *debt*	0.26229** (0.13042)	0.25494* (0.13315)	0.28320** (0.12793)	0.25834** (0.12996)	0.27805** (0.12701)
ln $debt^2$	−0.01583** (0.00763)	−0.01579** (0.00779)	−0.01710** (0.00747)	−0.01562** (0.00760)	−0.01681** (0.00742)
ln *gdppercapita*	−0.25525*** (0.06282)	−0.14806*** (0.04975)	−0.28018*** (0.05545)	−0.25207*** (0.06246)	−0.27516*** (0.05404)
trade	0.01872 (0.02989)	0.02932 (0.03026)	0.00885 (0.02750)	0.01534 (0.02928)	0.00744 (0.02723)
fdi	−0.12354 (0.20793)	−0.03434 (0.20965)	−0.0866 (0.20311)		
ln *government*	0.11653*** (0.04313)		0.10975** (0.04234)	0.11247*** (0.04249)	0.10750** (0.04189)
govconsumption	−0.07204 (0.08505)	−0.02937 (0.08534)		−0.06145 (0.08297)	
ln *humancapital*	0.08554*** (0.02861)	0.11661*** (0.02675)	0.10169*** (0.02130)	0.08900*** (0.02795)	0.10249*** (0.02116)
Observed value	165	165	165	165	165
Central and western region					
ln *debt*	−0.25035 (0.23745)	−0.17264 (0.23967)	−0.27849 (0.23711)	−0.23972 (0.23626)	−0.26849 (0.23584)
ln $debt^2$	0.01701 (0.01626)	0.01135 (0.01640)	0.01903 (0.01623)	0.01631 (0.01618)	0.01837 (0.01615)
ln *gdppercapita*	−0.10434*** (0.03815)	−0.02937 (0.02930)	−0.12507*** (0.03535)	−0.10388*** (0.03808)	−0.12442*** (0.03527)
trade	−0.08058 (0.11915)	−0.10423 (0.12072)	−0.09821 (0.11875)	−0.06891 (0.11692)	−0.08739 (0.11641)
fdi	0.22628 (0.42897)	0.05779 (0.43183)	0.20576 (0.42959)		
ln *government*	0.08130*** (0.02706)		0.07951*** (0.02709)	0.07944*** (0.02679)	0.07784*** (0.02682)
govconsumption	−0.16508 (0.11559)	−0.14902 (0.11724)		−0.16303 (0.11536)	
ln *humancapital*	0.04421** (0.01885)	0.07404*** (0.01627)	0.04882*** (0.01861)	0.04513** (0.01874)	0.04960*** (0.01851)
Observed value	285	285	285	285	285

Notes: The implicit debt here includes the state debt of SOEs and city investment debt. The values in parentheses are standard errors. The constant term is not reported to save space (the same below). *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table II.
Local government debt (state debt of SOEs) and regional economic growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Eastern region					
ln *debt*	0.26899** (0.13161)	0.26160* (0.13431)	0.28919** (0.12937)	0.26559** (0.13119)	0.28464** (0.12854)
ln $debt^2$	−0.01629** (0.00770)	−0.01628** (0.00786)	−0.01753** (0.00755)	−0.01611** (0.00767)	−0.01727** (0.00751)
ln *gdppercapita*	−0.25432*** (0.06272)	−0.14805*** (0.04956)	−0.27946*** (0.05540)	−0.25128*** (0.06236)	−0.27466*** (0.05400)
trade	0.01864 (0.02986)	0.02914 (0.03022)	0.00867 (0.02748)	0.01532 (0.02925)	0.00731 (0.02720)
fdi	−0.12106 (0.20766)	−0.03321 (0.20930)	−0.08338 (0.20277)		
ln *government*	0.11558*** (0.04319))		0.10865** (0.04238)	0.11160*** (0.04255)	0.10650** (0.04194)
govconsumption	−0.07271 (0.08482)	−0.03022 (0.08505)		−0.06225 (0.08271)	
ln *humancapital*	0.08600*** (0.02857)	0.11679*** (0.02670)	0.10237*** (0.02124)	0.08943*** (0.02790)	0.10314*** (0.02110)
Observed value	165	165	165	165	165
Central and western region					
ln *debt*	−0.23513 (0.23715)	−0.14891 (0.23896)	−0.26568 (0.23668)	−0.22457 (0.23598)	−0.25572 (0.23541)
ln $debt^2$	0.01591 (0.01626)	0.00965 (0.01637)	0.01811 (0.01622)	0.01522 (0.01618)	0.01745 (0.01614)
ln *gdppercapita*	−0.10336*** (0.03811)	−0.02863 (0.02918)	−0.12424*** (0.03530)	−0.10284*** (0.03805)	−0.12355*** (0.03521)
trade	−0.08122 (0.11916)	−0.10417 (0.12072)	−0.09908 (0.11875)	−0.06955 (0.11693)	−0.08824 (0.11641)
fdi	0.22614 (0.42886)	0.05724 (0.43155)	0.20613 (0.4295)		
ln *government*	0.08101*** (0.02714)		0.07932*** (0.02717)	0.07912*** (0.02686)	0.07762*** (0.02689)
govconsumption	−0.16596 (0.11569)	−0.15099 (0.11733)		−0.16397 (0.11547)	
ln *humancapital*	0.04392** (0.01883)	0.07363*** (0.01623)	0.04849*** (0.01859)	0.04483** (0.01872)	0.04927*** (0.01850)
Observed value	285	285	285	285	285

Notes: The values in parentheses are standard errors. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table III.
Local government debt (explicit debt) and regional economic growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Eastern region					
ln *debt*	−0.01768 (0.02446)	−0.01864 (0.02468)	−0.01017 (0.02385)	−0.01666 (0.02328)	−0.00727 (0.02231)
ln $debt^2$	0.00314 (0.00312)	0.00423 (0.00310)	0.00238 (0.00308)	0.00296 (0.00284)	0.00189 (0.00274)
ln *gdppercapita*	−0.21634*** (0.06540)	−0.13113*** (0.04898)	−0.25436*** (0.05890)	−0.21843*** (0.06347)	−0.26129*** (0.05534)
trade	0.02209 (0.03022)	0.02866 (0.03032)	0.00843 (0.02848)	0.02297 (0.02947)	0.01008 (0.02800)
fdi	0.03368 (0.23961)	0.17743 (0.23005)	0.08341 (0.23725)		
ln *government*	0.09539* (0.04909)		0.08248* (0.04823)	0.09752** (0.04653)	0.08735* (0.04607)
govconsumption	−0.11492 (0.08690)	−0.08134 (0.08597)		−0.11683 (0.08554)	
ln *humancapital*	0.07488** (0.02870)	0.09376*** (0.02726)	0.09976*** (0.02173)	0.07432*** (0.02834)	0.09941*** (0.02164
Observed value	165	165	165	165	165
Central and western region					
ln *debt*	−0.02969* (0.01755)	−0.03356* (0.01764)	−0.02946* (0.01760)	−0.02938* (0.01751)	−0.02919* (0.01755)
ln $debt^2$	0.00368 (0.00250)	0.00550** (0.00241)	0.00361 (0.00251)	0.00358 (0.00249)	0.00352 (0.00250)
ln *gdppercapita*	−0.10448** (0.04255)	−0.02752 (0.02837)	−0.12550*** (0.04036)	−0.10543** (0.04243)	−0.12612*** (0.04026)
trade	−0.11565 (0.12640)	−0.07637 (0.12650)	−0.13638 (0.12599)	−0.10827 (0.12515)	−0.12974 (0.12464)
fdi	0.19406 (0.42974)	0.17297 (0.43361)	0.16878 (0.43051)		
ln *government*	0.07899** (0.03278)		0.07697** (0.03284)	0.07869** (0.03273)	0.07673** (0.03278)
govconsumption	−0.17436 (0.11437)	−0.16321 (0.11533)		−0.17237 (0.11410)	
ln *humancapital*	0.04795** (0.01918)	0.06170*** (0.01848)	0.05283*** (0.01896)	0.04892** (0.01903)	0.05362*** (0.01882)
Observed value	285	285	285	285	285

Notes: The values in parentheses are standard errors. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table IV.
Local government debt (total debt) and regional economic growth

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Eastern region					
ln *debt*	0.25246* (0.15128)	0.26044* (0.15430)	0.27752* (0.14858)	0.25312* (0.15090)	0.27590* (0.14805)
ln $debt^2$	−0.01520* (0.00869)	−0.01595* (0.00886)	−0.01671* (0.00853)	−0.01523* (0.00867)	−0.01660* (0.00849)
ln *gdppercapita*	−0.24622*** (0.06190)	−0.14387*** (0.04925)	−0.27221*** (0.05467)	−0.24410*** (0.06161)	−0.26870*** (0.05346)
trade	0.02172 (0.02994)	0.03190 (0.03029)	0.01145 (0.02766)	0.01874 (0.02931)	0.01035 (0.02737)
fdi	−0.10743 (0.20829)	−0.02429 (0.21005)	−0.06691 (0.20320)		
ln *government*	0.11371*** (0.04303)		0.10629** (0.04220)	0.11036** (0.04243)	0.10470** (0.04180)
govconsumption	−0.07655 (0.08533)	−0.03321 (0.08542)		−0.06701 (0.08309)	
ln *humancapital*	0.08168*** (0.02845)	0.11326*** (0.02633)	0.09860*** (0.02128)	0.08487*** (0.02770)	0.09930*** (0.02111)
Observed value	165	165	165	165	165
Central and western region					
ln *debt*	−0.19665 (0.27452)	−0.14916 (0.27826)	−0.21679 (0.27475)	−0.18273 (0.27264)	−0.20409 (0.27279)
ln $debt^2$	0.01339 (0.01853)	0.0099 (0.01877)	0.01486 (0.01854)	0.01248 (0.01841)	0.01402 (0.01841)
ln *gdppercapita*	−0.10608*** (0.03785)	−0.03301 (0.02940)	−0.12688*** (0.03510)	−0.10556*** (0.03778)	−0.12619*** (0.03501)
trade	−0.08028 (0.11939)	−0.10462 (0.12094)	−0.09796 (0.11902)	−0.06929 (0.11709)	−0.08792 (0.11661)
fdi	0.21056 (0.43016)	0.04061 (0.43294)	0.18851 (0.43081)		
ln *government*	0.08044*** (0.02682)		0.07823*** (0.02683)	0.07871*** (0.02655)	0.07671*** (0.02657)
govconsumption	−0.16771 (0.11550)	−0.14813 (0.11708)		−0.16571 (0.11526)	
ln *humancapital*	0.04655** (0.01881)	0.07670*** (0.01614)	0.05137*** (0.01855)	0.04730** (0.01872)	0.05199*** (0.01847)
Observed value	285	285	285	285	285

Notes: The values in parentheses are standard errors. *,**,***Significant at 10, 5 and 1 percent levels, respectively

5.2.2 The impact of local government debt on economic growth in the central and western region. The estimates in Tables I–IV using the central and western region as a sample indicate that when implicit debt, SOEs' state debt or the sum of all debt that have been estimated are used as the proxy variables of local government debt (Tables I, II and IV), the coefficients before the primary and secondary terms of per capita debt are both insignificant, that is, in the central and western region, the impact of implicit debt and the sum of implicit and explicit debt on economic growth is not significant. In comparison, when only the estimated explicit debt is used as the proxy variable of local government debt (Table III), it is found that the coefficient before the primary term of per capita debt is significantly negative at the 10 percent significance level, and the result is stable, but the effect of the coefficient before the quadratic term on the economic growth rate is not significant. This shows that in the central and western region, the growth rate of GDP per capita and the explicit debt level of local governments have monotonically decreasing relation.

The results of other variables in the model are consistent with existing literature: when the debt level under whichever statistical caliber is used as the proxy variable of local government debt, the regression results of both samples, the eastern region and the central and western region, indicate that the coefficient before the logarithm of GDP per capita that lags one phase is significantly negative, which indicates that the economies of the relatively developed eastern region and the relatively underdeveloped central and western region in China are conditionally convergent to some extent, and the studies of Lu Ming and Chen Zhao and other scholars have also observed obvious conditional convergence; as with the studies of (Shiyi and Jun, 2008; Shuai and Zhongying, 2008) and other scholars, the impact of the variable, human capital, on economic growth is significantly positive under various circumstances, and the results are relatively stable. In addition, the impact on economic growth of other variables such as trade openness, foreign direct investment and local government consumption expenditure is not stable. The instability of the effect of these variables on growth is supported by the empirical studies of Ming and Zhao (2009), Xibao and Zhi (2009) and other scholars. In general, the estimated results that other variables are consistent with theoretical predictions or existing literature also prove to some extent the credibility of the empirical model used in this paper.

5.2.3 Empirical conclusions and their comparison with theoretical predictions. The empirical results show that different types of local government debt differ in their impact on the economic growth in the eastern region and the central and western region. In the eastern region, implicit debt, i.e., the state debt of SOEs and city investment debt, has significant impact on economic growth and the impact of explicit debt on economic growth is not significant, while the situation in the central and western region is on the contrary. The possible reason is that the eastern region has a larger scale of implicit debt and wider channels of government financing, which severely restricts the impact on economic growth of debt financing, including foreign borrowing by local governments, local government bonds issued by the central government and other explicit debt. For example, by the end of 2010, the state debt of SOEs in 11 eastern provinces and cities accounted for 66.3 percent of the national total (excluding Chongqing); city investment debt issued by financing platforms accounted for 62.86 percent of the national total[14]; in contrast, the state debt of SOEs in the central and western region was relatively low, and some places, like Tibet, have not issued any city investment debt yet. Due to narrow debt financing channels, local governments' foreign borrowing, bonds issued by the central government and other explicit debt play an important role in the growth of the central and western region.

In addition, for the eastern region, when the state debt level of SOEs is low, the economic growth rate increases as the debt level increases, but when the debt level exceeds a certain

critical value, the economic growth rate begins to decline gradually, and the economic growth and per capita debt level show an inverted U-shaped relation, which is the same with the theoretical model, when the local government is not subject to debt constraints; in the central and western region, the economic growth rate decreases gradually as local governments' explicit debt increases, and the monotonically decreasing correlation in the model appears when the government is subject to debt constraints. The possible reason is that the existence of crowding out effect makes the economic growth rate in the eastern region only reach a relatively low value in the short term, and the positive externality of public investment makes the growth rate undergo a rising phase. However, such positive externality can only slow down the decline of marginal productivity; the ultimate decline of the marginal productivity of factors makes the economic growth rate decline gradually as the per capita debt level increases. In contrast, the absence of crowding out effect in the central and western region makes its economy undergo relatively rapid growth at the beginning, and the growth rate does not experience the rising stage of the eastern region.

6. Conclusions

As the economy slows down and fiscal revenue growth decelerates, local governments face increased debt pressure. In this context, clarifying the relation between local government debt and economic growth is significant for giving full play to the positive role of local debt in stabilizing growth. This paper tries to answer the questions raised in the introduction part both theoretically and empirically. In the theoretical part, this paper constructs a dynamic game model consisting of individuals, enterprises and the government, and examines through numerical simulation the relation between debt and such variables as consumption and economic growth based on whether the local government is subject to debt constraints. The study shows that when the government is not bound by debt, the crowding out effect of excessive government debt and investment behavior is more obvious. For this reason, the growth rate will experience a rising stage at the beginning of the period, and the growth rate and per capita debt level show inverted U-shaped relation; when the government is subject to debt constraints, the growth rate and per capita debt level are negatively and monotonically correlated. At the same time, the per capita consumption level presents an inverted "U" curve for being affected by the tax revenue effect, and limited debt financing delays, to some extent, the decrease of the per capita consumption level.

Based on the theoretical model, this paper explores the impact of local government debt on the economic growth of the eastern region and the central and western region and the regional differences of such impact with the explicit debt of local governments, state debt of local SOEs and city investment debt as the proxy variables of local government debt. The empirical results show that for being affected by the total size of debt (including implicit debt) and government financing channels, the eastern region and the central and western region differ in the impact of different types of local government debt on growth. In the eastern region, the state debt of SOEs and city investment debt have significant impact on growth and that of explicit government debt is not significant, while the situation in the central and western region is the opposite. In addition, the economic growth in the eastern region has an inverted U-shaped relation with the per capita state debt of SOEs and city investment debt, that is, the promoting effect of such debt on the economy has a turning point, and excessive government debt may lower the growth rate; the economic growth rate in the central and western region gradually decreases as the explicit debt of local governments increases, and the empirical analysis results are basically consistent with the predictions of the theoretical model.

The conclusions of this paper not only help understand the relation between local government debt and economic growth and the regional differences of such relation, but

also influence the utilization of local government debt financing to promote local economic development. Since the impact of different types of debt on growth differs from region to region, it is particularly important to adjust the management of government debt financing structure to local conditions. For example, it is suggested that the eastern region put more emphasis on the standardization and transparent management of such implicit debt as the debt of SOEs and financing platforms, and strive to keep its debt level at a reasonable level. Besides supervising and managing government debt, the central and western region is also suggested to try to help local SOEs improve their business performance so that their debt funds can play a better role of driving corporate development and even promoting local economic development; on the other hand, this region is also suggested to actively expand financing channels for local governments and support the building and maintenance of local financing platforms.

Notes

1. Audit Report No. 24 of 2013 of the National Audit Office of China: Audit Results of Governmental Debt of 36 Local Governments.
2. Annual Audit Report of 2014, National Audit Office of China.
3. Available at: http://finance.sina.com.cn/china/20151201/175823902057.shtml
4. Audit Report No. 35 of 2011 of the National Audit Office of China: Audit Results of Nationwide Local Governmental Debts.
5. Audit Report No. 35 of 2011 of the National Audit Office of China: Audit Results of Nationwide Local Governmental Debts; Audit Report No. 24 of 2013 of the National Audit Office of China: Audit Results of Governmental Debt of 36 Local Governments.
6. Available at: http://english.caijing.com.cn/2012-10-23/112218305.html
7. Considering the possible influence of parameters and initial values in the model on simulation results, a sensitivity analysis is also carried out and relevant conclusions remain valid. The analysis is not shown in the paper due to space, but it can be requested from the authors.
8. Here we may eliminate the U-shaped relation between the per capita output growth rate and the per capita debt level by expanding the range of the horizontal and vertical axes, that is, when the government is bound by debt, the per capita output growth rate will not increase as the per capita debt level increases.
9. The selection of measurement indexes for human capital is still controversial. Besides the average number of students enrolled in colleges and universities out of every 1,000 people in the population adopted in the thesis, Yifu and Xifang (2008) used the ratio of students enrolled in secondary schools and institutions of higher learning to the entire population to measure the stock of human capital, while Xibao and Zhi (2009) and other scholars used the average years of education received in their studies.
10. For example, local government debt has spillover effect on economic development through such channels as public goods expenditures. Similarly, the degree of economic development may also affect the debt level of local governments: in general, highly mobile residents (usually wealthy residents) are more likely to pass the future tax burden of repaying debt on to a less mobile group by moving out of a place of residence, so that such people are more inclined to be in debt (Feng and Li, 2005). Therefore, the more developed the economy in a region, the more mobile its population, the higher its proportion of rich people, and the more likely for the region to be in debt. Besides, the concept of "too big to fail" and the existence of soft budget constraints will further drive the impulse to borrow for economically developed regions.
11. Due to the lack of Chongqing's separate data before 1997, Chongqing is excluded from the analysis.

12. The paper refers to the studies of other scholars and the regional division method of the National Bureau of Statistics issued on June 13, 2011: eastern provinces are Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan; and central and western provinces are Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

13. Other related debt refers to debt that is raised by relevant enterprises and public institutions for public welfare projects and repaid with the revenues of their own or such projects. The local government neither provides guarantees nor has any legal obligations for such debt, but when the debtor has difficulties in repaying it, the government may need to provide some assistance. For details, please refer to the "Audit Report No. 35 of 2011 of the National Audit Office of the People's Republic of China."

14. Data on the state debt of SOEs and city investment debt are compiled in accordance with *China Statistical Yearbook* and provided by the database Wind, respectively.

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