Department of Land Economy
Environment, Law & Economics

UNIVERSITY OF
CAMBRIDGE
Real Estate Research Centre

Working Paper Series
No. 2021-02

Title: When the Iron Hand Shakes the Visible Hand: Financing Infrastructure Projects through Local Government Debts in China

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When the Iron Hand Shakes the Visible Hand: Financing Infrastructure Projects through Local Government Debts in China

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Abstract:

This study is a response to the call for further research on infrastructure financing from China in the 2019 special issue of *Urban Studies* on "Funding, Financing and Governing Urban Infrastructures". We develop a theoretical model to investigate the complex relationship between local government debt issuing for infrastructure financing, land finance, and demand from the private sector in China. Using local government financing vehicles' accounting data, we find that not only the visible hand of local governments is working creatively to meet infrastructure development targets handed down by the 'iron hand' of the central government, but also the visible hand is getting more effective by considering activities from the private sector in their debt issuing decisions. By studying the two financing methods in one unified framework, our work provides reliable and practical evidence on how infrastructure financing works in China. The policy implications of our findings are also discussed in light of the newly announced Dual Circulation economic development strategy in May 2020.

Keywords: urbanisation, local government financing vehicles, fiscal decentralisation, China

JEL classifications: R51, R53, R58

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1. Introduction

Since the beginning of its economic reform in the 1980s, China has been investing heavily in infrastructure projects in and outside of the country. According to the World Bank, China's share of gross fixed capital formation in GDP increased from 24% in 1990 to 43% in 2018, whilst its GDP has been growing at an impressive rate over the same period (see Figure 1). Although a high level of investment in infrastructure is expected among emerging economics, China's commitment to infrastructure pales that of India, Russia, and Brazil (i.e., the rest of the BRIC block), of which the gross fixed capital formation in GDP ranges between 20% to 29% in 2018.

Infrastructure investment is an important tool for the Chinese government to stimulate economic growth (Wu, 2010), to counter regional and global economic crises (World Bank, 2010), and to promote geopolitical agenda (Mohan and Tan-Mullins, 2019). Consequently, infrastructure development has always been a part of the central government's master plans. For example, infrastructure investment in roads and bridges is central to the One Belt One Road initiative. Although China has made significant transition from a central planning system to a market-oriented economy in the last four decades, infrastructure development is still firmly controlled by the central government's 'iron hand'.

In the last three decades, many developing countries have embarked on fiscal decentralisation, transferring the responsibility of public goods provision from central government to local governments (Bardhan and Mookherjee, 2006). Recently, the responsibilities of infrastructure provision have been gradually shifted to the 'visible hand' of local governments in China as well. In the context of infrastructure financing, how the local government's strategy evolves along with the market-oriented and decentralisation transition has been of great interest to researchers and policymakers (Tsui, 2011; Wang et al., 2011). This issue is especially prominent in China where rapid urbanisation and economic development in China put increasing pressure on local government to finance infrastructure development (He et al., 2016).

Furthermore, China's 1994 tax sharing reform transferred the bulk of tax revenues to the centre, leaving local governments with large fiscal shortfalls. In less than 20 years, local governments' share of national government revenues has dropped below 40%, while their share of national government expenditure stands above 60% (Fan and Lv, 2012; Shen et al., 2014). This fiscal institutional change and the GDP-orientated cadre evaluation system strongly motivate local governments to seek extra-budgetary and off-budgetary revenue (Ong, 2012).

Land leasing revenue, accounting for the lion's share of extra budgetary revenue, has become an important funding source for urban infrastructure (Ding et al., 2014; Feng et al., 2015; Wang et al., 2011; Wu, 2010). This phenomenon is referred as "land finance" in the literature and public media (see, for instance, Fu, 2015; Pan et al., 2017; Wu et al., 2015). In 2018, the total land leasing revenue in China reached 39.9% of local government revenue. Local governments also hoard land to control land supply and to raise land price (Du and Peiser, 2014). This strategy helps local government collect more revenue from land leasing to fund infrastructure projects (He et al., 2014), resulting in an upward spiral among land prices, land revenue, and infrastructure investment.

After the 2008 financial crisis, local government debt has become another important financing method for infrastructure development. China introduced an economic stimulus plan in 2009 for large scale infrastructure investment (Shi and Huang, 2014). Meanwhile, the central government liberalised the financial market for local governments (Bai et al., 2016). Both the countercyclical policy and financial liberalisation enabled local governments to secure credits from the financial market for infrastructure development. Although the 1994 Budget Law

2

prohibited local governments from issuing debts and running a deficit, local governments worked around this law by setting up off-balance sheet financing vehicles, i.e., local government financing vehicles (LGFVs hereafter). LGFVs are state-owned enterprises that are initially set up by local governments to borrow from banks and bond markets for infrastructure financing and construction (Chen et al., 2017). As China became the biggest spender on fixed investment (in absolute value) in the world, this debt-driven infrastructure financing fever also made China the most indebted country among emerging markets (Dobbs et al., 2015).

Despite of the importance of the topic, there have been limited research on infrastructure financing in China, and particularly Chinese local governments' debt financing strategy for infrastructure projects. There are only a few studies showing evidences of local governments using land as collateral for municipal debt (see, for example, Jiang and Waley, 2018; Li and Chiu, 2018; Wu et al., 2016), and land leasing revenue positively affecting local government debt volume between 2009 and 2012 (Pan et al., 2017). To bridge this gap in the literature, we develop a theoretical model to investigate how land finance and business activities from the private sector influence local government debt issuing. Our theoretical model predicts that, if local governments consider business activities from the private sector in debt issuing decisions, local government debt level should be determined by the land demand for private development, and a higher level of land revenues should encourage local governments to borrowing more from the credit market. In the empirical investigation, we focus on the debts raised by LGFVs, which is the largest component of local government debt in China.

Our research contributes to the literature by responding to the call for studies on infrastructure financing in the global South (O'Brien et al., 2019; Whiteside, 2019). This is one of the few investigations into alternative funding and financing models of infrastructure projects in China (see, for example, Tan and Zhao, 2019). On the policy front, our findings provide timely assessment of how well the 'iron hand' of the central government and the 'visible hand' of local governments are working together on infrastructure provisions. In May 2020, the Chinese government announced its new development strategy in the latest Five Year Plan: the Dual Circulation strategy. It is a new balance away from global integration (i.e., the first circulation) and toward increased domestic reliance (i.e., the second circulation) (Blanchette and Polk, 2020). Such strategy requires infrastructure development decisions to be more responsive to the demand from domestic markets (Buckley, 2020). Our findings suggest that the reforms of local government debt markets in the last decade has paved the road for this transition.

The rest of the paper is organised as follows. Section 2 gives a review of local government debt and LGFVs in China, followed by the development of a theoretical framework and testable hypotheses in Section 3. Empirical implementation is presented in Section 4 and findings are discussed in Section 5. The last section gives policy implications and conclusions.

[Insert Figure 1 Here]

2. Local government debt and LGFVs in China

2.1 Institutional Background

China's political institution can be described as a "regionally decentralized authoritarian regime" (Xu, 2011), which is a highly hierarchical system that allows the central government to set the criteria of promotion (and demotion) for subordinate governments (province, municipal, and county levels). Since the economic reform in the 1980s, greater weight has been put on local economy growth, as measured by local GDP growth rate. This results in a

GDP-orientated cadre evaluation system. Not surprisingly, local governors are highly motivated to boost the GDP growth in their jurisdiction in order to compete with their peers (Chen et al., 2017; Li and Zhou, 2005).

Meanwhile, subordinate governments are also granted some degree of autonomy over local economic activities, as well as the discretion over the use and distribution of local endowments such as land and financial resources. Land and infrastructure are crucial to the growth in productivity and economic development as they provide the space and public services to support the expansion of economy. They have become two critical factors in many important decisions by local developments under China's GDP-orientated cadre evaluation system. For instance, Ding et al. (2014) note that local governments show a tendency to channel a large proportion of land revenue toward growth orientated infrastructure such as urban roads and highway rather than welfare spending. In addition, land revenue has been invested in specific infrastructure that is more likely to attract FDI, which stimulates economic growth in urban area (He et al., 2014; Tao et al., 2010). Such land use strategies in China indeed improves local governors' chances for promotion. Chen and Kung (2016) find that, other things being equal, land leasing is positively related to the likelihood of promotion of city governors. Local governors turn to land leasing to finance urban development and to advance their political career ultimately.

2.2 LGFVs in China's Land and Financial Markets

In the aftermath of the financial crisis in 2008, the central government orchestrated the stimulus plan and credit relaxation, The Ministry of Finance and China Bank Regulation Committee (CBRC) opened a new credit channel by encouraging the establishment of LGFVs to invest in infrastructure (Chen et al., 2017). Since then, LGFV becomes an active and important player in the land market and a major borrower in the financial market. The central government also has gradually opened the market of private projects such as commercial and residential development to LGFVs (Bai et al., 2016). In order to raise funds from banks and bond markets, local governments injected public assets such as land and budgetary funds into LGFVs to improve their balance sheets. By doing so, LGFVs are able to meet the requirements for bond issuance, such as the minimum total net asset volume and the debt to equity ratio set by the regulatory bodies.

As the monopoly supplier in the urban land market in China, local governments can choose between two options of injecting land to LGFVs: state allocation (*huabo*) and conveyance (*churang*). Land transferred to LGFVs through state allocation is free but for public use only, such as infrastructure construction or military uses. In addition, the law prohibits state-allocated land from transferring, leasing and mortgage lending.

Land injected through land conveyance is not free but can be used in for-profit projects. LGFVs must pay the fee to secure land use right from local governments. Land conveyance of land use right are conducted through tender, auction or listing, with listings account for over 70% of all transactions (Huang and Du, 2017). In addition to infrastructure projects, LGFVs can used the land that they leased from local governments in commercial projects, such as residential or commercial real estate development (Bai et al., 2016).

LGFVs also borrow heavily from the financial market to finance both of their public and private projects. Before 2009, more than 90% of LGFVs debt were in the form of bank loans (Bai et al., 2016), which are worth 5.57 trillion RMB (Pan et al., 2017). Although the average maturity of these loans are three to five years, LGFV projects usually lasts decade-long. To deal with this maturity mismatch, LGFVs' borrowing channel has shifted from bank loan to bond market

4

since 2013 (Chen et al., 2017). Local government debt in China reached 17.89 trillion RMB in 2013, which accounted for 31.5% GDP of that year (Wu et al., 2018). The geographical variation and the level of local governments' dependence on LGFV in infrastructure development are illustrated in Figure 2.

[Insert Figure 2 Here]

2.3 Regulations of LGFV debt

LGFV debt, which are essentially local government debt, can expose the central and local government to substantial systematic risks. First, LGFVs are established to be off-budget entities of local governments and run as a corporate. The lack of transparency and accountability in LGFVs could be detrimental to the financial system. Second, although local governments are monitored and not allowed to run fiscal budget in deficit, LGFVs as separate entities are allowed to have a budget deficit. In addition, local governments have reserved a proportion of fiscal revenues for LGFVs' solvency. Therefore, the rapid accumulation of local government debt has become a great concern for the central government.

In response to the growing risks associated with the ballooned local government debt volume, the central government released a series of regulations to curb the debt growth. In 2010 and 2013, two nation-wide audits were carried out by the National Audit Office to identify and classify the outstanding amount of local government debt. In a document issued in 2013, the organizational department of CCP included "the outstanding of local government debt" as a critical criterion for local cadres' promotion. In 2014, the State Council issued the *'No.43 Document'* that imposed strict restrictions on LGFVs to initiate new debt. Meanwhile, the Organization Department of the China Communist Party included municipal debt outstanding amount as a criterion in the cadre evaluation system. These regulations from the central government might have resulted in some fundamental changes in LGFVs' debt financing strategy. In 2015, the *Amended Budget Law* took effect and allowed the local governments to raise new debt. Afterwards, the Ministry of Finance initiated a large-scale debt swap program, under which a considerable amount of LGFV debt can be swapped by the general obligation municipal bond issued by the central government. This to certain extent reduces the financial risk associated with local government debt.

3. Theoretical Framework

We develop a two-period model to describe the local government's behaviour of infrastructure financing. In this two-period cycle, the local government aims to develop infrastructure with a target (denoted by q), while choosing optimal land allocation to maximise land revenue. Following the practice in infrastructure studies, q is measured by the area of land for infrastructure development, with the unit cost k.

In the first period, the local government aims for infrastructure development target q_1, and thus the infrastructure investment can be calculated as kq_1. The local government balances the fiscal expenditure including the support to industrial development I_1 with unit subsidies s, by using land finance (LF_1) and debt finance (D_1), as described in the equation below.

$$LF_1 + D_1 = kq_1 + sI_1 \,,$$

where the land revenue mainly comes from the leasing of commercial and residential lands. Specifically, $LF_1 = n_1C_1 + p_1R_1$, where n_1 and p_1 are the prices of commercial and residential lands, and C_1 and R_1 are the quantity of commercial and residential lands. Industrial land leasing is not included in this calculation because it doesn't generate positive revenue (e.g. the land price is equal to or less than the cost of land clearance). This is because local governments

5

in China has been keeping industrial land prices low, and sometimes even for free or at a net loss, in order to boost local economic growth (Cao et al., 2008).

In the second period, the local government aims for infrastructure development q_2 so that $q_1 + q_2 = q$. The local government intends to maximise the fiscal balance that consists of the land revenue $LF_2 = n_2 C_2 + p_2 R_2$, the infrastructure investment kq_2, and the support to industrial development with subsidies sI_2. The final fiscal balance is

$$V_2 = LF_2 - kq_2 - sI_2 .$$

Following Cai and Treisman (2005), the total productivity of a city is determined by the public and private investments. Specifically, assume a Cobb-Douglas productivity function as follows.

$$Y_t = AQ^\sigma I^\alpha C^\beta ,$$

where Q, I and C represent the stock of infrastructure, industrial, and commercial development at time t respectively. $A > 0$ denotes multi-factor productivity capturing the effect of the local endowment on the output. $\alpha, \beta, \sigma > 0$, and $\alpha + \beta + \sigma < 1$ indicates decreasing return to scale. With log-linear approximation, the growth rate of total productivity for each period is

$$y_t \equiv ln \frac{Y_t}{Y_{t-1}} \approx \left[1 + \sigma \frac{q_t}{Q} + \alpha \frac{I_t}{I} + \beta \frac{C_t}{C} \right],$$

where q_t, I_t and C_t are the flow of infrastructure, industrial and commercial development at time t, respectively. In the short run, land prices grow as wages and productivity improve (Roback, 1982). In this case, land prices change at the rate of y_t in each period. For instance, the prices of commercial land from period 1 to period 2 becomes

$$n_2 = n_1 \left[1 + \sigma \frac{q_1}{Q} + \alpha \frac{I_1}{I} + \beta \frac{C_1}{C} \right] \text{ and } p_2 = p_1 \left[1 + \sigma \frac{q_1}{Q} + \alpha \frac{I_1}{I} + \beta \frac{C_1}{C} \right].$$

Meanwhile, land is non-renewable and limited resource. The local government faces a land budget constraint for commercial development, i.e., $C_1 + C_2 = N$.

Thus, the local government in the second period has the fiscal balance of

$$V_2 = n_2 C_2 + p_2 R_2 - kq_2 - sI_2$$

$$= n_1 \left[1 + \sigma \frac{q_1}{Q} + \alpha \frac{I_1}{I} + \beta \frac{C_1}{C} \right] (N - C_1) + p_1 \left[1 + \sigma \frac{q_1}{Q} + \alpha \frac{I_1}{I} + \beta \frac{C_1}{C} \right] R_2 - k(q - q_1) - sI_2 .$$

From F.O.C., we have

$$\frac{\partial V_2}{\partial C_1} = n_1 \left[\left(\frac{\sigma n_1}{kQ} + \frac{\beta}{C} \right) (N - c_1) - \left(1 + \sigma \frac{LF_1 + D_1 - sI_1}{kQ} + \alpha \frac{I_1}{I} + \beta \frac{c_1}{C} \right) \right] + \frac{\beta}{C} p_1 R_2 + n_1 = 0.$$

With some arrangements, the equation becomes

$$\frac{\beta}{C} p_1 R_2 + \left(\frac{\sigma n_1}{kQ} + \frac{\beta}{C} \right) n_1 N - n_1 \sigma \frac{D_1}{kQ} = n_1 \left\{ \sigma \frac{LF_1}{kQ} - \left(\frac{\sigma s}{kQ} - \frac{\alpha}{I} \right) I_1 + \left(\frac{\sigma n_1}{kQ} + \frac{2\beta}{C} \right) c_1 \right\}, \tag{1}$$

Take derivatives (*w.r.t.* D_1, LF_1, I_1, C_1, R_1) on both sides, we obtain

$$-\frac{\sigma}{kQ} dD_1 = \frac{\sigma}{kQ} dLF_1 + \left(\frac{\alpha}{I} - \frac{\sigma s}{kQ} \right) dI_1 + \left(\frac{\sigma n_1}{kQ} + \frac{2\beta}{C} \right) dC_1, \tag{2}$$

The maximum of debt that the local city government can raise in a given period is regulated by provincial government with a quota system (Huang and Chan, 2018). In this two-period model, the debt quota is assumed to be D, i.e., $D_1 + D_2 \leq D$. Meanwhile, the rate of national treasury bond has been declining and money supply (M2) has been increasing in China. As a result, local government debt becomes a popular option to raise funds. Most local governments try to use up all the quota, and equation (2) becomes

6

$$\frac{\sigma}{kQ}dD_2 = \frac{\sigma}{kQ}dLF_1 + \left(\frac{\alpha}{I} - \frac{\sigma s}{kQ}\right)dI_1 + \left(\frac{\sigma n_1}{kQ} + \frac{2\beta}{C}\right)dC_1, \tag{3}$$

This gives us the following propositions that captures the role of land finance and the private sector in local governments' debt financing of infrastructure development.

(i) $\frac{\partial D_2}{\partial C_1} = n_1 + \frac{2\beta}{C}\frac{kQ}{\sigma} > 0$. This suggests that commercial development in the current period has a positive effect on local government debt issuing in the next period. Specifically, the commercial sector affects the local government debt through two channels, i.e., immediate contribution to land revenue (through n_1) and potential contribution to productivity (through $\frac{2\beta}{C}\frac{kQ}{\sigma}$).

(ii) $\frac{\partial D_2}{\partial I_1} = \frac{kQ}{\sigma}\left(\frac{\alpha}{I} - \frac{\sigma s}{kQ}\right) < 0$ when $\frac{\alpha}{I} - \frac{\sigma s}{kQ} < 0$. This condition indicates that the industrial sector affects the local debt through two channels: a positive contribution to productivity through $\frac{\alpha}{I}$ and a negative contribution to land revenue through $-\frac{\sigma}{kQ}s$[1]. The condition is equivalent to compare $\frac{\alpha}{s}\frac{1}{I}$ and $\frac{\sigma}{k}\frac{1}{Q}$. Firstly, we have $Q < I$ as Chinese cities have promoted industrial development for the past decades. Secondly, $\frac{\alpha}{s}$ and $\frac{\sigma}{k}$ represents the ratio of the productivity to the cost when investing in industry and infrastructure, respectively. The infrastructure development shows a substitute effect as it brings more efficiency to boost local economy compared to industrial development in China (e.g. Shi and Huang, 2014). Thus, the condition $\frac{\alpha}{I} - \frac{\sigma s}{kQ} < 0$ indicates that the industrial development in the current period has a negative total effect on the local government debt in the next period.

(iii) $\frac{\partial D_2}{\partial LF_1} = 1$. The positive value indicates that land finance in the current period positively affects local government debt issuing in the next period. An increase in land revenue is often taken by the local government as a signal of strong land demand from the private sector, which will lead to an increase in the demand for infrastructure. Meanwhile, a higher level of land revenue is also associated with optimistic anticipation in economic growth. This gives the local government both the incentive and the confidence to issue new government debts to finance infrastructure projects.

Because the residential sector is not included in the production equation $Y_t = AQ^\sigma I^\alpha C^\beta$, equation (3) shows no direct implications on the role of residential sector. However, the boom in residential real estate market in China causes resources misallocation between real estate and other sectors in the economy. Specifically, residential real estate sector in China has a strong crowding-out effect on non-real estate investment (Chen and Wen, 2017). Lenders favour residential real estate development projects because they offer higher returns than other industries (Allen et al., 2019). Due to the crowding-out effect of residential sector, we expect a negative (albeit indirect) relationship between residential land transaction and debt for infrastructure investment.

Based on the three propositions derived from equation 2(a) and our analysis on the residential real estate sector, we derive the following four hypotheses.

Hypothesis 1A*: The land acquired by the commercial sector positively affect the amount of local government debt devoted to infrastructure development.*

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[1] We could consider $LF_1 - sI_1$ as the total revenue of land leasing in the first period.

Hypothesis 1B: *The land acquired by the industrial sector negatively affect the amount of local government debt devoted to infrastructure development.*

Hypothesis 1C: *The land acquired by the residential sector negatively affect the amount of local government debt devoted to infrastructure development.*

Hypothesis 2: *Land finance positively affects the amount of local government debt devoted to infrastructure development.*

Specifically, Hypothesis 1 regards the roles of private sectors while Hypothesis 2 regards the role of land finance in the debt dynamics of local government. The empirical verification of our theoretical model and hypotheses are given in the next section.

4. Empirical Implementation

We collect data from WIND database to facilitate the empirical analysis. The data set covers 33 major cities[2] in China between 2009 and 2017, because LGFVs activities were limited before 2009. Variable definitions and descriptive statistics of all variables are shown in Table 1. All data are in quarterly frequency.

[Insert Table 1 Here]

4.1 The Measurement of LGFV debt for Infrastructure Development

To test the hypotheses in Section 3, we need reliable measurement of local government debt for infrastructure development. Some exiting studies use LGFV bonds as the proxy, and the data between 2009 to 2017 is available (see, for example, Pan et al., 2017). Technically, LGFV bonds should be primarily used for infrastructure projects. In practice, it is not the case as a part of the fund raised in LGFV bonds is often used for commercial development or for public spending (Bai et al., 2016). It is difficult to distinguish the proportion of LGFV bonds for infrastructure financing from other uses, because such information is not available to public. Consequently, LGFV bonds are not reliable measurement of LGFV debt that were used for infrastructure development.

To address this issue, we use cash flow data of LGFVs to reliably identify the proportion of funds used for infrastructure development, because cash flow data gives micro-level accounting information that subjects to annual auditing. Our procedure involves three steps to obtain the estimate of the debt that the local government raised for infrastructure investment.

The first step is to obtain the cash outflow of investments ($InvCF$). Under China's accounting standards, it consists of four sub-accounts: 1) *cash paid for purchasing and constructing fixed assets, intangible assets and other long-term assets*, 2) *cash paid for investment*, 3) *net cash amount paid for acquiring subsidiaries and other business units*, and 4) *cash paid for activities related to investment*. The first sub-account records the cash outflow related to LGFVs' infrastructure investment. We also include the other three as it is a common practice that LGFVs manipulate the account and require their subsidiaries to construct infrastructure behind the scenes.

The second step is to calculate the cash inflow of operating activities ($OpCF$) that contains several sub-accounts. The largest sub-account is *cash inflow from selling goods and providing services*, which represents LGFV's real earning under the cash basis accounting system. By

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[2] The 33 cities are selected from the list of 35 major cities excluding Lhasa and Ürümqi. The list is defined by National Bureau of Statistics in China.

using this sub-account, we can estimate the cash inflow related to commercial earning. The rationale behind this practice is that, only commercial activities can generate cash inflows, while most of infrastructure projects cannot produce cash inflow into LGFV account. The constructed infrastructure will be transferred from *construction in process* into *account receivable* and will be kept on the balance sheet generating zero cash inflow until the local government pay and take over it.

Finally, we calculate the gross investment cash flow of LGFVs (GCF) as the difference between the cash outflow of investments and cash inflow of operating activities, i.e., $GCF = InvCF - OpCF$. This forms our measurement of the debt that the local government raised for total infrastructure investment in a city.

4.2 The Measurement of Land Finance and Investment from Private Sectors

Data is obtained from WIND to measure land finance and investments from private sectors. To gauge investment activities from private sectors, we obtain data on land acquisition in the industrial, residential, and commercial sectors (denoted as *IndTran, ResTran, ComTran*, respectively, as defined in Table 2).

The measurement of land finance is challenging. We consider three alternative measurements as outlined below. The first variable is the total revenue of land leasing ($TotalRev$). It is the leasing revenues of industrial ($IndRev$), commercial ($ComRev$) and residential ($ResRev$) land combined and is commonly used in the land finance literature (Pan et al., 2017). We also constructed two variables to quantify land finance ($LandFin$). The first is the ratio of the total land revenue to the total budgetary revenue of the local government ($Land2Fis$). This ratio measures the fiscal reliance of local governments on land revenue (Mo, 2018). In addition, land revenue to GDP ($Land2GDP$) is adopted in our models as an alternative measurement to $Land2Fis$ (Mo, 2018). $Land2Fis$ and $Land2GDP$ are better measurements of local government's reliance on land sale revenues. They also alleviate the potential multi-collinearity issues by including both land transaction volume and revenue in the model at the same time.

4.3 The Model

With the variables defined above, we estimate the following equation

$$GCF_{i,t} = \alpha_0 + \alpha_1 IndTran_{i,t-1} + \alpha_2 ResTran_{i,t-1} + \alpha_3 ComTran_{i,t-1} + \delta LandFin_{i,t-1} + \boldsymbol{\varphi X}_{i,t-1} + T_t + S_t + \varepsilon_{i,t}$$

where *i* and *t* are indicators of city and time, respectively. $\boldsymbol{X}_{i,t}$ is a matrix of variables that controls for factors that are likely to affect the dependent variable. It includes the change in price index of fixed investment ($FIP_{i,t}$), capital cost (i.e., the lending rate r_t), GDP growth rate at city level ($GDP_{i,t}$) and the log prices of residential, industrial and commercial land at city level ($Land\ price_{i,t}$), and fixed effects including year effect (T_t) and seasonal effect (S_t). Descriptive statistics of these variables can be found in Table 2.

To test Hypotheses 1A through 1C, we expect that $\alpha_1 > 0$, $\alpha_2 < 0$, and $\alpha_3 < 0$. For Hypothesis 2 to be true, the coefficient estimate of $LandFin_{i,t-1}$ should be positive.

5. Empirical Findings

5.1 Fixed-effect Panel Regression Estimations

We firstly estimate both fixed-effect and random-effect panel regression models with clustered standard errors at the city level. Hausman test results suggest that fixed-effect models fit the data better. Our discussions are based on the fixed-effect panel regression outputs given in Table 2.

First, the coefficients of $IndTran$ and $ResTran$ are negative, and the coefficient of $ComTran$ is positive. This supports Hypothesis 1. These three sectors, however, have weak impacts on local government debt as none of the coefficients is statistically significant. In other words, local governments did not take the future development of private sectors into account when using debt financing. Second, the coefficients of the three land finance measurements, i.e., $TotalRev$, $Land2Fis$ and $Land2GDP$ are positive and statistically significant at 10%. The results support Hypothesis 2 that the land finance positively affect the local government debt.

[Insert Table 2 Here]

We further explore the data by including the revenue from residential land leasing ($ResRev$) and commercial land leasing ($ComRev$) separately in the model. On average, residential land revenue accounts for 70% of total land revenue while commercial land revenue takes up 20%. The industrial revenue is excluded because previous studies show that Chinese local governments have controlled industrial land prices to sell lands to private sectors at low price, and sometimes even for free or at a net loss to boost local economic growth (Cao et al., 2008). Models 4 and 5 show that $ResRev$ positively and significantly affects local government debt while $ComRev$ has a negative but insignificant effect. One possible reason for the latter is that commercial land revenue is not a major source for local governments to finance infrastructure. The findings of land revenue are similar to those of land finance reliance, and support Hypothesis 2. A higher level of land finance would lead to a higher level of local government debt financing for infrastructure.

5.2 Instrumental Variable Estimations

As LGFV debt and land finance are under the control of local governments, our estimations may be biased by endogenous variables that are calculated based on land revenue (i.e., $TotalRev$, $Land2Fis$ and $Land2GDP$). To address this issue, the instrumental variable (IV) approach is employed to re-estimate the models.

Following the strategy for instrumenting land revenue in the study of local governance and politics in Chen and Kung (2016), we select several proxies to instrument the supply and the demand. First, the land suitable for commercial and residential developments in a city is a suitable candidate to instrument the supply. We use the average slope of terrain ($slope$) as the IV accordingly. House prices (lhp) is adopted as the IV for land demand. We then include the interaction between housing price and terrain slope for the IVs. In addition, land transactions are found to be distorted by government corruption (Chen and Kung, 2016). Hence, the interaction between house prices and corruption index (crp) is employed to be an additional IV for land revenue. Descriptive statistics of these variables can be found in Table 2.

The two-stage (2SLS) estimation within fixed effect panel model is applied for the IV regression. To confirm our identification strategy, we regress both the dependent variable and endogenous land finance on the instrumental and control variables in the first stage of the estimation. The standard errors are clustered at the city level. We found an insignificant relationship between the dependent and IVs while significant relationships between land finance and IVs. This suggests that these two IVs are valid.

In the second stage, GCF is regressed on the predicted values of land revenue from the first stage estimation and control variables. We report the results in Panel A in Table 3. The IV estimations show some improvements over the OLS panel regression results in Table 2. Firstly, the results of IV regression are consistent with the results of panel regression. The point

10

estimates (absolute value) of 2SLS are greater than those of OLS, which suggests that OLS estimate is likely to be downward biased. We find a negative effect from the industrial and residential sectors, and a positive effect from the commercial sector on local government debt for infrastructure development across five models. The findings are consistent with our Hypothesis 1. However, only the coefficients of *ResTran* are significant at the 10% level in model (III) and (IV). Overall, the support to Hypothesis 1 is weak. Secondly, all instrumented land finance variables except for *ComRev* show that the land finance significantly and positively affects local government debt; Hypothesis 2 is true.

5.3 Evidence of Structural Changes

As discussed in Section 2.3, the two documents issued between 2013 and 2014 may have significantly changed local government's borrowing behaviours. It is possible that there is a structural break at around year 2013. Thus, the five models in the Panel A of Table 3 are re-estimated by using the subsamples between 2013-2017. The results are reported in Panel B in Table 3.

The subsample results suggest that land finance significantly and positively affects local government debt in Models I through IV. The results are consistent with those of the full sample. The patterns of the private sectors are consistent with those of the full sample as well. Industrial and residential sectors negatively influence while the commercial sector positively influences the local government's debt financing for infrastructure development across the five models. The direction, relative magnitude, and statistical significance of the effects of land finance remains the same as in the full-sample models.

Furthermore, the effects of commercial and residential sectors become significant in Models I through IV. This supports Hypothesis 1A and 1C. The difference in the significance of coefficients of private sectors between sub-sample and full sample indicates that '*Document 43*' reshaped local government's strategy in infrastructure financing. After 2013, local governments' debt financing of infrastructure projects is more responsive to activities in private sectors in their cities. Specifically, local governments take into account the development of the commercial and residential sectors, because the former would enhance debt solvency through tax revenue in the long run and the latter would crowd out other sectors from capital markets.

In summary, both the public and the private sectors affect local government debt issuing for infrastructure financing. For the public sector, land finance propels the debt level, and the pattern is not affected by the local government debt market reform around 2013. The influence from activities in private sectors (i.e., the residential and commercial real estate markets), on the other hand, is only significant after 2013. Although our theoretical model implies the industrial development should restrict local governments' debt financing, the data shows that the industrial sector has small, negative impacts on local government debt.

[Insert Table 3 Here]

6. Policy Implications and Conclusions

One of the most important tasks that public policy needs to perform is the provision of public goods and infrastructure (Collier and Venables, 2017). This is a challenging undertaking for developing countries, where local and central governments often face tight fiscal constraints. In China, local governments have been using the land-value capture model to finance infrastructure projects. Although this strategy served China's rapid urbanisation process well so far, there has been widespread concern about the potential systematic risk resulted from the

11

land finance model. Local governments are under pressure to find alternative financing methods.

In the last decade, local governments debt, and particularly LGFV debt, has become an important source to finance infrastructure development in China. Technically, the use of land lease revenue can reduce the total cost of infrastructure project as it does not involve interest payment. Meanwhile the interest payment of local government debt can be justified by tax revenues generated from infrastructure-supported activities from the private sector. A well-balanced 'capital structure' of infrastructure projects is a good mix of land lease revenue (i.e., equity) and local government debt, such that local governments are neither heavily reliant on land leasing revenue nor overly burdened with debt interest payment.

As the outstanding of local government debt soaring after the 2008 financial crisis, it is important to investigate whether local government debt issuing is responsive to activities in the private sector. Our analysis of LGFV data between 2009 and 2017 shows a positive relationship between land finance and local government debt for infrastructure development throughout the sampling period. This relationship became slightly stronger after stricter regulations on local government debt announced between 2013-2014. On the other hand, local government debt issuing only shows meaningful response to the private sector after the tightening of local government debt in 2013/14. During the 2013-2017 subsampling period, local government debt is positively affected by commercial sector development, and negatively affected by the residential sector development. The relationship between local government debt level and the industrial sector remains insignificant throughout the whole sampling period.

Our empirical results suggest that not only the visible hand of local governments is working creatively to meet infrastructure development targets handed down by the 'iron hand' of the central government, but also the visible hand is getting more effective by considering activities from the private sector in their debt issuing decisions. The regulations of local government debt issuing in 2013/14 are the triggers of such responsiveness to market information. Although the transformation has not been completed across all sectors, this does suggest that financing model of infrastructure project is heading in a promising direction.

This study is a response to the call for further infrastructure financing research from the global South in general and China in particular in the 2019 special issue of *Urban Studies*. we provide both a theoretical model and the empirical evidence of the complex relationship between local government debt issuing for infrastructure financing, land finance, and demand from the private sector in China. More importantly, this study also has significant policy implications for the *Dual Circulation* economic development strategy, which is an essential part of the latest Five-Year Plan announced in May 2020 (The People's Daily, 2020). This requires the funding, financing, and management of infrastructure projects to be more responsive to the domestic markets than foreign direct investment. The responsiveness of local government debt issuing to business activities in the commercial and residential sectors, and the irresponsiveness of local government debt issuing to the industrial sector (which is more driving by foreign direct investment) indicate that the 2013/14 local government debt reform may have paved the way for the implementation of the Dual Circulation strategy. Policy makers should be cautious about the strong and consistent positive relationship between land lease revenue and local government debt level, particular after the central government tightened the local government debt markets in 2013/14. The regulation of local debt markets will trigger the adjustment of other financing means, such as land lease revenue. The central government should be aware of such intriguing interrelationships among alternative financing methods.

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13

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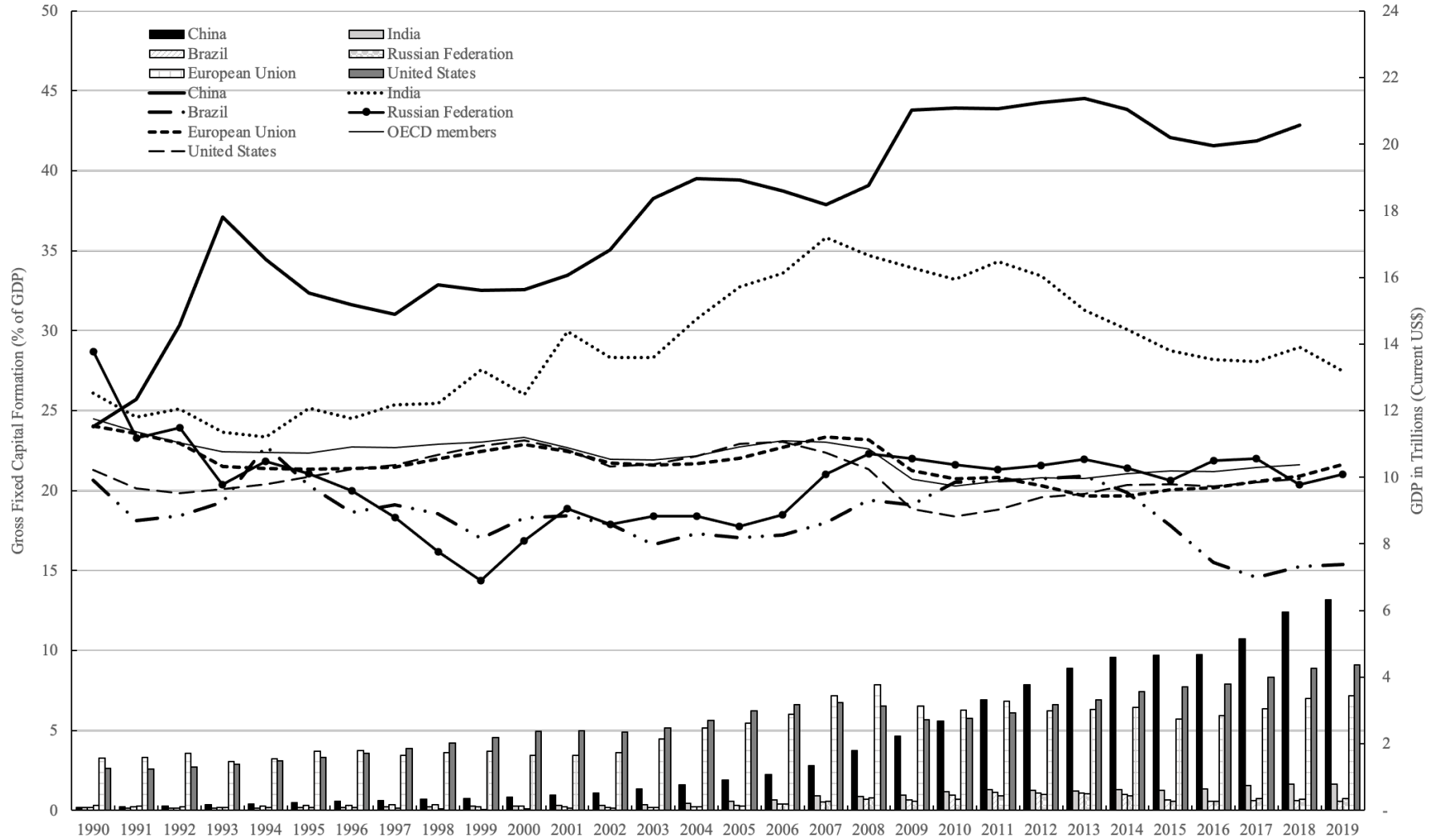Figure 1: Gross Fixed Capital Formation (% of GDP) and National GDP in Trillions (current US$), 1990 – 2019.

Source: The World Bank (https://data.worldbank.org/indicator/NE.GDI.FTOT.ZS and https://data.worldbank.org/indicator/NE.GDI.FTOT.CD).
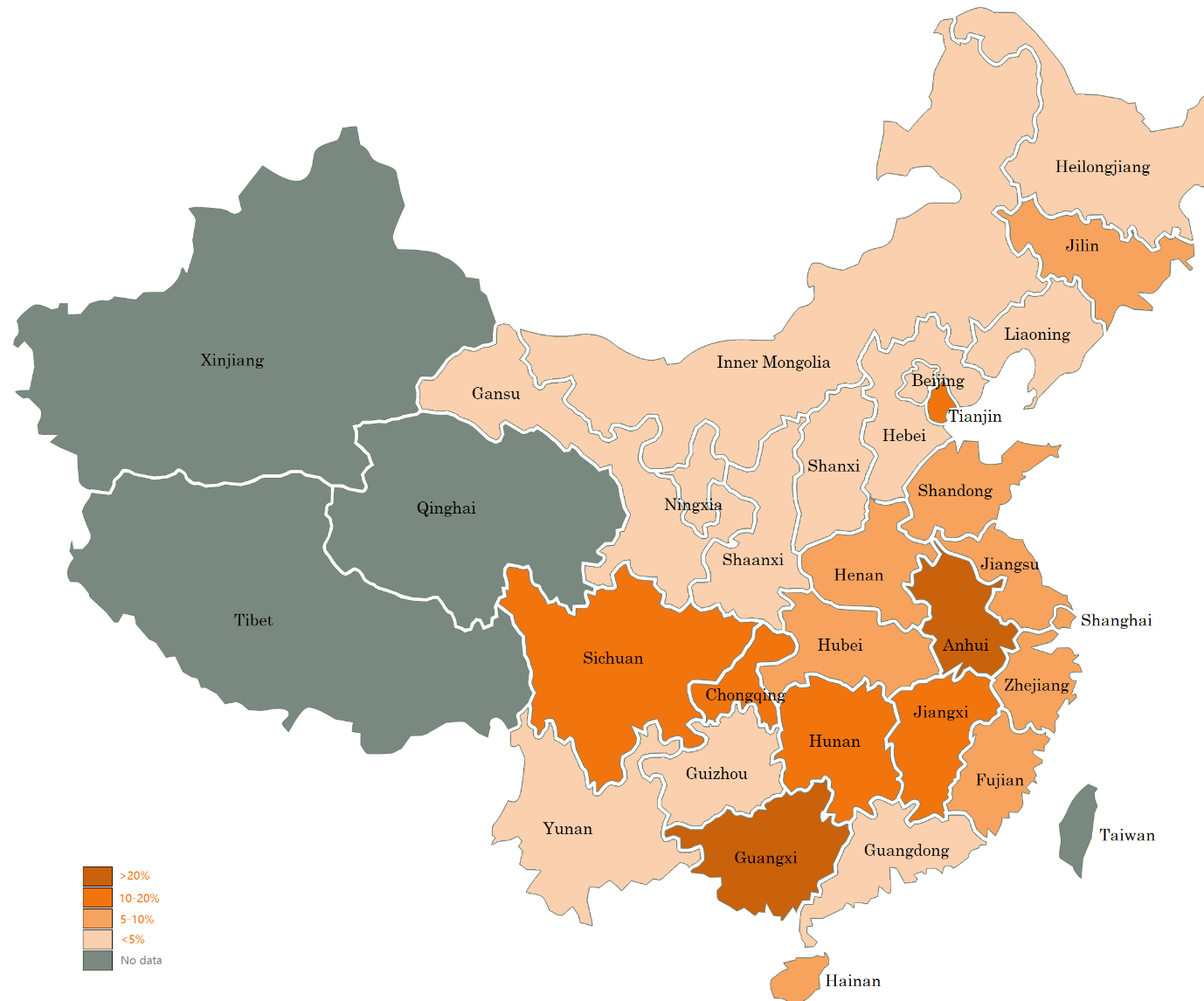
Figure 2. Proportion of LGFV debts in total infrastructure development in China (2009-2017)

Table 1. Variable definitions and descriptive statistics

Variable	Definition	Data Source	Mean	Std. Dev	Min	Max
InvCF	The cash outflow of LGFV investments in a city	*WIND*	61.83	110.94	0.00	1125.36
OpCF	The cash inflows of LGFV operating activities in a city	*WIND*	2.48	12.48	-84.25	91.42
GCF	Gross cash flow of LGFVs in a city, $GCF = InvCF - OpCF$	*WIND*	59.36	111.45	-21.46	1176.66
IndTran	Total industrial land sale area	*WIND*	121.30	154.65	0.00	1487.35
ResTran	Total residential land sale area	*WIND*	107.69	131.21	0.00	1644.39
ComTran	Total commercial land sale area	*WIND*	29.83	35.86	0.00	316.55
IndRev	Total industrial land revenue	*WIND*	0.56	0.76	0.00	7.65
ResRev	Total residential land revenue	*WIND*	8.17	11.35	0.00	94.34
ComRev	Total commercial land revenue	*WIND*	2.01	3.68	0.00	38.58
TotalRev	Total land revenue	*WIND*	10.74	13.69	0.00	110.40
r	Capital cost, the national basic lending rate	*WIND*	6.24	0.91	4.76	8.06
Indpr	Log land price of industrial sector in a city	*WIND*	6.52	0.46	5.53	8.31
Respr	Log land price of residential sector in a city	*WIND*	8.48	0.90	6.44	11.11
Compr	Log land price of commercial sector in a city	*WIND*	8.85	0.83	6.82	10.91
FIP	Change in the price index of fixed investment	*WIND*	0.01	0.03	-0.08	0.10
GDP	GDP growth rate in a city	*WIND*	0.03	0.09	-1.01	0.69
FisRev	The local government's budgetary revenue collected in a city	*WIND*	21.50	26.29	0.28	213.10
slope	The average slope of terrain in a municipal	*GIM cloud* *(http://www.dsac.cn/DataProduct/Detail/200803)*	2.15	1.71	0.06	5.77
crp	The corruption index measured by the total misconduct officials divided by the total officials in each province	*Annual Report on the work of each province's procuratorate*	0.00	0.00	0.00	0.01
lhp	Log housing price in a city	*WIND*	9.15	0.51	7.89	10.92