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The Transition of Local Government Financing Platforms in China: Risks, Incentives, and Regulations

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In this paper, we build on the Dewatripont-Tirole (2012) model and argue that leverage caps can be used as an instrument to regulate the deeply indebted local government financing platforms in China. The key incentive scheme places different leverage caps on different types of platforms, and the control right shifts from the government to the debt holder if the cap is exceeded. We also propose different means to tackle a moderate macroeconomic shock, including *ex ante* adjustment of the cap, *ex post* debt rollover, and debt-to-equity conversion. Direct governmental bailout is necessary when the shock is sufficiently large. In this case, we calculate the upper bound of the bailout that the central government is willing to provide, and show that it increases with the long-term prospect for the economy after the shock.

1. INTRODUCTION

After the tax-sharing reform was introduced in China in 1994, the most lucrative sources of revenue were centralized by the central government and local governments faced an increasing imbalance between their revenue and spending responsibilities. At the same time, the budget law prohibited the local governments from directly borrowing from the financial markets. Local government financing platforms (LGFPs) are local state-owned enterprises (SOEs) that help local governments to finance their expenditure from the capital markets, mainly through domestic banks and bond market investors. The earliest LGFPs emerged in the 1990s as local trust and investment companies that enabled local governments to raise funds from domestic and foreign investors. However, in the late 1990s, thousands of LGFPs were forced to shut down by local governments.

In late 2008, at the beginning of the 2008-2009 global financial crisis, the central government introduced a "4 trillion" (RMB) stimulus package to shield the domestic economy from external shocks. However, the central government only contributed RMB1.8 trillion, with the remaining 2.2 trillion being provided by local governments, whose fiscal gaps had been

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significantly widened by their huge incremental expenditures. To circumvent the budget law, local governments again resorted to using LGFPs to collect funds, which triggered a rapid proliferation of LGFPs. The subsequent injection of capital in the form of budget revenue, land use rights, and other state owned assets greatly enhanced the borrowing capacity of the LGFPs, leading to a rapid accumulation of local governmental debt. According to the National Auditing Office of the People's Republic of China (NAO), local governmental debt reached RMB 10.3 trillion by the end of 2010, of which 4.97 trillion was LGFP debt. In an updated audit report released in December 2013, the NAO stated that local governmental debt and LGFP debt were RMB10.89 trillion and 4.08 trillion, respectively, at the end of June 2013, which was roughly the same as two years earlier (Wu, 2016). These are the latest official data on the debt levels of the LGFPs. When the new budget law took effect in January 2015, LGFP debt was excluded from local governmental debt, as confirmed by the Ministry of Finance of the People's Republic of China (MOF)[1][2].

To place the growth of local governmental debt on a sustainable path, in October 2014, the China State Council (CSC) issued Rule No. 43, which laid out new guidelines for the supervision of local governmental debt, including stripping government financing from the LGFPs. In April 2017, the MOF and another five ministries and commissions jointly issued Rule No. 50, which further restricted the relationship between local governments and the LGFPs. Moreover, the new rule required LGFPs to transform into market oriented SOEs financed independently in a more competitive capital market, without any explicit or implicit guarantees from the local governments. Although this ended their primary function of providing government financing, the main business of the LGFPs, such as infrastructure construction, real estate development, and urban landscape construction, remained roughly the same. After decades of rapid urbanization, the demand side of the urban construction industry began to contract, leaving a large portion of LGFPs to excess. According to the Wind Database, that 11,567 LGFPs were actively participating in the bond market in June 2018, up from 6575 in December 2010.

1.1. Overview of the Paper

Following Dewatripont and Tirole (2012), in this paper, we formulate three corporate strategic options that LGFPs can choose, namely liquida-

[1] http://www.mof.gov.cn/zhengwuxinxi/caizhengxinwen/201611/t20161104_2450669.htm

[2] Since December 2017, the MOF has released monthly data on outstanding local governmental debt, according to which, at the end of June 2018, the outstanding local governmental debt was RMB 16.8 trillion. Although this includes LGFP debt, the proportion is not clear.

tion, continuation, and transformation, which correspond to the three types of LGFPs that the CSC defined in its Notice Guofa No.19, 2010. The type 1 LGFPs only undertake financing tasks for public welfare projects, mainly rely on fiscal revenue to repay their debt, and are liquidated after repaying all of the debt obligations. The type 2 LGFPs not only undertake financing tasks, but also construct and operate public welfare projects. Once the government financing function has been divested, these platforms are allowed to continue their construction and operation businesses. The type 3 LGFPs undertake public or non-public projects, and repay their debt with earnings from the projects. After their government financing function has been terminated, the platforms are allowed to transform into independent market participants with a modern governance structure, subject to the company laws of the People's Republic of China.

We show that leverage caps can be introduced to provide an incentive compatible mechanism under which each of the three types of platforms choses a corporate strategy as the regulator demands. Although leverage caps are widely used as an instrument for banking regulation, for example, in the form of capital adequacy requirements in the Basel Accords, they are rarely used to regulate non-banking enterprises. From a free-market perspective, firms are free to choose their leverage ratios as long as their outside investors and other creditors do not file bankruptcy proceedings. Although theoretically the upper bound of a firm's debt ratio is 1, it is not hard to find companies with debt ratios higher than 1 in the market. Hence, it is natural to question why banks are treated differently than other firms with regard to leverage ratios. Although we do not attempt to give a detailed response to this question, the explanation may be that banks are too vulnerable to shocks if they have insufficient capital to meet their obligations and absorb any unexpected losses, and their insolvency can easily trigger macroeconomic shocks. This raises the further question of whether a leverage cap would provide an effective alternative policy instrument for regulating firms with high overall leverage, high sensitivity to negative shocks, highly contagious individual risk, and whose insolvency will likely trigger an economic downturn? As discussed above, it is apparent that the LGFPs meet these features and provide the context for addressing this question in this paper.

Leverage caps have been included in several regulatory documents that aim to control the credit risk of enterprises. For example, in December 2012, the National Development and Reform Commission released a notice demanding bond issuers with debt ratios greater than 65% be further reviewed with respect to their solvency. At a regular meeting in August 2017, the CSC proposed the establishment of a debt ratio warning system for SOEs, which would put greater weight on the debt ratios for enterprises

whose ratios were above the warning line in their annual performance assessments.

Although the regulations on enterprises' debt ratios are perceived to distort their financing behavior, this paper argues that leverage caps can be used as a part of an incentive scheme to facilitate the re-classification and rectification of the existing LGFPs. Because the supply of land in China has fueled monetary growth in the past decade (Cao et al., 2008; Liu and Huang, 2016) and LGFPs exhibit some attributes of banks in terms of the creation of money, we extend Dewatripont and Tirole's (1994a, 2012) theory on outside capital structures with macroeconomic risk to include a "durable asset," namely the land assets of LGFPs, to highlight its effects on the corporate strategies of LGFPs and their implications for government regulation under different circumstances.

The remainder of this paper is organized as follows. In sections 2 and 3, we establish and solve the model to capture the idea that leverage caps can be used as an instrument to regulate LGFPs in China. In section 4, we propose several means to tackle a moderate macroeconomic shock, including *ex ante* adjustment of the cap, *ex post* debt rollover, and debt-to-equity conversion. In section 5, we calculate an upper bound of the bailout and analyze its relationship with the long-term prospects for LGFPs for sufficiently large macroeconomic shocks. Section 6 concludes the paper.

1.2. Relation to the Literature

This paper builds on a number of contributions. We borrow extensively from the literature on bank regulation that uses corporate debt as a disciplining device (Dewatripont and Tirole, 2012), which in turn relates to the incomplete contract approach of Grossman and Hart (1986). Following Dewatripont and Tirole (1994b), who provided a rationale for bank regulation, we propose that the rationale for regulating LGFPs lies in its similarity to that for banks in relation to the creation of money in China (Mookerjee and Peebles, 1998; Cao et al., 2008; Liu and Huang, 2016). In examining the presence of macroeconomic shocks and the need for government bailouts, this paper is also related to work of Farhi and Tirole (2012) and Dewatripont and Tirole (2018), among others. However, our paper differs from these studies in that we calculate the specific cost of a non-interest-rate bailout and analyze how it relates to the long-term prospects of the economy.

This paper is also related to the local public finance literature (Zhang and Zou, 1998; Jin and Zou, 2002; Martinez-Vazquez et al., 2014, Zhang and Barnett, 2014) and the research on LGFP regulation in China (Zheng and Chen, 2009; Lu and Sun, 2013; Jin and Rial, 2016). Most of these studies treat LGFP regulation as a local governmental debt management issue. Although a variety of strategies have been proposed to reduce the

levels of outstanding LGFP debt, to the best of our knowledge, no studies have formally examined the transition of LGFPs.

2. THE MODEL

To choose the appropriate long-run corporate strategy for a typical LGFP, we model the decision as a capital structure choice problem. It is assumed that the platform has no financial resources (except land use rights, or land for short) to cover the investment cost and thus has to turn to outside investors. A manager is hired by the platform, whose level of effort affects the realization of the short-term payoff y, on the basis of which the platform's control right is determined. Then, a signal about the future prospects is realized and the party in control chooses a corporate strategy A from $\{L, C, T\}$, which correspond to liquidation, continuation, and transformation, respectively. More precisely, we divide the life cycle into five stages as follows.

1. Stage 1, *set up a platform.* The local government (the shareholder)[3] provides land as paid-in capital and appoints an official who is familiar with infrastructure as the manager. The manager then chooses a project with a scale of I, by raising long-term debt d from outside investors (long-term debt holders, or simply debt holders in the absence of confusion).

2. Stage 2, *motivate the manager.* The manager is induced by an incentive scheme to choose an effort level $e \in \{\underline{e}, \bar{e}\}$, $\underline{e} < \bar{e}$, that incurs a disutility Φ.

3. Stage 3, *realization of short-term profit.* In this stage, the short-term profit from the project is realized, $y \in \{\underline{y}, \bar{y}\}$, $\underline{y} < 0 < \bar{y}$. The probability that $\bar{y}$ will occur is conditional on the manager's effort, that is, $\bar{p} = prob\{\bar{y}|\bar{e}\}$ and $\underline{p} = prob\{\bar{y}|\underline{e}\}$. The control right is also allocated at this stage, conditional on the short term profit and regulation of the leverage cap. Usually, the control rights belong to the government if $\bar{y}$ is realized, and belong to the outsider investor if $\underline{y}$ is realized.

4. Stage 4, *choose a corporate strategy.* If an unverifiable signal about future prospects ,$s \in [\underline{s}, \bar{s}]$, with density function $f(\cdot)$ and distribution function $F(\cdot)$, independent of y, is observed, the party in control selects an action A from $\{L, C, T\}$. Action L generates a residual value r, and other actions generate a long-term profit at the next stage.

5. Stage 5, *realization of long-term profit.* If action C is chosen, it will generate α with probability s, β with probability s, and 0 with probability $1 - 2s$. If T is chosen instead, it will generate α with probability $s + t$, and 0 with probability $1 - s - t$. It is evident that $\bar{s} < 0.5$.

[3]In the following, "the government" refers to local government if there is no special explanation.

For a typical platform, it is worth noting that the three parties of the contract share a common interest to a large extent. Specifically, the managers are officials appointed by the government rather than chosen from a competitive labor market, and the debt holders are mostly state-owned banks whose lending decisions are under the pressure of direct administrative orders, among which the China Development Bank is the most prominent example (Sanderson and Forsythe, 2012). For simplicity, all parties are assumed to be risk neutral and to not discount the future. The manager receives a given wage, which is normalized to 0, and does not respond to monetary incentives beyond that level. This assumption is widely used in the literature, such as in Aghion and Tirole (1997) and Holmstrom and Tirole (1998). Coincidentally, this is confirmed by the rigid salary system for government officials in China. In addition to the given wage, the manager receives private benefit b unless corporate strategy L is chosen, and in equilibrium, this can be seen as the managers information rent. It is this position rather than the manager's effort that brings private benefits. This scenario is especially true in an economy of "crony capitalism," as named by Bai et al. (2014), in which government officials have a great deal of discretion in determining which projects to choose. To satisfy the incentive compatibility constraint, the incentive scheme requires that $\bar{p}b - \Phi \geq \underline{p}b$, or equivalently,

$$b \geq \Phi/(\bar{p} - \underline{p}). \tag{1}$$

Hence, the manager's utility function can be written as

$$-\Phi \mathbf{1}_{e=\bar{e}} + b\mathbf{1}_{A\neq L}, \tag{2}$$

in which $\mathbf{1}_{(\cdot)}$ is the indication function. The utility functions for the government and outside investors are defined entirely on their share of the project's profit. Because it is difficult to specify each possibility here, they are defined in later sections. It is also assumed that if $y = \underline{y}$, this short-term loss must be repaid before the beginning of stage 5, that is, before any long-term strategy is implemented. For expositional convenience, let $r > \underline{y}$ indicate that the residual value of the platform's land is always greater than the short-term loss. This is always true if there is no systematic risk, because the land price is very stable in the short-run and remains in the upward channel.

It is necessary to emphasize that although a direct administration order is an available policy option in China, we seek a more market-oriented solution. In the next sections, leverage caps are used to motivate the three types of platforms to choose the optimal long-term corporate strategy, as the regulator demands. To justify the CSC's classification and the regulator's guidelines on transition, we define each type in terms of the long-term payoffs.

Definition 2.1. The payoff for the type 1 platforms satisfies:

$$r > (s+t)\alpha > s(\alpha+\beta), \forall s; \tag{3}$$

The type 2 platforms satisfy:

$$\underline{s}(\alpha+\beta) > r > (\bar{s}+t)\alpha; \tag{4}$$

The type 3 platforms satisfy:

$$(\underline{s}+t)\alpha > r > \bar{s}(\alpha+\beta). \tag{5}$$

The inequalities in (3) indicate that for the type 1 platforms, neither continuation nor transformation will generate a payoff larger than that of liquidation, regardless of whether the long-term prospect is good or bad, hence liquidation is the first best choice. The first inequality of (4) states that for the type 2 platforms, even under the worst prospect $\underline{s}$, continuation is better than liquidation. The second inequality means that even under the best prospect $\bar{s}$, transformation is no better than just liquidation. Contrary to (4), condition (5) means that for the type 3 platforms, transformation is always better than liquidation, and continuation is always the worst option. As Notice Guofa No.19 demands, the type 1 platforms only undertake financing tasks for public welfare projects and mainly rely on fiscal revenue to repay their debt. This is equivalent to stating that neither continuation nor transformation will achieve a hopeful prospect, which is the situation summarized by condition (3). Similar implications from condition (4) and (5) can be drawn analogically and hence are not detailed here. Although it does not exhaust all of the possible combinations of payoffs, this definition makes the distinction between the different types clear and formal comparison possible. [4]

3. INCENTIVE SCHEMES WITH LEVERAGE CAPS

3.1. Incentive scheme for type 1 platforms

As abovementioned, the type 1 platforms' only business is to raise funds for local governments, and they do not have the capacity to engage in

[4]Two remarks are given for those platforms that do not satisfy either (3), (4), or (5). 1. If $\exists.s$, such that $s(\alpha+\beta) > r > (s+t)\alpha$; or $(s+t)\alpha > r > s(\alpha+\beta)$, the incentive scheme can be made contingent on the realization of s, or dependent on the expected payoff because we assume risk neutrality, and the results are identical to those in subsections 3.2 and 3.3 with more complicated notations. 2. All of the remaining omitted combinations must satisfy either $(\underline{s}+t)\alpha > \underline{s}(\alpha+\beta) > r$ or $\underline{s}(\alpha+\beta) > (\underline{s}+t)\alpha > r$, the incentive scheme for the former satisfies (10) and (11) and that for the later satisfies (15) and (17). Hence, the results in section 3 are robust.

project construction and operations. Because the direct administrative orders are excluded from our policy toolbox, the leverage cap should be set in a range such that liquidation will be chosen regardless of who owns the control rights. A basic principle in incentive theory is that the agent should not be responsible for results that are out of his or her control (Holmstrom, 1979). We examine two kinds of risks in this paper, namely, that both the short-term payoff y and the long-term payoffs (α, β) are uncertain. Because liquidation is chosen regardless of the effort the manager provides, and the manager gets no private benefit, by observing his utility function (2), it is apparent that he will always chose $\underline{e}$ and lose his job at the end of stage 4.

As defined above, the first best strategy for a type 1 platform is liquidation, thus we assume for now that the debt holder will choose L whenever he is in control. The face value of the debt is d, which is a claim on the platform's long-term profit. This claim is senior to the government's claim, and we assume that $\alpha > d$ for convenience. For the government to choose L when it is in control, the expected payoff of choosing C and T must be less than that of choosing L,

$$r - d \geq s(\alpha + \beta - 2d); \tag{6}$$

$$r - d \geq (s + t)(\alpha - d). \tag{7}$$

We assume here that $s > t$ and $\alpha > \beta$, then by the definition (3), it is evident that (7) implies (6), and solving for d from (7), we have

$$d \leq \frac{r - (s + t)\alpha}{1 - s - t} \equiv \bar{d}(s). \tag{8}$$

We have defined a debt threshold $\bar{d}(s)$, below which L is chosen by the government. Because d is repaid with the residual value with priority, when d is large enough and violates 8, there is nothing left for the government, thus the manager may risk choosing C or T. That is, L dominates only if d is small enough.

Now it remains to check that the debt holder will always choose L if he is given the control right. Note that if he chooses L, he gets d with certainty; if C or T is chosen, his expected payoff is $2sd$ and $(s + t)d$, respectively, both of which are smaller than d, as $t < s < 0.5$. Now we are ready to give a leverage cap for the regulation of the type 1 platforms, which we denote by d_1. Although any d_1 that is smaller than $\bar{d}(s)$ will implement the strategy L, to make the analysis more interesting, we assume that

$$r > d_1, \quad r < d_1 - \underline{y}.$$

The first part guarantees that the residual value is sufficient to cover a long-term debt d_1, and the second part gives a lower bound for d, so that

the net proceedings from liquidation left for the government equal 0 when $y = \underline{y}$. The above arguments are summarized in the following proposition.

PROPOSITION 1. *Given condition (3), $s > t$, and $\alpha > \beta$, the manager chooses an effort $\underline{e}$ and loses his job at the end of stage 4; the regulator chooses a leverage cap d_1 such that $r + \underline{y} < d_1 \leq \bar{d}(s)$, in which $\bar{d}(s)$ is defined by (8), such that the government is in control provided that $d \leq d_1$, otherwise, if $d > d_1$, the control right shifts to the debt holder; and L is chosen regardless of who is in control.*

This result has been confirmed by the "Guidance on Strengthening the Balance of Assets and Liabilities of State-owned Enterprises" jointly released by the Central Office of the Communist Party of China and the CSC in September 2018, which demanded that LGFPs that lose their solvency be subject to liquidation. Anticipating this, a government that owns a type 1 platform will find that it is superfluous to motivate the manager, and the allocation of control of the platform will be irrelevant because liquidation is the only outcome.

3.2. Incentive scheme for type 2 platforms

As defined in (4), the first best choice for a type 2 platform is C. Hence, the prospect arising from a continuation strategy is much better than from a transformation strategy. It is assumed that $\underline{s} > t$ and $\beta > \alpha > d$. Because L will not be chosen in the optimal scheme, the manager will participate in the platform's operations in stage 5, bringing him private benefit b.

3.2.1. Manager's incentive problem

Because the manager can only obtain private benefits if L is not chosen, then choosing strategy C or T yeilds a positive payoff in itself. Because the probability of $\bar{y}$ depends on the manager's effort, to motivate him to choose $\bar{e}$, it is necessary to make the strategy L contingent on the realization of $\bar{y}$. So if the realized short-term profit is $\underline{y}$, there should be a probability for the government to choose L. We propose the following scheme to motivate the manager.

PROPOSITION 2. *The government chooses L if and only if it observes $\underline{y}$ and $s < s^*$, in which s^* is defined by*

$$[1 - (1 - \bar{p})F(s^*)]b - \Phi = [1 - (1 - \underline{p})F(s^*)]b. \tag{9}$$

The left hand side of (9) is the payoff from providing a high level of effort $\bar{e}$ net of the disutility, and the right hand side is the payoff if the manager

chooses $\underline{e}$. Note that both sides of the equation are decreasing in s^*, and because $\underline{p} < \bar{p}$, as s^* rises, the left hand side decreases slower than the right hand side. Hence, the manager always provides the highest effort. The magnitude of the buffer s^* depends on the value of Φ and b, such that when Φ is larger and b is smaller, the manager needs to become more motivated, which requires a larger s^*. As mentioned in the previous section, the managers of LGFPs are officials appointed by the government who derive private benefits from their control of a monopolistic position rather than the effort they provide. The logic behind this is different from that of the inter-regional competition among local governments being transmitted to the yardstick competition among local officials, including the managers of LGFPs (Maskin et al., 2000; Li and Zhou, 2005). Rather, the logic here is similar to that of Su et al. (2012), namely, that one needs to occupy the position to be promoted and the daily routine in the position requires no exclusive ability and effort. Hence, the condition (9) given by proposition 2 is mostly determined by the institutional structure of the economy, rather than being specifically determined by a single local government.

3.2.2. Local government's incentive problem

Interestingly, the government's strategy has already been given in the above proposition. Thus, the remaining work is to verify that under a given leverage cap, the government chooses the optimal strategy. Before considering the allocation of the control rights, we formulate the government's choice when it is in control. We ignore the short-term loss for now because it is covered before the control rights allocation. If the government chooses L, it will definitely receive $r-d$, if it chooses C, the expected payoff will be $s(\alpha-d)+s(\beta-d)$. Then the condition for the government to choose C rather than L is

$$s(\alpha - d) + s(\beta - d) > r - d, \tag{10}$$

By the first inequality of (4), we know that $r < s(\alpha + \beta), \forall s$. Because $\bar{s} < 0.5$, $d(1-2s) > 0, \forall s$. These conditions imply that $s(\alpha+\beta)+d(1-2s) > r$, which is equivalent to (10). It remains to check that C also dominates T, which requires that $s(\alpha-d)+s(\beta-d) > (s+t)(\alpha-d)$, rearranging items, or $s(\beta-d) > t(\alpha-d)$. Because $s > t$, it requires that

$$d < \frac{s\beta - t\alpha}{s - t} \equiv \hat{d}(s). \tag{11}$$

It is evident that $\hat{d}(s) > 0$ and is decreasing in s, and it gives an upper bound on the long-term debt d, under which the government always chooses C rather than T. Hence, we propose a leverage cap of d_2 for the type 2 platforms, satisfying $d_2 - \underline{y} > r > d_2$. If $d \leq d_2$, the government gains control, otherwise the control right shifts to the debt holder. Given the initial long-term debt is exactly d_2, the government's control right is not lost when $y = \bar{y}$. However, if $y = \underline{y}$, the government loses control unless it reinvests the absolute value of $\underline{y}$. It is worth doing so if

$$s(\alpha - d_2) + s(\beta - d_2) + \underline{y} \geq 0. \tag{12}$$

Remember we have made the choice of liquidation conditional on s^* when the manager's incentive scheme is devised. Thus, it is convenient to define a specific d_2 as follows,

$$s^*(\alpha - d_2) + s^*(\beta - d_2) + \underline{y} = 0,$$

s^* is defined in (9), from which we can solve for d_2,

$$d_2 = \frac{s^*(\alpha + \beta) + \underline{y}}{2s^*}. \tag{13}$$

Then, if $y = \underline{y}$ and $s < s^*$, (12) is violated and the control rights shift to the debt holder. It remains to ensure that the manager will choose L, or equivalently, the inequality

$$r \geq s^*(\alpha + \beta) + \underline{y} \tag{14}$$

holds, which is easy to satisfy given $\underline{y}$ is small enough. Hence, the leverage cap defined by (13) implements the manager and government's incentive problems simultaneously. The above arguments are summarized in the following proposition.

PROPOSITION 3. *Given condition (4), $\underline{s} > t$, and $\beta > \alpha > d$, the regulator chooses a leverage cap d_2 such that $r + \underline{y} < d_2 \leq \hat{d}(s)$, in which d_2 and $\hat{d}(s)$ are defined by (13) and (11), respectively, such that the government gains control when $d \leq d_2$, otherwise, if $d > d_2$, the control rights shift to the debt holder; and L is chosen if $y = \underline{y}$ and $s < s^*$.*

Proposition 3 states that a type 2 platform should control its debt ratio to avoid liquidation, which is exactly the logic behind the "List of Local

Government Platforms" released quarterly by the China Banking Regulatory Commission (CBRC) since the third quarter of 2010. All of the platforms on the list are subject to strict supervision. The most direct way to be deleted from the list is to go into liquidation, as proposition 2 concluded, and the other way is to meet two regulatory requirements made by the CBRC: (1) that the debt-to-asset ratio is controlled under 70%, and (2) the cash flow from the existing projects is enough to cover all liabilities. The former is an example of leverage cap d_2, and the latter is the requirement of a good long-term prospect that confirms the viability of continuation or transformation. It is also necessary to stress here that choosing the continuation strategy means continuing the existing business, with the function of governmental financing been removed. Here, a pressing issue is to find a new channel of project financing, and obviously the regulator will also notice this problem. Rule No. 43 released by the CSC in November 2014 encourages private capital to finance public welfare projects through public and private partnership (PPP) contracts. In less than a month, the National Development and Reform Commission released instructions for the implementation of PPP projects (No. 2724, 2014).

It remains to check that the inequalities used above are not incompatible. Using the definition of d_2, we can rewrite (14) as $d_2 \leq r/2s^*$, and combined with the assumption that $r + \underline{y} < d_2$, this requires $r + \underline{y} < d_2 \leq r/2s^*$. Because $\underline{y} < 0$ and $s^* \leq 1/2$, the range of d_2 is not an empty set. Finally, we check that $d_2 \leq \hat{d}(s^*)$ is true. It is convenient to rewrite d_2 as

$$d_2 = \frac{\alpha + \beta}{2} + \frac{\underline{y}}{2s^*}.$$

Because $\underline{y} < 0$, it is evident that $d_2 < (\alpha + \beta)/2$. Rewrite $\hat{d}(s^*)$ as

$$\hat{d}(s^*) = \frac{\alpha + \beta}{2} + \frac{(s^* + t)(\beta - \alpha)}{2(s^* - t)}.$$

By the assumption that $\underline{s} > t$ and $\beta > \alpha$, it is easy to find $\hat{d}(s^*) > (\alpha+\beta)/2$. Hence, $\hat{d}(s^*) > d_2$.

3.3. Incentive scheme for the type 3 platforms

Although the first best choice for the type 3 platforms is T, the manager's incentive problem is the same as that for the type 2 platforms, because choosing C or T is irrelevant to the manager's payoff. Hence, only the government's incentive problem needs to be addressed in this section, which is, not surprisingly, similar to that of the last section. We describe it in a much briefer manner here.

Along with the condition (5), it is assumed that $t > s$, $t + \bar{s} < 1$ and $\alpha > \beta > d$, which make T more attractive relative to C. When the government has the control right, the condition for it to choose T rather than C is

$$(s + t)(\alpha - d) \geq r - d, \tag{15}$$

which is equivalent to $(s + t)\alpha + (1 - s - t)d \geq r$, because $s + t < 1$, (15) is implied by condition (5). If T dominates C, it requires

$$(s + t)(\alpha - d) \geq s(\alpha + \beta - 2d), \tag{16}$$

or equivalently,

$$d \leq \frac{t\alpha - s\beta}{t - s} \equiv \tilde{d}(s). \tag{17}$$

It is evident that $\tilde{d}(s) > 0$ and is increasing in s. We define a leverage cap d_3 for the type 3 platforms, satisfying $d_3 - \underline{y} > r > d_3$, such that the government gains control when $d < d_3$, otherwise the control right shifts to the debt holder. Suppose that the long-term debt is exactly d_3, then the government loses control only if $y = \underline{y}$, unless it reinvests the absolute value of $\underline{y}$, which requires

$$(s + t)(\alpha - d_3) \geq -\underline{y}. \tag{18}$$

It is convenient to define a specific d_3 as

$$(s^* + t)(\alpha - d_3) = -\underline{y}, \tag{19}$$

in which s^* is defined in (9). Solving for d_3,

$$d_3 = \alpha + \frac{\underline{y}}{s^* + t}. \tag{20}$$

Then, if $y = \underline{y}$ and $s < s^*$, (18) is violated and the control right shifts to the debt holder. It is easy to verify that the debt holder will always choose L given $\underline{y}$ is sufficiently small. Similarly, the incentive scheme is given in the following proposition:

PROPOSITION 4. *Given condition (5), $t > \bar{s}$, and $\alpha > \beta > d$, the regulator chooses a leverage cap d_3 such that $r + \underline{y} < d_3 \leq \tilde{d}(s)$, in which d_3 and $\tilde{d}(s)$ are defined by (20) and (17), respectively, such that the government gains control when $d \leq d_3$, otherwise, if $d > d_3$, the control right shifts to the debt holder; and L is chosen if $y = \underline{y}$ and $s < s^*$.*

The compatibility issue of the inequalities is similar to that which follows proposition 3, and hence is omitted here. In our solution to the incentive problem for each type of platform, it is shown that a leverage cap combined with contingent allocation of control rights is not only effective in constraining the local government's behavior, but is also able to make flexible adjustments for different types of platforms. This advantage makes implementing different corporate strategies with a single instrument possible. By comparing the assumptions made in proposition 3 and 4, we can see that the nature of a platform lies in the distribution of its long-term payoff, which is reliant on the range of the leverage cap and the scheme's compatibility. Another advantage of this model is that by relating the leverage cap d_i $(i = 2, 3)$ to a threshold of future prospect s^*, it simultaneously solves the incentive problems for the local government and the manager. The flexibility of the leverage cap is further utilized in the next section, when it is adjusted according to different risks.

It is beneficial to now examine the logic behind placing a cap on the platform's debt ratio. As is noted in (10) and (16), a large debt d undermines the long-term profitability of continuation and transformation, but the propensity of local governments in China to over-invest means they cannot control the debt ratio themselves (Chen et al., 2011). This mechanism is similar to that in the debt-overhang literature (Myers, 1977). Specifically, if the existing debt is large, the platform cannot borrow to start the profitable projects that become available after the choice of continuation and transformation.

4. TACKLING THE MACROECONOMIC SHOCKS

There are two kinds of risks in the analyses in the preceding sections: the realization of short-term and long-term profits, and that the signal for the future prospect is random. In the absence of macroeconomic risk, these risks are assumed to be independent because they are defined for a single platform. This is a convenient assumption, for the central government is able to bail out a single platform. However, if the economy is hit by a negative macroeconomic shock, such that all of the platforms' short-term or long-term profit is reduced by an amount that triggers bankruptcy, the central government may not have enough resources to bail all of them out. Anticipating a macroeconomic shock, the regulator may demand a stricter leverage cap in advance, and the government may renegotiate a debt rollover or relief agreement with the debt holder when the shock hits.

In the worst case, the central government will eventually have to bail out the platforms. There are two reasons why the government will need to address the macroeconomic shocks to the platforms. First, with the existing debt problem unsolved, the platforms will be in a rather fragile position during the transition after losing the connections to local government. Second, as defined in condition (4) and (5), it is socially optimal to guarantee the success of continuation and transformation for the type 1 and type 2 platforms, given the shock is not too large. To this end, in October 2016, the CSC released an emergency response plan to tackle the local governmental debt risks (No. 88), which lists a set of tools for responding to the risks. Moreover, in August 2018, the Central Office of the Communist Party of China and the CSC distributed a guidance on preventing and mitigating the hidden debt risks of local governments, however the details are unknown because it was not released to the public. For illustrative purposes, we use the type 3 platforms as an example to address these issues in this section. It is worth noting that the land asset plays a key role in the analysis, owing to the property that its value is stable in the absence of macroeconomic shocks, but falls rapidly to a small value if one occurs. The close relationship between the government and the debt holder of a platform also facilitates the following analysis.

4.1. Ex ante risk adjustment to the leverage cap

Suppose the economy is hit by a macro shock, which changes the short-term profit of each platform to $y+\epsilon$, in which $\epsilon \in \{\underline{\epsilon}, \bar{\epsilon}\}$, with probabilities q and $1-q$, respectively. Let $\underline{\epsilon} < 0 < \bar{\epsilon}$, that is, $\underline{\epsilon}$ is a negative shock, and $\bar{\epsilon}$ is a positive shock. For convenience, it is also assumed for now that $\bar{y}+\underline{\epsilon} > 0$ and $\underline{y}+\bar{\epsilon} < 0$, that is, the shock does not change the direction of the short-term cash flow. It is evident that the shock does not affect the allocation of control rights when $y = \bar{y}$, because in this situation T is always chosen. However, when $y = \underline{y}$ and the shock ϵ occurs, the government needs to reinvest $-\underline{y} - \epsilon$ to remain in control. Because the manager's payoff is not affected given the threshold s^* does not change, as can be seen from (9), we adjust the leverage cap d_3 according to (20):

$$d_3(\epsilon) = \alpha + \frac{\underline{y} + \epsilon}{s^* + t}. \tag{21}$$

It is evident that d_3 is increasing in ϵ. Note that $s^* + t < 1$, to ensure that $d_3(\epsilon) > 0$, this requires,

$$\underline{\epsilon} > -\alpha(s^* + t) - \underline{y} > -\alpha - \underline{y}. \tag{22}$$

That is, the absolute value of the negative shock should be smaller than the long-term payoff in good times net of the short-term profit. The new leverage cap $d_3(\epsilon)$ defined in (21) implies that to keep the second best incentive scheme effective, it is necessary to make the leverage cap adjustable to shocks. Because d_3 is increasing in ϵ, it implies that the leverage cap can be set higher when the shock is expected to be positive, and be set lower when negative. Although this may appear to be a simple task, it is difficult to forecast which state would eventuate. Moreover, even if the regulator has collected sufficient evidence and believes one of the states will occur, a simultaneous pro-cyclical adjustment of the leverage caps for all platforms may cause a macro shock in itself. Although the implementation of the adjustment is a crucial issue, we do not address this issue in this paper. The above results are summarized in the following proposition:

PROPOSITION 5. *Anticipating a macroeconomic shock ϵ, the regulator can adjust the leverage cap according to (21), with the manager's incentives unchanged, provided that $(s^* + t)\alpha + \underline{y} + \underline{\epsilon} > 0$.*

The significance of this proposition is confirmed by Rule No. 43 released in 2014, which demands that platforms stop borrowing for local public welfare projects, replace their existing debt with local government bonds, and hence lower their debt ratios in advance of possible macroeconomic shocks that may prevail during the anticipated economic downturn. The MOF has led the replacement of local governmental debt since 2015, a large portion of which is on the balance sheets of LGFPs. According to the statistics released by the MOF[5], RMB 10.9 trillion of local governmental debt had been replaced by government bonds by the end of 2017. This debt replacement action is expected to end in 2018, thus contributing to the deleveraging of the LGFPs' balance sheets. In October 2016, the CSC released "The Guidance on Actively and Steadily Reducing the Leverage Ratio of Enterprises" (No. 54), which provides a set of means for deleveraging.

4.2. Debt rollover as an ex post adjustment to the leverage cap

We have argued that ex ante leverage cap adjustments are hard to put into practice. A more passive approach is to roll over some of the short-term debt to ensure the government is still in control when hit by the shock. It should be noted that only when $y = \underline{y}$ and $\epsilon = \underline{\epsilon}$ is a rollover needed, because we assumed above that $\bar{y} + \underline{\epsilon} > 0$. Given s^* and d_3 are unchanged

[5]For the detailed statistics, please refer to `http://yss.mof.gov.cn/zhuantilanmu/dfzgl/sjtj/index.html`.

as defined in (9) and (20), and letting λ be the amount of short-term debt to be rolled over, it is worth doing so if

$$(s^* + t)(\alpha - d_3 - \lambda) \geq -\underline{y} - \underline{\epsilon} - \lambda. \tag{23}$$

The left-hand side of the inequality represents the expected net payoff with debt rollover under the transformation strategy, and the right hand side is the amount of reinvestment needed to guarantee government control. Because $s^* + t < 1$, we can solve for the smallest λ that satisfies the above equation, which we denote by λ^*,

$$\lambda^* = \frac{-\underline{\epsilon}}{1 - s^* - t}. \tag{24}$$

It is obvious that $\lambda^* > -\underline{\epsilon}$, that is, the debt rolled over is always greater than the negative shock, because the government can defer its debt obligations with a probability of $(1 - s^* - t)$ in the future. We assume that $|\underline{\epsilon}|$ is not too large so that $\alpha > d_3 - \underline{y} - \underline{\epsilon}$, which means the negative shock does not destroy the long-term profitability, and the largest λ is $-\underline{y} - \underline{\epsilon}$, that is, the short-term loss is then rolled over together with the loss from the negative shock.

It remains to check that the *short-term* debt holder (to whom $\underline{y}$ is owing) will always accept the rollover proposal. Let the residual value of liquidation conditional on the macroeconomic shock be $\underline{r}$. Because the land value decreases quickly when the economy is hit by a macroeconomic shock, we assume that it will be small enough such that $\underline{r} < d_3$. If the short-term debt holder does not accept the proposal, the control shifts from the government to the long-term debt holder, who chooses liquidation for the platform. Because $\underline{r} < d_3$, there is nothing left for the short-term debt holder. Otherwise, if the debt holder accepts that λ^* be rolled over, his expected payoff is

$$\int_{s^*}^{\bar{s}} \lambda^*(s + t) f(s) ds,$$

which is always greater than 0 because λ^* is positive given $\alpha > d_3 - \underline{y} - \underline{\epsilon}$. Hence, it is compatible for the short-term debt holder to accept an agreement on the debt rollover. From an *ex post* point of view, the leverage cap is increased to $d_3 + \lambda^*$ *per se*, which makes the debt rollover equivalent to an *ex ante* leverage cap adjustment. We conclude the above arguments in the following proposition.

PROPOSITION 6. *When the economy is hit by a negative macroeconomic shock $\underline{\epsilon}$ satisfying $\alpha > d_3 - \underline{y} - \underline{\epsilon}$, the government negotiates an agreement*

to roll over at least λ^* with the short-term debt holder to ensure that the incentive scheme devised in the previous section remains valid.

The proposition becomes more significant as the expected wave of default of local governmental debt is gradually realized, as when the sixth agricultural division of the Xinjiang Production and Construction Corps defaulted the payment of the principal and interest on the bond "17SCP001" in August 2018. The MOF released the "Guild for Tackling Different Local Governmental Debt Risks" (No. 152, 2016) two years ago, recommending debt rollover agreements between creditors and debtors as a solution in cases of insolvency. Although delayed, the bond "17SCP001" was eventually repaid based on an informal debt rollover agreement.

It is worth noting that the above conclusion relies on that the land value will decrease in the presence of a macroeconomic shock, which is summarized as the condition $\underline{r} < d_3$. This contrasts with the assumption $r > d_3$ in the absence of macroeconomic shocks, that is, land value is very stable under independent shocks. This property of land assets is crucial in the analysis of both a single platform and the sector as a whole, and the related issues are common in China today and are often referred to as land finance issues. Another point worth noting here is that the ultimate burden of the macroeconomic shock is solely borne by the short-term debt holder as long as $|\underline{\epsilon}|$ is not too large such that $\alpha > d_3 - \underline{y} - \underline{\epsilon}$. The reason behind is that the control right never shifts to the short-term debt holder. When the debt holder refuses to accept the debt rollover agreement, it shifts directly to the long-term debt holder, who will give priority to paying off his own claims.

4.3. Debt-to-equity conversion and debt exemption

Still letting $y = \underline{y}$ and $\epsilon = \underline{\epsilon}$, is there any feasible remedy when $|\underline{\epsilon}|$ is so large that $\alpha < d_3 - \underline{y} - \underline{\epsilon}$? Because the future payoff does not cover the debt obligations, the methods of postponing debt repayment used above are not sufficient to survive the shock. We have learned from the above analysis that the short-term debt holder has made the biggest concession, and the other two parties inevitably have to bear part of the loss. One solution is to make some of the long-term debt convertible to the platform's equity, conditional on the macroeconomic shock exceeding some threshold value of $|\underline{\epsilon}|$. Let the amount of contingent convertible debt be δ, $0 < \delta < d_3$, and $\gamma \in (0, 1)$ be the share belonging to the long-term debt holder after the conversion. It is evident that δ satisfies

$$(s^* + t)(\alpha - (d_3 - \delta)) = -\underline{y} - \underline{\epsilon},$$

or,

$$\delta = \frac{-\underline{y} - \underline{\epsilon}}{s^* + t} - (\alpha - d_3). \tag{25}$$

That is, δ is the minimum amount that needs to be converted to ensure the platform does not go to bankrupt. We assume here that $(s^*+t)\alpha+\underline{y}+\underline{\epsilon} > 0$ to guarantee the δ defined in (25) is positive. It remains to check that the long-term debt holder is willing to do so. The control right shifts to the long-term debt holder if he refuses to convert δ into equity of the platform, with which he can choose liquidation and receive $\underline{r}$ or instead operate the platform himself to gain $(s^*+t)\alpha+\underline{y}+\underline{\epsilon}$. Because $\underline{r}$ is very small and $\underline{y}+\underline{\epsilon}$ can be relatively large, there is no similar condition as (14) with which one can decide whether liquidation is worth choosing. However, if the debt holder accepts the debt conversion proposal, his payoff becomes

$$(s^* + t)(d_3 - \delta) + \gamma(s + t)(\alpha - d_3 + \delta),$$

in which $(s^*+t)(d_3-\delta)$ is the expected debt repayment, $\gamma(s+t)(\alpha-d_3+\delta)$ is his claim on the expected payoff of the platform, and γ is increasing in δ. It is evident that given $\underline{y}$, $\underline{\epsilon}$, and $\underline{r}$ are sufficiently small, accepting the debt conversion agreement is always the better choice. In practice, debt-to-equity conversion is frequently used in debt restructuring when a firm, or the economy, is in serious financial trouble (Krugman, 1988). In September 2018, the General Offices of the CPC Central Committee and the State Council jointly released the "Guidance on Strengthening the Balance of Assets and Liabilities of State-owned Enterprises," encouraging SOEs in financial trouble, including local government platforms, to engage in debt-to-equity conversion [6].

We conclude these arguments in the following proposition:

PROPOSITION 7. *For a negative macroeconomic shock $\underline{\epsilon}$ that satisfies $(s^* + t)\alpha + \underline{y} + \underline{\epsilon} > 0$, the government and the long-term debt holder can negotiate a debt-to-equity conversion or a debt exemption agreement for an amount larger than or equal to δ to prevent the platform from going bankrupt, in which δ is defined by (25).*

It is worth noting that debt exemption is a special case of debt-to-equity conversion, with $\gamma = 0$ for any $\delta > 0$, that is, the debt holder voluntarily gives up the shares he deserves. Although this seems unbelievable, it

[6] `http://www.gov.cn/xinwen/2018-09/13/content_5321717.htm`.

occurs frequently in practice because the debt holder is usually acting in concert with the government. For example, Shaoyang[7] City Construction and Investment Co., Ltd. borrowed RMB 163.5 and 96.8 million from the city level and subordinate district level bureaus of finance, respectively. However, the bureau of finance is a department of the government, who is also the owner of the platform! Because the interests of the two parties are relatively consistent, it is much easier to implement debt-to-equity conversions and debt exemptions for distressed platforms. In November 2018, the National Development and Reform Commission released a notice encouraging financial institutions to participate in debt-to-ratio conversion (No. 1442), laying the foundation for implementing this proposition.

It should be also noted that with all of the above instruments for countering macroeconomic risk, the threshold value s^* defined by the manager's incentive constraint remains unchanged, implying that the original incentive scheme for the manager is still valid.

4.4. A note on the long-term effects of shocks

Although macroeconomic shocks have thus far only been defined as being relevant to short-term payoffs, they may also have long-term consequence. Here, we consider the possibility that a shock leads to a deterioration in the long-term prospect, specifically, the distribution of s is changed to $G(\cdot)$ such that F dominates G in the sense of first-order stochastic dominance, that is, the probability of observing a low value of s is higher, given the range of s is unchanged (Ingersoll, 1987).

A change in the distribution of s will directly affect the manager's incentive. Thus, to ensure his incentive scheme remains valid, we need to replace $F(\cdot)$ with $G(\cdot)$ in (9), hence the new threshold value $\tilde{s}$ can be solved from

$$[1-(1-\bar{p})G(\tilde{s})]b-\Phi=[1-(1-\underline{p})G(\tilde{s})]b. \tag{26}$$

It is evident that $\tilde{s}<s^*$, that is, in the presence of $\underline{y}$, the government chooses liquidation only if the future prospect is sufficiently poor such that $s<\tilde{s}$.

A worse future prospect will also make *ex ante* the risk adjustments to the leverage cap more conservative. To see this, from the structure of $d_3(\underline{\epsilon})$ defined in (21), we can observe that $d_3(\underline{\epsilon})$ is increasing in s^*. Hence, a lower $\tilde{s}$ makes $d_3(\underline{\epsilon})$ smaller, and beyond the effect of a negative shock $\underline{\epsilon}$. For the *ex post* debt rollover by observing (24), is evident that λ^* is increasing in s^*. Hence, a smaller $\tilde{s}$ implies a smaller λ^*. Note that λ^* is the smallest

[7]Shaoyang is a prefecture-level city in Hunan Province.

amount of debt to be rolled over, which implies that the government would like to propose a smaller amount because the probability of deferring its debt obligation becomes larger. Similar results can be obtained for the case of debt-to-equity conversion. For example, it can be inferred from (25) that the amount to be converted δ is decreasing in s^*. Hence, a smaller $\tilde{s}$ implies a larger δ, that is, a larger amount of long-term debt should be converted to equity. We conclude the above results in the following proposition.

PROPOSITION 8. *For a negative macroeconomic shock $\underline{\epsilon}$ that changes the distribution function of s to $G(\cdot)$, which is dominated by $F(\cdot)$ in the sense of first-order stochastic dominance, the adjustment schemes discussed in this section become more conservative, specifically:*

a.the regulator will demand a stricter leverage cap ex ante with a lower value of $d_3(\underline{\epsilon})$;

b.the government will accept a wider range of value for the debt rollover agreement;

c.and the long-term debt holder will require a larger amount of debt-to-equity conversion.

5. LARGE SHOCKS AND GOVERNMENT BAILOUTS

Although the details are different, the risk adjustment schemes discussed in the previous section share a common feature, that is, all concessions are made by the three parties and the central government provides no direct aid, provided that $|\underline{\epsilon}|$ is not too large. More specifically, $|\underline{\epsilon}|$ is required to satisfy $(s^* + t)\alpha + \underline{y} + \underline{\epsilon} > 0$ for proposition 5 and 7 to hold, and satisfy $\alpha > d_3 - \underline{y} - \underline{\epsilon}$ for proposition 6 to hold. Hence, if $|\underline{\epsilon}|$ is so large that neither of the two inequalities hold, the platform cannot withstand the shock alone unless the central government provides a direct bailout. These arguments are summarized in the following corollary.

COROLLARY 1. *For a negative macroeconomic shock $\underline{\epsilon}$,*

a.if it satisfies $(s^* + t)\alpha + \underline{y} + \underline{\epsilon} > 0$, the regulator can impose a risk adjustment rule on the platform, or the government can negotiate a debt-to-equity conversion agreement with the long-term debt holder to enable the platform to survive the shock;

b.or, if it satisfies $\alpha > d_3 - \underline{y} - \underline{\epsilon}$, the government and the short-term debt holder reach a debt rollover agreement;

c.or, if it satisfies

$$\underline{\epsilon} < min\{-\alpha(s^* + t) - \underline{y}, d_3 - \alpha - \underline{y}\}, \tag{27}$$

the platform cannot survive the shock without a direct bailout from the central government.

Hence, a natural question is how much financial aid is the central government willing to provide if (27) is satisfied. Suppose the central government is a benevolent central planner that maximizes the total social welfare (or output in this paper). Given that $y = \underline{y}$ and $\underline{\epsilon}$ are small enough such that (27) is satisfied, with the aid of the central government, the total social output is:

$$F(s^*)\underline{r} + \int_{s^*}^{\bar{s}} (s + t)\alpha f(s)ds,$$

in which $f(\cdot)$ is the density function corresponding to $F(\cdot)$. This output is the total resources available to repay the short-term and long-term debt, and a dividend to the local government, regardless of the actual size of the debt obligation. Otherwise, without the aid, the total output will be *underliner*. Hence, the largest bailout the central government is willing to provide is

$$\bar{a} \equiv \underline{r}(F(s^*) - 1) + \int_{s^*}^{\bar{s}} (s + t)\alpha f(s)ds, \tag{28}$$

which is positive because $\underline{r}$ is sufficiently smallin the presence of a macroeconomic shock. It is straightforward to put this in the following proposition:

PROPOSITION 9. *Given $y = \underline{y}$ and $\underline{\epsilon}$ satisfies*

$$min\{-\alpha(s^* + t) - \underline{y}, d_3 - \alpha - \underline{y}\} > \underline{\epsilon} \geq min\{-\alpha(s^* + t) - \underline{y}, d_3 - \alpha - \underline{y}\} - \bar{a},$$

the central government provide a direct bailout of at most $\bar{a}$ to shield the platform from the shock, otherwise if

$$\underline{\epsilon} < min\{-\alpha(s^* + t) - \underline{y}, d_3 - \alpha - \underline{y}\} - \bar{a},$$

there will be no bailout.

This proposition gives the condition under which it is worth for the central government to directly bail out those platforms that are in trouble,

given it has sufficient resources. It is also interesting to evaluate the further effect of a deteriorated future prospect on the amount of bailout. Substitute s^* with $\tilde{s}$, $f(\cdot)$ with $g(\cdot)$, and $F(\cdot)$ with $G(\cdot)$, then the largest amount of bailout under macroeconomic shocks with long-term effects is

$$\hat{a} \equiv \underline{r}(G(\tilde{s}) - 1) + \int_{\tilde{s}}^{\bar{s}} (s+t)\alpha g(s)ds. \tag{29}$$

Intuitively, $\hat{a}$ must be smaller than $\bar{a}$ because a worse prospect is less attractive for the central government. We state this formally in the following proposition.

PROPOSITION 10. *Given $G(\cdot)$ is dominated by $F(\cdot)$ in the sense of first-order stochastic dominance, s^* and $\tilde{s}$ are defined by (9) and (26), respectively, and then $\hat{a} < \bar{a}$.*

Proof. Comparing (9) and (26), it is apparent that $G(\tilde{s}) = F(s^*)$, hence

$$\begin{aligned}
\bar{a} - \hat{a} &= \int_{s^*}^{\bar{s}} (s+t)\alpha f(s)ds - \int_{\tilde{s}}^{\bar{s}} (s+t)\alpha g(s)ds \\
&= (\tilde{s} - s^*)G(\tilde{s}) + \int_{\tilde{s}}^{\bar{s}} G(s)ds - \int_{s^*}^{\bar{s}} F(s)ds \\
&= -\int_{\tilde{s}}^{s^*} G(\tilde{s})ds + \int_{\tilde{s}}^{\bar{s}} G(s)ds - \int_{s^*}^{\bar{s}} F(s)ds \\
&> -\int_{\tilde{s}}^{s^*} G(s)ds + \int_{\tilde{s}}^{\bar{s}} G(s)ds - \int_{s^*}^{\bar{s}} F(s)ds \\
&= \int_{s^*}^{\bar{s}} G(s) - F(s)ds \\
&> 0
\end{aligned}$$

The second equation uses a transformation of integration by parts, and the last inequality stems from the fact $G(\cdot)$ is first-order stochastic dominated by $F(\cdot)$. ∎

Hence, we have established a cost-benefit framework for determining the magnitude of government bailouts based on proposition 9, and its adjustment to long-term prospects based on proposition 10. Note that while we have given an upper bound of the bailout, less interestingly, we can also give a lower bound of the bailout as the gap between $\underline{\epsilon}$ and $min\{-\alpha(s^* + t) - \underline{y}, d_3 - \alpha - \underline{y}\} - \bar{a}$ instead of its specific value, because the central government is a social welfare maximizer.

6. CONCLUSION

In this paper, we build on Dewatripont and Tirole's model (2012) and emphasize that leverage caps can be used as an instrument to regulate the deeply indebted local government financing platforms in China. Different leverage caps are determined for different types of platform, which are classified by their relative closeness to public welfare projects. The key incentive scheme is formulated in the spirit of the incomplete contract approach of Grossman and Hart (1986), that is, the control rights shift from the government to the debt holder if the cap is exceeded. We again emphasize the two assumptions made for LGFPs on which the validity of our policy instruments is heavily reliant. First, the land value is stable in the absence of a macroeconomic shock, but falls rapidly to a small value when one occurs. Second, the debt holders of the platforms usually act in concert with the shareholder. With respect to the policy implications, we propose different means to tackle moderate macroeconomic shocks, including *ex ante* adjusting the cap, *ex post* debt rollover, and debt-to-equity conversion. It is also shown that a direct governmental bailout is necessary when the shock is sufficiently large, under which we calculate an upper bound of the bailout, and show that it increases with the long-term prospect after the shock.

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