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Yardstick competition in a Federation: Theory and Evidence from China

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Abstract

While some scholars argue that fiscal decentralization gave Chinese local governors strong incentives to promote local economic growth, traditional fiscal federalism theories are not directly relevant to explain such an effect in the particular context of China. In this paper, we explain the existence of competition among Chinese local officials using a model of yardstick competition "from the top." In this model, the central government (rather than local voters) creates competition among local officials by rewarding or punishing them on the basis of relative performance in providing public spending. Our theoretical framework predicts that, in this context, the central government involves strategic interactions among local governors. Then, by estimating a spatial lag dynamic model for a panel data of 29 Chinese provinces from 1980 to 2004, we provide empirical evidence of the existence of such public spending interactions. We propose a rigorous empirical framework which takes into account heterogeneity, endogeneity problems and spatial error dependence. The results suggest that there actually are strategic interactions among Chinese provinces.

JEL Classification: D72, H7

Keywords: Decentralization, China, public spending interactions, yardstick competition, spatial panel data.

1 Introduction

China's remarkable growth in the 1980s and 1990s coincided with fiscal decentralization so that some scholars like Zhuravskaya (2000) argue that the latter gave Chinese local officials strong incentives to promote local economic growth, creating a basis for nationwide high economic performance. This paper proposes an explanation for the existence of such competition between Chinese local governments by considering a yardstick competition "from the top," in which the central government creates competition among local governors by judging them on the basis of relative performance in providing public spending.

Fiscal decentralization has been a critical component of economic reform in China but "Chinese style decentralization" is actually conceptually different from decentralization in many other countries. First, China's current fiscal system is largely decentralized while its governance structure is rather centralized with strong top-down mandates and a uniform governance structure. According to Maskin, Qian, and Xu (2000), it can be described as a multidivisional-form hierarchy structure in which the central government exerts great influence on the local administrations' actions.[1] Second, the power of provincial governments is not based on a system of electoral representation: the governors are appointed by the central government in Beijing.[2] Lastly, population mobility between provinces still limited in spite of the relaxations of the *Hukou* system.[3] In traditional fiscal federalism theory, decentralization is supposed to increase the efficiency of public spending by inducing competition between local officials, through a "vote with feet" or a "yardstick competition" created by local voters. In China, traditional disciplining devices such as local elections and exit option are not available. Hence, fundamentally, these theories are not relevant in this context.

Following Blanchard and Shleifer (2001), we argue that vertical control can ensure accountability of local governors and induce interjurisdictional competition. Indeed, Tsui (2005) describes how Chinese provincial leaders operate within a well-defined career structure

[1] China's intergovernmental relations are a hierarchical system of bureaucratic control where provincial governments must accept the unified leadership of the State Council which has the power to decide on the division of responsibilities and to annul inappropriate decisions and orders of provincial governments. A representative of the Communist Party of China is appointed by their supervisors and acts as the policy maker. The Party Secretary is always in precedence above the leader of the People's Government.

[2] We can note that there are elections at village level.

[3] The Hukou system is a household registration system which imposes strict limits on Chinese citizens changing their permanent place of residence.

inside the political hierarchy. They undergo detailed performance reviews by their superiors, and are rewarded or penalized according to their success in achieving specific targets. Promotions, demotions, and job-related benefits all depend on such reviews, which have become increasingly formal.[4] Maskin, Qian, and Xu (2000) actually show that provincial officials are more often promoted to the Party's Central Committee if their province's relative growth rate increases. Similarly, Li and Zhou (2005) examined the careers of top officials in 28 provinces from 1979 to 1995 and found that promotions are significantly more likely in provinces with higher growth. Local governors may consider the risk of damaging their careers since the probability of their reappointment depends on how well they perform in fulfilling their mandates from above. So career concerns may create strong incentives to improve local economic performance, as in democratic countries. The idea that the performance of local governments can be evaluated by making comparisons between them was previously proposed by Salmon (1987) and formally developed by Besley and Case (1995). Here we modify the model of the latter to apply yardstick competition to China. This competition is not "from the bottom" but "from the top" since the principal is the central government, and not the local voting populations. While Besley and Case (1995) provide a model of political economy of tax-setting, we focus on public spending choices. Indeed, although provincial autonomy in managing fiscal resources is controversial, everybody agrees that they have a lot of freedom as regards the amount of their extrabudgetary financing and, hence, to determine the amount of their public expenditure. In this way, we propose a possible explanation of the existence of competition among Chinese local governments despite the absence of electoral accountability and population mobility.

Firstly this paper develops a model of public spending choices in a multijurisdictional world with asymmetric information, where the central government makes comparisons between local governors to overcome political agency problems. As in the traditional yardstick competition model, information spillovers from other jurisdictions affect the delivery of public services in a jurisdiction. Thus, when the central government uses neighboring performance to judge a governor, the latter is encouraged to consider neighboring fiscal decisions so that

[4] Under Mao, promotion in part depended on ideological conformity but as reformers came to dominate in the 1980s, targets increasingly focused on economics. As of the mid-1990s, the system for evaluating provincial leaders assigned 60 out of 100 points to targets related to economic performance (Zhang, 2006).

we should observe strategic interactions among local decision-makers. Moreover, we show that we should not observe such strategic interactions in a centralized fiscal system. Secondly this paper estimates a spatial lag model for a panel data of 29 Chinese provinces from 1980 to 2004 taking into account heterogeneity, endogeneity problems and spatial error dependence to test the theoretical model's predictions. To our knowledge, this study is the first attempt to test public spending interactions in China. Indeed, most of the empirical literature focuses on strategic interactions with respect to taxes in developed countries. Little attention has been paid to the public expenditure side,[5] especially in developing or emerging countries.[6] Our empirical analysis actually provides evidence of the existence of strategic interactions among Chinese local governments operating in a vertical bureaucratic control system. We also show that such interactions are reinforced by a higher degree of fiscal decentralization.

The paper is structured as follows: Section 2 develops a theoretical model of yardstick competition "from the top;" Section 3 estimates a spatial lag model for a panel data of 29 Chinese provinces from 1980 to 2004 to test the existence of public spending interactions. Section 4 concludes.

2 Theoretical framework: Yardstick competition "from the top"

Besley and Case (1995) introduced yardstick competition between governments as a discipline device for rent-seeking politicians in the context of a developed and democratic country. This paper modifies the traditional approach by considering a model of yardstick competition "from the top" and by focusing on public spending choices to apply yardstick competition to the particular context of China. Moreover, while Besley and Case (1995) focus on the effect of yardstick competition on the probability of being reelected, we focus on its effect on the

[5] We can mention the works of Redoano (2007) or Foucault, Madies, and Paty (2008). They find that some interactions take place among neighboring jurisdictions with respect to expenditures for EU countries and French municipalities respectively.

[6] Akin, Hutchinson, and Strumpf (2005) analyze the decentralization of health care provision in Uganda and provide evidence for the hypothesis that spillover effects cause spending on public goods in one district to reduce spending in neighboring districts. Arze, Martinez-Vasquez, and Puwanti (2008) focus on local discretionary expenditures in Indonesia and highlight strategic complementarity of local public spending. Caldeira, Foucault, and Rota-Graziosi (2008) have also found strategic complementarity among local public spending among Beninese municipalities.

existence of strategic interactions among local governments.

2.1 The model

Following Besley and Case (1995), we consider a principal/agent model.

1. The agents are local officials. They are assumed to know more about the short term economic shocks at local level than do the central government.

2. The principal here is the central government. It is assumed to use performance indicators of neighboring local officials as a benchmark to appraise whether agents waste resources and deserve to remain in office.

3. The main incentive mechanisms used to discipline governors are reappointment (instead of elections). The central government decides whether or not to reappoint an agent.

We consider a jurisdiction whose local government provides public services of a given quality (G_i) financed by taxes (t). The final level of fiscal revenue is $t\theta_k$, with θ_k, the product stochastic and observed only by the local government. θ_k can take three values: high (H), medium (M) or low (L) with probabilities p_H, p_M and p_L, which are assumed to be evenly spaced with difference $\frac{\Delta}{t}$.[7]

The local governments are potentially of two kinds: it can be "good" (g) with probability γ or "bad" (b) with probability $(1-\gamma)$. We assume that $\gamma \geq \frac{1}{2}$.[8] Agent's strategies are denoted by $G(\theta_k; T)$, with $k \in (H; M; L)$ and $T \in (g; b)$. Good local governors do not rent-seeking or waste resources while bad ones do. The latter can subtract 0, Δ or 2Δ as rent or waste. Formally, we have:

$$G(\theta_k; g) = t\theta_k, \tag{1}$$

and

$$G(\theta_k; b) = t\theta_k - r_i, \tag{2}$$

with r_i, the rent.

[7] Note that three levels of product are necessary to obtain interesting results.

[8] This hypothesis will allow us to highlight the discipline effect of the yardstick competition. Indeed, if $\gamma < \frac{1}{2}$, under yardstick competition, bad local governments will never reduce their rent since the central government won't be willing to reappoint them even if they both reduce their rent (see Section 2.3.2).

As in Besley and Case (1995), we consider two time periods with a discount factor δ satisfying $\frac{1}{2} < \delta < 1$. The central government observes public spending decisions and reviews its belief that the agent is good using Bayes' rule.[9] Hence it chooses whether or not to reappoint him since it wants to maximize public spending for a given level of taxes in period 2. The central government strategy is denoted by

$$\mu(G_i)\epsilon[0;1], \tag{3}$$

which corresponds to the probability that it reappoints a local governor who sets a public spending level G_i. A bad local official chooses public spending to maximize his discount utility which depends positively on the rent in period 1 and on expected rent in period 2:

$$E\left[V\left(G_i\left|\theta_k\right.\right)\right] = r_i + \mu(G_i)\delta 2\Delta, \tag{4}$$

A bad official who is reappointed sets no period 2 discipline and takes a rent equal to 2Δ.[10] So, he contemplates between the rent in period 1 and the expected rent in period 2.[11]

2.2 The centralized fiscal system

As a benchmark, we first consider the case in which the fiscal system is centralized. All tax revenues are collected by the central government at local level and transferred back to local governments according to a spending plan made by the center. It corresponds to the perfect information case. Formally, we have:

$$G(C_i, g) = C_i \text{ and } G(C_i, b) = C_i - r_i, \tag{5}$$

with G_i, the level of public spending, C_i, the fiscal revenue transferred by the central government and r_i, the rent. In this case, a local governor who sets a level of public spending lower

[9] Note that we can easily consider that the central government has no capacity to make a credible pre-commitment on transparent rules of career evolution depending on fiscal performance only. Indeed, promotions of a close relative of the leaders of the central government are common in China. For instance, recently, Li Xiaopeng, the son of former Chinese premier Li Peng was promoted to governor of Hunan province.

[10] More generally, 2Δ can be considered as a reward to behave as a good governor in period 1 such as a promotion.

[11] Note that it is assumed that there is no sanction, i.e., a local governor is not bound to give back what he took as a rent in period 1.

than the fiscal revenue transferred by the central government will be automatically seen as a bad local governor and will not be reappointed. Strict dominance arguments rule out any equilibrium in which $G(C_i, b) = C_i$ ($\Delta = 0$) as long as $\delta < 1$. Then, providing $G_i = C_i - \Delta$ gets less rent with no gain in the probability of staying governor so that bad local governors are not encouraged to reduce their rent and take 2Δ.

Lemma 1 *Under perfect information a centralized fiscal system is characterized by:*

(i) Good governors set: $G(C_i, g) = C_i$.

(ii) Bad governors set: $G(C_i, b) = C_i - 2\Delta$.

(iii) Central government sets: $\mu(C_i - \Delta) = \mu(C_i - 2\Delta) = 0$ and $\mu(C_i) = 1$.

Proof. See Appendix A.1.1 ■

In this case, the information about the nature of the local government is revealed. Yardstick competition is useless and has no effect on local officials' public spending choices which are independent of what other agents are doing.

Proposition 1 *Under our assumptions, when the fiscal system is centralized, there is no horizontal strategic interaction.*

2.3 The decentralized fiscal system

We now consider a decentralized case with asymmetric information between the local officials and the central government. The nature selects the type of the local governor and the product. We deduce five possible public spending levels, $\{G_1; G_2; G_3; G_4; G_5\}$ with $G_1 > G_2 > G_3 > G_4 > G_5$. A good governor always provides public spending consistent with the true level of tax revenue:

$$G(\theta_H; g) = t\theta_H = G_1 \text{ and } G(\theta_M; g) = t\theta_M = G_2 \text{ and } G(\theta_L; g) = t\theta_L = G_3.$$

A bad governor can choose to take no rent, a rent of Δ or 2Δ. According to the products, the level of public spending can be:

$$G(\theta_H; b) = t\theta_H = G_1 \text{ or } (t\theta_H - \Delta) = t\theta_M = G_2 \text{ or } (t\theta_H - 2\Delta) = t\theta_L = G_3,$$

$$G(\theta_M; b) = t\theta_M = G_2 \text{ or } (t\theta_M - \Delta) = t.\theta_L = G_3 \text{ or } (t\theta_M - 2\Delta) = G_4,$$

$$G(\theta_L; b) = t\theta_L = G_3 \text{ or } (t\theta_L - \Delta) = (t\theta_M - 2\Delta) = G_4 \text{ or } (t\theta_L - 2\Delta) = G_5.$$

The following table sums up the possible levels of public spending:

Table 1: Levels of public spending depending on product and rent levels

Type\Product	**High**			**Medium**			**Low**		
Good	G_1			G_2			G_3		
Bad	$\mathbf{r = 0}$	$\mathbf{r = \Delta}$	$\mathbf{r = 2\Delta}$	$\mathbf{r = 0}$	$\mathbf{r = \Delta}$	$\mathbf{r = 2\Delta}$	$\mathbf{r = 0}$	$\mathbf{r = \Delta}$	$\mathbf{r = 2\Delta}$
	G_1	G_2	G_3	G_2	G_3	G_4	G_3	G_4	G_5

2.3.1 Perfect Bayesian Equilibrium without yardstick competition

We consider first one jurisdiction and we find Perfect Bayesian Equilibrium of the public spending game.

With $\delta < 1$, strict dominance argument rules out any equilibrium where $G(\theta_H; b) = G_1$, $G(\theta_M; b) = G_2$ and $G(\theta_L; b) = G_3$. Moreover, the central government will always believe that a local government who sets G_4 or G_5 is bad, so that $\mu(G_4) = \mu(G_5) = 0$. Hence, by applying strict dominance rule, a bad governor will always take a maximal rent when the product is low: $G(\theta_L; b) = G_5$. Then, if $p_L \geqslant 1/2$ a bad governor takes a reduction in rent when the product is medium (θ_M) in order to be reappointed: $G(\theta_M; b) = G_3$. Indeed, observing G_3, using Bayes' rule, the central government is willing to reappoint the local government if $p_L \geqslant 1/2$, a high enough value for it to be sufficiently likely that a governor who chooses G_3 is actually good. Hence, since $\delta > 1/2$, the governor is encouraged to reduce his rent when the product is medium (θ_M) to be reappointed, setting no discipline and a rent equal to 2Δ in period 2. On the contrary, when the product is high (θ_H), it is worse off playing G_2 since it gets less rent with no gain in the probability of reappointment so that a bad governor takes a maximal rent when the product is high: $G(\theta_H; b) = G_3$.

The following proposition illustrates Perfect Bayesian Equilibrium in an interesting and simple case: $p_L \geqslant 1/2$.

Lemma 2 *Under asymmetric information, without yardstick competition, if* $p_L \geqslant$

1/2, *the Perfect Bayesian Equilibrium is:*

(*i*) *A bad local governor sets:*

$$\begin{cases} G(\theta_H; b) = t\theta_H - 2\Delta = G_3, \\ G(\theta_M; b) = t\theta_M - \Delta = G_3, \\ G(\theta_L; b) = t\theta_L - 2\Delta = G_5. \end{cases}$$

(*ii*) *Central government sets:*

$$\begin{cases} \mu(G_1) = \mu(G_2) = \mu(G_3) = 1, \\ \mu(G_4) = \mu(G_5) = 0. \end{cases}$$

Proof. See Appendix A.1.2 ■

Without yardstick competition, a local governor can be encouraged to reduce his rent to be reappointed. But, local governments' public spending choices are independent of what other local officials are doing.

2.3.2 Perfect Bayesian Equilibrium with yardstick competition

We now consider two neighboring jurisdictions with identical environments and shocks in which appointed officials may be of different types. We analyze the effect of the central government's information about public spending in both jurisdictions. Like Besley and Case (1995), we assume that local officials know each other's types.[12] We keep considering the case where $p_L \geqslant 1/2$ to compare equilibrium with and without yardstick competition. We note $\mu(G_i|G_j)$ the probability that the central government reappoints a local governor i who sets a public spending level G_i, observing a level G_j in the neighboring local jurisdiction j and $G(\theta_H; T_i|T_j)$ the strategy of the local governor i who knows the type of its neighboring local government j. We have three cases to consider (see Appendix A.1.3).

First, if both local governments are good, both set public spending equal to $t\theta_k$, $k \in (H; M; L)$.

[12] In other words, we suppose that neighboring local governments know more about each other than the central government do.

Second, if both local governments are bad, both local governors choosing the same strategy gives the central government more confidence that they are good. In particular, it is now willing to reappoint a governor if it observes G_3 in both jurisdictions if $p_L \geqslant 1-\gamma$. This condition is weaker than the previous one since, by assumption, $\gamma \geq 1/2$. Hence, both bad governors act in the same way and reduce their rent when the product is medium to be reappointed. It follows that local governors are better able to make the central government believe that both are good by choosing the same strategy. In this case, yardstick competition involves a discipline effect which leads bad governments to increase the level of public spending in period 1.

Third, we consider the case where one local government is good and the other is bad. In this case, the bad incumbent will be found out by providing a level of public spending above his neighbor. Hence, when the product is medium (θ_M) playing G_3 now results in being unseat. A bad government can no longer reduce its rent when θ_M to be reappointed: it takes a maximal rent when θ_M: $G(\theta_M; b) = G_4$. The good local government inflicts an externality on the bad one, reducing the latter's reappointment chances. In this case, the yardstick competition separates good governments from bad governments (selection effect) but involves a decrease of public spending in period 1.

Lemma 3 *Under asymmetric information, with yardstick competition, if* $p_L \geqslant 1/2$, *the Perfect Bayesian Equilibrium is:*

(i) *If both local governments are good, they both set:*

$$\begin{cases} G(\theta_H; g|g) = t\theta_H = G_1, \\ G(\theta_M; g|g) = t\theta_M = G_2, \\ G(\theta_L; g|g) = t\theta_L = G_3. \end{cases}$$

If both local governments are bad, they both set:

$$\begin{cases} G(\theta_H; b|b) = t\theta_H - 2\Delta = G_3, \\ G(\theta_M; b|b) = t\theta_M - \Delta = G_3, \\ G(\theta_L; b|b) = t\theta_L - 2\Delta = G_5. \end{cases}$$

If one local government is good and the other is bad, they set:

$$\begin{cases} G(\theta_H; b|g) = t\theta_H - 2\Delta = G_3, & G(\theta_H; g|b) = t\theta_H = G_1, \\ G(\theta_M; b|g) = t\theta_M - 2\Delta = G_4, & G(\theta_M; g|b) = t\theta_M = G_2, \\ G(\theta_L; b|g) = t\theta_L - 2\Delta = G_5. & G(\theta_L; g|b) = t\theta_L = G_3. \end{cases}$$

(ii) The central government sets:

$$\begin{cases} \mu(G_1) = \mu(G_2|G_2) = \mu(G_3|G_3) = 1, \\ \mu(t\theta_k - r_i \ |t\theta_k) = \mu(G_4) = \mu(G_5) = 0, . \end{cases}$$

Proof. See Appendix A.1.3 ■

Our results are similar to those of Besley and Case (1995) and we distinguish the two effects of the yardstick competition highlighted by Canegrati (2006): the discipline effect and the selection effect. When both local officials are bad, choosing the same strategy gives the central government more confidence that governors are good so that bad local officials decide, as soon as possible, to both reduce their rent. When one local official is good and another is bad, the bad governor always takes a maximal rent since it has no chance to be reappointed by reducing its rent. Finally, when the central government makes comparisons between local jurisdictions, local officials care about what other local governments are doing since it affects its own probability of being reappointed.

Proposition 2 *Under our assumptions, the yardstick competition "from the top" involves horizontal strategic interactions among neighboring local governments.*

We can note that there is no common agreement about the ability of the yardstick competition to reach citizens' welfare. Economists who believe that government is benevolent are prone to see intergovernmental competition as a source of negative externalities which lowers welfare. On the contrary, the public choice perspective which regards governments as Leviathan sees yardstick competition as potentially beneficial for welfare (Besley and Smart, 2002). Brülhart and Jametti (2007) support the view that tax competition can be a second-best form of welfare enhancement by constraining the scope for public-sector revenue maximization. They find evidence of welfare-increasing "Leviathan taming". Economic

theory also provides statements of the conditions under which tax competition may be "a force for good" or "a force for bad".[13] Belleflamme and Hindriks (2005) analyze the role of yardstick competition for improving political decisions and find a generally neutral result. In our case, it is straightforward to show that the total level of public spending provided with tax held fixed is higher with yardstick competition: it is lower in period 1 but this effect is offset in period 2 since bad local governors are less likely to be reappointed.[14]

3 Empirical evidence of strategic interactions among Chinese provincial governments

Our theoretical framework shows that the yardstick competition "from the top" involves strategic interactions among neighboring local governments (Proposition 2). Hence, first, we empirically test the existence of such horizontal strategic interactions in determining public spending. We do not pretend that strategic interactions always arise through a yardstick competition only. But, in the Chinese context, such interactions cannot arise through traditional channels like population mobility or electoral discipline so that we can argue that a yardstick competition "from the top" should be the principal source of strategic interactions. Second, according to Proposition 1, when the fiscal system is centralized, we should not observe any horizontal strategic interactions. Empirically, we test the effect of the degree of centralization on the existence of horizontal strategic interactions. Before that, we provide an overview of the decentralization process in China and some descriptive statistics.

3.1 Decentralization in China

The basic hypothesis of our analysis is that the Chinese provinces acquired an autonomous budgetary power which allows them to determine the amount of their spending. One of the major objectives of the fiscal reform was to make local governments fiscally self-sufficient (see Jin, Qian, and Weingast (2005) for a detailed overview of the decentralization process in China.). Provincial governments have been given considerable latitude in shaping local

[13] Edwards and Keen (1996), for instance, show that the net welfare effect of tax competition hinges on the relative magnitude of two parameters: the marginal excess burden of taxation and the government's marginal ability to divert tax revenue for its own uses.

[14] This is true as soon as $\gamma > \frac{1}{4}$.

policies and managing fiscal resources: more than 70 percent of the entire public expenditure was incurred at local levels in 2004 (see Figure 1 in Appendix A.2.1).[15]

Before 1979, China practiced a "unitarian budgetary system" (*tongshou tongzhi*). This fiscal system was characterized by centralized revenue collection and centralized fiscal transfers. Most taxes and profits were collected by local governments and were remitted to the central government, and then in part transferred back to the local governments according to expenditure needs approved by the center. This system was in accord with the planned economy. The fiscal decentralization policy was implemented in 1980. The highly centralized system was changed into a revenue-sharing system called "fiscal contracting system" (*caizheng chengbao zhi*). Although the central government retained the responsibility for defining the fiscal system, the administration and the collection of taxes were widely devolved to provinces. There were three basic types of revenue under this reformed system: central revenues that accrue to the center, local revenues that accrue to the local governments, and shared revenues. Actually, during this period, the local governments controlled the effective tax rates and bases by offering varying degrees of tax concessions to enterprises and shifted budgetary funds to extrabudgetary funds.[16] This period is generally considered as one of great autonomy for provincial governments. From 1980 to 1993, the central government's share of total budgetary revenue declined from 51 percent to 28 percent. Hence, the central government decided in late 1993, to replace this system with a "separating tax system", a system of allocation of the various categories of taxes between the center and the provinces. The center and provinces became responsible for the administration and collection of their own taxes. To a certain extent, the reform may have strengthened the fiscal autonomy of provinces. Indeed, local governments' tax revenue no longer depends on negotiation with the center, provincial taxes have an important fiscal potential and the provinces benefit from tax revenues they collect.

Provincial autonomy results in a very different fiscal effort from one province to another and in the existence of deficits during the execution of the budgets (Bahl, 1999). Moreover,

[15] Provincial levels are first-level local state administrative organs in China. By conventional measure, there are five tiers in the China fiscal system: the central government, 33 province-level regions, 333 prefecture-level regions, 2,862 county-level regions and 44,741 township-level regions.

[16] They thus minimized tax sharing with the central government. Moreover, for most local governments, there was a strong incentive to conceal their revenue capacities, as the center tended to revise the rules of the game to penalize local governments with fast-growing revenues.

although provincial fiscal autonomy evolution from one reform to another is controversial, everybody agrees that they have a lot of freedom as regards the amount of their extrabudgetary spending. In spite of their name, these fiscal revenues belong to the budget since provinces plan formally to collect them and to spend them.[17] The development of the extrabudgetary financing illustrates central government's tolerance of the fiscal initiatives of local governments (Zhang, 1999). Hence, local governments are not deprived of their freedom to determine the amount of their public expenditure.

3.2 Descriptive statistics

Our panel dataset covers the period 1980-2004 for 29 provinces. We consider the 22 provinces or *sheng* (Anhui, Fujian, Gansu, Guangdong, Guizhou, Hainan, Hebei, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Liaoning, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan and Zhejiang), the 5 autonomous regions or *zizhiqu* (Guangxi, Nei Mongol, Ningxia, Xinjiang Uygur, Xizang) and the 4 municipalities or *shi* (Beijing, Chongqing, Shanghai and Tianjin).[18]

Data for provinces' public expenditure come from the *China Statistical Yearbook* for various years. Public expenditure is divided into five spending categories: appropriation for capital construction, expenditure for enterprise innovation, expenditure for supporting agricultural production, culture, education, science & health care and government administration spending. As shown in Figure 2 (see Appendix A.2.1), social expenditure in culture, education, science and health care represent around 40% of local government expenditure. Capital expenditure also represents an important (but unstable) share of public spending.

Over the past 30 years, China has transformed itself, posting extraordinary rates of growth. At the same time, it has become a far less equal nation, with vast differences emerging between those living in rural and urban areas or inland and coastal areas. In particular, incomes in coastal areas have grown faster than in inland provinces, opening a coastal-inland income gap that has widened continuously. This pattern is not surprising given

[17] In 1978, total extra-budgetary revenue was about 10% of the GDP while total budgetary revenue was about 31%. In 1993, the extra-budgetary revenue was up to 16% of the GDP and the budgetary revenue was down to 16% of the GDP (Statistical Yearbook of China, 1995).

[18] We excluded the Xizang region (Tibet) since data are likely to be overvalued. Moreover, in 1997, Chongqing separated from Sichuan to become an independent prefecture in its own right but we have no data for this prefecture before 1997. So, we have combined Chongqing with Sichuan.

that much of China's recent economic development was led by rapidly expanding exports, financed to a considerable extent by foreign direct investment. Local governments play an essential role in providing social services. However, many local governments, especially those in poor western regions, are providing fewer and lower quality public services. Regarding total public spending we see that coastal provinces account for 65% of the total local governments' expenditure. The distribution of per capita central transfers by province increases these inequalities: Shanghai, the richest province, is the largest recipient of central transfers per capita in 2004 (5,079 yuan) while Henan, a relatively poor province, is the smallest one (646 yuan).

Finally, the level of public spending seems to be largely spatially correlated due to spatial heterogeneity of provinces. Our empirical framework consists of testing the existence of substantive strategic interaction between Chinese neighboring local governments. We have to ascertain that the observed spatial auto-correlation can be attributed to a real strategic interaction process among local authorities and not to exogenous correlation in omitted provinces characteristics or common shocks to local fiscal policy.

3.3 Are there public spending interactions among Chinese provinces?

3.3.1 Econometric framework

To test the existence of horizontal strategic interactions, in line with earlier literature, we consider a specification in which (the log of) public expenditure in province i in year t, G_{it}, is a function of (the log of) its neighbors' public spending, G_{jt}.[19] We allow G_{it} to depend on a vector of specific controls X_{it} and we include a province-specific effect α_i.

$$G_{it} = \sum_{ij} \rho_{ij} G_{jt} + \beta X_{it} + \alpha_i + \varepsilon_{it}, \tag{6}$$

where $i = 1, \ldots, n$ denotes a province and $t = 1, \ldots, T$ a time period, ρ_{ij}, β and α_i are unknown parameter vectors and ε_{it} a random error. All time-invariant community characteristics, observed or unobserved are represented by α_i. Since there are too many parameters

[19] See, for instance, Devereux, Lockwood, and Redoano (2008), Foucault, Madies, and Paty (2008) or Redoano (2007).

ρ_{ij} to be estimated, we consider:

$$G_{it} = \rho A_{jt} + \beta X_{it} + \alpha_i + \varepsilon_{it}, \tag{7}$$

where $A_{jt} = \sum w_{ij}.G_{it}$ is the weighted average vector of public spending in the set of neighbors local governments j at time t.

The first problem concerns the way the neighbors of a province are defined. An 'a priori' set of interactions has to be defined. We try to rely on insights derived from our theoretical model. In the latter, the central government introduces a yardstick competition among local jurisdictions which are comparable, with identical environments and shocks. A scheme that assigns weights based on geographical proximity is commonly used in the empirical literature of interjurisdictional interactions and seems to be particularly relevant in China where heterogeneity of provinces is widely spatially distributed. Hence we have first chosen two geographical definitions of neighboring communities. The first is based on the Euclidean distance between provinces, w_{ij}^{dist}.[20] The second, w_{ij}^{cont}, is based on a contiguity matrix where the value one is assigned if two provinces share the same border and zero otherwise. Then, following Lockwood and Migali (2009), we compare these weights to 'placebo' weights, w_{ij}^{plac}, which are chosen randomly without regard to any economic considerations.[21] This placebo weighting scheme gives us a useful benchmark to ascertain that the potential observed spatial auto-correlation can be attributed to a substantive strategic interaction process and not to some general positive correlation between all public spending generated by omitted common shocks.[22]

Following Devereux, Lockwood, and Redoano (2008), Foucault, Madies, and Paty (2008), Veiga and Veiga (2007) and Redoano (2007), we introduce the lagged dependent variable, G_{it-1} , as a right hand side in order to take into account persistency in public expenditure:

$$G_{it} = \lambda G_{it-1} + \rho A_{jt} + \beta X_{it} + \alpha_i + \varepsilon_{it}. \tag{8}$$

[20] Weights w_{ij} are given by $1/d_{ij}$ where d_{ij} is the Euclidian distance between provinces i and j for $j \neq i$.

[21] We generate a random number distributed between 0 and 1 for each province. Then, the value 1 is assigned if the difference between random numbers of two provinces is higher than 0.5 and 0 otherwise.

[22] Weights are normalized so that their sum equals unity for each i for all weight matrices. This assumes that spatial interactions are homogeneous: each neighbor has the same impact on the province.

Lastly, we introduce specific control variables commonly used in the relevant empirical literature to avoid exogenous correlation in omitted provinces characteristics or shocks to local fiscal policy which may generate spatial error dependence and provide false evidence of strategic interaction,

$$G_{it} = \lambda G_{it-1} + \rho A_{jt} + \beta_1 P_{it} + \beta_2 G\mathrm{R}_{it} + \beta_3 U_{it} + \beta_4 O_{it} + \beta_5 F_{it} + \beta_6 C_{it} + \beta_7 T_t + \alpha_i + \varepsilon_{it}, \quad (9)$$

where P_{it} is the population density of province i in year t, which captures the possibility of economies of scale in public spending and may be spatially distributed,[23] $G\mathrm{R}_{it}$ is the Gross Domestic Product (GDP) growth rate in province i in year t, which controls for common shocks spatially correlated, U_{it} is the fraction of urban population in the total population of provinces, knowing that urbanization is spatially distributed and may increase public spending needs in particular in terms of infrastructures (Guillaumont Jeanneney and Hua, 2001 and Rodrik, 1998), O_{it} is a trade openness measure[24] at provincial level which could have many effects on public finances,[25] as well as F_{it}, the foreign direct investment inflow in province i in year t. T_t is a trend variable which captures a common trend for all provinces.[26] We also introduce C_{it}, the central government transfers for province i in year t, the centre may want to transfer more resources to increase spending in a specific part of the country. The central government transfers are introduced as control variable only as a robustness check, this data reducing our observations number since it is available only from 1995 to 2004.[27]

In estimating equation 9 we are confronted with important econometric issues (Brueckner, 2003). First, as already mentioned, the omission of explanatory variables that are spatially dependent may generate spatial dependence in the error term. When spatial error dependence

[23] Per capita expenditures and population are in logarithmic terms.

[24] We measure the trade openness as a ratio of total foreign trade (exports plus imports) to GDP as it is most often used in empirical studies.

[25] In particular, Rodrik (1998) shows that there is a positive correlation between an economy's exposure to international trade and the size of its government because government spending plays a risk-reducing role in economies exposed to a significant amount of external risk.

[26] We cannot introduce time dummies since we use GMM System with external instruments and we have too many instruments with time dummies. However, introduce a trend is a good way to ascertain that the potential observed spatial auto-correlation can be attributed to an interaction process and not to a "common trend". Indeed, Manski (1993) suggests that fiscal choices appear to be interdependent not because jurisdictions behave strategically but because they actually follow a "common trend" that drives fiscal choices in the same directions.

[27] Data for the central government transfers come from China Financial Yearbook from 1995 to 2004.

is ignored, estimation can provide false evidence of strategic interactions. To deal with this problem, one possible approach is to use the maximal likelihood (ML) estimator, taking into account the error structure or the instrumental variables (IV) method which yields consistent estimates even with spatial error dependence (see Kelejian and Prucha, 1998).[28] Saavedra (2000) or Foucault, Madies, and Paty (2008) use the robust tests of Anselin, Bera, Florax, and Yoon (1996) to verify the hypothesis of error independence.[29] Secondly, because of strategic interactions, public expenditure in different provinces is jointly determined: if local governments react to each others' spending choices, neighbors' decisions are endogenous and correlated with the error term ε_{it}. In this case, ordinary least squares estimation of the parameters is inconsistent, requiring alternative estimation methods based on the IV method or on the ML.[30] Under IV approach, a typical procedure is to use the weighted average of neighbors' control variables as instruments (Kelejian and Prucha, 1998). Lastly, since we introduce the lagged dependent variable as a right hand side to consider the autoregressive component of the time series, the previous estimators are inconsistent (Nickell, 1984).

We propose to use the GMM-System estimator in addition to the IV estimator of the spatial coefficient, after verifying the hypothesis of error independence and estimating the static model with ML estimator. As for the neighbors' spending decisions, we use the weighted average of neighbors' control variables, i.e., their socio-economic characteristics ($w_{ij}X_{jt}$), as instruments. The GMM estimators allow controlling for both unobserved country-specific effects and potential endogeneity of the explanatory variables.[31] The GMM-System estimator combines in one system, the regressions in difference and the regressions in level. Blundell and Bond (1998) show that this extended GMM estimator is preferable to that of Arellano and Bond (1991) when the dependent variable, the independent variables, or both are persistent.

[28] Case, Rosen, and Hines (1993) or Brueckner (1998) use the maximum likelihood approach. Brett and Pinkse (2000), Heyndels and Vuchelen (1998), Figlio, Kolpin, and Reid (1999) and Buettner (2001) are examples of empirical studies that use the IV approach to estimate spatial coefficients.

[29] The use of panel helps to eliminate spatial error dependence which arises through spatial autocorrelation of omitted variables which are time-invariant.

[30] The ML method consists of using a non-linear optimization routine to estimate the spatial coefficient ρ (Brueckner, 2003).

[31] There are conceptual and statistical shortcomings with the first-difference GMM estimator as it exacerbates the bias due to errors in variables (Hausman, Hall, and Griliches, 1984). Thus, we use an alternative system estimator that reduces the potential biases and imprecision associated with the usual difference estimators (Arellano and Bover, 1995 and Blundell and Bond, 1998) and also greatly reduces the finite sample bias.

3.3.2 Results

To investigate whether spatial lag or spatial error dependence are the more likely sources of correlation, we use two robust tests (for spatial lag dependence and for spatial error dependence) based on the Lagrange Multiplier principle for panel data (Anselin, Le Gallo, and Jayet, 2006). As shown in the Table 2 (see Appendix A.2.2), spatial tests indicate the presence of spatial lag dependence for public spending but not the existence of spatial error dependence for both matrices. As the hypothesis of error independence is verified, we estimate equation (9) using ML with specific-effects for both contiguity and distance matrices without taking into account the lagged value of our dependent variable ($\lambda = 0$). The estimation results are shown in Table 2. In these first estimations, the coefficient of the weighted average vector of public expenditure in the set of other local governments is always significant and positive for both matrices.

We then estimate with GMM-System the dynamic model (equation 9) for both weighting schemes taking into account the lagged value of our dependent variable ($\lambda \neq 0$). We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of other explanatory variables.[32] As noted before, the weighted average vector of per capita public spending in other provinces is also instrumented by the weighted average of neighbors' control variables. We collapse instruments and limit their number since too many instruments leads to inaccurate estimation of the optimal weight matrix, biased standard errors and, therefore, incorrect inference in overidentification tests (see Roodman, 2009).[33] Table 3 shows these estimation results for distance matrix and Table 4 for contiguity matrix (see Appendix A.2.2). The consistency of GMM-System estimator is given by two specification tests (Arellano and Bond, 1991): the Hansen test and the serial correlation of residuals tests. Here, we conclude that orthogonality conditions are correct and instruments used valid. We introduce the control variables progressively to check the robustness of our results. We can also note that

[32] Population density, trend and urbanization rate.

[33] The lags of at least two periods earlier for weak exogenous variables and three periods earlier for endogenous variables are used as instruments. The lagged dependent variable is instrumented by lags of the dependent variable from at least two periods earlier.

We use two lags for endogenous and weak exogenous variables. Note that we consider external instruments as weak exogenous but we use only one lag when the number of instruments exceeds the number of units.

the coefficient of the lagged dependent variable is always significant and positive. As this coefficient provides an estimated λ varying between 0.45 and 0.89 significant at 1% level, the result indicates persistency of public expenditure and confirms the consistency of the autoregressive specification.

The coefficient of the weighted average vector of public expenditure in the set of other provinces is significant at least at 5% level and positive for both matrices. Moreover, it is robust and relatively stable with the introduction of the control variables. However, if we continue to find evidence of strategic interactions with the placebo matrix, it would cast doubt on our claim that we have found evidence of public spending interactions. But we see from Table 4 (last column), that placebo matrix do not show any evidence of positive strategic interactions. This shows that the phenomenon of fiscal interactions detected with geographical matrices is not an artefact of the estimation procedure. So, we can conclude that there are strategic interactions between Chinese provinces and that public expenditure seem to be strategic complements: an average public spending increase of 10% in the neighboring provinces induces an increase of around 5,9% with the distance matrix and 2,8% with the contiguity matrix in provincial expenditure.[34] These results are similar to those obtained in previous tests carried out in other countries.[35]

3.3.3 Extension

Case, Rosen, and Hines (1993) and Foucault, Madies, and Paty (2008) suggested that there is no reason to assume that patterns of expenditure interdependence are identical for all categories of public spending. So, we extend our empirical analysis by testing the existence of horizontal strategic interactions for each category of public spending. Results are provided in Tables 5 and 6 (see Appendix A.2.3) for distance and contiguity matrices. Regarding

[34] As expected, the parameter associated with population is negative and significant: it indicates the presence of economies of scale in public spending. We find a positive and significant sign for the parameter associated with the GDP growth rate, which indicates the effect of economic conjuncture. Results also tend to show that urbanization actually increases public spending needs. The coefficient associated with the central government transfers is also positively correlated with the level of public expenditure, as it is generally the case for trade openness.

[35] The empirical evidence for public spending interactions and their strategic complementarity relates to the United States (Case, Rosen, and Hines, 1993 and Figlio, Kolpin, and Reid, 1999), European countries (Redoano, 2007), Indonesia (Arze, Martinez-Vasquez, and Puwanti, 2008) or French municipalities (Foucault, Madies, and Paty, 2008). For empirical evidence of yardstick competition see Ashworth and Heyndels (1997) for Flemish Belgium, Bordignon, Cerniglia, and Revelli (2003) for Italy, Schaltegger and Kuttel (2002) for Switzerland and Revelli (2006) for the United Kingdom.

coefficients associated with weighted average vector of public expenditure in neighboring provinces for the various categories of public spending, interactions seem to be strongest and most significant for the category "appropriation for capital construction" and for "expenditure for enterprise innovation." Estimations provide estimated coefficients of 0.35 and 0.24 respectively, significant at 1% level with the distance matrix. Strategic interactions are smaller for local social expenditure ("culture, education, science & health care") and results provide no evidence of interactions for expenditure for supporting agricultural production and local government administration spending.

Since the principal is the central government rather than local voters, this may explain that competition is rather on economic than on social performance (education, health, culture). This may be to answer the requirements of the central government in terms of economic performance that the competition mainly concerns infrastructure supply and enterprise innovation. Indeed, if local governors are to be evaluated by the central government in accordance with formal set of performance criteria including social development, economic items are more numerous. An alternative explanation was provided by Foucault, Madies, and Paty (2008). They also found a higher coefficient for investment expenditure and argued that there are spending interactions between neighboring French municipalities for the most "visible" category of expenditure.

3.4 The effect of the degree of centralization on strategic interactions

As already stated, according to Proposition 1, when the fiscal system is centralized, local officials' public spending choices are independent of what other agents are doing so that we do not expect any horizontal strategic interactions. We cannot test this hypothesis directly since we lack data for the period before decentralization. So we propose to test the effect of the degree of centralization on the existence of horizontal strategic interactions. The horizontal strategic interactions should be lower when the degree of centralization is higher.

To test this, we interact the neighbors' spending decisions (A_{jt}) and an indicator of the

degree of centralization (C_{it}) and we estimate:

$$G_{it} = \lambda G_{it-1} + \rho' A_{jt} + \rho''(A_{jt} * C_{it}) + \beta_1 P_{it} + \beta_2 G\mathrm{R}_{it} + \beta_3 N_{it} + \beta_4 O_{it} + \beta_5 U_{it} + \beta_6 T_t + \beta_7 C_{it} + \alpha_i + \varepsilon_{it}, \tag{10}$$

If the centralization actually reduces strategic interactions, we should observe the coefficients ρ' being significantly positive and ρ'' being significantly negative. To rely on insights derived from our theoretical model, fiscal centralization is defined as transfers from central government as a percentage of local government revenue.

Table 7 (see Appendix A.2.4) gives the estimation results for both matrices. Our results tend actually to show that public spending interactions are reduced by fiscal centralization (column (1) and (2)). Indeed, central government transfers have reduces competition between governors: the coefficient associated with the interaction between the neighbors' spending decisions (A_{jt}) and an indicator of centralization (C_{it}) is significantly negative while coefficients associated with (A_{jt}) and (C_{it}) are both positive. As a robustness test, we use an approximation of fiscal decentralization and evaluate its effect on the existence of strategic interactions in columns (3) and (4). Following the relevant literature,[36] we choose an usual approximation of fiscal decentralization, Dec_{it}: local expenditure as a percentage of national expenditure.[37] As expected, on the contrary, public spending interactions are reinforced by fiscal decentralization. For both matrices, coefficients associated with A_{jt} and $(A_{jt} * Dec_{it})$ are significantly positive.[38]

4 Conclusion

There is a divergence between the assumptions of orthodox fiscal federalism theories and the institutional realities in China so that these theories cannot explain that fiscal decentralization induced incentives to promote local economic growth in China. Our work fills a gap in the existing literature by providing an explanation of the existence of competition among

[36] In particular, Huther and Shah (1998), Fisman and Gatti (2002), Arikan (2004), Treisman (2000), Rodríguez-Pose and Krøijer (2009) or Enikolopov and Zhuravskaya (2007) in their studies of the effects of fiscal decentralization on governance, corruption, growth and political institutions.

[37] More precisely, we use the ratio of local government's public spending per capita over the total central government public spending per capita, for each province.

[38] Note that we tested the joint significance of the coefficients.

Chinese local governments despite the absence of electoral accountability and population mobility. We show that the central government created a yardstick competition among local officials by rewarding or punishing them on the basis of relative performance as voters do in democratic countries. In this context, information spillovers from neighboring local governments involve strategic interactions among governors. The empirical analysis validates our theoretical framework by emphasizing the existence of public spending interactions among Chinese local governments through the estimation of a spatial lag model for a panel data of 29 provinces from 1980 to 2004.

Generally, a necessary assumption for the existence of interjurisdictional competition is that local governments are directly elected by the constituents. Moreover, the fiscal decentralization process has to be total. In China, on the contrary, it is the centralized political system associated with the decentralized fiscal system which seems to ensure political accountability of local leaders and leads to competition between local authorities. Indeed, we formally show that principals can use yardstick competition to increase local agents' performance whether the principals are local voters or central leaders. Finally, an alternative explanation for local officials' increasing efforts to promote growth is the system's enduring centralization. We may wonder if control by the citizens is always more effective than control from the center.

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A Appendix

A.1 Theoretical framework

A.1.1 Proof of Lemma 1: Centralized fiscal system

- Strict dominance arguments rule out any equilibrium in which $G(C_i, b) = C_i$ as long as $\delta < 1$

$$\begin{aligned} E\left[V\left(C_i \left| C_i\right.\right)\right] &= 0 + \mu(C_i)\delta 2\Delta \\ &< E\left[V\left(C_i - 2\Delta \left| C_i\right.\right)\right] = 2\Delta + \mu(C_i - 2\Delta)\delta 2\Delta \end{aligned}$$

  If the central government observes $G_i = C_i$, it will always believe that the local government is good and reappoints him:

$$\mu(C_i) = 1. \tag{11}$$

- If the central government observes G_i smaller than C_i ($G_i = C_i - \Delta$ or $G_i = C_i - 2\Delta$), it will always believe that the local government is bad with probability 1, so, we have:

$$\mu(C_i - \Delta) = \mu(C_i - 2\Delta) = 0. \tag{12}$$

  Hence, we establish by applying strict dominance argument that local governments will never play $G_i = C_i - \Delta$ since

$$\begin{aligned} E\left[V\left(C_i - \Delta \left| C_i\right.\right)\right] &= \Delta + \mu(C_i - \Delta)\delta 2\Delta = \Delta \\ &< E\left[V\left(C_i - 2\Delta \left| C_i\right.\right)\right] = 2\Delta + \mu(C_i - 2\Delta)\delta 2\Delta = 2\Delta. \end{aligned}$$

  Indeed, playing $G_i = C_i - \Delta$ gets less rent with no gain in the probability of staying governor. Hence, a bad local governor will always sets

$$G_i = C_i - 2\Delta, \tag{13}$$

A.1.2 Proof of Lemma 2: Decentralized fiscal system without yardstick competition (with $p_L \geqslant 1/2$)

- First, we show that, by applying strict dominance arguments rule, we are always left with cases in which $G(\theta_H; b) = G_2$ or G_3 and $G(\theta_M; b) = G_3$ or G_4 and $G(\theta_L; b) = G_5$ and that $\mu(G_1) = 1$ and $\mu(G_4) = \mu(G_5) = 0$.

– Strict dominance arguments rule out any equilibrium in which $G(\theta_H; b) = G_1$, $G(\theta_M; b) = G_2$ and $G(\theta_L; b) = G_3$ as long as $\delta < 1$

$$\begin{aligned} E\left[V\left(G_1 \left|\theta_H\right.\right)\right] &= 0 + \mu(G_1)\delta 2\Delta \\ &< E\left[V\left(G_3 \left|\theta_H\right.\right)\right] = 2\Delta + \mu(G_3)\delta 2\Delta \end{aligned}$$

$$\begin{aligned} E\left[V\left(G_2 \left|\theta_M\right.\right)\right] &= 0 + \mu(G_2)\delta 2\Delta \\ &< E\left[V\left(G_4 \left|\theta_M\right.\right)\right] = 2\Delta + \mu(G_4)\delta 2\Delta \end{aligned}$$

$$\begin{aligned} E\left[V\left(G_3 \left|\theta_L\right.\right)\right] &= 0 + \mu(G_3)\delta 2\Delta \\ &< E\left[V\left(G_5 \left|\theta_L\right.\right)\right] = 2\Delta + \mu(G_5)\delta 2\Delta \end{aligned}$$

Hence, the central government will always believe that a local official who sets G_1 is good with probability 1. Indeed, the probability that a local government is good given a choice G_1 is

$$P\left[g \left|G_1\right.\right] = \frac{\gamma p_H}{\gamma p_H} = 1,$$

So that

$$\mu(G_1) = 1. \tag{14}$$

– If, the central government observes G_4 or G_5, it will always believe that the local official is bad with probability 1, or in other terms

$$P\left[g \left|G_4\right.\right] = P\left[g \left|G_5\right.\right] = 0,$$

and then we have

$$\mu(G_4) = \mu(G_5) = 0. \tag{15}$$

Hence, we establish by applying strict dominance argument that local governments will never play $G(\theta_L; b) = G_4$ since it gets less rent than playing G_5 with no gain in the probability of reappointment.

$$\begin{aligned} E\left[V\left(G_4 \left|\theta_L\right.\right)\right] &= \Delta + \mu(G_4)\delta 2\Delta = \Delta \\ &< E\left[V\left(G_5 \left|\theta_L\right.\right)\right] = 2\Delta + \mu(G_5)\delta 2\Delta = 2\Delta. \end{aligned}$$

A local government will always chooses

$$G(\theta_L; b) = G_5. \tag{16}$$

- Second, we consider the case where $p_L \geqslant 1/2$ and show that Proposition 2 defines a Perfect Bayesien Equilibrium

– Using Bayes' rule, if the central government observes G_3, it believes that a local governor is good with the following probability

$$P\left[g \left|G_3\right.\right] = \frac{\gamma p_L}{\gamma p_L + (1-\gamma)(p_H + p_M)}.$$

which is higher or equal to γ if $p_L \geqslant 1/2$, so that the central government is willing

to reappoint a local government who sets G_3, in other terms we have

$$\mu(G_3) = 1 \tag{17}$$

– Since by assumption $\delta > 1/2$, when θ_M a local government never finds it worthwhile to deviate from G_3 (Δ) to G_4 (2Δ) given that he will not then be reappointed.

$$\begin{aligned} E\left[V\left(G_4\left|\theta_M\right.\right)\right] &= 2\Delta + \mu(G_4)\delta 2\Delta = 2\Delta \\ &< E\left[V\left(G_3\left|\theta_M\right.\right)\right] = \Delta + \mu(G_3)\delta 2\Delta = \Delta + \delta 2\Delta \end{aligned}$$

So we have

$$G(\theta_M; b) = G_3. \tag{18}$$

– When θ_H, it is always worse off playing G_2 since it gets less rent than playing G_3 with no gain in the probability of reappointment (whether the central government reappoint a local government who sets G_2 or not).

$$\begin{aligned} E\left[V\left(G_2\left|\theta_H\right.\right)\right] &= \Delta + \mu(G_2)\delta 2\Delta \\ &< E\left[V\left(G_3\left|\theta_H\right.\right)\right] = 2\Delta + \mu(G_3)\delta 2\Delta = 2\Delta + \delta 2\Delta. \end{aligned}$$

So, we have

$$G(\theta_H; b) = G_3. \tag{19}$$

– Lastly, under the proposed strategy

$$P\left[g\left|G_2\right.\right] = \frac{\gamma p_M}{\gamma p_M} = 1.$$

So that

$$\mu(G_2) = 1 \tag{20}$$

- Third, we show that Proposition 2 defines the unique Perfect Bayesien Equilibrium when $p_L \geqslant 1/2$. After applying strict dominance arguments rule, we are left with cases in which $G(\theta_H; b) = G_2$ or G_3 and $G(\theta_M; b) = G_3$ or G_4. So, we have three other strategy profiles to consider:

  – $G(\theta_H; b) = G_2$ and $G(\theta_M; b) = G_3$. This strategy profile is not rational. A bad local government will reduce its rent and provide G_3 when θ_M only if the central government is willing to reappoint an official who sets G_3. Under the proposed strategy profile, using Bayes' rule, the central government will actually reappoint a local government who sets G_3 ($P\left[g\left|G_3\right.\right] = \frac{\gamma p_L}{\gamma p_L + (1-\gamma)p_M} \geqslant \gamma$ if $p_L \geqslant 1/2$). However, in this case, when θ_H, a bad local government will play G_3 since playing G_2 gets less rent with no gain in the probability of reappointment.

  – $G(\theta_H; b) = G_3$ and $G(\theta_M; b) = G_4$. This strategy profile cannot be rational given the belief system and the belief system consistent given the strategy profile. A bad local government will take a maximal rent and provide G_4 when θ_M only if the central government is not willing to reappoint a local government who sets G_3. But, under the proposed strategy profile, using Bayes' rule, the central government will reappoint an official who sets G_3 ($P\left[g\left|G_3\right.\right] = \frac{\gamma p_L}{\gamma p_L + (1-\gamma)p_H} \geqslant \gamma$ if $p_L \geqslant 1/2$).

– $G(\theta_H; b) = G_2$ and $G(\theta_M; b) = G_4$. Once again, as previously, a bad local government will provide G_4 when θ_M only if the central government is not willing to reappoint a local government who sets G_3. But, under the proposed strategy profile, using Bayes' rule, the central government will reappoint an official who sets G_3 ($P[g|G_3] = \frac{\gamma p_L}{\gamma p_L} = 1 > \gamma$).

The full characterization of the equilibrium is available upon request.

A.1.3 Proof of Lemma 3: Perfect Bayesian Equilibrium with yardstick competition (with $p_L \geqslant 1/2$)

Applying strict dominance arguments rule, we are left with cases in which $G(\theta_H; b) = G_2$ or G_3 and $G(\theta_M; b) = G_3$ or G_4 and $G(\theta_L; b) = G_5$ and we have $\mu(G_1) = 1$ and $\mu(G_4) = \mu(G_5) = 0$.

Both local governments are good

- Good local governors always play:

$$G(\theta_k; g) = t\theta_k,$$

So, we have

$$\left\{ \begin{array}{l} G(\theta_H; g|g) = t\theta_H = G_1, \\ G(\theta_M; g|g) = t\theta_M = G_2, \\ G(\theta_L; g|g) = t\theta_L = G_3. \end{array} \right\} \tag{21}$$

Both local governments are bad

- We consider the case where $p_L \geqslant 1/2$. Using Bayes' rule, if the central government observes G_3 in both jurisdictions, it believes that a local governor is good with the following probability

$$P[g|G_3|G_3] = \frac{\gamma^2 p_L}{\gamma^2 p_L + (1-\gamma)^2(p_H + p_M)}.$$

$P[g|G_3|G_3] \geqslant \gamma$ if $p_L \geqslant 1 - \gamma$ which is true since $\gamma > 1/2$. In this case, the central government is willing to reappoint a local government who sets G_3 if it observes G_3 in both jurisdictions

$$\mu(G_3|G_3) = 1 \tag{22}$$

- Since by assumption $\delta > 1/2$, when θ_M a local government does not find it worthwhile to raise its rent given that he will not then be reappointed. So we have

$$G(\theta_M; b|b) = G_3. \tag{23}$$

- When θ_H, playing G_2 gets less rent with no gain in the probability of reappointment so that

$$G(\theta_H; b|b) = G_3. \tag{24}$$

- Then, under the proposed strategy profile, if the central government observes G_2 in both jurisdictions, it believes that a local governor is good with the following probability

$$P\left[g\,|G_2|G_2\right] = \frac{\gamma^2 p_M}{\gamma^2 p_M} = 1.$$

So that

$$\mu(G_2\ |G_2) = 1 \tag{25}$$

One local government is good and the other is bad

- Good local governors always play: $G(\theta_k; g) = t\theta_k$. The bad official will be found out by providing a level of public spending above his neighbor's

$$\mu(t\theta_k - r_i\ |t\theta_k) = 0 \tag{26}$$

- Hence, the bad local government will always take the maximal rent when the product is medium or low:

  - If the central government observes G_3 in one jurisdictions and G_2 in another, it knows that the local governor who sets G_3 is bad. Now, playing G_3 when θ_M gets less rent with no gain in the probability of reappointment so that the bad local government plays:

$$G(\theta_M; b|g) = G_4. \tag{27}$$

  - If the central government observes G_2 in one jurisdictions and G_1 in another, it knows that the local governor who sets G_2 is bad. Playing G_2 when θ_L gets less rent with no gain in the probability of reappointment. The bad local government takes the maximal rent:

$$G(\theta_L; b|g) = G_3. \tag{28}$$

A.2 Empirical analysis

A.2.1 Descriptive statistics

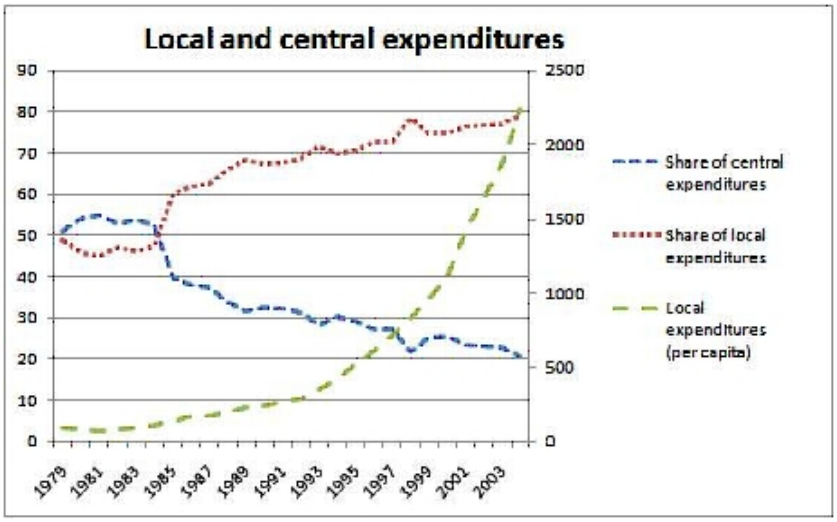

Figure 1: Local and central expenditures

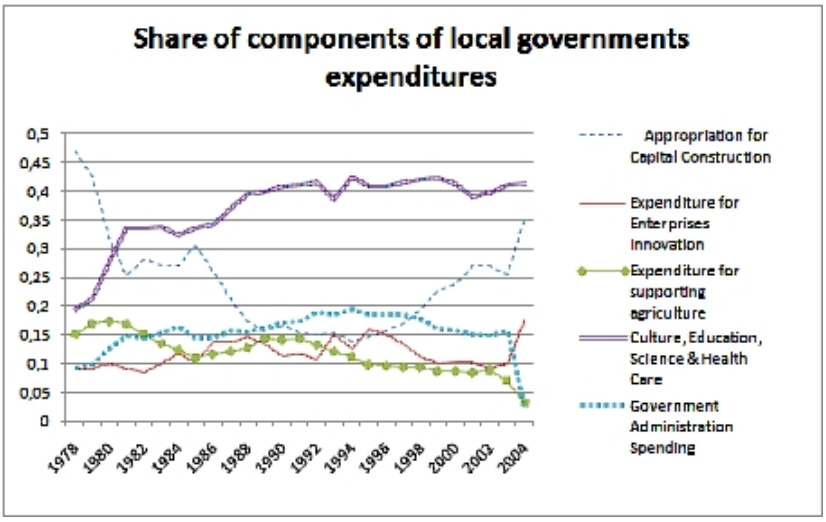

Figure 2: Share of components of local governments expenditures

A.2.2 Estimation results - Strategic interactions and complementarity of public expenditure

Table 2: Estimation results with LM and spatial tests

Dependent variable: Local Government expenditure				
Weighting scheme:	w_{ij}^{dist}		w_{ij}^{cont}	
Spending in j	0.659***	(0.10)	0.462***	(0.02)
Population density	-0.278	(0.18)	-1.600***	(0.33)
GDP growth rate	0.633***	(0.03)	-0.041	(0.06)
Urbanization rate	1.001***	(0.12)	1.559***	(0.25)
Trade openness	0.067***	(0.01)	0.015*	(0.01)
FDI inflow	0.960***	(0.13)	1.700	(2.60)
Trend	0.025*	(0.01)	-0.120***	(0.03)
Log-Likelihood	-377.17		-381.12	
LMlag (p-value)	12.33	(0.002)	11.02	(0.005)
LMerr (p-value)	1.35	(0.25)	1.25	(0.20)

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level.

We use ML-Estimation with specific effects. The robust Anselin tests for spatial lag dependence and for spatial error dependence are based on the Lagrange Mutiplier principle and require only the OLS residuals from the non-spatial model.

Table 3: Estimation results with GMM-System - Distance matrix

Dependent variable: Local Government expenditure							
Lagged dep.var	0.524***	0.573***	0.526***	0.452***	0.461***	0.490***	0.783***
	(0.07)	(0.08)	(0.08)	(0.08)	(0.13)	(0.12)	(0.08)
Spending in j	0.511***	0.459***	0.479***	0.550***	0.532***	0.596***	0.459**
	(0.07)	(0.07)	(0.07)	(0.07)	(0.12)	(0.15)	(0.20)
Population density	-0.203***	-0.184***	-0.164***	-0.196***	-0.178***	-0.166***	-0.006
	(0.04)	(0.04)	(0.02)	(0.02)	(0.04)	(0.04)	(0.03)
GDP growth rate		0.378***	0.283***	0.241*	0.181	0.172	0.144
		(0.11)	(0.10)	(0.12)	(0.12)	(0.12)	(0.15)
Urbanization rate			0.578**	0.431*	0.448*	0.417*	0.086
			(0.25)	(0.21)	(0.25)	(0.23)	(0.07)
Trade openness				2.169***	2.035**	1.844**	1.185
				(0.77)	(0.79)	(0.71)	(0.76)
FDI inflow					0.619*	0.805*	-0.518
					(0.34)	(0.40)	(0.51)
Central transfers							0.022**
							(0.01)
Trend						-0.013	-0.063**
						(0.01)	(0.03)
AR(1) test: p-value	0.001	0.000	0.001	0.001	0.019	0.010	0.017
AR(2) test: p-value	0.114	0.115	0.174	0.205	0.120	0.163	0.366
Hansen: p-value	0.139	0.227	0.220	0.278	0.114	0.142	0.169
Nb of instruments	23	26	27	28	26	27	27
Nb of units	29	29	29	29	29	29	29
Observations	745	741	705	689	574	574	191

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level. We use one-step robust GMM-Estimation. We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of population density, trend and urbanization rate. The weighted average vector of per capita public spending in other provinces is also instrumented by the weighted average of neighbors' control variables. We collapse instruments and limit its number.

Table 4: Estimation results with GMM-System - Contiguity and Placebo matrix

Weighting scheme:	w_{ij}^{cont}							w_{ij}^{plac}
Dependent variable:	Local Government expenditure							
Lagged dep.var	0.642***	0.763***	0.685***	0.768***	0.760***	0.768***	0.893***	0.894***
	(0.09)	(0.09)	(0.10)	(0.09)	(0.08)	(0.10)	(0.09)	(0.07)
Spending in j	0.395***	0.270***	0.335***	0.257***	0.240***	0.286***	0.258**	0.013
	(0.09)	(0.08)	(0.10)	(0.09)	(0.07)	(0.09)	(0.11)	(0.01)
Population density	-0.103***	-0.069*	-0.069*	-0.047*	-0.045*	-0.036	-0.047	-0.023
	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)
GDP growth rate		0.523***	0.491***	0.521***	0.434***	0.420***	0.085	0.389***
		(0.09)	(0.09)	(0.09)	(0.10)	(0.11)	(0.18)	(0.09)
Urbanization rate			0.361*	0.204*	0.242*	0.216*	0.083	0.104
			(0.16)	(0.11)	(0.12)	(0.12)	(0.09)	(0.08)
Trade openness				0.646	0.765**	0.668*	0.695	0.735**
				(0.44)	(0.35)	(0.38)	(0.71)	(0.34)
FDI inflow					-0.168	0.071	-1.66**	-0.009
					(0.27)	(0.36)	(0.72)	(0.37)
Central transfers							0.020**	
							(0.08)	
Trend						-0.005	-0.047*	0.016
						(0.01)	(0.02)	(0.01)
AR(1) test: p-value	0.001	0.000	0.001	0.000	0.000	0.000	0.015	0.000
AR(2) test: p-value	0.271	0.195	0.196	0.259	0.133	0.172	0.305	0.144
Hansen: p-value	0.170	0.165	0.208	0.155	0.283	0.213	0.225	0.070
Nb of instruments	23	26	27	28	26	27	27	27
Nb of units	29	29	29	29	29	29	29	29
Observations	721	717	685	675	572	572	191	574

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level. We use one-step robust GMM-Estimation. We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of population density, trend and urbanization rate. The weighted average vector of per capita public spending in other provinces is also instrumented by the weighted average of neighbors' control variables. We collapse instruments and limit its number.

A.2.3 Estimation results - Extension

Table 5: Estimation results with GMM-System for each category - Distance matrix

Weighting scheme: w_{ij}^{dist}					
Dependent variable:	Appropriation for capital construction	Enterprises innovation	Agriculture support	Social expenditures	Government administration
Lagged dep.var	0.665***	0.822***	0.763***	0.800***	0.812***
	(0.05)	(0.07)	(0.13)	(0.06)	(0.04)
Spending in j	0.353***	0.240***	0.169	0.160***	0.020
	(0.09)	(0.11)	(0.12)	(0.05)	(0.07)
Population density	-0.159***	-0.053	-0.122*	-0.044**	-0.057**
	(0.03)	(0.03)	(0.06)	(0.01)	(0.02)
GDP growth rate	0.338	0.547	0.483***	0.463***	0.537***
	(0.28)	(0.43)	(0.15)	(0.05)	(0.09)
Urbanization rate	0.245	0.201	-0.049	0.171*	0.097
	(0.23)	(0.31)	(0.08)	(0.08)	(0.06)
Trade openness	1.178	1.333	1.415**	1.08**	0.060
	(0.99)	(1.41)	(0.58)	(0.42)	(0.42)
FDI inflow	4.173***	1.414***	-1.513**	0.128	0.251
	(1.34)	(1.73)	(0.66)	(0.26)	(0.46)
Trend	-0.003	-0.004	0.018	0.007	0.025***
	(0.009)	(0.01)	(0.02)	(0.06)	(0.007)
AR(1) test: p-value	0.000	0.000	0.002	0.013	0.000
AR(2) test: p-value	0.359	0.127	0.563	0.158	0.293
Hansen test: p-value	0.122	0.402	0.201	0.172	0.097
Nb of instruments	27	27	27	27	27
Nb of units	28	28	28	28	28
Observations	550	502	546	550	555

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level. We use one-step robust GMM-Estimation. We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of population density, trend and urbanization rate. The weighted average vector of per capita public spending in other provinces is also instrumented by the weighted average of neighbors' control variables. We collapse instruments and limit its number.

Table 6: Estimation results with GMM-System for each category - Contiguity matrix

Weighting scheme: w_{ij}^{cont}					
Dependent variable:	Appropriation for capital construction	Enterprises innovation	Agriculture support	Social expenditures	Government administration
Lagged dep.var	0.710***	0.740***	0.742***	0.822***	0.738***
	(0.09)	(0.13)	(0.14)	(0.06)	(0.09)
Spending in j	0.251*	0.358*	0.123	0.055*	0.172
	(0.12)	(0.20)	(0.09)	(0.03)	(0.15)
Population density	-0.122***	-0.022	-0.120*	-0.038*	-0.068*
	(0.04)	(0.07)	(0.07)	(0.02)	(0.04)
GDP growth rate	-0.280	0.170	0.303*	0.540***	0.418***
	(0.32)	(0.61)	(0.24)	(0.09)	(0.12)
Urbanization rate	0.177	0.211	0.042	0.138**	0.093
	(0.19)	(0.36)	(0.10)	(0.05)	(0.12)
Trade openness	1.265	1.504	1.079*	1.011**	0.200
	(0.99)	(1.24)	(0.61)	(0.38)	(0.34)
FDI inflow	4.153**	2.536	-0.946	0.605	0.456
	(1.79)	(1.86)	(0.65)	(0.53)	(0.71)
Trend	0.007	-0.012	0.023	0.018**	0.014
	(0.01)	(0.014)	(0.01)	(0.008)	(0.01)
AR(1) test: p-value	0.001	0.013	0.008	0.034	0.010
AR(2) test: p-value	0.705	0.555	0.511	0.520	0.407
Hansen test: p-value	0.422	0.932	0.538	0.305	0.248
Nb of instruments	27	27	27	27	27
Nb of units	28	28	28	28	28
Observations	401	286	387	401	446

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level. We use one-step robust GMM-Estimation.. We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of population density, trend and urbanization rate. The weighted average vector of per capita public spending in other provinces is also instrumented by the weighted average of neighbors' control variables. We collapse instruments and limit its number.

A.2.4 Estimation results - Decentralization and strategic interactions.

Table 7: Estimation results with GMM-System for decentralization degree effect

Dependent variable: Local Government expenditure				
Weighting scheme:	(1) w_{ij}^{dist}	(2) w_{ij}^{cont}	(3) w_{ij}^{dist}	(4) w_{ij}^{cont}
Lagged dep. var.	0.690***	0.708***	0.643***	0.838***
	(0.07)	(0.10)	(0.07)	(0.05)
A_{jt}	0.783***	0.244***	0.619***	0.652**
	(0.22)	(0.06)	(0.12)	(0.03)
$(A_{jt} * C_{it})$	-0.031***	-0.011***		
	(0.007)	(0.003)		
$(A_{jt} * Dec_{it})$			0.288**	0.291**
			(0.10)	(0.11)
Population density	-0.072	0.029	-0.080**	-0.021
	(0.02)	(0.27)	(0.03)	(0.01)
GDP growth rate	0.169	-0.098	0.124	0.293***
	(0.15)	(0.13)	(0.09)	(0.07)
Urbanization rate	0.097	0.129*	0.146	0.087
	(0.09)	(0.07)	(0.10)	(0.05)
Trade openness	1.535***	1.608*	0.731	-0.334
	(0.64)	(0.79)	(0.49)	(0.44)
FDI inflow	-0.739	-1.012**	1.782***	0.421
	(0.56)	(0.42)	(0.47)	(0.43)
C_{it}	0.229***	0.112***		
	(0.04)	(0.03)		
Dec_{it}			-0.530	1.048*
			(0.53)	(0.55)
Trend	-0.066**	-0.019	-0.042***	-0.013*
	(0.03)	(0.02)	(0.01)	(0.007)
AR(1) test: p-value	0.003	0.030	0.006	0.000
AR(2) test: p-value	0.262	0.405	0.521	0.608
Hansen test: p-value	0.752	0.875	0.522	0.243
F-test: p-value	0.0006	0.0004	0.019	0.0001
Observations	191	191	454	454

Robust standard errors are in brackets.***: coefficient significant at 1 % level, **: at 5 % level, *: at 10 % level. We use one-step robust GMM-Estimation. We adopt the assumption of weak exogeneity of GDP growth rate, trade openness, foreign direct investment inflow and central government transfers and the assumption of strict exogeneity of population density, trend and urbanization rate. The weighted average vector of per capita public spending in other provinces is also