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Fiscal Relations between the Central and Local Governments in China and the Concepts of "Bao (Contract)" and "Bisai (Contest)": A Contract Theory Analysis◆

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Abstract

We use a contract theory/mechanism design framework to analyze the fiscal relations and reforms between the Central and Local governments in China, which are said to have made great contributions to economic growth since the "Economic Reform". First, we present the mechanism (a fiscal incentive contract model), which has created incentives for the development agent (Local government), and clarify theoretically how the concept of "Bao (Contract)" works. We then comprehend the concept of "Bisai (Contest)" within the framework of the yardstick competition between Local governments, and review the mechanism which encourages proper information revelation through intergovernmental comparison and competition. Lastly, we make a theoretical comparative analysis on the fiscal system reform (from the Fiscal Contracting system to the Tax Sharing system), from the perspective of how much room was left for the "Ratchet Effect" in the dynamic relation between the Central and Local governments, and how it was solved (or mitigated) in the two fiscal systems.

JEL: D82, D86, H11, H77

Key Words: Fiscal Contracting, Tax Sharing, Adverse Selection, Mechanism Design, Yardstick Competition, Ratchet Effect

Highlight

・Fiscal incentive contract which has created incentives for the development agent (Local government) in China and the concept of "Bao (Contract)".
・Yardstick competition between Local governments and the concept of "Bisai (Contest)".
・"Ratchet Effect" in the dynamic relation between Central and Local governments and the comparison of the solutions in the two fiscal systems (Fiscal Contracting system and Tax Sharing system).
・Enforcement through "Shading" as a Solution for the Ratchet and Renegotiation problems in the No Commitment environments.

1. Introduction

Since the "Economic Reform" in 1978, the Chinese economy has achieved significant growth. Based on previous studies (e.g., Oi(1992), Qian and Weingast(1996,1997), Jin., Qian and Weingast(2005)) that reported that the fiscal reforms between the Central and Local governments implemented from the 1980s to the 1990s made great contributions to China's economic growth, and taking a hint from the concepts of "**Bao 包(Contract)**" and "**Bisai 比賽 (Competition**, **Contest),**" we analyze the structure of the fiscal relations between the Central and Local governments by using mechanism design and contract theory as analytical tools.

First, we present the mechanism (**a fiscal incentive contract model**) that has created incentives for the development agent (Local government) and clarify theoretically how the concept of "Bao (**Contract**)" works. We then consider the concept of "Bisai (**Competition, Contest**)" within the framework of the yardstick competition between Local governments, and we review the mechanism that encourages proper information revelation through intergovernmental comparison and competition. Finally, we clarify theoretically how much room had (has) been left for the "**Ratchet Effect**" in the dynamic relation between the Central and Local governments by relating it to China's governance reform during the "Reform Era" (after "Reform and Door-opening"), especially fiscal system reform (from the Fiscal Contracting system to the Tax Sharing system), from the perspective of how it has been addressed in China.

Let us start by presenting the following table to gain a broad perspective of China's "Reform Era", that is, the periods after "Reform and Opening up in 1978".

Leader	**Deng Xiaoping**	**Jiang Zemin**	**Hu Jintao**
Period	1978－1992	1992－2002	2002－2012
Centralization vs. Decentralization	Decentralization, Deregulation	Centralization Reform Power of the Center	Redistribution, but Rising Inequality
Fiscal System	Fiscal Contracting System	Early-stage Contractual Tax sharing System	Latter-stage Tax Sharing System

Table1: China's "Reform Era"= since "Reform and Door-Opening"

- **Two Key Concepts: Contract 包 ("Bao") and Contest 比賽 ("Bisai")**

We insist that the two concepts Contract 包 ("Bao") and Contest 比賽 ("Bisai") play a key role in understanding and explaining the essential structure of the fiscal relations between the Central and Local governments in China.

Contract 包 (“Bao”)

The **Fiscal Contracting System** in table 1 was an arrangement under which a certain portion (a fixed amount or a fixed rate) of the national fiscal revenue collected by Local governments was paid to the Central government, the remainder being available for free spending by Local governments. This **Fiscal Contract agreement** implied that the more local economies grew, the more fiscal revenue they would receive, including money they could spend freely. Local governments, therefore, tried to make use of the authority they had obtained through decentralization and to work vigorously toward the region’s development and economic growth (see, e.g., Oi’s (1992) “Local State Corporatism” and Qian and Weingast’s (1996, 1997) “Market-Preserving Federalism, Chinese Style”).[1]

Competition, Contest 比賽 (“Bisai”)

The GDP growth rate of the jurisdictional region (e.g., province) was taken into account in reviewing personnel performance. **This promotional competition system** also incorporated the mechanism by which if they won, they were promoted, and if they lost, they were demoted. To be promoted or to remain in position, local executives had to keep producing higher performances, which means higher growth than other regions.

Because industrialization and economic growth were directly connected to increased income or the promotion of local executives in this way, greater efforts would be required on their part to promote economic development.[2] Thus, the local government-driven economic growth was (has been) realized (although high inflation also occurred, and regional gaps widened, as Miyake (2005) notes).

Based on such motivation, we first construct a fiscal incentive contract model between the Central (principal) and Local (agent) governments to explain how it has created incentives for the development agent (Local government), and we clarify theoretically how the concept of “Bao (**Contract**)” works. We then construct a framework of yardstick competition between the Local governments, review the mechanism that induces proper information revelation and incentives through comparison and competition, and uncover how the concept of “Bisai (**Competition, Contest**)” works.

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[1] Blanchard and Shleifer (2001) indicate that another ingredient is crucial, namely, political centralization. Its original idea comes from Riker (1964), who first developed the idea that for federalism to function and to be ensured, it must come with political centralization. Xu (2011) notes the importance of both political centralization and regional decentralization, which implies more than just fiscal decentralization.

[2] Based on a political science perspective, Miyake (2005) argues that the Central government could control the Local governments to a considerable degree through appropriately designing the promotion contest among regional leaders (local executives).

- **Ratchet Effect**

We further take note of the third concept, Ratchet Effect, in order to compare the two fiscal systems: Fiscal Contracting (1980~1993) and Tax Sharing (1994~). We use a dynamic contracting framework to present the comparative analysis, and we propose a new theoretical explanation.

"Fiscal contracting" (1980~93) was a system whereby Local governments would collectively tax (and collect taxes for the Central government) and allocate the tax revenue in accordance with the allocation decision drawn up between the Central and Local governments. However, there was no clear rule under which the Central and Local governments committed themselves to the decision on tax allocation, and there was also a possibility that it might be changed by mutual negotiation *ex post*. Thus, both governments failed to commit to the predetermined allocation ratio over a long-term period and instead "renegotiated" it later.

Hence, there were possibilities of a **"Ratchet effect"** and a **"Renegotiation problem"** posed by the dynamic contracting relation between the Central and Local governments, which generated a potential adverse effect inhibiting Local governments' proper ex-ante information revelation.

The **"Tax sharing system"** (1994~) fulfilled its **commitment** by carving up the share of the Central government clearly as a tax item, improving the predictability ("transparency") of the system, and diminishing the possibility of the ratchet effect. "Transparency" in the tax sharing system would be institutionally evaluated as an "aspect of **ex-ante commitment**".

Although there remained the possibility of a **"Ratchet Effect"** in theory under the **"Fiscal Contracting system"**, it would be natural to consider that it had been solved (or mitigated) by some kind of mechanism because the average GDP growth rate had been astonishing (9-10%) throughout the 1980s and until 1993, as the table below indicates.

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
%	7.91	5.20	9.10	10.90	15.20	13.50	8.80	11.60	11.30	4.10	3.84
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
%	9.18	14.24	13.96	13.08	10.93	10.01	9.30	7.83	7.62	8.43	8.30
Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
%	9.08	10.03	10.09	11.31	12.68	14.16	9.64	9.21	10.45	9.24	(8.23)

Table2:Real GDP Growth = Real Economic Growth Rate (1980～2012)

Black %: Fiscal Contracting Era (1980-1993) and Red %: Tax Sharing Era (1994-Present)

Taking notice that China's institutional structure is a combination of formality and informality, we present our two explanations based on the self-enforcement mechanism (a la Greif (1993) in Game Theory) and the shading mechanism (a la Hart-Moore (2008)) as its alternative.

The first self-enforcing mechanism is as follows. In the dynamic fiscal relation between the Central government and more than one Local government, if the Central government suddenly changed the tax rate (or tax amount) and cheated the Local governments, the Local governments would then walk off "their job as a tax collecting institution" from the next year, and the Central government would suffer retaliation in the form of Local governments not conducting the taxation work properly. Moreover, there was a possibility that information that the "Central government had behaved as a 'cheater'" might have spread to many other provinces, and various forms of objection and rejection might have occurred. Because it would entail a substantial cost on a long-term basis to renegotiate the fiscal contract *ex-post* and to cheat Local governments, the Central government voluntarily abstained from doing so. Being afraid of any future "retaliation" from more than one Local government, the Central government did not conduct any *ex-post* hold up (cheating by changing its taxation scheme), and it maintained cooperative behavior (tried not to deviate from the second-best commitment solution). This is a solution by a reputation mechanism for a "commitment problem" and is part of the "informal" governance mechanism within China's intergovernmental fiscal relation between the Central and Local governments.

As the second mechanism, we present the "Shading" mechanism a la Hart and Moore (2008). That is, after observing the hold-up or cheating by the Central government at the beginning of the second term, the local governments can "shade" (punish) the Central government by a constant times their "aggrievement" levels. When it is sufficiently large, the Central government, fearing being shaded, will not hold up (cheat) the Local governments, even though they have obtained this type of information from the first term outcome. This will, in turn, induce truthful information revelation in the first term. Thus, we show that the Ratchet and Renegotiation problems can be solved through the "Shading" Mechanism even under the No-Commitment environment in the "Fiscal contracting" regime (1980-1993). We believe our explanation of the enforcement mechanism through shading is new.

We also discuss the complementarity with Tax system reform. In the Fiscal Contracting era (1980-1993), the local tax collection bureau was in charge of both Central and Local government revenues. Thus, responding to the cheating (deviation) behavior by the Central government, the local tax collection bureau could "shade (punish)" the Central government severely by walking off the job as a tax collecting institution of the Central government, which could strengthen the enforcement mechanism by shading. That is, the Tax System in the "Fiscal contracting" era reinforced the enforcement mechanism by shading. As far as we know, this viewpoint on institutional complementarity is also novel.

This paper is constructed as follows. In section 2, we present our basic hidden-information framework of Fiscal Incentive Contract between the Central (Principal) and Local (Agent) Governments, solve the second best problem by the Central Government, and then link the optimal solution to the concept of "Bao" 包 (Contract). In section 3, we analyze the framework of the yardstick competition between the Local governments, show the information disclosure function through comparison and competition, and link it to the Concept of "Bisai 比賽 (Contest)". In section 4, we consider the dynamic contractual relation between the Central and Local Governments and analyze the possibility of the Ratchet Effect (dynamic time-inconsistency) and the Renegotiation Problem in the no-commitment environments. Then, we present its solution by a Self-enforcing mechanism and its alternative mechanism ("Shading") and discuss the link with the Tax system reform (implemented in the change from Fiscal Contracting to Tax Sharing). In Section 5, we conclude the paper.

2. Model Analysis

2.1 Fiscal Incentive Contract between the Central (Principal) and Local (Agent) Governments

Let the Central government be the Principal and the Local government be the Agent. The Local government has productivity θ; θ is either one of two types, high productivity $\overline{\theta}$ or low productivity $\underline{\theta}$, i.e. $\theta \in \left\{\underline{\theta}, \overline{\theta}\right\}$, and this is private information known only to the Local government.

The ratio of each type is $\lambda : 1-\lambda$, where $\lambda \in (0,1)$.

Let e be the effort for regional development by the Local government (which is the "actual working unit of the development governance"), which includes support for the local economic environment and various approaches to regional development.[3]

The output (GDP) Y of the region is,

$$Y = \theta + e \tag{1}$$

The fiscal revenue of the Local government is calculated by deducting the Tax paid to the Central government (the Central government share or fiscal revenue) T as below.

$$Y - T \tag{2}$$

When letting the fiscal contract between the Central and Local governments be $\{Y, T\}$ (a combination of GDP Y and the Tax paid to the Central government T), each type θ has to

[3] The role of Local government was important, such as acting to back up the activities of private companies.

choose its effort level $e = Y - \theta$ (from $Y = \theta + e$), and $C(e) = C(Y - \theta)$ represents the effort cost of the type θ agent when producing the output (GDP) Y. We assume the convexity of the effort cost function, i.e., $C'(Y-\theta) > 0, C''(Y-\theta) > 0$ is fulfilled.

Hence, **the payoff function for Local government** (**type θ agent**) is as below.[4]

$$\underbrace{Y - T}_{\text{Fiscal Revenue of Local Government}} - \underbrace{C(e)}_{\text{Effort Cost}} = Y - T - C(Y-\theta) = \underbrace{Y - C(Y-\theta)}_{\text{Total Surplus when type } \theta \text{ generates GDP } Y} - \underbrace{T}_{\text{Tax paid to Central Government}} \quad (3)$$

2.2 Perfect Information Solution (First Best Solution)

Fiscal contracts for each Local government of the two types (high productivity, low productivity) are $\{\overline{Y}, \overline{T}\}$ and $\{\underline{Y}, \underline{T}\}$. Under a complete information regime where the Central government knows the Local government's type $\theta \in \{\underline{\theta}, \overline{\theta}\}$, the Central government imposes a fiscal scheme that maximizes central fiscal revenue while satisfying the participation constraint of each type $Y - T - C(Y-\theta) \geq 0$. Thus, the problem is:

$$\max_{T} \; T \qquad s.t.\; Y - T - C(Y-\theta) \geq 0$$

The participation constraint has equality at the optimal solution ($T = Y - C(Y-\theta)$).

This results in total surplus maximization for each type: $\max_{Y} \; Y - C(Y-\theta)$

The first order condition for the optimality is $1 - C'(Y-\theta) = 0$, and marginal benefit and marginal cost are equalized for each type. For each type $\overline{\theta}, \underline{\theta}$, $1 = C'(\overline{Y} - \overline{\theta}) = C'(\underline{Y} - \underline{\theta})$ is fulfilled.

Therefore, the effort levels of each type are equal in the first best solution. $\overline{e}^{FB} = \underline{e}^{FB} = e^{FB}$
At this time, $\overline{Y}^{FB} = \overline{\theta} + e^{FB}, \underline{Y}^{FB} = \underline{\theta} + e^{FB}$, and the participation constraint is binding.
Therefore,

$$\overline{T}^{FB} = \overline{Y}^{FB} - C(\overline{Y}^{FB} - \overline{\theta}) = \overline{\theta} + e^{FB} - C(e^{FB})$$

[4] There are similarities with the formulation of Mirrlees' (1971) optimal taxation model.

$$\underline{T}^{FB} = \underline{Y}^{FB} - C\left(\underline{Y}^{FB} - \underline{\theta}\right) = \underline{\theta} + e^{FB} - C\left(e^{FB}\right)$$

Through the difference in the Taxes paid to the Central government ($\overline{T}^{FB} - \underline{T}^{FB} = \overline{\theta} - \underline{\theta}$), the payoff of each type is equalized at 0.

2.3 Asymmetric Information Environment, where there is asymmetric information concerning the type θ of the Local government (Agent)

The fiscal scheme to be imposed on each type with the first best solution is as below.

For type $\overline{\theta}$, $\{\overline{Y}^{FB} = \overline{\theta} + e^{FB}, \overline{T}^{FB} = \overline{\theta} + e^{FB} - C\left(e^{FB}\right)\}$

For type $\underline{\theta}$, $\{\underline{Y}^{FB} = \underline{\theta} + e^{FB}, \underline{T}^{FB} = \underline{\theta} + e^{FB} - C\left(e^{FB}\right)\}$

Under asymmetric information, it becomes a problem whether each agent has an incentive to reveal its type truthfully.

First, we check the incentive for the high productive type $\overline{\theta}$ to reveal its type information:

＊If he tells the truth, that is, when choosing his own menu, his payoff is 0 as is already shown.

＊If he chooses the contract for type $\underline{\theta}$ $\{\underline{Y}^{FB} = \underline{\theta} + e^{FB}, \underline{T}^{FB} = \underline{\theta} + e^{FB} - C\left(e^{FB}\right)\}$, that is when telling a lie, his payoff is $\underline{Y}^{FB} - \underline{T}^{FB} - C\left(\underline{Y}^{FB} - \overline{\theta}\right) = C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right) > 0$

Because the high productivity type $\overline{\theta}$ has an incentive to disguise himself as type $\underline{\theta}$, **both types result in choosing the menu {$\underline{Y}^{FB}$, $\underline{T}^{FB}$} for the low productive type $\underline{\theta}$.**[5]

We thus consider **an incentive-compatible fiscal contract** that gives the high productive type $\overline{\theta}$ an incentive to reveal its own information truthfully.

➢ **Incentive Constraint on the Local government of high productive type $\overline{\theta}$**

The incentive constraint for the high productive type $\overline{\theta}$ not to choose the scheme for the low productive type $\underline{\theta}$ is as follows.

$$\overline{Y} - \overline{T} - C\left(\overline{Y} - \overline{\theta}\right) \geq \underline{Y} - \underline{T} - C\left(\underline{Y} - \overline{\theta}\right) \tag{6}$$

[5] We can easily check that the low productivity type $\underline{\theta}$ does not have an incentive to choose the contract for type $\overline{\theta}$, i.e. $\overline{Y}^{FB} - \overline{T}^{FB} - C\left(\overline{Y}^{FB} - \underline{\theta}\right) = C\left(e^{FB}\right) - C\left(e^{FB} + \left(\overline{\theta} - \underline{\theta}\right)\right) < 0$

➢ **Participation Constraint** [6] **for the Local government of low productive type** $\underline{\theta}$

The participation (individual rationality) constraint for the low productive type $\underline{\theta}$ is as follows.

$$\underline{Y}-\underline{T}-C\left(\underline{Y}-\underline{\theta}\right)\geq 0 \tag{7}$$

2.3.1 Second-Best Optimal Solution

The optimization problem to be solved by the Central government (=the design problem of an optimal self-selection mechanism) is:

$$\max_{\substack{\{\bar{Y},\bar{T}\}\\ \{\underline{Y},\underline{T}\}}} \underbrace{\lambda\bar{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of high productivity } \bar{\theta}}} + \underbrace{(1-\lambda)\underline{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of low productivity } \underline{\theta}}}$$

Subject to $\bar{Y}-\bar{T}-C\left(\bar{Y}-\bar{\theta}\right)\geq \underline{Y}-\underline{T}-C\left(\underline{Y}-\bar{\theta}\right)$ (6)

------Incentive constraint for Local governments of the high productive type $\bar{\theta}$

$$\underline{Y}-\underline{T}-C\left(\underline{Y}-\underline{\theta}\right)\geq 0 \tag{7}$$

------Participation constraint for Local governments of the low productive type $\underline{\theta}$

At the optimal solution, the "participation constraint for the low productive type $\underline{\theta}$" is binding.

$$\underline{Y}-\underline{T}-C\left(\underline{Y}-\underline{\theta}\right)=0 \tag{7'}$$

Combining the "Incentive constraint for the high productive type $\bar{\theta}$" with the "(binding) participation constraint for the low productive type $\underline{\theta}$", we have

$$\bar{Y}-\bar{T}-C\left(\bar{Y}-\bar{\theta}\right)\geq \underline{Y}-\underline{T}-C\left(\underline{Y}-\bar{\theta}\right)=C\left(\underline{Y}-\underline{\theta}\right)-C\left(\underline{Y}-\bar{\theta}\right)$$

This is also binding at the optimal solution, so that

$$\bar{Y}-\bar{T}-C\left(\bar{Y}-\bar{\theta}\right)=C\left(\underline{Y}-\underline{\theta}\right)-C\left(\underline{Y}-\bar{\theta}\right) \tag{6'}$$

Therefore, Local governments of the high productive type $\bar{\theta}$ obtain the **information rent**

[6]We interpret the "participation constraint" for the local government such that the local government officials (including the executives) obtain the payoff 0 from outside opportunities by leaving the office.

$C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})$ at the optimum. This is a reward (a carrot) to encourage Local governments of the high productive type $\bar{\theta}$ to reveal the information $\bar{\theta}$ truthfully, and at the same time is a cost for Central government (in the form of lower tax revenue).

When $\underline{T} = \underbrace{\underline{Y}-C(\underline{Y}-\underline{\theta})}_{\text{Total Surplus generated by } \underline{\theta}}$ from (7') and

$\bar{T} = \underbrace{\bar{Y}-C(\bar{Y}-\bar{\theta})}_{\text{Total Surplus generated by } \bar{\theta}} \underbrace{-\{C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\}}_{\text{Information Rent}}$ from (6') are substituted into the objective function of the optimization problem, and then organized, we have

$$\underbrace{\lambda\cdot\bar{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of high productivity } \bar{\theta}}} + \underbrace{(1-\lambda)\cdot\underline{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of low productivity } \underline{\theta}}}$$

$$= \underbrace{\lambda\left[\bar{Y}-C(\bar{Y}-\bar{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of high productivity type } \bar{\theta}}} + \underbrace{(1-\lambda)\left[\underline{Y}-C(\underline{Y}-\underline{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of low productivity type } \underline{\theta}}} - \underbrace{\lambda\left[C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\right]}_{\substack{\text{Information rent given to}\\ \text{high productivity type } \bar{\theta}}}$$

∗The first order condition for the optimal solution $\bar{Y}$ for the high productive type $\bar{\theta}$ is,

$$1-C'(\bar{Y}-\bar{\theta})=0 \qquad (8)$$

and is consistent with the first best solution $\bar{Y}^{FB}$.

∗The optimal solution $\underline{Y}$ for the low productive type $\underline{\theta}$ reflects the balance between the first term and the second term below.

$$\max_{\{\underline{Y}\}} \underbrace{(1-\lambda)\left[\underline{Y}-C(\underline{Y}-\underline{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of low productivity type } \underline{\theta}}} - \underbrace{\lambda\left[C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\right]}_{\substack{\text{Information rent given to}\\ \text{high productivity type } \bar{\theta}}}$$

The first order condition for the optimality is

$$\underbrace{(1-\lambda)\left[1-C'(\underline{Y}-\underline{\theta})\right]}_{\substack{\text{Marginal total surplus with}\\ \text{Low productivity type } \underline{\theta}}} - \underbrace{\lambda\left[C'(\underline{Y}-\underline{\theta})-C'(\underline{Y}-\bar{\theta})\right]}_{\text{Marginal information rent}} = 0$$

$$\Leftrightarrow 1-C'(\underline{Y}-\underline{\theta}) = \frac{\lambda}{(1-\lambda)}\left[C'(\underline{Y}-\underline{\theta})-C'(\underline{Y}-\bar{\theta})\right] \qquad (9)$$

which means that the optimal solution $\underline{Y}$ should be chosen in a manner such that the increase in total surplus that a marginal growth of GDP $\underline{Y}$ of the low productive type $\underline{\theta}$ produces and the corresponding growth of the information rent (an increase in the cost incurred for having the information $\bar{\theta}$ revealed truthfully) are well-balanced.

From the above first order conditions, it is optimal to set the first best solution (***"Efficiency at***

Top") $\overline{e} = e^{FB}$ for the high productive type (8), and a "Low-powered" incentive which gives ***"Downward Distortion at Bottom"*** $\underline{e} < e^{FB}$ for the low productive type (9). In summary, we have:

Proposition 1[7]

The second-best fiscal contract under asymmetric information has the properties of

(1)*Efficiency at the top* (for the high productive type) $\overline{Y}^* = \overline{Y}^{FB} \Leftrightarrow \overline{e}^* = e^{FB}$

(2)*Downward distortion at the bottom* (for the low productive type) $\underline{Y}^* < \underline{Y}^{FB} \Leftrightarrow \underline{e}^* < e^{FB}$

The result of $\underline{Y}^* < \underline{Y}^{FB}$ for the low productive type $\underline{\theta}$ can be understood by looking at the below figure, which shows that the optimal solution $\underline{Y}^*$ is determined such that the marginal benefit 1 equals the marginal *virtual cost* (the marginal cost $\frac{\partial C(\underline{Y}-\underline{\theta})}{\partial \underline{Y}}$ plus the marginal information rent $\frac{\partial C(\underline{Y}-\underline{\theta})}{\partial \underline{Y}} - \frac{\partial C(\underline{Y}-\overline{\theta})}{\partial \underline{Y}}$ for the high productive type $\overline{\theta}$.

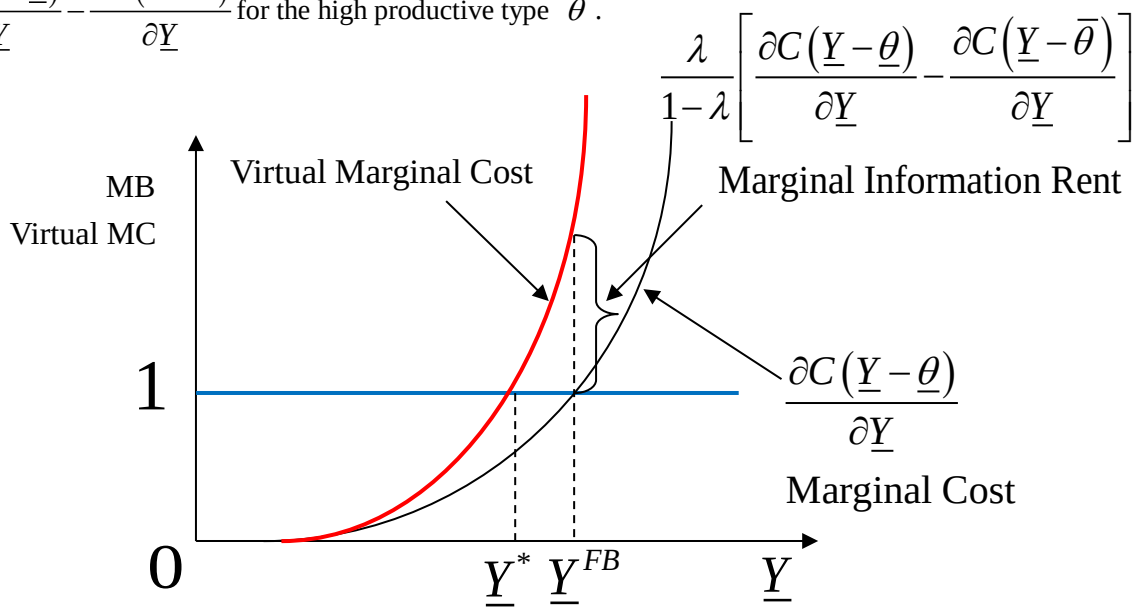

Figure 1: Optimal Solution $\underline{Y}^*$ for Low Productivity Type $\underline{\theta}$

The Concept of "Bao 包 (Contract)"

The concept of "Bao" 包 (Contract) can be understood better by exploring the optimal fiscal incentive contract between the Central and Local governments.

[7] This is a familiar result in the literature (e.g. Baron and Myerson (1982), Maskin and Riley (1984), and Bolton and Whinston (2005)).

First, by differentiating both sides of $\overline{T}=\overline{Y}-C\left(\overline{Y}-\overline{\theta}\right)-\left\{C\left(\underline{Y}-\underline{\theta}\right)-C\left(\underline{Y}-\overline{\theta}\right)\right\}$ by $\overline{Y}$, and combining the first order condition (8), we have $\overline{T}'\left(\overline{Y}^{FB}\right)=1-C'\left(\overline{Y}^{FB}-\overline{\theta}\right)=0$, which means that regarding Local governments of the high productive type (abundant regions), the marginal Tax paid to the Central government according to the marginal growth of GDP is zero at the optimum. It follows that $1-\overline{T}'\left(\overline{Y}^{FB}\right)=1$, which means that 100% of the marginal rate of the remainder of the local fiscal revenue belongs to the Local government of the high productive type (abundant regions).[8] That is, the high productive type $\overline{\theta}$ can receive 100% of the marginal benefit from GDP growth. This, in essence, is the same as the "100% piece-rate system".[9]

Next, by differentiating both sides of $\underline{T}=\underline{Y}-C\left(\underline{Y}-\underline{\theta}\right)$ by $\underline{Y}$ and combining the first order condition (9), we have $\underline{T}'\left(\underline{Y}\right)=1-C'\left(\underline{Y}-\underline{\theta}\right)=\frac{\lambda}{(1-\lambda)}\left[C'\left(\underline{Y}-\underline{\theta}\right)-C'\left(\underline{Y}-\overline{\theta}\right)\right]$

$\underline{T}'\left(\underline{Y}\right)>0$ means that regarding the low productive type $\underline{\theta}$, the marginal Tax paid to the Central government according to the marginal growth of GDP is positive. That is, Local governments cannot receive 100% of the marginal benefit of GDP growth, i.e., $1-\underline{T}'\left(\underline{Y}\right)<1$ and $\underline{T}'\left(\underline{Y}\right)$ flows to the Central government. Therefore, the marginal incentive also decreases $\underline{Y}^{*}\leq\underline{Y}^{FB}$ at the optimum. In summary, we have

Proposition2 The degree of "Bao" 包 (Contract) $b(\theta)$ can be understood as **the marginal rate of the local fiscal revenue**. It increases in the productivity type θ at the optimum, as follows.

$$b(\theta)=1-T'\left(Y^{*}(\theta)\right)=\begin{cases}1-\overline{T}'\left(\overline{Y}^{FB}\right)=1 \text{ for } & \theta=\overline{\theta}\\ 1-\underline{T}'\left(\underline{Y}^{*}\right)<1 \text{ for } & \theta=\underline{\theta}\end{cases}$$

The theoretical intuition behind this proposition is as follows. To maximize the expected total surplus (efficiency), the Central government should set the GDP for the low productivity region $\underline{\theta}$

[8] The concept of "Bao" 包 works similarly in the "Household contract responsibility" system, which began in rural areas in 1978. The system introduced market incentives to agricultural production and resulted in a dramatic increase in agricultural productivity. See, McMillan, J. (1992) and McMillan, J. et al. (1989).

[9] Jin, Qian, and Weingast (2005) found a high marginal piece-rate value of 0.8~0.9 in 1989-1993 (later "Fiscal contracting" period).

at the first best level $\underline{Y}^* = \underline{Y}^{FB}$. However, the Central government must then give up the larger information rent for the high productive type $\overline{\theta}$. As an optimal solution to the trade-off between the GDP for the low productivity region $\underline{\theta}$ and the information rent for the high productive region $\overline{\theta}$, the Central government induces the lower GDP $\underline{Y}^* < \underline{Y}^{FB}$ for the low productivity region $\underline{\theta}$, which is a *second-order* loss, but attains the Tax increase through reducing the information rent for the high productive region $\overline{\theta}$, which is a *first-order* gain. To induce the lower GDP $\underline{Y}^* < \underline{Y}^{FB}$, the Central government adopts a less-than 100% "Bao" (Contract) $b\left(\underline{\theta}\right) < 1$, that is, a lower-powered incentive scheme for the low productivity local government $\underline{\theta}$.[10]

2.3.2 Graphical Explanation

The objective function of the Local government (agent of type θ) is

$$U\left(Y,T:\theta\right) = Y - T - C\left(Y-\theta\right)$$

and this draws an indifference curve of type θ on the $\left(Y,T\right)$ plane.

We obtain a marginal rate of substitution for type θ $MRS_{YT}^{\theta} = \left.\frac{dT}{dY}\right|_{U=\text{const.}} = 1 - C'\left(Y-\theta\right)$.

The first order condition for the optimality which characterizes the first best solution is $1 - C'\left(Y-\theta\right) = 0$, from which we define $Y - \theta = e^{FB}$. This then proves that at the first best solution, the effort levels of each type are equal $\overline{e}^{FB} = \underline{e}^{FB} = e^{FB}$, and since $\overline{Y}^{FB} - \underline{Y}^{FB} = \overline{\theta} - \underline{\theta}$, the difference in GDP level is only the difference in the productive type. In this case, as

$$MRS_{YT}^{\theta} = 1 - C'\left(Y-\theta\right)\begin{cases} > 0 & if \;\; Y < \theta + e^{FB} \\ = 0 & if \;\; Y = \theta + e^{FB} \\ < 0 & if \;\; Y > \theta + e^{FB} \end{cases}$$

shows, the indifference curve of each type θ reaches its peak at the first best GDP level

[10] This argument is based on the (standard) assumption that the Central government maximizes only its own expected payoff and does not put any weight on the Local governments' payoffs. In the appendix, we examine the optimal solution when the Central Government is altruistic and puts a positive weight on the high productivity type's payoff.

$Y^{FB} = \theta + e^{FB}$ and becomes an upward-convex symmetric parabola (see diagram below). The first best solutions are L and H in the diagram.

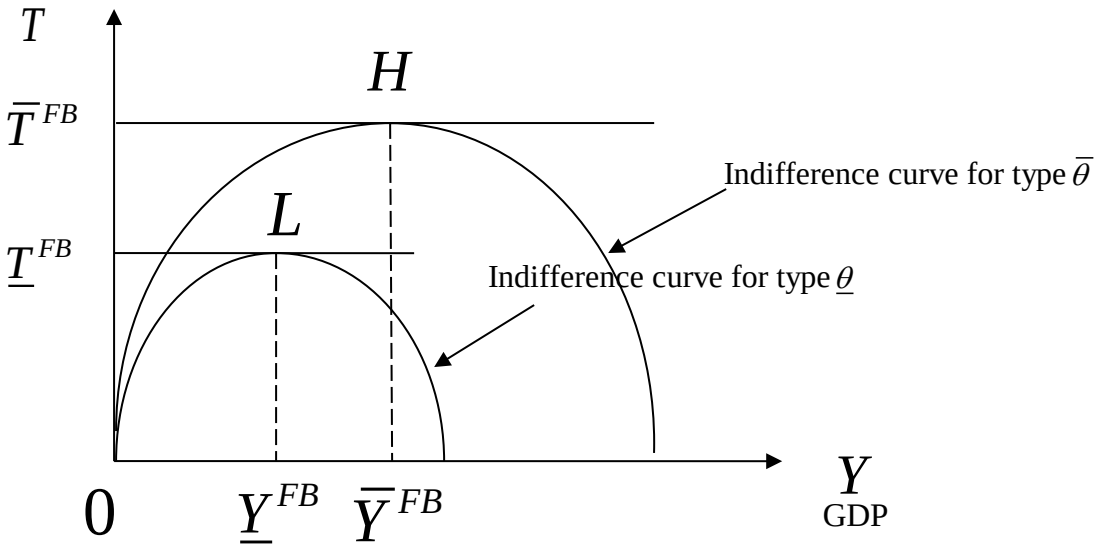

Figure 2: Indifference Curves and First Best Solutions for both types $\underline{\theta}$ and $\overline{\theta}$

Under perfect information, the Central government is able to identify type information, such that it can assign and enforce the point L in the diagram to type $\underline{\theta}$ and the point H to type $\overline{\theta}$.

However, <u>under asymmetric information</u> as in the diagram below, the gain will be higher by $C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)$ if the high productive type $\overline{\theta}$ chooses point L instead of point H, and this produces an incentive to disguise its information as being the low productive type $\underline{\theta}$.

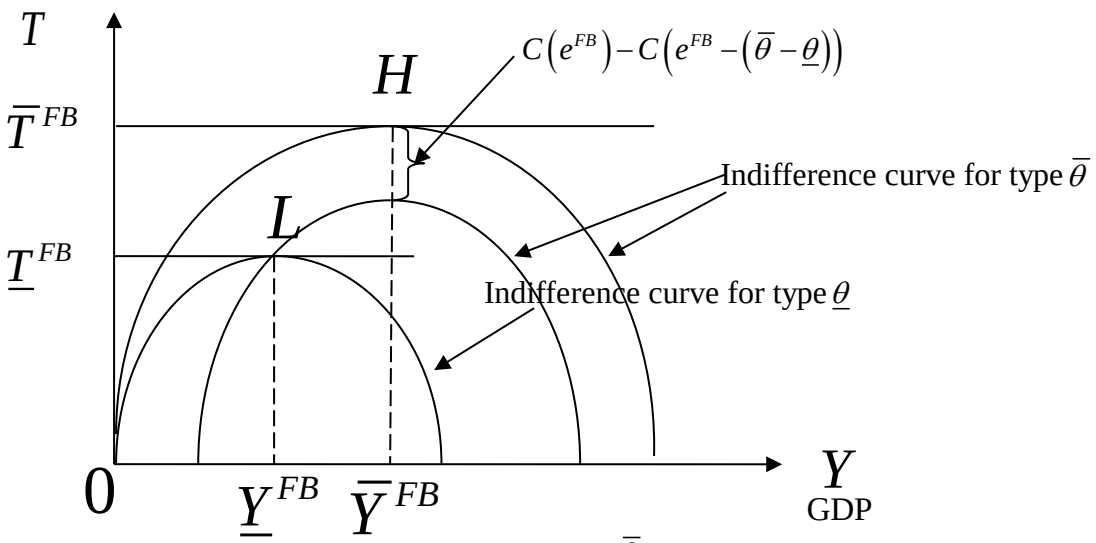

Figure 3: Incentive for high productive type $\overline{\theta}$ to choose point L

This will result in lowering the tax revenue of the Central government ($\overline{T}^{FB} - \underline{T}^{FB} = \overline{\theta} - \underline{\theta}$). Therefore, the Central government gives up the first best solution, offers the two contract menus $\{L', H'\}$ as shown below, elicits true information by inducing type $\underline{\theta}$ to choose L', and type $\overline{\theta}$ to choose H', and achieves a payoff increase.

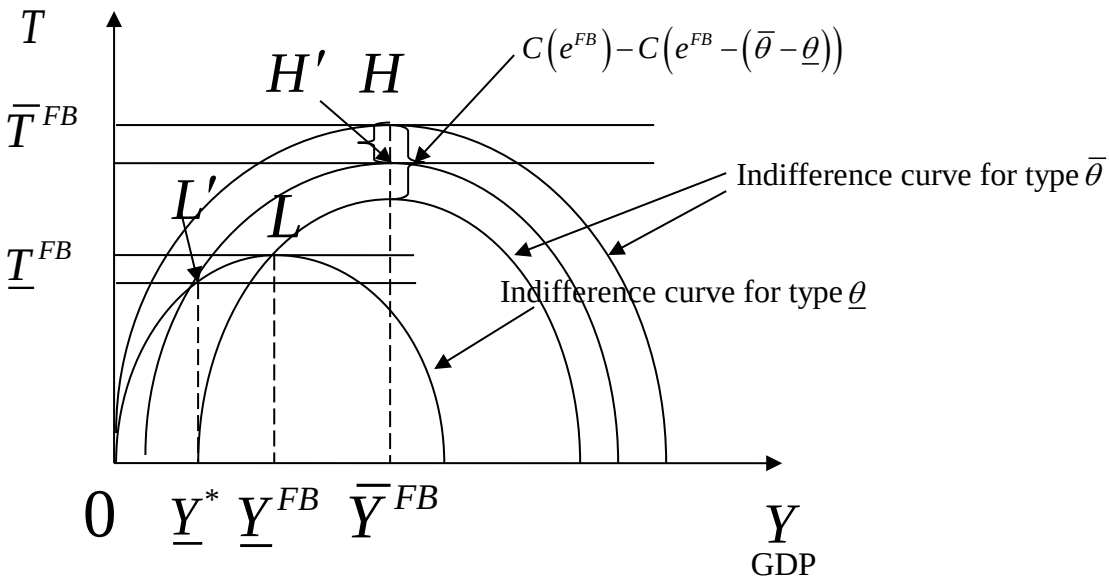

Figure 4: Second Best Solutions H' and L'

At point H', because $T'\left(\overline{Y}^{FB}\right) = 0$, the rate to be paid to the Central government according to the marginal growth of the regional GDP is zero, and with $1 - T'\left(\overline{Y}^{FB}\right) = 1$ being virtually the same as **a "100% piece-rate system,"** 100% of the marginal GDP growth belongs to the Local government. Therefore, an incentive for the first best solution is derived ("Efficiency at Top").

Conversely, because $T'\left(\underline{Y}^*\right) > 0$, Local governments **cannot receive 100% of the marginal result of GDP growth** at point L', and the portion $T'\left(\underline{Y}^*\right)$ flows to the Central government**.** Thus, the derived marginal incentive also decreases ("Downward Distortion at Bottom").

3. Competition between Local Governments: the Yardstick Mechanism in Correlated Environments

The Concept of "Bisai 比賽 (Contest)"

It is also said that "**Bao 包(Contract)" and "Bisai 比賽 (Competition)" function in combination within the relation between the Central and Local governments** as an institutional basis of the Chinese economy after "reform and opening-up." Now, 比賽 (Competition) will be analyzed within the framework of the yardstick competition between the Local governments to show the information disclosure function through comparison and competition.

In the case where productivity information is "perfectly correlated"[11] between two regions, truth-telling (honest revelation of productivity) can be achieved as a dominant strategy equilibrium by generating a **"Prisoner's Dilemma"** game of information revelation. In equilibrium, there is no need to give informational rent to the Local government, and the first best solution can be achieved. Even when the situation is not in perfect correlation but is close to it, informational rent could be decreased and efficiency increased, compared with the case without comparison and competition.

The private information $\left(\theta_i, \theta_j\right)$ of Local governments i, j are perfectly correlated, i.e.

$$\left(\theta_i, \theta_j\right) = \begin{cases} \left(\overline{\theta}, \overline{\theta}\right) & \text{with prob. } \lambda \\ \left(\underline{\theta}, \underline{\theta}\right) & \text{with prob. } 1-\lambda \end{cases}$$

$Y_i - T_i\left(Y_i, Y_j\right) - C\left(Y_i - \theta_i\right)$ is the payoff function of Local government i in the case where the Local government i (type θ_i) achieves Y_i (GDP), and Local government j (type θ_j) achieves Y_j (GDP). $T\left(Y_i, Y_j\right)$ is the tax amount paid to the Central government (Taxation). Hence, we can regard $T\left(Y_i, Y_j\right)$ as a "**Fiscal contract**" proposed by the Central government.[12]

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[11] We can generalize it to a more general setting, including imperfect correlation. Although a possible framework would be an optimal auction model, it seems to be rather difficult for the Central government (the State) to design the elaborate optimal auction-type mechanism ex ante and commit to it. In other words, some contract incompleteness would accompany the concept of "Bisai" (Contest) and its mechanism.

[12] We describe the relationship between the central and local governments by the contract theory framework that assumes players are independent entities, according to the "Local State Corporatism" of Oi (1992), rather than by a hierarchical relationship in an organization.

$$T_i\left(Y_i,Y_j\right)=\begin{cases}\bar{\theta}+e^{FB}-C\left(e^{FB}\right) & \text{if } \left(Y_i,Y_j\right)=\left(\bar{Y}^{FB},\bar{Y}^{FB}\right)\\ \underline{\theta}+e^{FB}-C\left(e^{FB}\right) & \text{if } \left(Y_i,Y_j\right)=\left(\underline{Y}^{FB},\underline{Y}^{FB}\right)\\ \underbrace{\bar{\theta}+e^{FB}-C\left(e^{FB}\right)}_{\text{FB total surplus for type}\bar{\theta}}-\underbrace{\left[C\left(e^{FB}\right)-C\left(e^{FB}-\left(\bar{\theta}-\underline{\theta}\right)\right)+\Delta\right]}_{\text{Information Rent}+\Delta} & \text{if } \left(Y_i,Y_j\right)=\left(\bar{Y}^{FB},\underline{Y}^{FB}\right)\\ \underbrace{\underline{\theta}+e^{FB}-C\left(e^{FB}\right)}_{\text{FB total surplus for type}\underline{\theta}}+\underbrace{\left[C\left(e^{FB}\right)-C\left(e^{FB}-\left(\bar{\theta}-\underline{\theta}\right)\right)+\Delta\right]}_{\text{Information Rent}+\Delta} & \text{if } \left(Y_i,Y_j\right)=\left(\underline{Y}^{FB},\bar{Y}^{FB}\right)\end{cases}$$

The point of this scheme is **the side transfer (payoff transfer) from** the Local government **with a low GDP** $\underline{Y}^{FB}$ **(**$\underline{\theta}$ **reported) to** the Local government with a **high GDP** $\bar{Y}^{FB}$ **(**$\bar{\theta}$ **reported).** This scheme incorporates the payoff change, the term Δ, due to the promotion/demotion of the local executives (officials) based on the relative outcome of the regional growth (GDP) competition. As a whole, therefore, we can interpret the model of this section as a contest model to incorporate the incentive effect of yardstick competitions.[13]

First, we explore the incentive of the local government of type $\theta_i=\bar{\theta}$ in the state $\left(\bar{\theta},\bar{\theta}\right)$ under the above scheme. His payoff function is written as $Y_i-T_i\left(Y_i,Y_j\right)-C\left(Y_i-\bar{\theta}\right)$, which is the payoff when the Local government of type $\theta_i=\bar{\theta}$ chooses the output (GDP) Y_i given that the other Local government chooses the output (GDP) Y_j.

*Suppose that the other Local government $\theta_j=\bar{\theta}$ chooses the low output $\underline{Y}^{FB}$.

Then, if the Local government $\theta_i=\bar{\theta}$ chooses the low output $\underline{Y}^{FB}$, he will obtain the payoff

$$\underline{Y}^{FB}-T_i\left(\underline{Y}^{FB},\underline{Y}^{FB}\right)-C\left(\underline{Y}^{FB}-\bar{\theta}\right)=C\left(e^{FB}\right)-C\left(e^{FB}-\left(\bar{\theta}-\underline{\theta}\right)\right).$$

If the Local government $\theta_i=\bar{\theta}$ chooses the high output $\bar{Y}^{FB}$, he will obtain the payoff

[13] Li and Zhou (2005) empirically show that in China, the government official promotion process resembles a tournament, and the final decision is mainly based on relative performance in economic growth. The contest model of this section would be suitable for such situations.

$$\bar{Y}^{FB} - T_i\left(\bar{Y}^{FB}, \underline{Y}^{FB}\right) - C\left(\bar{Y}^{FB} - \bar{\theta}\right)$$
$$= \bar{\theta} + e^{FB} - \left\{\bar{\theta} + e^{FB} - C\left(e^{FB}\right) - \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]\right\} - C\left(e^{FB}\right)$$
$$= C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta .$$

Hence, the Local government $\theta_i = \bar{\theta}$ has an incentive to choose the high output (GDP) $\bar{Y}^{FB}$.

*Next, suppose that the other Local government $\theta_j = \bar{\theta}$ chooses the high output (GDP) $\bar{Y}^{FB}$.

Then, if the Local government $\theta_i = \bar{\theta}$ chooses the low output (GDP) $\underline{Y}^{FB}$, he will obtain the payoff

$$\underline{Y}^{FB} - T_i\left(\underline{Y}^{FB}, \bar{Y}^{FB}\right) - C\left(\underline{Y}^{FB} - \bar{\theta}\right)$$
$$= \underline{\theta} + e^{FB} - \left\{\underline{\theta} + e^{FB} - C\left(e^{FB}\right) + \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]\right\} - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right)$$
$$= -\Delta$$

If the Local government $\theta_i = \bar{\theta}$ chooses the high output (GDP) $\bar{Y}^{FB}$, he will obtain the payoff

$$\bar{Y}^{FB} - T_i\left(\bar{Y}^{FB}, \bar{Y}^{FB}\right) - C\left(\bar{Y}^{FB} - \bar{\theta}\right) = 0 .$$

Hence, the Local government $\theta_i = \bar{\theta}$ has an incentive to choose the high output $\bar{Y}^{FB}$. That is, regardless of the other player $\theta_j = \bar{\theta}$'s choices, the Local government $\theta_i = \bar{\theta}$ has a strict incentive to choose the high output $\bar{Y}^{FB}$.

The incentive structure of the Local government $\theta_j = \bar{\theta}$ is also the same. Regardless of the other player $\theta_i = \bar{\theta}$'s choices, the Local government $\theta_j = \bar{\theta}$ has a strict incentive to choose the high output $\bar{Y}^{FB}$. The choice of $\bar{Y}^{FB}$ is the dominant strategy for the agent $\theta_j = \bar{\theta}$.

The payoff matrix is as follows.

Note that perfect correlation of the private information $\left(\theta_i, \theta_j\right) = \left(\bar{\theta}, \bar{\theta}\right)$ can be relaxed. Essentially, as the payoff matrix shows, the Central government places the two Local governments in a ***prisoner's dilemma*** game. By exploiting this structure, the Central government can implement the

full information first best optimum in the unique dominant strategy equilibrium.[14]

$\theta_i = \overline{\theta}$ \ $\theta_j = \overline{\theta}$	$\underline{Y}^{FB}$	$\overline{Y}^{FB}$
$\underline{Y}^{FB}$	$C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)$ $C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)$	$C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right) + \Delta$ $-\Delta$
$\overline{Y}^{FB}$	$-\Delta$ $C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right) + \Delta$	**0** **0**

Table 3: Incentive Structure for High Productivity Types $\left(\overline{\theta}, \overline{\theta}\right)$

Next, we explore the incentive of the agent of type $\theta_i = \underline{\theta}$ in the state $\left(\underline{\theta}, \underline{\theta}\right)$. His payoff function is written as $Y_i - T_i\left(Y_i, Y_j\right) - C\left(Y_i - \underline{\theta}\right)$ when the Local government $\theta_i = \underline{\theta}$ chooses the output (GDP) Y_i given that the other Local government chooses the output (GDP) Y_j.

*Suppose that the other Local government $\theta_j = \underline{\theta}$ chooses the low output $\underline{Y}^{FB}$.

Then, if the Local government $\theta_i = \underline{\theta}$ chooses the low output $\underline{Y}^{FB}$, he will obtain the payoff

$$\underline{Y}^{FB} - T_i\left(\underline{Y}^{FB}, \underline{Y}^{FB}\right) - C\left(\underline{Y}^{FB} - \underline{\theta}\right) = \underline{\theta} + e^{FB} - \left[\underline{\theta} + e^{FB} - C\left(e^{FB}\right)\right] - C\left(e^{FB}\right) = 0.$$

If the Local government $\theta_i = \underline{\theta}$ chooses the high output $\overline{Y}^{FB}$, he will obtain the payoff

[14] A key problem in the design of optimal contracts in correlated environments is the possibility of *multiple equilibria* in the subgame played by the parties whose private information is correlated. As noted by Demski and Sappington (1984), multiple equilibria do not pose a problem when the private information is *perfectly correlated*. Shleifer (1985) presents a theory of Yardstick Competition in the perfect correlation environment in the regulation context.

$$\bar{Y}^{FB} - T_i\left(\bar{Y}^{FB}, \underline{Y}^{FB}\right) - C\left(\bar{Y}^{FB} - \underline{\theta}\right)$$
$$= \bar{\theta} + e^{FB} - \left\{\bar{\theta} + e^{FB} - C\left(e^{FB}\right) - \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]\right\} - C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right)$$
$$= C\left(e^{FB}\right) + \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right] - C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right)$$
$$= \underbrace{2\left[C\left(e^{FB}\right) - \frac{C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right)}{2}\right]}_{-} + \Delta$$

The negative sign is due to the convexity of the cost function $C' > 0, C'' > 0$.

Hence, the Local government $\theta_i = \underline{\theta}$ has an incentive to choose the low output (GDP) $\underline{Y}^{FB}$ if Δ is sufficiently small.

*Next, suppose that the other Local government $\theta_j = \underline{\theta}$ chooses the high output (GDP) $\bar{Y}^{FB}$.Then,

if the Local government $\theta_i = \underline{\theta}$ chooses the low output (GDP) $\underline{Y}^{FB}$, he will obtain the payoff

$$\underline{Y}^{FB} - T_i\left(\underline{Y}^{FB}, \bar{Y}^{FB}\right) - C\left(\underline{Y}^{FB} - \underline{\theta}\right)$$
$$= \underline{\theta} + e^{FB} - \left\{\underline{\theta} + e^{FB} - C\left(e^{FB}\right) + \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]\right\} - C\left(e^{FB}\right)$$
$$= -\left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]$$

If the agent $\theta_i = \underline{\theta}$ chooses the high output $\bar{Y}^{FB}$, he will obtain the payoff

$$\bar{Y}^{FB} - T_i\left(\bar{Y}^{FB}, \bar{Y}^{FB}\right) - C\left(\bar{Y}^{FB} - \underline{\theta}\right)$$
$$= \bar{\theta} + e^{FB} - \left[e^{FB} + e^{FB} - C\left(e^{FB}\right)\right] - C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right) = C\left(e^{FB}\right) - C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right) < 0.$$

Taking the difference of the payoffs, we have

$$C\left(e^{FB}\right) - C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right) + \left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + \Delta\right]$$
$$= \underbrace{2\left[C\left(e^{FB}\right) - \frac{C\left(e^{FB} - \left(\bar{\theta} - \underline{\theta}\right)\right) + C\left(e^{FB} + \left(\bar{\theta} - \underline{\theta}\right)\right)}{2}\right]}_{-} + \Delta$$

Thus, the Local government $\theta_i = \underline{\theta}$ has a strict incentive to choose the low output $\underline{Y}^{FB}$, or it has no

incentive to deviate from $\underline{Y}^{FB}$ to $\overline{Y}^{FB}$, if $\Delta(>0)$ is sufficiently small.

Thus, regardless of the other Local government $\theta_j = \underline{\theta}$'s choices, the Local government $\theta_i = \underline{\theta}$ has an incentive to choose the low output $\underline{Y}^{FB}$, if $\Delta(>0)$ is sufficiently small. The choice of $\underline{Y}^{FB}$ is the dominant strategy for the low productivity Local government $\theta_i = \underline{\theta}$.

The incentive structure of the agent $\theta_j = \underline{\theta}$ is the same. Regardless of the other player $\theta_i = \underline{\theta}$'s choices, the Local government $\theta_j = \underline{\theta}$ has a strict incentive to choose the low output $\underline{Y}^{FB}$, if $\Delta(>0)$ is sufficiently small. The choice of $\underline{Y}^{FB}$ is the dominant strategy for the low productivity Local government $\theta_i = \underline{\theta}$. The payoff matrix is as below.

$\theta_j = \underline{\theta}$ \ $\theta_i = \underline{\theta}$	$\underline{Y}^{FB}$	$\overline{Y}^{FB}$
$\underline{Y}^{FB}$	0 0	$\underbrace{2\left[C\left(e^{FB}\right)-\frac{C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)+C\left(e^{FB}+\left(\overline{\theta}-\underline{\theta}\right)\right)}{2}\right]}_{-}\underbrace{+\Delta}_{+}<0\ (?)$ $-\left[C\left(e^{FB}\right)-C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)+\Delta\right]<0$
$\overline{Y}^{FB}$	$-\left[C\left(e^{FB}\right)-C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)+\Delta\right]<0$ $\underbrace{2\left[C\left(e^{FB}\right)-\frac{C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)+C\left(e^{FB}+\left(\overline{\theta}-\underline{\theta}\right)\right)}{2}\right]}_{-}\underbrace{+\Delta}_{+}<0\ (?)$	$C\left(e^{FB}\right)-C\left(e^{FB}+\left(\overline{\theta}-\underline{\theta}\right)\right)<0$ $C\left(e^{FB}\right)-C\left(e^{FB}+\left(\overline{\theta}-\underline{\theta}\right)\right)<0$

Table 4: Incentive Structure for Low Productivity Types $(\underline{\theta},\underline{\theta})$

Perfect correlation of the private information $(\theta_i,\theta_j)=(\underline{\theta},\underline{\theta})$ can also be relaxed here. As the

payoff matrix shows, the Central government places the two Local governments in a *prisoner's dilemma* game, thereby implementing the full information first best optimum in the unique dominant strategy equilibrium at no incentive cost.

Summarizing the arguments so far, we have:

Proposition3:

Under *perfect correlation* of the private information of the two agents, the Central government can implement the full information first best optimum in the unique dominant strategy equilibrium[15], without giving any information rent. Equilibrium contracts are Pareto efficient in both states $\left(\overline{\theta},\overline{\theta}\right)$ and $\left(\underline{\theta},\underline{\theta}\right)$, if $\Delta\left(>0\right)$ is sufficiently small.

Numerical Example

Taking into consideration the convexity of the cost function, we set

$$C\left(e^{FB}\right)-C\left(e^{FB}-\Delta\theta\right)=4,\ C\left(e^{FB}+\Delta\theta\right)-C\left(e^{FB}\right)=8,\ \Delta=1.$$

We then have the following numerical examples, where the structure of the $\left(\overline{\theta},\overline{\theta}\right)$ game is a prisoner's dilemma and truth-telling is the dominant strategy.

High Productivity Type $\left(\overline{\theta},\overline{\theta}\right)$

Each Strategy	$\underline{\theta}$ (Lie)	$\overline{\theta}$ (Truth)
$\underline{\theta}$ (Lie)	4,4	−1,5
$\overline{\theta}$ (Truth)	5,−1	0,0

Low Productivity Type $\left(\underline{\theta},\underline{\theta}\right)$

Each Strategy	$\overline{\theta}$ (Lie)	$\underline{\theta}$ (Truth)
$\overline{\theta}$ (Lie)	−8,−8	−3,−5
$\underline{\theta}$ (Truth)	−5,−3	0,0

Note that the term Δ in the above fiscal contract can be interpreted as **a potential gain from promotion opportunities**, or **the strength of the promotion opportunities**. Our model corresponds to the situation where the potential gain from promotion through winning the contest (**"Bisai"比賽**) of regional growth $C\left(e^{FB}\right)-C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)+\Delta$ exceeds the information rent from disguising

[15] Of course, in this dominant strategy equilibrium, the Nash incentive compatibility constraints are also satisfied, in the sense that it is optimal for agent i to behave truthfully *given* that agent j behaves truthfully, and vice versa.

the region's true information $C\left(e^{FB}\right)-C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)$ by Δ. This could be said to be a **"Chinese-style"** situation.[16]

However, in the case where Δ is sufficiently large (e.g. $\Delta=5$) to make up for the net cost of producing a high GDP outputs (reporting false information), it becomes the dominant strategy equilibrium for both players of $\left(\theta_i,\theta_j\right)=\left(\underline{\theta},\underline{\theta}\right)$ to produce a combination of high GDP outputs $\left(\overline{Y}^{FB},\overline{Y}^{FB}\right)$.

	$\overline{\theta}$ (Lie)		$\underline{\theta}$ (Truth)	
$\overline{\theta}$ (Lie)	−8	−8	1	−9
$\underline{\theta}$ (Truth)	−9	1	0	0

In this case, the pooling equilibrium emerges, where both (high and low) types produce high GDP outputs, which will bring about high inflation in theory. Indeed, double-digit inflation continued for three years until 1995 when the Law of the People's Bank of China (Central bank of China) was enforced. Until 1995, the local government could collude with the local branch of the Central bank and *soften its budget constraint*[17] through its financing. Hence, when the promotional benefit was larger than making up for the (net) extra effort cost required to attain the high GDP output $\overline{Y}^{FB}$, i.e., $\Delta>\left[C\left(e^{FB}+\left(\overline{\theta}-\underline{\theta}\right)\right)-C\left(e^{FB}\right)\right]-\left[C\left(e^{FB}\right)-C\left(e^{FB}-\left(\overline{\theta}-\underline{\theta}\right)\right)\right]$, the low productive type $\underline{\theta}$ of the local government had an incentive to collude with the local branch of the Central bank and secure the promotion (win the contest).[18] After 1995, such loopholes through collusion and soft budgeting were prohibited by law, and as a result, high inflation was suddenly suppressed in 1996 and 1997.

[16] As Blanchard and Shleifer (2001) argue, in China, the Communist party has the power to appoint and dismiss local executives, and has exercised this power both to reward those whose regions have performed well economically, and to punish those who have followed anti-growth policies. The term Δ could be interpreted to imply a prize as the difference between promotion reward and demotion penalty. Our model has a property of both fiscal federalism which has played a helpful role in promoting China's economic growth and high centralization in personnel controls, i.e. political centralization.

[17] For the Soft Budget Constraint (SBC) problem, see, e.g. Dewatripont and Maskin (1995).

[18] Suzuki (2007) considered the three-tier agency hierarchy, where the low productive agent $\underline{\theta}$ can collude with the supervisor and secure a good job (win the contest). Because the candidate agents have exactly the same incentive structure, this can lead to fierce competition for coalition formation with the common supervisor. The logic is close to an incentive for the low-productive Local government to attain high GDP output through collusive soft budgeting and try to win the promotion contest ("Bisai").

4. Dynamic Contractual Relation: Ratchet Effect and Renegotiation Problem

4.1 Commitment Case

Assuming that the relation between the Central and Local governments is 1:1, the setting is back to where the type information of the Local government $\theta \in \{\underline{\theta}, \overline{\theta}\}$ is private and unknown to the Central government. We now assume that this relation is **repeated for two fiscal terms**.[19]

In the case where the Central government can make an **ex-ante commitment** to the fiscal contract, it is most appropriate to repeat the second best optimal solution of the first term's model $\{L', H'\}$ for every term. The Central government elicits true information by inducing type $\underline{\theta}$ to choose L' and type $\overline{\theta}$ to choose H', and it obtains fiscal revenues $\underline{T}^*$ and $\overline{T}^*$ in every term with the optimal solution of the one term model L' H'.

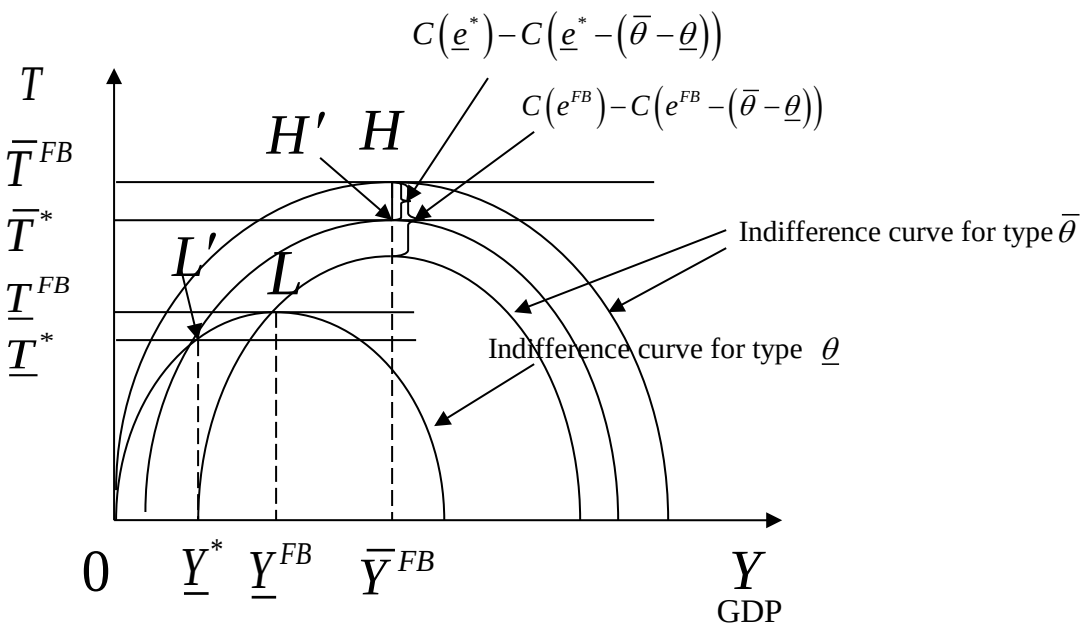

Figure 5: Second Best Commitment Solutions H' and L'

4.2 No-Commitment Case

However, in the case where the Central government **cannot make a commitment** to the fiscal contract, there exists an incentive for the Central government to change the commitment solution *ex-post* by using the information the Local government disclosed during the first term.[20]

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[19] We assume that the productivity of the local government is constant over time.

[20] The early literature that studied this problem includes the following: Dewatripont (1989), Hart and

When the low productivity type $\underline{\theta}$ reveals information by choosing contract L' for the first term, there exists an incentive for the **Central government to increase the payoff (central tax revenue) for the second term by removing the *"Downward Distortion at Bottom,"*** which has been made against the low productivity type. Therefore, it **offers an efficient contract L instead of contract L' in the above.**[21] As long as the low productivity type has veto power and the Central government has to obtain an agreement on the change in policy, L' and L become indifferent. Conversely, the payoff for the Central government increases precisely by $\underline{T}^{FB} - \underline{T}^{*}$, and the new point L has achieved a **Pareto improvement** over the original point L'. This can be said to be a ***"Renegotiation Problem"*** in the dynamic contractual relation.

Meanwhile, the Central government can absorb all of the information rent by offering a contract H to the high productivity type for the second term because it has revealed information that its type is $\overline{\theta}$. Because it is already known that this region has high productivity and high potential, the Central government has an incentive to increase the central tax from $\overline{T}^{*}$ to $\overline{T}^{FB}$ and make a larger gain. This is called the ***"Ratchet Problem"***. If the high productivity type $\overline{\theta}$ foresees this change in advance, the incentive constraint of the *ex-ante* information disclosure cannot be satisfied. The Local government $\overline{\theta}$ will disguise itself as a low productivity type $\underline{\theta}$ by choosing contract L' for the first term and will attempt to secure the information rent in the future.

If the **high productivity type $\overline{\theta}$ foresees the above-mentioned *ex-post* modification**, it will disguise itself as a low productivity type by **choosing L' instead of its proper contract H' for the first term, and then choose L for the second term so that it can maximize its dynamic payoff.** In fact, this is beneficial for the high productivity type because it does not change the payoff for the first term ($C\left(\underline{e}^{*}\right) - C\left(\underline{e}^{*} - \left(\overline{\theta} - \underline{\theta}\right)\right)$), and it still obtains the information rent for the second term $C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)$.

In short, the **H type foresees the Central government's *ex-post* policy modification ("Hold-up") and chooses L' for the first term and L for the second term, while the L type similarly chooses L' for the first term and L for the second term.** Thus a so-called **pooling equilibrium** may be realized.[22]

Tirole (1988), and Laffont and Tirole (1988). This subsection 4.2 is essentially based on their results.

[21] Note that the indifference curve of the Central government (horizontal line) and the indifference curve of the low productive type cross (are inefficient) at point L', while they are tangential (efficient) at point L.

[22] This could be viewed as the ex post *Soft-Budgeting* incentive by the Central government in the form of increasing Central Tax revenues $\underline{T}^{*}$ at $\underline{T}^{FB}$, and $\overline{T}^{*}$ at $\overline{T}^{FB}$. As the literature (e.g., Dewatripont and Maskin (1995)) indicates, this brings about ex-ante inefficient behavior, in this case, in the form of inhibiting the proper information revelation by the Local government.

4.3 Comparison between the "Fiscal contracting system（財政請負制）(from 1980 to 1993)" and the "Tax sharing system（分税制）(from 1994 onward)"

Qian et al. concluded that the "Fiscal contracting system" had ensured incentives for Local governments and played a considerable role in economic development and structural reform. The "Fiscal contracting system" strengthened the fiscal incentive of Local governments, and this in turn promoted the growth of non-state owned enterprises (private companies) and drove the structural reform of state owned enterprises (SOEs). Qian evaluated this system as the driving force that effected the astounding annual average rate of GDP growth of 10% throughout the 1980s.

However, there was an **"uncertainty" in condition setting** in that the rate and amount paid to the Central government for each year was decided by negotiation between the Central and Local governments. Therefore, **"Fiscal contracting（財政請負制）" was a system where room for discretionary negotiations between the Central and Local governments continued to be important,** and there were also possibilities of **a "ratchet effect"** and **a "renegotiation problem"** posed by the dynamic contracting relation. There was a potential adverse effect inhibiting Local governments' proper *ex-ante* information revelation. [23]

Conversely, the **"Tax sharing system（分税制）" achieved its commitment** by **carving up the share of the Central government clearly as a tax item**, **improving the predictability ("transparency") of the system**, and **diminishing the possibility of the ratchet effect**, which allowed the increase in revenue to be confiscated ex-post by the Central government. **"Transparency"** in the tax sharing system was institutionally evaluated as an "**aspect of ex-ante commitment**".

4.4 Ratchet effect (dynamic time-inconsistency) and its solution by a Self-enforcing mechanism

Although there remained **the possibility of a "Ratchet Effect" in theory under the "Fiscal Contracting system"**, **it would be natural to consider that it had been solved (or mitigated) by some kind of mechanism because** the GDP growth rate had been astonishing throughout the 1980s. Taking note that China's institutional structure is **a combination of formality and informality**, we consider the following.

China's taxation system was called **"classified management（分級管理）,"** where **tax was collected by Local governments and used by the Central government.** In this structure, **the tax collecting operation was dependent on Local governments.** Here, in the dynamic fiscal relation between the Central government and more than one Local government, **if the Central government**

[23] This can be viewed as one of the bad aspects of "flexibility" or "flexible systems", which will lead to some dissipation of surplus. Hart and Moore (2008) highlighted this idea as a basic motivation in their (behavioral) incomplete contracting model.

suddenly changed the tax rate (or amount) to be paid and cheated the Local governments, the Local governments would then walk off "their job as a tax collecting institution" from the next year, and the Central government would suffer retaliation in the form of Local governments not conducting the taxation work properly. Moreover, there was a possibility that **the information that the "Central government had behaved as a 'cheater'" might have spread to many other provinces**, and various forms of objection and rejection might have occurred. Because it would entail a substantial cost on a long-term basis to renegotiate the fiscal contract *ex-post* and to cheat Local governments, the Central government voluntarily abstained from doing so.

Being afraid of any future "retaliation" from more than one Local government, the Central government did not conduct any *ex-post* hold up (cheating by changing its taxation scheme), and it maintained cooperative behavior (tried not to deviate from the second best commitment solution).[24] This is **a solution implemented by the Central government in an effort to build trust**, that is, **a solution by a reputation mechanism for a "commitment problem,"** and this is part of the **"informal" governance** mechanism within China's intergovernmental fiscal relation between the Central and Local governments.

4.5 A New Theoretical Explanation: the "Shading" Mechanism a la Hart and Moore (2008)

Although a solution through reputation for a "commitment problem" is a so-called trigger mechanism in Game Theory (see, e.g., McMillan (1992)), it works within an infinite-horizon repeated game framework. Because our model is a two-term (two-period) model, we may have to present a more explicit punishment mechanism in our two-term framework. Thus, we present the "Shading" mechanism a la Hart and Moore (2008). That is, after observing the hold-up or cheating by the Central government at the beginning of the second term, the local governments can "shade" (punish) the Central government by a constant times their "aggrievement" levels. When it is sufficiently large, the Central government, fearing being shaded, will not hold up (cheat) the Local governments, even though it has obtained the type information from the first-term outcome. This will in turn induce truthful information revelation in the first term.

The incentive for an opportunistic renegotiation offer by the principal after the information revelation $\bar{\theta}$ in the first term is $C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)$, which means the principal does not pay the information rent to type $\bar{\theta}$. Conversely, the entitlement for the agent of type $\bar{\theta}$ is just $C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)$ because it is the fair reward promised ex ante to the agent of type $\bar{\theta}$ for

[24] The essential idea could be said to be the same as the self-enforcement mechanism through the multi-lateral punishment a la Grief (1993). Levin (2002) proposes a similar self-enforcement mechanism in the principal-multi agent employment relationships.

revealing its information truthfully. Hence, faced with the opportunistic renegotiation offer by the principal, the agent feels aggrievement $C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)$ and shades (punishes) the principal by a constant γ times its aggrievement $\gamma\left[C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)\right]$, where $\gamma \le 1$.

However, the shading by only one agent may not be enough to suppress the opportunistic renegotiation by the principal because

$$\underbrace{C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)}_{\text{Deviation Incentive by Central Government}} \ge \underbrace{\gamma\left[C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)\right]}_{\text{Shading by One Local Government}}, \text{for } 0 \le \gamma \le 1$$ [25]

Nonetheless, as we argued in Section 4.5, there was a possibility that the information that "the Central government has behaved opportunistically or held up" would spread to many other (say, $N \ge 2$) provinces and that various forms of objection and rejection might occur.

That is, if the shadings by N multiple agents (N multiple Local Governments) occurred at the same time, it would be possible to suppress the deviation behavior by the principal (Central Government), as the following incentive constraint shows. [26]

$$\underbrace{C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)}_{\text{Deviation Incentive by Central Government}} \le \underbrace{N\gamma\left[C\left(\underline{e}^*\right)-C\left(\underline{e}^*-\left(\bar{\theta}-\underline{\theta}\right)\right)\right]}_{\text{Shading by N Local Governments}} \Leftrightarrow N\gamma \ge 1$$

This is essentially the same logic as the incentive constraint (self-enforcing constraint) for the principal in the trigger strategy equilibrium in the infinite horizon repeated games, in that even though the principal has an incentive to deviate, she does not deviate in a self-enforcing way, expecting her payoff loss by the severe shading (punishment) behaviors of N agents. [27]

Proposition 4.1

The Ratchet Problem in the No-Commitment environment under the "Fiscal contracting" regime can be solved through the "Shading" Mechanism if either the shading parameter γ is greater than 1, i.e., $\gamma > 1$, or even if the shading parameter γ is less than 1, i.e., $\gamma \le 1$, the shadings by N multiple Local Governments occur, and $N\gamma \ge 1$ holds.

Next, let us discuss the incentive for Pareto-improving renegotiation at point L' in the second term.

[25] If the degree of shading strength γ can be greater than 1, i.e., $\gamma > 1$, the right-hand side of the inequality can be greater than the left-hand side. That is, the shading by only one agent is sufficient to deter the opportunistic renegotiation by the principal.

[26] Note that this condition may not always hold because it depends on γ (the degree of shading strength) and N (the number of shading agents). However, it would be consistent with the changeover to the formal, complete contractual Tax Sharing system.

[27] Fehr et al (2014), in their experimental paper on the buyer-supplier relationship, conjecture that the buyer will not renegotiate opportunistically as often in equilibrium if he expects a large increase in shading on the side of the seller or the shading reaction by the seller, and they indeed obtain a supportive experimental result. This result would provide a behavioral foundation to our logic here.

At point L', the Central government will have an incentive to make the Pareto-improving offer to the low productivity type $\underline{\theta}$ in order to restore the second-order loss $\underline{T}^{FB} - \underline{T}^{*} = \left(e^{FB} - C\left(e^{FB}\right)\right) - \left(\underline{e}^{*} - C\left(\underline{e}^{*}\right)\right)$. That is, the Central government will offer the first best contract L instead of the second best one L'. However, the high productivity type $\overline{\theta}$ would in turn think that he should now be entitled to obtain the information rent $C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)$. Nonetheless, the contract H' only assures the information rent $C\left(\underline{e}^{*}\right) - C\left(\underline{e}^{*} - \left(\overline{\theta} - \underline{\theta}\right)\right)$ for him. Hence, the high productivity type $\overline{\theta}$ would feel that the remaining information rent $\left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right] - \left[C\left(\underline{e}^{*}\right) - C\left(\underline{e}^{*} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right]$ was aggrieved. He shades (punishes) the Central government by a constant γ times its aggrievement

$$\gamma\left\{\left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right] - \left[C\left(\underline{e}^{*}\right) - C\left(\underline{e}^{*} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right]\right\}$$

If this shading loss is greater than the renegotiation incentive by the Central government, that is,

$$\underbrace{\left(e^{FB} - C\left(e^{FB}\right)\right) - \left(\underline{e}^{*} - C\left(\underline{e}^{*}\right)\right)}_{\text{Renegotiation incentive}} \leq \underbrace{\gamma\left\{\left[C\left(e^{FB}\right) - C\left(e^{FB} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right] - \left[C\left(\underline{e}^{*}\right) - C\left(\underline{e}^{*} - \left(\overline{\theta} - \underline{\theta}\right)\right)\right]\right\}}_{\text{Shading loss}}$$

the Central government will refrain from proposing the Pareto-improving renegotiation offer in the second-term.[28] Thus, the shading mechanism makes point L' *renegotiation-proof.*

<u>Proposition 4.2</u>

The Renegotiation Problem in the No-Commitment environment under the "Fiscal contracting" regime can also be solved through the "Shading" Mechanism. That is, the shading mechanism can make the second-best contract L' for the low productivity type ***renegotiation-proof*.**

<u>Complementarity with the Tax system before 1994</u>

In the Fiscal Contracting era (1980-1993), the local tax collection bureau was in charge of <u>both</u> Central and Local government revenues. Thus, by responding to the cheating (deviation) behavior by the Central government at the beginning of the second term, the local tax collection bureau could "shade (punish)" the Central government severely by walking off the job as a tax collecting institution of the Central government. Indeed, it could strengthen the enforcement mechanism by shading. We summarize this argument as:

[28] Because the left-hand side (renegotiation gain) is the second-order gain and the right-hand side (shading loss) is the first-order loss, this inequality can indeed hold for γ above a positive threshold.

Proposition5

Under the "Fiscal contracting" regime, the local tax collection bureau was in charge of both the central and local government revenues, and so could shade (punish) the Central government severely by sabotaging the job as a tax collecting institution. That is, the Tax System in the "Fiscal contracting" era reinforced the enforcement mechanism by shading.

4.6 From *Ex-post* Discretion (Fiscal Contracting) to *Ex-ante* Commitment (Tax Sharing)

The solution to the commitment problem (the Ratchet effect) under the fiscal contracting system, which relied on a reputation mechanism (**short-term gain vs. continuation loss**) or on a shading mechanism (**deviation gain vs. shading loss**), was unstable as an institution because of its informal and self-enforcing nature. In fact, the reputation mechanism would collapse if the relationship of trust between the Central and Local governments wavered. As game theory also shows, if the Central and each of the Local governments have different beliefs, there exist many other inefficient equilibria (including the above-mentioned pooling equilibrium, where the ratchet effect just appears). Similarly, the shading mechanism would not work if the enforcement power of shading is not so strong.

Hence, in 1994, in order to "formally" demolish the opportunity for *ex-post* renegotiation, where the Central government might cheat Local governments, and attempt to ensure "transparency," the fiscal system moved to a complete contractual fiscal system, namely, the current "Tax Sharing System," which commits to the second best solution for two terms (when seen for two consecutive terms).

This could be interpreted as meaning that the fiscal system has moved to the "Tax Sharing System" as a commitment solution, which defines more clearly the revenue allocation and clerical allocation between the Central and Local governments: the Central Government has thus secured (long-term) stable fiscal revenue as a result.[29]

Complementarity with the Tax system reform in 1994

The tax system reform was carried out together with the Tax Sharing system（分税制）in 1994, at which time the central and local governmental tax collection bureaus were separated（分機構）. That is, the national tax collection bureau is in charge of the central government revenues and the local bureaus are in charge of the local governmental revenues under the simple, transparent tax structure of the 1994 reform. This could be considered a complementary institutional change for achieving the complete contractual commitment solution of the Tax Sharing system（分税制）.

[29] In fact, the Central government's fiscal revenue increased discretely in 1994 (due to the introduction of the Tax Sharing System), and has maintained stable revenue since then.

5. Conclusion

Since the "Economic Reform" in 1978, the Chinese economy has achieved significant growth. Based on a previous study that reported that the fiscal reforms between the Central and Local governments implemented from the 1980s to the 1990s made great contributions to economic growth, and taking a hint from the concepts of "**Bao (Contract)**" and "**Bisai (Competition, Contest),**" we analyzed the structure of the fiscal relations between the Central and Local governments by using the mechanism design and contract theory framework.

We shall summarize our analysis. The concepts of Bao 包(Contract) and Bisai 比賽 (Contest) have both worked effectively since the implementation of Fiscal Contracting (1980～1993) through Tax Sharing Systems (1994～). Nonetheless, there exists a difference between the two systems from the viewpoint of the **"Ratchet Effect"**. In Fiscal Contracting (1980～1993), there existed the possibility of the Ratchet Effect through ex-post discretion, which had been solved or mitigated by an informal, self-enforcing mechanism through Reputation or Shading. In that period (1980～1993), Local tax collection bureaus were in charge of both central and local government revenues, which strengthened the effect of the self-enforcement mechanism through making the punishment stronger. However, because it was still unstable and unclear, the fiscal system had moved to an Ex-ante Commitment, Formal and Complete Contractual Tax-sharing system (1994～). At the same time (in 1994), the Central and Local governmental tax collection bureaus were separated, which was also viewed as a complementary institutional change because the Central government committed to its clarified tax share (items) and collected its own tax revenues for itself without depending on the local tax collection bureaus. The following table summarizes the argument.

Fiscal Contracting System **1980～1993**	**Tax Sharing System** **1994～**
" Bao 包" (Contract) "Bisai 比賽" (Contest)	" Bao 包" (Contract) "Bisai 比賽" (Contest)
Ex-post Discretion Possibility of Ratchet Effect Informal, Self-enforcement Mechanism through Reputation or Shading	Ex-ante Commitment Formal, Complete Contractual Commitment Solution
Local tax collection bureau was in charge of **both** central and local government revenues	Central and local governmental tax collection bureaus were **separated**

Table 5

<u>Appendix</u>: Optimal Solution under the Central Government's Altruism

Let us consider the optimization problem by the Central government under the assumption that the Central Government is altruistic and has a concern $\alpha \in [0,1]$ for the high productivity type $\bar{\theta}$.[30] Then, the problem is as follows.

$$\max_{\substack{\{\bar{Y},\bar{T}\}\\ \{\underline{Y},\underline{T}\}}} \underbrace{\lambda\bar{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of high productivity } \bar{\theta}}} + \underbrace{(1-\lambda)\underline{T}}_{\substack{\text{Central Fiscal Revenue from Local}\\ \text{Government of low productivity } \underline{\theta}}} + \alpha\ \underbrace{\lambda\left[C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\right]}_{\text{Information Rent for high productivity } \bar{\theta}}$$

Subject to $\bar{Y}-\bar{T}-C(\bar{Y}-\bar{\theta}) \geq \underline{Y}-\underline{T}-C(\underline{Y}-\bar{\theta})$

------Incentive constraint for Local governments of the high productive type $\bar{\theta}$

$\underline{Y}-\underline{T}-C(\underline{Y}-\underline{\theta}) \geq 0$

------Participation constraint for Local governments of the low productive type $\underline{\theta}$

According to the same procedure as before, we have the following objective function, namely, the expected total surplus minus *net* expected information rent (incentive cost):

$$\underbrace{\lambda\left[\bar{Y}-C(\bar{Y}-\bar{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of high productivity type } \bar{\theta}}} + \underbrace{(1-\lambda)\left[\underline{Y}-C(\underline{Y}-\underline{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of low productivity type } \underline{\theta}}} - (1-\alpha)\underbrace{\lambda\left[C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\right]}_{\substack{\text{Information rent given to}\\ \text{high productivity type } \bar{\theta}}}$$

We see that because the Central Government also considers the payoff of the high productivity type $\bar{\theta}$ with the weight $\alpha \in [0,1]$, it discounts the information rent (the incentive cost for the Central Government) by its portion.

∗The first order condition for the optimal solution $\bar{Y}$ for the high productive type $\bar{\theta}$ is,

$$1-C'(\bar{Y}-\bar{\theta})=0$$

and is still consistent with the first best solution $\bar{Y}^{FB}$.

∗The optimal solution $\underline{Y}$ for the low productive type $\underline{\theta}$ reflects the trade-off between the first term and the second term below.

$$\max_{\{\underline{Y}\}} \underbrace{(1-\lambda)\left[\underline{Y}-C(\underline{Y}-\underline{\theta})\right]}_{\substack{\text{Total surplus by local government}\\ \text{of low productivity type } \underline{\theta}}} - (1-\alpha)\underbrace{\lambda\left[C(\underline{Y}-\underline{\theta})-C(\underline{Y}-\bar{\theta})\right]}_{\substack{\text{Information rent given to}\\ \text{high productivity type } \bar{\theta}}}$$

[30] For example, note that the "Deng Xiaoping Theory" placed high importance on the payoffs of richer regions, that is, regions with higher productivity $\bar{\theta}$.

The first order condition for the optimality is

$$1-C'(\underline{Y}-\underline{\theta})=\frac{(1-\alpha)\lambda}{(1-\lambda)}\left[C'(\underline{Y}-\underline{\theta})-C'(\underline{Y}-\overline{\theta})\right]$$

Hence, the optimal solution $\underline{Y}^*$ will increase because the marginal information rent (the right hand side) decreases by the altruism parameter $\alpha \in [0,1]$. The below figure depicts this logic.[31]

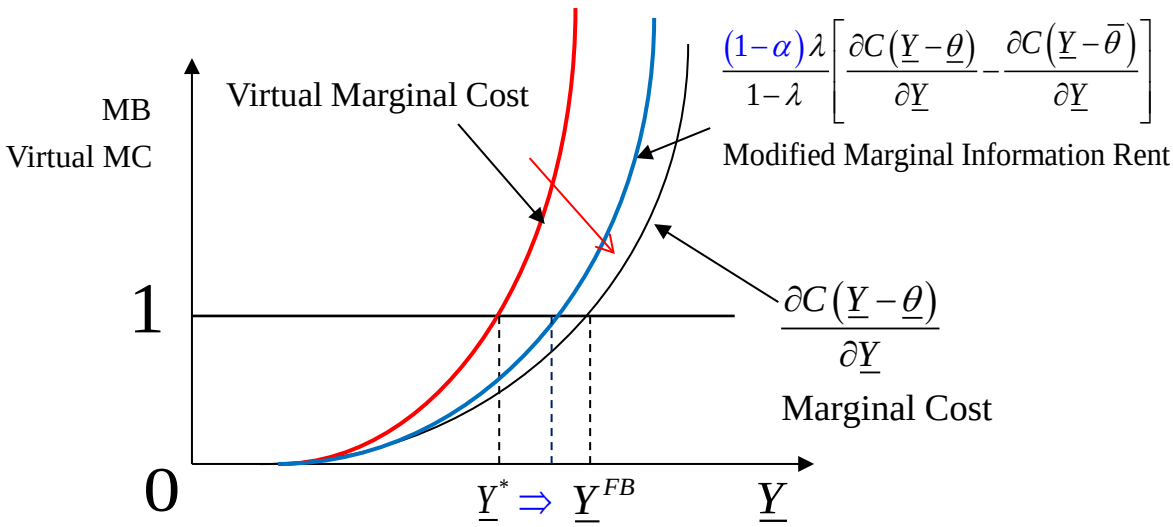

Figure 6: Optimal Solution for Low Productivity Type $\underline{\theta}$ under Central Government Altruism

The increase in the low productive type's GDP $\underline{Y}^* \uparrow$ is generated through the increase in the marginal rate of local fiscal revenue for the low productive type $\underline{\theta}$. That is, the degree of "Bao (Contract)" $b(\underline{\theta})$ increases for low productive type $\underline{\theta}$. This results in increased Tax for the low productive type and an increase in the information rent for the high productive type and, thus, a decrease in the Tax for the high productive type:

$$\underline{T}^*=\underline{Y}^*-C(\underline{Y}^*-\underline{\theta})\uparrow,\ C(\underline{Y}^*-\underline{\theta})-C(\underline{Y}^*-\overline{\theta})\uparrow$$

[31] Note that under perfect altruism $\alpha=1$ for high productivity type $\overline{\theta}$, the optimal solution for low productive type $\underline{\theta}$ becomes $\underline{Y}^*=\underline{Y}^{FB}$. Namely, the "distortion at the bottom" is removed and the first-best outputs are achieved for both types $\overline{\theta}$ and $\underline{\theta}$.

and $\bar{T}^* = \underbrace{\bar{Y}^{FB} - C\left(\bar{Y}^{FB} - \bar{\theta}\right)}_{\text{First Best total surplus}} - \underbrace{\left[C\left(\underline{Y}^* - \underline{\theta}\right) - C\left(\underline{Y}^* - \bar{\theta}\right)\right]}_{\text{this information rent will increase}\uparrow} \downarrow$

<u>Proposition A2</u>

Suppose that the Central Government has a concern $\alpha \in [0,1]$ for the high productivity type $\bar{\theta}$. Then, the optimal output $\underline{Y}^*$ for the low productive type $\underline{\theta}$ increases with the increase of the "Bao (Contract)" $b(\underline{\theta})$. Furthermore, the Tax $\underline{T}^*$ for the low productive type $\underline{\theta}$ increases, the information rent for the high productive type $\bar{\theta}$ increases, and so the Tax $\bar{T}^*$ for the high productive type $\bar{\theta}$ decreases.

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