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The paradox of green credit in China

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Abstract

The green credit policy has made remarkable achievements in energy saving, emission reduction and industrial structure optimization, however, due to the collusion between enterprises and local government, a huge gap exists between the reality and expectation in the process of policy execution. The collusion is the result of cooperative game through Nash bargaining. Banks, as agents in carrying out the green credit policy, offer preferential interest rate that influences the collusion. This paper analyzes the collusion and factors affecting its incidence on the basis of constructing the expected profit functions of both the enterprise and the local government. Meanwhile, we obtain the optimal volume of loans and offer several relevant suggestions for policy.

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1. Introduction

With the increasing urgency of protecting the environment, in mid-July 2007 the State Environmental Protection Administration and People's Bank Regulatory Commission jointly issued the Suggestions on the implementation of environmental protection policies and regulations against credit risk. In this document, the green credit mechanism is formally proposed to curb the blind expansion of high-pollution industries and the credit tilt is provided to support environmentally friendly infrastructure projects, institutional reform of traditional industries and pollution control projects.

Green credit, also known as sustainable finance, mainly aims at obtaining sustainable development through adjustment of the financial industry's business philosophy, management policies and operation processes. Concurrently, actively performing banks allocate the credit funds following one vote veto

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principle, which means that loans in no circumstances flow into enterprises without Qualification Certificate of Environmental Protection issued by the local government. Once serious environmental accidents occur in enterprises or construction projects, banks immediately stop providing funds and even recover the already granted loans.

The green credit policy originally intends to hinder the development of the enterprises that possess "high pollution, high consumption, and high emission" and to prevent blind start-up of projects that probably pose potential threats to the environment. Since the policy has been promulgated, environmental protection work did effect in China. However, the results and expectations are widely divergent. This phenomenon is referred to as the Paradox of Green Credit in China. There are two main reasons responsible for it. On one hand, due to feeble environmental awareness, shortage of talents and non-standard operating procedures, financial institutions do lack the sensitivity to environmental risks; on the other hand, in current system in China, banks have to face collusion between local government and businesses when they jointly cheat banks of credit funds with forged Qualification Certificate of Environmental Protection. Encountering this reality, is the green credit policy the antidote to increasingly urgent environmental problems? Can't the policy unlock the magic spell of collusion as a rent-seeking tool at the expense of the environment?

Many scholars have done research on the collusion in organizations. Kofman et al. (1993) studied collusion in hierarchical agency. Tirole (1992) constructed the theoretical framework of collusion behavior and collusion-proof incentive mechanism. Collusion occurs mainly due to information asymmetry among agents, supervisors and principals and existence of rent in the general contract. Laffont et al. (1998) found that limits on communication between the agent and the principal create collusion, undermining the efficiency of the centralized arrangement. Laffont et al. (2000) also discussed mechanism design under collusion. In previous analysis of collusion in environmental issues, there exist two main ideas. One focuses on discussing the formation conditions of collusion between local governments and enterprises, constructing the game model and solving the mixed strategy Nash equilibrium. Through comparative static analysis, it analyzes how all the related variables exert the influences on collusion. Chun-Ying Zhang (2008) and Lilong He et al. (2009) found out, when the game reaches equilibrium, collusion incidence has positive relationship with central government's regulatory costs, and has negative relationship with successful regulation rate and the amount of penalty. Others mainly depict the information structure and utility functions of all participants, and then discuss the incentive compatibility constraints and participation constraints and establish the collusion-proof mechanism. Huihua Nie (2006) and Yu-Long Ren et al. (2008) established the optimal mechanisms under the analytical framework of principal-agent theory.

At present, there is little in-depth research on green credit paradox from the perspective of collusion. This paper is distinguished from other relevant study into green credit problems by specially analyzing the behaviour of banks. On one hand, in the relationship among "principal (central government), supervisor (local government) and agent (enterprises)", the bank, as an independent fourth party, influences collusion with the exertion of preferential interest rate. On the other hand, as a for-profit operating body, the bank has to adjust management strategy and make scientific decisions on offering loans to maximize its profit. Model one discusses how collusion incidence is determined as a result of Nash bargaining. And model two, basing on the bank's angle, discusses ways to rationalize control variables on loans to gain the greatest profit.

2. Model One: collusion incidence

2.1. Information structure and cost-benefit analysis

In this model, central government acts as the principal mandating enterprises to protect the environment. But supervising all companies' environmental friendliness is impossible. So the supervision has to count on the local government for access to environmental information. In the absence of supervision under the central government, the local government has motive to conceal the truth and colludes with enterprises. In order to prevent such collusion, principal selects irregular random investigation. The probability of the central government disclosing the collusion is d, the probability otherwise is $1-d$. Once collusions are disclosed, the enterprises and local governments will be fined at f_c, f_g respectively.

Local governments play the role of supervisor in this principal-agent relationship, for its information symmetry with local businesses. Bounded by prevailing official performance evaluation system, local governments usually lay over-emphasis on the GDP. Wrong concept of political performance, together with the temptation of bribes from enterprises, leads to distortion of the cost-benefit function which gives rise to collusion. In the case of no collusion, the main revenues of local government come from corporate tax revenues $t\mathrm{E}_c$, otherwise, it will additionally receive bribe B, but once collusion is brought to light, the penalty amounts to f_g.

As rational economic entities, enterprises protect the environment not only for social morality and public welfare, but optimizing the profits. Typically, the cost of a company starting a major project is interests I ($I = Ai$, A denotes principal, i denotes interest rate). A company selects environmental protection at the probability of $1-v$, hence, the probability of not to do so is v. If the company chooses the latter, only by colluding (reasonable assumption), can it get loans from banks, therefore, collusion incidence exactly equals to v. Not protecting the environment saves an enterprise environmental facility construction fees ΔC, whose consideration is the bribe B, if the collusion is unveiled, it will loss f_c.

The bank is the fourth party, but it has to allocate credit funds under such conditions as information asymmetry, the same situation as the central government. On one hand, banks rely on *Qualification Certificate of Environmental Protection* issued by local government as the basis of *one vote veto*. On the other, in the effort of risk management, banks usually evaluate authenticity of that certificate. Although the bank doesn't know the accurate collusion incidence, but it can roughly estimate the incidence by means of checking the company's accounts and site inspections. As there is a wide range of factors influencing banks' estimation, the estimated incidence will be close to the fact. Hence, the estimated collusion incidence follows the normal distribution with parameters μ and σ, thereof $\mu = v$.

Banks determine the interest rate $i_{(v')}$ according to the estimated collusion incidence v', which is an important means to control environmental risks. Even so, if the collusion is disclosed and the involved company is shut down, the risk still can not be avoided. Then the principal A will proportionally become dad debts.

2.2. Collusion incidence

In green credit policy, there are three states of an enterprise:

①It chooses to protect environment at the probability of $1-v$;

②It chooses not to protect environment at the probability of v, and collusion occurs, then it is disclosed at the probability of d;

③It chooses not to protect environment at the probability of v , and collusion occurs, but it is not disclosed at the probability of $1-d$;

An enterprise's expected profits:

$$
\mathrm{E}_c = (1-v)(-I_{(v')}) + v\left[d(\Delta C - f_c - I_{(v')} - B) + (1-d)(\Delta C - I_{(v')} - B)\right]
$$

$$
= v\Delta C - vdf_c - I_{(v')} - vB \tag{1}
$$

Local government's expected profits:

$$
\mathrm{E}_g = t(1-v)(-I_{(v')}) + v\left\{d\left[-f_g + B + t(\Delta C - f_c - I_{(v')} - B)\right] + (1-d)\left[B + t(\Delta C - I_{(v')} - B)\right]\right\}
$$

$$
= v(1-t)B + tv\Delta C - tI_{(v')} - vdf_g - vdtf_c \tag{2}
$$

Once the collusion is profitable, it occurs. In the collusion, bribe B is an important parameter affecting allocated interests between the enterprise and local government. The bribe is the result of cooperative game through Nash bargaining based on the respective expected profits and bargaining power of two participants. We assume the bargaining power of the enterprise and the supervisor are respectively $1-\alpha$ and $\alpha(0 < \alpha < 1)$, so the bribe B can be determined as follows:

$$
\max_B \ \left(v\Delta C - vdf_c - I_{(v')} - vB\right)^{1-\alpha}\left[v(1-t)B + tv\Delta C - tI_{(v')} - vdf_g - vdtf_c\right]^{\alpha} \tag{3}
$$

The optimal bribe is：

$$
B = \frac{(\alpha - t)v\Delta C - vd(\alpha - t)f_c - (\alpha - t)I + (1-\alpha)vdf_g}{v(1-t)} \tag{4}
$$

If the value of B is substituted in $\mathrm{E}_c, \mathrm{E}_g$, we get:

$$
\mathrm{E}_c = v\Delta C - vdf_c - I_{(v')} - vB
$$

$$
= \frac{1-\alpha}{1-t}v\Delta C - \frac{1-\alpha}{1-t}vdf_c - \frac{1-\alpha}{1-t}I_{(v')} - \frac{1-\alpha}{1-t}vdf_g \tag{5}
$$

$$
\mathrm{E}_g = v(1-t)B + tv\Delta C - tI_{(v')} - vdf_g - vdtf_c
$$

$$
= \alpha v\Delta C - \alpha vdf_c - \alpha I_{(v')} - \alpha vdf_g \tag{6}
$$

It has been mentioned that banks determine the interest rate i on the basis of estimated collusion incidence v' , a normal distribution of which the mean is the true incidence v , hence $\mathrm{E}(v') = v$. Assuming that $i_{(v')} = i_0 + m(\mathrm{E}(v'))^2$, $m > 0$, m denotes discriminatory interest rate coefficient. When $m > 1$, the coefficient helps the interest rate rise multiple times with the estimated collusion incidence. In short, m plays an important role in deciding the level of interest rate, and thus affects the collusion incidence. i_0 denotes the basic interest rate to the environmentally friendly businesses. The higher the estimated collusion incidence is, the greater the company's financing costs are. Collusion occurs at a certain rate when both the enterprises and local governments maximize their expected profits, so：

$$\max_{v} \quad E_c$$

$$\max_{v} \quad E_g \tag{7}$$

solution：

$$v = \frac{\Delta C - df_c - df_g}{2Am} \tag{8}$$

2.3. Comparative static analysis

From solution (8), conclusion incidence v is determined by four factors, environmental facility costs ΔC , collusion disclosure probability d , penalty f_c and f_g , discriminatory interest rate coefficient m . Research on each variable's impact on v with comparative static analysis is as follows:

$$\frac{\partial v}{\partial \Delta C} > 0, \quad \frac{\partial v}{\partial f_c} < 0, \quad \frac{\partial v}{\partial f_g} < 0 \tag{9}$$

Lemma one: collusion incidence has a positive correlation with ΔC , but a negative one with f_c and f_g .

Remark: obviously, ΔC is the company's saved cost after collusion and equivalent to additional gains. The desire for collusion becomes stronger with the enhancement of ΔC . On the contrary, f_c and f_g are risks that both sides of collusion is confronted with, the higher the fines are, the more conservatively and discreetly enterprises behave.

$$\frac{\partial v}{\partial d} < 0, \quad \frac{\partial v}{\partial m} < 0 \tag{10}$$

Lemma two: the collusion disclosure rate reduces v , so does the discriminatory interest rate coefficient m .

Remark: The collusion can only be unveiled and disposed of by central government. The power of monitoring acts in the same way as penalty. Banks can control the loans in advance rather than supervise and punish the enterprises. m functions to amplify the collusion risks. Banks can raise m to retard collusion.

3. Model Two: the bank's optimal behaviour

3.1. The bank's revenue function

The most notable difference between our research and others which merely focus on collusion between government and enterprises lies in the involvement of banks. As the main part of the green credit policy, banks undertake the risk shifted from environmental-unqualified enterprises being shut down. However, faced with the collusion, banks can neither get the real information, nor punish them. To make the optimal choice, banks have to control interest rate and credit lines to achieve their own maximum benefit. For the bank, no matter whether the enterprise is environmentally friendly or not and the collusion is revealed or not, the enterprise will receive interests I . In spot-checks, once a company is

identified as environmentally unfriendly, it will be fined or even shut down. If the company gets off so mildly that its repayment ability isn't fundamentally affected, it is still possible for the bank to recover the principal; otherwise, in the case of heavy fines or bankruptcy, the loss is often huge to banks. Suppose that the company's probability of repaying principal is $1-k$, hence they're insolvent at the rate of k .Then the expected value for the bank to recover the loan principal is:

$E(A) = kA + (1-k) \times 0 = kA$. By above analysis, the bank's revenue function is:

$$E_B = (1-v)I_{(v')} + v\left[d(I_{(v')} - E(A)) + (1-d)I_{(v')} \right]$$
$$= I_{(v')} - vdkA \tag{11}$$

And $\quad \dfrac{\partial E_B}{\partial k} < 0,$

Lemma three: if the enterprise is not environmentally friendly, in order to raise the expected return, banks must enhance the probability of company's repayment of the principal as much as possible.

Remark: for one thing, banks should strengthen subsequent supervision on loans, for another, cooperation between banks and the central government should be deepened to establish and the loan loss provisions mechanism and compensation mechanism should be reformed.

3.2. *Optimal relationships* among *control variables*

We have concluded that $v = \dfrac{\Delta C - df_c - df_g}{2mA}$.

When the value of v is substituted, we obtain that

$$E_B = Ai_0 + \frac{(\Delta C - df_c - df_g)^2}{4Am} - \frac{dk(\Delta C - df_c - df_g)}{2m}$$

Obviously, E_B is dependent on loan principal A . On one hand, larger principal raises interest income; on the other hand, once banks cannot recover them, risks turn into default. Hence, banks can determine a proper A to maximize its expected proceeds.

From $\quad \dfrac{\partial E_B}{\partial A} = 0$, we obtain $A = \sqrt{\dfrac{(\Delta C - df_c - df_g)^2}{4mi_0}}$.

Lemma four: To banks, loan principal A , discriminatory interest rate coefficient m and basic interest rate i_0 as a whole can enhance the profits as well as control the risks. When the three satisfy certain relationships, the bank can achieve profit maximization.

4. Conclusion

In the current system, the distortion of concept of political performance and malversation, such as rent-seeking, add so many obstacles to the central government's policy that it is difficult to resolutely implement. Based on the above analysis, we can obtain from the model not only the probability of collusion but its dominants, and we also discuss how banks can achieve their maximum benefit. We put forward a number of suggestions for policy to carry out the green credit policy from the following perspectives.

A) To ensure the collection and disclosure of environmental data, strengthening supervision and punishment.

Information asymmetry between central government and banks of corporation's environmental protection data gives rise to collusion between government and enterprises. First of all, a multi-agent information linkage mechanism should be established to achieve transparency of information, to create frequent information exchange between local environmental protection departments and financial institutions. Second, the central government should strengthen supervision and more actively and effectively control the enterprise's environmental situation in various regions. A supervision system should be established as a stable and long-term mechanism and a credit information database should be integrally set up including information about enterprises' breaking environmental laws, getting environmental approvals and progressing in energy saving. In addition, the central government should take tough measures to raise fines, increasing the explicit costs. In the long run, the existing wrong view of political performance should be reformed to enhance the hidden losses brought by collusion.

B) To improve the banks' environmental risk management, and pay attention to the use of market measures.

As to banks, granting green credit is not a mere public benefit activity or a response to the policy, but an important means to enhance their core competitiveness and operational capacity. It just hit the point of green credit policy for banks to adjust the parameters of granting a loan, using the market instruments to allocate credit resources. Discriminatory interest rate coefficient serves as a shield for environmentally friendly enterprises, but a punishment mechanism to unsatisfactory businesses. Reasonable increase in that coefficient can reduce the probability of collusion; basic rate, that coefficient and the amount of loans should be comprehensively set to maximize the expected proceeds. In Model one corporations are roughly divided as environmentally friendly and unfriendly, however, in reality, corporations can be rated in details in terms of environmental protection level. In the credit process, banks should correctly evaluate possible types of environmental risk encountered by businesses, classify them and perform the discriminatory interest rate management.

Banks should lay particular emphasis on post control, at any time monitoring the debtor's daily business operations and environmental conditions. Although banks can not detect symptom of high pollution with field survey methods, they're able to refer to account books. Once the bank finds debtor's over-inflated profits, extremely low amortization amount of environmental protection facilities costs etc., it ought to timely pay great attention and take appropriate measures to reduce the losses. Banks can create a series of supporting systems covering green credit bad debt write-offs, risk provision accrue and close-ended payments to ensure the security of credit funds.

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