

Incomplete Enforcement of Pollution Regulation

Bargaining Power of Chinese Factories

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In dealing with local environmental authorities, Chinese firms facing adverse financial situations have more bargaining power than other firms, while those generating more complaints from the public about their emissions have less.



Summary findings

Only a small number of studies have empirically examined the determinants of the monitoring and enforcement performed by environmental regulators, and most of these have focused on industrial countries. In contrast, Wang, Mamingi, Laplante, and Dasgupta empirically examine the determinants of enforcement in China. More precisely, they analyze the determinants of firms' relative bargaining power with local environmental authorities with respect to the enforcement of pollution charges.

The authors show that private sector firms appear to have less bargaining power than state-owned enterprises. Contrary to earlier findings, they also show that firms facing adverse financial situations have more bargaining power than other firms and are more likely to pay smaller pollution charges than they should be paying.

Finally, the authors show that the greater the social impact of a firm's emissions (as measured by complaints), the less bargaining power it has with local environmental authorities.

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Incomplete Enforcement of Pollution Regulation: Bargaining Power of Chinese Factories

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1. Introduction

A large amount of theoretical research has been conducted on the incomplete enforcement of environmental regulation, and how regulators and firms respond to optimal enforcement and compliance strategies. However, on the empirical side, only a handful of empirical studies have been undertaken, almost exclusively in the context of developed countries.¹

A small number of papers have empirically examined the determinants of the monitoring and enforcement activities performed by the environmental regulator. Dion et al. (1998) have examined the determinants of environmental inspections (monitoring) in the pulp and paper industry in Canada, and found that local conditions (such as employment conditions, and local environmental damages) explain variations in monitoring intensity across plants: the lower the unemployment rate in a region, and the higher the potential of damages from a firm's emissions, the higher the probability of inspections. Deily and Gray (1991), and Gray and Deily (1996) have similarly analyzed the determinants of inspections and enforcement activities in the steel industry in the United States. In particular, Gray and Deily (1996) found that larger firms in the steel industry as well as firms with higher gross profit rates faced less enforcement actions from the United States Environmental Protection Agency.

In this paper, we empirically examine the determinants of the enforcement of pollution charges in China.² China's pollution levy system is one of the most extensive in the world. According to this system, central government sets up the level and structure of the pollution levy but let local (municipal) environmental authorities responsible for collecting the levies from industrial facilities. This effectively leaves in the hands of the local regulators the responsibility of establishing how much of the calculated levies to collect from each facility. As may be expected, Wang and Wheeler (1996) have observed that the collection of the fees by local authorities diverges from the legal system

¹ See Garvie and Keeler (1994), and references therein. See Cohen (1998) for a literature review.

² The pollution charge system in China is most often referred as pollution 'levy'. We thus adopt this terminology in this paper.

established by the central government. In particular, the level of completeness in levy collection varies markedly across polluting firms: some firms pay 100% of the pollution charges they should be paying, while others will pay a much smaller percentage. Using database of plants located all across China, Dasgupta et al. (1997) and Wang and Wheeler (2000) have shown that the actual collection of pollution levies is sensitive to differences in economic development and environmental quality: air and water pollution levies are higher in areas which are heavily polluted. While this result supports the normative theory of regulation where it is assumed that the regulator seeks to maximize social welfare (Posner, 1974), these papers do not seek to explain how the characteristics of individual firms may impact their relative bargaining power with local authorities.

In this paper, we seek to analyze the determinants of the relative bargaining power that firms may have in their relation with local environmental authorities pertaining to the enforcement of pollution levy. We show that firms from the private sector appear to have less bargaining power than state-owned enterprises. We also show, contrary to Gray and Deily (1996), that firms facing an adverse financial situation have more bargaining power and are more likely to pay *less* pollution levies than what they should be paying (less enforcement). Finally, we also show that the higher the social impact of a firm's emissions (as measured by the presence and number of complaints), the smaller the bargaining power of the firms with local environmental authorities.

The paper is organized as follows. The next section presents a short description of Zhenjiang municipality where the analysis takes place, and of the pollution levy system in China. The analytical and statistical models are presented in Section 3, while results are presented in Section 4. We briefly conclude in Section 5.

2. Policy Context

(i) *China's pollution levy*³

China's pollution levy is one of the few economic instruments with a long, documented history of application in a developing country. In sheer magnitude, the current Chinese system may be without peer in the world. The Chinese environmental protection law specifies that "in cases where the discharge of pollutants exceeds the limit set by the state, a compensation fee shall be charged according to the quantities and concentration of the pollutants released." In 1982, after three years of experimentation, China's State Council began nationwide implementation of pollution levies. Since then billions of yuan (US\$1 = 8.2 yuan) have been collected each year from hundreds of thousands of industrial polluters for air pollution, water pollution, solid waste, and noise. In 1996, the system was implemented in almost all counties and cities. Four billion yuan were then collected from about half a million industrial firms. Numbers are increasing each year with as the number of firms included in the program increases.

There are some unique features to the levy system in China. For wastewater, the system first calculates a pollution levy only on those pollutants that do not comply with regulatory effluent standards. Then, among these calculated levies (for each pollutant that does not comply with the standard), the firm must pay the charge only on the pollutant which violates the standard by most.⁴ The levy collected is used to finance environmental institutional development, the administration of the program, and to subsidize firms' pollution control projects. When a firm invests in pollution abatement, a maximum of 80% of the levy paid by the firm can be used to subsidize the investment project proposed by the firm.

³ For a comprehensive overview of environmental legislation and institutions in China, see Mei (1995) and Sinkule and Ortolano (1995). For a detailed discussion of the pollution levy system itself, see Wang and Wheeler (1996), and Dasgupta et al. (2001).

In China, the effective implementation of environmental laws and regulations, including the implementation of the pollution levy, is in large part the responsibilities of local, especially municipal, governments. Article 16 of Chapter 3 of the Environmental Protection Law (EPL) indeed states that “the local people’s governments at various levels shall be responsible for the environmental quality of areas under their jurisdiction and shall take measures to improve the quality of the environment.” As a result, Environmental Protection Bureaus (EPB) have been created at all levels of local governments, from provinces to counties. These EPBs are thus responsible for the implementation of the pollution levy system.

(ii) *Zhenjiang municipality*

Zhenjiang, with a population of approximately 3 million people, is an industrial city located on the South Bank of the Yangtze River. It is directly under the leadership of the Jiangsu provincial government. Zhenjiang’s industrial growth has been extremely rapid during the period of China’s economic reform. Over the course of the last decade, Zhenjiang’s industrial output increased at an average rate of 9% annually. The industrial sector is the most important economic sector of Zhenjiang employing a large percentage of the total labor force, and the industrial base is large and diversified. State owned enterprises do not dominate Zhenjiang industry as private investments have considerably increased in the last decade. Given its importance, the rapid growth of the industrial sector has contributed significantly to improving living standards. However, as a result of this rapid expansion, environmental quality – both air and water ambient quality – has significantly deteriorated.

Zhenjiang Environmental Protection Bureau (ZEPB) is at the apex of decision-making and interagency coordination on environmental policies in Zhenjiang. The activities include the collection of pollution levies and non-compliance fees, the monitoring of air and water ambient quality, and the monitoring and inspection of

⁴ After 1993, the government started charging for wastewater discharges (flow) whether the effluent met regulatory concentration standards or not.

industrial facilities. The monitoring and inspection of industrial facilities in Zhenjiang (and in all other EPBs in China), follow a precise procedure. Apart from regular inspection activities, complaints made by citizens regarding environmental incidents may give rise to field inspections.⁵ If the polluter is found at fault, various administrative penalties or warnings may then be imposed. These may also include the need for the polluter to install treatment facilities. In extreme cases, the plant may be ordered to cease and relocate its operations.

Like in other areas of China, even though Zhenjiang EPB is legally responsible for enforcing environmental regulations, it has limited resources and power to fully enforce the policies. As a result, many polluters can effectively avoid paying charges, fines or other penalties. While Zhenjiang EPB is in a position to assess and determine the pollution levy that must be paid by each individual polluter, in fact, it lacks all necessary power to collect the entire levy it has assessed. In practice, local authorities must negotiate with polluters.⁶ Hence, the effective payment made by the polluter is the result of a negotiation and bargaining process with the EPB. It is this negotiation process that we seek to model below.

3. Model

(i) *Analytical framework*

Two groups of factors may determine the level of completeness of the enforcement of a nationwide policy. A first group of determinants pertains to local socio-economic and environmental conditions. Indeed, the national policy may or may not reflect the optimal level of pollution control in a local area. In such circumstances, local

⁵ All Chinese citizens have a right to file complaints on pollution matters, and these have to be filed and dealt with in a very precise manner. Zhenjiang EPB is entitled to bring cases to court on behalf of the public.

⁶ For more discussions on environmental enforcement issues in China, see Wang (2001).

governments may want to adjust the national policy to reflect those local conditions. This creates a phenomenon of endogenous enforcement of a national policy.⁷

The second group of determinants of the level of enforcement is associated with the polluters themselves. Indeed, in most circumstances, local regulators will have to negotiate with polluters. In the case of pollution charge system, regulators will have to negotiate on the amount of charges that the polluters will effectively have to pay for its emissions. To the extent that the agreed upon payment is less than what the firm should be paying (according to the legislation), this causes incomplete enforcement of the regulation.

Define the completeness of pollution levy enforcement in China (noted EL_{ij}) as the ratio of the pollution charges actually collected from a polluter i in a region j (L_{ij}^c) to the charges that should be collected according to the national standards (L_{ij}^s):

$$(1) \quad EL_{ij} = L_{ij}^c / L_{ij}^s$$

Following the above discussion, the degree of enforcement of the national pollution levy system is expected to be a function of local government's enforcement adjustment of the national policy, and the relative bargaining power of an individual firm. We note $EL_{ij} = f(R_j, P_{ij})$ where R_j is a vector of local variables which determine the nature of the local adjustment of a national policy in region j , and P_{ij} is a vector of variables which determine a polluter's relative bargaining power vis-à-vis the local enforcement agencies. R_j may include variables such as local income, education level, environmental condition as well as local industrial development. In China, we expect the following firm specific variables to impact the relative bargaining power of the firm:

⁷ In the environment field, this phenomenon has been empirically analyzed in Dion et al. (1998), Deily and Gray (1991), Gray and Deily (1996), Pargal and Wheeler (1996), and Wang and Wheeler (2000).

- *Plant ownership.* We expect a privately owned plant to have less power to bargain with a municipal EPB and elicit a lower payment than other types of firms, namely than state-owned enterprises. We thus expect EL_{ij} to be higher for privately owned firms;
- *Employment.* Firms which employ more workers should have stronger power to negotiate with the EPB for levy payment. We thus expect EL_{ij} to be lower the larger the plant is (in terms of number of employees);
- *Pollution discharge.* A large polluter may or may not have stronger power in negotiation. Therefore, the effect of the scale of pollution discharge is an empirical issue. Moreover, pollution discharge itself may be a function of the levy collection. In this paper, pollution discharge is treated as an endogenous variable;
- *Industrial sector.* This effect remains an empirical issue;
- *Profitability.* It is expected that the relative power and effort to negotiate with an enforcement agency for less levy payment should be stronger if a company has a lower level of profitability. In other words, the more profitable is a firm, the more it can afford to pay the pollution levy, and the smaller its capacity to negotiate and evade payment of the full amount of the calculated pollution levy;
- *Pollution control effort.* A company which demonstrates significant effort to abate or reduce pollution should be more likely to succeed in bargaining with the environmental enforcement agency;
- *Negative image.* A firm with a negative environmental image (as measured for example by the number of environmental incidents or citizen complaints) should have less bargaining power than another firm with a positive environmental image;
- *Levy refund.* As indicated previously, a polluter in China is entitled to get some refund of the levy it has paid if it can demonstrate that the refund will be used for its pollution control activities. It is expected that a firm which is successful in getting a refund in previous years may reasonably expect to get a similar refund in the current year, and may therefore exert less effort to bargain for lower levy payment;

- *Number of inspections.* As for the pollution discharge variable, we expect the number of inspections at any given facility to be itself endogenous to the pollution levy, and it will thus be treated that way.

(ii) *Econometric modeling*

Since in this paper we are focusing our research effort strictly in one municipality (Zhenjiang), the vector of variables R_j is treated as a constant vector in the function $EL_{ij} = f(R_j, P_{ij})$. Therefore, variance in EL_{ij} is expected to be determined only by P_{ij} . Given that both the number of inspections and the level of discharges are treated as endogenous variables, the system of equations we seek to estimate is as follows:

$$(2) \quad Insp_{it} = c + a_1 Time + a_2 Lcinsp_{i,t-1} + a_3 Lcc_{i,t-1} + a_5 PO_{i,t-1} + b_i + v_{it}$$

$$(3) \quad PO_{it} = c + X_{it}\beta + Z_i\gamma + \delta_1 Insp_{it} + \delta_2 PO_{i,t-1} + d_i + m_{it}$$

$$(4) \quad EL_{it} = c + X_{it}\phi_1 + Z_i\phi_2 + S_{it}\phi_3 + PO_{it}\phi_4 + Insp_{it}\phi_5 + \alpha_i + u_{it}$$

Where

$i = 1, 2, 3, \dots, N$ stands for firm;

$t = 1, 2, 3, \dots, T$ stands for time;

$Insp$ is the number of inspections;

$Lcinsp$ is the cumulative number of inspections up to time $t-1$;

Lcc is the cumulative number of complaints up to time $t-1$;

PO is the level of discharges relative to the standard;

X is a matrix of time-varying variables which consists of:

Emp (number of employees);

$State$ (dummy variable to indicate state owned enterprise);

$Coll$ (dummy variable to indicate collectively owned enterprise);

Fjv (dummy variable to indicate joint venture);

Z is the matrix of dummies for sectors such as textile, petrol, tobacco, construction, food, beverage, metal, paper, and chemical;

EL is the ratio of water levy actually paid to water levy that should be paid;
 S is the matrix of time-varying variables which consist of:
Profem (profit per number of employees);
Lref (lag refund / lag levy paid);
Ratwtop (pollution control operation cost / total operating cost);
Cmpaccon (complaints or accidents or conflicts with local communities);
 b_i, d_i, α_i are firm specific effects in the first, second, and third equation;
 v_{it}, m_{it}, u_{it} are the usual error terms.

The following assumptions are made in estimation:

- the firm specific effects are random;
- the three error terms are uncorrelated and well behaved;
- the lagged pollution variable is uncorrelated with the error term in the first equation and correlated with the corresponding error term in the second equation;
- all the right-hand side variables in the first equation are doubly exogenous; that is, uncorrelated with the firm specific effects as well as with the error term;
- inspection is an endogenous variable in the second equation;
- inspection and pollution are endogenous variables in the third equation.

This system of equations is recursive and dynamic. Since the model is recursive, we can estimate it equation by equation.⁸ Here, however, we are interested in the third equation.

To eliminate the individual effects we transform equation (4) into the following:

$$(5) \quad \Omega^{-1/2} EL_{it} = \Omega^{-1/2} c + \Omega^{-1/2} X_{it} \phi_1 + \Omega^{-1/2} Z_{it} \phi_2 + \Omega^{-1/2} S_{it} \phi_3 + \Omega^{-1/2} PO_{it} \phi_4 + \Omega^{-1/2} Insp_{it} \phi_5 + \Omega^{-1/2} e_{it}$$

where variables are defined as above, and e_{it} is the new error term, defined as the sum of the firm random specific effects (α_i) and the regular error term (u_{it}). The matrix omega is the appropriate matrix to eliminate the individual effects. It is constructed as follows:⁹

⁸ See Lahiri and Schmidt (1978) for further details.

⁹ See, for example, Ahn and Schmidt (1995) for details.

$$(6) \quad \Omega^{-1/2} = Q_V + P_V \theta$$

with

$$(7) \quad P_V = I_N \otimes l_T l_T' / T$$

$$(8) \quad Q_V = I_N - P_V$$

and

$$(9) \quad \theta^2 = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_\alpha^2}$$

For any integer m , let l_m be an $m \times 1$ vector of ones. The idempotent matrix Q_V transforms the original variables into deviations from individual means, and P_V transforms original variables into a vector of individual means.

4. Data and Estimation Results

(i) Dataset

In order to perform this analysis, a primary dataset was recently collected with detailed information on several hundreds industrial plants in Zhenjiang, covering the period 1993 to 1997. In 1997, the total number of plants included in our sample is 640. Of these, 26% are state owned enterprises, the majority being collectively-owned enterprises. Most of the plants in the dataset are medium and small enterprises, with only 4% of the enterprises being large. These large plants, however, account for approximately one third of the total value of output of the enterprises in the dataset. A further breakdown indicates that the timber processing, the food processing and the petroleum processing industries represent the largest number of sectors in our dataset with 17.2%, 15.6% and 10.2% of the plants, respectively.

Table 1 describes the water pollution discharges of the firms in 1997. In brackets is the number of firms on which the entry has been computed (since the information was not always available for all the firms in the dataset). Note that a large proportion of the

firms in the dataset have paid water levies, and therefore, was not complying with at least one regulatory standard.

Table 1
Water discharge characteristics in 1997

Average discharges (kg/year)	
TSS (total suspended solids)	47,861 (530)
COD(chemical oxygen demand)	48,591 (626)
Average concentration (mg/l)	
TSS (total suspended solids)	99 (503)
COD (chemical oxygen demand)	280 (507)
Proportion of firms paying levy	45 %

In 1997, the 640 enterprises were the object of 5,287 inspections, most of them (99.4%) performed by the Zhenjiang Environmental Protection Bureau. These enterprises were also the object of 78 water related complaints, and 163 air related complaints.

Table 2 provides the mean and coefficient of variation of the variables of interest in this analysis. Some remarks are useful before commenting the statistics of interest. First, given the presence of missing observations, the number of observations used to compute these statistics is not necessarily the same for all variables. Second, the coefficient of variation instead of the standard deviation has been used as a measure of dispersion to compare variables with different means and different units of measurement. Noteworthy are the mean values of the number of inspections, the ratio of total refund to the levy paid in the previous year as well as the ratio of total profit to total employment. On average a plant got inspected 8 times a year. In fact, the highest number of inspections recorded in a single plant was 61 in one single year. This is quite an impressive number. Also observe that the variable “refund” is important since on average

in the previous year “refund” was greater than total levy paid. Finally, the ratio of total profit to total employment is on average negative indicating that most firms incur losses. Note however that this average is most likely affected by outliers (minimum value is – 218 and maximum value stands at 41.67). The median value, which is a better measure of central tendency, has a value of 0.0146. Finally, note that the coefficient of variation varies a great deal. It goes from 29.80% (*EL*) to 6,069.44% (*Profemp*). The typical variation is between 100% and 1000%. There seems to be a great difference in variations between discharges using total suspended solids (3,840.85%) and those for chemical oxygen demand (306.01%). Care should thus be exercised when interpreting results using variables with greater variability since the variables might contain some outliers.

Table 2
Means and coefficients of variation for variables of interest in 1997

Variable Names	Definition	Mean	CV in % ¹
EL	Water levy paid / water levy charged	0.9566	29.80
State	1=a plant is a state-owned enterprise; 0=otherwise	0.3228	144.83
Coll	1=a plant is a collectively-owned enterprise; 0=otherwise	0.5964	82.26
Fjv	1=a plant is a joint venture; 0=otherwise	0.0706	362.75
Textile	1=textile industry; 0=otherwise	0.0189	721.16
Chemical	1=chemical industry; 0=otherwise	0.0224	660.42
Profemp (profitability)	Total profit / total employment	-0.1056	6,069.44*
Lref (refund)	Total refund from the levy fund divided by total levy paid in 1996	2.2256	337.60
Ratwtop (pollution control effort)	Total operation cost of water pollution abatement divided by total production operation cost	0.0016	418.75
Cmpaccon (social impact)	1=having environmental accidents, environmental conflicts or citizen complaints on its pollution; 0=otherwise	0.1848	210.06
Bentss (TSS violation)	Level of discharges of total suspended solids with respect to the standard	0.0674	3,849.85
Bencod (COD violation)	Level of discharges of chemical oxygen demand with respect to the standard	1.5923	306.01
Insp (number of inspections)	Total number of inspections to a plant	7.7604	127.17

¹ CV stands for coefficient of variation. It is calculated as the ratio of the standard deviation to the mean.
“*” indicates the absolute value.

(ii) *Estimation results*

Given the presence of endogenous variables in the equation of interest, the general method of moments (GMM) is an appropriate method of estimation to obtain under some conditions consistent and efficient estimates. Thus, the GMM is applied to equation (5). The instruments we use here are¹⁰

$$(10) \quad (Q_v X, Q_v S, P_v X, P_v S, P_v Z)$$

where the variables are defined as above. Note, however, that in equation (10), the matrix X also contains the time variable as well as the constant term c .

Results of estimations are presented in Table 3¹¹. All results are consistent with expectations except that two different pollutants give two different signs. The default ownership variable in the model is private ownership, which should have a positive relationship with the ratio of levy payment because three other forms of ownership - state-owned, collectively owned and joint ventures, all have negative effects. This thus indicates, perhaps unexpectedly, that privately owned enterprises (voluntarily or not) have less bargaining power with respect to the payment of the pollution levy.

Profitability has a positive relationship with the levy payment ratio just as expected but the relationship is not significant. Pollution abatement effort has a significant, negative relationship with the levy payment ratio. This negative relationship indicates that a company which has spent more on pollution abatement (which may be an indication of goodwill or greater awareness of environmental and pollution issues) will more easily get waived of paying for the levy charged. Precisely, a 1% increase in pollution control brings about a 0.01% decrease in the levy payment ratio¹².

¹⁰ See Ahn and Schmidt (1995) for a thorough discussion on instruments .

¹¹ Note that in the X and Z matrices, variables that are not significant have been eliminated.

¹² All responses are elasticities. Each elasticity is the coefficient of the variable of interest times the mean of the variable and divided by the mean of EL .

Table 3
GMM Results for equation (5) – Dependent variable: EL

Independent Variables	Parameter Estimates Model 1 (TSS)	Parameter Estimates Model 2 (COD)
State	-0.0607** (0.013)	-0.0729** (0.013)
Coll	-0.0843*** (0.000)	-0.1195*** (0.000]
Fjv	-0.0421* (0.094)	-0.0581 (0.136)
Textile	0.2423*** (0.000)	0.1586*** (0.007)
Chemical	0.1159** (.016)	0.1321*** (0.000)
Profemp (profitability)	0.0003 (.119)	0.0000 (0.869)
Lref (refund)	0.0059*** (0.001)	0.0067*** (0.001)
Ratwtop (pollution control effort)	-3.8832* (.057)	-5.5717*** (0.003)
Cmpaccon (social impact)	0.0504** (0.023)	0.0725** (0.012)
Bentss (TSS violation)	-0.0094* (.099)	
Bencod (COD violation)		0.0202* (0.093)
Insp (number of inspections)	-0.0007 (.283)	-0.0033** (.050)
Test overid. rest.	14.0825 (0.295)	13.1836 (0.356)
# observations	382	378

Note: (...) are p-values. Standard errors are robust standard errors. Test overid. rest. is the test for the validity of over-identifying restrictions. (***), (**), and (*) means significant at the 1%, 5%, and 10% level, respectively.

A firm which has suffered environmental accidents, conflicts with residents on environmental issues or is the object of citizen complaints is more likely to pay for the full pollution charge. A firm which has received a refund from the levy funds in the previous year appears more willing to pay for the levy charged in the current year. A 1% increase in discharges of ratio of total suspended solids to its standard brings about a decrease of the order of 0.007% in the levy payment ratio. On the contrary, a 1% increase

in discharges of chemical oxygen demand with respect to its standard gives rise to a 0.04% increase in the levy payment ratio. As explained previously, both results are consistent with expectations regarding the uncertain impact of pollution discharges on the bargaining power of the firm. Finally, a 1% increase in the number of inspections brings about a 0.04% decrease in the levy payment ratio. This result is of interest. In a previous paper, Dasgupta et al. (2001) have shown that inspections reduce pollution discharges of industrial establishments in China. However, results here indicate that a greater level of inspections is associated with a reduction in the levy payment ratio. While more inspections may improve the environmental performance of the plants, more inspections also appear to indicate that the plant is less willing to pay for a pollution charged.

5. Summary and conclusion

There are two issues associated with the implementation of a national environmental policy at the local level such as the pollution levy system in China: endogeneity of enforcement and incomplete enforcement. With a primary database collected in Zhenjiang, China, this paper has analyzed the issue of incomplete enforcement, which is caused by the relative bargaining power of the industrial establishments. Unlike previous papers which have mainly focused on the impact of socio-economic and environmental conditions, in this paper we have examined more precisely the impact of firms' characteristics (such as financial status, pollution control effort, social impact of pollution emission, magnitude of emission violation, as well as refund of levy paid and number of inspection received on the amount of levy paid relative to the amount that should have been paid if the national system had been strictly applied. With a stronger bargaining power in the hands of the industrial sector, we expect the degree of enforcement to be lower.

The empirical results are consistent with prior expectations. Firms which are privately owned have less bargaining power in levy payment. A bad financial situation entails a higher relative bargaining power and a bigger effort to bargain for less levy payment. A plant which spent more on pollution control is more likely to get waived, the

some portion of the levy payment. The higher the social impact of pollution emissions of a plant, the less is the bargaining power in levy payment. A plant which had more levy refund before is less likely to spend strong effort to bargain for less levy payment. Finally, the number of inspections received has a significant, negative correlation with the ratio of levy payment. However, conflicting results are found in the magnitude of emission violation between two different pollutants: total suspended solids and chemical oxygen demand. Although the signs of the correlation are empirical issues, the reason for this divergence is not known.

Empirical work of the nature performed here which seeks to analyse and comprehend the actual implementation of environmental policies still remains a rarity in the literature. This is especially the case for developing countries where very little is known on implementation issues. Yet designing environmental policies and legislation while ignoring how these will be implemented may in all likelihood lead to the adoption of policies which may appear effective, perhaps even cost efficient in design, but lead to only minimal results in practice. We hope this paper provide a further understanding of the determinants of the implementation of environmental policies in China.

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