

ECONOMY AND ENVIRONMENT PROGRAM FOR SOUTHEAST ASIA

The Pollution Charge System in China: An Economic Incentive?

Yun Ping

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September 1998

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The Pollution Charge System in China: An Economic Incentive?

Yun Ping*

ABSTRACT

By adopting both case study and survey methods in investigating enterprises' compliance behavior in dealing with the Pollution Charge System (PCS) in China, this project found that no matter what the existing fee level is compared to the optimal fee level, the enterprises respond to it in an economic way. However, most of their compliance behavior and the local environmental protection bureaus' (EPBs) enforcement behavior lower both the incentive functions that the existing fee level could have offered and the overall effectiveness of the PCS. Thus there is a need for reforms within PCS itself, (e.g., removing subsidy and raising fee rate) and institutional reforms within the EPBs.

1.0 BACKGROUND

As a national environmental policy, the Pollution Charge System (PCS), has been carried out in China for 18 years. Local and international researchers are interested in the effectiveness of this "most important market-based environmental policy". However, the results on whether or not the PCS in China functions as an economic incentive, tends to be conflicting. Past studies have shown that the existing fee is too low. The theoretical conclusion therefore is that the existing fee would not provide sufficient incentive for pollution control. This study has shown that even if the fee is at the optimal level, there are distortions that exist in the behavior of both the enterprises and the regulatory bureaus that could lower the incentive for pollution control.

1.1 The Pollution Charge System (PCS)

Pilot implementation of PCS began in the 1970s but it became widely used in the country only after the Provisional Measures for the Assessment of Pollution Charges was issued in 1982. It covers four types of pollution: water, air, solid waste, and noise¹.

The PCS is a two-step policy with a fee collecting system and a pollution control subsidy system. It provides for the collection of fees when discharge standards are exceeded. These fees are calculated based on the multiple by which the standards were exceeded and the volume of wastewater discharged. Payment of the fees is in addition to, rather than in lieu of, the responsibility to treat the effluent that failed to meet the applicable standards. Eighty percent of the revenue from the fees is designated for rebate and subsidy to assist enterprises in the construction of waste treatment facilities. The remaining 20 percent is allocated for EPBs use such as the purchase of monitoring equipment (NEPA 1982).

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¹ A charge on noise was newly introduced in 1991. This study will focus only on water pollution for the following reasons: a) charges on water are more systematically implemented and b) revenue from water charges accounts for 60% of the total.

1.2 The Definition of Incentive

In the diagram below, when the charge rate is set at point F^* , the optimum pollution control level P^* (i.e. that which satisfies the profit-maximizing condition) is achieved. At that point, the sum of abatement costs and damage costs are minimized. There is no doubt that such a charge system has the incentive function.

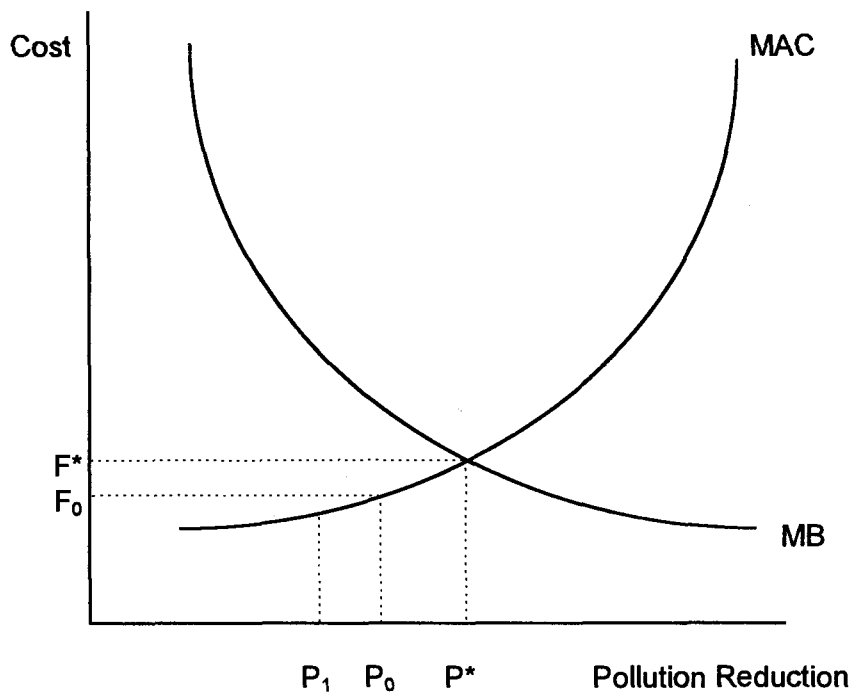


Figure 1. - Optimal Level of Pollution Reduction

In China's case, the charge rate is inevitably lower than F^* , say it is at F_0 . This corresponds to pollution reduction level P_0 . At P_0 level of pollution reduction, the total costs of pollution is not the minimum but the charge rate can still be considered a kind of incentive because at any rate lower than point F_0 , the level of pollution reduction will be lower than P_0 . This analysis presupposes that the effects of other policies are not considered. The most significant evidence of impact of the imposition of a charge rate is the dramatic reduction in pollution discharges on those years just after this policy took effect. Nevertheless, the rate F_0 does not always give the incentives to reach P_0 . The effectiveness of the incentives may be influenced by certain factors. For example, if the enterprises expect to receive the 80 percent refund from their payment despite the charge being higher than the marginal abatement costs, then they will prefer to pay the charges (i.e., only $F_0—P_1$ can be achieved). It is easy to expect that even if the charge rate reaches F^* , P^* still can not be achieved if this factor is considered. Therefore, this study assumes that F_0 can also provide an incentive toward controlling pollution more cost-effectively and identify why $F_0—P_0$ can not be achieved. It then suggest ways to achieve the move toward $F^*—P^*$.

1.3 Behavioral Assumption

A characteristic of Chinese enterprises is that they try hard to maximize production, not profit (Jiang 1991). When the planning system was still predominant, the political pursuit was the most important factor in assessing the benefits. Output maximization was the enterprises' target. With the political and economic reform that started in the late 1970s, political ambition was gradually replaced by income motivation. Maximizing income (wages and bonus) of managers and workers constitute the most important goal of the enterprises' economic activity. Later, with the transition from planning to market economy, profit maximization gradually becomes the end goal of production.

The author also believes that enterprise behavior is determined not only by internal motivation, but also by external environment. This includes changing the economic system and enforcement by authorities, among others.

2.0 PART ONE: CASE STUDY

Case studies in three cities were conducted from June to December in 1995. The cities studied are shown in the table below:

Table 1. Cities where case studies were conducted.

City Selected	Position	Province	City Size	Percent of State-owned Enterprises
Anyang	North China	Henan	Small	High
Changzhou	East China	Jiangsu	Middle	Average
Shundex	South China	Guangdong	Small	Low

The case study focused on two major interest groups—enterprises and the EPB (Environmental Protection Bureau, the enforcer of PCS)—even if other sectors were also involved. The following institutional analysis provides more details about the PCS.

2.1 Institutional Analysis

Several institutions are involved in the implementation of the PCS. Each institution plays a different role, and has a different interest in the system, but they must all work out a viable compromise for each case. Some are enforcers of the policy while others are involved in only part of the implementation. Some of them strive for local tax and budget balance of the whole city, while others seek to support development of enterprises which are subject to them. Each one however seeks to ensure that implementation of PCS is somewhat more reliable.

In this part of the report, all the sectors involved in PCS implementation is described. Also discussed is how these sectors relate to each other and form the mechanisms for this process.

2.1.1 Enterprise

Enterprises remain the main PCS target. The concern of firm managers has switched from output (before the economic reform, in the late 1970s) to profit and the bonus requirement of their employees (after the reform). According to the PCS, those who produce effluents with concentrations exceeding national or local standards should pay a certain amount of pollution charges on a monthly basis. The pollution charge is divided into two parts: (1) the normal charges which can be included in the production costs by enterprises, and (2) "four small pieces", referring to the fines for the following cases:

1. increasing the charge rate five percent per year after the third consecutive year that the standards are violated;
2. double pricing when a newly set-up factory (after 1979 when the National Environmental Law was promulgated) is violating the standards;
3. fine for such behavior if the self-reported discharges are less than those found by the local EPB in their infrequent, unannounced inspection and improper operation of their treatment facilities, etc.; and
4. interest on late payments.

The "four small pieces" should be paid using the enterprises' own fund. This mechanism is designed to exert more pressure on enterprise to protect the environment (NEPA 1988).

It is easy to see that the pollution charges will have negative effects on the enterprises' profit, on their retained revenue, and thus on workers' bonus. Enterprises must therefore have the internal incentive to reduce the payment of pollution charges. This can be accomplished in two ways: first, by improving the management and reducing the wastes; and secondly, by applying technological methods to deal with pollution problems.

In China, 80 percent of the revenue from pollution charges is refunded by enterprises, who pay through grants or loans designed to supplement earmarked pollution control projects (NEPA 1982). This encouraged enterprise to avoid paying pollution charges by building pollution control facilities. However, with the continuous increase in prices of raw materials and electricity, the operation costs gradually exceeded the pollution charges, and the attractiveness of getting the subsidies to meet the standards is diminishing. More enterprise would rather pay the charges than make provisions for pollution control. Nevertheless, with the emergence of the market system and the expansion of foreign investment, the environmental performance — more specifically, the possession of pollution control facilities — becomes the prerequisite for gaining foreign investment and setting up joint-venture investments². To some extent, these motivate enterprises to invest in pollution control.

2.1.2 Local Environmental Protection Bureau (EPB)

Local EPBs are the enforcers of PCS. They are responsible for environmental management and environmental quality of the whole city. The main functions of EPBs include collecting pollution charges; organizing pollution control efforts; monitoring,

² Interview, environmental engineer, Shunde Silk Plant, Shunde, June 12, 1995.

collecting and publishing data on environmental quality; and providing technology assistance and training programs, among others.

Twenty percent of the revenue raised from the pollution charges can be used by the EPB itself to purchase large monitoring apparatus and to supplement other administrative expenditures (NEPA 1982). However, it is highly possible that self-interest during PCS implementation will result in bias in accomplishing the policy goals.

Environmental protection is a comprehensive effort which requires the support and cooperation of government sectors such as financial and industrial bureaus, planning and economic committees, and local banks among others. Thus, it is important that the EPBs ensure proper coordination among these sectors. They have found that one effective way³ to do this is by gathering key persons from all government sectors for a "working party" at the end of each year. At that meeting, the EPB expresses its gratitude for the smooth cooperation of all the sectors during the past year and informs them of plans for the new year.

2.1.3 Industrial Bureau

Every industrial bureau manages a cluster of enterprises in similar lines of production. In the PCS process, pollution registration or the earmarking of project application of enterprises should be approved by the industrial bureaus before their cases are reported to the EPB. When enterprises are at odds with the EPB because of such things as amount of pollution charges and responsibility for an environmental accident, they turn to their industrial bureau for help and protection. On behalf of the enterprise concerned, the industrial bureau bargains with the EPB to seek a compromise.

Generally, the industrial bureaus do not reject requests of enterprises to list proposed pollution control projects in an inventory, submitted to the EPB once or twice a year for final approval. Usually, the bureaus will improve the project proposal from the technological point of view. However, in some cities, each industrial bureau is responsible for the allocation of a limited amount of subsidies for distribution to its subsidiaries. In this case, the industrial bureau must behave selectively, choosing only those projects with greater maturity and net benefits.

2.1.4 Local Financial Bureau

The revenue raised from the pollution charges should be transferred to the financial bureau every three months, and the disbursement of this revenue (the 80 percent for the enterprises or the 20 percent for the EPBs) should be approved by the financial bureau.

As mentioned above, the normal pollution charges can be paid from the production costs; after translating to a reduction of income taxes paid by the enterprises. To some extent, the raising of pollution charges has negative effects on the fiscal revenue of the whole city. For this reason, the financial bureau does not support increases in charge rate and the total amount of the charges. In some extreme cases, some financial bureaus have set a ceiling level for the total amount of charges to be raised by the EPBs⁴.

³ Interview, Chief, Anyang Environmental Protection Agency, Anyang, September 18, 1995.

⁴ Interview, chief, Changzhou EPB, Changzhou, April 23, 1996.

Because of the EPB's access to 20 percent of the pollution charges, the financial bureaus are reluctant to assign adequate administrative expenditure for the EPBs⁵. More or less, this influences the behavior of the EPBs when they implement PCS.

2.1.5 Local Banks

Pollution charges are paid through the local banks. Each month, the EPBs send to the banks a list of the enterprises and amount of charges they must pay. The local banks then deduct this amount directly from the enterprises' accounts, and transfer this to the EPBs' accounts. Delivery of the subsidy (in the form of grant or loan) for the earmarked projects is also done through the local banks and if the subsidy is a loan, then the banks are responsible for managing repayment of interests and loans. In turn, the local banks charge service fees.

According to the contract between EPBs and the local banks, the banks have another function related to this task – supervising the EPBs' use of the charge revenue. However, since the charge revenue does not belong to the banks' own fund, whether or not the use is rational does not greatly affect the banks. Thus, this function is not effectively performed⁶.

2.2 Compliance Behavior of Enterprises

Enterprises, comply with the PCS through the following:

- a) pollution registration;
- b) paying charges;
- c) applying for subsidy; and
- d) operating the pollution treatment facilities.

When dealing with EPB enforcement, enterprises depend on a complicated system of interactive, interwoven compliance behavior.

2.2.1 Pollution Registration

Under-/Over-reporting Strategy. The basis for calculating the pollution charges is the pollutant concentration in the discharge and the effluent quantity. Thus, quality and quantity of each polluter's effluent must be determined and constitute the monitoring aspect of PCS. If this task were carried out by the EPBs, it would engage too much of their administrative capacity. This is why in China's PCS, the self-reporting system is employed. The enterprises are responsible for daily monitoring of their effluent concentration and quantity, obtaining the monthly value and presenting this to the EPBs. Only after the EPBs' confirmation, which often involves the EPB officials' experience and the routine monitoring by the EPBs two to four times per year, can the value be used as the basis for calculating the charges. EPBs also conduct unannounced inspections. If the results of the latter are higher than those self-reported, a penalty (double rate or fine) is imposed on the enterprise concerned. The self-reported data is directly correlated with the pollution charges paid by the enterprise (i.e., lower concentration and smaller quantity mean lower expenditure on pollution charges). This is why some enterprises resort to under-reporting.

⁵ Interview, chief, Changzhou EPB, Changzhou, April 23, 1996.

⁶ Interview, chief, Anyang EPB, Anyang, September 18, 1995.

When EPB officials confirm self-reporting results, there is a vertical comparison of the production-discharge coefficient with that of last month's or last year's results, and a horizontal comparison with results of other enterprises having similar production processes. This method, to a certain extent, is rational. Unfortunately for many cases it fails to be accurate enough to become a defense for the under-reporting phenomenon. The irregular, unannounced inspection is thought to be effective in constraining under-reporting. However, with the EPBs' inadequate monitoring capacity, inspection frequency can not be expected to be high enough to catch cases of under-reporting. To make things even worse, even when an under-reporting enterprise is caught, EPB's action on the erring enterprise takes several steps thus, giving the enterprise concerned time to enter into a bargaining situation; in most instances, the case never progresses beyond the first step⁷. With non-compliance costs being equal to the probability of being caught times the penalty of being caught, the low values of these two factors provide the incentives for under-reporting.

There could also be an incentive for over-reporting. According to the PCS, the charge is levied on the basis of the pollutant resulting in the highest payment, if there are several types of pollutants exceeding the standards at the same time. An enterprise can over-report other pollutants as long as the resulting payments do not exceed the highest payment, which is what the enterprise actually pays. The advantage in this is avoiding the inconvenience of EPBs' unannounced inspection at times of abnormally high production, thus causing higher pollution from other sources.

2.2.2 Paying the Charges

Bargaining. Owing to the special relationship between the government and the enterprises, bargaining is the predominant system in all levels of economic activities. Not surprisingly, therefore, it also exists in the implementation of the PCS. Enterprises (especially those that are state-owned), with financial problems may ask the EPBs for reduction in the total payment for pollution charges.

Another kind of bargaining is between the enterprises and the industrial bureaus. The enterprises may argue that since they have to pay a certain amount for pollution charges, their tax quota should be reduced. Generally, this kind of bargaining succeeds because the pollution charges account for a relatively low percentage of the taxes/profits.

Late payment of the charges. Enterprises with financial problems may owe the government overdue pollution charges for months or years. Besides pollution charges, they may also have unpaid bills for taxes, water, electricity, and employee wages⁸. Usually when cash flow increases, these enterprises first pay the money owed to their employees. Second priority is paying taxes to ensure that they get the bonus for accomplishing their contracts. then they pay the water and electricity bills to prevent the public utility companies from cutting these services. By the time they are ready to pay the pollution charges, money has probably run out. In most cases, even though there is a penalty for overdue pollution charges, the EPBs generally exempt interest for late payment after they receive the delayed payments.

⁷ Interview, environmental manager, Anyang Chemical Fabric Textile Plant, Anyang, September 22, 1995.

⁸ Interview, manager, Anyang Paper Mill, Anyang, September 24, 1995.

Intent to pay more than they should. In contrast to the “owing fee” behavior, some enterprises in good economic condition, would like to pay more than they should in terms of the normal pollution charges⁹ (i.e., not the “four small pieces”). The normal pollution charges can be paid out of the production costs, and the enterprises who pay the charges are authorized to get back 80 percent of the charges they paid, for specific uses. Thus, paying more means an enterprise gives the EPBs money they should be paying the financial bureau in terms of income taxes. This is done because they expect to receive the 80 percent refund (see Case Study I for details). In order to accomplish the quota set sometimes by the higher level EPBs (i.e., the provincial EPBs) or to get the 20 percent of the revenue (i.e., the self-interest motivation), some EPBs (especially those who regard raising revenue as their first goal in implementing PCS) tend to welcome this kind of behavior. The refunds takes two forms: grant and loan. If the refund is in a loan, then an enterprise is expected to pay it back, and cash flow would be different. However, enterprises always can get a 100 percent exemption from the debt (for detailed analysis see EPBs’ behavior).

2.2.3 Applying for the Subsidy

Subsidy seeking behavior. The initial refund system has encouraged the enterprises to scramble for the subsidy, not necessary for pollution control, but for investment purposes, a traditional behavior of Chinese enterprises (Jiang 1992). Even after loans were given instead of grants in 1988, the requirements for exemption are so easy that the charge hardly made a difference.

Disregarding the soundness of new projects. In order to get the subsidy, the prerequisite is the submission of a proposal for a technological project. As shown above, the most important motivation in proposing a project is to get the investment. Thus, the project selection and proposal probably lacks complete understanding of the proposed project’s feasibility and effectiveness. This results in a waste of money.

2.2.4 Operation of the Pollution Treatment Facilities

Through nearly 20 years of implementation, the charge rate has been readjusted by about 40 percent higher only once in 1991. Because operation and maintenance of the treatment facilities has been far more costly than paying pollution charges, many enterprises prefer not to operate their facilities at all. For example, an investigation carried out 10 years ago on the operation performance of 5,554 sets of wastewater treatment facilities found out that only 1/3 were in operation, 1/3 were out of operation and another 1/3 were in operation only occasionally (Li 1992). It is believed that this scenario has not improved. In addition, those who continue operation do so not because it is cheaper but because of environmental consciousness or political positioning (e.g., trying to become a model environmental enterprise). Such reasons can not be easily pinpointed and quantified.

All these are typical ways by which enterprises react to PCS requirements. Obviously, some are more relevant to certain kinds of enterprises (i.e. state-owned or TVIEs). For example, state-owned enterprises have stronger bargaining power with the EPBs and are more likely to owe for pollution charges because of their soft-budget constraints. On the other hand, TVIEs are more conscious of the effects of pollution charges on their profits since they are facing more market factors.

⁹ Interview, environmental staff, Changzhou Liquor Plant, Changzhou, December 18, 1995.

Case Study I: An Economic Analysis

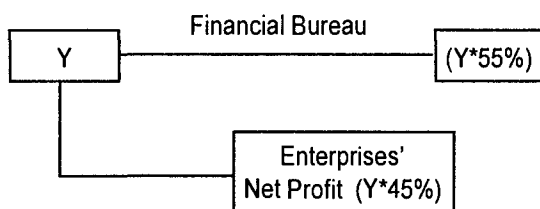
During the case study, a surprisingly popular phenomenon was found: enterprises without financial problems thought that as long as their economic condition permitted, they are willing to pay more charges than what they should. They described this payment as "just like depositing money in a bank". In some cases, this behavior was done depending on the will of the environmental managers. With the 80 percent refund, it was helpful for pollution control, for easing work when dealing with other units of the same enterprise, and for promoting their reputation within the enterprise. Many "smart" directors said that they would like to pay more to the EPBs. Thus the question: What effects does the pollution charge impose on the budget balance of an enterprise? The answer may be obtained by an analysis of cash flow of a hypothetical enterprise.

To make things simple many details are omitted in the following equation (without considering the pollution charges): $\text{Gross Profit} = \text{Sale Revenue} - \text{Sale Cost} - \text{Production Tax}$

Assume the gross profit is Y million US dollars and that the enterprise has to pay 100 million dollars' pollution charges (or even more). Then the gross profit of $(Y - 100)$ million dollars is obtained. The income tax is levied on the basis of the gross profit with the rate of 55% for state-owned enterprises (before 1994). Following are diagrams of the cash flow of these two options.

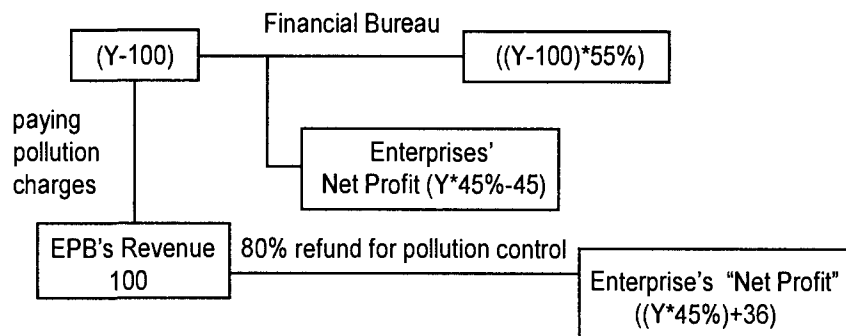
Not Paying the Pollution Charges (or Not Paying More)

Enterprise's Gross Profit; 55% of it transfers to financial bureau as income tax



Paying the 100 Million US DOLLARS' Pollution Charge (or Paying More)

Enterprise's Gross Profit, 55% of it transfers to financial bureau as income tax



Obviously, the "paying more" option is preferred since the enterprise can get more "net profit". However on July 1, 1994, the income tax rate was changed from 55% to 33%, and the attractiveness of this option is expected to decrease. Even though the subsidy (in grant or loan) is issued in terms of earmarking projects, in fact, many enterprises use the money to purchase raw materials, to develop new products, and to pay employees bonuses¹⁰. When the money runs out even if the projects have not been completed, they simply apply for a next project. The EPBs do not have enough personnel, mechanisms, and will to control this situation.

For the case studies conducted in these three cities, 10 enterprises were investigated: four of which are state-owned and six are TVIEs¹¹. When these 10 enterprises were compared, it was found that the TVIEs' environmental performance was not necessarily worse than that of the state-owned enterprises. This finding was contrary to the prevailing belief, especially in the light of the finding that the percentage of TVIE treated wastewater is even higher than that of state-owned enterprises. Strangely, however, the percentage of discharged water that met standards was not higher. This suggests an important fact: the production technology and the quality of TVIEs' human resources are less developed than those of state-owned enterprises. For example, a TVIE manager of Shunde city in Guangdong Province complained in the interview¹² that their water treatment results were not satisfactory because the operators were not proficient in calculating the quantity of materials added to the wastewater being treated; most of the time, they added more than necessary. Interestingly, there is another example from a state-owned enterprise in Changzhou. The environmental specialist complained that because the price of white lime (CaO) continued to rise, the manager prohibited its use and treatment effectiveness reduced. CaO is both a substance used in water treatment and a raw material used in the production process. Enterprise ownership plays an important role in affecting PCS compliance results. However, no evidence was found confirming the claim made by the commentators that the private enterprises are far more likely to be caught. Instead it was found that these two kinds of enterprises (i.e. state-owned and non-state-owned, including private enterprises) face different levels of administrative pressure from the EPBs. More specifically, the state-owned enterprises face more stringent enforcement for the following reasons:

- a) State-owned enterprises are still the main policy target of the PCS. EPBs still do not have yet the capacity to include in their enforcement many TVIEs or private enterprises which are scattered in the area.

¹⁰ Interview with a group of environmental staff from nine enterprises under the chemistry industry, and the environmental official of the Industry Bureau of Changzhou, Changzhou, December 22, 1995.

¹¹ According to some, the case study and survey should have included private enterprises. However, the average EPB rarely includes many private enterprises, in their enforcement. In another words, most of the private enterprises are not required to comply with PCS. Thus, private enterprises were included in TVIEs rather than as a different kind of ownership. For the characteristics of private enterprises, the writer interviewed a specialist from the China Social Academy and learned that private enterprises share many similar characteristics with TVIEs (e.g., market pressure). Generally speaking, the size of private enterprises is very small, averaging 470 thousand RMB's registered capital and 15 employees. Economically, they are facing discriminate condition on taxes and loan requirements, and image problems (low quality imitations are damaging business). The conclusion is that private enterprises would seek to combine with local governments when they develop to a certain level and face such problems as human resources and land use, and a mixture type of ownership will emerge.

¹² Interview, firm manager, Nanfang Silk Corporation, Shunde, June 9, 1995.

- b) Generally, the TVIEs (and the private enterprises) are supervised by county EPBs or EPOs (environmental protection office), that are even more dependent on the county government for financial support. This is why the bargaining phenomenon is even more prevalent.

2.3 Enforcement Behavior of EPBs

All the behaviors mentioned above have only one result: lower the incentive function from (Fo—Po) to (Fo—P1). Why enterprises behave this way is understandable: they can spend less (i.e. benefit maximization). But another question that may emerge is why all these behaviors can be effective in reducing the enterprises' responsibilities for their pollution. The answers lie in, on one hand, the irrationality and inconsistency of the policy system per se, such as the mono-factor of charge determinant and the subsidy to the specific enterprises who pay the charges. On the other hand, there is the "government failure" of EPBs and other government sectors.

The behavioral assumption of "benefit maximization" is also applicable for the EPBs. With the close relationship between the pollution charges raised by the EPBs and the EPBs' survival (Table 2), the EPBs are more concerned with how much they can raise the charges than how good is the water quality¹³. In order to ensure a certain amount of pollution charges, EPBs tend to take PCS implementation as their priority task¹⁴, inputting a large amount of human, physical, and capital resources into it. Even in PCS implementation, the EPBs tend to take greater effort in charges collection than in charges utilization. Furthermore, during the charge-collection process, EPBs can provide enterprises with privilege condition to comply with the PCS. However, it is exactly the privilege condition that damages the incentive function of the PCS.

Table 2. Financial sources of EPBs (10,000 Chinese Yuan)

City	Sources of revenue of EPBs			Total revenue for use by EPBs*
	Normal Charges	Four small pieces	Grants from Financial bureau	
Anyang	1000	24	96	320
Changzhou	900	100	20	300
Shunde	345	300	110	480

* Total Revenue for use by EPBs = 20% of normal charges + 100% of Four small pieces + 100% of grants

For example, some EPBs charged only 20 percent of the total amount, which is designed to be used by the EPBs, while the other 80 percent is retained in the enterprises (Ma Xiaoying's case study, Wuhan 1994). Another example is that some EPBs provide opportunities for enterprises to avoid parts of their income tax. According to the PCS,

¹³ In the interviews with the EPBs' officials, some thought that it is important that a certain number of enterprises exceed the discharge standards to ensure the charges revenue.

¹⁴ Interview, chief of the Planning and Finance Division, Changzhou EPB, Changzhou, December 27, 1995.

the receipts of the normal part of charges and the “four small pieces” should be different. That is to say, if an enterprise has to pay both the normal charges and the “four small pieces”, it should receive two different payment receipts to be listed under different accounts: production costs (before-tax) and retained profits (after-tax), respectively. However, intentionally or not, some EPBs (for example, Changzhou EPB) only give one receipt even though an enterprise must pay these two kinds of charges at the same time¹⁵. Then the enterprise, not surprisingly, lists this receipt in the production costs account so as to pay less income tax. In a word, the effectiveness of the pollution charges is reduced.

However, the most obvious example is the EPBs’ attitude toward the reform of the “loans from grants” utilization of the charge revenue. Before 1988, enterprises benefited from the charge revenue by being allowed to avail themselves of grants. This arrangement however, was widely criticized by many researchers for its low efficiency. Then in 1988, a reform known as “loans from grants” was implemented, requiring that users of this revenue pay back the amounts used. This reform was implemented to reduce the attractiveness of paying pollution charges (see Case Study I) and hold back enterprises from seeking the refund. Many foreign experts claimed that this reform was a promising step toward cost-effective pollution control (Spofford 1994; Panayotou 1995). However, did it work? The three-city case study revealed that the reform had contributed little or none at all toward ensuring cost-effective pollution control. More specifically, the EPBs were mainly responsible for the latter.

Case Study I shows that under certain circumstances, paying the pollution charge is preferable to not paying at all. An example of such a circumstance would be the refund of the charges. If the refund mechanism no longer exists (as suggested by the “loans from grants” reform), enterprises will be reluctant to pay pollution charges. After all, they can bargain with the government, decline to pay, or ignore the bills from the EPBs. In this situation, EPBs have two alternatives if they wish to ensure payment of a certain amount of pollution charges:

- (1) enlarge administrative capacity and strengthen enforcement by taking those who owe the charges to court, or
- (2) continue the existing situation.

In actual situation, the government is trying to protect enterprise, (especially state-owned ones) in financial trouble, by “easing enterprise burdens”, even though this could be at odds with the basic national policy of environmental protection¹⁶. EPBs, therefore can not count on the government to back them up in the first option. Not surprisingly, nearly every EPB in the country has taken the latter step, figuratively “walking on the old road in new shoes”. They give loans to enterprises (which are required to pay charges; loans can not exceed 80 percent of the charges) with low interests. Also a 100 percent exemption is issued to nearly every enterprise with a loan¹⁷. In some cities (e.g., Changzhou), this strategy is used even more “creatively”— they do not grant

¹⁵ Interview, Chief Accountant, Changzhou EPB, Changzhou, April 23, 1996.

¹⁶ China’s national policy states that economic development and environmental protection have equal priority and should be undertaken at the same level. In reality, economic development is the first priority and everyone interviewed on this point acknowledged that economic development takes priority over environmental protection and that environmental protection will necessarily always lag behind.

¹⁷ Interview, chief, Anyang EPB, Anyang, September 18, 1995.

exemptions. Instead they allow enterprises to pay back their loans by continuously paying a given amount of pollution charges even though their effluent can satisfy the standards after the project is put into operation¹⁸. In fact, it is also a kind of "paying more" strategy, which benefits both the enterprises and the EPBs since the amount paid can be divided between them again.

In the three cities studied, the EPBs practices in PCS implementation are similar because all must follow the same rules from the National EPA. However, the different settings in each EPB cause differences in enforcing this policy and have different effects on policy results.

In the previous discussion about EPB behavior, it was noted that the Changzhou EPB is motivated by strong incentives to collect as much pollution charges as possible. However, in most of the cases, the results weaken PCS effectiveness as an incentive for pollution control. Table 2 shows that less than 7 percent of the total administrative expenditure of Changzhou EPB is from the government financial budget. The lowest one among the EPBs in three cities studied, this figure could, to some extent, explain the strong motivation to distort enforcement of this policy.

The second factor has to do with the hierarchy in China's environmental management system. If a city has both state-owned enterprises and TVIEs, usually there are two levels of environmental authorities within corresponding levels of government: EPB is mostly in charge of the state-owned enterprises in urban area, while EPO (environmental protection office) mostly takes care of TVIEs, which are normally located in the suburbs. Corresponding to the county government, a lower level government than the municipal level, the EPOs are more dependent on the pollution charges for their own survival. Therefore, they are more likely to cause distortion in enforcing the PCS.

Generally speaking, lower level environmental authorities like EPOs have fewer staff and less able human resources than the EPBs. Under this situation, state-owned enterprises and TVIEs are not exposed to the same regulatory pressures, leading state-owned enterprises to think it is unfair for some of their counterparts (or even competitors) to be under easier requirements and looser control. As a result, their incentive to comply with the PCS is affected¹⁹. This is what happened in Changzhou city. Similar complaints about this situation were not heard in Shunde city which has only one EPB. Shunde city was recently upgraded from a country city to municipal city.

3.0 PART TWO: SURVEY

Interviews with the case study enterprises served as bases for some of the behavior patterns explained in the case study report. How widespread are these behaviors? What does the effectiveness of the PCS as an economic incentive look like from the standpoint of the enterprises, the target of this policy? A survey was designed and carried out in Changzhou City²⁰, Jiangsu Province, Eastern China, one of the case study cities, with the help of the local EPB. Included in the survey were 110 enterprises

¹⁸ Interview, chief, Changzhou EPB, Changzhou, April 23, 1996.

¹⁹ Interview, with a group of environmental staff from nine state-owned enterprises under the chemistry industry, and the environmental official of the Industry Bureau of Changzhou, Changzhou, December 22, 1995.

²⁰ As suggested for this stage of the study the researcher focused on a relatively narrow area (i.e., one city) for better results.

(50 state-owned and 60 non-state-owned, including Town and Village Industrial Enterprises or TVIEs, private enterprises, and joint-ventures); with 99 received (46 state-owned and 53 non-state-owned). The survey covered industries such as the textile industry, the chemical industry, and the food and drug industry which are the main contributors of the wastewater or chemical oxygen demand (COD). The data gathered was from 1989 to 1995.

From the first part of the survey, the researcher derived information about the enterprises' behavior patterns and PCS effectiveness. Using this information, attempts were made to develop and test models describing these behavior patterns and tentative conclusion.

3.1 Descriptive Analysis on the Survey Results

This section features an overview of the responses to the questionnaire. It concentrates on key questions regarding the effectiveness of the PCS as an economic incentive and omits much of the background details (e.g., the attributes of the respondent enterprises' size, age, location, and industrial category). However, for comparison, all questions were analyzed according to the types of enterprise ownership (i.e., state-owned and non-state-owned, with the latter containing TVIEs and private industries). Then, a regression is provided, revealing some observations that can only be obtained from the quantitative analysis.

3.2 The Effectiveness of PCS as an Economic Incentive

When considering the effectiveness of the PCS, the question most likely to be raised is: Is the PCS effective in providing enterprises with incentives to control the pollution they create? And if it is, to what extent? In order to investigate this point, two related questions are asked in the questionnaire. Answers were evaluated to determine the enterprises' practical and hypothetical responses to the PCS.

Table 3. Answers to Q: In practice, how do you comply with the PCS?

	average	state-owned	non-state
A. paying charges, with no treatment facility;	27%	26%	28%
B. paying charges with treatment facilities, because of either technological or financial problems	34%	39%	31%
C. controlling effluent effectively, paying no charges.	38%	35%	41%

Table 3 reflects the following:

- There is not much difference between the two types of enterprises. The majority of the surveyed enterprises (73 percent) have had their water treatment facilities in place because of the PCS or/and other environmental regulation(s);
- Of those with pollution control facilities, only 38 percent have discharges that satisfy the national or local effluent standards. The other 34 percent still can not comply with these standards because of either technological problems or/and financial deficit;

- c) The percentage (34) of those who have treatment facilities but not operating properly is somewhat higher than the percentage (27) of those who do not have any treatment facility at all.
- d) The last point is a confirmation of the phenomenon that enterprises are more likely to have a treatment facility in place rather than to just pay the charges with no investment in environmental protection at all. There are two possible explanations for this phenomenon. First, under PCS, paying the charges is in addition to, rather than in lieu of, the responsibility to treat effluent which fails to meet applicable standards. Besides, along with the PCS, there are other policies that regulate the behavior of enterprises' regarding installation of the water treatment plant. Second, after the treatment facilities are in place, operational costs are higher than the charges. So, although paying charges is much cheaper than installing pollution control facilities, enterprises are still investing in them. After these facilities are in place, enterprises are in a better position to decide whether to continue to pay charges or operate the facilities.

However, the discussion above introduces another important question: if there are other policies that influence the enterprises' decision on whether to control their pollution or not, (and in fact, such policies do exist, such as Three Synchronization, Pollution Control Within Deadlines), then when PCS effectiveness in providing incentive to control pollution is considered, the effects of other policies effects must be net out. This is very difficult to do but as an attempt, the following question is asked.

Table 4. Answers to Q: In your opinion (hypothetically), which option is the most effective in complying with the PCS?

	Average	state-owned	non-state
A. paying charges	7%	11%	4%
B. controlling pollution while paying the charges	49%	42%	54%
C. controlling pollution	26%	36%	17%
D. never comparing	18%	11%	25%

The highlights of Table 4 include:

- a) There is a substantial difference in option between state-owned enterprises and non-state-owned enterprises, an indication that the type of ownership does play a role in determining opinion and real response toward the PCS.
- b) For state-owned enterprises, the percentage (37 percent) of enterprises that preferred pollution control was nearly the same as the percentage (39 percent) of those who satisfied the PCS requirements through pollution control. Apparently, for this kind of enterprise, the PCS is the most effective policy for regulating enterprise control of their pollution. The opinions of the other (63 percent) enterprises are distributed to the other three options, with a majority (43 percent) preferring the "paying while controlling" strategy. Thus, enterprises

without any treatment facilities and who had to pay the commensurate charges also tended to install some facilities while paying the charges at the same time.

- c) For non-state-owned enterprises, the difference between the opinion and the actual behavior (compared with the former table) was far more obvious, showing that regulating non-state-owned enterprises, the PCS is not the only policy which has influence on the enterprises' decisions regarding pollution control. In other words, comparing these two points, policies other than the PCS have more influence on the non-state-owned enterprises than on state-owned ones.
- d) A large number of the enterprises (both types) preferred the third option, because they were after the subsidy from EPBs. In other words, many enterprises preferred not to meet the effluent standards, at least to some extent, to enable them to keep paying the charges and keep receiving subsidies. The PCS subsidy system seems to inhibit its own effectiveness.

3.3 Main Factors Affecting the PCS as an Economic Incentive

The last point above is not a new finding. As indicated in the case study report, the low fee rate and the subsidy system in the PCS in China are two points that have received the most criticism, and the most that need to be reformed. The next topic concerns the hypothetical subsidy system.

Table 5. Answers to Q: Suppose that the government decides to abolish the subsidy system, will your enterprise _____ the usage of this fund?

	average	state-owned	non-state
A. Increase	21%	20%	23%
B. Reduce	31%	44%	18%
C. With no change	48%	37%	59%
And at the same time, will you intend to...			
A. Pay the charges	15%	25%	6%
B. Control the pollution	74%	70%	78%
C. Others	11%	5%	16%

The following observations were made from Table 5:

- a) A large majority of enterprises (both state-owned and non-state-owned) believed that they can control more pollution if the subsidy is removed. It shows that the present subsidy plays a role in encouraging enterprises to pay the charges instead of controlling their pollution.
- b) About one third of the enterprises would reduce the use of the environmental loan (converted from the subsidy) while the other two thirds would either increase (21 percent) or maintain present use of this fund (48 percent).

- c) It should be noted that those who claimed they would reduce the use of this fund are not saying that they would reduce efforts to control their pollution. Instead, they would turn to other financial sources because many enterprises indicated that they would do more treatment of effluents while reducing use of the subsidy.
- d) The two types of enterprises continued to behave differently in this hypothetical situation.

Table 5 also shows if the subsidy is removed, the number of enterprises that preferred the paying charges option would be reduced. In the next table, one finds that if there are fee rate reforms, similar results would be expected.

Table 6. Answers to Q: If the fee rate would be adjusted upward, will you...

	average	State-owned	non-state
A. Treat more pollution so as to reduce payment of charges?	65%	60%	70%
B. Continue to pay charges?	11%	13%	9%
C. A or B, depending on how much the rate would increase;	18%	22%	15%
D. Others.	5%	2%	3%

From the responses obtained in Table 6, one could see that:

- a) Majority felt that increasing the fee rate would be effective in encouraging pollution control (65 percent). Another 18 percent indicated they may choose not to pay the charges (i.e. control their pollution) if the fee rate is sufficiently high.
- b) There is no obvious difference between the state-owned and non-state-owned enterprises' reaction to the supposed rate-increase, showing that increasing the fee-rate would be effective in encouraging pollution control for both types of the enterprises.

As a conclusion, 76 percent of the enterprises believed that PCS' overall role in pollution control is more of enhancing environmental conscience than serving as an incentive to pollution control.

3.4 Regression Analysis

This part of the paper details an investigation of the consistency between the data gathered, the paradigms or theories obtained from the case studies, and discussions from the previous parts. An econometric model was used as the major approach. The researcher realizes that most of the factors which might effect compliance outcomes of the enterprises, (e.g. propensity to pay more than required, EPBs behavior, etc.) are

latent variables. Therefore the effects of these variables might not be obtained directly. However, it is possible to regress some other variables which might affect the enterprises' compliance outcomes more directly.

3.4.1 Dependent Variable

This involved the determination of a variable that could stand for the compliance outcome of PCS. In water pollution control in China, the NEPA has focused on COD control because it is viewed as the most important of the so-called "conventional pollutants". Although the EPBs of different cities differ in terms of which pollutants they regulate, virtually all cities regulate and monitor COD discharge level. Also, technologies that control COD discharges tend to reduce the levels of other pollutants. Thus, if it is possible to determine the factors influencing the behavior of enterprises in complying with COD requirements, those factors will likely apply to other pollutants as well. Notice that through the PCS, NEPA is still regulating COD concentration in the discharges. The dependent variable in this regression model is the log of the annual average COD concentration (LCOD) in the effluent²¹.

3.4.2 Independent Variables

The independent variables or the main factors hypothesized to affect the compliance results include the following two sets of variables:

- a) social economic characteristics of enterprises, such as size, type, economic condition, degree of environmental efforts; and
- b) regulatory condition of EPB, such as the frequency of monitoring.

3.4.3 Model

Even though the regression analysis could be extremely complicated, static linear relationships using Ordinary Least Square (OLS) were assumed.

The data set is a panel data, and even though several independent variables, (i.e. TYPEDUM), have been identified to be the same for each enterprise across the whole time period, there are still other unquantified factors such as the abilities of the enterprises' chief environmental managers. Therefore, serial correlation of the error term is expected. Since the purpose here of the regression is to obtain explanation, rather than prediction, the unbiased estimators for the coefficients of the regressors will be achieved by OLS. For comparison, estimators from both the Fixed Effect (FE) and Random Effect (RE) models are also presented.

²¹ According to the research proposal, other variables like treatment rate (i.e., the rate of discharged water being treated over the total amount of discharges) and the proportion of enterprises delaying paying their pollution charges, are designed to be used as dependent variables, for comparisons. However, in the data collecting stage, it was found that the data on those delaying payment of pollution charge is difficult to get, especially for the non-state-owned enterprises because of the bargaining process between enterprises and the EPBs on the amount of pollution charges paid. As for the treatment rate, it turned not to be relevant to the goal of PCS. From the data of the surveyed enterprises, the treatment rate of non-state-owned enterprises was far higher than that of the state-owned ones, but the COD concentrations were still lower than those of state-owned enterprises.

Table 7. Definition of the independent variables²²

VARIABLE		DEFINITION
General attributes of enterprises'	TYPEDUM	dummy variable on the ownership: 1 for state-owned and 0 for non-state-owned
	OUTPUT	physical outputs of enterprises in 10,000 Yuan, showing the size effects ²³
	LOSSDUM	dummy variable for enterprise's economic condition, 1 for loss and 0 for non-loss
	CHEMICAL	dummy variable for chemical industry enterprises
	DRUG	dummy variable for drug industry enterprises
	TEXTILE	dummy variable for textile industry enterprises
	MECH	dummy variable for mechanical industry enterprises
	FOOD	dummy variable for food industry enterprises
	OTHER	dummy variable for other industries enterprises
Environmental efforts made by enterprises	MONITOR	number of workers involved in environmental monitoring (not including persons who operate the treatment facilities)
	MANAGER	number of workers who served as environmental managers
	TREAT	percentage of effluent treated before discharge
	ENVLOAN	environmental investment from the subsidy and loan (10,000 Chinese Yuan/a)
	OPERCOST	operation costs of water treatment facilities (10,000 Chinese Yuan/a)
	SELFMONI	frequency of self-monitoring (times/a)
EPB's enforcement	EFEE-FEE	effective water levy on water discharged violating the applicable standards (Chinese Yuan/ton)
	MEET1	times for EPBs to visit enterprises to collect charges, discuss subsidies, etc.(times/a)
	MEET2	times EPBs meetings with enterprises regarding implementation of PCS (times/a)
	EPBMONI	frequency of EPB-monitoring (times/a)
Others	YEAR89	dummy for data from 1989
	YEAR90	dummy for data from 1990
	YEAR91	dummy for data from 1991
	YEAR92	dummy for data from 1992
	YEAR93	dummy for data from 1993
	YEAR94	dummy for data from 1994
	YEAR95	dummy for data from 1995

²² Since there is more than one variable that describes a factor, all these variables are obtained by doing the bivariate analysis. For example, when the factor of environmental protection workers is considered to have some influence on the compliance outcomes, there are the total number of worker involved in environmental protection, the number of those only involved in environmental management, and the number of those who have a certain level of education, etc., to choose from. In this situation, those with the largest correlation coefficient (with the dependent variable) were chosen to be included in the regression model.

²³ The criteria for determining size of enterprise to be either large, medium or small are not consistent across different industrial sectors. For this reason, the physical output was chosen to depict the effects that the size of enterprises might have on their environmental performance.

3.4.4 Hypothesis

There are some hypotheses to be tested in the regression model:

1. The effectiveness of the PCS (the compliance results of PCS) has a correlation with the compliance behavior of enterprises.

Sub-hypothesis

- a) *There is a correlation between the size of enterprises and the compliance results of PCS. By OUTPUT.*
 - b) *There is a correlation between the type (i.e., state-owned or TVIEs) of enterprises and the compliance results of PCS. By TYPEDUM.*
 - c) *There is a correlation between the financial status of enterprises and the compliance results of PCS. By LOSSDUM.*
 - d) *There is a correlation between the industrial catalogs of enterprises and the compliance results of PCS. By CHEMICAL, DRUG, TEXTILE, MECH, FOOD AND OTHER.*
 - e) *There is a correlation between the environmental efforts made by enterprises and the compliance results of PCS. There are several aspects showing the environmental efforts made by enterprises. First is the investment made in this field. ENVLOAN is used to show this effect. Second, the appropriate operation of the water treatment facilities is also crucial in determining the compliance outcomes. OPERCOST is used to depict this effect. And finally, the quality or/and quantity of the personnel an enterprise devotes to environmental protection, and the effectiveness of their work also show the efforts made in accordance with PCS requirements. MANAGER, MONITOR and SELFMONI are also included.*
2. The effectiveness of PCS is also affected by the implementation of EPBs.

Sub-hypothesis

- a) *There is a correlation between the severity of EPBs management and the compliance results by enterprises.*

From the case study, it was learned that the behavior of EPBs (or the severity of EPBs in implementing regulation) has greatly affected the severity of the policy, and therefore, the enterprises' compliance outcomes. However, since the data here are all from one city, only one EPB was part of the study. This causes greater difficulty in defining a variable to represent these effects. EPBMONI, the frequency of EPB to do the on-site, unannounced monitoring for each enterprise per year, could be a proxy. And there is another variable, the EFFE-FEE (i.e., the effective levy faced by each enterprises), which also could be viewed as regulatory variable rather than a price factor.

- b) *There is a correlation between the sufficiency of support of EPBs and the compliance results of enterprises.*

Besides enforcement, EPBs are supposed to provide technical support and consultations for enterprises regarding in compliance to PCS. This is also a effect without direct measurements. MEET1 and MEET2 where chosen to grasp this kind of effects.

3.4.5 Data Source

All data came from the questionnaire.

3.4.6 Regression Results

Table 8 presents regression results using OLS, FE, and RE estimation methods.

Results from the regression were robust to changes during the period of analysis, in terms of the signs and statistical significance of the estimated coefficients. The adjusted R square for the ordinary least squares (OLS) versions of the equation is 0.336. The empirical analysis yield coefficients that generally support the expected outcomes. For example, the estimated coefficient for the number of environmental manager (MANAGER) has the expected positive²⁴ effect. However, there are other explanatory variables whose coefficients turn out to be contrary to ones expectations. Of these, the dummy for the economic condition of the enterprise (LOSSDUM) is the most important.

The rest of this section looks at the effects on the compliance outcomes of the various independent variables. It examines, in more detail, the coefficients of the attributes of enterprises (e.g. size, type of ownership); and environmental protection efforts made by enterprises, and management of EPBs. The section concludes with a discussion of what the empirical results suggest about the effectiveness of raising the fee-rate.

Effects of the Attributes of Enterprises. Influence of the attributes of the enterprises such as size and type of ownership often combine to affect the compliance outcomes.

Size of Enterprises. Usually, people think that large enterprises have better environmental performance because they would benefit from economies of scale, more chances of being chosen as regulated targets, better management practices, and better human resources. However, the regression results do not support this common perception. The coefficient of OUTPUT and its significant level show that the opposite holds true.

Type of Ownership. From the regression outcomes, ownership is significantly correlated with compliance outcomes. The magnitude of this coefficient (TYPEDUM) can be interpreted to mean, on the average, that the concentration of effluent of the state-owned enterprises is 32% higher than that of non-state-owned ones. In turn, this means that the state-owned enterprises do more polluting than their non-state-owned counterparts.

²⁴ Since the dependent variable is the average concentrations in the effluent, the lower it is, the better the compliance outcomes. Negative coefficient sign means positive effects.

Such a result is interesting in light of the unresolved controversy over which part of China's economy, the state-owned enterprises or TVIEs (which account for large majority in the category of non-state-owned enterprises), contribute most to the whole pollution package. However, people usually think that TVIEs are more polluting because of their out-of-date technologies, poor management, and poor personnel qualifications among other reasons.

The following factors, however, may offset the effects of the above-mentioned conditions. First, most of the TVIEs were built after the PCS came into being. Like other TVIE characteristics, (e.g. small size, market-oriented mechanism), they are more flexible in changing to less polluting products. The state-owned enterprises are usually larger in size, making it harder for them to shift to other products. Second, with soft-budgets, many heavily polluting state-owned enterprises without adequate pollution control measurements are allowed to continue their operation. Third, it seems that the TVIEs are more likely to get foreign investment²⁵. They import new technologies, obtain better management experience, and have more capital. At the same time they are attractive to qualified employees who can be absorbed by jobs in the environmental protection field.

All in all, the discrepancy on the effects of ownership on the compliance outcomes is derived from research works that have been done under different contexts and in different part of the country. In this survey, there are also some facts that might have caused bias. First, the selection of the non-state-owned enterprises might not be representative because it was not possible to include in the survey those enterprises which were not under EPB's enforcement. Unfortunately, only a small percentage of non-state-owned enterprises have been taken into EPBs' regulation so far. Second, the study site, Changzhou City, does not have many of the small paper mills owned by towns and villages. These mills are believed to be the most important contributor of COD in wastewater discharges.

Further research on this point is still needed.

Loss or not. While not statistically significant, the sign of the coefficient for this variable obviously runs counter with the information obtained from the case study, suggesting either the presence of collinearity or the poor-definition of LOSSDUM as a variable.

As discussed in the case study report, economic loss was a prevailing phenomena in China in the late 1980s' and early 1990s'. At present, many enterprises still must recover from the economic slump. A conservative estimate describes the popularity of this economic loss as "1/3 (of all enterprises) is gaining, 1/3 is losing, and the other 1/3 is potentially losing". An enterprise that is classified to have a potential loss may not be financially losing but has stock which can not cover production costs (Wu et al. 1993).

The "potential loss" might be unique to China, because of the special relationship between government and enterprises. According to the contract between the government and enterprises, if an enterprise suffers a financial loss, many bonuses such as the promotion of the director, retained profits, and wage raises may not be given. Thus, enterprises, especially those that are state-owned, are often reluctant to report that they are suffering an economic loss.

²⁵ Probably because TVIEs are less of a burden when foreign investors consider where their investments go in terms of less retired workers, medical services and housing requirements to be taken care of.

Table 8. Regression Results

VARIABLE	OLS	FE	RE
C	4.87 (32.651)	5.86 (43.0510)	5.07 (22.539)
EPBMONI	.00024 (.037)	-.0206 (-2.431)	-.0202 (-2.721)
LOSSDUM	-.108 (-1.252)	-.045 (-1.042)	-.0348 (-.807)
MANAGER	-.0323 (-1.068)	.0176 (.54)	.0262 (.879)
MONITOR	-.0344 (-2.125)	-.00859 (-.411)	-.0147 (-.804)
MEET1	.023 (1.48)	(dropped)	.0302 (.825)
MEET2	(.098) (3.219)	(dropped)	.0658 (.928)
OPERCOST	3.12e-07 (2.121)	1.58e-08 (.156)	1.16e-08 (.117)
SELFMONI	-.00026 (-.894)	-.00243 (-4.209)	-.00078 (-2.521)
TYPEDUM	.323 (2.511)	(dropped)	.349 (1.429)
OUTPUT	.000013 (2.172)	1.85e-06 (.343)	4.21e-07 (.083)
ENVLOAN	.106 (2.437)	.00112 (.622)	.0018 (.99)
EFFE-FEE	.000726 (1.46)	-.000245 (-.701)	-.000206 (-.605)
TREAT	-.000309 -.185	-.000506 (-.591)	-.000431 (-.507)
5 industrial sector dummies			
6 time dummies		.2306(within)	.1992(within)
Adjusted R-Square	.3363	.0127(between) .0033(overall)	.3018(between) .3008(overall)
Sample size	303	303	303

In the data gathered, only 27.8% claimed that they are in a financial loss (Table 9). This could explain why such variable did not come out significant in the regression models.

Table 9. Percentage of enterprises who are in economic loss from the survey data

Year	1989	1990	1991	1992	1993	1994	1995
Average	11.4%	17.6%	27.8%	17.9%	21.7%	24%	26.5%
State-owned	7.5%	15%	13.6%	11.1%	24.4%	26.1%	32.6%
Non-state-owned	16.7%	20.6%	45.7%	25.6%	19.1%	22%	21.2%

Environmental Efforts made by Enterprises. In response to PCS requirements, enterprises responded to the stipulations for environmental protection by: investing in pollution treatment facilities, which included both construction (ENVLOAN) and maintenance (OPERCOST), allocating an appropriate number of environmental staff (MANAGER), and setting up a routine monitoring program (SELFMONI) to collect data on the performance of the facility and to assist in environmental decision-making.

Construction and Operation of Pollution Treatment Facilities. It is expected that with larger ENVLOAN and OPERCOST, compliance outcomes would be better. In other words, LCOD would be smaller and the signs of the coefficients would be negative. However, from the regression results, opposite results were obtained. Furthermore, these relationships were statistically significant, indicating a more complicated cause-effect relationship than previously thought.

Neither ENVLOAN nor OPERCOST is exogenous to LCOD, the dependent variable. On the contrary, they are largely determined by it, and enterprises with large LCOD are more likely to become the EPBs enforcement targets²⁶. Thus, they invest more on pollution control, and have larger ENVLOAN and OPERCOST.

Size of Environmental Staff. In quantifying this variable, there are several alternatives to choose from — total environmental staff, sub-units such as environmental manager (MANAGER) and monitoring staff (MONITOR). However, only after the sub-units are used can significant results be obtained.

The outcomes in Table 9 demonstrate a strong positive relationship between the compliance outcomes and the number of environmental managers per enterprise. If each enterprise increased its number of environmental managers by one, the average COD concentration in its discharge would decrease by 3.2%. The same result is applicable to monitoring staff. These results support the common observation that the lack of well-educated, environmental personnel constitutes a major constraint to more effective implementation of China's environmental policies (Qu et al. 1984; Wu 1987).

²⁶ Because of the inadequate management capacity, most EPBs take the heavier pollution into their enforcement system first. In this way, they believe they can get the optimal control outcomes with the existing resource constraints.

Although details are not reported in this report, when the number of environmental managers of each enterprise is divided by the number of workers, the coefficient becomes very insignificant, suggesting that the size of environmental staff need not necessarily change with the size of the enterprise. This observation has two implications: for large enterprises, the environmental staff does not need to maintain a certain percentage of its number of workers. On the other hand, small enterprises must maintain a certain level of environmental staff to ensure a satisfactory environmental performance.

Enforcement by EPBs. EPBs play a crucial role in determining to what extent the PCS's implementation affect enterprises' behavior and compliance outcomes. The most obvious example is the failure of the reform in the use of the pollution fee collected in 1988 to achieve pre-designed goals (See Case Study). However, the implicit effects may be difficult to quantify. Furthermore, this survey was done in only one city, and involves only one EPB. Therefore, no variations could be observed in many aspects.

There are still some variables like MEET1, MEET2 and EPBMONI which could be used in an attempt to depict their effects. However, from Table 9, the sign of coefficients of MEET1, MEET2 and EPBMONI are not as expected. The reasons for the contradiction are the same as those discussed in the coefficients of ENVLOAN and OPERCOST. It is understandable that EPBs are more likely to inspect and meet more often with heavier polluters.

3.5 Effectiveness of Raising the Fee-rate

When talking about the ineffectiveness of China's PCS, the most likely suggestion for this problem is: raise the fee-rate. However, it must first be determined whether the higher fee-rate will make a difference in terms of the compliance outcomes and by how much. In other words, what is first needed is to determine the price elasticity of the water quality of the receiving water body in terms of the discharge concentrations. However, an inherent problem in coming up with such an estimate is the absence of variation in fee-rates across the country. Furthermore, the fee-rate has been relatively stable since the time it was first implemented.

The regression analysis uses a concept of "effective pollution charge" (EFFE-FEE) introduced by a World Bank working paper (Wang et al. 1996), which shows that the actual price the EPB collected for the water discharged exceeds applicable standards. However from the regression, the sign of this variable is not what is expected, largely because the enterprises "paid more than what is required".

4.0 CONCLUSIONS AND POLICY IMPLICATIONS

PCS in China has achieved a degree of success in industrial wastewater control, at least in terms of encouraging enterprises to install water treatment facilities. Even though the proportion of wastewater being treated and the proportion of the discharged water meeting applicable effluent standards (about 30% and 55%, respectively) remain unchanged (or slightly increased) from 1989 to 1995, the progress should be regarded as more impressive when one considers the dramatic economic growth that took place over the same time period.

Analysis of both the case study and the survey results show that reforming the subsidy system and raising the fee-rate would be effective methods to improve the PCS's function as an economic incentive. These results justify the proposed PCS reforms of which the most important are the reform in the subsidy system and raising of the fee-rate. However, while the influence of EPBs' behavior on the compliance behavior of enterprises can not be analyzed through the regressions, the case study analysis strongly indicates that the EPBs' can affect the PCS implementation and effectiveness dramatically. The policy implication here is that when these kinds of reforms are being considered, the same attention should be given to an analysis of possible EPB reactions. The most important thing is probably to include the EPBs' growth plan into the PCS reform package.

Results from the econometric analysis do not support the general belief underlying the existing practice of transferring enforcement focus from state-owned enterprises to non-state-owned ones. From the regression results, the non-state-owned enterprises have better compliance outcomes. EPBs may find it more effective if they keep pressure on state-owned enterprises while expanding enforcement efforts in non-state-owned enterprises. Obviously, a policy strategy like that may be difficult to implement considering the already inadequate number of EPB staff.

China is in a transitional period from a planned economy to a market one, and with the increasing budget constraints, enterprises (including state-owned ones) are expected to become more market-oriented and may decide to make cuts in the number of environmental manager, a variable which has been identified as having a positive relation with compliance outcomes. Though the econometric analysis indicates that it is not necessary to keep the number of environmental managers at a given proportion of the total work staff, it also shows that this should be kept at a certain level. Considering that in China the average number of environmental managers per enterprise was only 1.85, China could benefit from increasing its investment in environment management education and training.

For those counter-intuitive outcomes obtained from the regression analysis, even though some of them could be improved by redefining and remodeling, the serious distortions that exist in this incentive system of China will very unlikely change the outcome of the analysis. One implication could be that the recognition that an adequate understanding of the institutional context is essential in the development of a meaningful quantitative assessment.

5.0 AREA FOR FURTHER RESEARCH

The analysis in this paper also reveals that the country is facing difficulties in allocating adequate money into environmental protection because of many competing uses. On the other hand, pollution control facilities built using the scarce money are subsequently systematically unused or under used. As shown in the case study, both enterprises and EPBs seem able to gain from the distorted incentives within the PCS. One question that must be asked is who are the losers in this situation? Also needed is further research on the fiscal and economic implications of the funding of the existing incentives to build waste treatment facilities, as opposed to an efficient incentive system for pollution control in China.

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APPENDIX A

Abbreviations Used

PCS	Pollution Charge System
COD	Chemical Oxygen Demand
EPB	Environmental Protection Bureau
NEPA	National Environmental Protection Agency
TVIE	Town and Village Industrial Enterprise
CaO	White Lime

APPENDIX B

Variables used in the model

TYPEDUM	dummy variable on ownership: state-owned or non-state-owned
OUTPUT	physical outputs of enterprises in 10,000 Yuan, showing the size effects
LOSSDUM	dummy variable for enterprise's economic condition, loss or not
CHEMICAL	dummy variable for chemical industry enterprises
DRUG	dummy variable for drug industry enterprises
TEXTILE	dummy variable for textile industry enterprises
MECH	dummy variable for mechanical industry enterprises
FOOD	dummy variable for food industry enterprises
OTHER	dummy variable for other industry enterprises
MONITOR	number of workers involved in environmental monitoring (not including persons who operate the treatment facilities)
MANAGER	number of workers who served as environmental managers
TREAT	percentage of effluent treated before discharge
ENVLOAN	environmental investment from the subsidy and loan (10,000 Chinese Yuan/a)
OPERCOST	operation costs of water treatment facilities (10,000 Chinese Yuan/a)
SELFMONI	frequency of self-monitoring (times/a)
EFPE-FEE	Effective water levy on water discharged violating the applicable standards (Chinese Yuan/ton)
MEET1	times for EPBs to visit enterprises to collect charges, discuss the subsidies, etc. (times/a)
MEET2	times EPBs meetings with enterprises regarding implementation of PCS (times/a)
EPBMONI	frequency of EPB-monitoring (times/a)
YEAR89	dummy for 1989 data
YEAR90	dummy for 1990 data
YEAR91	dummy for 1991 data
YEAR92	dummy for 1992 data
YEAR93	dummy for 1993 data
YEAR94	dummy for 1994 data
YEAR95	dummy for 1995 data

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