# Reducing industrial emissions: evidence of China 2006-2010

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***Abstract:*** Employing the nonparametric model, this research explores the industrial emission reduction. The research obtains several evidences based on the data of more than two hundred prefecture-level cities during the "Eleventh Five-Year Plan" period in China. First, the industrial structural changes to industrial emissions is insignificant; Second, the industrial emissions should be particular monitored which those cities with their proportion of the secondary industry under 55 percent; Third, FDI and pollution control cost are two important contributors for reducing industrial emissions, and the effect of the former is larger. Finally, the reducing industrial emissions are design for the cities with the proportion of the secondary industry under 55 and 35 percent respectively.

***Keywords:*** Industrial emissions reduction, Nonparametric model, Wastewater discharge

## 1. Introduction

An enormous range of variables have been studied as the determinants of pollution. Previous studies generally analyzing from different angles can be divided into four categories: Firstly, the relationship between economic growth and environmental change; Secondly, what's the impact of foreign direct investment to environmental pollution; The third category is the relationship between international trade and pollution emissions; The fourth category of researches take other factors into account, including financial development, social capital, economic structure, technology fund investment and so on.

Shown by the data announced by Nation Bureau of Statistics, energy consumption for unit GDP production this year has risen 0.09 percent compared with the same period in the last year. Up to 2009, the total energy consumption per unit GDP has descended 15.61 percent. But the "Eleventh Five-Year Plan" stipulates that unit GDP energy consumption in 2010 should reduce nearly 20 percent compared to that in 2005. Ministry of Industry and Information Technology holds the opinion that in order to achieve the target, the energy consumption for industrial added value of industrial enterprises above designated size should reduce 7 percent and the total energy consumption per unit GDP this year should reduce 5 percent. However, according to the official figures, the energy consumption for industrial added value of industrial enterprises above designated size has reduced just 1.25 percent this year. Therefore, it is rather difficult to get the target of reducing 7 percent in the next six months.

The rest of this paper is organized as follows. Section 2 lists out the previous researchers. Section 3 describes the method of estimation and the Path-converged design approach. Section 4 identifies the environment impacts of economic structure, FDI and pollution control cost, and designs the pollution reduction programmers for particular cities. Section 5 finally presents the conclusions.

# 2. Literature Review

## 2.1 Economic growth and pollution

Over the past few years, the relationship between economic growth and environmental pollution has been the subject of a great quantity of researches. At the very center of this discussion stands the concept of the Environmental Kuznets Curve (EKC). Song et al. (2008) using Chinese provincial data over 1985–2005, based on the EKC hypothesis, found by panel cointegration test that there is a long-run cointegrating relationship between the per capita emissions of three pollutants and the per capita GDP. The results also show that all three pollutants are inverse U-shaped. Jalil and Mahmud (2009) examine the long-run relationship between carbon emissions and energy consumption, income and foreign trade in the case of China by employing time series data of 1975–2005. A quadratic relationship between income and CO2 emission has been found supporting EKC relationship. The results also indicate that the carbon emissions are mainly determined by income and energy consumption in the long run. Trade has a positive but statistically insignificant impact on CO2 emissions. Gryz (2009) analyzes the impacts of economic growth and international trade on the level of air pollution. Using the estimation of the Structural Equation Model with two factors, the estimation results suggest that in the developing countries both international trade and per capita income lead to changes in the structure of economic activity and – as a consequence – to the increase in air pollution. In addition, Ma and Li (2006), Song and Li (2006), Li et al. (2009) research the waste emissions and economic growth using different variables, the conclusions are inconsistent. View from the existing literature, as the economic situation, competitive advantage, industry structure and levels of development vary from country to country, researches on the relationship between economic growth and environmental pollution have drawn different conclusions, even using the same method. The research method commonly used at home and abroad are EKC, cointegration test, two-variable response model (Tom Verbeke, Marc De Clercq, 2006), etc., whose results are usually inconsistent.

However, even the most commonly used method of EKC, when applied in different countries, as the economic situations alter, the results are different and the turning points are not universal.

## 2.2 FDI , trade and pollution

Another highly debated topic with respect to environmental degradation is the impact of FDI and trade to the emissions. According to Cole (2004), trade may reduce pollution emissions due to great competitive pressure. Trade can affect the environment in two ways: terms of trade effect and trade-induced technological effect (Maria and Smulders, 2004). Managi and Kumar (2009) find that increased trade openness correlates to increased pollution. International capital transactions might also affect national pollution levels. Antweiler et al. (2001) incorporate inward foreign direct investment as percentage of GDP (FDIGDP) in their analysis. Yang et al. (2005) as well as Yu and Qi (2007) find that: FDI has negative effects on environment in certain areas in China. He (2010) adapts the log-mean Divisia Index Decomposition method and applies it to Chinese data to analyze how trade openness affects aggregate industrial $SO_2$ emissions.

## 2.3 Other factors

Tamazian et al. (2009) investigate the linkage between not only economic development and environmental quality but also the financial development. They find that higher degree of economic and financial developments decrease the environmental degradation in BRIC economies. Cole and Neumayer (2004) argue that a higher share of urban population implies a higher density of means of production which decreases environmental quality. On the other hand Cole et al. (2006) contend that greater exposure to industrial pollution might have a positive effect either. If a higher amount of citizens face high pollution the propensity to vote in favor of higher standards of environmental protection increases which in turn reduces pollution. Lu and Li (2009) consider the environmental impact of social capital, and get the conclusion that industrial $SO_2$ emissions shows N-shaped characteristics, social capital is an important factor to explain the emissions of environmental pollutants. Zhuo (2008) analyzes how to optimize the industrial structure in order to achieve energy conservation and emissions reduction. Tu (2008) takes the economic structure (including light and heavy structure, size structure and ownership structure), the per capita level of output, technology investment funds (R&D intensity, investment intensity and the introduction of technology transformation) and FDI in to account and investigates the determining factors which are beneficial to the coordination of environmental and industry.

The differences between this paper and the existing literature are the research perspective and methods. This paper employs the nonparametric model from the perspective of more than two hundreds prefecture-level cities. In the research, not only identify the industrial emissions reduction effect of industrial structure, FDI and pollution control cost respectively, but also design pollution reduction programmers for particular cities.

The object of this paper is to explore: firstly, whether the adjustment of the industrial structure between 2005 and 2008 has been significantly beneficial for the pollution reduction. If the answer is negative, try to find out the emphasis in emissions reduction control for further work. Secondly, whether FDI has negative impact in industrial pollution reducing? And finally find out the affect of the pollution control cost.

# 3Nonparametric model

## 2.4 Benchmark model and path-converged design

Estimation of the underlying structure of pollution emissions is given by the kernel density estimation:

$$S_1 : f_n(x, X) = \frac{1}{n}\sum_{i=1}^{n} h^{-1} K(\frac{x - X_i}{h}) = \frac{1}{n}\sum_{i=1}^{n} K_h(x - X_i) \qquad (1)$$

$X_i = X_i(t)$ , *i=1, 2…n,* is the pollution emission observation of city *i* at time *t*.

$K(\cdot)$ stands for the kernel function and *h* stands for the bandwidth.

While considering the influential factors, the conditional kernel density approach is provided with path-converged design of underlying structure of pollution emissions.

Take FDI for instance, estimation of conditional density function of conditional structure is given:

$$S_2: \quad f_n(x, X / FDI) = \frac{f_n(x, X, FDI)}{f_n(FDI)}$$

$$= \frac{\frac{1}{n}\sum_{i=1}^{n} K_{h0}(x - X_i, FDI - FDI_i)}{\frac{1}{n}\sum_{j=1}^{n} K_{h1}(FDI - FDI_j)} \qquad (2)$$

Taking a product kernel:

$$K_{h0}(x - X_i, FDI - FDI_i) = K_{h1}(FDI - FDI_i) K_h(x - X_i) \qquad (3)$$

Let: $$\omega_i = \frac{K_{h1}(FDI - FDI_i)}{\sum_{j=1}^{n} K_{h1}(FDI - FDI_j)} \qquad (4)$$

Here $\omega_i \omega(t)_i$ refers to the weight of FDI or other factors in city *i* at time *t*, *i=1,2,…,n*.

Therefore, conditional density function is given by:

$$f_n(x, X, \omega) = f_n(x, X / FDI) = \sum_{i=1}^{n} \omega_i K_h(x - X_i) \qquad (5)$$

If the FDI path identification shifts leftward compared with the benchmark identification, which validates the exterior factor has a negative impact to the pollution emissions and it is beneficial to pollution reduction. Otherwise, if the FDI path identification shifts rightward, it has a positive impact to the benchmark identification and will increase the level of pollution emissions.

The problem of identification of FDI investment efficiency can be defined as follows:

The city x is said to be ω allocation efficient if $f_n(x, X) < f_n(x, X, \omega)$ . Furthermore, the ω efficient interval is comprised of all efficient points; i.e., efficient interval: $D = \{x : x \text{ is efficiency}\}$ .

The strength of ω path efficiency is defined by the integral area between the benchmark density function and the path density function at an efficiency interval, i.e.

$A = \int_D (f_n(x, X, \omega) - f_n(x, X)) d\, x$ If the city *x* is ω allocation efficient. The efficiency strength indicates the impact degree of the exterior factor.

## 2.5 Choices of kernel function and bandwidth

Nonparametric density estimation is usually done by a Gaussian kernel estimator, the asymptotic properties of which are well established for independent identically distributed (i.i.d.) data and for time series data. However, a drawback is that the Gaussian kernel density estimator is known to have substantial problems for bounded random variables with high density at the boundaries. In order to avoid this boundary bias problem, we apply a gamma kernel estimator instead of a Gaussian kernel. A crucial difference between the gamma kernel estimator and other fixed kernel estimators is that the gamma kernel estimator is an adaptive density estimator. The support of the gamma kernel matches the support of the probability density function to be estimated, therefore no weight is lost when the density is estimated at the boundary region. Besides, the gamma kernel density estimator is always non-negative and easy to implement (Bouezmarni and Rombouts, 2010).

The gamma kernel estimator is defined as follows: We observe $X_1, X_2 \ldots X_n$ from a non-negative process with density function $f$. Our goal is to estimate the function $f(x)$ nonparametrically for $x \in [0,\infty)$. $S_1$ can be written as:

$$S_1 : f_n(x, X) = \frac{1}{n}\sum_{i=1}^{n} K_h(x - X_i) = \frac{1}{n}\sum_{i=1}^{n} K_{\rho h(x),h}(x - X_i) \tag{6}$$

Here the kernel $K_{\rho h(x),h}$ is defined as:

$$K_{\rho h(x),h}(x - X_i) = \frac{X_i^{\rho h(x)-1}\exp(-\frac{x - X_i}{h})}{h^{\rho h(x)}\Gamma(\rho h(x))},$$

$$\rho h(x) = \begin{cases} \frac{x}{h} & if\ x \geq 2h \\ \frac{1}{4}\left(\frac{x}{h}\right)^2 + 1 & if\ x \in [0, 2h). \end{cases} \tag{7}$$

Bandwidth $h$ is selected by a Plug-in approach.

# 3. Empirical study

The objectives of our empirical estimation are to examine how the variables including industrial structure, FDI and pollution control cost are related to the industrial wastewater discharge in China in the "Eleventh Five-Year Plan" period, and to test the degree of influence. Another goal of the study is to give a reasonable allocation of pollution control cost for each city in 2008 under the condition that effluent discharge of each city in 2010 is limited.

## 3.1 Data description

Environmental pollution includes air pollution, water pollution and solid waste pollution. In our empirical analysis, we select water pollution as analysis objects. Of various forms of pollution emissions, industrial pollution emissions occupy a large proportion in aggregate emissions. The reduction proportion of industrial emissions is greater than the reduction proportion of total pollution, so industrial pollution emissions reduction is the focus among the pollution reduction implementations. Taking data availability into account, we choose the industrial waste water discharge as a measurement of water pollution discharge variable.

During the development of emissions reduction process, governments usually consider the ratio of pollution emissions to GDP as an emission indicator, so we use the ratio of industrial wastewater discharge to the gross industrial output value as the environmental indicator (measured in kilogram per Yuan). We denote that ratio as wastewater discharge level for notational simplicity. About influencing factors, the composition of GDP, the ratio of foreign direct investment (actual value) and the cost of pollution control investment per unit GDP are chosen. All the variables are chosen according to their environmental relevance meanwhile they are available on China City Statistical Yearbook. The data we used in this study are selected from 278 prefecture-level cities and cover the period of 2005-2008.

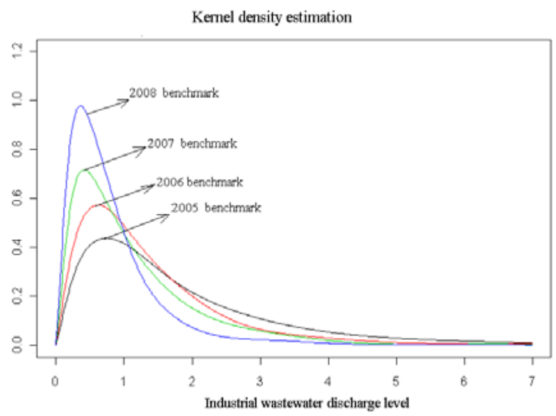


Fig.1 Benchmark identification of wastewater discharge level distribution in China each year

### 3.2 Characteristics of the general situation

Figure 1 presents the benchmark identification of industrial wastewater discharge level distribution of all prefecture-level cities in China during 2005 to 2008. The horizontal axis is the industrial wastewater discharge level, which is the division of a city’s industrial wastewater discharge by the city’s gross industrial output value. Calculate the expected value of each curve. $EX = \int_{0}^{\infty} x f_n\left(x, X\right) dx$. The EX is 2.011, 1.53, 1.146 and 0.919 respectively in 2005, 2006, 2007 and 2008. It illustrates the benchmark identification of each year shifts leftward compared with the benchmark identification of the last year, which indicates the wastewater discharge level is lower year by year. In the "Eleventh Five-Year Plan" period, the wastewater emissions are reducing by a certain percentage each year. Pollution emissions reduction has got notable achievements.

### 3.3 Impact of industrial structure

Over the years, expanding the investment scale and increasing material input have become important aspects of China's economic development, which mainly depends on the development of general processing industries and increasing the number of processing industry enterprises specifically. This extensive model of economic growth which continuously increases pressure on resources and environment is difficult to sustainable. As a result, the "Eleventh Five-Year Plan" proposal emphasizes that we should accelerate the transformation of economic growth. Adjustment and optimization of economic structure is an effective measurement to reduce the environmental damage while keeping economic continuously growing. The subject analyzed by this paper is industrial wastewater discharge, which has great relationship with the proportion of the secondary industry to the GDP. The secondary industry consists of industry (including extractive industry, manufacturing industry, producing and supplying of electricity, gas and water) and construction business.

According to the data from China Statistical Yearbook, compared to 2005, China’s industrial structures in 2008 have experienced slight changes. The proportion of the secondary industry to GDP is 47.7 percent in 2005 and rises to 48.6 percent in 2008, while the tertiary industry remains 40.1 percent. The increasing in the rate of the secondary industry goes against to pollution reducing, which is not an environment friendly change in the economic structure. This section analyzes the impact of the change in the secondary industry structure to the pollution reduction and points out which kind of cities need strengthen emission monitoring then designs the pollution reduction programmers for those cities.

China is a huge geographical country, with unbalanced economic development in different cities. The economic structures also vary from city to city. Hence we classify all of the 278 cities into three categories according to the proportion of the secondary industry to GDP:

The first category：The proportion of the secondary industry is less than 35 percent;

The second category：The proportion of the secondary industry is between 35 and 55 percent;

The third category：The proportion of the secondary industry is larger than 55 percent.

According to the classification, it can be derived that the secondary industry in the cities of the first category is relatively weaker than that in the other two categories. Economic developing in the cities of the third category is more depending on the secondary industry, which occupies more than 55 percent of GDP. On the basis of equation one, we estimate the benchmark identification of all the categories of the cities in 2005 and 2008, the results can be seen in figure 2 and figure 3.

Calculate the expected value for all three categories in 2005 and 2008 (see table 1).

**Table 1.** Expected value of all three categories

| EX | Overall | The 1st category | The 2nd category | The 3rd category |
|---|---|---|---|---|
| 2005 | 2.011 | 3.523 | 1.898 | 1.093 |
| 2008 | 0.919 | 1.414 | 1.035 | 0.580 |

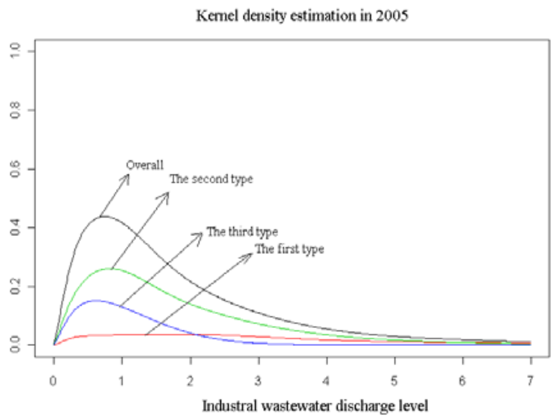


Fig.2 Benchmark identification of all categories in 2005

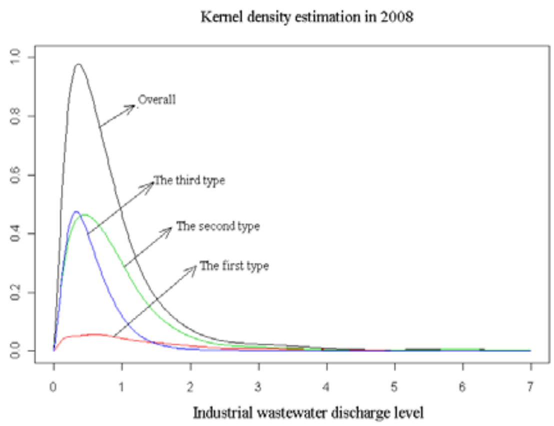


Fig.3 Benchmark identification of all categories in 2008

From figure 2, we can see that the waste water discharge amount of the second category accounts for the largest share of the total amount, and the first category accounts for the smallest share. That indicates the most part of the wastewater discharge came from the cities in the second category in 2005. According to table 1, the expected value of the second category is the closest to the EX of the overall distribution in 2005, the EX of the third category is almost the half of the EX of the overall distribution, and the EX of the first category is much larger than that of the overall distribution. Therefore, the cities in the third category have got the greatest achievements in wastewater discharge reduction although their economics are relied more on the secondary industry. The cities in the first category are relatively less relied on the secondary industry in developing but have the highest level of wastewater discharge.

According to figure 3, the whole wastewater discharge level in 2008 is lower than that in 2005, and the expected value drops from 2.011 to 0.919. As in 2005, wastewater discharging of the cities in the second category remains accounting for the largest share of the total amount. Compared with figure2, wastewater discharge amount of the third category obviously increased in figure3, the reason is that more cities are classified to the third category in 2008 while they are concluded in the second category in 2005. As can be seen from table 1, EX of each category has dropped for a degree during the period of 2005 to 2008. The EX of the first category in 2008 has dropped to less than half of that in 2005. However, it is still higher than the EX of the overall level. Similar to the situations in 2005, cities in the third category have got the greatest achievements in wastewater discharge reduction, and the first category has the highest wastewater discharging level in all of the categories. Since cities in the first category have a lower proportion of industry, they probably don't have a large amount of the wastewater discharging. A high wastewater discharging level may own to district pollution control. As a result, we can infer that those cities need strengthening supervision in pollution emissions.

Industrial wastewater discharge reduction programmers can be designed for each category based on the different characteristics of them. The first category of cities position in the highest levels of all the cities, which has great potential in reducing pollution emissions, need to enforce monitoring. The quantities of the cities in the second category are quite large, and the wastewater amount discharged by this category accounts for the major part of the total amount. Besides, the expected value of the second category's distribution is closest to the EX of the overall distribution; hence the wastewater discharge level of this category will directly affect the overall discharge level. If the emission levels drop in such cities, the overall level will obviously reduce correspondingly. The third category is the best category in pollution emissions control. Its discharge level is much less than the overall level. Therefore, this study doesn't make pollution reducing design for this category.

As the EX of benchmark identification of the third category in 2005 is close to the EX of the overall distribution in 2008, pollution reducing design for 2005 can be made according to this characteristic, taking the discharge level of the third category as a baseline for design. $X_{in}$ denotes the industrial wastewater discharge level in city $i$ of category $n$. $Y_{in}$ denotes the industrial wastewater discharge level in city $i$ of category $n$ after discharge reducing design. Process of designing wastewater reducing is as follows:

(1) In the first category, if $X_{i1} \geq 1.093$, let: $Y_{i1} = X_{i1} - (3.523 - 1.093)$ ;if $X_{i1} < 1.093$ ,then let: $Y_{i1} = X_{i1} * 1.093 / 3.523$ $i$=1,2…,48;

(2) In the second category, if $X_{i2} \geq 1.093$, let: $Y_{i2} = X_{i2} - (1.898 - 1.093)$ ;if $X_{i2} < 1.093$ ,then let: $Y_{i2} = X_{i2} * 1.093 / 1.898$ $i$=1,2…,167;

(3) In the third category, let: $Y_{i3} = X_{i3}$ $i$=1, 2…, 63.

After the designs for the wastewater discharge level in 2005 and 2006, we make kernel density estimation of $Y_i$ according to equation one. (See figure 4 and figure 5)

Compare the new benchmark identification after design for 2005 and the benchmark identification of 2007 in figure four, it is obvious that the two distributions are quite close. In figure five, the new benchmark identification after design for 2006 and the benchmark identification of 2008 are quite close. According to this regular, is reasonable to infer that the new benchmark identification after design for 2008 might be close to the benchmark identification in 2010 (See figure 6). Therefore, this new benchmark identification of 2008 can be considered as the benchmark identification of 2010.

During the period of 2005 and 2008, certain changes of the industrial structure have taken places in all of the cities. In this section we denote the proportion of the secondary industry as PSI for

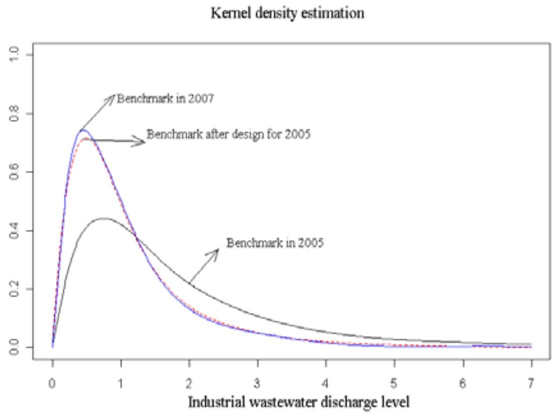


Fig.4 Benchmark identification after design for 2005

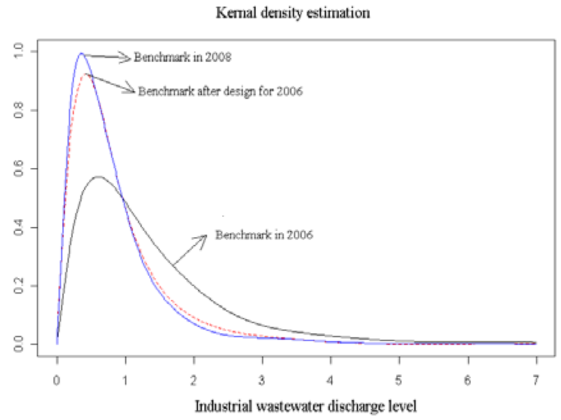


Fig.5 Benchmark identification after design for 2006

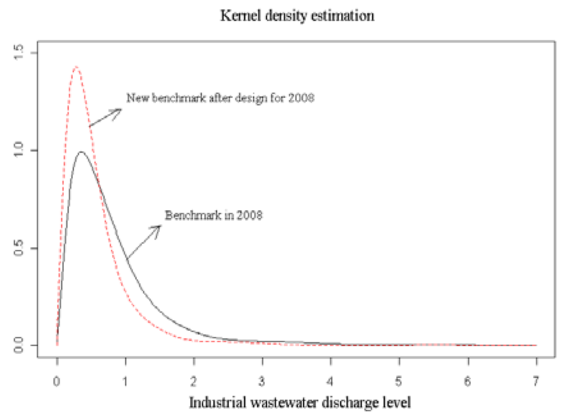


Fig.6 Benchmark identification after design for 2008

notational simplicity. Here we add PSI into the model, based on equation five, the PSI path identification in 2005 can be seen in figure 4. In order to find out how the changes of PSI influencing wastewater discharges, we replace the PSI of each city in 2005 into the PSI in 2008 and estimate the PSI path identification which recorded as PSI08 path identification.

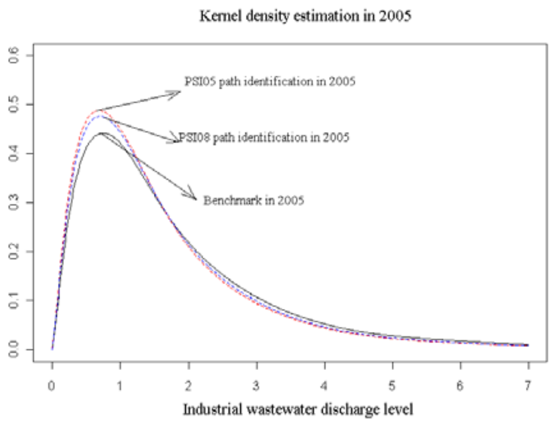


Fig.7 PSI path identification in 2005

As is shown in figure 7, two PSI path identification are quite close to each other, the peak of the PSI08 path identification is a little lower than the peak of the PSI05 path identification, which means the former has lower efficiency strength. Calculate the expected value of those two path identification, the EX of PSI05 path identification is 1,769, and the EX of PSI08 path identification is 1.811. As the proportion of the secondary industry has risen a little from 2005 to 2008, the impact from this change is obvious. It is slightly detrimental to pollution reduction. That means China has not taken advantage of economic structure optimization to reduce pollutions. Therefore, the economic structure adjustment during that period is not beneficial for the environment quality. In 2008, the ratio of the secondary industry to GDP is 48.6 percent in China, and the tertiary industry is 40.1 percent, which remain the level of a developing country. And in some developed countries, the proportion of service trades to GDP reaches 70 percent. We can infer that there are great potentialities for changes of economic structure in China. Make unremitting efforts to adjust the economic structure and deepen the economic restructuring are effective measures in reducing industry pollution emissions.

### 3.4 Impact of FDI

The existing studies about the relationship between FDI and the environment have three viewpoints: The first one supports the "pollution haven" hypothesis, which suggests that FDI has direct relationship with the pollution emissions in host countries. Those countries with weak environment regulation are attractive to the enterprises in the countries with strong environment control. As a result such countries become a haven for polluters. The second point supports the "pollution halo" hypothesis. They believe that while the multinational companies invest in the host countries, they spread green technologies either. As they would apply unified environment standards, it is beneficial for the host countries reducing environment pollutions. The last point considers the increasing of output. As FDI promotes a substantial increase in output, which would naturally leads to corresponding increase in pollution.

Figure 8 presents the benchmark identification and FDI path identification in 2005 and 2008. In 2005, the average levels of the wastewater discharge (EX) are 2.01 and 1.71 respectively for benchmark identification and FDI path identification. In 2008, the average levels of the wastewater discharge are 0.92 and 0.75 respectively for benchmark identification and FDI path identification. It demonstrates that no matter in 2005 or 2008, FDI path identification has a negative impact to the benchmark identification of wastewater discharge level. Hence, FDI has a positive impact to environment improvement. The impact strengths are 0.106 and 0.101 respectively in 2005 and 2008. We can conclude that the general environment impact of FDI is positive, and importing foreign investment is in favor of reducing wastewater discharge and environment protection.

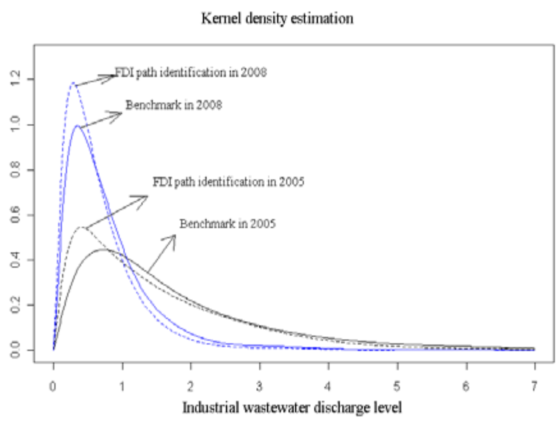


Fig.8 FDI path identification in 2005 and 2008

### 3.5 Impact of pollution control cost

Pollution control cost is usually invested to improve technology of energy consuming efficiency and reducing emissions, or to strengthen monitor. It is no doubt that investment of pollution control cost is favorable for environment protection. Based on equation one and five, we estimate the benchmark identification of 2005 and 2007. As the pollution control cost data of the cities in 2008 are unavailable, we estimate the pollution control cost path identification of wastewater discharge level in 2005 and 2007. In this section we denote pollution control cost as PCC for notational simplicity.

Compared to the benchmark identification, PCC path identification in each year has shifted left for a certain degree. In 2005, the expected value of benchmark identification is 2.01, and the EX of PCC path identification is 1.97. In 2007, the expected value of benchmark identification is 1.24, and the EX of PCC path identification is 1.1. The dropping of the EX implies the pollution control cost has positive impact to the environment protection. The efficiency strengths are 0.059 and 0.067 respectively in 2005 and 2007, which are weaker than the impact strengths of FDI.

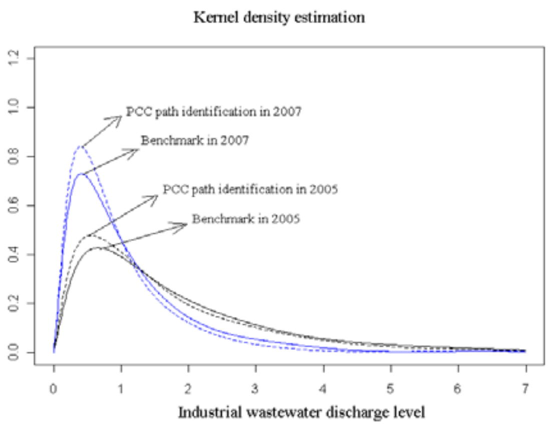


Fig.9 PCC path identification in 2005 and 2007

## 4. Conclusion

The previous studies remain some debates about how economic structure, FDI and other economic indicators affect pollution reduction. In this paper, from the perspective of 278 cities in China, we employ the nonparametric model to analyze the water pollution discharge reduction effectiveness in the period of the "Eleventh Five-Year Plan". By applying a Path-Converged Design approach and changing the weights of the model, we explore the impacts of some relevant economic variables. Empirical results are as follows:

1. Generally, the distribution line shifts leftward each year compared with that of the last year. The wastewater discharge level is gradually reducing every year and the pollution reduction implements have got certain achievements annually.

2. Considering the industrial structure, the cities with the proportion of the secondary industry to the GDP under 35 percent have achieved great reduction in wastewater discharge from 2005 to 2008. But compared with other two kinds of cities, their levels of pollution emissions are still higher, thus such cities have great capacities in pollution reduction. Besides, most of the wastewater is discharged by the cities in the second category with the proportion of the secondary industry between 35 and 55 percent. Focus on those two categories of cities, the paper designs a wastewater reduction programmer. The distribution of the wastewater discharge level after design is quite similar to the distribution of that in two years later. Make a design for the wastewater discharge in 2008, the identification can be considered as the benchmark identification in 2010. In future, the government should pay more attention and enhance monitoring to those two categories of cities. During the period of 2005 to 2008, there is a slight increase in the ratio of industry to GDP, which has a negative impact to environment protection. Adjustment and optimization of economic structure should be attached more importance by the government.

3. Foreign direct investment has played an important role in environment protection. The impact of FDI to wastewater reduction is relatively larger than other variables in China. Induce more foreign investment is beneficial for both economic growth and pollution reduction.

4. The investment amount of pollution control cost has positive affect to the pollution reduction. But the impact strength is weaker than the impact of FDI.

Above all, we can conclude that in the "Eleventh Five-Year Plan" period, industrial pollution emissions reduction is a long-term programmer and has got certain achievements. According to the situation in China, inducing FDI and investing pollution control cost are effective in improving pollution reducing. The change of economic relationship from extensive mode to intensive mode is always emphasized in recent years. But the proportion of the second industry is still increase, which has produced great pressure to environment protection.

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