ARE FOREIGN INVESTORS ATTRACTED TO WEAK ENVIRONMENTAL REGULATIONS?
Evaluating the Evidence from China*

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Abstract

One of the most contentious debates today is whether pollution-intensive industries from rich countries relocate to poor countries with weaker environmental standards, turning them into "pollution havens." Empirical studies to date show little evidence to support the pollution haven hypothesis, but suffer potentially from omitted variable bias, specification, and measurement errors. This paper estimates the strength of pollution-haven behavior by examining the location choices of equity joint venture (EJV) projects in China. We derive a location choice model from a theoretical framework that incorporates the firm's production and abatement decision, agglomeration and factor abundance. We estimate conditional logit and nested logit models using new data sets containing information on a sample of EJV projects, effective environmental levies on water pollution, and estimates of Chinese pollution-intensity for 3-digit ISIC industries. Results from 2,886 manufacturing joint venture projects during 1993-96 show EJVs from all source countries go into provinces with high concentrations of foreign investment, relatively abundant stocks of skilled workers, concentrations of potential local suppliers, special incentives, and less state ownership. Environmental stringency does affect location choice, but not as expected. Low environmental levies are a significant attraction only for joint ventures in highly-polluting industries with partners from Hong Kong, Macao, and Taiwan. In contrast, joint ventures with partners from OECD sources are not attracted by low environmental levies, regardless of the pollution intensity of the industry. We discuss the likely role of technological differences in explaining these results.

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I. Introduction

One of the most contentious issues debated today is whether inter-country differences in environmental regulations are turning poor countries into "pollution havens." The main argument is that stringent environmental standards in industrial countries drive firms to close plants at home and establish them instead in developing countries, where standards are relatively weaker. Since more pollution-intensive industries will have a larger incentive to move, a haven of such industries will build up in poor countries. A corollary is that developing countries may purposely undervalue environmental damage, in order to attract more foreign direct investment (FDI). This, in turn, could generate a "race to the bottom" with all countries lowering environmental standards in order to attract and retain investment.

This study estimates the strength of pollution-haven-seeking behavior by foreign firms investing in China. We derive and estimate a model of FDI location choice in the presence of inter-provincial differences in environmental stringency. Our theoretical framework is built upon Copeland and Taylor's (2003) firm production and abatement decision model, amended to include agglomeration. From this model, we derive an econometric model which is estimated using two new and unique datasets. The first contains information on 2,886 manufacturing foreign equity joint venture (EJV) projects in China during 1993-96, including provincial location, industry classification, and whether the foreign partner is based in Macao, Taiwan or Hong Kong or in a non-ethnic-Chinese industrial (primarily OECD) economy. The second contains information from the annual Chinese environmental and economic censuses. The environmental data allow us to construct effective water pollution levy rates, by province and year, as a measure of provincial environmental stringency. They also include Chinese water-pollution intensities at the 3 digit ISIC industry level, as a measure of industrial pollution intensity. The economic data allow us to construct a rich set of provincial characteristics, including agglomeration, potential local suppliers, and labor skill shares.

Early empirical studies suggested that environmental stringency had no discernible effect on location choice.[1] Though FDI in pollution-intensive industries did occur, there was little evidence that it had been influenced by differing pollution abatement costs, or had flowed faster into developing countries relative to industrial countries.[2] Recent econometric studies have adopted one of three approaches to investigate whether FDI flows have resulted in pollution havens: inter-state plant location choice; inter-industry FDI flows within a country; and inter-country FDI location choice. Results from these studies are mixed.

In his review of four studies that use the first approach to study US plant location choice, Levinson (1996a) finds little evidence that inter-state differences in environmental regulations affect the location of plants in the US. Levinson (1996b) finds only one of six environmental stringency indicators has a significant impact on the location of new branch plants across US states, and its impact is small. However, controlling for unobserved state characteristics and adjusting their abatement cost measure for inter-state differences in industrial composition, Keller and Levinson (2003) find evidence that pollution costs have a moderate deterrent effect on foreign investment into US states.

Eskeland and Harrison (2003) adopt the second approach, examining the pattern of foreign investment across industries within Mexico, Venezuela, Morocco, and Cote d'Ivoire. They find that abatement costs are not significant determinants of the distribution of foreign investment among manufacturing industries within a country. In addition, the relationship between FDI and pollution-intensity depends on the pollutant.[3] Within an industry, foreign ownership is actually significantly and robustly associated with lower energy use (a proxy for lower pollution intensity).

Smarzynska and Wei (2001) adopt the third approach, evaluating the foreign investment choices of multinational firms locating across Eastern Europe and the former Soviet Union. They emphasize the

[1] Reviews of the literature can be found in Dean (1992, 2001) and Copeland and Taylor (2004).
[2] Leonard (1988) found some evidence that governments used lenient environmental regulations to attract FDI in the 1970s, but he also found that incentives were not substantial enough to offset other determinants of location choice, particularly labor productivity, infrastructure and stability.
[3] While there is some evidence of a positive relation between FDI share and air pollution-intensity, there is a negative relation between FDI share and both water pollution and toxic-release intensity.

problem of omitted variable bias in previous work: corruption may deter FDI, but may be correlated with laxity of environmental controls. The authors control for the role of corruption, but find little support for the hypothesis that lower environmental standards attract investment, or for the hypothesis that lower standards are more attractive to pollution-intensive FDI. However, these results are sensitive to the measures chosen to proxy environmental stringency and pollution intensity.[4]

Our choice of theory, data, and method attempt to address five problems arising in the recent literature. First, as noted by Antweiler, Copeland, and Taylor (2001) most studies of openness and the environment have been loosely motivated by the theoretical literature on pollution emissions and abatement, potentially giving rise to specification error. In response, we use the Copeland and Taylor (2003) emission and abatement framework to derive a reduced form estimating equation. Second, the absence of relative factor abundance and agglomeration from many of these studies--critical determinants of FDI in China--may cause omitted variable bias. We draw on Zhang and Markusen (1999), Cheng and Kwan (2000), and Head and Ries (1996) to incorporate these features into the theoretical framework and resulting estimating equation.

Third, as Smarzynska and Wei (2001) emphasize, many studies have had to rely on highly aggregated FDI data, and very broad proxies for environmental stringency or pollution intensity, potentially causing measurement error. In contrast, we have created a panel of FDI projects, allowing us to control for the pollution intensity of the activity and for the source of the foreign funding. The availability of provincial effective water pollution levy rates allows us to specify the stringency of regulations using a price-based policy instrument at the level of administration. We thereby avoid the use of national proxies (e.g. participation in environmental treaties), which may bear scant relation to actual practices, or average abatement costs, which are influenced by local production technologies, factor prices, and industry concentrations.

[4] Measuring stringency and pollution-intensity by participation in international treaties and an emissions index, the authors find dirty projects more likely to locate in areas with low stringency. However, this result is not robust to alternative measures such as actual standards and an abatement index.

Fourth, Keller and Levinson (2002) note that unobservable features of a location, such as natural resources or sector-specific tax subsidies, may be correlated with both regulatory stringency and investment and lead to omitted variable bias. The direction of the bias cannot be predicted, but it may account for the failure of previous studies to find a negative relationship between environmental stringency and investment inflows. We use a number of methods to control for observed and unobserved provincial characteristics: a rich set of control variables; a nested logit procedure to allow for similarities among provinces in the same region; and robustness tests incorporating regional and provincial fixed effects.

Finally, Ederington, Levinson, and Minier (2003), argue that certain features of an industry allow it to respond to greater stringency more dramatically than others. We expect that firms will respond more strongly to inter-provincial differences in pollution taxes, when these taxes represent a significant cost. Moreover, we expect that these differences in sensitivity will occur both between and within industries, if abatement efficiency varies across firms. Accordingly, we estimate the deterrent effect of regulatory stringency by the pollution intensity of the industry and by the source of the foreign investment.

Results from our sample of joint venture projects suggest an important linkage between technology and pollution-haven behavior. For the sample of projects from OECD source countries, we find no evidence of pollution-haven-seeking behavior by investors, regardless of the pollution intensity of the industry. In contrast, projects in highly polluting industries from Chinese sources (Hong Kong, Macao, and Taiwan) are significantly deterred by pollution taxes. One possible explanation for this finding, supported by other studies, is that investment from advanced countries embodies newer technology, implying lower costs for abatement and a higher probability that a given plant will meet standards and avoid taxation. Our evidence provides some support for the idea that firms from developing countries may be attracted by weak environmental regulations. Thus, the attraction may be contingent on lack of access to advanced technology.

In the next section, we describe FDI flows into China and China's pollution levy system. In the third section, we present a model of location choice, incorporating the firm's endogenous response to pollution taxes, local factor prices, and local market conditions. We specify a profit function and we derive a proposition that forms the basis for our empirical work. In the fourth section, we describe our econometric approach and describe the data. Next, we present the results of the conditional and nested multinomial logit analysis. Finally, we interpret our results and suggest some likely explanations for the differences we find in firm behavior.

II. FDI Flows and Environmental Stringency in China

In many ways, China is an ideal site for a study of pollution-haven behavior. China has been the largest recipient of FDI in the developing world since 1990 (Broadman and Sun, 1997; Henley, *et al*., 1999). During the period we will examine, 1993-96, FDI inflows surged dramatically across most of the country. This surge followed the 1992 liberalization in trade and foreign exchange regimes, which included some new favorable terms for FDI (Shuguang, et al., 1998). Yet the distribution of investment within China is highly uneven, raising obvious questions about the factors that attract capital inflows. Henley *et al.* report that 80% of cumulative FDI inflows have located in one of China's ten eastern provinces. This distribution clearly reflects the influence of special incentive programs,[5] and the policy of gradual opening pursued before the new guidelines issued in 1992.[6] However, as Huang (2003) notes, in comparison to investment flows to other countries at similar stages of development, the inflows to China were remarkable for their wide distribution among industries and provinces. Of the 28 manufacturing industries included in the 1995 Industrial Census, none had received more than 10 percent of total FDI.[7] Moreover, while the interior regions of China received only about 13 % of cumulative FDI flows between

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[5]In 1979, the Chinese national government began accepting foreign investment and in 1980 established four special economic zones (SEZs) within Guangdong and Fujian provinces. In 1984, fourteen coastal cities received special incentive programs for FDI. Additional zones have been established since to encourage development of interior locations. As Head and Ries (1996) note, however, after the issue in 1986 of a new legal framework governing foreign investment, certain incentives were available anywhere in China to foreign enterprises that produced for export or introduced advanced technology.

[6]See Tseng and Zebregs (2002). In 1992, the Chinese government significantly liberalized its FDI regime. As Lardy (1994) reports, it removed a number of sectoral and regional restrictions on FDI and decentralized approval from the central government to local governments. New rules introduced in 1995 grouped investment into three categories. "Encouraged" investment includes new agricultural technology; construction of energy, communications, and raw materials projects for local industry; projects that enhance exports; projects that use renewable resources or involve new technology or equipment for pollution control or prevention; and investments developing the central and western parts of China. "Restricted" investment includes projects already developed, where the technology has already been imported and capacity can meet demand; projects in industries where the state is experimenting with foreign investment while a state monopoly still exists; exploration and/or extraction of minerals; and projects in industries requiring central planning. "Prohibited" investment includes dangerous, polluting, or wasteful processes. See Henley, *et al*. (1999).

[7] See Huang (2003), Table 1.4.

1992 and 1998, its total value was $31.5 billion, exceeding the entire FDI inflow to India during the same period.[8]

China also offers the opportunity to study the response of investors to the Chinese water pollution levy system--the broadest application of a price-based mechanism in the developing world (see Appendix A). We know of no previous study that estimates the strength of environmental regulation in shaping foreign investment flows within China.[9] The Chinese water discharge levy depends upon both concentration and volume. For each plant, a pollutant-specific discharge factor is calculated, based on both total waste water discharge and the degree to which pollutant concentration exceeds the standard for each water pollutant. Concentration standards are set jointly at the national and provincial level, and vary across provinces and across pollutants. If a pollutant concentration is more than (less than or equal to) the standard, a charge (no charge) is applied.[10] These charges, which are set at the national level, vary by pollutant but not by industry. For each plant, the potential levy is calculated for each pollutant. The final levy imposed on the plant is the greatest of these potential levies.

Another important feature of FDI in China which is relevant for testing the pollution haven hypothesis is differences across source countries. According to Henley, *et al*. (1999) between 1985 and 1996, 66.4% of FDI into China came from Hong Kong, Macao, and Taiwan. (An unknown proportion of this investment originated in mainland China and found its way back to China in a practice known as 'roundtripping.') While dispersed throughout China, FDI from these sources, especially from Hong Kong, concentrated in the southern coastal provinces. Much of this investment involved labor-intensive processing of imported inputs for re-export. During the same time period, only 8% of FDI came from the United States and 8% from Japan.[11] Investments from Japan and the West tended to be undertaken by

[8] Figures provided by Huang (2003), page 28.
[9] Levinson (1996a, 1996b) and Keller and Levinson (2002) perform such studies using US state-level abatement costs. Because state rules and implementation differ, they are able to identify the impact of controls on firm location. Henderson (1996) and Kahn (1997) use county-level variation in compliance with national air quality standards. The US does not rely primarily on a price-based system, however, and it is difficult to relate these measures to actual regulatory instruments.
[10] Beginning in 1993, a fee was imposed on all wastewater. See appendix A for details.
[11] No other country provided more than 3% of total FDI into China during 1985-96. See Henley, *et al*., Table 7.

transnational corporations that produced goods for the Chinese market.[12]

Investors based in Macao, Hong Kong, or Taiwan are likely to have family or business interests in neighboring provinces. These links may be very close, and as Head and Ries (1996) emphasize, an unobserved share of the investment from Chinese sources is 'roundtripping' and its location choice decision influenced by the location of mainland connections.[13] The fact that Chinese investment is largely for export, while transnational corporations generally target the local market , suggests that the two types of projects may be of substantially different character. Fung, Iizaka, and Parker (2002) find that investment from Japan and the U.S. is sensitive to provincial labor quality, while investment from Hong Kong and Taiwan is, in contrast, not sensitive to labor quality but to labor costs.[14] Head and Ries (1996) find evidence that previous foreign investment, high labor productivity, good transportation, and a large pool of local suppliers make a city more attractive to non-Chinese investors, but that low industrial wages have no significant influence.

It is also likely that EJVs from high-income countries use cleaner technologies than do Chinese EJVs. Since industrial countries generally have relatively stringent standards compared to Hong Kong, Taiwan, or Macao, they are more likely to develop and use cleaner technologies. Lanjouw and Mody (1996) report that the United States, Japan, and Germany were the most important sources of environmental innovation and diffusion during the 1970s and 1980s and that the share of these innovations related to water pollution control increased dramatically over time, as detailed emissions standards and technology specification became common. In addition, firms from high-standard countries report high costs to installing and maintaining older vintage technology in new plants, even when these plants are located in countries with weaker standards. Survey data on EJVs in China collected and reported by Loren Brandt and Susan Zhu indicate important technological differences among foreign

[12] While some authors describe investment from ethnic-Chinese economies as smaller scale, Huang (2003) reports that the average size of individual FDI projects from Japan, Korea, the United States, and Thailand are not substantially larger than those from Chinese sources.

[13] For this reason, Head and Ries (1996) exclude projects with partners from Hong Kong, Macao, and Singapore from their analysis of FDI flows to Chinese cities in 1984-1991.

[14] Similar results are found in Fung, Iizaka, Lin, and Siu (2002) and Gao (2002), who use more comprehensive measures of labor quality.

parents.[15] While performance requirements were common among joint ventures initiated during 1987-1993, Brandt and Zhu report that only about one-third of joint ventures from Hong Kong were required to transfer advanced technology from the parent firm, while about three-fourths of joint ventures from industrial country investors were required to do so.[16] This technological difference is even more likely if Chinese EJVs actually represent round-tripping. Thus, it is likely that Chinese and foreign EJVs have access to different pollution control technologies and we investigate separately the strength of each type of investor's attraction to provinces with weak standards.

Table 1 shows the percent of national FDI inflows (actually utilized[17]) locating in high, medium, and low-income provinces, based on income averages throughout the period.[18] In 1987, nearly 80% of foreign investment located in provinces with relatively high GDP per capita, while only 8% located in one of the lowest-income provinces. A similarly large gap is found in 1995, with high-income provinces receiving 64% of FDI while the lowest-income provinces only received 9%. A closer look, however, reveals that the rich-province share declines fairly steadily throughout the period. Flows into the low-income group appear stagnant, while the share of FDI flowing to the moderate-income group nearly doubles.

The relationship between FDI inflows and two indicators of environmental stringency are also shown in Table 1. Provinces are first grouped by average effective water pollution levy during the period. It is clear that the highest shares of FDI inflows are found in provinces with the most stringent environmental regulations. The differential is quite large, and holds for every year in the period. Provinces are also grouped by average discharge intensity (tons of COD discharge per million yuan

[15] Our thanks to Susan Zhu for making this information available.
[16] Brandt and Zhu (undated) write: For the joint ventures that have investors from Hong Kong, only 35% were required to transfer advanced technology from foreign parent and 5% were required to transfer a patent from foreign parent. For the joint ventures having investors from developed countries, 76% were required to transfer advanced technology and 29% were required to transfer a patent from foreign parent. Only 6% of the firms having partners from Hong Kong were required to manufacture certain components or final products in China, while 42% of the firms with partners from developed countries had this requirement. From this we may infer that the technology flow will be larger for the joint ventures that have foreign parents from developed countries. (p. 7)
[17] FDI inflow in a given year is not necessarily utilized immediately, since its use requires approval.
[18] Hainan and Tibet are excluded due to lack of data.

output (1990 yuan)) over the period. To the extent that discharge intensity is an indicator of laxity of standards and/or concentration of pollution-intensive industries, it appears that neither of these factors attracts FDI. Most FDI flows to provinces with relatively low discharge intensity.

Since per capita income and pollution levies are strongly correlated (Dean, 2002; Wang and Wheeler 2003, 2005), it is not clear from this evidence the extent to which each of these characteristics influences location choice. It is clear that FDI is *not* flowing to provinces with the least stringent regulations. Over time, however, there is a reduction in the share of FDI going to provinces with high pollution levies (low discharge intensity), and an increase in the share going to the group with moderate pollution levies (moderate discharge intensity). Since provinces show increased levies over time, the trends in Table 1 could indicate that FDI moves in response to stricter environmental regulations.

III. Theoretical Model

A Model of Production and Emissions

Like Smarzynska and Wei (2001) we consider a multinational firm that wants to invest one unit of capital to produce somewhere in a given region.[19] We assume that China has been chosen because it is the lowest-cost region in which to produce. Therefore, the decision for the firm is to choose the host province within China that produces the highest profit.

We treat foreign firms as price takers with respect to pollution taxes. Local variations in enforcement raise the possibility that firms may negotiate over pollution levies with local authorities. However, as explained in Appendix A, such negotiations occur after production and emissions decisions have been made by the firm, following an inspection by local authorities. We assume, therefore, that at the time that a location decision is made by the firm, the exact levy rate it will be charged is unknown but that the firm has information on the effective rate per unit that provincial regulators have actually charged local firms in the past. As this rate is influenced both by the statutory rate and by enforcement practices, we use this effective rate as the firm's indicator of provincial environmental regulatory stringency.

Our treatment of production follows Copeland and Taylor (2003). We consider a firm that jointly produces two outputs, good X and emissions Z, using variable inputs of unskilled labor, skilled labor, and intermediate (locally-provided) services. The capital input is embodied in the original investment and is fixed in the short run. Abatement of emissions is possible, so emission intensity is a choice for the firm. We assume that the firm can allocate an endogenous fraction, θ, of its inputs to abatement activity. This implies that abatement and production use factors in the same proportion. If $\theta = 0$, there is no abatement and, by choice of units, each unit of output generates one unit of pollution. The joint production technology is given by:

[19]We take the decision to produce abroad, as well as the region in which the project will be located, as made in a prior stage. Zhang and Markusen (1999) consider the firm's choice of producing at home and exporting or producing abroad.

$$X = (1-\theta)F\left(L_{x,}, H_x, I_x(s)\right),$$
$$Z = \phi(\theta)F\left(L_x, H_x, I_x(s)\right), \quad (1)$$

where L is unskilled labor, H is skilled labor, and s is a vector of locally provided services. The function $I_x(s)$ aggregates these local service varieties into an intermediate input for the foreign firm. We assume that F is increasing and concave, and $0 \le \theta \le 1, \phi(0) = 1, \phi(1) = 0$.

To aid our ability to derive an estimating equation, we follow Copeland and Taylor (2003) and assume that the relation between abatement activity and emissions is given by

$$\phi(\theta) = (1-\theta)^{1/\alpha}, \quad (2)$$

where $0 \le \alpha \le 1$. Using this form, we can eliminate theta and invert the joint production technology to obtain a net production function in which emissions is treated as an input:

$$X = Z_x^{\alpha}[F(L_x, H_x, I_x(s))]^{(1-\alpha)}. \quad (3)$$

If we assume that the production function is generalized Cobb-Douglas,

$$F(L_x, H_x, I_x) = AL_x^b H_x^d (I_x(s))^e, \quad (4)$$

where b, d, and e are constants, and A is a measure of Hicks neutral technological progress, the net production function becomes

$$X = Z_x^{\alpha} A^{(1-\alpha)} L_x^{\beta} H_x^{\delta} (I_x(s))^{\varepsilon}, \quad (5)$$

where $\beta = b(1-\alpha), \delta = d(1-\alpha)$, and $\varepsilon = e(1-\alpha)$. We note that $\alpha, \beta, \delta, \varepsilon$ are factor shares and in particular that α is the share of pollution taxes in the value of output.

Profit maximization implies cost minimization. Let τ be the emissions tax rate, u the wage for unskilled labor, h the wage for skilled labor, and $\tilde{p}_s$ a price index for locally-provided services. Using the net production function, the cost of producing X units in province j is

$$C_X(\tau_j, u_j, h_j, \tilde{p}_{sj}, X) = KA^{\frac{-(1-\alpha)}{\gamma}} \tau_j^{\frac{\alpha}{\gamma}} w_j^{\frac{\beta}{\gamma}} h_j^{\frac{\delta}{\gamma}} \tilde{p}_j^{\frac{\varepsilon}{\gamma}} X^{\frac{1}{\gamma}} = Kc_X(\vec{w}_j)X^{\frac{1}{\gamma}}, \quad (6)$$

where $\gamma = \alpha + \beta + \delta + \varepsilon < 1$ and the vector $\vec{w} = (\tau, u, h, \tilde{p}_s)$. To begin, we assume that the firm produces only for export to a third market, so the price of the final good produced by the project, p^f, does not vary by province. The maximum profit earned on fixed capital investment in any province *j* is given by the profit function:

$$\pi_{Xj}(p^f, \vec{w}_j) = \left[\gamma^{\frac{\gamma}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} \right] \left[p^f \right]^{\frac{1}{1-\gamma}} \left[\frac{1}{K c_X(\vec{w}_j)} \right]^{\frac{\gamma}{1-\gamma}}. \tag{7}$$

This profit function is multiplicative and, therefore, linear in logs.

Using (7), we can explore how an increase in the emissions tax rate changes the maximum profit that an investor can earn in a given province. The emissions tax rate enters the cost function, $c_X(\vec{w})$, so using Shepard's lemma and denoting proportionate changes with a "∧",

$$\frac{\hat{\pi}_{Xj}}{\hat{\tau}_j} = -\frac{1}{1-\gamma} \frac{\tau_j Z_X(p^f, \vec{w}_j)}{c_X(\vec{w}_j) X(p^f, \vec{w}_j)^{\frac{1}{\gamma}}} = -\frac{\alpha}{1-\gamma} < 0. \tag{8}$$

The maximum profit that can be earned in province *j* falls in response to a 1 percent increase in the emissions tax. Additionally, this effect is proportional to the share of pollution taxes in total variable costs when the firm chooses inputs optimally.

Equation (8) leads to the following proposition.

PROPOSITION 1: The effect of a higher pollution levy on potential profits:

(a) is larger for industries in which variable costs are a larger relative cost share;
(b) is larger for firms within an industry that are less efficient in their ability to abate pollution.

PROOF: This proposition follows directly from the properties of the profit function. Part a can be easily proved by comparing two industries that have the same abatement efficiency (the same value for α) but different values for the sum of *b*, *d*, and *e*. The industry with the larger sum has a larger variable cost share (a larger value for γ). Statement (a) then follows from equation (8): the effect of a levy increase on potential profits is larger for industries that have higher variable costs relative to total cost.

For part b, we note that the efficiency of a firm in abating pollution is governed by the abatement function (2). A less efficient firm has a higher α value, but the same factor shares *b*, *d*, and *e* as other firms in the same industry. Therefore, using equation (8), an increase in the pollution tax has a larger effect on the potential profits of the less efficient firm.

This proposition provides us with the basis for testable hypotheses about location choice. Part a of the proposition leads to the hypothesis that industries with highly polluting production technology will be more sensitive than low-polluting industries to pollution levy differences across provinces. Part b suggests the hypothesis that, within an industry, firms with less efficient abatement technologies will be more sensitive to differences in levy rates.

Foreign Investment and Local Suppliers

Previous research by Head and Ries (1996) suggests that firms have higher profits when they locate in areas where other foreign firms have located. We incorporate agglomeration into our model using the derivation in Head and Ries. The function, *I(s)*, aggregates local service varieties, s_i, into a composite intermediate good. It is assumed to take a constant elasticity of substitution form with the substitution elasticity given by σ. Positing a standard monopolistic competition framework for the market for local services, Head and Ries assume that all service providers face the same unit cost function, $c_S(\vec{w})$. If the number of suppliers is large, each firm faces an iso-elastic demand curve and sets the price $P_s = c_s(\vec{w}) / \sigma$. Given this symmetry, each service provider sets the same price and produces the same quantity. Moreover, final goods producers use the same amount of each variety, leading to the aggregated service input, $I(s) = N_s^{1/\sigma} s$ where s is the common quantity of each service variety.

We now develop an intermediates price index, which appears in the profit function and which measures the price per effective service unit. Note that the total amount paid by a final-good producer for intermediates is $P_s N_s s$, while the number of effective units is given by *I(s)*. Dividing the total amount paid by effective units provides the price index, $\tilde{P}_s = P_s N_s^{(\sigma-1)/\sigma}$. This price index is decreasing in the number of service providers, which reflects the notion that effective costs may be lowered by an increase in the number of varieties, as well as by a reduction in the price of a representative variety.

Head and Ries derive the equilibrium number of local service providers by assuming that they must invest in costly upgrading in order to serve foreign-invested firms. The net profits obtained by an entrant into the intermediates sector depend on the direct costs of upgrading to satisfy foreign quality requirements and on the value of any foregone opportunity. The total cost of upgrading is assumed to vary across potential entrants. Within this context, Head and Ries show that the number of local service firms is a function of local factor prices (because profits fall as costs rise), the final goods price, P^f, and the number of foreign-invested firms producing final goods, N^f, (because profits rise with a higher demand for intermediates from final-goods producers), and the number of potential suppliers, $\bar{N}_s$ (which implies a larger number of local firms that can profitably upgrade).[20] Thus, in equilibrium,

$$N_s = \zeta(\vec{w}, P^f, N^f, \bar{N}_s), \tag{9}$$

where the function $\zeta(\cdot)$ is multiplicative. Assuming that intermediates are produced with skilled and unskilled labor in a Cobb-Douglas technology and adopting the Head and Ries assumption that upgrading costs are uniformly distributed among potential entrants, it can be shown that the price index takes the form

$$\tilde{P}_s = \frac{c_s(\vec{w})}{\sigma}\left[\zeta(\vec{w}, P^f, N^f, \bar{N}_s)\right]^{(\sigma-1)/\sigma} = \left[K_2 u^{\mu} h^{\nu} (P^f) N^f \bar{N}_s\right]^{\rho}, \tag{10}$$

where K_2 is a constant and the exponents are functions of the underlying final-goods and intermediates production parameters.

[20]The derivation is contained in Head and Ries (1996), pages 42-44 and the appendix A.

Substituting this expression back into the foreign firm's profit function (7) yields a expression that is multiplicative in its arguments and, thus, linear in logs. The coefficients in the linearized profit function reflect the underlying production parameters. Under the assumption that local service providers do not pollute or are not subject to pollution fees, the pollution levy coefficient indicates the share of pollution fees in total variable cost. If local service providers do pollute and are subject to pollution fees, this coefficient reflects the share of direct plus indirect pollution fees in total variable cost. This coefficient can be estimated and used to test hypotheses based on Proposition 1.

Other Provincial Characteristics

Clearly other province-specific characteristics, such as special investment incentives, transport costs, and infrastructure, must be included in the overall location choice problem of the firm. Following Head and Ries (1996), incentives can be added as a proportionate shift factor to the profit function. We also introduce variables that capture transportation costs, which we implicitly assume are lower in provinces with larger infrastructure stocks. Finally, we relax the assumption that firms receive the same price in every province. The literature indicates that some firms, particularly those with joint venture partners based in the United States and Japan, produce for the local market. To capture the attractiveness of the local market, we introduce arguments to the profit function that attempt to measure local income and market size.

IV. Econometric Method and Data Description

Estimation Method

Thus far, the model assumes that all foreign investors within an industry are identical. Consequently, one province will be the highest profit site for all projects *within* an industry. Sample data, however, show considerable variation in the location choices within industries. To explain this, we posit that there are unobservable features of each firm that make some provinces more attractive than others. Suppose that for each investor *i* the attractiveness of province *j* depends on the sum of ln π_{ij} and a host of unobserved idiosyncratic features ε_{ij}. If ε_{ij} are distributed independently according to a Type I Extreme Value distribution (whose density is given by exp [-exp(ε)], then the probability, P_{ij}, that investor *i* chooses province *j* where *j* is a member of choice set *J* is given by

$$P_{ij} = F_{ij}(\ln \pi_{ij}) = \frac{\exp\left(\ln \pi_{ij}\right)}{\sum_{j \in J} \exp(\ln \pi_{ij})} \tag{11}$$

and we represent π_{ij} by equation (7). Our baseline estimation of equation (11) is a conditional logit. The conditional logit model is well suited for the location choice framework since it exploits extensive information on alternatives, can account for match-specific details, and allows for multiple alternatives.[21]

Equation (11) is estimated using data on 2,886 manufacturing equity joint ventures undertaken during 1993-1996 across 28 provinces and 27 3-digit ISIC industries. Estimation is done using the full sample and two subsamples: projects with partners from "Chinese" sources, including Hong Kong, Macao, Taiwan (China), Malaysia, Indonesia, and the Philippines; and projects from "Foreign" sources, including the United States, Japan, and other industrial countries.[22] A key assumption underlying the

[21] An alternative approach is to use count data and a Poisson or negative binomial specification. These count approaches are appropriate when there is a preponderance of zeros and small values for counts (Greene, 2003). Data used by Keller and Levinson (2002) and List (2001) have this characteristic.

[22] From our original data source, we identified projects as Chinese, other South East Asian, or non-Chinese in origin. The first two groups were designated "Chinese." We were not able to identify the source for 78 out of 626 projects in 1996, 113 out of 682 in 1995, 79 out of 801 in 1994, and 22 out of 777 in 1993. These projects are

conditional logit model estimates--the independence of irrelevant alternatives (IIA)--may not fit the Chinese circumstances well, given investors' geographic links to Coastal provinces, clustering of prior investment and natural resources, and the gradual nature of the opening process from the coast, then inland and finally west. If the IIA condition is not met, we can turn to the nested logit model. The location choice process becomes a two-level nested decision--choosing among Chinese regions and then making a specific choice of province within a region. We estimate the nested logit model using full information maximum likelihood estimation. [23]

Data Description and Sources

A complete description of all variable definitions and sources is provided in Appendix B. We compiled data for a sample of equity joint venture investments undertaken during 1993-1996, using project descriptions available from the Chinese Ministry of Foreign Trade and Economic Cooperation (MOFTEC).[24] In the tables and figures that follow provinces are grouped into four regions: north coast, south coast, inland and west.[25] The distribution of the sample of EJVs across provinces is shown in Table 2. Figures 1 and 2 provide the distribution of the EJV sample across provinces by source and by 2-digit ISIC industrial sectors, respectively. Figure 1 shows that both Chinese and Foreign partners engage in equity joint ventures in all provinces. Investment into the south coast region is predominantly Chinese, reflecting both the geographic proximity and early opening of these provinces. In contrast, investment into north coast region is split more equally between both sources, a feature sometimes linked to the industrial concentration there. Figure 2, however, shows that the source distribution is unlikely to be

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scattered across nearly all provinces. Since Chinese FDI constituted about two-thirds of total FDI to China in 1996, these projects were assumed to be of Chinese origin. We report the results of sensitivity analysis of this choice below.

[23] Further discussion of the application of these methods to modeling firm location decisions can be found in Ondrich and Wasylenko (1993).

[24] Equity joint ventures are limited liability companies incorporated in China, in which foreign and Mainland Chinese investors hold equity. For further details, see Fung (1997).

[25] North Coast: Beijing, Hebei, Heilongjiang, Jilin, Jiangsu, Liaoning, Shandong, Tianjin; South Coast: Fujian, Guangdong, Guangxi, Hainan, Shanghai, Zhejiang, Jiangsu; Inland: Anhui, Henan, Hubei, Hunan, Jiangxi, Shanxi; West: Gansu, Guizhou, Inner Mongolia, Ningxia, Qinghai, Shaanxi, Sichuan, Tibet, Yunnan, Xinjiang.

driven by industrial concentration to any great extent as most provinces received investment in a wide range of sectors. The most pronounced specialization occurs in the west region, where mining and other natural-resource based activities dominate. Separate calculations show that the distribution of Chinese and Foreign projects across industries grouped by pollution intensity is very similar. The correlation between the Chinese and Foreign industry shares is 0.99.

Figure 3 shows the distribution of EJVs across 3-digit ISIC industries by source. Since about two-thirds of total FDI in this time period is of Chinese origin, it is not surprising that Chinese FDI accounts for about 60-70 % of the FDI in most sectors. An even larger percent of investment in tobacco (314), leather goods (323), printing and publishing (342), and other manufactured products (390) is from Chinese sources.[26] In contrast, more than 50 percent of investment in petroleum refining (353), machinery manufacturing (382, 383) and professional and scientific instruments (385) is from the U.S., Japan, and other non-Chinese sources. This provides some support for the notion that Foreign investors are more specialized in relatively capital- or high-tech-intensive industries compared to Chinese investors.

Our theoretical framework indicates that our estimating equation should include controls for factor prices, the stock of FDI, the number of potential domestic suppliers, the presence of FDI incentives, infrastructure, and local market size. The *Chinese Statistical Yearbook* (various years) was used to compile data on labor supplies, agglomeration, and availability of intermediates suppliers, infrastructure and incentives. Summary data for provincial characteristics (period averages, 1993-1996) are shown in Table 3. Although provincial wage data are available, they are not differentiated across labor types. However, a distribution of the labor force by educational attainment categories is available for each province from the 1990 Population Census and a 1% sample of the population performed in 1995.[27] Since labor mobility between provinces is still low, we assume that relative labor supplies will proxy relative wages in each province. We define unskilled labor as the lowest educational level (illiterate and less than primary level), and skilled labor as the two top educational categories, senior secondary education and

[26] The tobacco industry is monopolized by the Chinese government and heavily regulated.
[27] We interpolate between these years to develop a time series.

college and beyond. We then construct relative factor supplies as the percentage of skilled (unskilled) labor relative to the percentage of semi-skilled labor (the sum of the remaining categories, primary level and junior secondary level).

Agglomeration is proxied by the real value of cumulative FDI, measured for the period 1983 to the year before the project is undertaken for each province.[28] Availability of potential suppliers of intermediate goods is proxied by the number of domestic enterprises. We create this measure by taking the total number of enterprises at the township level and above (thereby capturing larger enterprises that may have the capacity to supply a foreign-invested plant) and subtracting the number of enterprises that are wholly or partly foreign owned.[29] As in other studies, we include several measures of infrastructure. Transport infrastructure is proxied by the length of roads and inland waterways (both adjusted for provincial size). Telecommunications infrastructure is proxied by the number of urban subscribers relative to population . Given the numerous incentives given to FDI in China, an incentive dummy was created that takes a value of one if there is a special economic zone (SEZ) or open coastal city (OCC) in the province. This variable does not vary during the 1993-1996 period.

To measure China's regulatory stringency, we use an effective water pollution levy rate. This is calculated as total provincial water pollution tax revenues divided by tons of wastewater exceeding the provincial discharge standard. This effective tax rate has a number of useful features. It reflects actual charges to firms per unit of polluted wastewater and, thus, may reasonably be interpreted as a "factor price of emissions." It also varies across provinces and over time. Part of the variation is due to differences in concentration standards, which determine the extent of "excess" pollution, and which are determined jointly by the national and local governments. Part of the variation is also due to significant differences in enforcement capacity at the local level. Levies can be reduced or eliminated at the discretion of local regulators after inspection and, thus, vary with the weight placed upon environmental

[28] Calculated using data from Coughlin et al., 2000.
[29] Specifically, we subtract those firms which are classified as "foreign-funded" or "funded by entrepreneurs from Hong Kong, Macao, or Taiwan."

protection by local authorities. Provinces that commonly reduce the levy below its *de jure* level will receive few revenues from the tax and, by the effective levy measure, will have weak stringency.

The maps in figure 4 provide some perspective on the variation in water pollution levies and FDI location across provinces and over time. Higher (lower) levies are shown by darker (lighter) shades of grey, while the percentage of total FDI inflow to a province (in a given year) is shown by the height of the cylinder. In 1993 and still in 1996, FDI located largely in the north and south coastal regions. Some FDI located inland, but almost none in the west. Within the coastal and inland regions there is wide variation in the amount of FDI located in each province. In 1993 there is also wide variation in the effective pollution levies charged by each province, with the highest levies found largely along the coast. While there is still variation in 1996, nearly the entire map has darkened, indicating an increase in the pollution levies across most parts of the country. It is evident that in both 1993 and 1996, there is a positive correlation between the water pollution levy and the percent of FDI inflow locating in a province.

V. Results

Conditional Logit

Because the pollution levy has a similar effect to a factor price, we would expect all firms to be attracted to areas with low levies. Table 4 column (1) reports the conditional logit results for the full sample, without fixed effects. All variables are in logs (except growth) and are lagged 1 year so that they might represent the state of information available to an investor prior to the location decision that year. The most striking result is the strong positive response of EJVs to the pollution levy. This suggests that EJVs are attracted to provinces with relatively stringent standards, even after controlling for income level and income growth, which are often associated with better pollution regulation. This is clearly the opposite of the pollution haven hypothesis, but it is robust to the inclusion of many variables attempting to capture the public goods and services provided by regions with active local governments.

Based on previous work such as Head and Ries (1996) and Cheng and Kwan (2001), we expect all firms to be attracted to provinces with large stocks of FDI and large numbers of potential suppliers, as well as provinces with special incentives for foreign investment and good infrastructure. We find that EJVs are strongly attracted to provinces with high levels of prior FDI, large numbers of potential local suppliers, special incentives, rapid growth, and relatively abundant skilled workers. Results for the infrastructure variables indicate that firms seek dense road and waterway networks. The estimated coefficient for telephone coverage is negative and significant, but may simply be a poor proxy for telecommunications infrastructure.[30] We also expected that firms seeking to sell into the local market would be attracted to areas that have rich and growing local markets, as measured by provincial consumption per capita and real provincial GDP growth. While EJVs certainly appear attracted to fast-growing markets, they seem to seek out markets with lower consumption per capita.

[30] Other authors have found odd results using some measure of telephones. An alternate measure--the number of telephones (per thousand people) also yielded similarly odd results.

As in Keller and Levinson (2002), we find that inclusion of regional fixed effects is important.[31] In column (2) of table 4, we see that EJVs are much more likely to locate on the northern and southern coasts, and much less likely to locate in the west, relative to the inland region (the omitted region). Notably, although the positive coefficient on log levy is smaller, it is still strongly significant. Other results remain largely unchanged, with the exception of incentives and unskilled labor. The effect of having an SEZ or OCC is no longer significant, which is not surprising since this dummy is time-invariant.[32] The sign on log ratio of unskilled labor switches from negative to positive but becomes insignificant. This may be an indication of the importance of splitting the sample by source. If comparative advantages do differ, Chinese joint ventures do produce for export, and Foreign EJVs produce for the local market, then we might expect the response to the labor variables to differ. Chinese (Foreign) EJVs would be more attracted to markets with relatively large supplies of lower (higher) skilled workers, and deterred by markets with relatively large supplies of higher (lower) skilled workers.

By Proposition 1a, we expect the attraction of low levies to be stronger for high-polluting industries than for low-polluting industries. As the table below indicates, industries are quite varied in their water-pollution intensity, with ISIC 34 (paper and paper products, printing) by far the worst polluter.

Pollution Intensity by 2-digit ISIC Industry: 1995 COD (kg.)/Real output (1,000 yuan)								
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**
7.7	1.2	NA	51.7	2.3	0.4	0.8	0.1	0.9

Source: World Bank. Details in Data Appendix.

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[31] Inclusion of fixed effects at the provincial level was done, but required sacrificing the inclusion of the transport infrastructure variables which vary little over time (roads and inland waterways) and using an alternate measure of incentives which is time-variant. For the latter, we chose a 3-year moving average of the incentive index developed by Demurger et al. (2002). The inclusion of these provincial fixed effects, along with the other alterations described produced strong negative coefficients for agglomeration and the number of local suppliers--results which are at odds with the literature. However, it did not alter the results shown for the pollution levy. These result are available from the authors upon request.

[32] An alternative measure--a 3-year moving average of the incentive index developed by Demurger et al. (2002)--produced, oddly, a negative significant coefficient on incentives. However, it did not change the other results.

Using the data on COD-intensity of Chinese industrial output at the ISIC 3-digit level,[33] we divide the sample into low, medium and high water-polluting industries. Water pollution intensity (PI) is defined as low if it is below 1 kg per thousand yuan output (1990 yuan). About 60 percent of the EJV projects in the sample are in industries designated as low polluters. Another 24 percent of the sample are in industries with $1<PI<3.5$, and are classified as medium polluters. The final 16 percent are in industries with $PI>7$, and are denoted high polluters. We construct three dummy variables to represent these three ranges of pollution intensity, and we interact the levy variable with these pollution-intensity dummies to test whether these groups respond differently to pollution regulation.[34] The results, shown in column (3) still reveal a strong positive attraction to a higher pollution levy. Although there is no significant difference in the response of medium polluting industries, industries that are highly polluting show a significantly lower attraction for provinces with high levies.

Proposition 1b suggests that the attraction of weak environmental regulations depends on the technological sophistication of the firm within a given industry. As discussed above, there is prior evidence that projects from Chinese sources embody less advanced technology than do projects from non-Chinese sources. Our hypothesis is that the levy will have a stronger deterrent impact on Chinese firm location decisions than on Foreign firms, all else equal. Columns (4) and (5) in table 4 show the conditional logit results for the Chinese and Foreign sub-samples.[35] Here we again see that foreign EJVs, rather than being attracted to low pollution levies, are strongly attracted to provinces with higher levies. This response is insensitive to the pollution intensity of the industry. However, Chinese investors have a much smaller positive response to higher pollution levies than Foreign investors. In addition, Chinese investors from highly polluting industries appear deterred by higher pollution levies. This is consistent with the idea that Chinese investors may be more deterred by stringent pollution regulations than Foreign investors due to the use of less advanced technology. However, a joint significance test shows that the

[33] When 3-digit pollution intensity information is unavailable, the 2-digit value is used.
[34] The conversion to three dummies is due to the lack of high within-group variation in pollution-intensity, despite high between-group variation.
[35] The results discussed here are also confirmed in a single equation estimation which allows varying parameters by source.

response of these highly-polluting industries is not significantly different from zero. Thus, at this point we can say that any attraction investors found from higher pollution levies vanishes if the firms are Chinese and highly-polluting.

Columns (4) and (5) also show that Chinese investors are less strongly attracted to locations with high ratios of skilled workers, and more positively attracted to locations with high ratios of unskilled workers (though the latter is not significant). While Foreign investors are strongly attracted by government incentives and rapid growth, Chinese investors are not. These results are broadly consistent with descriptions of Chinese investment as smaller scale, destined for export rather than for domestic consumption, and more labor-intensive than investment from industrial countries. It may be that the group designated "Chinese" is too broad, including more South Asian countries than would merit inclusion based on Chinese populations or round-tripping concerns.[36] In light of this possibility, all conditional logits were rerun with the South Asian sample omitted, but the results were unaffected.

Nested Logits

It is possible that the decision to locate EJVs in China is actually a nested one. If so, it may be that our lack of support for the pollution haven hypothesis is simply an artifact of choosing particular geographic regions within which to invest. Based on Hausman tests using the conditional logit specifications in table 4, the null hypothesis of IIA was indeed rejected. Thus, we re-estimate the model using nested logit. The investor is assumed to first choose which region (north coast, south coast, inland, or west) in which to invest, and then which province within the region. At the regional level, we assumed that investors would be attracted by overall development, size of market, and growth potential. Thus we include regional averages of consumption per capita, population, and real income growth as determinants of regional choice.

Table 5 shows results for the full sample, the full sample with pollution-intensity incorporated, and finally the Chinese and Foreign subsamples. For both the full sample and the source subsamples, the null hypothesis that the IV parameters =1--that the decision is not nested--is rejected. In the full sample

[36] We are indebted to K.C. Fung for this observation.

results, investors are significantly attracted to regions with high consumption per capita and with high annual real income growth, a finding consistent with the view that firms look for relatively rich and growing local markets for their products. The Chinese investors actually appear attracted to regions with high incomes, large populations, and high real income growth, while Foreign investors are influenced by the first two, but not the last.

Within a region, the characteristics that attract investors follow the same patterns as were found in the conditional logits. For the full sample, once again investors are attracted by higher pollution levies, although there is no significant difference in the response based on pollution intensity. Looking at the source subsamples, we again see that Chinese investors have a much smaller positive response to the levy than Foreign investors. Once again, there is no attraction for the Chinese highly-polluting EJVs.[37] Foreign EJVs respond positively to higher levies, regardless of pollution intensity. Other differences between the two investment sources also persist. Foreign EJVs show a larger positive response than Chinese EJVs to relatively large supplies of skilled labor, provincial real growth rates, and the presence of special incentives.[38]

State Ownership

Thus far, the analysis has made no adjustment for the level of state ownership across provinces or changes in state ownership over time. Table 3 shows the share of industrial output from state-owned entreprises (SOEs) for each province, averaged over the period. The range is wide--from a low of 19% in Zhejiang to 80% in Tibet. It is also somewhat distinct regionally, with the lowest levels found in the South coast, and the highest in the west. Changes in the level of state ownership between 1993 and 1996 are also quite varied, ranging from decreases of 1 (Shandong) to 26 (Hubei) percentage points, with an increase of 7 percentage points in Xinjiang.

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[37] The estimated coefficient for high pollution industries (-0.29= 0.28-0.57) is not significant at the 95% confidence level.

[38] All nested logits were also subjected to the same sensitivity tests: exclusion of S. Asian observations; alternate telecom proxy; alternate incentive index. In no case did these tests produce significant differences in the results shown in table 5.

We make several modifications to our specification to incorporate the effects of SOEs into the analysis. First, investors may see low levels of SOEs as indicative of a more market-oriented economy. Hence the appeal of certain features of a province may be reduced if that province has a large level of SOEs. In the previous results both incentives and consumption per capita had either perverse or insignificant effects for part or all of the sample. To test whether this might be due to state ownership, we interact these two variables with the degree to which the economy is *non*-state-owned (1-share of industrial output from SOEs). Second, large reductions in state ownership may be a signal of commitment to liberalization. To account for this, we introduce the annual change in the share of industrial output from SOEs as a determinant of location choice. Overall we anticipate that the impact of SOEs will be more relevant for Foreign investors relative to Chinese, since the former are producing for the local market.

The results of introducing SOEs into the conditional and nested logits are shown in tables 6 and 7, respectively. While the coefficient estimates for the pollution levy are smaller in all specifications, the impact of the levy remains the same. For the full sample, FDI is still attracted by higher levies. This attraction still vanishes for highly polluting industries in the conditional logit estimates; the nested logit estimates again show no sensitivity to pollution intensity. Chinese investors are not influenced significantly by the levy, except for highly polluting EJVs. In both the conditional and nested logits, the joint significance tests now show the reaction of Chinese high polluters to be negative and significantly different from zero. Foreign investors are again consistently attracted by high levies, regardless of the pollution intensity of the industry.

Notably, FDI is now strongly attracted by special incentives, both in the full sample and Chinese and Foreign subsamples. FDI is also now strongly attracted to provinces with higher consumption per capita in both the full sample and the Foreign subsample. These two results suggest that higher state ownership does dampen the appeal of other features of a province for the investor. Finally, a larger drop in state ownership increases the likelihood that the investor will locate there. This effect is particularly strong in the nested logit results, for both the full sample and the Foreign subsample. Overall, the Foreign subsample does appear more sensitive to incentives, higher incomes, income growth, and reductions in state ownership than the Chinese subsample.

VI. Conclusion

Because it is host to the largest share of direct investment flows to the developing world, and because environmental stringency varies among its provinces, China is an excellent location for testing the pollution haven hypothesis. We have created and analyzed a new compilation of foreign equity joint ventures into China during 1993-1996, categorized by industry and province. These data exhibit a wide dispersion of foreign investment across 3-digit industries and provinces. We categorize projects by the source of funds, dividing them into those funded from non-Chinese and Chinese countries. Our evidence from conditional and nested logit analysis suggests that both types of investment are attracted to prior foreign investment, the number of local suppliers, and special incentives. Both non-Chinese-sourced and Chinese-sourced investment appears to be attracted to provinces with high relative endowments of skilled labor.

Conditional logit analysis indicates that Chinese-sourced equity joint ventures in highly polluting industries are *deterred by* relatively stringent pollution regulation. This finding is consistent with the behavior described in the pollution haven hypothesis, though it contradicts the notion that the pollution havens are created by industrial country investors. In contrast, equity joint ventures from non-Chinese sources are actually *attracted to* provinces with more stringent environmental regulations, regardless of pollution-intensity--the opposite of the pollution haven hypothesis. This attraction also holds for Chinese equity investment in low and medium pollution-intenstive industries, though to a lesser extent. Even after accounting for the possibility of a nested decision, environmental stringency still significantly attracts non-Chinese equity investment, while significantly deterring only Chinese equity investment in highly pollution-intensive activities. In all specifications, corrections for the degree of state ownership reduce the size of the pollution levy effects, but do not alter their effects or significance.

These results suggest the importance of accounting for firm heterogeneity in considering the attraction of weak environmental regulations. Firms in industries that use low-polluting processes appear to respond positively to higher pollution taxes. Firms using heavily polluting processes, while expected to respond significantly to the implied factor-price difference, do not all respond in the same way. In the most highly polluting activities, only investment from sources similar to the host country, indeed perhaps from the source country itself, is deterred by high environmental stringency. Foreign investment, primarily from the United States and Japan, is not deterred by low pollution taxes. Instead, it appears to be attracted to the services or signals that stringency provides about the local investment environment.

The economic significance of these results is substantial. If foreign investment from industrial countries provides cleaner technology and seeks rather than avoids locations with high regulatory standards, investment by high-income countries in the developing world has the potential to improve environmental outcomes in host countries. A substantial number of research questions remain, such as identifying the correct counterfactual for thinking about the effect of FDI on global pollution flows, before we can claim that foreign investment is good for the environment. However, this research suggests that there is little evidence for the pollution haven hypothesis--except in highly polluting industrial investment from developing countries--and technology differences may help explain why.

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APPENDIX A
THE CHINESE POLLUTION LEVY SYSTEM[39]

China's State Environmental Protection Administration (SEPA) estimates that industrial pollution accounts for over 70% of the national total, including 70% of organic water pollution (COD, or chemical oxygen demand); 72% of SO_2 emissions; and 75% of flue dust (a major component of suspended particulates) in 1995. One of China's responses to this problem is its pollution charge, or levy system. Almost all of China's counties and cities have implemented the levy. Charges are levied for water and air pollution, solid and radioactive waste, and noise. Water pollution charges contribute the largest share of the total. Funds from the pollution levy are used for pollution source control, damage remediation and development of environmental institutions. Despite recognized weaknesses, the Chinese levy system is by far the broadest application of price-based pollution control instruments in the developing world.

The levy system is based on a discharge standard system, and only discharges exceeding the standards were subject to a fee before 1993.[40] Discharge standards are considered stringent. In 1993, among the 3000 biggest industrial water polluters in China, about 90% were violating the discharge standards and, therefore, paying levies. Air pollution emission standards are less stringent than those for water pollution and pollutant charge rates are lower. In 1993, only approximately 50% of the biggest air polluters violated the emission standards.[41]

Under the levy system, polluters report their emissions and local (municipal and county) environmental authorities are responsible for verification and collection. All polluters are required to register with local environmental authorities, and to provide information in the following categories: 1) basic economic information (sector, major products and raw materials); 2) production process diagrams; 3) volume of water use and waste water discharge; pollutant concentrations in waste water; 4) waste gas volume and air pollutant concentrations (before and after treatment); 5) noise pollution by source; 6)

---

[39] The material in this appendix is drawn from Wang and Wheeler (2005), where additional details can be found.
[40] There is also a standard unit fee for wastewater discharge starting from 1993. In 1993, a maximum charge of 0.05 yuan per ton of waste water discharge was announced by the national government. Since 1996, charges have been assessed on SO_2 (sulfur dioxide) emissions, even if they meet the regulatory standard. Additional proposals for reform of the levy system are under study.
[41] Information on polluters is drawn from Wang and Wheeler (2005), who report results of a plant-level survey.

discharge of solid wastes; 7) others. The local environmental authorities check polluters' reports in several ways, including internal consistency, consistency with material balance models, historical data from the facility, direct monitoring, and surprise inspections. Penalties are imposed for false reporting and for non-cooperation with government inspections.

The water discharge levy varies by both concentration and volume as it calculates a pollutant-specific discharge factor, P, based on both total waste water discharge and the degree to which pollutant concentration, C, exceeds the standard, C_s. The precise national levy formula for water discharges is:

$$\text{(A1)} \quad P_{ij} = D_i \frac{C_{ij} - C_{sj}}{C_{sj}}, \qquad W_{ij} = \left.\begin{matrix} W_{0j} + R_{1j} P_{ij} \\ R_{2j} P_{ij} \end{matrix}\right\} \begin{cases} P_{ij} > T_j \\ P_{ij} < T_j \end{cases}$$

where for facility i and pollutant j:

P_{ij} = Discharge factor
D_i = Total wastewater discharge
C_{ij} = Pollutant concentration
C_{sj} = Concentration standard
W_{ij} = Total water levy
W_{0j} = Fixed payment factor
T_j = Regulatory threshold parameter

R_1 and R_2 are charge standards with $R_2 > R_1$. For continuity at T_j, $R_{2j}T_j = W_{0j} + R_{1j}T_j$. When a pollutant concentration, C, is less than or equal to the standard, C_s, which is jointly set by the central and local governments, a zero charge is made. The charge rate, R, is determined relative to a critical factor, T. Both R and T are set by the central government and vary by pollutant but not by industry. For each polluter, the potential levy, W_j, is calculated for each pollutant. The actual levy is the greatest of the potential levies. Note that the levy formula (A1) implies that the marginal tax rate is lower for firms with discharge factors above the threshold amount.

The national air pollution levy is implemented in a similar manner to the water levy: the polluter is charged only for the highest of the calculated potential levies, L_j. The levy formula for air pollution is:

$$\text{(A2)} \quad A_{ij} = R_j V_i (C_{ij} - C_{sj})$$

where for facility i and pollutant j:

R_j = Charge rate for pollutant j
V_i = Total volume of air emission
C_{ij} = Pollutant concentration
C_{sj} = Concentration standard
A_{ij} = Total levy

As in the case of water levies, the concentration standard, C_s, is jointly set by the central and local government while the charge rate, R, is set by the central government.

There are four major sources of provincial variation in pollution tax rates. First, as noted above, concentration standards are set jointly by the national and local governments. Second, standards differ by effluent, thus differences in the concentration of industries across provinces will lead to different effective tax rates. Third, there are significant differences in enforcement capacity at the local level. Finally, the levy can be reduced or even eliminated at the discretion of local regulators after appropriate inspections.[42] Such latitude introduces considerable variation into regional enforcement practices. In general, regulation is stricter in areas where incomes are higher, access to information is better, and pollution is heavier. At the provincial level, Wang and Wheeler (2003) show that effective water levy rates are responsive to measures of ambient quality and development. Studying provincial-level averages over an eight year period, they find striking changes in water pollution control and environmental performance. Real effective levy rates more than doubled in some provinces and fell in others, while the countrywide average increased significantly. Average air and water pollution intensities fell sharply; they fell most rapidly in areas when pollution intensity was initially highest.

[42] The actual levy paid by a firm is the result of bargaining between the government and the firm. Survey evidence suggests that state-owned enterprises pay lower effective rates than privately-owned firms and that levy rates are positively related to firm profitability. For additional detail see Wang, Mamingi, Laplante, and Dasgupta (2003).

Appendix B
Data Definitions and Sources

Variable	Definition	Source
EJV project data: Location Amount Source Industry	 Province Units: $10,000 Chinese=Macao, Taiwan, Hong Kong, other South Asian countries Non-Chinese=all other countries 3-digit ISIC classification	*Almanac of China's Foreign Economic Relations and Trade,* various years Coded by authors Coded by authors Coded by authors
Levy	Total collected water pollution levies/ wastewater exceeding standard (yuan/ton)	*China Environmental Yearbook*, various years
Skilled labor	Percent of population who have a senior secondary school education level or above	*China Statistical Yearbook*, various years, and calculations by authors
Unskilled labor	Percent of population who are either illiterate or have less than primarily level education	*China Statistical Yearbook*, various years, and calculations by authors
Semi-skilled labor	Percent of population who have primary or junior secondary education level	*China Statistical Yearbook*, various years, and calculations by authors
Cumulative FDI value	Cumulative value of real contracted FDI, from 1983 until t-1 (in 1980 prices), $million.	Coughlin, et al. (2000)
Number of domestic enterprises	Number of industrial enterprises-(number of foreign-funded industrial enterprises)-(number of Chinese-funded industrial enterprises). All for the township level and above. (in thousands)	*China Statistical Yearbook*, various years
Telephones	Number of year-end urban subscribers/population, lagged one year	*China Statistical Yearbook,* various years
Incentive	Dummy variable for a province with either SEZ or Open Coastal City (as of 1996)	Constructed by authors.
Roads	Highways (km)/land area (km^2)	*China Statistical Yearbook*, various years
Railroads	Railway (km)/land area (km^2)	*China Statistical Yearbook*, various years
Pollution-Intensity	COD (kg)/output (thousand 1990 RMB yuan)	China Environmental Yearbook, various years
Consumption per capita	Consumption (1000 yuan)/population	*China Statistical Yearbook*, various years
Growth rate of real GDP	Percentage change in annual real industrial output (1990 yuan), lagged one year	*China Statistical Yearbook*, various years
Change in State Ownership	Difference between share of industrial output from SOEs in year t and t-1.	*China Industrial Yearbook* Various years

Figure 1: Source distribution of JV sample, by province, 1993-1996

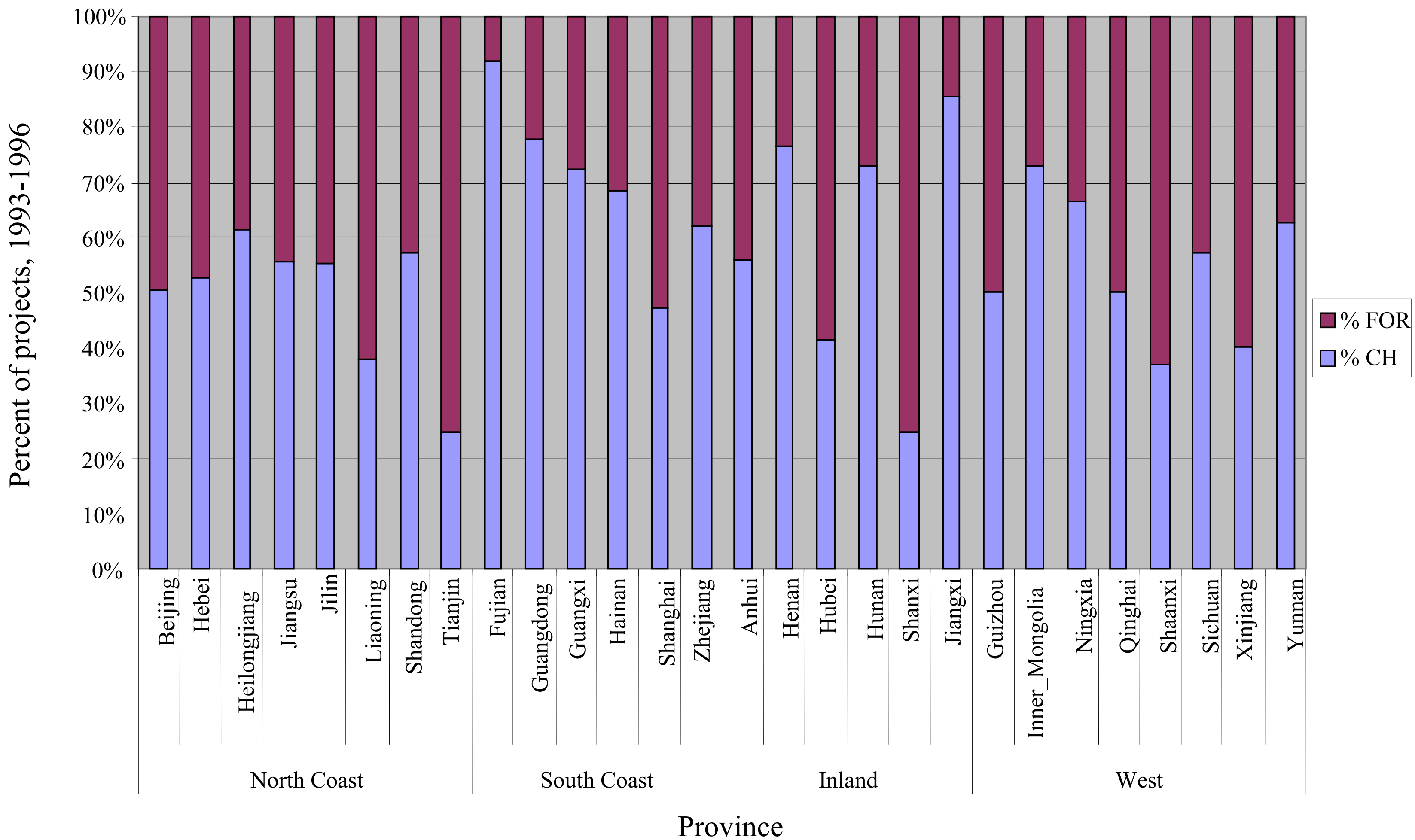


Figure 2: ISIC distribution of JV sample, by province, 1993-1996

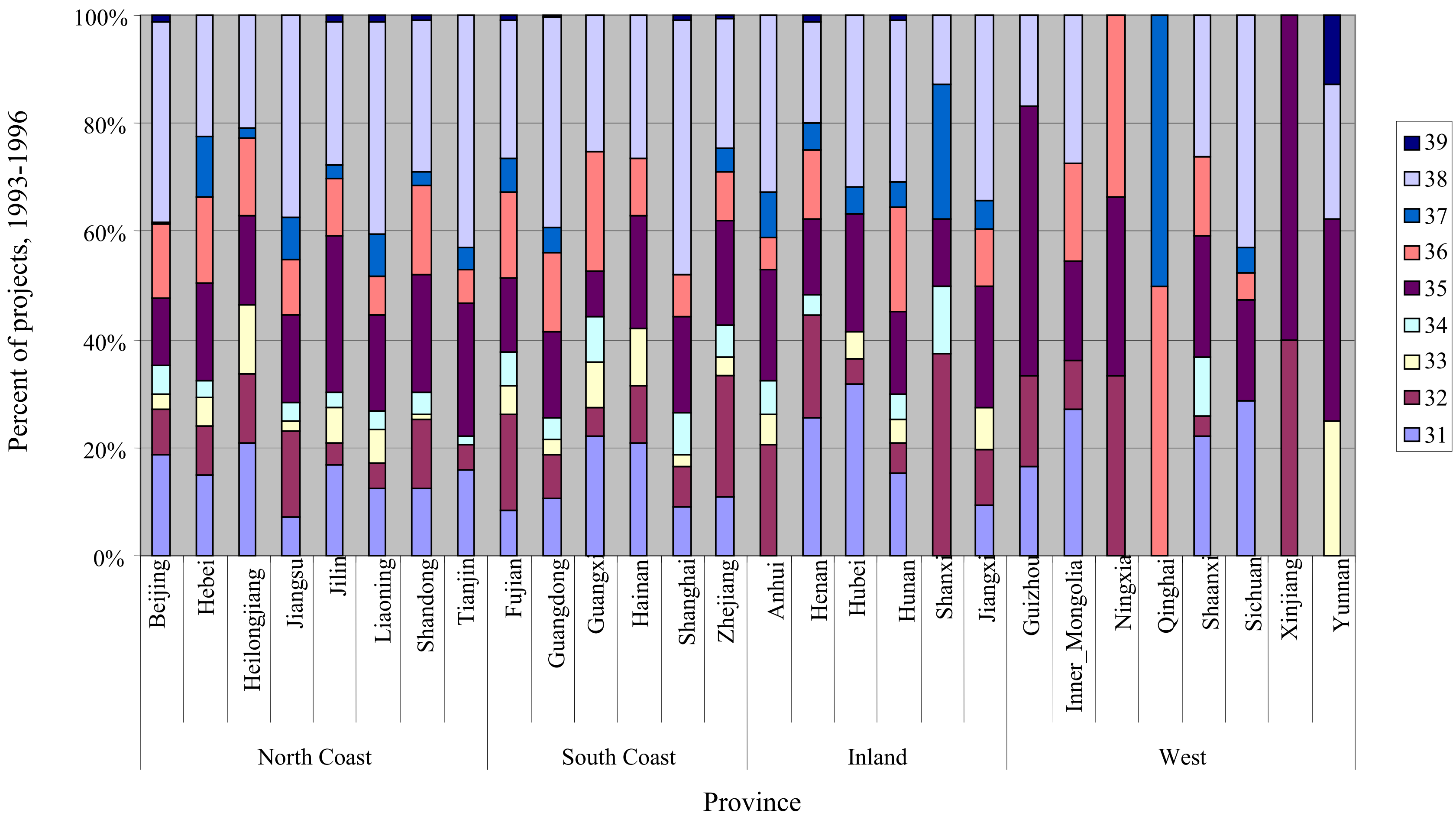


Figure 3: Source Distribution of EJV Sample, by ISIC code, 1993-1996

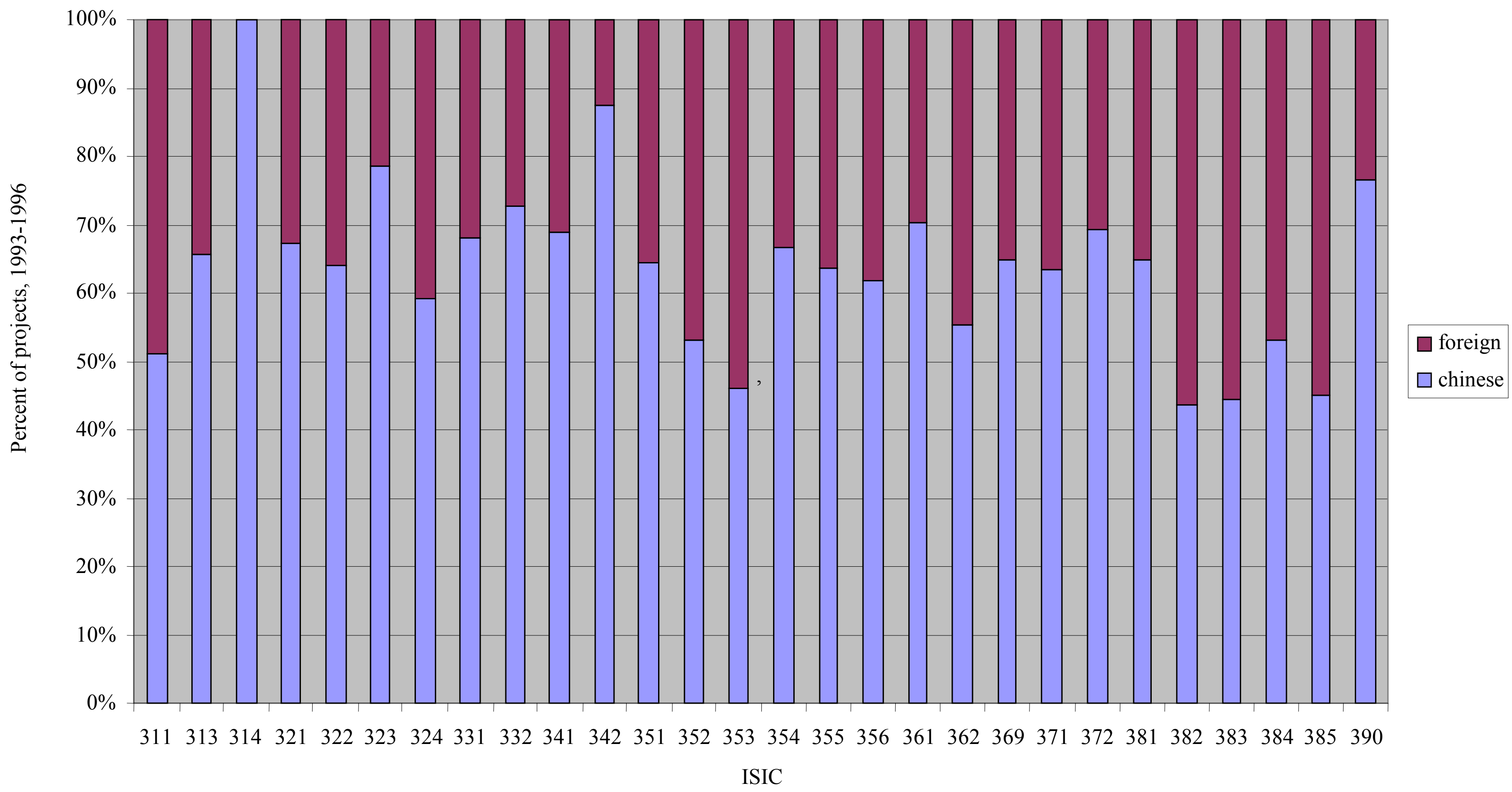
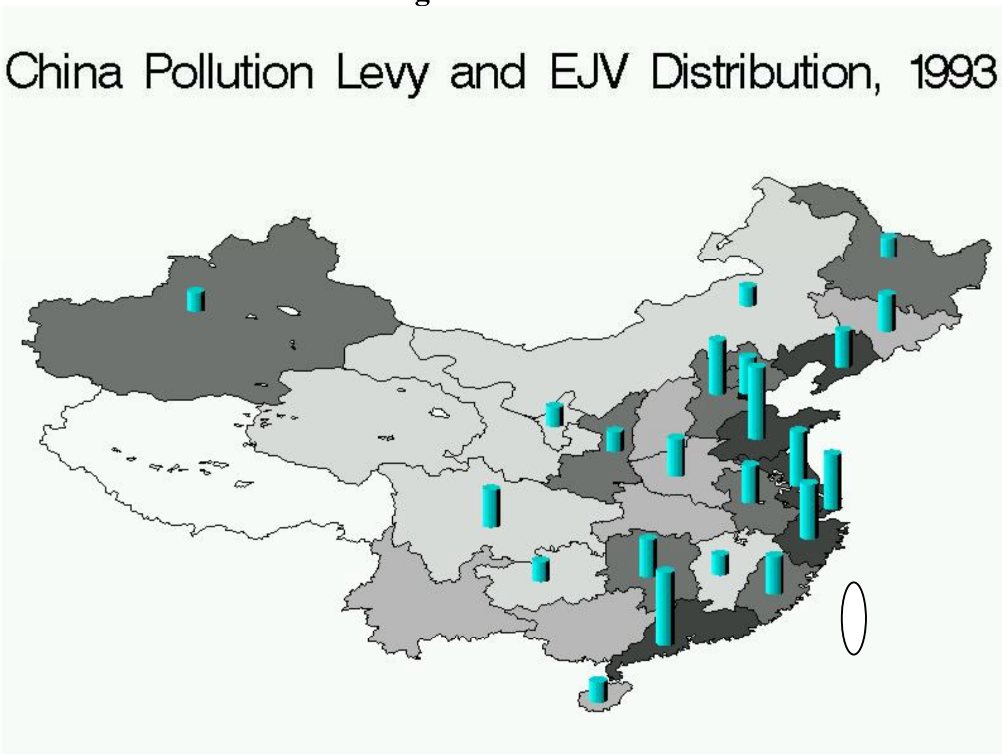


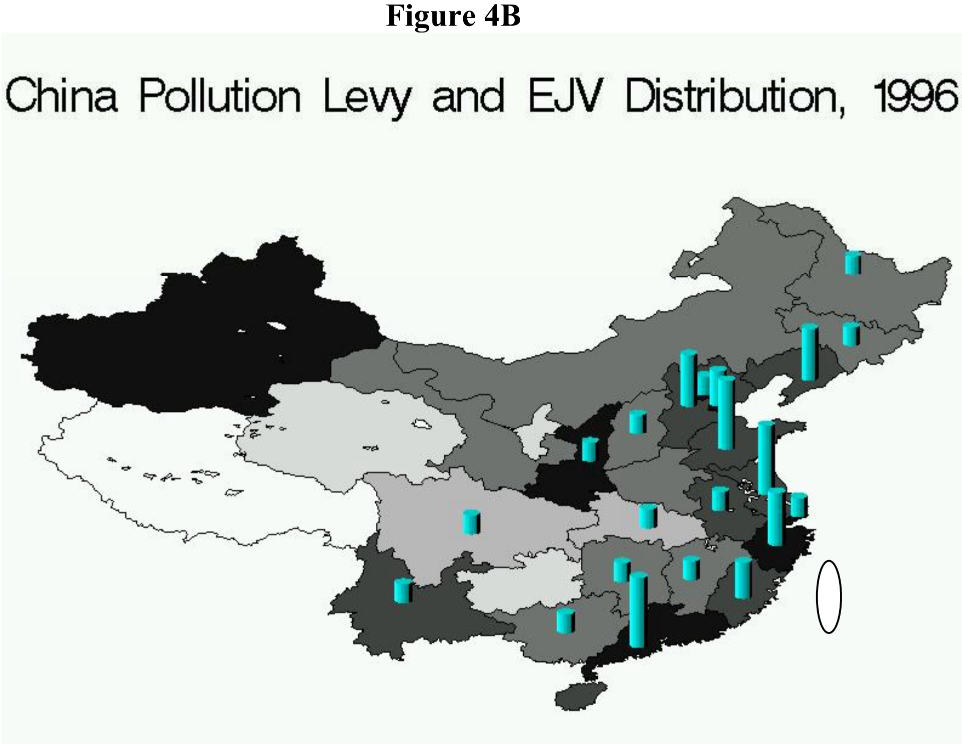
Figure 4A



Source: EJV distribution constructed from the sample EJV data. Effective pollution levy constructed from dataset available at http://www.worldbank.org/nipr/data/china/status.htm.

Levy (yuan per ton)	
	missing
	0.0-0.07
	0.08-0.09
	0.10-0.15
	0.16-0.29
	0.30-0.60
% Total FDI inflow	
	Height

Figure 4B



Source: EJV distribution constructed from the sample EJV data. Effective pollution levy constructed from dataset available at http://www.worldbank.org/nipr/data/china/status.htm.

Table 1. FDI Inflows into China across Provincial Groups (1987-1995)

	% of TOTAL FDI Inflows [1]		
PROVINCES GROUPED BY:	**1987**	**1992**	**1995**
Average GDP p.c.[2]			
High: >3500 yuan	79	69	64
Medium: 1500-3500 yuan	12	26	27
Low: <1500 yuan	8	5	9
Average Water Pollution Levy *(yuan per ton excess wastewater)*[3]			
High: >13 yuan	83	78	71
Medium: 8 - 13 yuan	13	17	22
Low: <8 yuan	4	5	6
Average Discharge Intensity *(tons of COD per million 1990 yuan output)*[4]			
High: >5.5 tons	5	4	7
Medium: 3.5-5.5 tons	17	28	31
Low: <3.5 tons	79	68	62

[1]The table reports the sum of FDI inflows actually utilized in each group of provinces, as a % of the total FDI actually utilized nationwide in that year. Note that Hainan and Tibet are excluded due to lack of data.
Source : calculated from data available at http://www.worldbank.org/nipr/data/china/status.htm.
[2] High: Beijing, Guangdong, Jiangsu, Liaoning, Shanghai, Tianjin, Zhejiang. Medium: Fujian, Hebei, Heilongjiang, Hubei, Hunan, Inner Mongolia, Jilin, Ningxia, Qinghai, Shandong, Shanxi, Xinjiang. Low: Anhui, Gansu, Guangxi, Guizhou, Henan, Jiangxi, Shaanxi, Sichuan, Yunnan.
[3]High: All high income provinces plus Shandong and Xinjiang. Medium: Medium income provinces (Fujian, Hebei, Heilongjiang,Hubei, Jilin, Shanxi,) and low income provinces (Anhui, Henan, Shaanxi, and Yunnan). Low: Low income provinces (Gansu, Guangxi, Guizhou, Jiangxi, Sichuan) and middle income provinces (Hunan, Inner Mongolia, Ningxia, and Qinghai).
[4] High: Low income provinces (Anhui, Guangxi, Yunnan), middle income provinces (Hunan, Inner Mongolia, Jilin, Xinjiang). Medium: Medium income provinces (Fujian, Hebei, Heilongjiang,Hubei,Ningxia, Shangdong, Shanxi,), low income provinces Henan, Jiangxi, Sichuan) and high income Zhejiang. Low: All high income provinces (except Zhejiang) plus low income provinces (Gansu, Guizhou, Qinghai, and Shaanxi).

Table 2: Equity Joint Venture Sample, by Province, 1993-1996					
Province	**Number of Projects**	**Contracted Value**	**Shares of Contract Value**	**Utilized FDI**	**Shares of Utilized FDI**
Beijing	248	49787	0.0787	55358.7	0.0808
Hebei	99	22547.5	0.0356	22430.3	0.0327
Heilongjiang	62	11201	0.0177	8339	0.0122
Jiangsu	565	122013.3	0.1929	162205	0.2368
Jilin	76	13381.4	0.0212	9593.8	0.014
Liaoning	166	37223.9	0.0588	37875.8	0.0553
Shandong	400	78368.1	0.1239	73166	0.1068
Tianjin	68	20830	0.0329	25944.6	0.0379
Fujian	95	20908.3	0.0331	30247.2	0.0442
Guangdong	325	86095.4	0.1361	91830.7	0.1341
Guangxi	36	9816.1	0.0155	9858.3	0.0144
Hainan	19	4237	0.0067	6495.6	0.0095
Shanghai	114	40148.3	0.0635	44075.3	0.0643
Zhejiang	176	31768.4	0.0502	34860.3	0.0509
Anhui	34	8432.7	0.0133	5200.6	0.0076
Henan	85	12249.5	0.0194	8357.3	0.0122
Hubei	41	8360.2	0.0132	7461.8	0.0109
Hunan	110	23289.1	0.0368	26248.5	0.0383
Jiangxi	76	9893.4	0.0156	8284.1	0.0121
Shanxi	8	2542	0.004	1822.4	0.0027
Gansu	0	0	0	0	0
Guizhou	6	1182.7	0.0019	437	0.0006
Inner Mongolia	11	2905.4	0.0046	1812	0.0026
Ningxia	3	781.4	0.0012	365.7	0.0005
Qinghai	2	291.1	0.0005	150.5	0.0002
Shaanxi	27	5677.7	0.009	5734.8	0.0084
Sichuan	21	5702.7	0.009	5301.9	0.0077
Tibet	0	0	0	0	0
Yunnan	8	1973.9	0.0031	1064.1	0.0016
Xinjiang	5	927.1	0.0015	526.3	0.0008
SUM	2886	632534.5	1	685047	1

Notes: All the values are in 1990 constant price.

Table 3. Provincial Characteristics: Period Averages (1993-1996)											
Province	Cons. p.c. (yuan)	Water Levy (yuan/ton)	Domestic Entrepr. (000s)	Cum. Real FDI	Skilled Labor (%)	Unskilled Labor (%)	Highways (km/km2 area)	Inland waterway (km/km2 area)	Telephones per 000 people	SEZ or OCC	Indus. Output from SOE (%)
Beijing	2972	0.22	9.4	1986.7	33	14	0.72	0.000	129.02	1	51
Hebei	1458	0.12	22.7	543.2	9	22	0.27	0.000	20.62	1	38
Heilongjiang	2394	0.11	18.9	419.5	15	18	0.10	0.000	31.87	0	72
Jiangsu	2197	0.17	40.5	4069.9	13	21	0.25	0.233	39.49	1	23
Jilin	2027	0.12	13.2	321.4	18	17	0.15	0.006	37.09	0	65
Liaoning	2573	0.21	29.0	2004.3	14	16	0.29	0.004	41.71	1	49
Shandong	1662	0.18	26.5	2814.5	10	24	0.33	0.012	20.36	1	30
Tianjin	3018	0.33	9.1	1002.4	23	16	0.34	0.007	79.39	1	41
Fujian	2522	0.12	14.3	4347.0	8	28	0.37	0.031	37.76	1	23
Guangdong	3104	0.20	29.2	13862.7	12	22	0.42	0.059	68.98	1	25
Guangxi	1452	0.10	12.9	910.0	8	22	0.17	0.019	11.94	1	50
Hainan	1928	0.14	1.5	1297.1	12	25	0.40	0.009	32.21	1	53
Shanghai	5869	0.20	11.9	3422.1	30	14	0.57	0.317	125.54	1	46
Zhejiang	2478	0.24	36.5	1198.8	9	22	0.34	0.106	47.78	1	19
Anhui	1426	0.12	24.1	338.4	7	30	0.24	0.040	14.05	0	41
Henan	1183	0.10	23.6	431.8	9	24	0.29	0.007	11.53	0	40
Hubei	1745	0.11	23.4	674.8	11	25	0.26	0.042	19.97	0	49
Hunan	1587	0.09	25.6	460.8	9	21	0.27	0.047	16.39	0	48
Jiangxi	1338	0.07	18.4	283.5	8	26	0.20	0.029	12.96	0	50
Shanxi	1430	0.10	11.5	103.7	12	20	0.21	0.001	18.61	0	49
Gansu	1118	0.07	7.2	44.3	10	40	0.08	0.013	15.41	0	72
Guizhou	1070	0.05	7.7	88.1	6	35	0.18	0.010	6.71	0	71
Inner Mongolia	1511	0.08	9.9	77.5	13	23	0.04	0.001	22.76	0	68
Ningxia	1430	0.07	1.8	10.7	11	35	0.16	0.008	23.13	0	74
Qinghai	1539	0.04	1.6	4.8	11	44	0.02	0.000	18.11	0	83
Shaanxi	1274	0.14	13.3	480.2	12	26	0.19	0.005	16.36	0	61
Sichuan	1408	0.06	41.3	735.8	7	25	0.18	0.014	10.75	0	44
Tibet	1127	0.03	0.3	2.0	3	70	0.02	0.000	9.94	0	80
Yunnan	1379	0.10	7.9	109.0	5	35	0.18	0.004	9.14	0	73
Xinjiang	1852	0.14	6.9	66.4	14	25	0.02	0.000	22.16	0	71

Table 4. Conditional Logit[1,2,3]

	Full Sample						Chinese		Foreign	
	(1)		(2)		(3)		(4)		(5)	
Provincial Variables (in logs)	**Coeff**	**Z**	**Coeff**	**Z**	**Coeff**	**Z**	**Coeff**	**Z**	**Coeff**	**Z**
Levy	0.63**	7.23	0.40**	4.34	0.52**	4.96	0.36*	2.55	0.67**	4.20
Levy*Medium Polluter					-0.15	-1.18	-0.15	-0.93	-0.08	-0.41
Levy*High Polluter					-0.37**	-2.84	-0.50**	-2.94	-0.16	-0.79
Local Firms	0.64**	10.25	0.69**	8.89	0.69**	8.9	0.70**	6.95	0.74**	5.76
Agglomeration	0.43**	13.08	0.40**	11.65	0.40**	11.65	0.48**	11.33	0.24**	3.88
Ratio skilled labor	0.92**	8.13	0.81**	4.20	0.83**	4.26	0.51*	2.00	1.41**	4.47
Ratio unskilled labor	-0.39*	-1.92	0.34	1.46	0.35	1.51	0.41	1.39	0.16	0.43
SEZ or OCC	0.71**	7.97	0.08	0.58	0.08	0.56	-0.33†	-1.72	0.50*	2.39
Consumption p.c.	-1.04**	-6.19	-0.67**	-3.33	-0.68**	-3.36	-1.06**	-4.04	0.22	0.67
Real provincial growth[3]	2.45**	5.66	0.95*	2.07	0.98*	2.14	0.53	0.89	1.87*	2.46
Telephones	-0.56**	-4.78	-0.47**	-3.88	-0.48**	-3.92	-0.31*	-2.03	-1.10**	-5.23
Roads	0.22**	3.46	0.30**	3.16	0.30**	3.16	0.48**	3.44	0.30*	2.16
Inland navigable waterways	0.13**	8.46	0.09**	5.13	0.09**	5.12	0.12**	5.24	0.06*	2.22
North Coast			0.70**	4.85	0.70**	4.88	0.86**	4.33	0.83**	3.75
South Coast			0.37**	2.12	0.38*	2.19	0.74**	3.13	0.19	0.69
West			-0.87**	-6.11	-0.87**	-6.13	-1.12**	-6.04	-0.37†	-1.66
Obs	80808		80808		80808		47694		32844	
Likelihood	-7959.61		-7902.13		-7898.09		-4677.20		-3130.67	
LR test	3314.27**		3429.22**		3437.31**		2061.74**		1556.02**	

[1] **, *, and † indicate significance at the 1%, 5%, and 10% levels, respectively.
[2] Gansu and Tibet excluded since no foreign investment located there during the time period.
[3] All variables lagged one year.
[4] Three-year moving average. Not in logs.

Table 5. Nested Logit[1,2,3]

	Full Sample				Chinese		Foreign	
	(1)		(2)		(3)		(4)	
Provincial Variables (in logs)	**Coeff**	**Z**	**Coeff**	**Z**	**Coeff**	**Z**	**Coeff**	**Z**
Levy	0.53**	7.62	0.54**	7.70	0.28†	1.75	0.49**	3.60
Levy*Medium Polluter			-0.02	-1.66	-0.24	-1.37	-0.08	-1.21
Levy*High Polluter			0.00	0.25	-0.57*	-2.72	0.05	1.01
Local Firms	0.66**	10.01	0.66**	9.96	0.66**	6.57	0.75**	6.06
Agglomeration	0.44**	13.67	0.44**	13.7	0.49**	11.23	0.24**	4.15
Ratio skilled labor	0.73**	5.93	0.73**	5.82	0.21	0.89	1.19**	4.69
Ratio unskilled labor	0.46*	2.22	0.47*	2.25	0.25	0.88	-0.01	-0.01
SEZ of OCC	-0.10	-0.83	-0.10	-0.87	-0.13	-0.74	0.57*	2.77
Consumption p.c.	-0.82**	-4.40	-0.82**	-4.38	-1.08**	-3.92	0.26	0.79
Real provincial growth[4]	0.86*	2.15	0.85*	2.21	0.48	0.72	1.57†	1.83
Telephones	-0.34**	-3.08	-0.34**	-2.96	-0.09	-0.59	-0.93**	-4.42
Roads	0.28**	2.98	0.28**	2.98	0.41**	3.01	0.28*	1.90
Inland navigable waterways	0.09**	5.24	0.09**	5.26	0.13**	5.73	0.06*	2.41
Regional Variables								
Average Consumption p.c.	0.88**	3.43	0.85**	3.21	0.94**	4.72	1.24*	2.78
Average Population	0.03	0.87	0.03	0.77	0.02*	1.84	0.06*	2.66
Average Annual Real Growth[5]	4.60*	2.38	4.69*	2.43	4.37**	3.18	2.67	0.88
IV Parameters								
North Coast	5.62**	2.99	6.15**	2.66	1.20**	4.74	1.09	1.26
South Coast	-1.22	-0.83	-1.01	-0.66	0.98**	3.54	0.27	0.30
Inland	0.43	0.34	0.46	0.35	1.08**	4.00	-0.95	-0.56
West	0.39	0.77	0.47	0.86	0.88*	2.51	-1.77	-1.00
Obs	80808		80808		47964		32844	
Likelihood	-7871.17		-7869.08		-4667.59		-3121.24	
LR test	3491.14		3495.32		2080.95		1574.88	
LR test: IV Parameters=1	69.58**		63.88**		8.26†		42.05**	

[1]**, *, and † indicate significance at the 1%, 5%, and 10% levels, respectively.
[2] Gansu and Tibet excluded since no foreign investment located there during the time period.
[3]All variables lagged one year. [4] Three-year moving average. Not in logs. [5] Not in logs.

Table 6. Conditional Logit with Correction for State Ownership[1,2,3]

	Full Sample				Chinese		Foreign	
	(1)		(2)		(3)		(4)	
Provincial Variables (in logs)	Coeff	Z	Coeff	Z	Coeff	Z	Coeff	Z
Levy	0.19*	2.05	0.30*	2.88	0.17	1.19	0.43*	2.66
Levy*Medium Polluter			-0.13	-1.08	-0.14	-0.86	-0.07	-0.35
Levy*High Polluter			-0.36*	-2.77	-0.48*	-2.87	-0.16	-0.78
Local Firms	0.46**	5.78	0.46**	5.78	0.43**	4.20	0.64**	4.58
Agglomeration	0.33**	9.33	0.33**	9.32	0.41**	9.64	0.11†	1.73
Ratio skilled labor	0.61**	3.27	0.62**	3.32	0.19	0.78	1.44**	4.60
Ratio unskilled labor	-0.13	-0.52	-0.11	-0.47	0.00	0.00	-0.40	-0.94
Weighted SEZ or OCC[4]	0.98**	4.48	0.97**	4.44	0.75*	2.54	0.93*	2.75
Weighted Consumption p.c.[4]	0.45*	1.91	0.45*	1.94	0.26	0.84	1.46**	3.72
Real provincial growth[5]	1.07*	2.36	1.09*	2.43	0.76	1.31	1.49*	2.01
Change in State Ownership	-1.06	-1.47	-1.06	-1.47	-0.92	-0.96	-2.01†	-1.76
Telephones	-0.76**	-6.79	-0.77**	-6.87	-0.63**	-4.58	-1.38**	-6.88
Roads	0.35**	3.97	0.35**	3.98	0.41**	3.24	0.53**	3.83
Inland navigable waterways	0.11**	6.15	0.11**	6.15	0.15**	6.18	0.07*	2.71
North Coast	0.32*	1.98	0.33*	2.03	0.23	1.03	0.92**	3.52
South Coast	-0.32†	-1.80	-0.31†	-1.73	-0.27	-1.12	-0.03	-0.10
West	-0.84**	-6.02	-0.84**	-6.04	-1.16**	-6.25	-0.24	-1.14
Obs	80808		80808		47694		32844	
Likelihood	-7887.39		-7883.57		-4680.93		-3109.465	
LR test	3458.70**		3466.35**		2054.27**		1598.42**	

[1] **, *, and † indicate significance at the 1%, 5%, and 10% levels, respectively.
[2] Gansu and Tibet excluded since no foreign investment located there during the time period.
[3] All variables lagged one year.
[4] Weighted by (1-share of industrial output from SOEs).
[5] Three-year moving average. Not in logs.

Table 7. Nested Logit with Correction for State Ownership[1,2,3]

	Full Sample				Chinese		Foreign	
	(1)		(2)		(3)		(4)	
Provincial Variables (in logs)	Coeff	Z	Coeff	Z	Coeff	Z	Coeff	Z
Levy	0.30**	4.53	0.46**	6.21	0.11	0.63	0.38**	3.20
Levy*Medium Polluter			-0.05	-1.44	-0.19	-0.98	-0.05	-1.34
Levy*High Polluter			-0.05	-1.56	-0.51†	-1.73	0.03	1.01
Local Firms	0.58**	7.95	0.51**	7.10	0.47**	4.36	0.61**	4.55
Agglomeration	0.30**	10.84	0.34**	9.95	0.42**	9.62	0.12*	1.93
Ratio skilled labor	0.90**	7.99	0.73**	4.60	0.06	0.26	1.36**	6.65
Ratio unskilled labor	0.35†	1.79	0.44*	2.24	-0.01	-0.03	-0.64*	-1.87
Weighted SEZ of OCC[4]	0.50**	3.11	0.38*	1.90	0.79*	2.63	0.98**	3.40
Weighted Consumption p.c.[4]	0.71**	3.71	0.68**	2.90	-0.11	-0.29	1.53**	4.87
Real provincial growth[5]	0.81*	2.35	1.17*	2.53	0.57	0.91	1.24†	1.82
Change in State Ownership	-1.90**	-4.34	-1.85*	-2.81	-1.55	-1.43	-2.58*	-2.15
Telephones	-0.97**	-10.47	-0.88**	-9.28	-0.43**	-2.97	-1.38**	-8.75
Roads	0.43**	5.37	0.41**	4.60	0.40**	3.15	0.54**	3.83
Inland navigable waterways	0.10**	5.69	0.10**	5.94	0.15**	6.14	0.08**	3.02
Regional Variables								
Average Consumption p.c.	6.58**	3.57	1.21**	3.44	0.65*	2.40	3.76**	3.59
Average Population	-0.06	-0.75	0.06*	1.96	0.01	0.33	0.09**	3.51
Average Annual Real Growth[6]	49.36*	2.33	0.67	0.25	4.53**	3.18	8.39	1.57
IV Parameters								
North Coast	-3.03	-1.54	1.47*	3.14	0.93**	4.15	-0.49	-0.66
South Coast	-7.03	-2.76	-0.72	-1.52	0.75**	3.08	-2.67*	-2.54
Inland	-20.05	-2.32	1.69†	1.77	0.96**	3.08	-3.41†	-1.77
West	-3.65	-3.27	0.29	0.72	0.53	1.25	-2.53*	-2.52
Obs	80808		80808		47694		32844	
Likelihood	-7857.69		-7869.50		-4669.76		-3094.51	
LR test	3518.10		3494.48		2076.62		1628.33	
LR test: IV Parameters=1	64.73**		32.34**		6.56		62.38**	

[1]**, *, and † indicate significance at the 1%, 5%, and 10% levels, respectively. [2] Gansu and Tibet excluded since no foreign investment located there during the time period. [3]All variables lagged one year. [4] Weighted by (1-share of industrial output from SOEs). [5] Three-year moving average. Not in logs. [6] Not in logs.