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Environmental Policy and the Location of Foreign Direct Investment in China

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Abstract

This paper introduce an environmental policy variable, i.e., the provincial pollution levy paid by an average firm, and measure its impact on the foreign investors' location decisions over the 1987 to 1998 period. We argue that less developed regions in China are more inclined to sacrifice environmental policies as an instrument to attract foreign direct investment (FDI). National level results show that stringent environmental policies have insignificant effect on foreign investors' location decision, and that transportation, economic growth, and regional location matters more. At the provincial level stringent environmental policies reduce FDI in the less developed regions.

Key words: Foreign Direct Investment, Environmental policy

***JEL Classification**: C23, E24, F21, H25, O53, Q28*

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1. Introduction

Since the inception of economic reforms in 1978, China has emerged as a dominant recipient of foreign direct investment (FDI), which is increasingly pouring into most areas of the country. The literature contains several theories and factors explaining the location of FDI. Recent studies have suggested that environmental regulations might play an important role in manufacturers' choice of location, Levinson (1996) and List and Co (2000)[1]. This is closely linked to the pollution haven hypothesis, which states that firms take advantage of lax environmental standards. The empirical evidence of firms flocking to regions with less stringent environmental policies is, however, scarce, Eskeland and Harrison (2002). In addition, other studies, like Wang and Wheeler (2000), have shown a significant heterogeneity in environmental policies across China's provinces. It is not clear, however, in what way FDI in China responds to these variations. The primary objective of this paper is to examine how FDI has evolved across regions and provinces with different development levels, particularly focusing on the impact of heterogeneous environmental policies.

To the extent that policy-makers intentionally design environmental policies to appeal to foreign investors, for example by implicitly subsidizing production through lowered environmental fees, policies may serve as a means to maintain or increase employment levels. Thus, there is an incentive for policy-makers in less developed areas to sacrifice environmental quality for employment, and as pointed out by The World Bank (1997) and Xu (2000), there is substantial tension between environmental quality objectives and development goals within Chinese local governments[2]. Environmental policies have also been in focus recently because of the growing concern that higher environmental levies will induce firms to lay off workers in their pursuit of profits, (Lucas, 1996). Stringent environmental policies may in a similar fashion raise the cost of production and deter foreign firms from investing in China. The question is then whether more lax environmental polices can be used as an instrument to attract FDI.

The potential link between environmental quality and the level of FDI (and thus development) is interesting from a policy perspective. If local governments intentionally use lax environmental policies to attract FDI to promote employment opportunities and economic expansion, then the central authorities face divergent environmental goals, and

[1] There is a related debate, which discusses whether heavily-polluting firms locate in regions with low pollution fees. See for example Eskeland and Harrison (2002).

[2] There is an obvious link to the literature on the so-called environmental Kuznet curve in this framework, see for example Selden and Song(1994).

need to decide how to tackle the trade-off between development and environment quality[3]. To measure this specifically we introduce an environmental policy variable, i.e., the provincial pollution levy paid by an average firm during a given year, and measure its impact on the foreign investors' location decisions over the 1987 to 1998 period. Our findings corroborate previous literature that lax environmental policies drive parts of the location decision of FDI in China. This effect is more pronounced in less developed regions and, hence our results support the pollution haven hypothesis.

The paper is organized as follows: Section 2 briefly describes the characteristics of FDI inflows. Section 3 describes the environmental policy variable. Section 4 outlines the theoretical and empirical considerations about the factors affecting FDI allocation. Section 5 presents the data and the methodology. The empirical results are presented in section 6 and, finally, section 7 concludes the paper.

2. Regional and Provincial Distribution of Foreign Direct Investment

China's integration with the global economy began in earnest only after the market-oriented reforms that were instituted in 1978. Capital inflows, in particular, were minimal in the 1970s and 1980s, impeded by capital controls and the reluctance of international investors to undertake investment in a country with weak institutions and limited exposure to international trade. All of this changed in the early 1990s, when FDI inflows surged dramatically on account of the selective opening of China's capital account as well as the rapid trade expansion, which in conjunction with China's large labor pool, created opportunities for foreign investors. These inflows have remained strong ever since.

Provincial distribution of FDI has, however, been skewed with 88 percent going to provinces in eastern China. Diffusion from the eastern region to the inland areas was slow until 1991, and further fuelled growing social and income differences between provinces, (Chen, 1997). By the late 1980s, to create a more level playing field throughout China, the existing eastern region FDI policies were gradually spread to a majority of China's regions, (see Ma 1997, and Chen 1997). This policy change was sparked by Deng Xiapoing's 1992 call for deeper and faster economic reform and liberalization and marked the official move from regional priority toward nationwide implementation of preferential FDI policies. Simultaneously China launched massive complementary programs to attract FDI, (Chen, 1997).

[3]Influences such as China's entry into the World Trade Organisation (WTO) further accentuate this issue as well as the importance of conformity in environmental policies.

Increased provincial independence in combination with a desire for further development inspired many provinces to formulate their own preferential policies for FDI sometimes without the full consent of the central government, (Ma, 1997). By the end of 1992, almost two thousand development zones had been set-up, of which a large share was located in inland areas. But as inflationary problems emerged, the government rectified existing economic development zones and put in place a requirement for central government approval to establish new ones, (Shirk, 1994). As a result, the central government partly deprived provincial governments of their independence in forming industrial policies.

Table 1 presents the distribution of the accumulated actually utilized FDI during the 1987 to 1998 period. We specifically look at the average share of total FDI and provincial GDP for two periods, 1987 to 1991 and 1992 to 1998. First, we notice that the combined share of FDI in the eastern region accounts for around 88-89 percent of the total. The accumulated FDI share of the central provinces increased from 5.2 percent in the first period to 8.7 percent in the second period. Finally, the western provinces' share of accumulated FDI dropped from about 2 percent in the first period to 1.8 percent in the second.

The distribution of FDI between China's provinces remains unequal with the bulk directed at the eastern region. But more importantly, FDI increasingly flows into provinces outside the traditional investment belt, and its importance for provincial economies seems to rapidly increase. This pattern points to a gradual but obvious expansion of FDI from 'priority' provinces towards later-opened provinces in China's interior.

Table 1. Accumulated foreign direct investment in China's provinces. Share of total FDI[A)] and GDP[B)], 1987 to 1998.

Region / province	1987-1991		1992-1998	
	% of total FDI	% of GDP	% of total FDI	% of GDP
Eastern				
Beijing	8.97	2.65	3.65	7.24
Tianjin	2.87	1.23	3.75	11.64
Hebei	1.01	0.18	2.19	2.11
Lianoing	5.71	0.85	4.45	4.14
Shanghai	8.00	1.41	8.74	9.80
Jiangsu	4.27	0.38	12.65	5.76
Zhejiang	1.70	0.28	3.24	2.67
Fujian	7.50	2.40	10.48	13.45
Shandong	4.32	0.45	6.78	3.69
Guangdong	41.88	4.29	28.10	13.52
Guangxi	1.30	0.43	2.10	4.04
Hainan	2.70	4.43	2.48	17.50
Total	**89.23**		**88.50**	
Central				
Shanxi	0.19	0.07	0.36	0.81
Jilin	0.97	0.34	0.91	2.20
Heilongjiang	1.19	0.25	1.15	1.60
Anhui	0.39	0.09	0.96	1.43
Jiangxi	0.30	0.11	0.86	1.85
Henan	1.07	0.17	1.16	1.11
Hubei	0.63	0.18	1.82	2.00
Hunan	0.45	0.10	1.53	1.88
Total	**5.19**		**8.70**	
Western				
Inner Mongolia	0.19	0.08	0.09	0.30
Guizhou	0.31	0.19	0.14	0.60
Yunnan	0.23	0.08	0.42	0.98
Shaanxi	0.87	2.51	0.81	2.27
Gansu	0.05	0.03	0.14	0.67
Qinghai	0.02	0.04	0.02	0.32
Ningxia	0.03	0.07	0.06	1.06
Xinjiang	0.32	0.16	0.12	0.43
Total	**2.02**		**1.80**	

Note: [A)] Shares of regional accumulated FDI, where total FDI includes FDI of the three provinces outside the sample. Accordingly, the shares do not add up to 100. [B)] Share of respective provincial GDP. 1993 constant prices. Sources: *China Statistical Yearbook* (1999) and the *Comprehensive Statistical Data and Materials On 50 Years Of New China* (1999).

The increased spread of FDI may have intensified competition between provinces in their effort to attract foreign investment. Because provinces are becoming more alike in terms of FDI regulation, administration efficiency and preferential policies, an incentive exists for provincial governments to use unorthodox measures to improve their

attractiveness. These may take the form of lax environmental policies for foreign owned firms; hence the environmental levy system (EL) may be designed to under-price pollution relative to neighboring provinces[4]. Indeed, our argument is supported by differences in environmental policies between provinces.

3. Trends in the Environmental Levy System

The environmental levy system is one of the three main components of China's pollution control. The other two are prevention and monitoring. Environmental levies are imposed on above-standard emissions and based on concentrations of the pollutant. Furthermore, levies are only imposed on the pollutant that exceeds its standard by the greatest amount. There are obvious incentive problems with this design but despite these deficiencies, the system does create incentives to control pollution, (Wang and Wheeler, 1996). Notably, considerable disparity exists in effective levy rates between different provinces, (World Bank, 1997, and Wang, 1998).

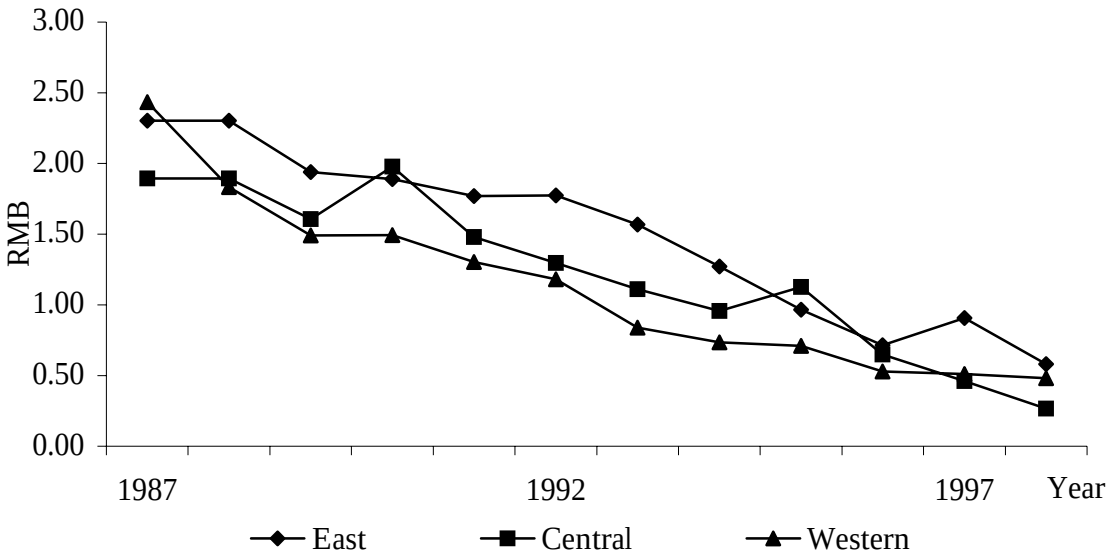
To prevent pollution, authorities stipulate that a mandatory percentage of a firm's total investment budget must be spent on abatement equipment. There is, however, a problem of properly defining environmental investments. This has occasionally led firms to label their regular investments as environmental, (Sunman *et al*. 1999). Consequently, some environmental investments are mis-specified and the efficiency of this policy is therefore probably lower than anticipated. Aggravating this fact is the relatively weak enforcement of the pollution control system. Although China's environmental levy system is consistent with international standards, the inadequate enforcement greatly undermines compliance[5].

China's central authorities have recently been aggressive in curbing environmental degradation. At the same time, they are under pressure to attract foreign investments to ensure positive spillover effects as well as to maintain the momentum of economic development. Since many firms use out-dated technologies, the environmental and developmental goals of the central authorities are sometimes at odds with each other. A closer look at the time path of the average environmental levy indicates that priority is given to development since real levy paid decreases over time. Figure 1 presents the graphs for

[4] Whether under pricing occurs or not is of course difficult to assess since marginal costs of pollution are not available. What we refer to here is simply pricing relative to other provinces.
[5] We have no information on differences in compliance behavior between foreign and domestic firms.

each of the three regions, showing the development paths of the real levy paid by the average firm[6].

Figure 1. Average environmental levy paid by a firm by region, 1987-1998. RMB by unit of measurement, 1987-1998.



Note: The pollution levy consists of two major components: (i) water, and (ii) gas. The respective graphs shows the average monetary amount paid, i.e., RMB, per 10 kilotons of water and 100 million Nm^3 of gases in 1993 constant prices. The pollution levy is collected on wastes exceeding the discharge standards. Source: *State Environmental Protection Agency's Yearbook*, (1988-1999).

The decline in the real levy paid in all three regions is significant, which implies that firms pay lower environmental fees over time. There are several potential explanations for this phenomenon. One is omission to adjust environmental levies for inflation. Another is firms' improved environmental performance over time, which naturally leads to lower levies. However, the latter explanation is not very realistic since: (i) the absolute level of pollution has increased in all provinces, while (ii) the average number of industrial firms has not increased except in the western region, *China Statistical Yearbooks* (1988 - 1999)[7]. Hence, we assume that the increased pollution is not caused by a larger number of industrial enterprises that, on average, have become increasingly efficient in their pollution abatement.

[6] Calculated by dividing the total amount of real environmental levy paid by the number of firms enrolled in the environmental levy system. Constant 1993 prices, RMB.

[7] The number of industrial firms increased between 1987 and 1992 in all three regions. In the western region the number of industrial firms increased during the entire period, while in the central and eastern regions the number of industrial firms seems to have increased between 1987 and 1992 and then decreased.

4. Theoretical and Empirical Guidance

The literature contains several theories and factors for explaining the location of FDI[8]. Applying industrial organization theory, Hymer (1960), asserted that certain firm-specific ownership advantages must be met for multi-national-corporations (MNCs) to conduct foreign production or investment. Later, authors like Kindleberger (1969), Caves (1971), and Dunning (1977), concentrated on identifying these firm-specific advantages. During the mid-1970s and early 1980s, Buckley and Casson (1976), and Rugman (1981), stressed that internalization advantages must be present for MNCs to serve foreign markets through direct investment. Indeed, as pointed out by Resimini (2000), host countries must satisfy the main concerns of MNCs. The early location theory argues that low labor costs, good infrastructure provision, and low transportation costs are important examples of such advantages. The OLI-paradigm (Ownership, Location, Internalization), as first presented by Dunning (1977), provides a good synthesis of these factors.

New location theory focuses on agglomeration effects associated with demand and supply linkages (see Krugman, 1991 a, b, Venables, 1993, and Markusen and Venables, 1995). It addresses the central role of agglomeration effects on knowledge spillages among firms within and between industries, thus improving economies of scale, (see Griliches, 1979, Romer, 1986, Gong 1995, and Braunerhjelm and Svensson, 1996). New trade theory and other recent literature on FDI allocation also discuss informational benefits from agglomeration on the location of FDI. Agglomeration can also improve the probability of finding firms nearby that can supply intermediate inputs for FDI production, (see Radner, 1992, Casson, 1994 a, b, and Mariotti and Piscitello, 1995).

Of special interest to this analysis is the design of policies directly affecting FDI, (see Ahiakpor, 1990, Lecraw, 1991, and Caves, 1996). Examples of traditional policies include tax exemptions and various subsidies. Prime examples are the renowned Special Economic Zones (SEZ) and open coastal cities (OCC) that were set up with special emphasis on promoting and facilitating the inflow of FDI. The early SEZ were located in eastern China, typically close to the major urban areas. As development unfolds and competition for FDI increases with foreign investors facing similar conditions across China, we argue that provincial governments are likely to explore alternative policy options such as environmental policies in their quest to increase local competitiveness. Furthermore, as markets in the eastern region mature, it is likely that many of the comparative advantages

[8] See for example, Chen (1997), Wei *et al*. (1999), and Resimini (2000), for a more detailed discussion of the theories of FDI determinants.

disappear. As a result, foreign investors increasingly widen their choice by looking at inland China, thus fuelling competition for FDI between the inland and eastern regions.

Recent empirical contributions, like Resimini (2000), have argued that market size is likely to influence the location of FDI. Others have included economic growth as a determinant of FDI location[9]. Insofar as the economy is in a steady state growth path, including growth as a determinant renders little problem. However, growth is prone to be erratic and includes short-term disturbances, such as macroeconomic shocks, which can be of importance to the location choice of FDI. We suggest using a variable, which captures the long, or medium-term growth path, such as a three year moving average of growth. In addition, this process removes some of the potential problem of endogeneity that may be present between GDP and FDI. Finally, emphasis has recently been placed on the role of human capital in the formation of FDI, (see Broadman and Sun, 1997, and Noorbaksh, 2001). The importance of human capital depends on the characteristics of labor demand and, particularly foreign investors' demand for skilled labor.

Studies examining the determinants of FDI in China, (see Lardy, 1995, Zhang, 1994, 2000, Head and Ries, 1996, Chen, 1997, Wei *et al.* 1999, and Henley *et al.* 1999), have used a combination of afore-mentioned determinants for the 1983 to 1998 period. In short, they conclude that good infrastructure provision, higher levels of GDP and GDP per capita, and potential market-share extensions influence the location of regional FDI inflow. None of the studies, however, has considered environmental regulations. Considering the empirical evidence and the hypothesis outlined for the present analysis, we divide the factors that are important for determining the attractiveness of a particular province in China as a FDI location into seven groups: environmental levy, labor costs, human capital, agglomeration, transportation, and moving average GDP growth. We also need to control for policy shifts and regional impacts during the period of investigation, such as the prevalence of SEZ and time specific events.

5. The Data and Definition of Variables

The empirical analysis is based on a panel of data including 28 of China's 31 provinces for the 1987 to 1998 period. Hence, the list includes the municipalities of Bejing, Tianjin, and Shanghai and the autonomous regions with provincial status. Tibet, Sichuan, and Chongqing

[9] A commonly used definition of market size used in the literature on the determinants of FDI is either GDP or GDP adjusted for the size of a country, or province.

provinces are excluded due to lack of data. The data is mainly compiled from the *State Environmental Protection Agency's Yearbook* between 1988 and 1999, and also from the *China Statistical Yearbook and the Comprehensive Statistical Data and Materials On 50 Years Of New China* (1999). All monetary values are converted to 1993 constant prices by using provincial GDP deflators.

The environmental policy variable is the provincial pollution levy paid by an average firm during a given year, i.e. the sum of the levy paid by all firms, subject to provincial regulation, divided by the number of firms paying the levy. This serves as a proxy for firms' environmental regulation costs in China. We have also solicited the opinions of representatives of the State Environmental Protection Agency (SEPA) in Beijing and representatives of foreign firms to ensure that firms subject to the levy have more or less similar abatement technology. Our sources confirm that *de facto* differences are very small between foreign-owned, jointly owned and domestic (native) firms' abatement technology. We also assume that foreign investors maximize profits through a set of activities, one of which is choosing location, which in turn depends on the province's relative advantages for foreign investment. FDI is measured in Renminbi and consists of realized investments by foreign entities' during a year[10].

We control for the size of a province by dividing FDI by GDP. As a proxy for the level of human capital, we use the share of secondary education compared to the total population. The growth path is, according to our previous discussions, smoothed by a three year moving average GDP growth. Agglomeration is defined as the share of non-agricultural population to the whole population. Labor cost is defined as real wages adjusted for productivity by multiplying wages by the ratio of industrial employment to industrial output. The proxy for transportation is the total kilometers of paved highways per square kilometer of land area[11]. The proximity to ports and vital markets of the east region is controlled for by the inclusion of geographical dummies depicting the three distinct regions in China, namely the eastern, central, and western regions.

We control for provinces that were originally allotted SEZs by including a dummy set to one if the province has SEZs, and zero if not. The inclusion of three time dummies controls for major policy shifts. The first dummy (*Time91*) corrects for an increase in the national environmental policy conducted in 1991. The second dummy (*Time92*) controls for

[10] Includes both genuine foreign firms and Chinese firms registered abroad but active in China, but excludes financial investments.
[11] The length, or concentration, of railways is not accounted for because of its low national expansion rate.

the shift in open-up policies in 1992, and the third dummy (*Time93*) controls for a lag of one year to capture late activities in conjunction with this policy shift. Table 2 lists all variables, their basic descriptive statistics, and their expected signs.

Table 2. Descriptive statistics, 1987-1998.

Variable		*Mean*	*Std dev*	*Min*	*Max*	*Observ*	*Sign*
Environmental Levy (*EL*)	overall between within	1.37	1.1 0.72 0.82	0.21	6.35	N=28 T=12	Neg
Foreign dir inv/GDP (*FDI/GDP*)	overall between within	0.46	0.65 0.55 0.36	0.0	4.0	N=28 T=12	
Labor cost (*LC*)	overall between within	7621	3843 2727 2749	2466	50200	N=28 T=12	Neg
Moving average GDP growth (*MAG*)	overall between within	0.08	0.5 0.2 0.5	-0.01	0.31	N=28 T=12	Pos
Human Capital (*HK*)	overall between within	0.05	0.066 0.026 0.061	0.0	0.869	N=28 T=12	Pos
Transport (*TR*)	overall between within	0.25	0.14 0.14 0.03	0.02	0.74	N=28 T=12	Pos
Agglomeration (*AGG*)	overall between within	0.29	0.18 0.17 0.07	0.11	0.79	N=28 T=12	Pos
Special econ. zone Dummies (*SEZ*)	overall between within	0.21	0.4 0.4 0.0	0.0	1.0	N=28 T=12	Pos

6. Methodology and Empirical Results

6.1 Specification test and model

To detect sources of spurious regression in time series estimation, we must search for the existence of unit roots in the variables. To this end, we use a recently developed method for detecting panel unit roots outlined by Im, Pesaran and Shin (1997), the 'IPS-test', which gives the *t*-test for unit roots in heterogeneous panels. The test allows for individual effects, time trends, and common time effects. Based on each panel variable's mean Dickey-Fuller *t*-statistics, the IPS-test assumes that all series are non-stationary under the null hypothesis.

The IPS-test is, thus, also consistent when only a fraction of the series is stationary[12]. From Table 3, we see that the null hypothesis of having a unit root is rejected for all of the variables including a trend and, hence the potential problem of a spurious regression is partly eliminated.

Table 3. IPS-test for stationarity

Variables	*FDI/GDP*	*EL*	*MAG*	*LC*	*HK*	*TR*	*AGG*
t-bar statistic	-1.88**	-6.8**	-2.2**	-2.6**	-2.6**	-12.4**	-4.2**

Note: *, and ** denotes significance at the 5 percent and 1 percent significance level respectively.

The typical approach for estimating the determinants of FDI is to regress the chosen dependent variable, e.g. the level of FDI in a particular area, against a set of independent variables, expected to affect the profitability of investment. Given stationary variables, we have considered both a random effect model and a fixed effect model, but since the Hausman test (χ^2 =5.33) does not reject the random effect model, we concentrate our efforts on the following specification:

$$FDI/GDP_{i,t} = \alpha + \beta_1 EL_{it} + \beta_2 MAG_{it} + \beta_3 LC_{it} + \beta_4 HK_{it} + \beta_5 TR_{it} + \beta_6 AGG_{it} + \\ + \beta_7 SEZ + \beta_8 GD_k + \beta_9 Time_l + \varepsilon_{it} + u_i \quad \text{(Eq. 1)}$$

where the independent variables are specified as outlined in Table 2. The intercept is denoted by α ; β_n are coefficient estimates; ε_{it} and u_i are individual and time specific errors where the latter are specific to each panel. SEZ is the dummy indicating whether the province contains any of these original preferential policy areas. The GD_k are dummies for

[12] The standardized *t*-bar statistics take the following form: $Z_{NT} = \dfrac{\frac{1}{N}\sum_{i=1}^{N} t_{iT}(p_i, \hat{\gamma}_i) - \frac{1}{N}\sum_{i=1}^{N} E[t_T(p_i,0)]}{\sqrt{\frac{1}{N^2}\sum_{i=-1}^{N} V[t_T(p_i,0)]}}$ where $t_{iT}(p_i, \hat{\gamma}_i)$ is the ADF statistic, *i* = 1, 2 ……, *N* (=28), and $\hat{\gamma}_i$ is the estimated vector of coefficients on the augmented lagged changes in the ADF with trend regressions, the $E[t_T(p_i,0)]$ and $V[t_T(p_i,0)]$ are tabulated values, and *T* is the number of time periods. Note that the present sample size may be too small to arrive at asymptotic distributions.

the three distinct regions previously described. $Time_t$ are time dummies for the years 1991, 1992, and 1993.

As economic benefits become increasingly exhausted in the more developed eastern region, FDI expands westwards. This implies that due to competition, provinces that lie immediately west of the eastern provinces must signal that they are attractive – for example by downgrading their environmental requirements. We expect, therefore, that the levy is more important to FDI in the less developed central, western and non-SEZ regions. In the following sections we start by presenting the aggregate estimate where we pool all provinces and estimate a random effects model. We then perform estimates for provincial groups with different geographic locations and SEZ status.

6.2. Aggregate results

The aggregate results are presented in Table 4. We report a random effects model corrected for autocorrelation according to the method outlined by Baltagi and Wu (1999). Since the Baltagi and Wu test statistics are between 0.82 and 1.2, we cannot reject autocorrelation.

We begin by discussing the estimates that are not statistically significant. The explanatory power of the environmental levy (EL) disappears when we control for autocorrelation. Hence, at the aggregate level, the environmental levy does not seem to have any significant bearing on the level of FDI, although it has a negative sign and is, thus, negatively related to FDI. The proxy for medium term economic performance, (MAG), is close to being statistically significant and, as expected, positively correlated with the level of FDI. This variable is intended to capture the long-term perspective on growth and hence, any other result would have been surprising.

Table 4. Random effects model FDI/GDP in China, 1987-1998.

Variable	Random effects model corrected for autocorrelation
Environmental Levy (*EL*)	-0.015 (0.02)
Moving Average Growth (*MAG*)	0.56 (0.37)
Labor costs (*LC*)	-2.2e-6 (4.6e-6)
Human capital (*HK*)	-2.85e-7 (1.16 e -08)
Transportation (*TR*)	1.39** (0.56)
Agglomeration (*AGG*)	1.29 e-7 (1.27 e-6)
Special economic zones (*SEZ*)	0.41** (0.22)
Central Provinces	-0.35** (0.17)
Western Provinces	-0.32 (0.20)
Time91	-0.094£ (0.05)
Time92	0.12** (0.06)
Time93	0.19** (0.05)
Constant	0.08 (0.24)
Nobs	333
Wald $\chi^2_{(10)}$	100.1
R^2	0.50

Note: £, **, *** denotes significance at the 12, 5 and 1 percent level respectively. Standard deviations are shown in brackets.

Labor costs (*LC*) are negative but do not seem to be important to the level of FDI. The statistical relevance of labor costs may be blurred in the aggregate, however, given the variable's low statistical significance, other determinants seem to be more relevant to FDI. The measure of human capital (*HC*) is not statistically significant and does not carry the expected positive sign. These results conflict with the recent finding of Noorbaksh *et al.*

(2001), that human resources are increasingly important to FDI. At the aggregate level, this seems to be an excessively strong statement for China, possibly because of the relatively high and evenly distributed enrollment in secondary education.

The proxy for agglomeration (*AGG*) is far from statistically significant. We have explored several other measures but with the same result; we do not find any significant agglomeration effect at the aggregate level. Finally, the regional location dummy for provinces in the western region is not statistically significant either.

Continuing with the significant estimates, we find that transportation (*TR*) is significant and positive indicating that it is a driver of the FDI location decision. Intuitively, an increase in the number of kilometers of highway is important for capturing market opportunities efficiently. The result is encouraging for infrastructure-related state investment, which is the main contributor to the road transport network. The dummy for provinces that were initially allotted SEZs is significant and positive. Once again, any other result would have been surprising. The regional location dummy for provinces located in the central region is negative and statistically significant at conventional levels. The sign of the regional location dummy indicates that the central and western regions receive less relative FDI compared to the eastern provinces. Finally, the time dummies for the shift in environmental policies in 1991 (*Time91*) seem to have a negative effect on FDI, while the open-up policy dummy (*Time92*) and its one-year lag (*Time93*) have positive effect, hence the policies seem to have been effective.

At this point, the negative but statistically non-significant effect of the average environmental levy is perhaps not surprising, and arguably encouraging to those environmentalists who prefer that environmental levies have a negligible impact on FDI. At the aggregate level offering subsidized levy rates can hardly be used as a competitive instrument to attract FDI . We know that there is a strong political inclination to boost development in the western areas and large-scale programs have been instigated, e.g. the "Go West" initiative. In the light of our results, this initiative seems to make sense. We now proceed by examining how the environmental levy and the other determinants of FDI behave at a regional level.

6.3. Regional results

We estimate the model for each region and across provinces without SEZs and make inferences about the potential regional pattern of FDI expansion. Since less developed

provinces are more likely to utilize environmental polices to attract FDI, we expect that provinces in the central and western regions will do so to a greater extent than eastern provinces. Consequently, environmental policies should be increasingly important to FDI in these regions.

Table 5 presents the results from a random effects model corrected for autocorrelation for each of the three geographical regions. Our expectation that the environmental levy is more prominent in the central and western regions is partially verified.

Table 5. Random effects model FDI/GDP across regions, 1987-1998

Variable	RE for eastern region	RE for central region	RE for western region
Environmental Levy (EL)	0.024 (0.04)	-0.034** (0.01)	-0.0089 (0.015)
Moving Average Growth (MAG)	2.4* (1.24)	-0.37 (0.24)	0.0088 (0.12)
Labor Costs (LC)	-0.000080£ (0.00004)	-1.57e-7 (1.23e-6)	-6.4e-6£ (4.1e-6)
Human Capital (HK)	0.0018£ (0.001)	-0.000017 (0.000015)	-5.25e-6 (6.4e-6)
Transportation (TR)	1.03 (1.13)	0.36£ (0.23)	-0.3 (0.25)
Agglomeration (AGG)	-5.89e-7 (2.6e-6)	5.94e-7 (4.17e-7)	3.42e-6£ (9.9e-7)
Special Economic Zones (SEZ)	0.18 (0.37)	Dropped	Dropped
Time91	-0.13 (0.1)	-0.029 (0.023)	-0.02 (0.026)
Time92	0.29* (0.12)	-0.018 (0.026)	0.0098 (0.027)
Time93	0.30* (0.11)	0.1** (0.02)	0.045£ (0.025)
Constant	-0.09 (0.85)	0.08 (0.07)	0.06 (0.05)
Nobs	143	106	84
Wald $\chi^2_{(10)}$	47.2	141.6	69.2
R^2	0.27	0.33	0.41

Note: All random effects models are corrected for autocorrelation. £, *, **, ***, denotes significance at 12, 10, 5 and 1 percent respectively. Standard deviation shown in brackets.

6.4. Eastern region

In the eastern region, only a few of the estimates are statistically significant at conventional levels. The environmental levy (*EL*), for example, is not statistically verified, which implies that environmental policies may not be efficient instruments for attracting FDI in the more developed eastern region. The estimate for economic performance (*MAG*) is statistically significant and positive, which implies that stable growth is essential to the realization of FDI. Similarly, labor costs (*LC*) also significantly affect the outcome of FDI, but with a negative sign, which is expected despite the existence of other studies where this estimate has been positive[13]. The level of human capital formation (*HK*) is also statistically significant, and in fact has the strongest impact across regions and in the aggregated estimate. The dummy for the increase in the environmental levy rate (*Time91*) is not significant, but has the expected negative sign. The two dummies controlling for the impact of opening-up policies (*Time92* and *Time93*) are both statistically significant and have the anticipated positive signs.

6.5. Central region

In this region, we see that the environmental levy (*EL*) is strongly significant and negative, which indicates that in the relatively less developed central region, the environmental levy does influence the level of FDI. Transportation, (*TR*), seems more pronounced in the central region than in the eastern region based on its statistical significance. The 1993 time dummy (*Time93*) is significant, but the dummies for 1991 and 1992 (*Time92* and *Time93*) are not, which supports the approach of adding a one-year lag on the 1992 dummy to capture late activities in conjunction with the policy shift. Neither the economic performance (*MAG*) nor the labor costs (*LC*) estimates are statistically significant.

It is possible that the relative importance of transportation (*TR*) in the *central region* can be ascribed to higher production costs in the *eastern region*, i.e. with rising production costs it becomes increasingly profitable to locate outside the eastern region. The domestic market, however, is still to a great extent concentrated to the eastern region, hence efficient transportation and good access to the eastern region are essential if located elsewhere. This holds true for both domestic and export oriented FDI, since the bulk of exports are transported by ship from harbors in the eastern region.

[13] See, Dunning 1980, and; Veugler 1981.

6.6. Western region

In the western region the environmental levy (*EL*) is not statistically significant but does have the expected negative sign. Hence, the environmental levy is less important as an explanation for the allocation of FDI in the western region. This is an expected outcome, since the natural step for foreign investors is to expand westwards step by step as the eastern region become increasingly exhausted. Hence, they first confront policy-makers of the central region. Labor costs (*LC*) are significant with the expected negative sign, which implies that labor costs are important to the level of FDI. Neither economic performance (*MAG*) nor transportation (*TR*) is, however, statistically important. For transportation this may be driven by the prohibitely long distance to domestic markets and harbors in the east. Instead, we find that agglomeration (*AGG*) is statistically significant with a positive effect, which interestingly enough implies that local markets are important to the FDI in western provinces. Of the dummy variables, only the dummy for 1993 (*Time93*) is significant which shows that FDI reacted with some lag after the 1992 policy change.

6.7. Provinces without Special Economic Zones

Finally, we redo the analysis for provinces without SEZs[14]. Table 6 shows the estimated results. Interestingly, we find again that the environmental levy (*EL*) is significant and negatively related to FDI. The economic performance (*MAG*) estimate is significant and with the expected positive sign, reflecting its relative importance to stable growth in those regions. Labor costs (*LC*) also carry the expected negative sign but are not statistically significant. Human capital (*HK*) carries a negative sign and is insignificant. Transportation (*TR*) is not significant either, but its positive sign reflects the necessity of efficient transportation routes to the coast and partly corroborates the results of the regional regressions.

The strong statistical significance and positive effect of agglomeration (*AGG*) is noteworthy. The positive sign implies that the market becomes more important to the level of FDI when located in regions without SEZs. This result is similar to that of the western region. The dummy for the increase in the environmental levy rate (*Time91*) carries the expected signs but is insignificant. The two dummies controlling for the impact of the opening-up policies (*Time92 and Time93*) have the expected sign, but only the 1993 dummy is

[14] We attempted to run the statistical model for provinces with SEZs but observations were too few to make reliable inferences.

statistically significant. Included in this regression is also a dummy for all provinces located in the central and western regions[15].

Table 6. Random effects model FDI/GDP provinces without special economic zones, 1987-1998.

Variable	Random effects model corrected for autocorrelation
Environmental Levy (*EL*)	-0.031* (0.016)
Moving Average Growth (*MAG*)	0.31£ (0.19)
Labor Costs (*LC*)	-1.01e-07 (2.34 e -06)
Human Capital (*HK*)	-3.08e-06 (3.79e-06)
Transportation (*TR*)	0.69 (0.50)
Agglomeration (*AGG*)	4.57e-06** (9.26 e-06)
Time91	-0.039 (0.28)
Time92	0.042 (0.031)
Time93	0.14** (0.027)
Non-eastern province	-0.28 (0.12)
Constant	-0.10 (0.17)
Nobs	262
Wald $\chi^2_{(10)}$	132.7
R^2	0.47

Note: £, *, **, *** denotes significance at 12, 10, 5 and 1 percent respectively. Std dev shown in brackets.

[15] We are aware of the small variation of the dummy for non-eastern provinces in the present sample. We have tried without any regional dummy and found similar results but with a slight decrease in EL significance.

7. Concluding Discussion

The primary objective of this paper is to examine the evolution of FDI in China across regions and provinces with different development levels, with particular focus on the impact of environmental polices. The analysis is based on panel data for 28 of China's 31 provinces and autonomous regions for the 1987 to 1998 period. Unlike other studies on the determinants of FDI in China, this study includes a variable to capture the specific role of environmental policies as a determinant of FDI.

The result of the analysis is particularly interesting because China is characterized by a dualistic development pattern and the economy is undergoing major structural changes. In addition, the positive contribution of FDI on China's economic performance is well documented in the literature. For example, Sun (2001) argues that FDI contributes to productive capacity (presumably through technology transfer) and export expansion but with varying strength across regions. Intuitively, because of the importance of FDI for provincial economies incentives exist to design environmental policies to appeal to foreign investors, for example by subsidizing levy rates.

In general, we conclude based on the econometric analysis that FDI is sensitive to regional differences in environmental policies. However, at the aggregate level, although environmental policies seem to have a negative effect on FDI, the effect is not statistically significant. At the regional level for the central region, on the other hand, environmental policies are statistically significant and negatively related to FDI. The evidence is somewhat weaker in the western region, but with a similar relationship to FDI. These results are consistent with our expectations that as economic development unfolds and competition for FDI increases, foreign investors face similar investment conditions across China. Thus, the results open an interesting discussion regarding provincial governments' use of environmental policies to increase local competitiveness.

More specifically, the environmental policy variable (i.e. the environmental levy) is more relevant for FDI in the central and western regions and for provinces without SEZs than for the more developed eastern region. Hence, the result suggests that adjusting environmental policies to attract new FDI is more important in the less developed parts of China. In the more developed region, FDI is, to a larger extent, influenced by economic growth and labor costs. We also notice that an efficient transportation network is an important determinant of FDI in areas closer to the eastern region, i.e. particularly in the

central region. Hence, there is a demand for transporting goods and people between 'westward' regions and the eastern region.

Agglomeration is another important determinant of FDI, increasing in importance the further inland we move and becoming statistically significant in the western region. FDI in this region is probably targeted at the local (surrounding cities and provinces) markets rather than the much larger eastern market or export markets, since it probably is prohibitorily expensive to transport products to these markets from the western region. Notably, the above pattern can also be discerned when comparing provinces with and without SEZs. To conclude, although results are not entirely uniform and we find varying levels of statistical significance, our results confirm that policies, economic growth rates, labor costs, transportation and geographical locations are important determinants of FDI in China. The central government is perhaps aware of these findings, but may be unaware of the relatively strong impact of environmental levies at the regional level. The results have important policy implications as they provide a rationale for a weak implementation of the environmental levy system in some provinces. First, provincial governments may, as the evidence suggests, use the environmental levy system to attract FDI – particularly in the central regions and in provinces without SEZs. Second, if the central government is dedicated to improving the environment across the board it must recognize that the environmental levy system (and other environmental policies) can be used as a means to compete for FDI west of the eastern region. Third and finally, it is by no means evident that this competition is limited to FDI. On the contrary, it is likely that domestic (native) and foreign firms regard environmental levies in the same way. Hence, it is possible that the overall investment level can be affected by the design of the environmental levy.

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