54 2016 April

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Does Environmental Governance matter for FDI? – Testing for Pollution Haven Hypothesis for Indian States*

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Abstract: This paper tries to see the role of the actual expenditure on pollution and control equipment in a particular State on the location choice of foreign firms in India. Based on Levinson (2001), we compute Industry-adjusted pollution abatement expenditure index for 25 States for different time periods using Annual Survey of Industries data to see if FDI inflow is affected by any variation in pollution abatement expenditure (reflecting environmental governance). The index compares the actual pollution abatement expenditure in a particular State, unadjusted for industrial composition, to the predicted abatement expenditure in the same State (where the predictions are based on nationwide abatement expenditures by industry and each State's industrial composition). If adjusted index is low for a State, this implies that the State has poor environmental governance and this would induce foreign firms to invest. In other words, our study tests for 'pollution haven' hypothesis. Our results do not find any evidence of pollution haven hypothesis for 21 Indian States. Other variables are more important in influencing foreign firms' decision than environmental stringency.

Keywords: *Pollution haven hypothesis, India, Abatement expenditure, environmental governance*

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1. Introduction

In the past three decades, developing countries have witnessed a significant inflow of foreign direct investment (FDI). The total FDI inflows to developing countries as a share of total world FDI has increased from 17% in the early 1990s to 52% in the year 2013 (UNCTAD, 2013). One obvious reason for large FDI inflow to these countries is the liberalisation process embarked on by several of these countries in early 1990s and consequently their high growth. Besides, the host countries have also devised suitable incentives to attract FDI. Another reason often cited in the literature is that FDI may be attracted to developing countries due to relatively lenient environmental regulations (termed as 'race to the bottom') (Grossman and Krueger, 1991; Xing and Kolstad, 1998; Keller and Levinson, 2002). In other words, a key factor influencing foreign firms' choice of location could be the compliance cost of local environmental regulation (Keller and Levinson, 2002).

One of the ways in which compliance costs can be measured is to look at how much firms are spending on the pollution abatement. If these costs are aggregated across firms in a particular location, they would reflect the environmental governance aspect in that location. A high value of pollution abatement expenditure *ceteris paribus* by a firm of a sector in a State vis-à-vis another firm in the same sector but in a different State would indicate greater environmental governance in the first State. The present paper tries to see the role of the actual abatement expenditure in a particular State on the location choice of the foreign firms in India. This is tested by computing an index of abatement expenditure for firms in a State using plant level data from the Annual Survey of Industries (ASI) for different years.

Earlier studies attempting to measure the environmental regulation have used either pollution intensity (see for example Mani *et al*., 1997; Rabindran and Jha, 2004; and Dietzenbacher and Mukhopadhyay, 2007) or pollution abatement cost divided by either total employment or gross state domestic product (GSDP) or State's manufacturing output without controlling for industry characteristics (see for instance, Friedman *et al*., 1992; Duffy-Deno, 1992; Crandall, 1993). A key problem with such measures is that they fail to adjust for industrial composition. States that have pollution-intensive industrial compositions such as steel, fertilizers, chemicals etc. will incur high pollution abatement costs, whether or not they have stringent regulations. Thus, one need to use the pollution abatement costs accounting for industry composition as an index of regulatory stringency.

In this paper, we compute industry composition adjusted abatement cost using unit level data from ASI for the period 2001-02 to 2009-10. We first aggregate the data at NIC 3 digit level (and also at NIC 2 digit level) and then compute the index. Subsequently we use panel data techniques to test for pollution haven hypothesis for 21 major States of India. Our results do not validate the pollution haven hypothesis for Indian States.

The remaining paper is organized as follows: the next section talks about how FDI and environment are linked. Section 3 discusses about measurement of environmental governance in the literature. This is followed by the methodology to see the role of environmental governance on FDI in different States in India in Section 4. The section also gives the methodology to construct industry adjusted environmental governance index. The descriptive statistics about the index and other control variables is given in section 5. Section 6 reports and discusses the estimation results and the paper concludes with policy implications in Section 7.

2. Relation between FDI and Environment

The FDI-environment relationship in literature has been grouped into three main strands: 1) the environmental effects of FDI flows; 2) the competition for FDI and its effects on environmental standards; and 3) the cross-border environmental performance (Pazienza, 2015). It has been argued that despite extensive empirical work and case study evidence, there is sill not a clear and conclusive understanding of their associated phenomena (Erdogan, 2014; Pazienza, 2015).

With respect to the first relationship, it has been argued that greater integration of the world economy through increased investment flows (and trade) and greater mobility of factors will have impact on the environment through three different effects – scale effect (moving from small to global scale), technique effect (adoption of cleaner technology) and the composition effect (shift in preferences to cleaner products and environment with increase in income) (Kathuria, 2008; Pazienza, 2015). The net of these three effects will get reflected in the ultimate impact on environment.

The literature exploring the relationship between FDI and environmental regulations (i.e., the second group), discusses two distinct phenomena: a) pollution haven hypothesis; and b) 'race to bottom' or 'regulatory chill hypothesis'. In the context of FDI, pollution haven hypothesis (PHH) emphasizes the possibility that investors seek those countries to locate their industries where it will be cheaper owing to lower regulatory requirements. Interestingly, most authors who focused on the PHH have adopted an empirical approach (see Dean, 1992 for survey before 1990 and Erdogan, 2014 for a recent survey).

The second argument, often has been used to oppose globalization, relates the impact of foreign investment on local environmental standards. Generally known as the 'race to the bottom' or 'regulatory chill effect', the argument states that the foreign firms may induce governments to reduce local environmental standards or freeze them at suboptimal levels (Erdogan, 2014). Evidence shows that in China, provinces have competed intensely for foreign capital and provincial leaders have been tempted to promise preferential treatment to potential foreign investors, which includes a tacit (or express) commitment to more lax enforcement of environmental standards (Esty and Gentry, 1997). On the other hand, in resource-seeking industries, where products are homogenous, small cost differences translate into large market share gains, and foreign investors can occasionally exert considerable pressure on recipient countries (Erdogan, 2014). The competitive pressures however, can also operate in the opposite direction as investors insist on higher environmental standards. Foreign investors in Costa Rican banana production have been observed to insist upon environmental care, as their European customers demand an environmentally sound product (Gentry, 1996 as referred in Erdogan, 2014).

The focus of the present study is however on testing for PHH for Indian states and not on responsiveness of environmental standards to FDI.

3. Pollution Abatement Cost as a Measure of Environmental Stringency/ Governance

Three broad methods have been used in the literature to characterize the measure of environmental stringency (Keller and Levinson, 2002). These are: a) qualitative indices of regulatory stringency, b) quantitative measure of enforcement effort on the part of states/countries, and c) measures of compliance costs incurred by plants. Crandall (1993) and Friedman *et al*. (1992) are the first few studies that have used industrial composition unadjusted pollution abatement cost (as a share of GSDP or employment) as a measure of environmental regulation. Later on studies by Levinson (2001) and Keller and Levinson (2002) have used industrial composition adjusted pollution abatement cost as the measure of environmental regulation.

It is to be noted that variation in State level environmental stringency though is smaller than variation across countries, but using State variation gives three benefits. First, there would be much better data on state environmental costs than costs at international level. Second, States are more comparable than different countries on other non-environmental parameters (Keller and Levinson, 2002: 691). Moreover in cross country studies, the costs would be different due to prevailing factor market conditions rather than pure abatement related costs. This bias is less if analysis is across States for the same country. Third, most studies on investment location decision-making processes indicate the level of environmental regulations is usually portrayed as having a very small role in these decisions (OECD, 1997), it is the factors like political stability, size and growth potential of market, access to other markets, labour costs, ease of repatriation of profits, transparency and predictability of administrative and legal framework, cultural affinity, infrastructure and quality of life are more important (Erdogan, 2014). Many of these factors, however are same across states, thus the major key variable influencing locational choice of foreign firms would be environmental cost.

Use of pollution abatement (operating) expenses as a measure of abatement cost is preferred for two reasons (Keller and Levinson, 2002). First, operating expenses for pollution abatement equipment are easier to identify separately. Abatement capital expenses may be difficult to disentangle from other investments in production process that have little to do with pollution abatement. Second, abatement capital expenditures are highest when new investment takes place. This implies that the states which have thriving economies such as Gujarat, Tamil Nadu etc., and are having sufficient manufacturing investment tend to have high levels of abatement capital expenses, regardless of the stringency of those States' environmental laws. Moreover, operating costs show more consistent year to year pattern (Levinson, 2001), whereas capital expenses may behave like an impulse more in line with industry business cycle. Thus, we should also take pollution abatement expenditure as proxy variable for environmental regulation. However, ASI only gives the following three measures: a) Expenses incurred in Repair & Maintenance of Pollution equipment,[1] which it discontinued from 2008 onwards; b) Gross Addition of Pollution Control Equipment expenses during the year; and c) Gross Closing Expenses of Pollution Control equipment at the end of the year. In the present paper, we use the latter two measures – Gross Addition Expenses and Gross Closing Expenses on Pollution Control equipment to compute an index of environmental governance.

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[1] *There exist one study (Neelkantha 2015) in Indian context that has used repair & maintenance expenses to compute abatement cost index for two years - 2002 and 2005. There seem to be problem in computation as industry adjusted abatement cost index are much below one for all the states. Since it is a relative measure, for some of the states which are doing more abatement as compared to other states, the index should have value greater than one.*

4. Methodology

Measuring Environmental Governance

As mentioned earlier, Friedman *et al*., (1992); Crandall (1993) and List and Co (2000) have used measure like pollution abatement costs divided by total employment or GSDP. Duffy-Deno (1992), on the other hand, has used total State-wide pollution abatement operating costs divided by gross State manufacturing output as measure of regulation stringency. A key problem with such measures is that they fail to adjust for industrial composition. Based on Levinson (2001), we compute Industry-adjusted abatement expenditure index for 25 States for the different time periods to see if FDI inflow is affected by any variation in abatement expenditure (reflecting environmental governance). The index compares the actual pollution abatement expenditure in a particular State, unadjusted for industrial composition, to the predicted abatement expenditure in the same State (where the predictions are based solely on nationwide abatement expenditures by industry and each State's industrial composition). The paper however improves from Levinson (2001) and Keller and Levinson (2002) paper as it computes industry adjusted abatement expenditure at NIC 3-digit level instead of NIC-2 digit level as computed by these studies.

Let the actual abatement expenditure per unit of output be denoted as[2]

$$S_{st} = \frac{P_{st}}{Y_{st}} \qquad [1]$$

Where P_{st} is pollution abatement expenditure in State *s* in year *t*, and Y_{st} is the manufacturing sector's contribution to the GSDP of State s in year *t*. S_{st} is the type of unadjusted measure of compliance costs commonly used. By failing to adjust for the industrial composition of each State, it probably overstates the compliance costs of States with more pollution-intensive industries and understates the costs in States with relatively clean industries. To adjust for industrial composition, compare equation (1) to the predicted pollution abatement expenditure per unit of GSDP in State *s*.

[2] *Note that we are using the same notations as has been used by Levinson (2001) and Keller and Levinson (2002).*

$$\hat{S}_{st} = \frac{1}{Y_{st}} \sum_{i=1}^{N} \frac{Y_{ist}\ P_{it}}{Y_{it}} \qquad [2]$$

where ‘N’ is total number of industries. In India’s case, industries are indexed from 15 through 36 (covering 22 industries) following the two-digit manufacturing National Industrial Classification (NIC) codes. Y_{ist} is the contribution of industry *i* to the GSDP of State *s* at time *t*, Y_{it} is the nationwide contribution of industry *i* to the national GDP, and P_{it} is the nationwide pollution abatement expenditure of industry *i*. In other words, S_{st} is the weighted average pollution abatement expenditure (per unit of GSDP), where the weights are the relative shares of each industry in State *s* at time *t*. To construct the industry-adjusted index of State’s stringency, S^{*}_{st}, we compute the ratio of actual expenditures in equation (1) to the predicted expenditures in equation (2).

$$S^{*}_{st} = \frac{S_{st}}{\hat{S}_{st}} \qquad [3]$$

When S^{*}_{st} exceeds 1, industries in State *s* at time *t* spend more on pollution abatement than those same industries in other States. When S^{*}_{st} is less than 1, industries in State *s* at time *t* spend less on pollution abatement. By implication, States with large values of S^{*}_{st} have relatively more stringent regulations than States with small values of S^{*}_{st} (Levinson, 2001).

Hypothesis

If adjusted index is low for a State, this implies that the State has poor environmental governance and this would induce foreign firms to invest. In other words, our study tests for ‘pollution haven’ hypothesis. We thus test the following hypothesis: “There exists negative relationship between FDI and environmental governance”. To test this hypothesis we used the following equation that relates FDI to environmental governance after controlling for several state-specific effects such as net state domestic product per capita (NSDPc), share of manufacturing in NSDP, quality of infrastructure, geographic dummy (nearness to coast) etc.

$$FDI_{s,t} = \alpha + \beta S^{*}_{s,t-1} + X'_{s,t}\gamma + \varepsilon_{s,t} \qquad [4]$$

β is the estimated parameter of State's abatement expenditure index and is predicted to have negative influence on the FDI inflow to the state i.e., higher the governance (forcing firms in the state to abate more) lower would be the FDI inflow. As can be seen, the index is used with a lag. Given the fact that firms' decision to invest, especially FDI is not instantaneous, it is governance in the past that may induce them to invest. γ's are the coefficients of control variables. The control variables included are per capita net income of the state (NSDPc), share of manufacturing in NSDP, quality of infrastructure, especially availability of electricity as measured by transmission and distribution (T&D) losses, investment received by the state i.e., IEM implemented and nearness to coast. The likely effect of these control variables is given below.

Control Variables

Market Size/Demand: A bigger market attracts FDI (Kathuria *et al*., 2015). This is due to large potential demand and thereby economies of scale (Walsh and Yu, 2010). The market size is measured by per capita net state domestic product (NSDPc). A bigger market size is hypothesized to have a positive sign (List and Co, 2000; Keller and Levinson, 2002; Frediksson *et al*., 2003; Drukker and Millimet, 2007). The variable is used in log form.

Manufacturing Share: State Domestic Product (SDP) accrues from primary (agricultural), secondary (manufacturing) and tertiary (services) sectors. The manufacturing sector is relatively more capital and energy intensive in contrast to the agriculture and the services sector. A state with higher manufacturing share is a reflection of the fact that the state is an industrial state and therefore would attract more FDI. Therefore the current study uses the manufacturing share (Manushr) as a control variable.

Availability of power: Due to high capital investment required in the initial period, a foreign investor often sees whether state has sufficient power. A State with higher installed capacity implies greater likelihood of available power, thus would be able to attract more FDI. Although installed capacity is a good measure of power availability, it may not be in Indian context where many of the states have transmission and distribution (T&D) losses to the tune of 50 per cent (Srivastava and Kathuria, 2014). In that scenario, to an investor, what is important is not the installed capacity but what is available. A high T&D loss also indicates effectiveness of industrial regulation in the state. Thus, we take T&D losses as one of the control variables, which would signal foreign firms to invest in the State. A state having high T&D losses would have low FDI.

Nearness to Coast: Many of the foreign firms use developing countries owing to their cheap labour, as manufacturing hub for their world-wide exports/supply chain (Zhang and Song, 2000). From foreign investor's point of view, a State to act as hub need to have good international connectivity in the form of a sea-port so that goods can be exported easily or import of any raw-material/component can happen unhindered. Thus, nearness to port would reduce transaction cost of the producer. Therefore, a state having sea-port will attract more FDI. Thus, is hypothesized to have a positive sign.

Clustering effect: An existing stock of investment allows positive spillovers through linkages. They are also indicative of conducive conditions for investment. The industrial entrepreneurs memorandum (IEM) implemented in the state may capture this clustering effect as it reflects readiness of State in attracting investment. The IEM implemented is also a reflection of better institutional characteristics like good governance, political stability, low corruption and ease of doing business. We hypothesize that higher the IEM implemented in a State, the more FDI it will attract unless the congestion cost exceeds the cost of relocating (Adersa and Ray, 1998).

Time dummy: As our data is for nine years, we have also used a time dummy (TIME) that accounts for any macroeconomic changes happening over the period and affecting all the states.

Data

One key problem while doing the analysis is non-availability of appropriate data, especially the FDI. Ideally, we should have used State-wise FDI in manufacturing sector. Unfortunately, FDI inflow is either available sector-wise or RBI region-wise but not State-sector-wise as is available from RBI or

Department of Industrial Policy and Promotion (DIPP). For example, FDI data as reported by Chandigarh RBI office comprises of investment in four States - Punjab, Haryana, Himachal Pradesh and Chandigarh, thereby using the data to carry out the State-wise analysis would yield biased results. In absence, we have used responses to parliamentary questions to get state-wise FDI.[3] To be specific, FDI data is response to Lok Sabha unstarred question numbers 182 dated 01.03.2005; 1032 dated 01.08.2006; 527 dated 24.02.2009 and 1074 dated 28.11.2011 respectively. The data for all other variables has been collected from different government sources. The per capita NSDP and Manufacturing share is from Central Statistical Organisation, Power availability and T&D losses are from Ministry of Power and reports of Planning commission, IEM are from Ministry of Industry and Handbook of Statistics on Indian Economy.

Econometric Specification

For the given objective, there exist a variety of estimation models. However a simple pooled ordinary least squares (OLS) model would yield biased and inconsistent parameters if time invariant covariates are omitted. If omitted time-invariant variables are correlated with the environmental governance variable, a fixed effect (FE) model will provide a consistent and unbiased estimate of the parameters while simultaneously controlling for unobserved unit heterogeneity. On the other hand, if these omitted time-invariant variables are uncorrelated with the policy variable, a random effect (RE) model would provide a more efficient estimate than FE model. The validity of these assumptions is examined by Hausman test. In case of presence of auto-correlation and heteroscedasticity, we will be using generalized least squares (GLS) method that corrects for these two. For the estimation purpose, we limit the sample to only 21 States and Union Territories (UTs)[4] for which data is available for all the

[3] *Incidentally, the data shows extremely high value of FDI for one state in 2006 (nearly 40% of total FDI received in the country). This spike and other state-wise data was cross-verified with RBI officials which indicated that the data is correct (Source: Personal communication with RBI official in August 2015).*

[4] *Union Territory (UT) means that the area is under the direct administration of the Government of India. A UT in India is similar to the District of Columbia in USA. It is to be noted that Delhi is still a UT, but has been given special status of National Capital Region with provision of legislative assembly and a council of ministers. For the present analysis, it has*

variables for the period 2002-03 to 2009-10. This is because, many of the north-eastern States and UTs have neither received any FDI nor any consistent data are available for their T&D losses or per capita power consumption, thereby restricting the number of States[5] for analysis to 21.

The final econometric model estimated is:

$$lnFDI_{st} = \alpha + \beta S *_{s,t-1} + \gamma 1 lnNSDP_{s,t} + \gamma 2 InstlCap_{s,t} + \gamma 3 T\&DLoss_{s,t} + \gamma 4 Manushr_{s,t} + \gamma 5 lnIEM_{s,t} + \gamma 6 Coastal_s + \gamma 7 - 14 Time_t + \varepsilon_{s,t} \quad (5)$$

The estimations are carried out in STATA 12.

5. Descriptive Statistics

Table 1 presents State-wise summary statistics for abatement cost after controlling for industrial composition (S*) at 3-digit NIC, 2-digit NIC (equation 3) and without controlling for industrial composition (S) (equation 1). The correlation between adjusted (for 3-digit NIC data) and unadjusted abatement expenditure index is 0.9. From the table, we can infer that several States which appear to have higher abatement expenditure as per unadjusted index have much lower ranking once we allow for their industrial composition. States like West Bengal, Meghalaya which are among top five in terms of unadjusted pollution abatement expenditure get much lower ranking once we account for industrial composition. Similarly, States like Uttarakhand and Jharkhand have higher rank after controlling for industrial composition. This implies that using the unadjusted measure of compliance would give a misleading picture of some of the States' relative stringency. Column 2 of the table gives adjusted abatement expenditure using 2-digit NIC classification. The ranking and values hardly change. The correlation between the two is 0.99. The table also indicates that there are nine States for which industry adjusted abatement expenditure is

been considered as UT only. In the present paper, though analysis includes but States and UTs, we have addressed them as States only.

[5] *In India, to reflect the popular sentiments, the official name of some of the States has been changed in recent past. For example, Pondicherry was renamed as Puducherry in 2006, Uttaranchal was renamed as Uttarakhand in 2007 and Orissa was renamed to Odisha in 2011. In the present study, we have referred them with their new names only, despite the fact that for most part of our data set, they were known by their earlier names.*

greater than one, this implies that they are spending much more than their industrial composition suggests.

Table 1: Adjusted vs. Unadjusted Abatement Cost Index, Averages 2001-2009

Statecode	State Name	Abatement Cost Index S* (3 digit)	Abatement Cost Index S* (2 digit)	Unadjusted Index, S
1	**Jammu & Kashmir (J&K)**	0.411	0.419	0.00201
2	**Himachal Pradesh (HP)**	0.309	0.284	0.00127
3	**Punjab (Pb)**	0.640	0.605	0.001934
5	**Uttrakhand (UK)**	1.568 **(4)**	1.469	0.005045
6	**Haryana (Hr)**	0.570	0.528	0.001081
8	**Rajasthan (Rj)**	1.077	1.099	0.005496
9	**Uttar Pradesh (UP)**	1.267	1.282	0.004616
10	**Bihar (Bi)**	0.098	0.104	0.000483
20	**Jharkhand (Jh)**	1.642 **(3)**	1.401	0.004923
21	**Odisha (Or)**	2.165 **(1)**	2.263	0.01251 **(1)**
19	**West Bengal (WB)**	1.447	1.476	0.00646 **(4)**
11	**Sikkim (Si)**	0.269	0.252	0.001755
13	**Nagaland (Na)**	0.002	0.001	0.000004
14	**Manipur (Ma)**	0.002	0.002	0.000013
16	**Tripura (Tr)**	0.000	0.000	0
17	**Meghalaya (Mg)**	0.829	0.789	0.00647 **(3)**
18	**Assam (As)**	0.062	0.069	0.000424
22	**Chhattisgarh (CH)**	1.287	1.242	0.005559
23	**Madhya Pradesh (MP)**	0.966	0.914	0.003674
24	**Gujarat (Gj)**	0.994	0.993	0.004878
27	**Maharashtra (MH)**	0.875	0.851	0.00291
30	**Goa (Go)**	0.388	0.390	0.001821
28	**Andhra Pradesh (AP)**	1.467 **(5)**	1.474	0.00643 **(5)**
29	**Karnataka (Ka)**	2.150 **(2)**	2.176	0.00715 **(2)**
32	**Kerala (Kl)**	0.911	1.023	0.003778
33	**Tamil Nadu (TN)**	0.663	0.691	0.002045
35	**Andaman & N. Island (ANN)**	0.000	0.000	0.000000
4	**Chandigarh (CG)**	3.223	2.910	0.007468
26	**Dadra & Nagar Haveli (DNH)**	0.091	0.086	0.000349
25	**Daman & Diu (DD)**	0.168	0.144	0.000431
7	**Delhi (DL)**	0.128	0.118	0.000206
34	**Puducherry (Po)**	0.097	0.082	0.000317
	Av. for lowest 5 states	0.035	0.033	
	Av. for highest 5 states	1.772	1.760	

Source: Own Computation

Table 2 gives trend of environmental stringency measure over three time periods: period 1 (2002 to 2004), period 2 (2005 to 2007) and period 3 (2008 to

2010). From Table 2, we can see that there are six States namely, AP, Punjab, Rajasthan, Odisha, Goa and Haryana which show increasing environmental stringency trend over the period. On the other hand, there are eight States namely, Assam, Chhattisgarh, Gujarat, Delhi, UP, Uttarakhand and Dadar & Nagar Haveli which started with high environmental stringency but over a period of nine years, they have become much laxed. Of the remaining states, eight States show declined value of index with increase in value in the middle period, whereas five States show improved stringency over 9 year period with decline in value of index in the middle period. The last row of the table gives average value of abatement index for the three periods, which indicates that there is hardly any change in environmental stringency across all the States overs the period.

Table 2: Adjusted Abatement Cost Index, Period wise Analysis

State	Period 1 (2002-04)	Period 2 (2005-07)	Period 3 (2007-10)	% Change from period 1 to 3	Environmental Stringency Pattern
AP	1.315	1.320	1.767	34.4	Increasing
Assam	0.071	0.067	0.049	-30.9	Decreasing
Bihar	0.149	0.070	0.077	-48.5	Declined
Chandigarh	3.932	3.959	1.779	-54.8	Declined
Chhattisgarh	1.379	1.298	1.184	-14.1	Decreasing
Dadra & Nagar Haveli	0.152	0.062	0.058	-62.0	Decreasing
Daman & Diu	0.228	0.133	0.142	-37.6	Declined
Delhi	0.179	0.135	0.069	-61.3	Decreasing
Goa	0.236	0.315	0.612	159.1	Increasing
Gujarat	1.115	1.016	0.850	-23.7	Decreasing
Haryana	0.479	0.571	0.659	37.6	Increasing
HP	0.218	0.193	0.516	136.2	Increased
Jharkhand	1.982	1.188	1.757	-11.3	Declined
Karnataka	2.286	2.410	1.754	-23.3	Declined
Kerala	0.886	0.932	0.916	3.4	Increased
MP	0.925	0.927	1.047	13.2	Increased
Maharashtra	1.049	0.883	0.693	-33.9	Decreasing
Manipur	0.000	0.000	0.006		Increased
Meghalaya	0.201	1.452	0.834	315.4	Increased
Odisha	1.555	2.273	2.669	71.7	Increasing
Puducherry	0.118	0.086	0.087	-26.4	Declined
Punjab	0.615	0.649	0.658	7.0	Increasing
Rajasthan	0.688	1.227	1.317	91.4	Increasing

Tamil Nadu	0.727	0.597	0.664	-8.7	Declined
Tripura	0.000	0.000	0.000		No-change
UP	1.500	1.153	1.149	-23.4	Decreasing
Uttarakhand	2.342	1.651	0.712	-69.6	Decreasing
WB	1.520	1.390	1.431	-5.9	Declined
Average	***0.923***	***0.838***	***0.927***	***0.4***	

Source: Own compilation

Figure 1 gives the plot for environmental stringency measure between two periods – period 1 and 3. States falling above 45 degree line indicates increased stringency whereas States falling below suggest decline in environmental stringency. As can be seen, barring Odisha and AP, for all other States, stringency of environmental governance has declined.

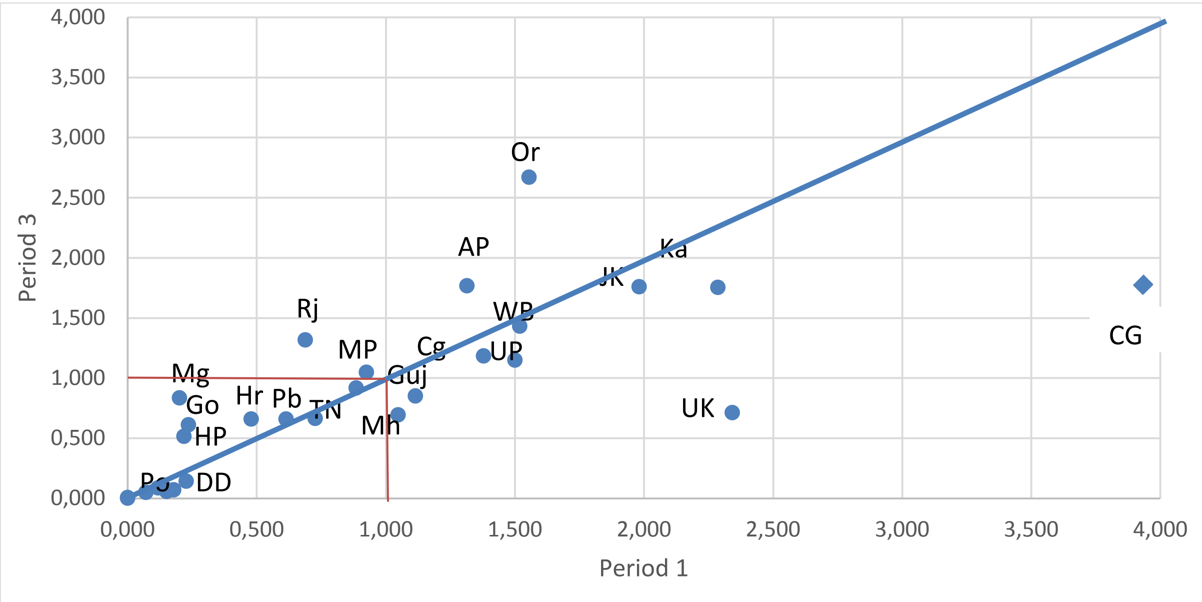

***Figure 1:** Change in industry adjusted abatement expenditure index (S*) - period 1 to 3*

Notes: CG, UK, DD, MH, WB, AP etc. are abbreviations for different states. For details, kindly see Table 1.

Interestingly, Figure 2, which gives scatter plot between *ln*FDI and lagged value of industry composition adjusted abatement cost index, does not indicate any perceptible relation between the two.

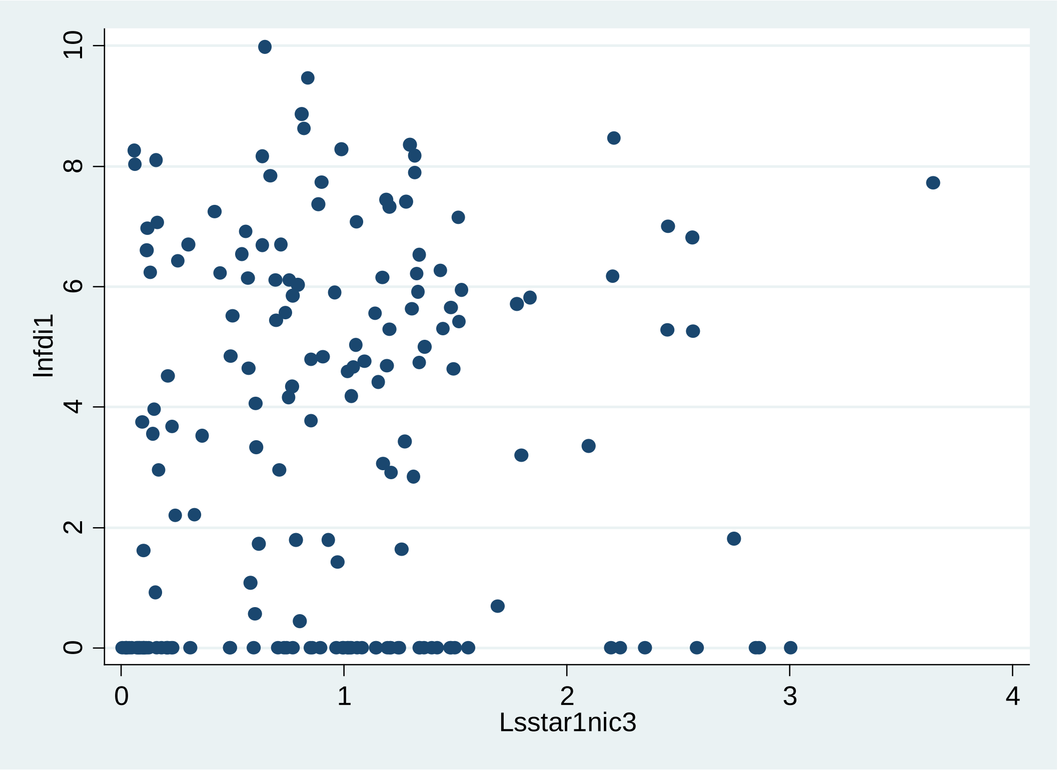

Figure 2: *Relation between* S^*_{t-1} *and lnFDI*

Table 3 gives the mean values of different variables used in the analysis. As can be seen from the table, there is huge variation in all the variables. There are states like Assam, Bihar and Jharkhand which have hardly received any FDI. On the other hand, Maharashtra tops the FDI recipient State with an average of Rs. 4,450 crore over this 9 year period. Similarly, share of manufacturing in NSDP is less than five per cent in Bihar against over 25 per cent in Gujarat, Goa and Puducherry. Regarding installed capacity, on one hand, we have Maharashtra, AP, Karnataka, Gujarat and TN which have more than 5000 MW of power generation each against States like Goa which does not produce any electricity. The northern States which are not receiving much FDI and have less electricity installation are also plagued with high T&D loss. On an average the four BIMARU (Bihar, MP, Rajasthan and UP) States account for 40 per cent T&D losses for the period. This may discourage FDI coming to these States.

Table 3: State-wise Descriptive Statistics (N=189)

State	FDI (Rs. Crore)	NSDP per capita (Rs.)	Mfrg share (%)	T&D Loss (%)	Installed Capacity (MW)	IEM Implemented (Rs. Crore)
AP	1235.72 **(5)**	22326.22	9.52	22.12 **(5)**	6898.51 **(2)**	988.33
Bihar	0.02	7791.111	4.40	41.08	598.98	11.44
Chhattisgarh	207.36	15894.67	15.07	31.75	1650.47	214.89
Delhi	1716.93 **(3)**	49469.5 **(1)**	7.61	37.26	883.87	1.33
Goa	66.18	47999.29 **(2)**	29.17 **(2)**	18.03 **(2)**	0.02	32.00
Gujarat	811.23	25429.13	25.56 **(3)**	28.10	5486.40 **(4)**	6202.11 **(1)**
Haryana	174.95	34153.44 **(4)**	16.89 **(5)**	32.76	2603.76	144.33
HP	97.13	27714.22	9.70	19.47 **(4)**	443.81	1114.33 **(4)**
Jharkhand	0.35	12981.88	21.71 **(4)**	47.13	1384.47	59.44
Karnataka	1253.97 **(4)**	22445.22	14.14	29.14	5188.08 **(5)**	438.11
Kerala	68.99	27237.88	6.92	27.51	2080.99	3.11
Maharashtra	4462.78 **(1)**	29185.33	16.57	33.59	10254.19 **(1)**	1297.22 **(3)**
MP	38.89	12899	7.51	42.42	3737.53	1571.56 **(2)**
Odisha	22.59	14562.78	10.76	46.91	2385.60	43.78
Punjab	2919.88 **(2)**	29484.78 **(5)**	13.00	23.60	4716.60	205.67
Puducherry	99.50	45540.67 **(3)**	50.98 **(1)**	13.83 **(1)**	32.83	12.56
Rajasthan	81.68	16441.44	8.72	40.40	3724.64	476.33
Tamil Nadu	695.85	24633.38	16.75	18.14 **(3)**	5620.21 **(3)**	694.89
Uttrakhand	3.18	20688.22	12.08	37.12	1160.33	510.89
Uttar Pradesh	132.97	11083.33	9.96	36.01	4721.37	1073.56 **(5)**
West Bengal	609.64	21032.89	8.28	28.70	4312.42	642.22
Average	699.99	24369.2	15.01	31.2	3232.62	749.43

Note: Figure in parenthesis are the top five ranked States for the variables.
Source: Own computation

6. Results and Discussion

Before estimating the model, we first see correlation between different control variables. Table 4 gives the spearman correlation matrix and also gives significance of the correlation coefficient at minimum 5 per cent level. We find that a State with higher NSDP per capita has high installed capacity (positively correlation), but has negatively correlation with high manufacturing share. A state with high installed capacity is not only able to attract more FDI (correlation being 0.55) but also more domestic investment (IEM) (correlation = 0.61) and is not having any correlation with T&D losses. Similarly, a coastal state gets high FDI (correlation = 0.36) with higher manufacturing share (correlation = 0.3). Consequently, with partial correlation being statistically significant for several variables, we could not use all the controlled variables together.

Table 4: Spearman Correlation Matrix

	*ln*FDI (Rs. Crore)	S^*_{t-1}	*ln*NSDPc (Rs. Crore)	Mfrg Share (%)	T&D Loss (%)	*ln*(Installed Capacity) (MW)	*Ln*(IEM Implemented) (Rs. Crore)	Coastal
***ln*FDI (Rs. Crore)**	1							
S^*_{t-1}	0.048	1						
***ln*NSDPc (Rs. Crore)**	0.339*	-0.441*	1					
Mfrg Share (%)	0.081	-0.005	0.402*	1				
T&DLoss (%)	-0.242*	0.315*	-0.664*	-0.356*	1			
***ln*(Installed Cap.) (MW)**	0.552*	0.456*	-0.089	-0.008	-0.004	1		
***ln*(IEM Imple) (Rs. Crore)**	0.357*	0.221*	0.052	0.0165	-0.018*	0.614*	1	
Coastal	0.363*	0.158*	0.310*	0.291*	-0.432*	0.324*	0.131	1

*Note: * indicates significance at minimum 5% level*

Econometric analysis

Table 5 reports the results for econometric estimations. We first estimated equation 5 by pooling the data for all the States (pooled OLS) (column 1, Table 5). As discussed, due to omitted variables, the OLS results will be biased, we need to use panel data techniques. Subsequently we ran both – fixed effect (FE) and random effect (RE) models. First we carry out an F-test to see whether individual FE exists or not. Since F value (5.41) is greater than the tabulated value, this implies we reject the null hypothesis (i.e., model is pooled OLS) and we need to estimate FE and RE models. Columns 2 and 3 of Table 5 give FE and RE estimates. Whether these omitted variables (state-specific differences) are fixed or random are tested using Hausman Test as given in the last row of Table 5. Since the tests statistic (3.44) is less than the critical value of a Chi-squared (1df, 5%) (3.84), we accept the null of RE being more efficient. To see whether RE exists, we carry out additional test i.e., Breusch-Pagan Lagrange-Multiplier test. As *LM* value (58.29) is larger than the critical value, we reject the null, thus there exists the individual random effect. Subsequently, we interpret only RE model (i.e., column 3).

Table 5: Testing for Pollution Haven Hypothesis (Dependent variable = *ln*(FDI))

VARIABLES	Pooled OLS (1)	FE (2)	RE (3)	Heteroskedastic panels corrected Standard errors (4)
S^*_{t-1}	-0.160	0.195	-0.0477	0.0492
	(0.306)	(0.416)	(0.348)	(0.259)

*ln*NSDPc	2.042***	0.872	1.849***	1.828***
	(0.184)	(3.409)	(0.396)	(0.186)
Mfrgshare	0.0347*	0.00909	0.0260	0.0321*
	(0.0205)	(0.0676)	(0.0353)	(0.0197)
T&D Loss	-0.103***	-0.0300	-0.0681**	-0.116***
	(0.0242)	(0.0374)	(0.0291)	(0.0211)
Coastal	0.546		0.936	0.499
	(0.472)		(0.816)	(0.435)
Constant	-15.76***	-5.381	-15.07***	-13.33***
	(2.290)	(36.50)	(4.438)	(2.136)
Time dummies	Yes	Yes	Yes	Yes
Observations	168	168	168	168
R-squared	0.52	0.112		0.512
F-test/Wald χ^2	27.09 (0.00)	1.55 (0.12)	16.1 (0.001)	216.65 (0.00)
Number of States		21	21	21
Hausman Test		2.32 (0.67)		

*Notes: ***, **, * indicates significance at minimum 1%, 5% and 10% significance level*
Source: Own computation

As can be seen from row 1, industry composition adjusted pollution abatement expenditure index (S*), though is negative, it is statistically insignificant, thus having no impact on FDI investment. This implies that States with more stringent environmental norms do not figure in the investment decision of foreign firms. With respect to control variables, a State having high per capita income (*ln*NSDPc), a reflection of bigger internal market, is able to attract more FDI. A high manufacturing share in the State does not ensure more FDI. On the other hand, availability of infrastructure as proxied by T&D losses has a direct bearing on foreign firms' location decision. A State with high T&D losses implies less power is available, thus foreign firms shy away from these states. The sign of Coastal dummy though is positive, it is not statistically significant in RE model.

The use of panel data with different variables showing change over time and consequently possibility of autocorrelation, necessitated the Wooldridge test for autocorrelation (where null is no first order correlation), which gives value of 2.09 with probability at 16% level. This indicates there does not exist autocorrelation. Pasaran CD (cross-sectional dependence) test is used to test whether the residuals are correlated across panels. Cross-sectional dependence (also called contemporaneous correlation) can lead to bias in tests results. The null hypothesis is that residuals are not correlated and is verified by the test results. We also carry out modified Wald test to test for group-wise heteroskedasticity. The chi-square value of 175.08 indicates the null of homoscedasticity (or constant variance) is rejected. Given the problems of heteroskedasticity, we subsequently correct for it using panel corrected standard errors (PCSE) model. The results are given in column 4 of Table 5. The coefficient values of S* and *ln*NSDPc retain the same sign and significance level even after the correction. Not only S*, all other control variables retain same sign and significance level except Mfrg Share which becomes highly significant. This suggests that a State with low T&D losses, more per capita income and more manufacturing share would attract more FDI. The environmental stringency does not influence foreign firms' decision when other infrastructure and market access related factors are available. In other words, our study does not validate the 'pollution haven hypothesis' in the case of Indian States.

Robustness Testing

In order to see whether results are robust to the inclusion of control variables, we carried out panel corrected heteroskedastic model after dropping control variables. Table 6 gives the results where some of the control variables are either dropped or alternate control variables are used. Column 2 (Model 2) reports the results when Coastal dummy is dropped and installed capacity (*ln*InstalCap) is used. The impact of environmental governance index (S*) variable remains same. Column 3 of the table (Model 3) adds investment implemented (*ln*IEM) to Model 2 and drops Mfrgshare. In column 4 (Model 4), we include only per capita income (*ln*NSDPc) and coastal dummy (Coast), whereas in Model 5, we use only the environmental governance index variable. In model 6 we use only State dummies and exclude all the control variables.

Table 6: Testing for robustness of results – Pollution Haven Hypothesis (Dependent Variable = *ln*(FDI))

VARIABLES	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
S^*_{t-1}	0.0492	0.25	0.49	0.49	0.22	0.18
	(0.259)	(0.313)	(0.32)	(0.32)	(0.33)	(0.313)
*ln*NSDPc	1.828***	2.93***	3.32***	2.38***		
	(0.186)	(0.89)	(0.90)	(0.46)		
Mfrgshare	0.0321*	-0.0097				
	(0.0197)	(0.027)				
T&D Loss	-0.116***	-0.046	-0.042			
	(0.0211)	(0.031)	(0.036)			
Coastal	0.499			1.47**		
	(0.435)			(0.76)		
ln(InstalCap)		0.916***	0.78***			
		(0.202)	(0.23)			
ln(IEM Imple)			0.233***			
			(0.102)			
Constant	-13.33***	-30.97***	-35.16***			
	(2.136)	(9.61)	(10.22)			
State Dummies	No	No	No	No	No	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	168	168	168	168	168	168
R-squared	0.512	0.39	0.46	0.34	0.41	0.74
F-test/Wald χ^2	216.65	49.31	68.8	82.36	21.96	2301.8
	(0.00)	(0.00)	(0.001)	(0.001)	(0.001)	(0.00)
Number of States	21	21	21	21	21	21

*Notes: ***, **, * indicates significance at minimum 1%, 5% and 10% significance level*

The sign and significance of environmental management index (S*) variable does not change in all the variants. The results are thus robust to non-inclusion of control variables. Results though not reported, we also use *ln*NSDP instead of *ln*NSDPc, but our main variable retains same sign and significance. Lastly, we re-estimate all the models after using S* computed at NIC 2 digit level, the results do not change. Our results also remain same irrespective of how we compute S* i.e., use of both Gross Closing Expenditure and Gross Addition Expenses on pollution abatement yield the same results. Based on the results, we can conclude that our study does not validate the 'pollution haven hypothesis' in the case of Indian States.

7. Conclusion

The present paper examined the role of environment governance on FDI (i.e., tested for Pollution Haven Hypthesis) for 21 States for the nine year period from 2002 and 2009. In order to test for the hypothesis, the study computed an abatement expenditure index adjusted for industrial composition at the State level using methodology given by Levinson (2001). The Industry adjusted abatement expenditure index indicates there are nine states for which industry adjusted abatement cost is greater than one. This implies that they are spending much more than their industrial composition suggests. Six States are increasingly more spending on abatement over the nine year period, whereas eight States show a decreasing pattern. For two States, Odisha and AP, abatement index shows not only higher value in 2007-09 period than 2001-03 period, but also is greater than one.

The paper then uses this industry composition adjusted pollution abatement expenditure index to test for pollution haven hypothesis in panel framework. The study finds that once we account for panel specific heteroscedasticity, environmental stringency does not influence FDI decision. Based on the analysis, paper concludes that a State with low T&D losses and more per capita income and manufacturing share would attract more FDI. The environmental stringency does not influence foreign firms' decision when other infrastructure and market access related factors are available. Subsequently, we test whether results are robust or not. This is done by either dropping the control variables or using alternate control variables in panel corrected heteroskedastic model. We find that the results are robust to inclusion of control variables. To conclude, our study does not validate the pollution haven hypothesis in the case of Indian States. Why our study could neither validate nor refute PHH? There are several possible reasons: first is though foreign firms establish operations abroad due to low operational cost, the relevance of pollution abatement cost vis-à-vis total operating cost may be highly limited (Erdogan, 2014). Second, even if this cost is high, this may be low as compared to other countries from where FDI is originating or alternate destinations. Therefore, it may not matter where to invest within a country. Third and last, studies have advocated that foreign firms generally seek consistent environmental enforcement and not lax enforcement (see for example, OECD, 1997). This may be true in the case of Indian States too.

The paper though comes up with important findings, has some limitations and can be extended to address these limitations. As mentioned, we had to rely on parliamentary questions to get State-wise FDI, which shows extremely high value of FDI for one State in 2006 (nearly 40% of total FDI received in the country). Moreover, the paper considers entire FDI inflow in the state. Instead of total FDI, only manufacturing FDI needs to be looked to see the effect of environmental governance. Another extension of present work would be testing pollution haven hypothesis only for polluting type FDI i.e., FDI in chemical or fertilizer sector. Lastly, if there is a race to bottom, instead of pollution haven hypothesis for Indian States, then FDI and environmental governance would be endogenous. The testing of which requires use of instrument variable estimations or GMM, thus a further extension of the present work.

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