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Does Environmental Regulation Matter?

Determinants of the Location of New Manufacturing Plants in India in 1994

Muthukumara Mani, Sheoli Pargal, and Mainul Huq

The costs attributable to complying with environmental regulation are not as important as other determinants of where Indian businesses locate new plants. The level of existing business activity overwhelms all other factors affecting location decisions.

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Summary findings

The cost of complying with environmental regulations has been cited as a major burden on businesses. Is it enough of a burden to influence where businesses locate new plants, which are not restricted in their choice of location?

Mani, Pargal, and Huq examine a unique establishment level dataset to find out whether the stringency of environmental regulation affects where firms locate new plants. Using a conditional logit model, they estimate the importance of different variables in plant location choice.

After controlling for the impact of factor price differentials, infrastructure, and agglomeration, they find that the number of new plants commissioned in different states of India in 1994 does not appear to be adversely affected by more stringent environmental enforcement at the state level. In other words, an environmental "race to the bottom" is unlikely.

They find that the level of existing business activity overwhelms all other factors affecting location decisions. Reliable infrastructure and factors of production are also critical.

This paper — a product of the Environment, Infrastructure & Agriculture Division, Policy Research Department — is part of a larger effort in the Department to study environmental regulation. Copies of this paper are available free from the World Bank, 1818 H Street NW, Washington DC 20433-0001. Please contact Evelyn de Castro, room N10-019x, telephone extension 89121, fax (202) 522-3230, internet address edecastro@worldbank.org (24 pages).

Does environmental regulation matter?
Determinants of the location of new manufacturing plants in India in 1994

by

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Introduction

The cost of complying with environmental regulations has been cause for complaint by businesses the world over. At the same time, the view that jurisdictions would compete to attract new investment by lowering environmental standards has led to much anguish over a possible environmental "race to the bottom". If these regulations are indeed as onerous as industry alleges, we would expect to find significant differences in the observed volume of new business activity across locations which vary in environmental stringency, ceteris paribus. Since new firms are not restricted in their choice of location by sunk costs, an examination of new firm location decisions would allow one to disentangle the impact of environmental regulations from other factors affecting the decision. This paper uses a unique establishment level dataset from India to test this proposition.

Following Schmenner's (1982) qualitative study of the factors motivating US businesses to locate where they do, existing empirical work has found mixed evidence of a locational impact of environmental regulation when comparing new business location choices across US states. Among the recent establishment level studies, Bartik (1985), Schwab and McConnell (1990), and Levinson (1995) have all followed Carlton (1983) in using conditional logit models to estimate the impact of different variables on firm profits as reflected in firm location decisions. Schwab and McConnell, analysing the US motor vehicle industry, find that at the margin, firms tend to avoid so called "non-attainment" areas where environmental enforcement tends to be tightest. Levinson (1995) finds evidence that new branch plants of large multiplant firms locate in states with the least stringent environmental regulations.

For developing countries, data has been sparse. For instance, a firm level study by Henderson and Kuncoro (1996) has analysed the centralization of manufacturing activity in Indonesia, but ignored the effects of regulation. In India the impact of environmental regulation on the spatial distribution of industry has not attracted much academic attention. Casual empiricism on state level competition for new investment has not been followed by rigorous studies of the phenomenon. Also, the focus of most work on

intergovernmental relations has been fiscal federalism rather than environmental performance, with Gupta (1996) being an important exception. Based on an inspection of secondary data, Gupta cannot conclude that states compete for investment by lowering environmental standards. He does not, however, preclude the possibility of states using environmental enforcement as a means of differentiation in order to attract new industry.

This is one of the first analyses of the impact of environmental regulations on locational choice in a developing country. We have information on all new industrial projects over the size of Rs. 500 million commissioned in India in calendar 1994. The large size of these investments makes it reasonable to suppose that they are relatively footloose. Our establishment level data also allows us to avoid problems of plant closings and expansions that inevitably contaminate more aggregate measures of new business activity. Finally, having information on "greenfield" investment is as close to ideal as it gets.

After controlling for the impact of factor price differentials, infrastructure, and agglomeration we find that the number of proposed new plants in different states of India is not affected by the stringency of environmental enforcement at the state level. Interestingly, plant location is significantly positively related to the level of environmental spending by the state government, which leads us to conjecture that this variable proxies other qualities of the state government rather than environmental stringency.

Restricting our analysis to five highly polluting manufacturing sectors[1], we found a more significant but positive impact of environmental enforcement on location, and a very strong positive effect of environmental spending. We conclude from this that the stringency of enforcement of environmental regulations certainly does not have an adverse impact on the relative attractiveness of different sites for industrial location, and thus that it is not as important for investors as other attributes of potential sites.

This paper is organized as follows. Section 1 briefly describes environmental regulation in India. Our basic model is described in section 2, and the factors affecting business location discussed in section 3.

[1] The five most polluting sectors identified here are chemicals, rubber, paper, metals and non-metallic mineral products.

Data sources and description are provided in section 4. Section 5 presents our results, with conclusions in section 6.

I. Industrial regulation in India

There is a basic division of power between the centre and the states in India, reflecting the federal nature of the Indian Constitution. The mandate of the Central Pollution Control Board (CPCB) is to set environmental standards for all plants in India, lay down ambient standards, and coordinate the activities of the State Pollution Control Boards (SPCBs). The implementation of environmental laws and their enforcement, however, are decentralized, and are the responsibility of the SPCBs. Anecdotal evidence suggests wide variations in enforcement across the states. In fact it has been argued (Gupta 1996) that although states cannot compete by lowering environmental standards, they can get around this by lax enforcement in order to attract new investment.

From the mid 1950s until 1991, when a major liberalization and economic reform program was launched, the central government effectively dictated the location and magnitude of private investment in India through the system of industrial licensing (Gupta 1996). Thus, although India has had stringent pollution regulation on the books for a couple of decades, and there is wide variation in the industrial climate across the country, firms may not have been able to factor these comparisons into their location decisions until fairly recently. After the removal of licensing controls, the pattern of new industrial investment reflects a rational response to expected profitability across states. To the extent that history and agglomeration effects matter, however, the inertia in the system may be insurmountable!

The two main pollution control statutes in India are the Water (Prevention and Control of Pollution) Act of 1974, and the Air (Prevention and Control of Pollution) Act which came into being in 1981. Parliament passed the Environment (Protection) Act in 1986. This was designed to act as umbrella legislation for the environment, with responsibility for administering the new legislation falling on the

Central and State Boards. Before 1988 enforcement was only through criminal prosecutions initiated by the State Boards and by restraint injunctions. Boards can now, however, force closure of non compliant plants, as well as cut off their water and power by administrative fiat (Gupta 1996).

II. Econometric specification

Our basic premise is that new firms are free to locate anywhere in the country and that they are profit maximizers. Since they are rational, location choice is conditioned by expectations of where production is likely to be most profitable: firms are assumed to locate where revenues are perceived to be highest and costs lowest.

The restricted profit function of a representative new firm, i, located in state j, can be written as: $\pi_{ij}(p_j, w_j; s_j) = p_j.y(p_j)-C(w_j,y;s_j)$, where p is output price, w is a vector of factor prices, y is output, s is a vector of location specific fixed factors and C is the cost of production. As usual, $\partial\pi/\partial p>0$, and $\partial\pi/\partial w<0$.

For large plants, such as those being analysed here, there is a single nationwide market. So we ignore possible variations in output price and market size in our study, and focus on regulatory and factor price differences across states. Naturally, we look also at immobile factors that affect production costs by changing the productivity and thus the effective price and availability of inputs across states.

Letting x represent the vector of input prices and state characteristics, our reduced form model for profits of firm i in state j is $\pi_{ij}=F(x_j)$. Following Carlton (1983), we assume a multiplicative specification for profits and formulate the empirical model as: $F(x_j)= \sum_m \ln(x_{jm})\beta_m$ where m refers to the mth characteristic of location j. Thus, $\pi_{ij} = \sum_m \ln(x_{jm})\beta_m + \epsilon_{ij}$ with ϵ_{ij} assumed independent of all ϵ_{ik}, $k\neq j$. For each firm, i, the choice of state j is made s.t. $\pi_{ij} \geq \pi_{ik}$ for all $k\neq j$, i.e. $\sum_m \ln(x_{jm})\beta_m + \epsilon_{ij} \geq \sum_m \ln(x_{km})\beta_m + \epsilon_{ik}$. Long run expected profits for firm i are maximized in the chosen state j.

Given that firms maximize profits, and assuming an iid Weibull distribution for the error term, location choice probabilities can be estimated using McFadden's (1974) conditional logit model. The

probability of choosing state j is given by $P_j = \exp F(x_j)/\sum_k \exp F(x_k)$, where k indexes the different possible locations available. Thus the marginal impact of a percentage change in factor m on the probability of locating in state j can be calculated as: $\partial P_j / \partial \ln x_{jm} = \partial P_j / \partial x_{jm} . x_{jm} = P_j(1 - P_j)\beta_m$.

The iid assumption for the error terms in the empirical specification above implies "the independence of irrelevant alternatives", which is difficult to assume for our model of location choice across states. We have hence included regional dummies in our model to account for the effect of correlated disturbances within regions. This is equivalent to the nested logit approach, and mitigates the impact of the "independence of irrelevant alternatives" restriction on predicted probabilities (see Bartik 1985 and Levinson 1995).

III. Factors affecting firm location choice

The following section briefly discusses the variables we have used in our analysis. Profits equal revenues minus costs, where revenues are determined by market size and the elasticity of demand. As mentioned above, the demand side is not expected to vary significantly with location since the plants under consideration are large and have sales all over the country.

On the cost side, input prices and quality are expected to have a major bearing on profits. We have used the state level manufacturing wage, and electricity price as the prices of two critical factors that vary widely across states. Since wages will also reflect the quality of human capital, we are agnostic about the sign of their net effect in the location decision. In addition, the quality of the labor force can be captured through two other variables: the middle school enrollment rate as a proxy for education levels; and the extent of work disruptions due to strikes and other labor disputes. Middle school enrollment appears to be more relevant for our analysis than literacy or percent college educated since industrial workers typically have completed secondary school. The costs of labor unrest are high and need to be controlled for in the

Indian context. Anecdotal evidence, for instance, suggests that the two communist ruled states (Kerala and West Bengal) are least attractive to business due to frequent labor disputes.

Population density is used as a rough gauge of land prices as well as an indicator of the magnitude of the possible damage caused by pollution. Both these factors would tend to make more densely populated areas less attractive to firms.

The quality and availability of infrastructure also affect overall costs and thus the profitability of enterprises. We have two variables measuring infrastructure: road density per square km as a measure of the transportation network and thus the cost and availability of materials inputs; and the proportion of electricity demand that is unfulfilled due to power shortages. Our expectation a priori was that firms are rationed in terms of power availability in India and thus that the level of power shortages would be a binding constraint on industrial activity.

Other costs of doing business come from regulations of every kind. While basic laws and tax levels do not vary across the country, the government has often sought to attract business through various forms of subsidies for locating in particularly poor or "backward" districts. Our data does not include enough plants located in backward areas to allow us to reliably determine the factors important in such plants' location decisions. Variations in regulatory costs can also come from the strength of enforcement and monitoring which differ from state to state and can be particularly sensitive to local conditions. In addition, state "development expenditure", which is aimed at improving living conditions, may result in a more attractive business climate.

The level of environmental regulation in different Indian states is measured by two variables: the share of spending for environment and ecology (excluding forestry and wildlife conservation) in total Plan expenditures; and the total number of environmental cases (under the Air and Water Acts) brought by each SPCB, normalized by the number of large and medium plants in the state.[2] The two variables are not

[2] The initiation of litigation is one of the few ways in which an SPCB can take action against non-compliant plants.

correlated, and appear to measure very different aspects of government activity. We were able to obtain SPCB expenditure figures for only 8 of the 14 states in our sample, so decided to use the normalized number of cases as a proxy for regulatory stringency. Plan spending on the environment can be used as an indicator of general interest in environmental issues, and, we feel, also, as an indicator of the general quality of government. In addition, we have used per capita state GDP to capture a host of other attractive factors including the average quality of government, the labor force, and infrastructure.

Finally, we include the value of total manufacturing activity in the state to proxy the advantages that result from feedback or agglomeration effects: firms locate where hubs of activity already exist.[3] These can result from a variety of interactions, including inter-firm technological "knowledge networks", the availability of appropriate business and government services in centres of activity over a particular size threshold, as well as standard complementarities and positive spillovers from using facilities and suppliers used by other plants. [4]

Summary statistics on the data used in our analysis are provided in Table 1 and the correlation matrix in Table 2.

IV. Data and estimation.

The data on business location decisions used in this study comes from the database of investment projects put together by the Economic Intelligence Service of the Center for Monitoring the Indian Economy (CMIE). This database lists all investment projects that entail a capital expenditure of at least Rs. 500 million. Of the 462 new manufacturing projects that were commissioned in 1994, the 418 projects in the 14 largest industrial states in India were used in this study[5]. The state-wise breakdown of these projects is listed in Figure I, and the sectoral breakdown in Figure II. The majority of new investment went

[3] See Arthur (1990).
[4] For some more detail see Henderson and Kuncoro (1996) and Wheeler and Mody (1992).
[5] There were 1300 new investment projects overall, but only 462 in the manufacturing sector. Of these, 44 were not considered because of non-availability of corresponding state-level data or location in Union Territories.

to the industrial states of Gujarat and Maharashtra. In terms of sectors, Chemicals, Metals, and Non-metallic Mineral Products dominated. Almost half of the proposed new plants belonged to industrial groups. There were 120 projects proposed to be located in backward districts, and 151 involving foreign technical collaboration.

Figure 1: Number of New Plants by State

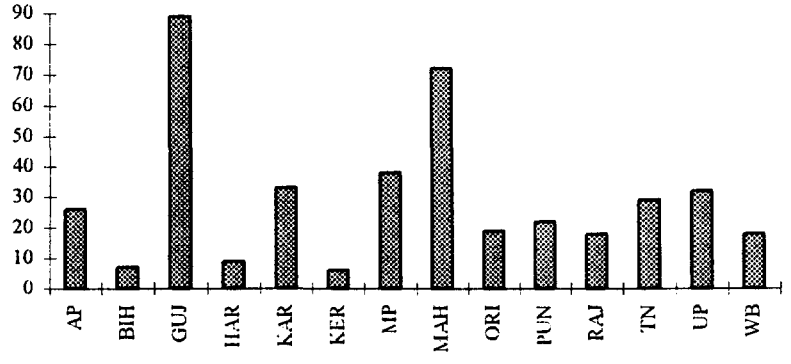
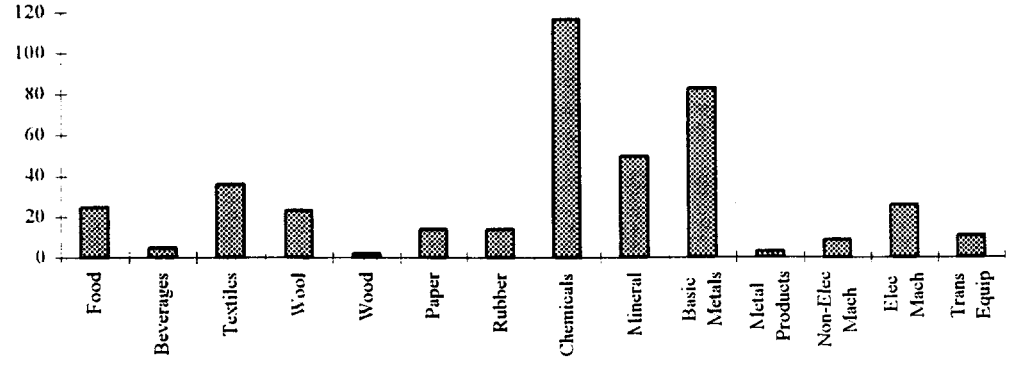


Figure 2: Number of New Plants by Sector



The aggregate industry data used in our study comes from the Annual Survey of Industries (1992-93) published by the Central Statistical Organization.[6] Data on the number of existing plants, value of

[6] This survey covers all plants registered under the Factories Act of 1948 that a)employ 10 or more workers and use power or b) employ 20 or more workers but do not use power, during the preceding 12 months.

manufacturing output, number of workers, and manufacturing wage by state were derived from this report. Data on labor disputes is obtained from the Bureau of Labor Statistics and relates to work-stoppages involving 10 or more workers that are exclusive of political or sympathetic strikes.

The variable used to measure power shortages is the shortfall in power supply in 1992-93 experienced by the states in relation to their actual requirements. The data on state-wise energy prices relates to the cost of generation and supply of power in paisa/kwh. All this information was obtained from the CMIE publication "Current Energy Scene in India".

Figure 3: Number of Man Days Lost Per Worker, 1993

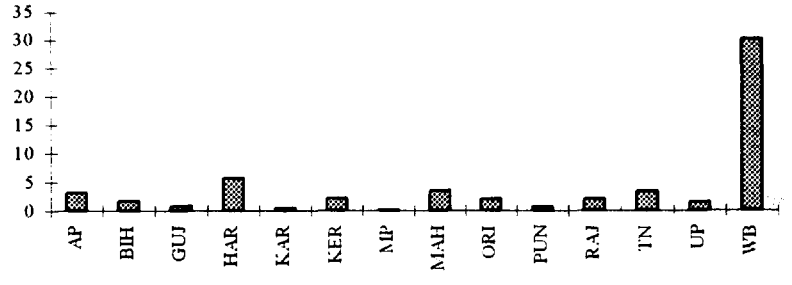
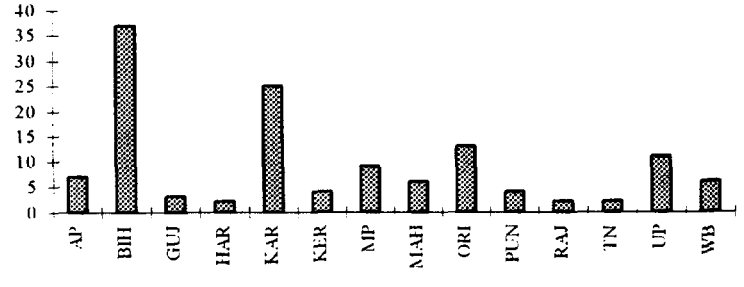


Figure 4: Percent Shortfall in Power Supply, 1993-94



Data on population, population density and literacy come from the population census of 1991. The education variable used is middle-school enrollment and was taken from a Planning Commission survey undertaken for the eighth five year plan. Information on road density was obtained from Gupta (1996). The data on state domestic product and state development expenditure were obtained from publications of the Ministry of Finance. Figure 5 illustrates the state-wise variation in income per capita which is calculated as per capita state domestic product.

Figure 5: Statewise Income Per Capita in Rupees, 1992-93

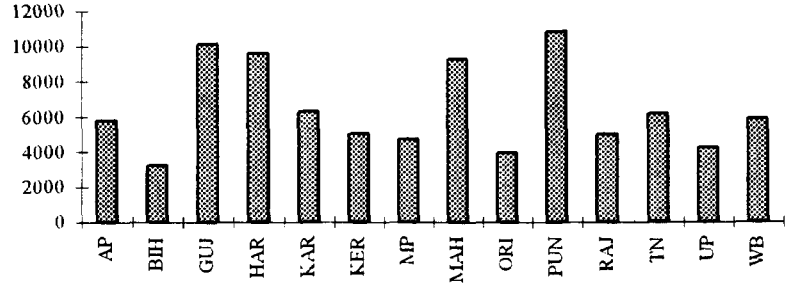


Figure 6 illustrates the variation in environmental stringency across states based on the number of cases filed by the SPCBs. The other indicator of environmental regulation available to us was the proportion of state Plan expenditure on "Environment and Ecology", which is distinct from the expenditures incurred by the SPCBs for enforcement as shown in Figure 7. Both sets of data were taken from Gupta (1996). Data sources are summarized in Table 3.

Figure 6: Percentage of Plants Involved in Environmental Litigation with SPCB's, 1992-95

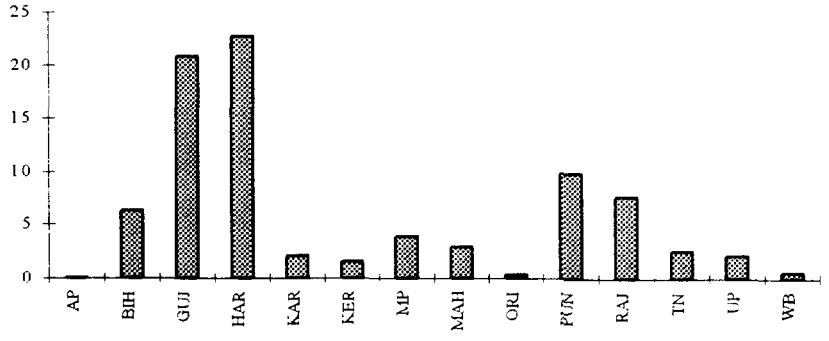
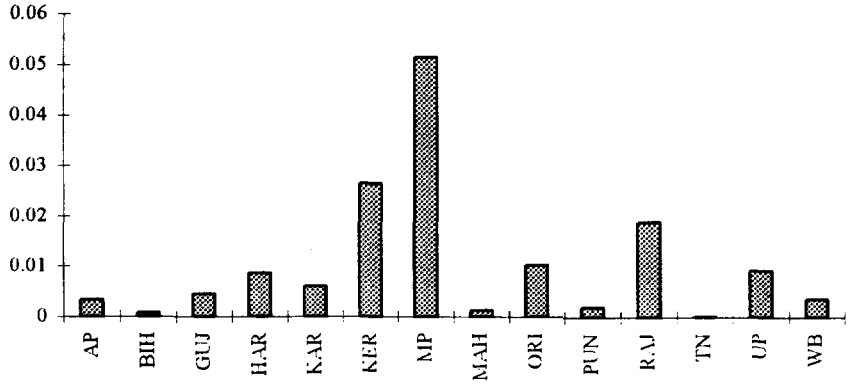


Figure 7: Percentage of Plan Expenditure Allocated for Environment in 1993-94



V. Results

a. Basic model

Our core model is presented in Table 4. The coefficients on factor prices are not significantly different from zero, indicating the low importance attached to them when choosing location. As expected, the sign on electricity price is negative. We interpret the positive sign on wage to indicate a willingness to pay for better trained manpower. Labor and energy input prices have not been found to be significant determinants of industrial location in the US either.

Interestingly, the coefficients on power shortages and mandays lost due to labor disputes are both significant and negative. This supports the hypothesis that it is power availability rather than price that is perceived to be a constraint by business. Also, the potential losses caused by a disruptive labor force appear to be more important in the cost calculus than the price of labor per se. It should be mentioned that Bartik (1985), Levinson (1995), and McConnell and Schwab (1990) all found a strong negative effect of union activity in their work on industrial location in the US.

Population density is negative and significant. This can be interpreted as a gross measure of the cost of land or the potential damage cost of polluting, but it is not really satisfactory as either when talking about entities as large as the states under consideration. As expected, plants prefer to locate in less densely populated areas. At the same time, there are strong agglomeration effects on the spatial distribution of industry as evidenced by the large and significant positive coefficient on the log of manufacturing output. Thus past governmental planning and licensing may well be the ultimate determinants of the pattern of manufacturing activity in India for decades to come!

State development spending per capita is highly correlated with per capita state domestic product (per capita income), and has an almost identical effect when included in the model in place of the latter. However, per capita income is a better reflection of the quality of government, infrastructure, and the labor force. Hence we use it in our analysis in preference to development expenditure. The coefficient on it is positive and significant, as expected.

The coefficient on the number of cases filed by the SPCB, normalized by the number of plants in the state, is positive but not significantly different from zero. This variable measures an important dimension of the stringency of enforcement of environmental regulation. Its lack of significance indicates that this is probably not an important factor in business decision making. At the same time, the other measure of environmental consciousness - the share of state Plan spending going to the environment - is positive and significant. This points to the possible existence of an underlying "good governance" factor

that is highly correlated with environmental spending, and which is attractive to investment. We conjecture that state governments that are efficiently run, with well-known, predictable rules are probably also those which are environmentally conscious -- but that from a business point of view, environmental costs pale before those of poor government.

The coefficient estimates on the three regional dummies - north, south, and west - are all significantly negative, indicating that after controlling for other factors, new investment rates are higher in the eastern region (Bihar, West Bengal, and Orissa) than elsewhere. This is a somewhat surprising result, but is robust to using any of the other regions as the excluded dummy.

We tried including road density in the model as a proxy for the quality of infrastructure in the state. But since it is highly correlated (0.69) with per capita income and also tended to absorb the effect of the latter, we dropped it from the regression. In addition, we had a strong prior belief that education levels would have a significant impact on plant location. Although education is not highly correlated with the other variables in the regression model, it had a very high standard error and inclusion led to a loss of significance for almost all other variables. Hence we decided not to retain it in the model.

In order to control for the magnitude of each project, we interacted the value of capital with dummies for each of the states (choices). Model II reported in Table 4 presents these results. West Bengal is the excluded choice in the estimation. Parameter signs in the core model remain unchanged, though the level of significance drops for some variables. In no case is the coefficient on capital significantly different from zero, indicating that investment size makes no difference to which factors affect the location decision.

b. Special cases

Overall, we find that our econometric results are fairly robust to alternative model specifications. We ran the core specification for different subsets of our data to assess whether particular groups found different factors more important than others. For instance, there has been speculation that firms with

foreign collaboration would be more sensitive to environmental regulation than others. We find no evidence of this. Interestingly, firms with foreign collaboration are significantly more likely to locate in high wage states: this could reflect the fact that projects involving foreign collaboration also require highly skilled manpower.

Our sample included too few public sector investment projects to obtain reliable econometric results, but we note that for the subset of the dataset consisting of public sector plants none of the variables described above was significantly different from zero, although the overall regression chi square statistic was significant at the 5% level.

Multiplant firms in the US are thought to search over a wide area to find the best location for a new plant, whereas single plant firms are usually located where the owner lives (Carlton 1983). Our results for multiplant firms indicate that their choice calculus is similar to that of single plant firms in most respects apart from the fact that electricity prices appear to be less important than for single plant firms. Again, there is little apparent sensitivity to the stringency of environmental regulation as measured by average prosecution levels.

Finally, we ran the core model for plants in the five sectors commonly considered to be the most polluting: chemicals, metals, non-metallic mineral products, paper, and rubber. Three things stand out: first, energy price is negative and very significant, suggesting that polluting sectors are very energy intensive. Next, the coefficient on per capita income is insignificant, and finally, environmental litigation now becomes significant but is still positive. Thus environmental regulatory stringency does not seem to play a major adverse role in influencing location decisions, even for the most polluting firms.

We estimated the marginal effects of a 1% increase in the different variables on the probability of locating in each state. Table 6 presents these results. For all states existing business activity, as measured by manufacturing output, has the largest marginal impact on location choice. A one percent increase in existing manufacturing output increases the probability of a new plant locating in Gujarat by 0.64,

Maharashtra by 0.58, and in Madhya Pradesh by 0.36, indicating the strength of agglomeration effects for these states. The share of environmental spending in state Plan expenditure, by contrast, has an impact on location probability of 0.09 in Gujarat, 0.08 in Maharashtra, and 0.05 in Madhya Pradesh. Location in these states is also more sensitive to labor disputes than others. For instance, in Bihar, West Bengal, and Orissa a one percent increase in labor disputes only causes a decline in the probability of their being chosen by new plants of 0.0002, 0.0004 and 0.0004 respectively. But in Gujarat, Maharashtra, and Madhya Pradesh the respective declines are 0.16, 0.15 and 0.10! The magnitudes and direction of the effect of power shortages are similar.

VI. Conclusions

This paper has used establishment level data to empirically analyse the determinants of firm location choice in India during 1994. Our results indicate the overwhelming importance of existing business activity as an attractive factor, supporting the thesis of spillover effects and agglomeration economies in location. At the same time, standard input prices and market related factors do play a role. From a policy perspective it is interesting that power availability, and not price, is the significant variable. Also, the losses due to labor unrest rather than the direct wage costs of labor are significant in our model. These determinants of location choice in India underline the importance of reliable infrastructure and factors of production in the business location decision.

In common with studies of business location in the US, our results do not support the proposition that businesses choose locations in response to differences in the stringency of environmental regulation across jurisdictions. It follows that the likelihood of an environmental "race to the bottom" in the Indian context is low. Further work is necessary to estimate the costs of compliance with regulations in India. It is clear from our study, though, that the costs imposed by environmental regulation are not large enough to overpower other costs of doing business and thus that they are not critical determinants of location choice.

Table 1: Summary Statistics

(Number of Observations: 5852)

Variable	Mean	Std. Dev	Min	Max
State manufacturing wage (Rs.)	25008.21	5560.517	15199	38478
Electricity cost (Paisa/Kwh)	111	23.00507	74	159
Power shortage (%)	9.357143	9.68592	2	37
Mandays lost due to labor disputes ('000s)	2207	4409.689	39	17666
Output (Rs.)	2507425	1778763	766321	7807251
Cases	416.2143	578.9563	5	2345
Plan environmental exp./Total Plan exp. (%)	0.0105	0.0134	0.0000977	0.0514
Per capita income (Rs.)	6462.357	2381.404	3280	10857
Population density (per sq. km)	367.751	194.0239	128.5651	766.1799

Table 2: Correlation Matrix

	Wage	Energy Costs	Power Shortage	Disputes	Output	Case per Plant	Plan Env. Exp./Tot. Plan Exp	Per Capita Income	Population Density	Road Density	Education
Wage	1.000										
Energy Costs	0.564	1.000									
Power Shortage	0.216	0.128	1.000								
Disputes	0.161	0.226	-0.292	1.000							
Output	0.243	0.280	-0.103	0.010	1.000						
Case per Plant	0.284	0.416	-0.332	-0.281	0.100	1.000					
Plan Env. Exp./Tot. Plan Exp	0.000	-0.355	0.040	-0.340	-0.488	-0.011	1.000				
Per Capita Income	-0.012	-0.090	-0.575	0.058	0.404	0.439	-0.191	1.000			
Population Density	-0.085	0.200	0.045	0.557	0.008	-0.098	-0.344	-0.030	1.000		
Road Density	0.040	0.287	-0.389	-0.079	0.594	0.542	-0.288	0.695	-0.126	1.000	
Education	-0.107	-0.165	-0.515	0.285	0.212	-0.096	-0.088	0.406	0.396	0.056	1.000

Table 3: Data Sources

Data	Source
Manufacturing Wage Bill (per state in '00,000 rupees), 1992-93	Annual Survey of Industries, 1992-93
Manufacturing Employment by state	Annual Survey of Industries, 1992-93
Energy Costs (paisa per kwh)1991-92	CMIE: Current Energy Scene in India, 1994
Power Shortage (percent), 1992-93	CMIE: Current Energy Scene in India, 1994
Industrial Disputes, (mandays lost in '000's), 1992	Bureau of Labor Statistics, 1994
Value of Manufacturing Output (in '00,000 rupees), 1992-93	Annual Survey of Industries, 1992-93
Environmental Cases Registered Against Plants (Air+Water), 1992-1995	Gupta 1996
Environmental Plan Expenditure (in millions of rupees), 1993-94	Gupta 1996, Planning Commission
Total Plan Expenditure (in millions of Rupees)	Economic Survey of India, 1994-95
Per Capita Income (in rupees), 1992-93	Economic Survey of India, 1994-95
Population Density, 1991	Population Census, 1991
Road Density (per '000 sq. kms) 1989	Gupta 1996, CMIE 1995
Education (percent enrolled in middle school),1992-93	Department of Education, 1992-93

Table 4: Conditional Logit Estimation (Core Models)

Independent variables (in logs)	Model I		Model II	
	Coefficient	T-Stat	Coefficient	T-Stat
Manufacturing Wage	0.874	1.879	0.223	0.368
Electricity Cost	-1.807	-1.902	-1.333	-1.169
Power Shortage	-0.703	-3.063**	-0.301	-0.976
Mandays lost due to disputes	-0.685	-3.702**	-0.300	-1.206
Output	2.670	5.93**	1.905	3.33**
Cases per Plant	0.053	0.485	0.121	0.878
Plan Env. Exp./Total Plan Exp.	0.373	3.849**	0.231	1.863
Per Capita Income	0.841	2.606**	0.485	1.209
Population Density	-0.463	-2.17*	-0.583	-2.179*
South	-2.640	-4.2**	-1.531	-1.942
West	-4.860	-4.45**	-2.720	-1.939
North	-3.101	-4.631**	-1.797	-2.104*
AP*CAP			-0.001	-1.289
BIH*CAP			-0.002	-1.005
GUJ*CAP			-0.0002	-0.74
HAR*CAP			-0.002	-1.309
KAR*CAP			-0.0001	-0.399
KER*CAP			-0.001	-0.735
MP*CAP			-0.0004	-1.047
MAH*CAP			-0.0005	-1.272
ORI*CAP			4.98E-06	0.012
PUN*CAP			-0.0002	-0.535
RAJ*CAP			-0.001	-1.214
TN*CAP			-0.0003	-0.731
UP*CAP			-0.0002	-0.463
Log Likelihood	-996		-992	
Chi Square	213		222	
Prob. Chi>0	0.000		0.000	
Pseudo R2	0.09		0.10	
Observations	5852		5852	

** significant at 1% confidence level

* significant at 5% confidence level

Table 5: Conditional Logit Model (Special Cases)

Model	Multiplant Firms		Plants with Foreign Collaboration		Public Sector Plants		Polluting Sector Plants	
Independent Variables (in logs)	Coefficient	T-Stat	Coefficient	T-Stat	Coefficient	T-Stat	Coefficient	T-Stat
Manufacturing Wage	1.553	1.894	2.479	2.534**	-0.465	-0.311	0.607	1.121
Electricity Cost	-0.692	-0.393	-3.675	-2.195*	-2.741	-0.686	-3.716	-3.137**
Power Shortage	-0.777	-1.921	-1.401	-2.831**	-0.448	-0.757	-0.788	-2.977**
Mandays lost due to disputes	-0.924	-2.816**	-1.107	-2.889**	0.017	0.031	-0.569	-2.577**
Output	3.707	5.165**	3.830	4.506**	1.584	0.75	3.571	6.325**
Cases per Plant	0.028	0.149	0.072	0.336	0.346	0.736	0.324	2.243*
Plan Env. Exp./Total Plan Exp.	0.578	3.803**	0.517	2.748**	0.0780	0.218	0.452	3.744**
Per Capita Income	1.262	2.053*	0.900	1.498	0.312	0.274	0.152	0.353
Population Density	-1.136	-2.241*	-0.223	-0.59	0.286	0.423	-0.834	-3.102**
South	-3.345	-3.254**	-4.121	-3.564**	-2.452	-0.916	-3.720	-5.014**
West	-6.794	-3.779**	-7.770	-3.675**	-3.186	-0.682	-6.550	-4.919**
North	-3.826	-3.514**	-4.680	-3.701**	-3.382	-1.258	-4.269	-5.241**
Log Likelihood	-447		-348		-87		-653	
Chi Squared	165		99		21		161	
Prob. Chi>0	0.00		0.00		0.048		0.000	
Pseudo R2	0.15		0.12		0.10		0.10	
Observations	2814		211 4		518		3892	

****significant at 1% confidence level**

*** significant at 5% confidence level**

Table 6: Marginal impact on location probability of a 1% change in different factors

State	Percent of new plants	Estimated probability of locating in the state	Wage	Power shortage	Electricity cost	Value of manfg. output	Population density	Mandays lost due to disputes	Plan environmental Exp. /Total Plan Exp	Cases per plant	Per capita income
AP	0.0622	0.0112	0.0109	-0.0088	-0.0226	0.0334	-0.0058	-0.0086	0.0047	0.0007	0.0105
BIH	0.0167	0.0007	0.0002	-0.0002	-0.0004	0.0007	-0.0001	-0.0002	0.0001	0.0000	0.0002
GUJ	0.2129	0.2313	0.2097	-0.1686	-0.4332	0.6402	-0.1111	-0.1642	0.0896	0.0128	0.2018
HAR	0.0215	0.0021	0.0058	-0.0047	-0.0120	0.0178	-0.0031	-0.0046	0.0025	0.0004	0.0056
KAR	0.0789	0.0075	0.0138	-0.0111	-0.0285	0.0421	-0.0073	-0.0108	0.0059	0.0008	0.0133
KER	0.0144	0.0005	0.0026	-0.0021	-0.0054	0.0080	-0.0014	-0.0020	0.0011	0.0002	0.0025
MP	0.0909	0.0193	0.1230	-0.0989	-0.2542	0.3757	-0.0652	-0.0963	0.0526	0.0075	0.1184
MAH	0.1722	0.5281	0.1911	-0.1537	-0.3949	0.5836	-0.1013	-0.1497	0.0817	0.0117	0.1840
ORI	0.0455	0.0002	0.0006	-0.0005	-0.0012	0.0017	-0.0003	-0.0004	0.0002	0.0000	0.0006
PUN	0.0526	0.0172	0.0147	-0.0118	-0.0303	0.0448	-0.0078	-0.0115	0.0063	0.0009	0.0141
RAJ	0.0431	0.0029	0.0121	-0.0098	-0.0251	0.0370	-0.0064	-0.0095	0.0052	0.0007	0.0117
TN	0.0694	0.1680	0.0121	-0.0097	-0.0250	0.0369	-0.0064	-0.0095	0.0052	0.0007	0.0116
UP	0.0766	0.0104	0.0210	-0.0169	-0.0434	0.0641	-0.0111	-0.0164	0.0090	0.0013	0.0202
WB	0.0431	0.0005	0.0005	-0.0004	-0.0011	0.0017	-0.0003	-0.0004	0.0002	0.0000	0.0005

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