Mineral Resource Endowments and Investment Destinations: A Panel Data Analysis of Indian States

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ABSTRACT

This study examines the role of mineral resources in the concentration of investment in states in India. It computes the mineral resource abundance of states, and analyse whether their resource endowment played any role in attracting investment between 2006 and 2012. The study finds that states with abundant mineral reserves attract more proposed investment, and that resource abundance does not impact actual investment. Proposed investment is concentrated into highly populated low income states, while actual investment is concentrated into states with large market size. Among transport facilities, port facilities are an important determinant of proposed investment.

1 INTRODUCTION

Minerals are one of the important factors of production for both resource-based manufacturing industries and power-generating industries. Industries/plants prefer to locate in regions/states abundant in resources to minimise cost of production. For instance, in the late 19th and 20th centuries in the US, manufacturing industries were located near regions abundant in resources and labour supply (Ellison and Glaeser 1999; Klein and Crafts 2012). Immobile factors of production (such as mineral resources) are, however, categorised as one of the centrifugal forces that disperse the agglomeration of industries into different regions (Krugman1999).[1] One of the seminal papers by Krugman (1991) demonstrates that large local markets and availability of inputs in a region attract manufacturing industries, and immobile factors are the forces opposing concentration. The theoretical literature on the New Economic Geography (NEG) theory focuses mostly on market size effects (forward and backward linkages) that attract the concentration of industries, and gives immobile factors of production less importance.

Mostly, empirical studies on developed and developing countries on the location of investment within a country use factors such as market size, labour, energy prices, transport, pollution abatement cost, etc. to determine the location of foreign branch plants (Keller and Levinson 2002; List and Co 2000; Chen-Hsun Chen 1996; Mani et al. 1997; Mukim and Nunnenkamp 2012) and aggregate investment into states (Glickman and Woodward 1988; Sun et al. 2002; and Wei et al. 1999). Pelegrin and Bolance (2008) capture the comparative advantage of regions/states by using the employment specialisation index for each sector in a given region. They use data on 17 regions in Spain between 1995 and 2000 and examine the role of agglomeration economies as locational determinants across industries. They find that, first, industries with high linkages were attracted to regions with high manufacturing activity; second that locations that accumulate research and development activities attract chemical industries; and third endowment led to the localisation of cost-oriented industries.

Only a few studies include immobile factors of production in their analysis. Bartik (1985) and Coughlin et al. (1991) use land area, among other state characteristics, as a proxy of potential sites for foreign investment into US states. They find potential sites an important determinant of foreign investment. A recent cross-country study (Poelhekke and Ploeg 2013) that examines the role of natural resources on resource and non-resource outward foreign investment from the Netherlands to 183 host countries between 1984 and 2002 finds that resource FDI is related positively with mineral resources of countries and negatively with per capita GDP. Resource discovery in countries that are not resource producers earlier causes non-resource FDI to fall.

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[1] Other centrifugal forces include immobile factors, land rents, and pure external diseconomies (Krugman 1999).

The empirical literature that analyses the locational determinants of investment does not adequately explore the importance of the abundance of mineral resource in states; and no study considers regional disparities in mineral resource deposits within the country and their impact on the concentration of investment. This is especially true for India.

India is mineral-rich, and leads the world in the production of many minerals (excluding crude petroleum, lead, mica, apatite and rock phosphate, and magnesite) (Indian Yearbook, various years), but the distribution of mineral deposits is not uniform throughout the country. Mineral resources are abundant in only a few states, several low income and middle income states have abundant reserves of coal, iron ore, and bauxites.

A review of the data on industrial investment in India between 2006 and 2012 shows an increasing trend in both proposed and actual investment. Between 2006 and 2012, proposed investment grew at 7.7 per cent per annum on average and actual investment grew at 5.6 per cent per annum between 2006 and 2011 on average.[2] But the spatial distribution of investment was not uniform throughout the country. Mineral-rich states attracted more proposed investment, while actual investment is relatively lower in these states. This erratic pattern of investment raises an important question: Do the mineral resources of Indian states play any significant role in attracting investment?

Quite a few studies examine the characteristics of Indian states where foreign firms have located plants (Mani et al. 1997; Mukim and Nunnenkamp2012). Mani et al. (1997) examine the impact of state characteristics (including environmental regulations) on location of foreign branch plants in states in 1994, and find reliable infrastructure and manufacturing wages to be important factors in attracting FDI. Mukim and Nunnenkamp (2012) analyse the decisions of foreign MNCs to invest in Indian districts during the post-reform period (1991–2005) and find that foreign investment is moving towards urban districts, and the districts with educated population and pro-business labour regulations. Several studies analyse the characteristics that attract investment in plants, but not the role of mineral resources in the concentration of investment. This study tries to fill that gap.

This study computes the mineral resource abundance of states and other characteristics, and analyses the impact of these state characteristics on the concentration of investment between 2006 and 2012. Since proposed investment in India is relatively higher than the actual investment, this study examines the role of state characteristics on the concentration of both proposed and realised investment in India.

The rest of the study is structured as follows. Section 2 discusses the empirical model used in the study. Section 3 describes the sources of data. Section 4 explains the pattern of

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[2] In Gujarat, actual investment increased dramatically in 2012.

investment and state characteristics. Section 5 discusses the empirical results. Section 6 concludes the paper.

2 EMPIRICAL MODEL

The literature highlights that state characteristics determine the geographic concentration of investment within a country. To examine the flow of aggregate private investment into Indian states, this study uses a model similar to the one Poelhekke and Ploeg (2013) used in examining the effect of natural resources on resource and non-resource outward FDI from the Netherlands to 183 host countries between 1983 and 2002. This study examines the role of mineral resources in the concentration of investment in states in India between 2006 and 2012. The study models investment in state '*s*' in year '*t*' as a function of several state characteristics including mineral resource endowment. Our empirical model is described as follows.

$$\ln(\Pr oInv_{st}) = \alpha_0 + \beta_1 \ln port_{st} + \beta_2 \ln Rail_{st} + \beta_3 \ln Road_{st}$$
$$+ \beta_4 \ln Pop_{st} + \beta_5 \ln PcNSDP_{st} + \beta_6 Skill_{st} + \beta_7 MineralRes_{st} + \varepsilon_{st}$$
(1)

$$\ln(\operatorname{Re} Inv_{st}) = \delta_0 + \delta_1 \ln port_{st} + \delta_2 \ln Rail_{st} + \delta_3 \ln Road_{st}$$
$$+ \delta_4 \ln Pop_{st} + \delta_5 \ln PcNSDP_{st} + \delta_6 Skill_{st} + \delta_7 MineralRes_{st} + \varepsilon_{st}$$
(2)

In equation (1), the dependent variable is proposed investment in state 's' in year 't'. In equation (2), the dependent variable is realised investment in state 's' in year 't'. In both equations, the dependent variable represents the investment made by domestic firms and foreign firms through their Indian subsidiaries. The right hand side of equations (1) and (2) is the same, and includes state characteristics attracting both domestic and foreign investment.[3]

Broadly, state characteristics consist of transport linkages, market potential, skill endowment, and mineral resources. The transport facilities included in the model are ports, railway density, and road density. Better transport facilities smoothens the movement of goods within and outside the country (exports and imports). Therefore, the coefficients of ports, rail, and roads are expected to be positive and significant. Port facility is measured by cargo handled at major and minor ports in state 's' in year 't'. Rail represents rail density and is measured by rail length in kilometer per 1000 square kilometers on land area of state 's' in year 't'. Similarly, road represents surface road density of highways, measured by surface road length in kilometers per 1000 square kilometers of land area of state 's' in year 't'. Our

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[3] Empirical studies find that the same state characteristics attract domestic and foreign investment (Glickman and Woodward 1988).

definition of rail and road density is consistent with that in Bartik (1985), Coughlin et al. (1991), Chen (1996), Keller and Levinson (2002), and in several other studies.

The market potential of regions/states is one of the important centripetal forces of industrial attraction (Head and Mayer 2004; Krugman 1991). In this study, market potential is captured by the log of population of state 's' in time period 't' and the log of per capita net state domestic product (NSDP) of state 's' in year 't'. The coefficients β_4 and β_5 are expected to be positive and significant.

The rest of the explanatory variables pertain to the factor endowment of states. The study considers the endowment of skilled manpower in states and reserves of mineral resources. Pelegrin and Bolance (2008) measure the skill endowment of states by two proxy variables: (1) the share of labour force having completed secondary education and (2) the share of labour force having completed higher education. There is no data on the supply of labour with professional education over the sample period; therefore, this study measures skill endowment by enrolment in professional education courses in state 's' in year 't'.[4] High-technology industries prefer to invest in regions/states with a pool of highly educated labour (Pelegrin and Bolance2008). Therefore, the coefficient β_6 is expected to be positive and significant.

Poelhekke and Ploeg (2013) capture the abundance of mineral resources by three variables: combined value of natural resource rents of oil, gas and coal; combined value of natural resource rents excluding oil, gas, and coal; and total oil, gas, and coal reserves in countries. This study measures mineral resource endowment of states through two indicators: (1) value of reserves and (2) quantity of important minerals reserves in each state. The data on value of reserves, which is not available, is calculated by multiplying the per unit price of mineral (computed from the production data of minerals) with the quantity of mineral reserves in each state (Appendix 2 details the methodology). The second indicator includes the volume of reserves of three main minerals (coal, bauxite, and iron ore) used extensively as an input in manufacturing industries. The study computes the share of mineral 'm' in state 's' in total reserves of mineral 'm' in India in year 't'. Data on mineral reserves are available for 2005 and 2010 only. Therefore, for the purpose of this variable, the compound annual growth rate (CAGR) is used for calculating the reserve volume for the remaining periods. The coefficient β_7 is expected to be positive and significant. Appendix 1 presents the summary of variables.

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[4] Courses in professional education include engineering/technical, medicine, agriculture, veterinary science, law, etc.

3 DATA SOURCES

Data on investment by state is obtained from Secretariat for Industrial Assistance (SIA) statistics, Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce. The SIA statistics provides state wise information on proposed investment (Industrial Entrepreneur Memorandum (IEM) filed) and actual investment (IEM implemented). The IEM is an application that an investor requires to submit for making an investment in excess of Rs 100 million in the manufacturing sector and Rs 50 million in the service sector. The sectors should be exempted from the requirement of license. An investor must apply to the SIA to propose investment (IEM Filed) and also before starting construction (IEM Implemented). This study collected data on IEMs filed as well as implemented by state from 2006 onwards as the data for earlier years are not available on the DIPP website.

Data on state characteristics are obtained from a variety of sources. Data on cargo handled at major and minor ports are obtained from Port Statistics, Ministry of Shipping, Road Transport and Highways. Statistics on railways are obtained from Indian Railways Yearbook, Ministry of Railways, and data on roads are obtained from Basic Roads Statistics in India, Ministry of Shipping, Road Transport and Highways. Data for the period on enrolment in professional courses, used as proxy for skill intensity, are obtained from the Statistical Abstract of India. Data on population by state during the sample period are obtained from the EPW Research Foundation. Statistics on reserves and production of minerals by state for various years are obtained from the Indian Mineral Yearbook.

4 INVESTMENT LOCATION AND STATE CHARACTERISTICS

This section highlights the location of industrial investment and characteristics of states. It categorises states/union territories by per capita NSDP into high income, middle income, and low income. The states surrounded by hills are kept into separate category. Investment is concentrated in a few states in each category; therefore, for the purpose of analysis, this section selects the three states in each category that have received the most investment. Gujarat, Maharashtra, and Tamil Nadu received the most investment in the high income category; Andhra Pradesh, Karnataka, and West Bengal in the middle income category; Odisha, Chhattisgarh, and Madhya Pradesh in the low income category; and Uttarakhand, Himachal Pradesh, and Assam received the most investment in the hilly states category.

Figures 1(a) and 1(b) show the patterns of proposed and realised investment over the 2006–12 period through three-period moving averages of share of investments for each group of states in total proposed and realised investment, respectively.[5]
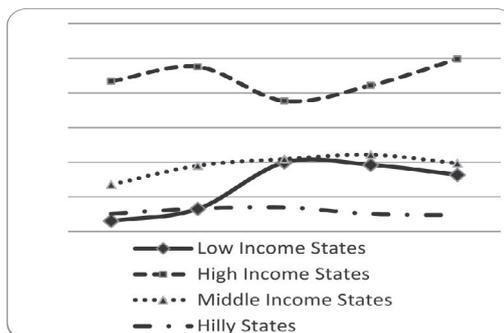
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[5] The study took three period moving averages to control for the annual fluctuations.

Figure 1 (a) Share of proposed Investment in different groups of states into total proposed investment in India
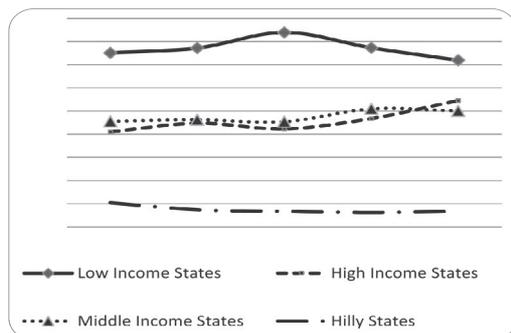
Figure 1 (b) Share of realised Investment in different groups of states into total realised Investment in India

Source: Authors' calculation

Source: Authors' calculation

Table 1 shows average investment over the 2006–12 period and average state characteristics over the 2005–11 period. Panel A in Table 1 shows proposed and realised investment, and Panel B covers various state characteristics. Proposed and realised investments are share of investment in each state in total proposed and realised investment, respectively, in India in the given year. The definitions of state characteristics are detailed in Appendix 1.

Table 1 Average investment and state characteristics (2006–2012)

Variable	Units	High Income States	Middle Income States	Low Income States	Hilly States
A Investment					
Proposed investment	%	8.09	8.0	12.17	0.50
Realised investment	%	15.56	5.73	3.31	1.67
B State Characteristics					
Port	cargo handled at ports in 000 tonnes/TEUs	152,334	61,547	15,608	-
Rail density	rail length in km per 1000 sq km of land area of states)	25.43	26.34	13.33	13.87
Road density– surface road	road length in km per 1000 sq km of land area of states)	5.11	4.00	2.33	3.27
Population	in 000'	77,444	76,065	44,701	15,297
Skill generation	enrolment in professional courses per 000' of population	5.40	3.25	4.75	2.83
Reserve value	in Rs. billion (at 2004-05 prices)	12,500	16,100	18,800	278
Coal reserve	million tonnes	22	15,900	43,300	133
Bauxite reserve	million tonnes	128	222	703	0
Iron ore reserves	million tonnes	257	3,826	2,880	9

Source: Authors' calculation

4.1 Locational Choice of Investment in India

The total proposed investment in India increased from Rs 5,395 billion in 2006 to Rs 10,496 billion in 2011, but declined in 2012 to Rs 3,706 billion (at 2004–05 prices). The pattern of proposed investment over 2006–12 shows that largest amount of investment was proposed in low income states followed by high income, middle income, and hilly states (Figure 1a). During 2006 to 2012, the average investment proposed in low income states was significantly higher in Odisha, at Rs 1,417 billion, and in Chhattisgarh, at Rs 1,229 billion (at 2004–05 prices). In the high income states category, the maximum investment was proposed in Gujarat (Rs 916 billion) and Maharashtra (Rs 720 billion). In the middle income states category, Andhra Pradesh and Karnataka received the highest proposed investment, Rs. 753 billion and Rs. 717 billion (at 2004-05 prices), respectively.

The average proposed investment between 2006 and 2012 was concentrated mostly in low income states, but realised investment was highest in high income states (Figure 1(b)), perhaps because these states provide good governance, infrastructure and education level (Ghosh 2012).

4.2 Characteristics of States

Transport facilities in high income and middle income states are better than in low income and hilly states; they rank higher on all three infrastructure indicators—port facility, rail density, and road density. The rank correlation between per capita NSDP and various transport facilities (except rail density) shows similar results in all states; as state income increases, transport facilities improve (Appendix3). Market size (as shown by population) is higher in these states than in low income and hilly states. However, many low income states (not included in this exercise) are highly populated (such as Uttar Pradesh, Bihar, West Bengal, etc.), and this makes the group highly populated if all the states in this category are taken into account. As far as human capital is concerned, skill generation is maximum in high income and low income states. In the case of mineral resources, low income states are relatively abundant in reserves than high income states.

In sum, low income states are rich in mineral resources. Enrolment in professional courses is higher in these states, so these are more effective in skill generation. These states also have the largest proposed investment. Actual investment is higher in high income states, which have better transport facilities and a pool of highly educated professionals. To see whether these characteristics play any role in attracting private investment, the next section presents the results of econometric equations (1) and (2).

5 ESTIMATED RESULTS

Regression results of equation (1) and (2) are provided in Tables 2 and 3, respectively. The results are represented in four columns R1–R4 of Table 2 and Table 3. Columns R1 and R2

represent results of equations (1) and (2) using different variables for mineral resources—real value of mineral resources (R1) and share of volume of coal, bauxite, and iron ore reserves of a state in total reserves of these minerals (R2). In columns R3 and R4, port facilities of states are shown by two variables—log of cargo handled at ports per TEU (R3) and a binary variable (R4). Binary variable is 1 for the states with ports (minor or major) facilities, and 0 for others.[6]

Two techniques are widely used for estimating panel data—fixed effect and random effect. For each specification in Tables 2 and 3, the study has conducted the Hausman test to find out the best estimation technique for equations (1) and (2). The results of the Hausman test suggest the random effect model in all cases. Also, the data of two variables for transport linkages—rail density and road density—do not change over the period for many states. Hence, the study uses the random effect model to estimate equations (1) and (2).

As shown in Table 2, the dependent variable in regression results is the log of real proposed investment in states. In all the four specifications, the market size of states, as represented by the log of state population, is positive and significant, which indicates the concentration of industrial investment in states with large markets. However, per capita NSDP is negative and highly significant, which indicates that states with low per capita income attract more proposed investment. This result is not surprising for proposed investment, as the concentration of investment is higher in low income states that have huge mineral reserves. It can be inferred that these states attract more resource investment than non-resource investment which, by nature, is not market seeking. A cross-country study by Poelhekke and Ploeg (2013) has also found similar results that low income countries attract more resource FDI than non-resource FDI.

Our principal variable, mineral resource abundance of states, when measured by using real value of reserves in states, is positive and significant in column R3 only. This implies that mineral-rich states attract more investment. When considering reserves of important minerals—coal, iron ore, and bauxite—separately, the study finds that states with abundant reserves of coal and iron ore attract more proposed investment (column R2 and R4). A one percent increase in the share of coal and iron ore reserves increases proposed investment by 13 per cent and 5 per cent, respectively.

Among transport linkages, the coefficient of port facility is positive and significant. This indicates that states with large ports attract industrial investment, due to linkages with other countries. The coefficient of skill intensity of states is positive and significant, although the magnitude of impact on proposed investment is very small.

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[6] The states that have ports are Andhra Pradesh, Goa, Gujarat, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu, and West Bengal.

Table 2 Regression results 1

Dependent variable is log of real proposed investment in state s in year t.

Variables	R1	R2	R3	R4
ln(port)	0.125*	0.138**		
	(0.0720)	(0.0646)		
Port dummy			1.107	1.258*
			(0.835)	(0.763)
ln (rail density)	0.446	0.204	0.458	0.201
	(0.295)	(0.248)	(0.298)	(0.250)
ln (road density)	0.0815	0.0692	0.0868	0.0741
	(0.0756)	(0.0767)	(0.0760)	(0.0772)
ln (population)	0.552*	0.802***	0.562*	0.834***
	(0.314)	(0.282)	(0.318)	(0.283)
ln (per capita NSDP)	-1.315***	-1.239***	-1.273***	-1.196***
	(0.464)	(0.458)	(0.463)	(0.457)
Skill intensity	0.000236***	0.000232***	0.000235***	0.000231***
	(7.40e-05)	(7.60e-05)	(7.35e-05)	(7.56e-05)
Share of coal reserves		0.122**		0.123**
		(0.0591)		(0.0595)
Share of bauxite reserves		-0.0142		-0.0106
		(0.0285)		(0.0294)
Share of iron ore		0.0457*		0.0464*
		(0.0263)		(0.0276)
ln (reserve value)	0.0812		0.0868*	
	(0.0503)		(0.0510)	
Constant	13.96**	11.96*	13.38**	11.25*
	(5.981)	(6.277)	(5.958)	(6.260)
R square	0.63	0.65	0.63	0.64
Observations	217	217	217	217
Number of states	31	31	31	31

Note:

i.   The study controls for heteroscedasticity.

ii.   Robust standard errors in parentheses.

iii. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

iv. Dropped Dadra and Nagar Haveli, Daman and Diu and Lakshadweep as there is no data on proposed investment.

Table 3 Regression results 2

Dependent variable is log of real actual investment in state s in year t.

Variables	R1	R2	R3	R4
ln(port)	-0.00705	0.0416		
	(0.0832)	(0.0818)		
Port dummy			-0.293	0.257
			(0.928)	(0.928)
ln (rail density)	-0.119	-0.256*	-0.108	-0.260*
	(0.207)	(0.149)	(0.208)	(0.150)
ln (road density)	0.113	0.113	0.114	0.116
	(0.268)	(0.271)	(0.269)	(0.272)
ln (population)	1.248***	1.422***	1.254***	1.449***
	(0.312)	(0.230)	(0.313)	(0.231)
ln (per capita NSDP)	1.399**	1.296*	1.446**	1.348**
	(0.632)	(0.666)	(0.629)	(0.663)
Skill intensity	-3.80e-05	-3.95e-05	-3.82e-05	-3.98e-05
	(2.51e-05)	(2.88e-05)	(2.47e-05)	(2.84e-05)
Share of coal reserves		0.0243		0.0246
		(0.105)		(0.106)
Share of bauxite reserves		-0.0270		-0.0243
		(0.0484)		(0.0491)
Share of iron ore		-0.00111		0.000436
		(0.0321)		(0.0330)
ln (reserve value)	0.0434		0.0480	
	(0.0568)		(0.0570)	
R square	0.47	0.46	0.47	0.46
Constant	-24.27***	-24.08***	-24.85***	-24.85***
	(7.543)	(7.893)	(7.500)	(7.845)
Observations	217	217	217	217
Number of states	31	31	31	31

Note:

i.   The study controls for heteroscedasticity.

ii.   Robust standard errors in parentheses.

iii. *** p<0.01, ** p<0.05, * p<0.1

iv.   Dropped Dadra and Nagar Haveli, Daman and Diu, and Lakshadweep, as there is no data on actual investment.

The results for state characteristics that attract actual investment are different from those that attract proposed investment. The market size of states, as represented by population and per capita NSDP, is an important determinant of realised investment. The coefficient of rail density is negative and significant, implying actual investment is concentrated in states with low rail density. This result for rail density is not as per the theory and thus requires further investigation. During 2006–12, the rank correlation between average income of states and average rail density was very low and insignificant (Appendix 3). This may be because in India, the rail network depends more on the political influence of states than on their economic and social significance. The study checked the results for actual investment, after dropping rail density in equation (2) (Appendix 4), and found no change in the results. This implies that rail density is not an important determinant for the location decision of investment.

We suspected one of the variables for market size, per capita NSDP, to be correlated with the error term, but found no correlation on testing for endogeneity using the Durbin-Wu Hausman test. The above regressions are corrected for any residual heteroscedasticity by adjusting standard errors for clusters in states. Significantly, the results do not change even after including time dummies in both specifications. The results are same even after taking one period lag value of all explanatory variables.

In general, the study finds that mineral reserves (particularly coal and iron ore) are important determinants of the concentration of proposed investment, while the reserves do not play much role in actual investment. The crucial reasons could be the relative political and bureaucratic inefficiency in communicating with the project affected people in low income states with huge mineral reserves; acceptability of large investments among the people in states in terms of acquiring land, providing for water, getting forest clearance; and abnormal delays in getting clearances, particularly environment and forest, from central regulatory authorities.

6 CONCLUSION

This study examines the role of mineral resources in the regional variation of private investment across Indian states between 2006 and 2012, by examining the impact of reserve values by states and the share of major reserves. The study controls for other state characteristics such as market size, skill intensity, rail density, road density, and ports. The study includes proposed as well as realised investment at the state level.

The study finds, interestingly, that low income states receive higher proposed investment, while the concentration of actual investment is higher in high income states. Unsurprisingly, market size is an attraction for realised investment, while proposed investment is concentrated into highly populated low income states. The study finds that among transport facilities port facilities are an important determinant for realised investment. While states with abundant mineral reserves attract more proposed investment, there is no significant impact of reserves on actual investment.

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APPENDIX

1 DEFINITION OF VARIABLES

Variables	Definition
ProInv	Proposed Investment: log of real proposed investment in Rs. Crore (at 2004-05 prices).
ReInv	Realised Investment: log of real realised investment in Rs. Crore (at 2004-05 prices).
Port	Cargo handled at major and minor ports in '000 tonnes/TEUs
Rail	Rail Density: Rail length in Km per 000' sq km of land area of states.
Road	Road Density: Road length in Km per 000' sq km of land area of states.
Market Size	log of population in 000'
Skill	Skill Intensity: Enrolment in professional courses per 000 of population.
Reserve value	log of real value of reserves in Rs (at 2004-05 prices). Reserve value is deflated by WPI of minerals.
CoalRes	Share of each state reserves of coal in total coal reserves in India in year t (%).
Bauxite Res	Share of each state reserves of bauxite in total bauxite reserves in India in year t (%)
Ironore Res	Share of each state reserve of iron ore in total iron ore reserves in India in year t (%)

2 METHODOLOGY FOR CALCULATING VALUE OF RESERVES IN EACH STATE

To compute the value of reserves in each state, the study considers total reserves (proved reserves and remaining reserves) and production by mineral in each state in a given year. The data on total reserves by mineral in states are available as on 1 April 2005 and 1 April 2010. Mineral-wise reserve (total reserve) data of states for 2005 are used for 2006, 2007, 2008, and 2009, while data on mineral-wise reserves for 2010 is used for 2011. The data on production of minerals gives information on the volume and value of each mineral produced in the state. Using these two datasets, the value of reserves for each state between 2005 and 2011 is calculated by the following steps.

1. Using the data on volume and value of minerals produced in each state, the price per unit of mineral is calculated in each state in the given year.

2. The two datasets—reserves and prices—are compared mineral-wise for each state over the period of time from 2005 to 2011. The study ignores minor minerals for this exercise. It has been found that some minerals are not produced despite of reserves in states. In such situation price of neighboring state is used if the mineral is produced there. Otherwise, the study has used weighted average of prices of all other states in which the mineral is produced. In this case, weights are the ratio of volume of production of mineral m of state s in time period t in total volume of production of mineral m in all states in the time period t. There are gaps in price data across the years. Therefore, the study has taken into account minerals for which data is available for all the years. These minerals include bauxite, chromite, coal, diamond, dunite, garnet, graphite, iron ore, lead-zinc ore, magnesite, mica, silver, apatite, ball clay, calcite, chalk, gold ore, gypsum, phosphorite/rock phosphate, vermiculite, and wollastonite.

3. The reserve value of each mineral is calculated using the prices and volumes of reserves of each mineral in state s in year t. The total value of reserves in state s in year t is calculated by adding the value of each mineral reserve in state s in the year t. The study does not calculate the value of gold ore because its higher unit price gave misleading results.

3 RANK CORRELATION BETWEEN PER CAPITA NSDP AND VARIOUS STATE CHARACTERISTICS

	Port	Road Density	Rail Density	Population	Skill Intensity
P	0.30	0.55	0.17	-0.42	0.46
Prob > |t|	0.10	0.00	0.34	0.01	0.00

Note: Simple average of all state characteristics are calculated across the years. The study includes all the states for computation of Rank Correlation.

Null Hypothesis: per capita NSDP and various other states characteristics are independent.

4 ALTERNATIVE SPECIFICATION—DROPPING RAIL DENSITY

Dependent Variable in is log of Actual Investment in state s in year t.

Variables	(1)	(2)	(3)	(4)
ln(Port)	-0.0151	0.0473		
	(0.0771)	(0.0807)		
Port Dummy			-0.380	0.299
			(0.857)	(0.916)
ln (Surface Road Density)	0.0978	0.0706	0.101	0.0739
	(0.266)	(0.267)	(0.266)	(0.269)
ln (Population)	1.142***	1.273***	1.158***	1.301***
	(0.225)	(0.217)	(0.225)	(0.218)
ln (Per Capita NSDP)	1.352**	1.068*	1.406**	1.125*
	(0.619)	(0.644)	(0.616)	(0.644)
Skill Intensity	-3.29e-05*	-2.58e-05**	-3.37e-05*	-2.61e-05***
	(1.72e-05)	(1.01e-05)	(1.74e-05)	(9.57e-06)
Share of Coal Reserves		0.0165		0.0168
		(0.102)		(0.103)
Share Bauxite Reserves		-0.0252		-0.0222
		(0.0472)		(0.0479)
Share of Iron Ore Reserves		-0.000148		0.00153
		(0.0319)		(0.0327)
ln (Reserve value)	0.0567		0.0601	
	(0.0416)		(0.0416)	
Constant	-23.01***	-20.23***	-23.74***	-21.05***
	(7.189)	(7.479)	(7.138)	(7.457)
R square	0.48	0.46	0.48	0.44
Observations	217	217	217	217
Number of State	31	31	31	31

Note:

i.   The study controls for heteroskedasticity
ii.   Robust standard errors in parentheses.
iii. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

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