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Infrastructure, Openness, and Regional Inequality In India

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ABSTRACT

This paper aims to quantify the driving forces behind the observed divergence of Indian economy. The results show that in a closed economy with agriculture as the predominant mode of production, the comparative advantage is mainly determined by the difference in land quality and climate across regions within a country. However, when the economy opens its door to the rest of the world, a region's comparative advantage is evaluated in a broader global context. Therefore, regions adjacent to more developed economies, or with better infrastructure such as ports and airports, enjoy a far better location advantage for trade and development than landlocked regions. More investment in physical infrastructure such as roads will bring the interior regions closer to the world markets and reduce regional disparity. Among all the factors considered, education is the only equalizing factor to regional development.

Keywords: Infrastructure, Openness, Regional Development, and Inequality.
JEL Codes: F150, H540, O150, R120, and R530.

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The neoclassical growth theory predicts that a region's growth rate tends to be inversely related to the initial levels of income, as in a closed economy, marginal returns to capital in a more developed region will decline, leading to convergence. In the new economic geographic and international trade literature, Elizondo and Krugman (1992) also argue that regional disparity in a federal economy may decline with economy globalization because increasing international competition erodes the monopoly power of the highly concentrated production and trade centers.

Contrary to these theoretical predictions, many empirical studies in the Indian context (Das and Barua, 1996; Rao, Shand, Kalirajan, 1999; Kurian, 2000; Jha, 2000; Pradhan, Saluja, and Venkatram, 2000) have found regional inequality on the increase, in particular since 1991 when liberalization and deregulation policies were carried out. Except for Das and Barua (1996), most of the studies attribute the widening inequality to domestic policies such as fiscal transfer and uneven development in infrastructure, paying little attention to the role of openness despite the fact that the validity of the growth theory depends upon a crucial assumption that the economy is closed. In fact, most recent fast growing states in India, except Haryana and Punjab, have vast coastlines. It is possible that internal geography and infrastructure conditions matter to the regional disparity when a spatially large economy, such as China and India, opens up. Studies (Démurger et. al, 2002; Zhang and Zhang, 2002) have shown that opening up has led to faster growth in coastal regions and resulted in widening regional inequality for at least

two reasons. First, coastal regions enjoy far lower transportation cost in international trade. Second, there exist institutional barriers on population movement by the so called "household registration system". Unlike China, migration is allowed in India. However, the low rate of literacy among the mass rural population restricts their mobility across regions to a large extent. An interesting question is: does a larger degree of openness also cause widening regional inequality in India?

To address the question, we use a panel data set including 17 states in the period of 1970 to 1998 from the Central Statistical Organization. In particular, we make an effort to quantify the effect of government policy, infrastructure development and openness on regional inequality. We first regress pre capita GDP on a set of variables and then apply the Shorrock's method to decompose the particular contributions of various factors to the overall inequality. We find that difference in internal geography and the uneven spread of infrastructure account for more than half of the observed regional inequality.

The paper is organized as follows. In the next section, we describe the patterns of regional development. In the third section, we use a newly developed framework to decompose the contributions of various factors to the overall regional inequality. Conclusions and policy implication are discussed in the last section.

THE PATTERNS OF REGIONAL DEVELOPMENT

Until the late 1980s, a primary objective of development strategy was to promote balanced economic growth across regions. Using various means of planning, the government tried to reduce regional disparity. The economic liberalization policies

taking place since the early 1990s have changed the landscape of economic geography across states and greatly weakened the traditional role of planning process. By the late 1990s, the large regional disparity has begun to cause great policy concerns within India.

From a snap shot year of 1998 as shown in Table 1, it is apparent that there exist large regional differentials in development performance. For instance, per capita GDP in Maharshtra and Punjap is more than four times higher than that in Bihar. More worse, regional inequality has increased over time as shown in Table 2 and Figure 1. According to two popular inequality measures, Gini coefficient and Generalized Entropy (GE), regional inequality across states has increased by 56% and 43%, respectively. The question is: what are the causes of the divergence? As revealed in the literature, government policy, human capital, and geographical differences are likely to be the major drivers.

Rao, Shand, and Kalirajan (1999) have argued that skewed distribution of public expenditures to the more affluent regions is the key contributory factor to widening regional inequality. To take this argument into account, we use per capita development expenditure and road density as proxies for government policy. It can bee seen from Table 1 that the level of government development expenditure ranges from 54 in the poorest state, Bihar, to 225 in Jammu and Kashmir, a strategic important boarder state. Although the level of per capita expenditure in Madhya Pradesh is high at 205, it is ranked as the third poorest state. The distribution of development expenditure does not show a well-defined targeting strategy on balanced regional development.

Road density in India, measured as the length of roads in kilometers per thousand square kilometers of geographic area, increased from 2,614 in 1970 to 5,704 in 1995, a

growth rate of more than three percent a year. For India as a whole, road development has contributed positively to the overall economic growth (Fan, Hazell, and Thorat, 1999). For, the data on road development at the state level show that the government may have taken some means to target the poor regions. For instance, in 1995, road density in the two poorest states, Bihar and Orissa, are 14,700 and 14,747, respectively, higher than that in the two richest states, Maharshtra and Punjab.

As suggested in the literature of new growth theory, human capital is a key factor to long-run economic growth. Here, we use literacy as an indicator for human capital. Bihar and Rajasthan, two poor states, are the only two states having a literate rate blow 30 percent. It seems there is a positive correlation between development and literacy except for Kerala. Kerala has outperformed other states by a large margin in literacy. However, its high level of human capita has not transformed to high level of economic development as measured by per capita GDP.[1]

In the recent literature on economic geography and international trade (Sachs and Warner, 1995; Fujita, Krugaman, and Venables, 2000), internal geography is argued to be a major determinant of economic development. Compared to the United States, Europe and Japan, India's geographic difference and climatic variability are much higher. To feed its large population, land in both coastal areas and hinterland has been cultivated as extensively as possible. As a result, a large proposition of population lives in interior regions, as opposed to US where most people reside in coastal areas. Similar to China, regional inequality was low when the economy was closed. In a closed economy with agriculture as the predominant mode of production, the comparative advantage is mainly

[1] As argued by Sachs, Bajpai, and Ramish (2002), the large flow of remittance from migrants is not accounted as in the State Gross Product. Therefore, using per capita GDP may underestimate the real income level in Kerala.

determined by the difference in land/labor ratios across regions within a country. When the economy opens its door to the rest of the world, a region's comparative advantage is evaluated in a broader global context. In that context, regions adjacent to more developed economies may enjoy a far better location advantage for trade and development than landlocked regions, and therefore may have a faster growth.

As shown in Table 1, states with major ports or airport hubs enjoy much higher level of economic development in the late 1990s, while those having boarder with other poor neighboring and hostile counties are much poorer. Figure 1 clearly reveals that regional inequality increased rather slowly until the mid-1980s but rose more dramatically since then when market reforms and openness policy were introduced. Following the decomposition approach outlined in Zhang and Kanbur (2001), Table 2 also presents the GE within-inequalities among port states and non-port states, and the between-inequality across the two groups of states. The polarization index is defined as the ratio of the between-group inequality to total regional inequality as shown in the third column. The between-group difference accounts for more than half of total inequality. Since the mid-1980s, similar to the Gini coefficient, the polarization index has also been on an increase. In other words, the geographical advantage in the port states has manifested after markets reforms were put in place.

Having describing the patterns of regional development, in the next section, we will quantify the relative contributions of various factors to observed patterns of regional development. In specific, we try to answer the following questions: To what extent have government policies affected regional economic growth and inequality? To what extent is the role of openness and economic reform on the patterns of regional development? To

what extent are the differences a manifestation of natural geographic and climate conditions?

INEQUALITY DECOMPOSITION

Most previous studies have used the growth literature pioneered by Barro and Sala-I-Martin (1995) to explain convergence or divergence. When using the growth rates as a dependent variable, only data for one cross-section is used, resulting in a loss of information. To overcome this problem, in this paper, we use an alternative approach to fully make use of all observations available. We assume that per capita GDP is determined in a following way:

$$y = a + b_1 k + b_2 e + b_3 r + b_4 g + e \,, \qquad (1)$$

where y = per capita GDP in logarithmic form,

k = per capita development expenditure in logarithmic form

e = education (literacy) in logarithmic form,

r = infrastructure variable (road density) in logarithmic form,

g = a vector of geographical and climatic variables,

a = intercept,

b_i = parameters to be estimated.

Following Shorrocks (1982), the variance of y in equation (2) can be decomposed as:

$$s^2(y) = \text{cov}(y, b_1 k) + \text{cov}(y, b_2 e) + \text{cov}(y, b_3 r) + \text{cov}(y, b_4 g) + \text{cov}(y, e)$$
$$= b_1 \text{cov}(y, k) + b_2 \text{cov}(y, e) + b_3 \text{cov}(y, r) + b_4 \text{cov}(y, g) + s^2(e), \quad (2)$$

where $s^2(y)$ is the variance of *y* and *cov* (*y*, •) represents the covariance of *y* with other variables. Since the right-hand side variables in equation (1) are not correlated with the error term, the covariance of *y* and *e* is equal to the variance of *e*. Considering that *y* is already in the logarithmic form, $s^2(y)$ is a standard inequality measure known as the logarithmic variance (Cowell, 1995). It has the property of invariance to scale. According to Shorrocks (1982), the covariance terms on the right hand side of (2) can be regarded as the contributions of the factor components to total inequality.

The equations (1) and (2) constitute the basis for our panel analysis on regional inequality. In particular, we first estimate the per capita GDP function specified in (1), and then decompose the inequality into the components of different factors following (2).

In terms of geographic and climatic variables, we mainly use those outlined in Table 1: having a port or airport hub; the percentage of land with arid climate; having a boarder with other countries. In addition to capture the effect of reform regime since 1990, we also include a dummy variable. Table 3 reports the estimation results. The first regression is for the whole period. To check where the port variable has a larger role in the era of openness, an interactive term between the port and regime dummy variables is included.

The adjusted R^2 is high at 0.801, implying that over eighty percent of the total variation can be explained by the variables included. All the variables are statistically significant with expected signs. Per capita development expenditure, literacy, road density, port or airport facilities, non-tropic climate contribute positively to the level of

economic development. But neighboring to a less developed, perhaps hostile country, would lead to a lower level of development because of limited bilateral trade and large exposure to potential conflict.

As the coefficients for the regime dummy and the interaction term between port and the regime dummy are significantly significant, we further conduct regressions in two separate periods. By comparing the regressions in the two sub-periods, we find that the roles of infrastructure and geographic location have become increasingly important when the economy opens up to the international markets. The coefficients for road density and port have increased from 0.063 and 0.310 to 0.126 and 0.433, respectively, while the coefficient for boarder has declined from –0.085 to –0.113.

The coefficient for per capita development expenditure has changed from 0.086 to –0.147, confirming to the finding by Kurian (2000) that the traditional planning process is becoming less relevant. Further research on how to improve the efficiency of government expenditures in the era of economic liberalization is warranted.

Given the estimated coefficients for per capita GDP presented in Table 3, we can now apply the inequality decomposition method outlined in equation (2) to quantify the contributions of government policy, infrastructure, human capital, and geographic difference to total regional inequality. Table 4 presents the overall inequality and the contributions from these factors to total inequality.

The inequality index, measured as the log variance, in the second column in Table 4 has increased from 6.3 in 1970 to 15.0 in 1993, indicating a widening regional gap in consistent with other inequality measures presented in Table 2. Several features are apparent from the table. First, geographic factors do matter significantly to the observed

regional inequality. In total, the contributions of the port and boarder variables contribute to more than fifty percent to overall inequality in the whole period. Second, the role of development expenditure in reducing regional inequality has become smaller. The share of contribution of development expenditure has declined from 6.8% to 4.7%. Third, education has been the only equalizing factor. For most years, the contribution of literacy is negative. Improvement in education not only enhances labor's productivity but also increases their ability to move, therefore reducing regional inequality. The finding is consistent with the literature on China (Fan, Zhang, and Zhang, 2002; Zhang and Zhang, 2002). Fourth, the uneven distribution of climate becomes a less important contributory factor to the overall inequality when the economy transforms from a closed agrarian economy to a more open and industrial economy. The share of arid climate has declined from 18.6% in 1970 to 8.6% in 1993. This also reflects the shrinking share of agricultural sectors in the whole economy as a country industrializes.

CONLCUSIONS

Using data at the state level, this paper shows that Indian economy has become divergent in contrary to the predictions by both neoclassical and new growth theory. There are competing hypotheses to explain the phenomena of divergence. Using a newly developed framework, we are able to quantify the contributions of various factors to the observed patterns of regional inequality and test the alternative hypotheses.

In a closed economy with agriculture as the predominant mode of production, the comparative advantage is mainly determined by the difference in land quality and climate

across regions within a country. But when the economy opens its door to the rest of the world, a region's comparative advantage is evaluated in a broader global context. Therefore, regions adjacent to more developed economies, or with better infrastructure such as ports and airports, may enjoy a far better location advantage for trade and development than landlocked regions, and therefore may have a faster growth. In contrast, those states neighboring to poor or hostile countries are lagging behind in the process of opening up.

Efforts thorough the planning process in the first several decades of independence might have positive effect in reducing regional inequality. But the traditional ways of allocating development expenditure means of planning may become obsolete in the era of economic liberalization. Therefore, new way of thinking is called to promote balanced regional development. More investment in physical infrastructure such as roads will bring the interior regions closer to the world markets. As education is the only equalizing factor to regional development, promoting wide access to basic education will enable more people to share the gains of market reforms and lead to a broad-based regional development.

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Table 1 State Characteristics

	GDP per capita (Rupees/month in 1997/8)	Arid	Major port city or airport hub	Boarder	Road density	Literacy	Per capita development expenditure
Andhra Pradesh	2,521	45		0	7,072	33.26	154
Bihar	1,261	0		0	14,700	27.77	54
Gujarat	4,505	82	Kandla	0	3,604	50.07	201
Haryana	4,516	87	Delhi	0	7,624	35.60	133
Himachal Pradesh		99		1	3,844	58.76	204
Jammu and Kashmir		100		1	3,013	30.89	225
Karnataka	3,109	60		0	7,236	37.84	159
Kerala	2,823	0		0	5,437	81.73	111
Maharashtra	5,690	9	Mumbai	0	2,235	33.41	97
Madhya Pradesh	2,286	39		0	5,498	40.52	205
Orissa	1,871	0		0	11,153	38.51	87
Punjab	5,079	76	Delhi	1	8,623	49.32	145
Rajasthan	2,621	80		1	1,816	28.40	112
Tamil Nadu	3,454	4	Chennai	0	14,747	49.80	173
Uttar Pradesh	2,023	8		1	2,560	36.55	61
West Bengal	3,308	0	Kolkata	1	6,369	52.50	85

Note: The second through fourth columns are from Sachs, Bajpai, and Ramiah (2002) and the rest columns are from Fan, Hazell, and Thorat (1999).

Table 2 The Patterns of Regional Inequality

Year	Gini	GE	Port	No-port	Within	Between	Polarization
1970	13.5	2.9	1.4	1.2	1.3	1.6	56.1
1971	13.8	3.0	1.3	1.3	1.3	1.7	56.6
1972	14.2	3.2	1.2	1.5	1.4	1.8	56.2
1973	14.7	3.4	1.2	1.7	1.5	1.9	55.2
1974	15.0	3.5	1.3	1.6	1.5	2.1	58.7
1975	15.3	3.6	1.4	1.4	1.4	2.3	61.9
1976	15.6	3.8	1.5	1.2	1.3	2.4	64.6
1977	15.9	3.9	1.6	1.1	1.3	2.6	67.0
1978	15.8	3.9	1.8	1.1	1.3	2.5	65.4
1979	15.6	3.9	1.9	1.1	1.4	2.5	63.6
1980	15.6	3.8	2.1	1.2	1.5	2.4	61.7
1981	15.5	3.8	2.2	1.2	1.5	2.3	59.7
1982	15.4	3.8	2.4	1.2	1.6	2.2	57.4
1983	15.4	3.8	2.5	1.3	1.7	2.1	55.2
1984	15.7	3.9	2.5	1.2	1.6	2.3	58.3
1985	16.1	4.1	2.5	1.1	1.6	2.5	60.7
1986	16.5	4.3	2.5	1.2	1.6	2.7	62.3
1987	17.0	4.6	2.6	1.2	1.7	2.9	63.2
1988	17.6	4.9	2.6	1.4	1.8	3.1	63.8
1989	18.3	5.3	2.6	1.5	1.9	3.4	64.1
1990	19.0	5.6	2.6	1.7	2.0	3.6	64.1
1991	19.7	6.0	2.6	1.9	2.2	3.9	63.9
1992	20.4	6.5	2.7	2.2	2.4	4.1	63.5
1993	21.1	6.9	2.8	2.4	2.6	4.4	63.1

Note: All the figures are in percentage.

Table 3 Estimation Results

	Whole period	Green Revolution period (70-85)	Post Green Revolution and reform
Per capita development expenditure	0.076**	0.086**	-0.147*
	(0.020)	(0.020)	(0.078)
Literacy	0.066**	0.068**	0.097
	(0.031)	(0.031)	(0.075)
Road density	0.074**	0.063**	0.126**
	(0.010)	(0.010)	(0.024)
Having a port or airport hub	0.320**	0.310**	0.433**
	(0.020)	(0.020)	(0.044)
Arid climate	0.003**	0.003**	0.004**
	(0.000)	(0.000)	(0.000)
Boarder states	-0.085**	-0.081**	-0.113**
	(0.018)	(0.019)	(0.039)
The reform (openness) regime	0.087**		
	(0.025)		
Port*openness	0.138**		
	(0.040)		
Adjusted R-square	0.801	0.810	0.756

Note: The dependent variable is per capita GDP with a constant price. Per capital GDP and development expenditure, literacy, road density are in logarithms. * and ** indicate statistical significance at the 10% and 5%, respectively. Figures in parentheses are standard errors.

Table 4 Decomposition of Regional Inequality

Year	Inequality	Development expenditure	Literacy	Road density	Port	Arid climate	Boarder	Other
1970	6.3	6.8	-0.8	13.6	46.5	18.0	6.4	9.4
1971	6.4	7.6	-0.8	14.7	46.2	17.6	6.5	8.3
1972	6.5	8.3	-0.8	15.8	45.2	17.1	6.4	7.9
1973	6.7	9.7	-0.8	16.4	43.9	16.3	6.3	8.2
1974	7.1	9.2	-0.6	15.7	44.0	15.8	5.9	10.0
1975	7.5	7.7	-0.4	14.8	43.9	15.3	5.6	13.3
1976	7.9	7.9	-0.2	15.9	43.5	14.7	5.2	13.0
1977	8.4	6.7	-0.1	16.2	42.9	14.1	4.9	15.3
1978	8.4	6.7	0.1	15.7	42.6	14.3	4.9	15.6
1979	8.4	7.9	0.2	15.3	42.1	14.6	5.0	15.0
1980	8.4	6.4	0.3	14.9	41.6	14.8	5.0	16.9
1981	8.5	6.7	0.4	14.5	41.0	15.0	5.1	17.3
1982	8.5	7.0	0.4	14.0	40.2	15.1	5.1	18.2
1983	8.6	8.0	0.3	13.4	39.4	15.2	5.1	18.6
1984	9.1	6.6	0.0	13.8	39.2	13.4	4.8	22.2
1985	9.8	6.2	-0.3	14.1	38.5	11.6	4.4	25.6
1986	10.6	5.1	-0.5	14.2	37.4	9.9	4.0	30.0
1987	11.5	5.6	-0.7	14.2	36.0	8.3	3.6	32.9
1988	11.9	5.2	-0.7	14.7	35.5	8.4	3.9	33.0
1989	12.4	5.3	-0.8	14.9	35.0	8.6	4.1	32.9
1990	13.0	4.5	-0.8	14.6	49.0	8.7	4.3	19.7
1991	13.6	5.8	-0.9	14.2	47.9	8.7	4.5	19.7
1992	14.3	4.5	-0.9	13.7	46.7	8.7	4.6	22.7
1993	15.0	4.7	-0.9	13.1	45.4	8.6	4.7	24.3

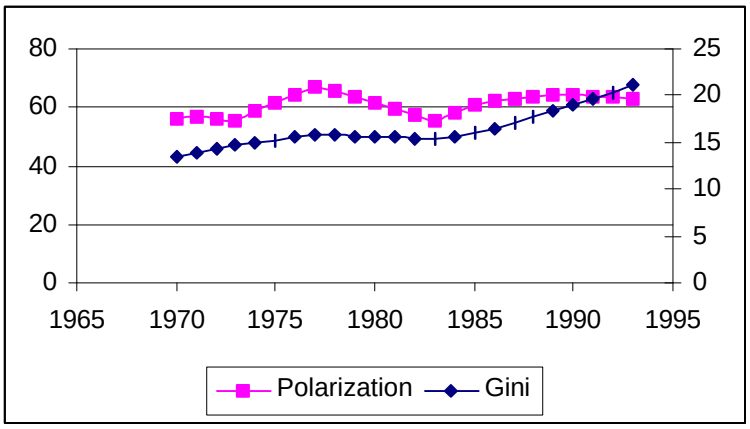

Figure 1 Regional Inequality (Gini coefficient)