IIMB-WP No. 672/2022

WORKING PAPER NO: 672

Ethnic Diversity and Economic Development with Spatial Segregation

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Year of Publication – November 2022

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November 22, 2022

Abstract

We revisit the negative association between ethnic diversity and development. We show how the diversity-development association is conditional on spatial segregation. We introduce a new census-scale micro-dataset from the Indian state of Karnataka (n = 36.5 million rural residents). Using the first-ever spatially explicit enumeration and coding of endogamous Indian caste groups (*jatis*), we develop a multi-group metric for measuring local spatial segregation. We find that diversity is a bane for development only when it is also accompanied by high levels of spatial segregation. Our results contribute to the emerging research on the implications of inter-group contact and spatial proximity for economic outcomes.

Keywords: *Ethnic Diversity; Residential Segregation; Caste; India*

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1 Introduction

Ethnic diversity is considered to lower economic development because it leads to coordination problems and behavioral biases inhibiting trade opportunities (Alesina and Ferrara, 2005). Recent evidence, however, suggests that the economic benefits of diversity outweigh its pernicious effects at finer geographic scales (Montalvo and Reynal-Querol, 2021). Diversity in skills increase specialization and greater familiarity reduces prejudice, thereby increasing inter-group trade. What happens when diverse ethnic groups are also spatially segregated?

We argue that when localized contact shapes individual behavior (Bazzi et al., 2019), spatial segregation modulates the effects of diversity. Segregation reduces the likelihood of inter-group contact and perpetuates behavioral biases resulting in diminished social capital and higher group anomie, thereby reducing avenues for trade. We test this hypothesis using a unique census-scale micro-dataset from rural India that includes the first-ever spatially explicit enumeration and coding of endogamous occupational caste groups (*jatis*). Using the information on every household's neighbor in a village, we compute a sociologically relevant novel metric of spatial segregation. Combining this with the workhorse fractionalization index as the measure of ethnic diversity, we provide a spatially refined test of the diversity-development relationship for rural India.

We find that one standard deviation increase in diversity is associated with 0.31 standard deviation decrease in the household asset index and 0.03 standard deviation increase in the poverty rate at the village level. However, upon interacting diversity with our measure of intra-village segregation, the coefficient on diversity index increases to 0.35 standard deviation in the case of the asset index and 0.04 standard deviation for the poverty rate. Our analysis of the average marginal effects of diversity, conditional on the level of segregation, further shows that diversity is a bane for development only when high levels of spatial segregation also accompany it.

2 Theoretical Argument

Caste system divides Indian society into over 3000 endogamous groups (*jatis*) based on traditional occupation. Spatial segregation is a central constitutive feature of the Indian caste system, as illustrated in Figure 1. The Figure represents the division of residential space in the village of Amminabhavi that was made famous by Spate and Learmonth (1954) as the archetype of spatial segregation in rural India. High-status castes (here, the Brahmans, the Lingayats, and the Jains) reside in the center of the village while the Dalits (the formerly

"untouchable" groups shown as "Harijans") and other laboring castes (Talwars, Shepherds, and Washermen) are consigned to the periphery. Such an unequal socio-spatial structure, despite being diverse, abets historical caste distinction through fomenting "spiteful preferences" (Fehr et al., 2008) which often lead to discriminatory practices that deter trade.

Reputational concerns among "upper" caste groups inhibit cross-group interaction and cooperation (Brooks et al., 2018; Choy, 2018). For example, Anderson (2011) documents the weakening of irrigation trade network across castes, leading to lower agricultural productivity. Similarly, greater prevalence of untouchability — another central aspect of caste-based segregation — is associated with higher poverty (Lawson and Spears, 2021), and homicide rates (Bros and Couttenier, 2015). More segregated villages report higher child undernourishment among "lower" caste groups (Coffey et al., 2019). The hierarchical caste order also affects human behavior and impacts labor supply decisions by reinforcing the ideas of the "self" into superior or inferior groups (Tajfel, 1978). A field experiment by Oh (2019) shows individuals refuse to take up a higher-paying jobs if it is inconsistent with their perceived caste status. In a nutshell, caste-based spatial segregation reduces cross-group interaction, and adds to the segmented beliefs about self-worth resulting in broader economic inefficiencies (Cassan et al., 2021).

3 Data & Methods

Measuring caste-based intra-village spatial segregation has hitherto not been possible as the Indian national census does not enumerate (*jatis*), let alone provide "immediate neighbor" information that can only be discerned from purpose-collected micro-data. The Indian national census data is also not suited to measure ethnic diversity as *jati* information is not enumerated. We overcome this challenge using `GOKS`, a 2015 census-scale micro-dataset from rural Karnataka, an Indian state as large as France ($n \approx 36.5$ million rural residents). The `GOKS` data that codes 717 unique endogamous *jati* groups comes from a socio-economic census-scale survey conducted by the Government of Karnataka in 2015. This survey was conducted to inform the identification of socially and economically backward social groups for implementing state-level affirmative action quotas. The survey was designed such that for every every unique household with enumeration-id k has $(k+1)$ and $(k-1)$ as its closest neighbors. This unique spatial feature of the `GOKS` data allows us to measure intra-village spatial segregation depicted in Figure 1.

While spatial proximity information has previously been used to measure street-level segregation between Blacks and Whites in American cities (Agresti, 1980; Logan and Parman,

2017), we adapt the well-established non-parametric "runs" test to extend this intuition to a multi-group setting (Wald and Wolfowitz, 1940). Consider a fictional ten-household village with three different *jatis* — '▧,' '●,' and '▲.' The actual spatial ordering of households in this village is as follows: ▧▧▧| ●●| ▧| ▲▲| ▧▧. This village has five unbroken chains, or "runs." Our measure of segregation compares this actual runs-count with the "expected" runs when the houses are randomly ordered. Figure 2 uses `GOKS` data to represent this immediate neighbor information for Amminabhavi — the same village depicted in Figure 1 that we used to motivate caste-based spatial segregation.The left panel in Figure 2 visually represents the actual neighbor information for each one of the 2,500 households in Amminabhavi. The right panel represents the hypothetical random arrangement of these 2,500 households.

In a village with N households and G caste (*jati*) groups, the expected number of "runs" under the assumption of random distribution is given by (n_g is the population of the group g):

$$E\left(R\right) = \frac{N(N+1) - \sum_{g=1}^{g=G} n_g^2}{N} \tag{1}$$

If $\tilde{R}$ is the actual number of runs observed in a village, the multi-group Wald-Wolfowitz segregation, WW, is computed as:

$$WW = 1 - \left(\frac{\tilde{R} - G}{E(R) - G}\right) \tag{2}$$

The Wald-Wolfowitz metric in Eq. 2 can in theory take on a negative value (when the actual spatial arrangement of households is more integrated than a random ordering of households). Further, WW is not defined for perfectly homogeneous villages. We, therefore, set a lower and upper bounds (0 and 1 respectively) on our operational segregation metric, SEG (Eq. 3). $SEG_i = 0$ corresponds to a perfectly integrated village i, and $SEG_i = 1$ is a perfectly segregated village.

$$SEG_i = \begin{cases} 1, & \forall\, G_i = 1 \\ WW_i, & \forall\, WW_i \geqslant 0, \text{ and } G_i > 1 \\ 0, & \forall\, WW_i < 0, \text{ and } G_i > 1 \end{cases} \tag{3}$$

Unlike conventional "dimensions of residential segregation" (Massey and Denton, 1988), our measure of segregation does not compare the demographic distributions *between* spatial units (for example, between a city and individual neighborhoods contained in the city). In-

stead, it measures how households are segregated *within* a spatial unit (for example, within a village or a single neighborhood in the city). While traditional measures of segregation metrics are only a "proxy for social interactions, social networks, and interpersonal exchange" (Logan and Parman, 2017), ours is a direct measure capturing the likelihood of daily interactions, exchange, and economic relations at the heart the diversity deficit hypothesis. The multi-group Wald-Wolfowitz metric that we have used here can potentially overstate the extent of segregation. With endogamy being a central characteristic of *jati*, it is plausible that familial links rather than *jati* links determine residential ordering in a village. For example, our metric will count cousins who are also neighbors to be segregated even when family homophily and not *jati* homophily is the central driver.[1] Our results are unlikely to be biased by this possible measurement error for two reasons. First, nuclear families are an exception rather than the rule in rural India. Second, there is no reason to expect that this potential bias is systematic.

We combine the segregation and diversity metrics as computed from the `GOKS` micro-data with village-level indicators for consumption-based poverty provided in the `SHRUG` dataset (Asher and Novosad, 2019). We also compute an asset index for every village using the 2011 national census data. Our village-level asset index comprises the following variables: share of households in a village with (i) access to water within the residential premises; (ii) electricity for lighting; (iii) toilet facilities at home; (iv) permanent dwelling structure; (v) access to automobile, TV, and bank account. We use the principal component analysis (PCA) to create the village-level economic asset index. We measure diversity using the workhorse fractionalization metric, $FRA_i = 1 - \sum \pi_{gi}^2$; where π_{gi} is the population share of *jati*, g in village, i. Intuitively, this index is the probability that two randomly selected households in village i belong to two different *jatis*.

4 Results

Village level estimates of the association between diversity, segregation and economic development – household asset index (models A1–A4) and poverty rate (models P1–P4) – are presented in Table 1. To highlight the mediating effects of segregation, we estimate both the independent and conditional channels linking diversity and segregation to local economic development outcomes. The benchmark models in Table 1, A1 and P1, confirm the well-established diversity-deficit hypothesis (Alesina et al., 1999). Models in Table 1 use normalized variables so that one standard deviation increase in *jati* fractionalization is associated with a 0.31 standard deviation decrease in asset index (model A1), and a 0.03

[1] We are grateful to an anonymous reviewer for pointing this out.

standard deviation increase in poverty levels (model P1). To the best of our knowledge, this is the first-ever confirmation of diversity deficit using village-scale *jati* data. The seminal work by Banerjee and Somanathan (2007) uses aggregated measures of diversity that mismeasure identity and group differences (Somanathan et al., 2018), leading to results that are empirically unstable (Bharathi et al., 2021).

We are mainly interested in the interaction between diversity and segregation, presented in Table 1 (A4 and P4). At average levels of diversity, a one standard deviation increase in spatial segregation is associated with a 0.35 standard deviation reduction in village asset index, and a 0.07 standard deviation increase in poverty rates. The true import of models A4 and P4 is better captured in the average marginal effects (AME) plots in Figure 3. The two panels in this figure show how the association between diversity and economic development is conditional on the level of spatial segregation. The bottom panel shows how the negative association between diversity and poverty does not hold in villages that are not highly segregated. The top panel shows how the negative association between village-level assets and diversity is more pronounced with increasing segregation.

Clean identification in this class of literature requires untenable assumptions (Chetty et al., 2014; Andrews et al., 2017), and therefore we only claim strong associations. We reckon that our results are unlikely to be driven by variation in migration rates across *jatis* and even less by potential cross-group mobility — two central sources of potential endogeneity in our models. The demographic composition of rural India has remained stable over many decades (Anderson, 2011; Munshi, 2020). The census category fractionalization indices across the last three national census enumerations (1991–2001–2011) displays near-perfect correlation (Bharathi et al., 2021). Further, by using high-dimensional *Gram Panchayat* (GP) fixed effect (we also cluster all standard errors at the GP level), we are able to control for a wide range of plausible omitted variables— local electoral politics (including quotas for marginalized castes), inter-village demography, and geography, among other factors — that can potentially bias our estimates. *Gram Panchayats* are small local clusters of villages that constitute the lowest level of government in India (the little over 26,000 villages in our analytic sample are drawn from $\approx 6,000$ GPs). Thus, with an average of little over four villages per *Panchayat*, we can be sure that our models are capturing only intra-village channels. Further, as indicated in Table 1, we also control for all potential village-level confounders.

5 Conclusion

The contributions of this paper are threefold. First, we use a unique census-scale data on *jatis* from rural India with spatial markers to study the diversity-development association. Revisiting the argument by Banerjee and Somanathan (2007) at a finer geographic scale and *jati* data, we show that diversity is an impediment only when intra-village spatial segregation is sufficiently high. Second, we develop a novel segregation multi-group segregation metric. This empirical refinement is increasingly relevant for diverse societies beyond India (Andrews et al., 2017). Third, our findings contribute to the debate around productivity enhancing ties in diverse settings (Baldassarri and Abascal, 2020; Mousa, 2020; Lowe, 2021) by illustrating that spatial segregation could dampen cross-group collaborative efforts. Together, we open up newer avenues to characterize social cohesiveness, prejudice, and cross-group collaboration in spatially segregated hierarchical societies.

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Tables

	Asset Index				Poverty Rate			
	(A1)	(A2)	(A3)	(A4)	(P1)	(P2)	(P3)	(P4)
Fractionalization	-0.31***		-0.29***	-0.27***	0.03***		0.03***	0.03***
	(0.06)		(0.06)	(0.06)	(0.01)		(0.01)	(0.01)
Segregation		-0.18***	-0.15***	-0.25***		0.01***	0.01	0.03***
		(0.06)	(0.06)	(0.07)		(0.01)	(0.01)	(0.01)
Fractionalization × Segregation				-0.35*				0.07***
				(0.19)				(0.02)
GP Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Village Controls	YES	YES	YES	YES	YES	YES	YES	YES
No. of Villages	26081	26081	26081	26081	24120	24120	24120	24120
Adj. R^2	0.65	0.65	0.65	0.65	0.41	0.41	0.41	0.41

Notes: Robust standard errors, clustered at Gram Panchayat level are reported in parentheses.
$^{*}\ p < 0.05,\ ^{**}\ p < 0.01,\ ^{***}\ p < 0.001$.
All models include GP (Panchayat) fixed effects. All models also control for the following village characteristics: population, area (in sq. km.), net sown area in acres, share of land under irrigation, proportion of village area classified as forests. All models also include the following demography controls — populations shares of SCST, Muslims, and OBC, workforce proportion, share of cultivators, population density, literacy rate, and sex ratio. We have also controlled for the distance to nearest town (kms.), number of hours of electricity, and whether a village is a gram panchayat headquarters.

Table 1: Diversity, Segregation & Development

Figures

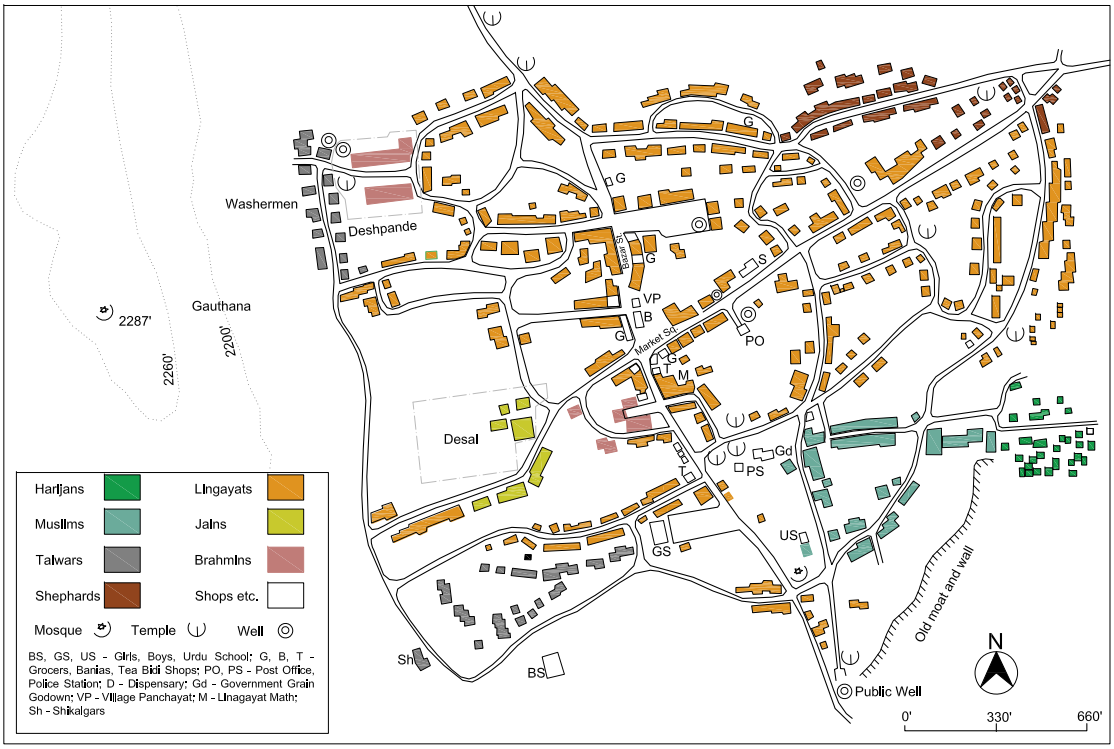

Figure 1: ***Amminabhavi, Dharwad District, c. 1950***. *(Digitized, and remastered by authors using original sketch from Spate and Learmonth, 1954, p.200).*

Amminabhavi: Abstract "Runs" Representation

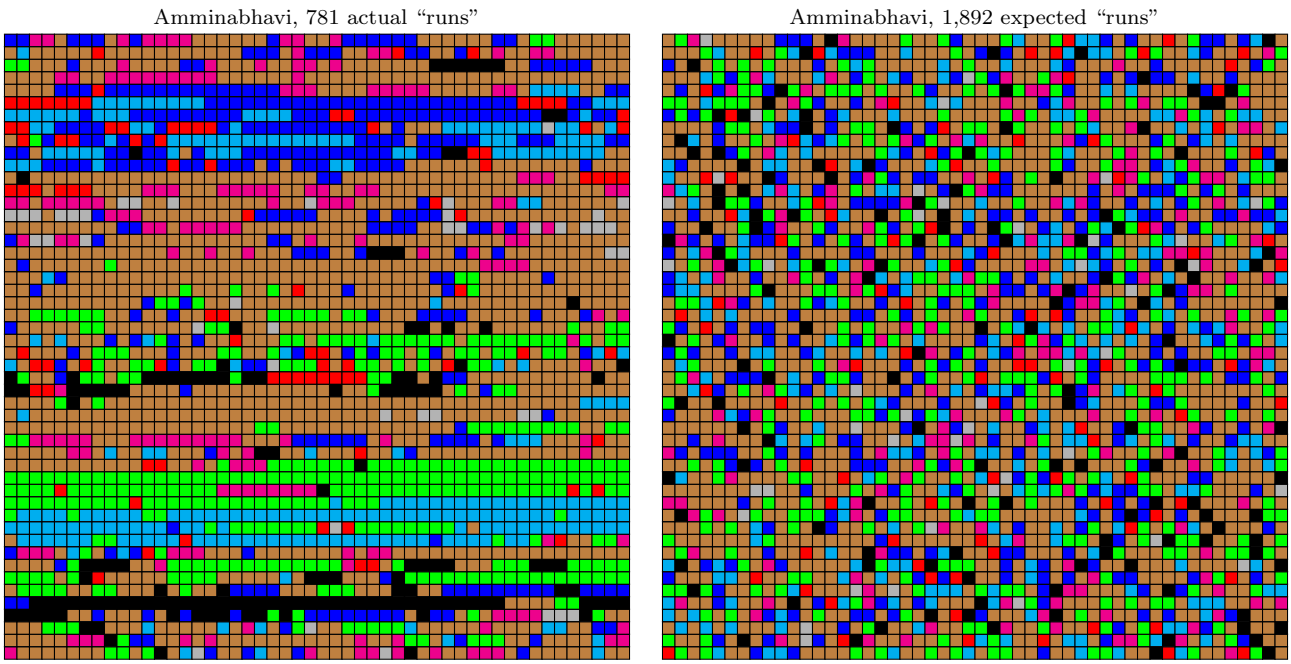

Figure 2: ***Spatial Segregation***. *Amminabhavi village from Figure 1 is represented here in the abstract with each colored square representing one of the 2,500 households in the village. The left panel shows the actual arrangement of households in the village, and the right panel shows the same households arranged randomly. Data from* GOKS.

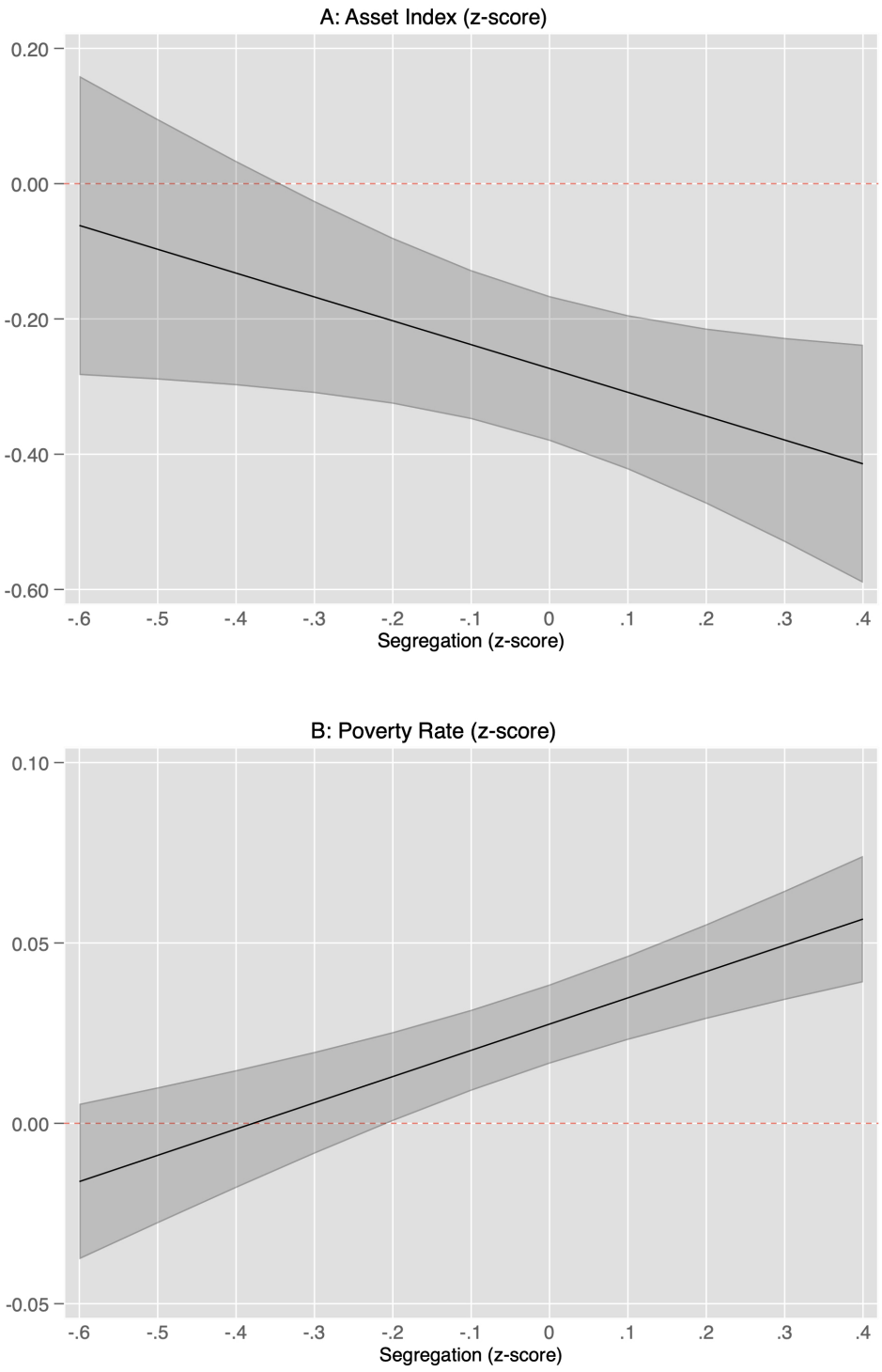

Figure 3: ***Average Marginal Effects (AME) of Diversity Conditional on Segregation***

Ethnic Diversity and Economic Development with Spatial Segregation

ONLINE APPENDIX

List of Tables

	N	Mean	SD	Min	Max
DEPENDENT VARIABLES					
Household Assets (PCA Index)	26501	0.01	1.56	-5.96	7.24
Poverty Rate (Fraction)	24545	0.2	0.14	0	1
INDEPENDENT VARIABLES					
Jati Diversity (Fractionalization Index, FRA)	26501	0.63	0.23	0	0.96
Jati Segregation (SEG)	26501	0.61	0.2	0	1
CONTROLS					
Population	26501	1362.35	1568.83	10	20163
Area (Hectares)	26501	646.04	812.7	0	25562.45
Literacy (%)	26501	61.58	11.42	0	100
Sex ratio	26499	98.72	11.14	0	600
Irrigated Land (%)	26500	18.77	20.15	0	100
Workforce (%)	26501	52.03	10.79	1.65	100
Cultivators (% in workforce)	26501	461.1	530.28	0	11060.73
Forested Area (Hectares.)	26501	92	450.75	0	25426.46
Net Sown Area (Hectares.)	26501	407.49	566.34	0	10685.08
Distance to Nearest Town (Km)	26501	16.83	9.24	0.5	90
Hours of electricity (Summer)	26501	10.46	4.91	0	24
Hours of electricity (Winter)	26501	11.57	5.19	0	24
SC-ST Population Share (%)	26501	0.33	0.26	0	1
OBC Population Share (%)	26501	0.43	0.3	0	1
Muslim Population Share (%)	26501	0.04	0.1	0	1

Table 1: Summary Statistics

Table 2: Asset Index: Full Results

	(1) Amenities	(2) Amenities	(3) Amenities	(4) Amenities
FRA: Jati	-0.31***		-0.29***	-0.27***
	(0.06)		(0.06)	(0.06)
SEG: Jati		-0.18***	-0.15***	-0.25***
		(0.06)	(0.06)	(0.07)
FRA: Jati × SEG: Jati				-0.35*
				(0.19)
No. of Jatis	0.01***	0.01***	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Population	-0.00**	-0.00	-0.00*	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Area (in Hectares.)	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Literacy (%)	0.05***	0.05***	0.05***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)
Sex ratio	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Irrigated Land (%)	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Workforce (%)	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Cultivators (%) in workforce	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Forested Area (in Hectares.)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Net Sown Area (in Hectares.)	0.00***	0.00***	0.00**	0.00**
	(0.00)	(0.00)	(0.00)	(0.00)
Kms. to town	-0.02***	-0.02***	-0.02***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)
Hours of electricity (Summer)	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Hours of electricity (Winter)	0.01*	0.01*	0.01*	0.01*
	(0.00)	(0.00)	(0.00)	(0.00)
PanchayatHQ	0.15***	0.15***	0.15***	0.15***
	(0.02)	(0.02)	(0.02)	(0.02)
SC-ST Share (%)	-1.21***	-1.22***	-1.20***	-1.19***
	(0.07)	(0.07)	(0.07)	(0.07)
OBC Share (%)	-0.54***	-0.54***	-0.54***	-0.55***
	(0.06)	(0.06)	(0.06)	(0.06)
Muslim Share (%)	-0.62***	-0.64***	-0.62***	-0.62***
	(0.11)	(0.11)	(0.11)	(0.11)
Constant	-1.72***	-1.66***	-1.73***	-1.72***
	(0.21)	(0.21)	(0.21)	(0.21)
No. of Villages	26081	26081	26081	26081
Adj. R^2	0.65	0.65	0.65	0.65

Notes: Robust standard errors, clustered at Gram Panchayat level are reported in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: Poverty Rate: Full Results

	(1) Poverty	(2) Poverty	(3) Poverty	(4) Poverty
FRA: Jati	0.03***		0.03***	0.03***
	(0.01)		(0.01)	(0.01)
SEG: Jati		0.01*	0.01	0.03***
		(0.01)	(0.01)	(0.01)
FRA: Jati × SEG: Jati				0.07***
				(0.02)
No. of Jatis	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Population	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Area (in Hectares.)	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Literacy (%)	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Sex ratio	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Irrigated Land (%)	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Workforce (%)	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Cultivators (%) in workforce	-0.00	-0.00	-0.00	-0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Forested Area (in Hectares.)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Net Sown Area (in Hectares.)	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Kms. to town	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Hours of electricity (Summer)	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Hours of electricity (Winter)	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
PanchayatHQ	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
SC-ST Share (%)	0.09***	0.10***	0.09***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)
OBC Share (%)	0.03***	0.03***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Muslim Share (%)	0.12***	0.12***	0.12***	0.12***
	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.07**	0.07**	0.07**	0.07**
	(0.03)	(0.03)	(0.03)	(0.03)
No. of Villages	24120	24120	24120	24120
Adj. R^2	0.41	0.41	0.41	0.41

Notes: Robust standard errors, clustered at Gram Panchayat level are reported in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.