Market Access and Firm Performance[1]

Evidence based on GIS Analysis of Road Network and Manufacturing-Plant-level Data of India

Somnath Sharma, Shashi Kant, Ranjeeta Mishra and Dina Azhgaliyeva

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Introduction

- Road infrastructure is known to affect accessibility, industrial location and regions' growth and development.
- Recent studies by Ghani et. al (2016), Gibbons et. al (2017) and Laird, Venables (2017) find that better road connectivity can raise productivity of firms or industry as a whole.
- Less work has been done on the effects of better market access on firm-level performance.
- We look at the internal market access in terms of better connectivity (reduction in travel-time distance) to bigger markets and its impact on the plant-level productivity in India.

GIS dataset

- Indian road network shapefile from Open Street Map. Data available for every year since 2014.
- Centroids (lat/long) of district polygons representing cities as points. Extracted using Open Street Maps API.

Brief intro about GIS dataset

- Roads are represented by lines
- Districts are bounded polygons
- Centroids of district polygons are points

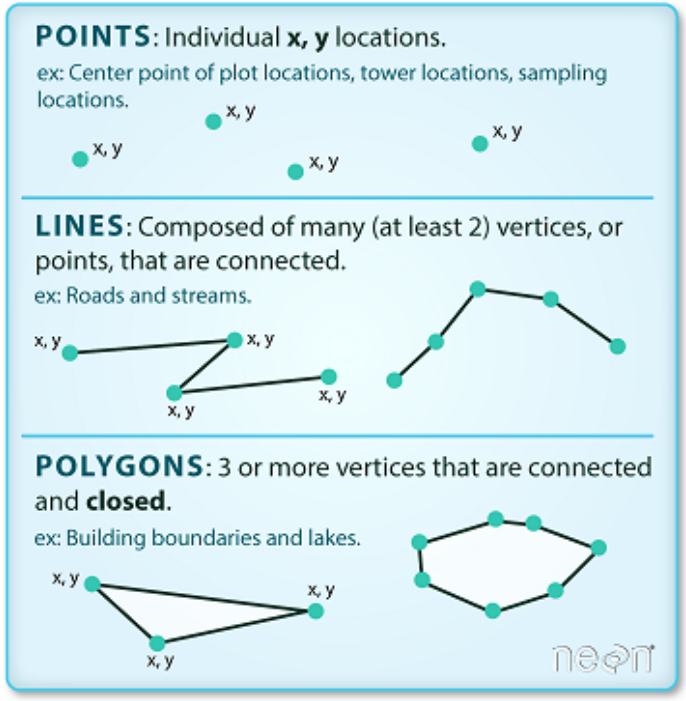
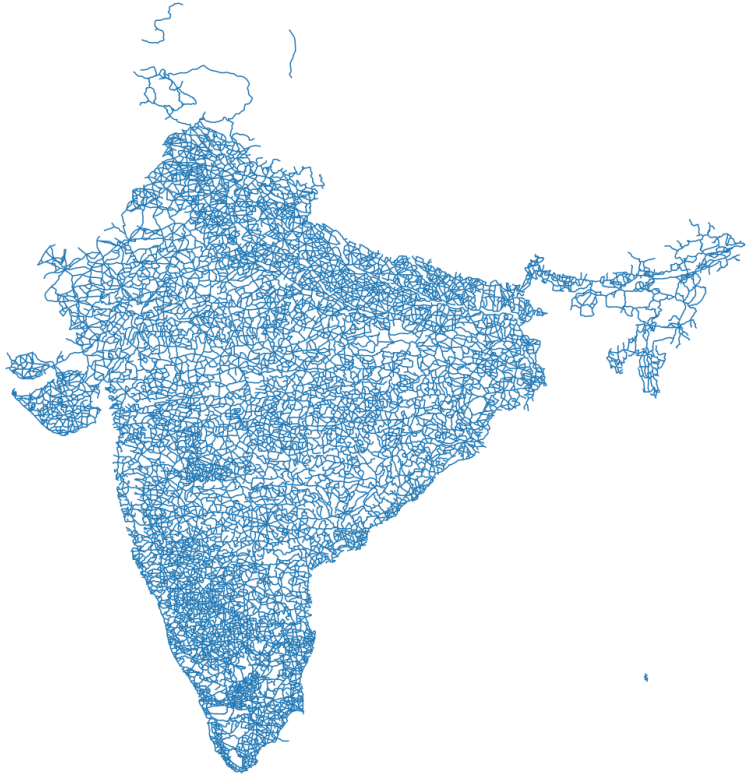


Figure 1: There are 3 types of vector objects: points, lines or polygons. Image Source: Colin Williams (NEON)

Methodology

- STEP 1: Convert road GIS shapefile into single connected road network.



- STEP 2: Find centroids of districts using Open Steet Maps OPI

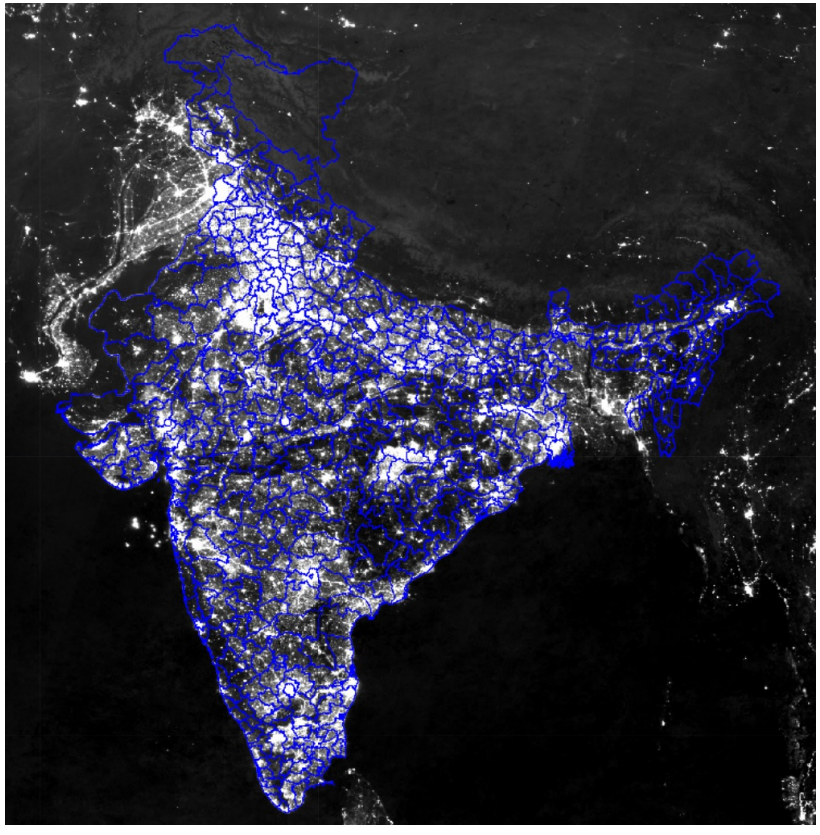
Methodology

- STEP 3: Overlay centroids on top of road network. Find closest nodes lying on road network which can represent centroids.

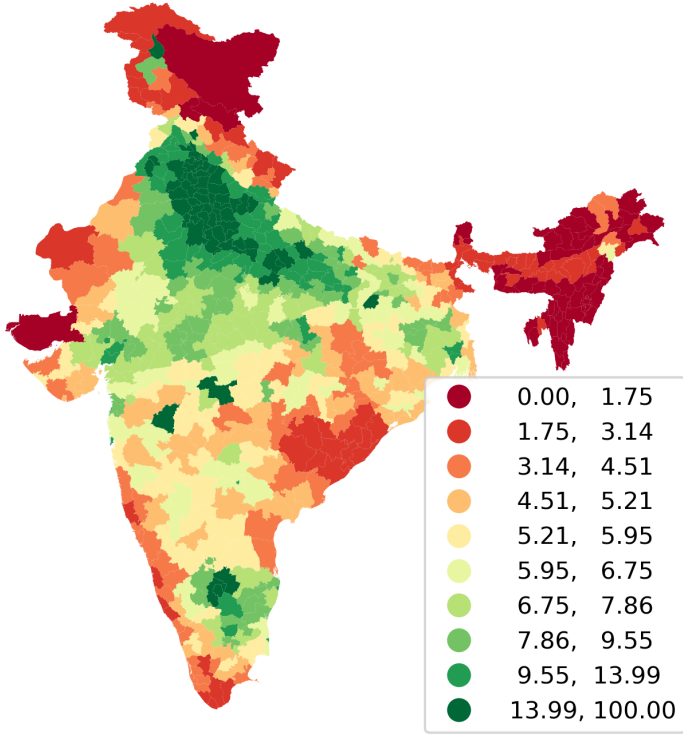
- STEP 4: Use Dijkshtra's algorithm to find shortest path between nodes. We will use the `igraph` package in R for estimation.
- STEP 5: Calculate market access index (Roberts, 2016): $MA_i = \sum_j \frac{GDP_j}{distance_{i,j}^2}$

Methodology

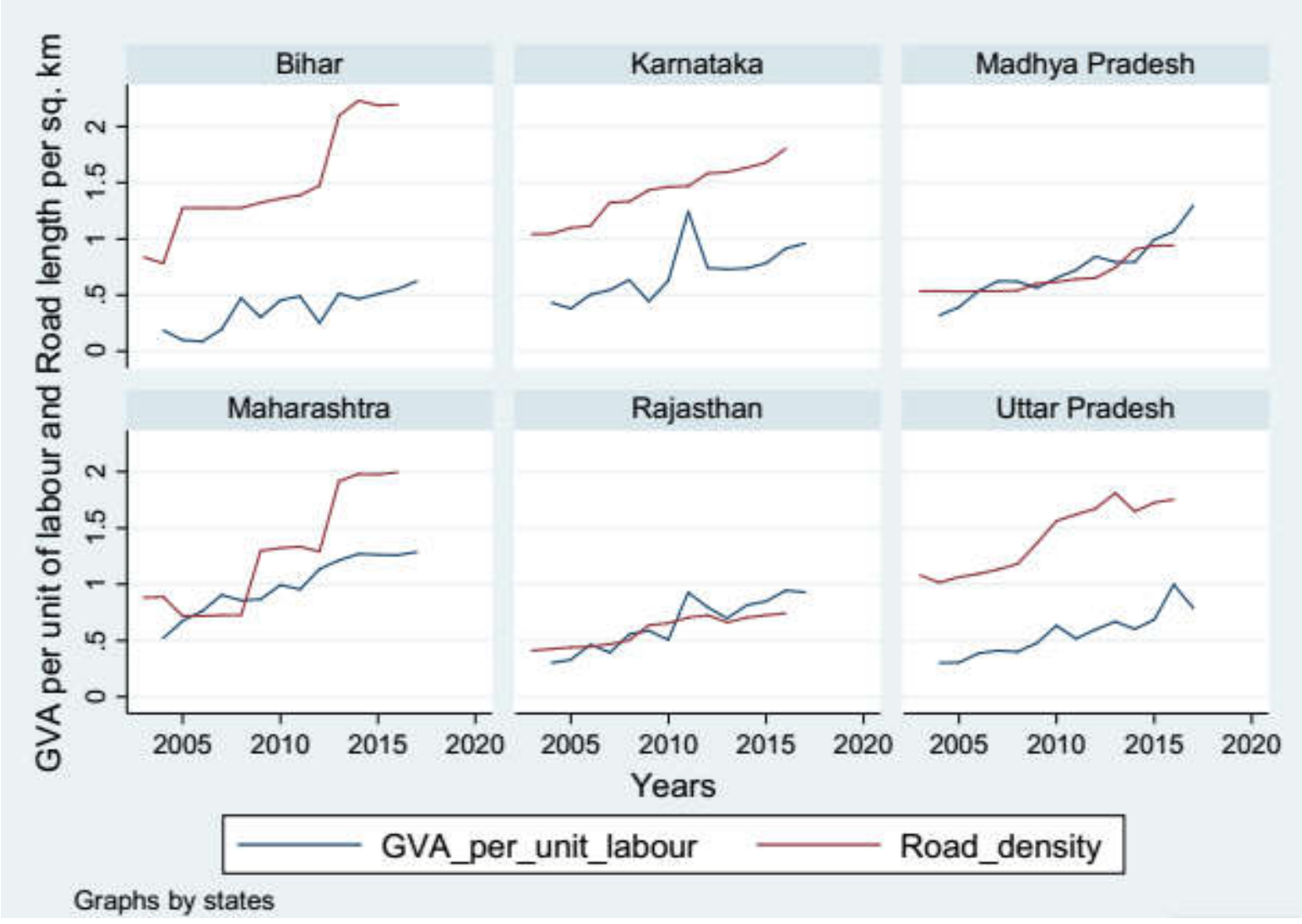
- STEP 6: Use nightlight intensity as proxy for district GDP.



- STEP 7: Spatial representation of market access index



Road Infrastructure and Productivity: Facts



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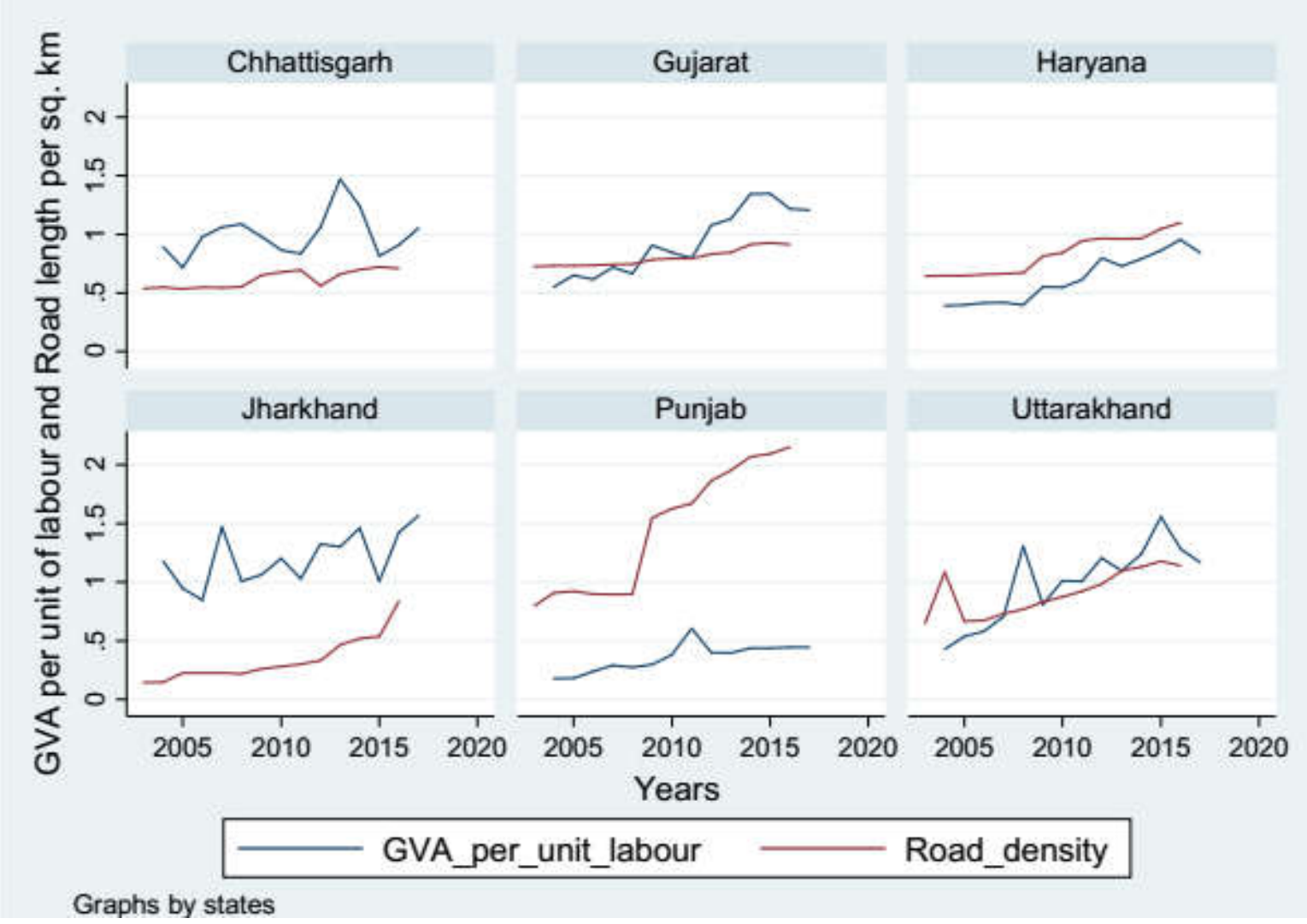
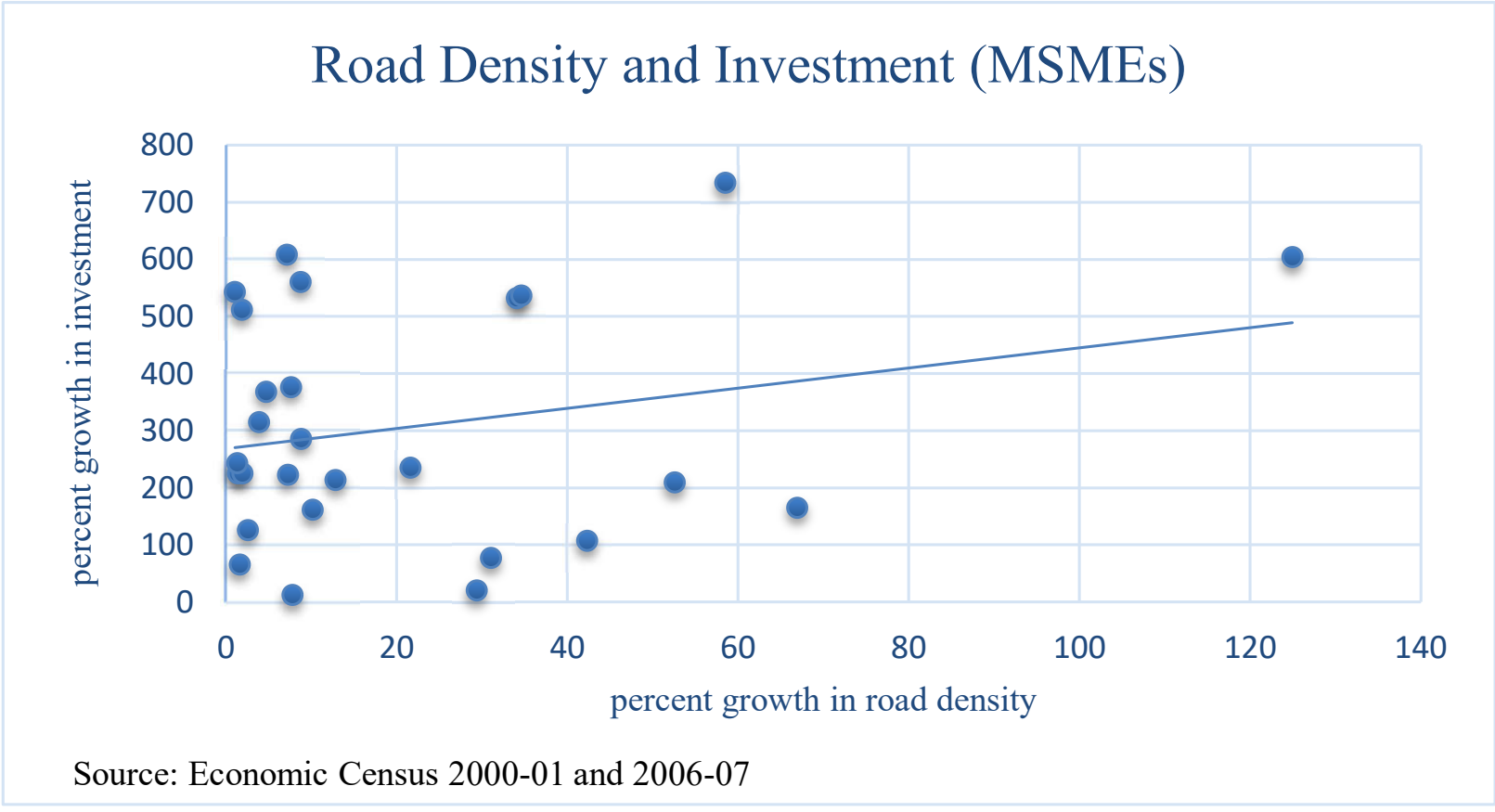


Road Infrastructure and MSME Investment: Facts



Source: Economic Census 2000-01 and 2006-07

Data: Annual Survey of Industries (India)

- We use the Annual Survey of Industries (ASI) panel data from 2000 to 2017.
- The ASI is the principal source of industrial statistics in India for the plant-level information of registered manufacturing firms.
- Most comprehensive and reliable source of organised manufacturing sector data providing disaggregated industry specific details of production, investment, employment and costs.
- ASI panel data gives the plant-level identifiers but does not give the district-wise location identifiers.

Estimation of ROA

We estimate the ROA by earnings before interest and tax payments (EBIT) divided by Total Assets(TA) as follows:

$$ROA_i = \frac{Net\ Value\ Added_i}{Total\ Assets_i} \tag{1}$$

And, State-level Theil's Index as:

$$Theil'sIndex = \sum_{i=1}^{n} \frac{ROA_i}{\overline{ROA}} log\left(\frac{ROA_i}{\overline{ROA}}\right) \tag{2}$$

Regression Specification

$$
\begin{aligned}
ROADispersion_{s,t} = \alpha_s + \gamma_t + \beta_1 MAI_s \\
+ \beta_2 CreditNSDP_{s,t} \\
+ \beta_3 ElectricityDeficit_{s,t} \\
+ \beta_5 ShareofStalledProjects_{s,t} \\
+ \beta_6 PerEnterprisePendingCivilCasess, t \\
+ \beta_7 InfantMortality_{s,t} + \nu_{s,t}
\end{aligned}
\tag{3}
$$

where s denotes states and t year, and α_s represents the state-level fixed effect. We control for the state-level and time fixed effects and clustering the standard error at state-level.

Results

	roa theil
Market access	-0.0815**
	(-2.79)
Credit nsdp ratio	0.000914
	(1.12)
Elec def perc	-0.000844
	(-0.23)
Share stalled	0.000681
	(0.13)
PC Pendening cases	0.0351**
	(2.64)
Infant Mort	0.00967*
	(2.20)
State Fixed Effect	Yes
Time Fixed Effect	Yes
Observations	225
Adjusted R-squared	0.942

Table 1: Regression: Results using ROA Theil's Index

Conclusions

- We establish that better access to the markets through roads reduces the dispersion of ROA as better infrastructure results into improvement in the allocation of capital.
- Bad governance and judicial conditions measured share of stalled projects and per-enterprise pending civil cases, respectively in the states are associated with greater dispersion of ROA.
- Inferior human capital reflects on the profitability of firms through greater dispersion of ROA.
- Improvement in infrastructure by better connected roads to the markets reduces the transport time and creates better business environment. This can help in reducing the misallocation of capital and improve profitability.

Thank You