Assessing the Impact of Delhi Meerut Expressway on Regional Development in India Using DiD

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INTRODUCTION

Infrastructure projects have a profound impact on urban development and regional growth. This study aims to quantify the influence of significant infrastructure projects, specifically focusing on the Delhi-Meerut Expressway. By analyzing satellite images through remote sensing technology, and the World Bank Enterprise Survey Data, we can observe the changes in urban development in the districts of Delhi, Ghaziabad, and Meerut, where the Delhi-Meerut Expressway passes.

OBJECTIVE

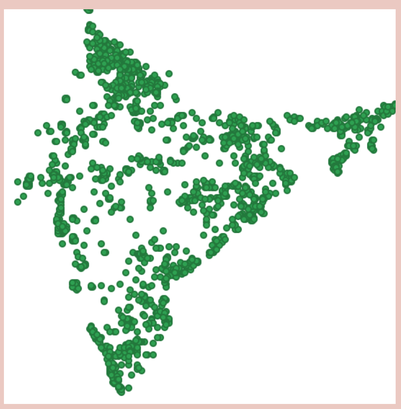
The study would assess the impact on firms and regions stationed near to the infrastructure and those who are further away from it. The outcome would be assessed through firm level variables like total sales, days of inventory held and perception of transport as an obstacle.

METHODOLOGY

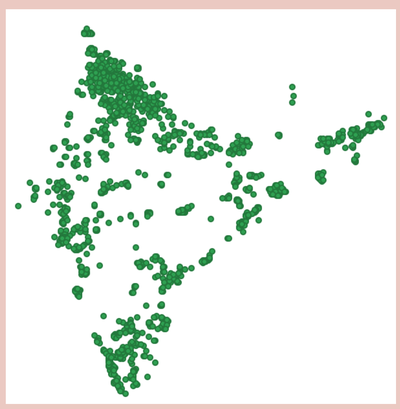
- The data used majorly comprised of World Bank Enterprise Survey for 2014 and 2022 and also a secondary data file with information about firm coordinates.
- The coordinates are processed and converted to the city names using Pandas and Geopy.
- A multiple regression model incorporating key financial and economic indicators—asset turnover, payout ratio, dividends, debt, exchange rate, and standard deviation of market returns—as independent variables.
- A Difference-in-Difference (DiD) model to identify the change in economic growth, utilizing data from 2014 and 2022.
- Creating shape files for the expressways and analysed the areas within buffer zones of varying widths using Google Earth Engine allowing us to assess urbanisation density and understand the spatial impact of the infrastructure projects on surrounding regions.

DATA PREPROCESSING

- The Delhi - Meerut Expressway was build in 2021 so we used data of 2014 and 2022 as our pre and post.
- In collaboration with the World Bank, we acquired detailed geo-coordinate data, encompassing latitude and longitude information. This strategic partnership facilitated the incorporation of high-precision spatial data, enhancing the rigor and accuracy of our analysis of infrastructure project impacts.
- We converted latitude and longitude data into city names and used QGIS to identify cities in close proximity to the targeted infrastructure projects.



2014



2022

DID MODEL

- The Difference-in-Difference (DiD) model is a statistical technique used to evaluate the causal impact of a treatment or intervention by comparing the changes in outcomes over time between a treatment group and a control group. This method controls for time-invariant differences between the groups and common trends affecting both groups. By analyzing data before and after the intervention, the DiD model isolates the effect of the intervention, providing a robust estimation of its impact on the dependent variable.

Total annual sales in fiscal year

$$y_{it} = \alpha + \beta \cdot \text{Treatment}_i + \gamma \cdot \text{Post}_t + \delta \cdot \text{Treatment}_i \text{Post}_t + \beta X + \varepsilon_{it}$$

To address the scale of the total sales variable, we standardized it by converting it to z-values. This transformation allowed for a more meaningful comparison and analysis within our regression model.

	Dependent variable:
	d2
Treatment:Post	0.365***
	(0.117)
Observations	16,937
Adjusted R2	0.118
F Statistic	568.482*** (df = 4; 16932)

Note: *p<0.1; **p<0.05; ***p<0.01

*d2 - Annual Sales

TOBIT - DID MODEL

The Tobit model is a statistical regression model designed to estimate relationships between variables when the dependent variable is censored.

Perception of Transport as an Obstacle

		No obstacle	Minor obstacle	Moderate obstacle	Major obstacle	Very Severe Obstacle
Transport	d30a	0	1	2	3	4

$$y_{it}^* = \alpha + \beta \cdot \text{Treatment}_i + \gamma \cdot \text{Post}_t + \delta \cdot \text{Treatment}_i \cdot \text{Post}_t + \beta X + \varepsilon_{it}$$

$$\begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^* & \text{if } 0 < y_i^* < 4 \\ 4 & \text{if } y_i^* \geq 4 \end{cases}$$

	Dependent variable:
	d30a
Treatment:Post	-0.822***
	(0.255)
Observations	16,830
Log Likelihood	-24,892.500

Note: *p<0.1; **p<0.05; ***p<0.01

*d30a - Perception of Transport as an obstacle

RESULTS

- The first model reveals that firms situated along the Expressway, after undergoing the treatment, have experienced an increase of 0.365 standard deviations above the mean. This finding is not only substantial but also statistically significant at the 1% level, indicating a strong and reliable impact of the infrastructure project on the economic performance of these firms.
- The Tobit model demonstrates that firms situated on the expressway, following the treatment, perceive transportation as 0.82 points less of an obstacle than firms that did not receive the treatment. This reduction in perceived transportation barriers is both notable and statistically significant at the 1% level, underscoring the positive impact of the infrastructure improvements on the operational efficiency of these firms.

FUTURE WORKS

- The low R^2 value can be improved by incorporating more robust independent variables, such as those from the Center for Monitoring Indian Economy (CMIE) Prowess dataset.
- The study can be expanded from firm-level analysis to regional analysis by utilizing satellite imagery data. This approach allows for a broader assessment of infrastructure impacts, capturing changes in regional development, land use, and urbanization patterns over time.
- By collaborating with the Department of Earth Sciences, this study can become interdisciplinary, leveraging Geographic Information Systems (GIS) to extract and analyze our dependent variables.
- In the future, this study can be expanded to include additional infrastructure projects such as inland waterways, freight corridors, and high-speed rail networks. This broader scope will allow for the analysis of their respective impacts on economic growth, urban development, and regional connectivity.

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