The Impact of Transportation Infrastructure on Economic Growth: Evidence from China

Shuting Chen

Advisor: Dr. Richard Evans

- **Motivation**
  - Developing countries have spent enormous amount of investment on transportation infrastructure
  - Transportation infrastructure has been treated as a key to facilitating economic growth

Introduction

- **Motivation - cont.**
  - Limited empirical analysis of examining the impact of transportation infrastructure on economic growth at the sub-national level, especially for developing countries
- **Research Question**
  - Exploring the impact/causality of transportation infrastructure on regional economic growth, based on economic outcomes for 178 non-metropolitan prefecture cities in China from 1997 to 2011
  - Whether having better access to transportation serves as engines of possible economic growth
  - Hypothesis: Holding everything else constant, cities having better access to transportation are more likely to experience higher economic growth

Literature Review and Contributions

- **Literature Review**
  - Banerjee et al. (2012) and Faber (2009): study the impact of overall transportation or recently constructed highways in China on economic development; adopt "straight line" identification strategy to deal with the endogeneity of transportation networks
  - Storeygard (2016): investigate the role of transportation in determining the income growth across sub-Saharan African cities using night lights data
- **Contributions**
  - Enrich empirical work by examining the impact of transportation on economic growth at the sub-national level
  - Using both official economic data and night lights data to mitigate the effect of measurement errors

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Methods

- **"Straight line" identification strategy**
  - Draw a straight line from one provincial capital city to the nearest provincial capital city/Treaty Port
  - Compute the nearest geographic distance from each prefecture city to a constructed straight line - exogenous variation for access to transportation
- **Estimation functions**:

$$TI_{cpt} = \alpha lnD_{cp} + \omega X_{ct} + \gamma_p + \delta_t + \varepsilon_{cpt} \tag{1}$$

$$\triangle lny_{cpt} = \beta \triangle ln\hat{T}I_{cpt} + \omega \triangle X_{ct} + \triangle\delta_t + \triangle\varepsilon_{cpt} \tag{2}$$

TI_{cpt}: transportation infrastructure of city c in province p in year t
D_{cp}: distance to the nearest straight line for city c in province p
y_{cpt}: economic outcome, X_{ct}: city-year fixed effects
γ_p: province fixed effects, δ_t: year fixed effects, ε_{cpt}: error term

Data

- **Night Lights Data**
  - Collected by U.S. Air Force Defense Meteorological Satellite Program (DMSP); become globally digital available in 1992
  - Grid-based datasets: every 30 arc-second pixel has been labeled by a digital number (0 - 63) - intensity of lights
  - 1997 - 2011: 26 satellite-year datasets, including 110 million pixels for 178 prefecture cities in China
- **Chinese Government Economic Data**
  - Provincial Statistical Yearbooks: published annually by each province in China
  - Using city-level data for 178 prefecture cities in 15 provinces: per capita GDP, population, land area, length of highway, length of railway

Data - cont.

- **Spatial Data**

- GIS maps based on 2010 China Prefecture Population Census Data
- "Straight line" identification strategy

Figure 5: Straight Lines and Transportation Infrastructure

Data Analysis and Results

- **Night Lights Data**

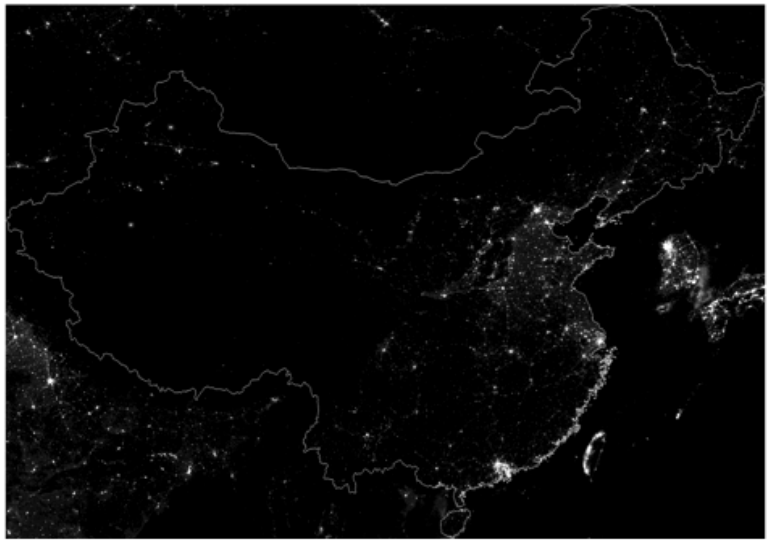

Figure 1: Lights at Night in China, 1997
Source: DMSP data collected by the United States Air Force.

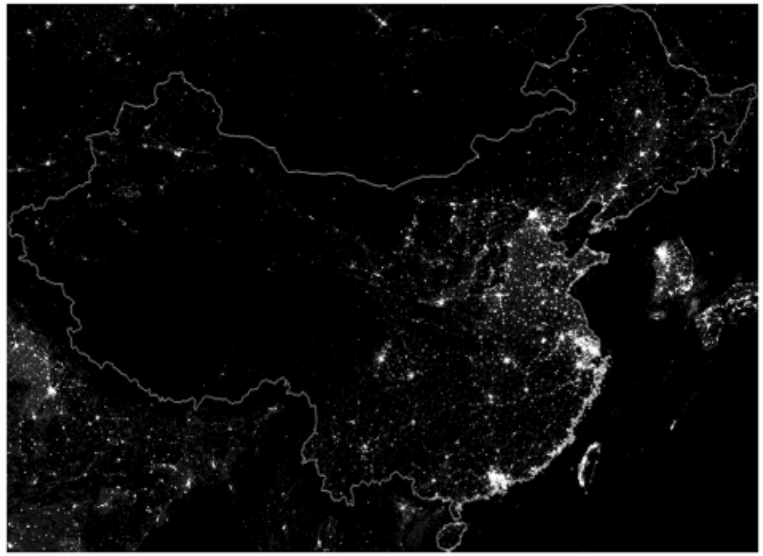

Figure 2: Lights at Night in China, 2011
Source: DMSP data collected by the United States Air Force.

- **Example of the extracted night lights data - Jiangsu Province, 1997**

OBJECTID	Province	Prefecture City	Num of Pixels	Total NTL	Prop Zero	DN - Min	DN - Mean	DN - Max
171	Jiangsu	Wuxi	6291	84038	0.089334	0	13.358449	59
172	Jiangsu	Xuzhou	15844	110300	0.158167	0	6.961626	61
163	Jiangsu	Changzhou	6008	59961	0.082723	0	9.980193	59
169	Jiangsu	Suzhou	11547	140323	0.136053	0	12.152334	58
167	Jiangsu	Nantong	12264	102877	0.01484	0	8.388536	55
165	Jiangsu	Lianyungang	10471	63890	0.159679	0	6.101614	59
164	Jiangsu	Huai'an	13946	62674	0.340528	0	4.494048	56
173	Jiangsu	Yancheng	21434	99440	0.23682	0	4.639358	57
174	Jiangsu	Yangzhou	9173	73695	0.119481	0	8.033904	58
175	Jiangsu	Zhenjiang	5256	52588	0.046613	0	10.005327	56
170	Jiangsu	Taizhou	7983	63939	0.048603	0	8.009395	56

Results

- First stage:

Dependent Variable: TI_{cpt}				
	Length of Highway		Length of Railway	
	(1)	(2)	(1)	(2)
ln Dist to Line	-0.3115	-0.2422	-0.0159	-0.0017
	(0.0803)	(0.0813)	(0.0037)	(0.0033)
Land Area		0.0153		0.0024
		(0.0034)		(0.0001)
Obs	2135	2135	1411	1411
Adj. R^2	0.065	0.075	0.769	0.819

- Second stage:

Dependent Variable: $ln\hat{T}I_{cpt}$				
	ln Per Capita GDP		ln Night Lights	
	(1)	(2)	(1)	(2)
ln Fitted Highway$_{cpt}$	0.2335	0.2335	0.4694	0.4323
	(0.0243)	(0.0243)	(0.0329)	(0.0325)
Land Area		$4.95 * 10^{-7}$		$-3.63 * 10^{-6}$
		$(5.08 * 10^{-7})$		$(6.81 * 10^{-7})$
Obs	2135	2135	2135	2135
Adj. R^2	0.098	0.097	0.254	0.263

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	ln Per Capita GDP		ln Night Lights	
	(1)	(2)	(1)	(2)
ln Fitted Railway$_{cpt}$	0.1081	0.0690	0.2298	0.1465
	(0.0304)	(0.0254)	(0.0457)	(0.0378)
Land Area		$-4.89 * 10^{-7}$		$-4.12 * 10^{-6}$
		$(5.80 * 10^{-7})$		$(8.64 * 10^{-7})$
Obs	1409	1409	1409	1409
Adj. R^2	0.099	0.096	0.167	0.184

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