FNCE 237

The Effect of Subway Systems on a City's Economy

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Research Question & Motivation

Research Question: Does the construction of a subway system boost the economy? If so by how much?

Alternative Hypothesis: Subway infrastructure leads to increases in labor productivity and boosts economic growth.

Null Hypothesis: Subway system will have no impact on the economy. Economic growth is reasonably similar with and without subway construction.

Studies have found that constructing a subway system can…

- Decentralize cities and increase the labor pool geographically
- Improve productivity/faster transportation time

Subway stations are costly…

- Most subway lines cluster in the range of $200 million to $500 million per mile
- Require high investment costs that often cannot be recoup

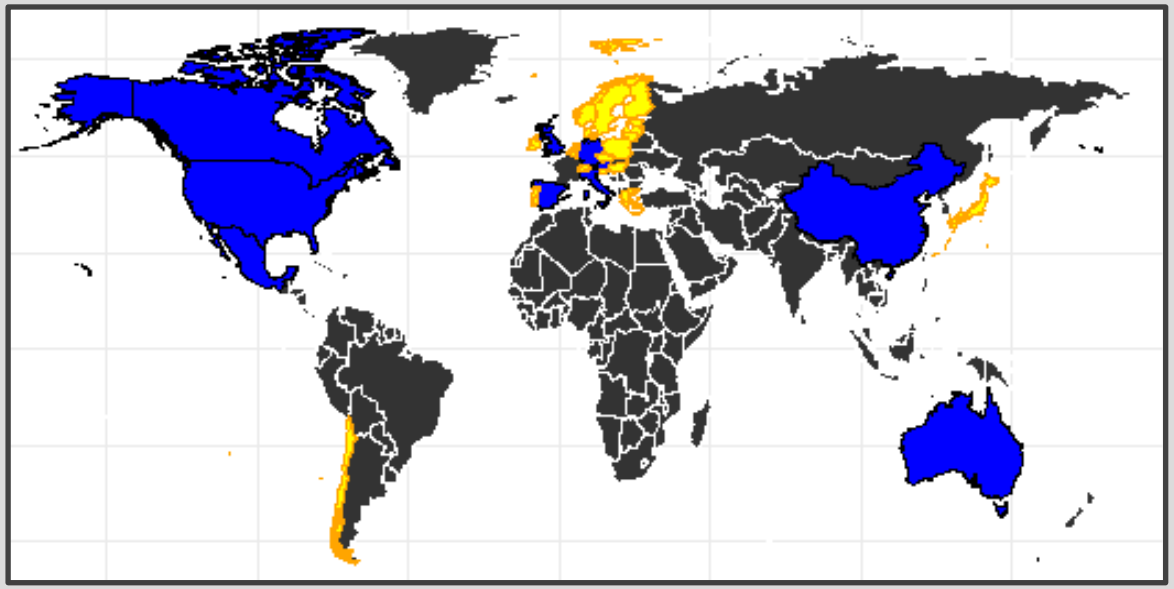
Motivation: This analysis can help governments decide whether such a project should be prioritized.

Data

Countries within the Dataset (2002-2019)

Top 10 countries with the most cities in the data set

Other countries in the dataset



355
Total Cities

30
Total Countries

29
Cities built metros during our time frame

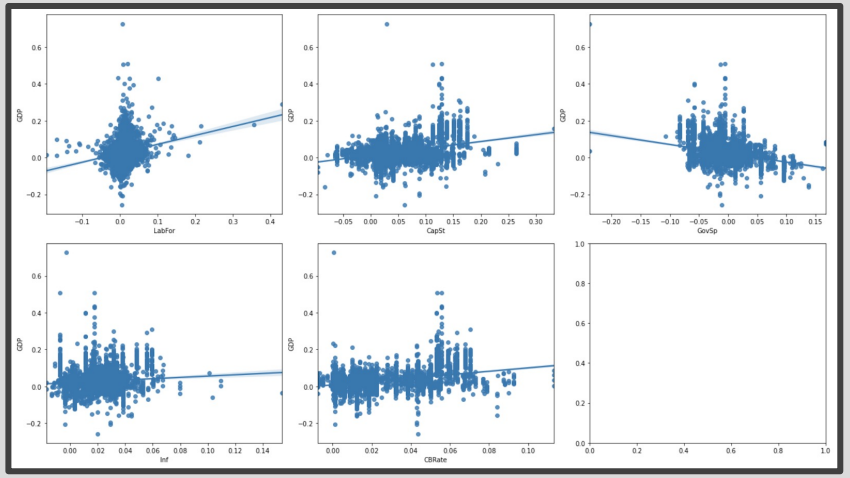
27
Cities in China built metros

40
Cities already had metros

Response Variable: GDP

- Data from BEA of U.S. Dept of Commerce, OECD, NBS of China
- Used percentage change
  - By taking the percentage change, we lost the first year of data for all cities and had to remove them

Confounding Variables



- Labor force – strong positive correlation with GDP
- Capital Stock – positive correlation
- Government Spending – strong negative correlation
- Inflation – weak positive correlation
- Central Bank Rate – weak positive correlation

Propensity Score Matching & T-Test

Split The Dataset

City
Create a treatment indicator for each city

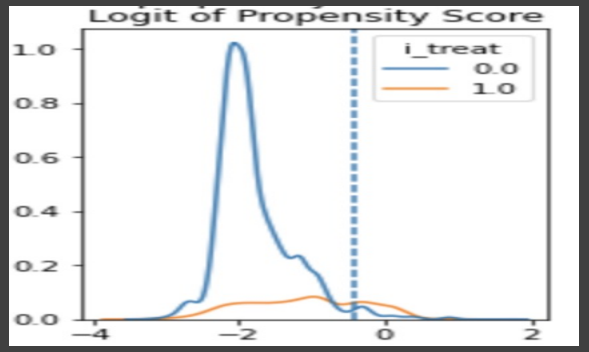
Control
City has no subway

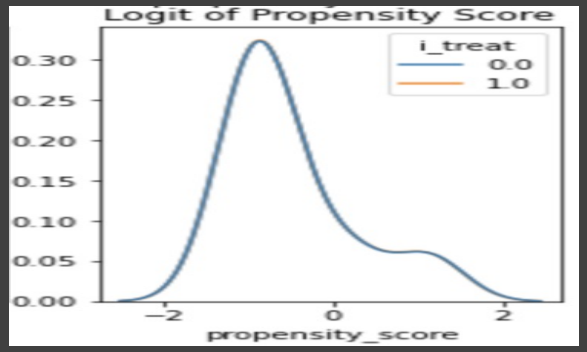
Treatment
City has subway as of 2021

Pre Treatment
Post-treatment indicator equals 0 for the years before a subway is built

Post Treatment
Post-treatment indicator equals 1 for the years after a subway is built

Match The Cities





- Logistic Regression: regress the treatment indicator on the cities' confounding variables
- Took log odds of those probabilities
- Use the nearest neighbor method to match each treatment data to a similar control data (maximum distance = 25% of one standard deviation)

Compare The Mean

- Calculated mean GDP growth in the year after the treatment city built the subway station for the entire treatment group and the entire control group
- Took difference
- Performed a two sample T-Test

Mean of Treatment ____ **Mean of Control** ____

3.8 Percentage Points Difference

Results & Conclusions

R- Squared = 0.476 **AIC**= -2.310e+04
Adj R-Squared = 0.474 **BIC**= -2.301e+04

	Coef	Std Err	t	P>|t|	[0.025	0.975]
Const	0.0174	0.002	8.726	0.000	0.014	0.021
I_Pos_Treat_2yr	0.0139	0.007	1.905	0.057	-0.000	0.028
I_Pos_Treat_1yr	0.0225	0.007	3.006	0.003	0.008	0.037
I_Post Treat	-0.0334	0.003	-11.997	0.000	-0.039	-0.028
I_Treat	0.0391	0.003	14.527	0.000	0.034	0.044
Inflation	-0.7515	0.046	-16.188	0.000	-0.842	-0.660
Gov Spending	-0.4741	0.016	-30.138	0.000	-0.505	-0.443
Capital Stock	0.1602	0.013	12.545	0.000	0.135	0.185
Labor Force	0.1861	0.024	7.804	0.000	0.139	0.233
C. B. Rate	0.3756	0.036	10.573	0.000	0.306	0.445
Previous GDP	0.3227	0.012	27.846	0.000	0.300	0.345
Year	-0.0024	0.000	-5.489	0.000	-0.003	-0.002
Year Squared	0.0001	2.38e-05	5.681	0.000	0.014	0.021

Regression Results

- Even controlling for all the covariates, the treatment group's GDP growth exceeds the control by 3.91 pp
- The treatment impact is positive in the short term but negative overall

Possible Explanations

- Opportunity cost: subway might not be the best investment
- Diminishing return: the subway becomes outdated and mal-adapted to the city's changing demands

Caveats

- The pre-treatment data is missing for many cities in developed countries
- The few cities that built a subway in 2002-2019 we have data for are concentrated in China