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Session E1: Equity and distributional considerations for users and non-users of economic-induced transportation investments.

CAUSAL LINKAGES BETWEEN PUBLIC CAPITAL, PRIVATE CAPITAL AND ECONOMIC GROWTH

EIRINI KASTROUNI,
NADIA GKRITZA &
MATTHEW G. KARLAFTIS

Outline

- Introduction
- Literature Review
- Data
- Methodology
- Results
- Conclusions

Introduction

- Investment in public infrastructure:
  - Engine for economic growth
  - Positive spillover effects
  - Contributes positively and significantly to a country or region's economic development

- Two major questions addressed in this presentation:
  1. *What is the magnitude of this contribution, its relative importance in comparison with private investment?*
  2. *Do different methodological approaches for measuring this connection yield different results?*

Literature Review

Study	Country	Analysis Level	Production Function	Output Elasticity of Public Capital
Mera (1973)	Japan	Regional	Cobb-Douglas	0.20
Eberts (1986)	U.S.A.	Metropolitan	Translog	0.03
Costa *et al.* (1987)	U.S.A.	State	Translog	0.20
Aschauer (1989)	U.S.A.	National	Cobb-Douglas	0.39-0.56
Munnell (1990)	U.S.A.	State	Cobb-Douglas/ Translog	0.15
Garcia-Mila & McGuire (1992)	U.S.A.	State	Cobb-Douglas	0.04
Ozbay *et al.* (2007)	U.S.A.	State	Cobb-Douglas/ Translog	0.21

Database

- Panel data for the 48 contiguous states in the U.S.
- Time Period: 1969-1988
- Why this database?
  - Most previous studies used the same time period
  - We can compare our results with previous results from the literature review

Data – Descriptive Statistics

Variable	Mean	St. Dev.	Min.	Max.
Gross State Poduct (1000$– 1982)	61,834.8	71,247	4,296	466,193
Total Public Capital (1000$ – 1982)	25,528.3	28,073.7	2,627.1	145,322
Highway Capital (1000$ - 1982)	10,330.2	9,272.5	1,816.9	47,699.4
Water Capital (1000$ - 1982)	3,760.4	4,483.4	228.5	27,209.4
Other Public Capital (1000$ - 1982)	11,421.7	14,890.8	538.5	80,728.1
Private Capital (1000$ - 1982)	60,910.7	63,329.2	4,052.7	40,0653
Per Capita income ($– 1982)	5,456.8	4,114.1	669.9	19,946.1

Methodological Approach

- Stochastic Frontier Production Analysis
- 2 functional form specifications:
  - Cobb-Douglas
  - Translogarithmic
- Fixed Effects to account for panel data use
- State-level analysis
- Granger Causality Test
  - Time lags 1 to 5 years

	Dependent Variable: GSP			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Independent Variables	**Coeff. Estimate**	**Coeff. Estimate**	**Coeff. Estimate**	**Coeff. Estimate**
Total Public Capital	0.73	0.75	-	-
Highway Capital	-	-	0.17	0.19
Water Capital	-	-	0.35	0.34
Other Public Capital	-	-	0.16	0.17
Private Capital	0.36	0.33	0.34	0.33
Per Capita Income	-	0.05	-	0.01
# of obs	960	960	960	960

Output Elasticities – Cobb-Douglas

Discussion:

- Total public capital seems to be the most influential in terms of contribution to economic development.
- Private capital investments also boost economic growth.
- All tested variables contribute positively to economic development.
- Highway capital affects GSP, but at a lower degree
- Per capita income is statistically significant in 2 out of 4 models, however the magnitude of effect is very small.
- Output elasticities for all variables: less than 1 → inelastic

All variables are stastically significant at a level of significance equal to 95%

	Dependent Variable: GSP	
	Model 1	**Model 2**
Independent Variables	**Coefficient Estimate**	**Coefficient Estimate**
Total Public Capital	1.11	1.29
Private Capital	-0.56	-0.67
Total Public Capital * Private Capital	0.40	0.33
(Total Public Capital)^2	-0.48	-0.42
(Private Capital)^2	-0.28	-0.21
Per Capita Income	-	0.04
# of obs	960	960

Output Elasticities - Translog

Discussion:

- Total public capital seems to be the most influential in terms of contribution to economic development (output elasticity>1 → elastic)
- Private capital investments also affect economic growth, however in a negative way and at a lower degree.
- Per capita income is statistically significant in 1 out of 2 models, however the magnitude of effect is very small.

All variables are statistically significant at a level of significance equal to 95%

Granger Causality Test

- Causality: whether evidence supports that changes in one variable cause changes in another
- H_0: Y does not Granger-cause X
- Test-statistic: $S = \frac{T(SSR_0 - SSR_1)}{RSS_1} \sim \chi^2(m)$
- Time lags: 1 to 5 years
- Level of significance: 95%
- 3 sample states:
  - South Dakota (low population)
  - Missouri (medium population)
  - New York (high population)

Granger-Causality Test Results

	1 lag	2 lags	3 lags	4 lags	5 lags
S. Dakota	×	×	✓	✓	✓
Missouri	×	×	×	✓	✓
New York	×	×	×	×	✓

- Whether public capital Granger-causes gross state product

	1 lag	2 lags	3 lags	4 lags	5 lags
S. Dakota	×	×	×	✓	✓
Missouri	×	✓	✓	✓	✓
New York	×	×	×	✓	✓

- Whether private capital Granger-causes gross state product

	1 lag	2 lags	3 lags	4 lags	5 lags
S. Dakota	✓	✓	✓	✓	✓
Missouri	✓	✓	✓	✓	✓
New York	×	✓	✓	✓	✓

- Whether gross state product Granger-causes public capital

Conclusions – Output Elasticities

- Translogarithmic output elasticities are greater than the Cobb-Douglas output elasticities
  - possibly due to the fact that the translogarithmic function may suffer from multicollinearity

- Compared to previous studies:
  - Higher output elasticities of public capital for both Cobb-Douglas and Translog specification

- Output elasticities' signs differ depending on the method chosen (e.g. privatecapital)

- Policy recommendations may vary depending on the modeling type used

Conclusions – Granger Causality Test

- Public capital Granger-causes gross state product
  - Time lag increases respectively to the state's population increase
- Private capital Granger-causes gross state product,
  - Relationship between time lag and state's population size: vague
- Gross state product Granger-causes public capital
  - Shorter time lag related to the state's population size

Thank you

Questions?