How Productive is Infrastructure?

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Roads are correlated with productivity

Note: Linear trend is removed from level of productivity and road stock before plotting
Explanations for link between productivity and public capital

- Public Capital $\Rightarrow$ Productivity?

- Productivity $\Rightarrow$ Public Capital?

- Correlation spurious, or reflects common factors?
Summary of Macroeconomic Literature

- Infrastructure appears either:
  - Enormously Productive (Aschauer, Munnell, and others)
  - Unproductive or Counterproductive

- Few studies deal carefully or explicitly with statistical issues of causation
  - Eberts 2000 (How Levels of Investment in Transportation Affect Economic Health) has a nice survey of this literature
Advantages of aggregate econometric studies

- Often we want to understand effects on cities, industries, the overall economy...
- If individual projects are generally worthwhile, then the benefits should show up in aggregate statistics
- Some benefits may be hard to measure in terms of specific projects
  - Firms in Chicago may benefit from, say, better roads in Ohio
  - More generally, network benefits (and even some costs) may be difficult to measure at level of individual projects
Disadvantages of aggregate econometric studies

• Statistical problems disentangling cause and effect
• Imprecise estimates
• Don’t tell you much about where to spend the marginal dollar, e.g.,
  • General: new construction v. better maintenance?
  • Specific: which particular projects to build?
Fernald *Roads to Prosperity?*
(American Economic Review 1999)

- Allows endogeneity to arise from *aggregate* shocks
  - Roadbuilding may respond to overall economic conditions

- Uses vehicle intensity to proxy for industry road use
  - Industries with lots of vehicles presumably use roads a lot, and should benefit most from them

- Model services of roads as subject to congestion
  Roads have become more congested over time--e.g., miles driven have risen sharply
Overview of estimating equation

• Industry TFP growth $dp$ depends on technology $du$ and contribution of infrastructure services $dg$.

$$dp_i = E_{Gi}dg + du_i = E_{Gi}dg + \bar{du} + \varepsilon_i$$

• Infrastructure might be endogenous, depending on aggregate (or average) technology, so we can’t estimate:

$$\bar{dp} = \bar{E}_Gdg + \bar{du}$$

• But if we assume infrastructure elasticity is proportional to “vehicle share” $s_{Vi}$, we can run:

$$dp_i - \bar{dp} = (E_{Gi} - \bar{E}_G)dg + \varepsilon_i$$

$$= \varphi_i(s_{Vi} - \bar{s}_V)dg + \varepsilon_i$$
Modeling infrastructure services

- Services could be proportional to road stock:
  \[ dg = d(\text{Road Stock}) \]

- But if congestion is important, perhaps it depends on roads relative to usage, e.g.:
  \[ dg = d(\text{Road Stock}/\text{Miles Driven}) \]

- Data are consistent with road congestion becoming important only after about 1973
The estimate before 1973 (when the interstate highway system was mainly being built) implies a rate of return of around 100 percent/year.

The post-1973 point estimate still implies about a 30 percent rate of return, but not statistically significant.

No evidence of abnormal rate of return today.
Conclusions

• Vehicle-intensive industries benefited disproportionately from the interstate highway system.
  • When road growth increased, productivity growth tended to rise faster than average in industries with a lot of vehicles.
• But the industry data don’t support view that roads offer an abnormal return at the margin.
• Unfortunately, policymakers can’t avoid difficult (microeconomic and project-based) questions about where, at the margin, dollars are best spent.