How Productive is Infrastructure?

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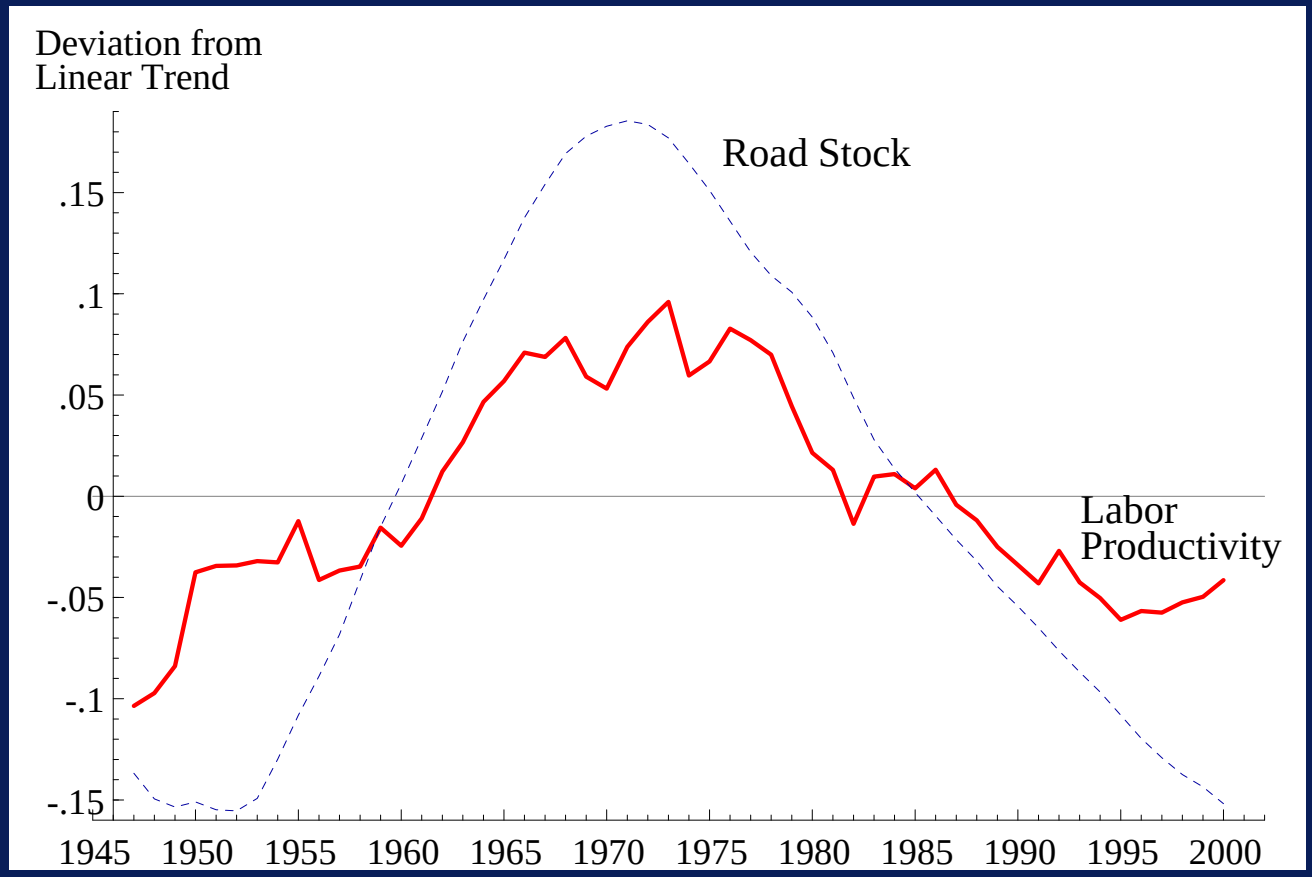
Roads are correlated with productivity



Note: Linear trend is removed from level of productivity and road stock before plotting

Explanations for link between productivity and public capital

- Public Capital => Productivity?
- Productivity => 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:

$$\overline{dp} = \overline{E_G}dg + \bar{du}$$

- But if we assume infrastructure elasticity is proportional to "vehicle share" s_{Vi}, we <u>can</u> run:

$$dp_i - \overline{dp} = (E_{Gi} - \bar{E}_G)dg + \varepsilon_i$$
$$= \varphi_i(s_{Vi} - \overline{s_V})dg + \varepsilon_i$$

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.:

$$dg = d(\text{Road Stock/Miles Driven})$$

- Data are consistent with road congestion becoming important only after about 1973

Selected result (Table 4 from paper)

σ(Pre-1973)	17.1*
	(3.1)
σ(Post-1973)	5.3
	(4.5)

- 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.