The Global Infrastructure Gap: Potential, Perils, and a Framework for Distinction by Camille Gardner and Peter Blair Henry

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Gardner and Henry's Comprehensive Overview of Infrastructure Gaps

- Main question: Is there really an "infrastructure gap" from the viewpoint of a benevolent social planner?

- Gardner-Henry offer many insights to help answer this question:

  - Develop dual hurdles based on alternative returns from rich country private capital and poor country private capital.

  - Reveal the lacuna of up-to-date estimates of returns.

  - Discuss factors that drive returns on poor country infrastructure.

  - And many more.

Main Theme

- Is there really an “infrastructure gap” from the viewpoint of a benevolent social planner?

- They argue that the planner should compare a country’s social rate of return on infrastructure (r_x) to two other hurdles:

  (i) own country rate of return on private capital (r_k)

  (ii) foreign country rate of return on private capital (r_{k*})

Outline of My Discussion

1. Discussion of hurdles.

2. Strategies for Estimating the Returns to Infrastructure Spending

   - Production function estimation
   - Natural experiments
   - RCTs

3. Difficulties in measuring social returns: what's left out of the production function approach.

4. Using congestion as a way to finance infrastructure and improve allocation: user fees.

Comments on Pass-Rate on Dual Hurdles

- Gardner and Henry result: Using Canning and Bennathan (2000) estimates, they find that only 7 of the 53 poor countries cleared the dual-hurdle efficiency tests in both roads and electricity.

- However, there is a more pessimistic conclusion than is deserved – why should we view roads and electricity as a joint package?

- Table 2 shows they do better when considered separately:

  - Panel A shows 21 of 26 poor countries pass the dual hurdle test for paved roads in 1985.

  - Panel B shows 18 of 49 poor countries pass the dual hurdle test for electricity generating capacity.

- I will have more to say about electricity later.

Do We Really Need to Consider Two Hurdles?

- With perfect capital markets, rates of return on private capital should be equalized: $r_k = r_{k^*}$.
- What would make $r_k \neq r_{k^*}$?
  - Limited access to foreign loans → $r_k > r_{k^*}$
  - Limited domestic ability to invest abroad → $r_k < r_{k^*}$
- 74 of 75 country/infrastructure type combos involve $r_k > r_{k^*}$

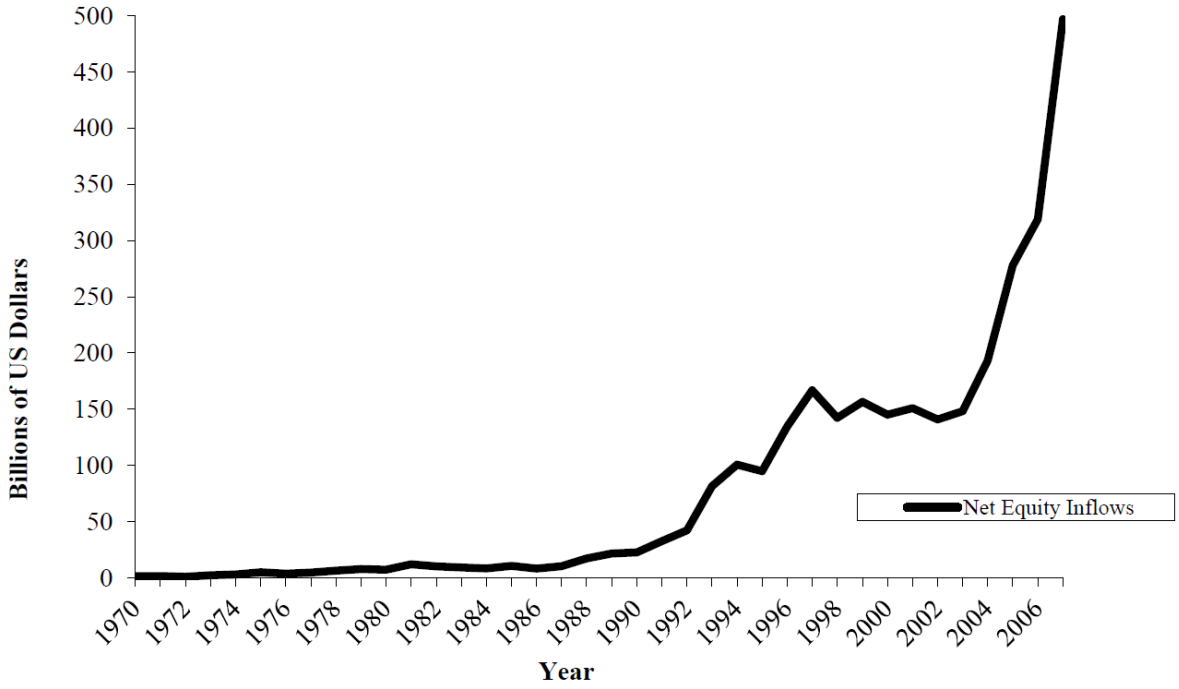
→ Quadrant II (where $r_k < r_x < r_{k^*}$) is rare

→ Sufficient to compare r_x to only one hurdle: r_k.

Why 1985 Estimates are Obsolete

Gardner-Henry provide evidence of the effects of the easing of legal barriers on foreign private capital inflows into poor countries

Figure 3. Net inflows of portfolio equity to poor countries soared after they eased restrictions on foreign ownership of domestic stocks in the late 1980s and early 1990s.



The data come from Global Development Finance (2011). The series is the sum, across Lower and Middle Income Countries, of: Portfolio equity, net inflows (BoP, current US$) and Foreign direct investment, net (BoP, current US$).

Strategies for Estimating the Return to Infrastructure Spending

1. Estimate a production function.

Aschauer (1989), Munnell (1991), Canning and Bennathan (2000)

$$ln(Y_t) = ln(A_t) + \theta_K \cdot ln(K_{t-1}) + \theta_N \cdot ln(N_t) + \theta_G \cdot ln(K^G_{t-1})$$

- The challenge is the endogeneity of public capital choices.

  - A rise in TFP (A_t) raises the optimal level of public capital K^G.

  - TFP is typically not observed, so OLS on this equation will produce estimate of θ_G that combines effect of A and K^G.

- Canning-Bennathan employ a very creative use of cointegration to overcome this issue.

  If a country's TFP in the long-run is determined by the world technology frontier, then the cointegration estimates in a panel dataset should be unbiased.

Strategies for Estimating the Return to Infrastructure Spending

2. Natural Experiments

e.g. Kraay (2012, 2014) work using World Bank funding.

3. Randomized Control Trials

e.g. Lee, Miguel, Wolfram (2020)

The problem with these two methods is that the data often do not permit an estimation of longer-run effects.

The Challenge of Measuring the Returns to Infrastructure: The Case of Electrification

Numerous papers haven't been able to find big impacts of electrification, e.g.

- Cowan Paradox: "More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave" 1985.
- Ramey (2009) J. of Economic History, "Time Spent in Home Production in the 20th Century U.S." – time spent in home production by housewives declined by only a few hours per week from 1900 to 1960s.
- Lee, Miguel, Wolfram (2020) – RCT in rural areas in Kenya. Estimated consumer surplus is only 1/5th the cost of constructing the electrical grid.

Long-Run Returns to Electrification

But other work suggests ways in which electrification had important impacts on U.S. historical development. In particular,

- Lewis (2018) found that rural electrification in the U.S. from 1930-1960 led to substantial declines in infant mortality.

- Lewis-Severini (2020) findings:

  - In the short run, rural electrification → ↑ agricultural employment, but not non-agricultural employment.

  - In the long run, rural counties with early access to electricity experienced higher growth, and rural counties near metro areas suburbanized.

Long-Run Effects of Electrification On Female Outcomes

- Cowan (1985) cited contemporary accounts that electrification and appliances allowed housewives to do the work without the help of their teenaged daughters.

- Lewis (2014, 2015) and Vidart (2022) explore these issues more.

They found that electrification raised the education levels and labor force participation rates of young women through multiple channels:

- Since education and fertility decisions are made while young, the daughters were the ones able to take advantage of new opportunities.

- The daughters were able to increase in their education because electrification freed them from household duties.

- Electrification also raised the labor market demand for educated females, since brains become more important than brawn → new jobs as secretaries, etc.

Long-Run Effects of Electrification On Female Outcomes

These results led Lewis (2015) to conclude:

"The results have relevance for current electricity policy in the developing world today, where 1.3 billion individuals lack access to electricity. In particular, they suggest that studies that focus on the immediate impact of new electrification projects may understate the long-term benefits of these infrastructure projects."

Using the Presence of Congestion to Finance Infrastructure

- Pure public good features: nonrivalry in consumption and non-excludability in use.

- But infrastructure in developing countries is often partially rivalrous in consumption (due to congestion) and excludable in use (e.g. tolls and other user fees).

- Let's think about some stylized production functions.

Optimal Capital – Stylized Neoclassical Model

$$Y = A K^{\theta_K} N^{\theta_N} K_G^{\theta_G}$$

Production Function

$$\theta_K = \alpha, \qquad \theta_N = 1 - \alpha$$

Increasing returns to scale in public capital.

$$\theta_K = \alpha, \qquad \theta_N = 1 - \alpha - \theta_G$$

Constant returns to scale in public capital

$$\frac{K_G}{Y} = \frac{1}{\beta^{-1} - 1 + \delta_G} \cdot \theta_G$$

Optimal ratio of public capital to output

Production Function with Congestion Externality

$$y = A k^{\alpha} n^{1-\alpha} \left(\frac{K_G}{K^{\alpha} N^{1-\alpha}} \right)^{\theta_G}$$

- Private firms choose y, k, and n and don't take into account congestion externality.

- The private market K/Y is distorted upward relative to the socially optimal amount

$$\frac{K}{Y} = \frac{\alpha}{\beta^{-1} - 1 + \delta}$$ Decentralized K/Y

$$\frac{K}{Y} = \frac{\alpha(1-\theta_G)}{\beta^{-1} - 1 + \delta}$$ Optimal K/Y

- Investing in public capital and financing it by taxing labor and capital income is optimal ($\tau = \theta_G \beta$).

But User Fees Might be More Politically Palatable

- Gardner and Henry discuss some of congestion on current infrastructure, roads in particular (e.g. Bangkok commutes).

- User fees serve triple purpose: (i) reduce congestion; (ii) help fund infrastructure; (iii) reveal private valuations.

Indian toll road, featured on otpp.org.

The Ontario Teacher's Pension Plan invests in a portfolio of toll roads in India.

Conclusions

- The Gardner and Henry paper offers a comprehensive overview of the issues involved in infrastructure spending in developing countries.

- They offer a useful framework for analyzing when projects are worthwhile.

  - Their framework is like a “recipe.”

  - However, the quality of the final dish depends on both the recipe and the ingredients.

  - We are currently woefully short of fresh ingredients, i.e., up-to-date estimates of rate of returns on infrastructure spending.