ELECTRIFICATION RATES ACROSS DEVELOPING COUNTRIES: FINDING AN EFFICIENCY FRONTIER

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Overview

Energy poverty indexing is only as helpful as it is instructive. Frontier analysis provides efficiency ratings which highlight underutilized input factors. This analysis compares 52 developing countries' existing infrastructure relative to their electrification rates. Hence, the results provide concerned nations not with a mere ranking, but a set of peers with which to compare themselves and specific areas to leverage to most easily increase access to electricity. This index doesn't just highlight which countries are not meeting their potential, it provides a roadmap to better energy infrastructure. The five variables in this simple model are share of population with GDP per capita, improved drinking water access, sanitation services, telephone landlines and use of solid fuels.

Note that this is preliminary piece of research. Going forward, imports and domestic production of fossil fuels as well as suitability for renewable resources will be added to the analysis along with a wide range of other variables like miles of installed power lines and physical distribution of populations.

Energy Poverty is defined as lack of access to reliable electricity. Hence, we focus on share of population with electricity. While simple, this statistic covers many important factors.

Replacing solid fuels with electrical heat drastically reduces local pollution. Electrical lighting allows children to study at night. For homemakers it saves many hours of work in preparing food. Additionally, it permits mobile phone ownership.

Methods

Data Envelopment Analysis allows comparison between an inefficient country and the group of peers: countries to which it has the most similar level of infrastructure in figure. Moreover, the analysis shows how far from the frontier an underperforming country is in each type of infrastructure.

Additionally, we plan to augment this research with stochastic frontier analysis. The nation-level variables used here are notoriously difficult of standardize across countries and regions. (Are all the nomads in the Sahara counted in our electrification rate? How do we compare this measurement error to those faced by tropical nations which have to count people living in jungles?) Stochastic frontier analysis allows for errors in those measurements and attempts to distinguish what share of distance from the frontier can be attributed to measurement error versus actual under performance.

Results

Generally, most countries are quite close to the frontier, with an average efficiency rating around 0.95. Near half the countries are fully efficient, or on the border.

While Mozambique has a much lower rate of electrification than Sri Lanka (15 vs 77 percent), it has a full efficiency rating of 1.00 while Sri Lanka has the lowest of observed countries at 0.699. How does Mozambique maintain a full efficiency ranking despite providing electricity to a much smaller share of its population than Sri Lanka? It is much poorer than Sri Lanka in many regards. Mozambique has one seventh the output (per capita) of Sri Lanka, and while Sri Lanka already has drinking water and improved sanitation services for almost all of it population, Mozambique has yet to get such service to a majority of its people. Hence, Data Envelopment Analysis controls for the difference in the wealth and infrastructure between these two nations.

Conclusions

Once controlling for income and infrastructure we see Mozambique is on the frontier while Sri Lanka is far from it as is evident in tables. This is the finding we would have hoped for as Mozambique, a relatively poor country, is rich in natural gas and has pursued a concerted government initiative to extend electricity access across its populace. Sri Lanka, on the other hand, has been mired in civil conflict for decades in civil violence. Further research into the causes of these disparities are planned before the conference, including regressing control variables on countries' distance from the frontier to determine what factors most strongly impact countries' abilities to provide electricity to their populations.