***THE IMPACT OF ELECTRICITY ON ECONOMIC DEVELOPMENT:***

***A MACROECONOMIC PERSPECTIVE***

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## Overview

This paper attempts to answer the following questions: How serious do electricity supply side problems have to be in order to constitute a serious brake on economic growth and to what degree has electrification prolonged or accelerated economic growth? What can be learnt from development experience of countries that have invested successfully in electrification systems?The paper was produced as a “state of knowledge paper” as part of a large project (“Energy for Economic Growth”) on electricity and economic growth in Sub-Saharan Africa and South Asia funded by the UK Department for International Development. We find that electricity use and access are strongly correlated with economic development, as theory would suggest. Despite large empirical literatures and suggestive case evidence, there are, however, few methodologically strong studies that establish causal effects on an economy-wide basis. There is some evidence that reliability of electricity supply is important for economic growth. We propose that future research focuses on identifying the causal effects of electricity reliability, infrastructure, and access on economic growth; testing the replicability of the literature; and deepening our theoretical understanding of how lack of availability of electricity can be a constraint to growth.

## Methods

## The paper consists of a literature review with some bivariate regression analysis to determine what are the stylized facts.

## Results

While electricity access is likely not sufficient for economic growth, the data show that electricity use and GDP tend to go hand-in-hand. Theory also suggests that electricity access is likely to be an important enabler of broad-based economic growth. But the review found limited existing empirical research of a high methodological quality, especially in terms of establishing causal effects.

The simple original empirical analysis in the paper finds that GDP and electricity use per capita are strongly positively correlated across countries with a roughly one to one proportional effect of economic growth on electricity use. There are also strong positive correlations between the level of GDP per capita and both electricity access and electricity reliability. There are negative correlations between the costs of both electricity connections and electricity use and GDP per capita. However, correlations between the rate of economic growth and other electricity and development outcome variables are weak and often negative because there is a weak negative correlation between the level and rate of growth of GDP per capita. This means that if there are actually strong connections between the rate of economic growth and electricity availability, more sophisticated techniques will be needed to uncover them.

The time series literature on electricity use and economic growth that uses the Granger causality approach is large but mostly inconclusive. However, the paper suggests that further meta-analyses or time series studies of the existing type would probably not be productive. Existing studies almost all suffer from omitted variables bias – testing the effect of electricity on growth while not controlling for other energy sources. Even a well conducted study will struggle with the likely small size of the effect of electricity on growth compared to the effect of income on electricity use and the various opposing ways that changes in electricity use might be related to changes in GDP. Estimation of structural models that can isolate and identify different channels of influence might be helpful.

The paper also found few methodologically strong studies on electricity infrastructure and growth, and even the best study using international data (Calderón, Moral-Benito, and Servén, 2015) does not specifically identify the effect of electricity infrastructure but instead aggregates electricity infrastructure with other infrastructure indicators. The results from the best quality studies find that the elasticity of GDP with respect to electricity generation capacity is between 0.03 and 0.1. Andersen and Dalgaard (2013) analyze the effect of electricity quality on economic growth in countries in SSA. Their results imply very large changes in the economic growth rate due to outages – a one standard deviation increase in outages is associated with a reduction in the rate of economic growth of 1.5 percentage points. This surprisingly large effect warrants further investigation.

Finally, while case studies of the growth outcomes of electrification success stories are suggestive, firm conclusions on the role of electricity in economic development would benefit from more rigorous statistical evidence. This is because in countries such as Vietnam or China many other policy changes accompanied the drive for greater electrification. In the more successful cases in Africa including Egypt, South Africa, and Ghana reliability remains a serious issue, which anecdotal evidence suggests has limited growth dividends.

## Conclusions

As a result of this research and feedback from stakeholders at workshops held in Kathmandu, Dar Es Salaam, and Washington DC, we propose the following priority questions for future research in order of priority:

1. What is the effect of electricity supply disruptions on economic growth?
2. Does electricity sector success boost economic success? This question is to be addressed with cross-country econometric research rather than the case study approach used in this paper.
3. How robust is the effect of electricity infrastructure on economic growth?
4. Are the key findings in the electricity-growth literature replicable?
5. How can electricity be a “binding constraint” on economic growth? Here a theoretical model needs to be developed.
6. Can a new generation of time series models better identify the role of energy in economic growth?

## References

Andersen, Thomas Barnebeck, and Carl-Johan Dalgaard. 2013. “Power Outages and Economic Growth in Africa.” *Energy Economics* 38: 19–23.

Calderón, Cesar, Enrique Moral-Benito, and Luis Servén. 2015. “Is Infrastructure Capital Productive? A Dynamic Heterogeneous Approach.” *Journal of Applied Econometrics* 30: 177–98.