PRODUCTIVITY AND ENERGY INTENSITY IN LATIN AMERICA

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Overview

The paper seeks to study the relationship between energy intensity—the amount of energy used per unit of output—and productivity. As countries develop, economies shift from agriculture, to industrialization, to services, which each, in turn, is characterized by different energy needs, being the intermediate stages of development the most energy intensive. This study seeks to assess the relationship between these variables in the industrial sector of four Latin American countries: Brazil, Chile, Peru and Mexico. Under alternative measures of productivity, namely, average labor productivity and total factor productivity (TFP), we find a statistically negative relationship between productivity and Energy intensity.

This paper intends to contribute to the literature in two ways: first, to our understanding there is no other study that has set out to explore the relationship between energy intensity and productivity narrowly defined as we do, and at the industrial-sector level. Second, we believe that a deeper understanding will come from studying the nexus between productivity-enhancing managerial interventions and their effect on energy and non-energy inputs alike.

Methods

First we look at correlations between energy intensity and productivity. These associations control for industry, country, and year for comparison purposes but do not probe the underlying determinants of energy intensity. Second, we run regression models to focus our attention on the link between energy intensity and productivity and based on industrial surverys and on country-level data, we run regression models to focus our attention on the relationship between energy intensity and productivity with the following controls variables: (i) investment in machinery and equipment, (ii) government education expenditure (as a proxy for human capital investment), (iii) energy production from hydropower (as a proxy for energy availability), (iv) energy imports (as a proxy for energy sufficiency), (v) trade volumes, (vi) electric power transmission and distribution losses (as a proxy for the quality of the power supply).

As for productivity, we work with two measures of productivity that are calculated by sector: 1) Total Factor Productivity (better known as Solow residual) and the 2) average labor productivity or output per worker. TFP can be tied to general improvements in the use of capital and labor; while, labor productivity relates to the complementarity between capital and labor and any other efficiency enhancements in the overall production process.

The data used for this study is based on publicly available sources from annual industrial surverys of Brazil, Chile, Mexico, Peru and the United States as well as country-level sources from the World Bank. Industrial surveys are representative surveys of the countries'industrial sector and are usually the basis of the calculation of the contributrion of industries to economic activity. The period covered in the analysis of the longest samples is for the years 2003 to 2014. Although data from manufacturing surveys spans up to 2015 in some cases, country variables only covered up to 2014.

Results

The model estimations confirm, for the most part, the expectation on the determinants of Energy Intensity that controlling for time, country, and industry EI is positively associated to investment in machinery and equipment because of the associated energy use. Government investment in education increases EI as part of the transition towards industry and eventually towards services, which at such point there would be another shift towards lower energy intensity. The estimation of the coefficient, though positive suggestive of industrialization, is not statistically significant. In terms of the countries' energy endowment, higher hydro generation presents a positive coefficient in connection to EI, but it is statistical significant in only one of the models, suggesting a form of comparative advantage stemming from such resources. Linked to endowments, too, more energy imports lower EI, pointing towards less specialization on energy intensive processes. Openness to trade is linked to higher EI which can reflect

a sharper industrial export profile. Power transmission losses are important to control as a potential deterrent to investment in energy intensive sectors; however, the point estimates suggest higher EI, this finding warrants further exploration. A possible explanation involves firms' investment in their own power generation capacity, as documented in IDB (2016).

The core of the question under study concerns the connection between EI and productivity. The findings on productivity reveal again that both, TFP and value added per worker are negatively related to EI. Higher EI means lower productivity.

Conclusions

The findings point that regardless of productivity measure, productivity and energy intensity move in oppositve directions. One possibility underlying this relationship is that productivity-enhancing interventions reduce energy and non-energy inputs alike. With this in mind, policies aimed at facilitating new vintage investment in physical capital, and incentives for more efficient factors use, shall increase productivity, either measured by TFP (residual of capital and labor) or average labor productivity.

Given the robustness of the findings, future research should be geared towards a finer level of data analysis, such as firm-level, and account for the recent findings in productivity trends

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