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The nexus between access to electricity and labour productivity in developing countries

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ABSTRACT

Due to the importance of the access to electricity in enhancing the prosperity of human kinds, this paper examines the impact of this access on labour productivity in developing countries in presence of gross capital formation, FDI, financial development and economic growth. It employs the panel cointegration tests of Pedroni (2004) and Westerlund and Edgerton (2008) with the level break/shift to a data set of 56 developing countries. The results provide evidence of a long run equilibrium relationship between access to electricity and labour productivity for developing countries in presence of the control variables. Furthermore, the Dumitrescu and Hurlin (2012) heterogeneous panel non-causality test underscores a bidirectional causal relationship between these two key variables in the short-run. Based on these results, we recommend that policymakers ensure access to electricity for mass people in developing countries to increase productivity and thus to improve the living standards of their citizens. The paper also provides specific policy initiatives related to the individual control variables in order to ensure access to electricity to advance productivity growth in the majority of the people in developing countries.

1. Introduction

Access to electricity (in KWH per capita) plays an important role in ensuring progress and prosperity of human kinds in multifaceted ways. It has been playing a predominant role in eradicating poverty across the world and is considered one of the major drivers in achieving the Millennium Development Goals (MDGs).[1] Very recently, the United Nations Development Program (UNDP) has included 'access to electricity' to its 'Multidimensional Poverty Index'. Walsh (2011) argues that the lack of access to electricity is not merely an indicator of poverty but it also represents the worst kind of poverty. If this poverty, known as 'energy poverty', cannot be alleviated, achieving the MDGs will be at stake especially in the poorest countries where access to electricity is still a far cry for the majority of the population. According to International Energy Agency (2015), more than 1.2 billion people in the world do not have access to electricity, of which 526 million (43%) live in South and South East Asia (i.e., 237 million in India, 60 million in Bangladesh, 50 million in Pakistan, 49 million in Indonesia and 39 million in Myanmar), in addition to 634 million (53%) in Sub-Saharan Africa (SSA). Almost half of the South Asian rural population (44%) do not have access to electricity, whereas only 13% of the rural population in the SSA have access to electricity. Although South Asia has been successful to some extent in connecting a substantial portion of the population to the power grid through continuous investments in the electricity sector, the SSA region has apparently failed to turn things around. With this evidence, it will not be an exaggeration to infer that the current global North-South digital and economic divide can be explained in large part by the difference in access to electricity.

The linkage between access to electricity and the level of poverty can be drawn through various intermediary transmission mechanisms. The overall results can, however, be reflected in the efficiency of factors of production, particularly labour. Education has long been recognized as a means to improve productivity and the extended role of electricity comes to term in regard to availability of education. Access to energy in general and electricity in particular can contribute greatly to children education in various ways including reducing their burden of domestic

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[1] https://www.iied.org/achieving-millennium-development-goals.

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work, providing them with modern learning tools, engaging them with the audio-visual learning systems. Second, electricity can improve productivity in maintaining good physical and mental health of human beings. According to the IEA (2017) estimation, about 2.8 billion people in the world rely on traditional biomass fuels in cooking, which is estimated to decline to 2.3 billion people in 2030 because of a slow progress of accessing clean energy like electricity. Smoke emissions from these fuels are identified as one of the top 10 risk factors of diseases, thereby causing about 4 million premature deaths annually (WHO, 2018). Working women of developing countries may expose to serious health hazards if they are forced by the lack of clean energy to cook using fossil fuels. Also, the society will bear serious consequences if access to electricity cannot be ensured for medical service providers. A study conducted by the World Health Organizaiton (2015) shows that up to 58% of health facilities in some SSA countries have no electricity. In such an environment, improved medical services cannot be rendered to those who are in need. This, in turn, delays the recovery from health-related problems, leading to chronic absenteeism from work as well as low productivity.

Although the issue is very timely and relevant as far as economic development of developing countries is concerned, the linkage between access to electricity and labour productivity remains largely unexplored. Very few studies are found in the existing development literature that address the concerned issue. Jorgenson (1984) for instance shows that energy plays a significant role in increasing productivity in the US. Similarly, Fan et al. (2004) find that investment in electricity has been the major contributor to agricultural productivity in Thailand. Fedderke and Bogetic (2006) in the context of South Africa, and Noumba et al. (2009) in the case of Middle East and North African find a positive association between electricity generation and labour productivity. Allcott et al. (2014) find that electricity shortages reduce average output of the Indian textile industry by about five percent. Similarly, Alby et al. (2013) argue that reliability of the power supply is positively associated with total factor productivity in garment manufacturing of Bangladesh, China, Ethiopia, and Pakistan. These studies, although noteworthy, concentrate on a single country or industry and hence conclusion drawn based on a specific country or industry may not be generalized for other countries. Moreover, the studies mentioned above do not employ solid and novel econometric methodologies often required for drawing pragmatic policy prescriptions. The current study, therefore, attempts to fill this gap.

The contribution of this study is threefold. As indicated above, this is a pioneering study that investigates the access to the electricity—labour productivity nexus in a panel framework. It employs 56 developing economies in the world which play an important role in the global economy. Hence, the findings derived from this large sample are expected to be robust and reliable that yield valuable policy implications. Second, it investigates the relationship between access to electricity and labour productivity by using the panel first and second generation cointegration tests and panel causality models. The analysis of causal relationships in the short-run by employing panel models is vital since the single equation approach ignores the causal relationships. On the other hand, the panel cointegration framework is also important to investigate the long-run relationships.

Finally, our study is fairly novel compared to the existing literature, since it employs various recently developed panel econometric techniques and applied them to many developed countries. For example, we apply the Pesaran (2004) cross-sectional dependence (CD) test to investigate whether the data series have cross-sectional dependence or not. This is an important test that should be used before the application of unit root tests since most of the traditional unit root tests assume cross-sectional independence, and thus they will have less power if applied to series that have cross-sectional dependence. Based on the results of the CD test, we employ the Pesaran (2007) cross-sectionally augmented Im-Pesaran-Shin (CIPS) unit root test, which assumes cross-sectional dependence. Moreover, we apply both the first generation and the second generation cointegration tests to investigate the long-run equilibrium association among the variables. The use of the second-generation panel cointegration test (Westerlund and Edgerton, 2008) with the level break/shift, considers the cross-section dependence, which is common in panel data and we have evidence of it in our sample data. Moreover, these tests allow for heteroskedastic and serially correlated errors along with unknown structural breaks at different time periods. To estimate the long-run elasticities, we employ the panel fully modified OLS (FMOLS). Moreover, to understand the impact of the variables under considerations on labour productivity at different levels of conditional distribution, we use the panel quantile regression analysis with panel fixed effects. Last but not least, to examine the Granger-causal relationship between the variables, we use the more recently developed Dumitrescu and Hurlin (2012) panel heterogeneous non-causality test. The novelty of this test is that it allows for heterogeneity across the cross-sections, while the conventional Granger-causality test ignores this property.

The empirical analysis of this study provides interesting and robust findings on the relationship between access to electricity and labour productivity. The robust panel cointegration tests imply that there is a long-run relationship between access to electricity and labour productivity along with the other control variables. The long-run elasticities under both the FMOLS and quantile regressions sanction that access to electricity improves labour productivity significantly in major developing countries. Further, the heterogeneous panel non-causality test supports a bidirectional causal relationship between access to electricity and labour productivity in the short-run. These findings bear significant implications for both academic research and policy formulations in the context of developing countries.

The remainder of this paper is organized into five sections. Section 2 discusses the relevant literature. Section 3 describes the data and the methodology, whereas Section 4 presents the results of the data analysis. Finally, Section 5 provides the conclusion and policy recommendations.

2. Review of the related literature

The question as to what drives productivity occupies the centre of growth economics. Also, this question has been investigated from several different dimensions across time and space. For instance, the traditional neoclassical growth model attributes the residual of productivity growth to technological progress after accounting for physical and human capital. The influential growth model of Robert Solow (1957) showed that the gross output per man hour or average productivity in America doubled between 1909 and 1949. Easterly and Levine (2002) argue that after accumulation for physical and human capital, total factor productivity (TFP) accounts for the bulk of the cross-country differences in the growth rate of gross domestic product (GDP) per capita among countries. Indeed, TFP is a black box which embodies the effect of many unexplained variables. Of course, the contemporary growth theories have made laudable endeavour to debunk this black box but there is still a lack of consensus among scholars. Easterly and Levine (2002) list several influential factors of TFP including technological change, impediments to adopting new technologies, externalities, sectoral development and cost reductions.

This neoclassical growth model which Sorrell (2010) labels as the ‘orthodox model’ recognizes no separate contributions of energy to TFP. The reason is that primary energy still accounts for a very small fraction of total factor cost, and thus energy cannot be an important source of productivity (Denison, 1979). Thanks to the low price of energy, Denison (1979) shows that the cost share of energy in the national accounts ranges between 4% and 5% for most OECD countries. However, if the energy price increases by a substantial percentage and it becomes costly to use in production processes, the neoclassical economists propose capital and labour to substitute for energy. Hence, energy cannot be considered a separate contributing factor for productivity and