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Electricity, income, and quality of life☆

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ABSTRACT

This paper looks at the effect of electricity on income, education, health, and labor productivity in Nepal. Our data comes from the Nepal Living Standards Survey-III, conducted in 2010–2011. To account for endogeneity issues, we estimate a simultaneous system of equations via the three-stage least squares (3SLS) method. We find that a household being connected to electricity has a very large and significant effect on income, educational attainment, and agricultural productivity. We find a positive but not significant effect of electricity on health. The effect of electricity on income is measured both directly and through the intermediaries of education, health, and agricultural productivity. The highly significant magnitude of electricity's impact on quality of life makes a powerful argument for the importance of including energy poverty in the development conversation.

1. Introduction

Energy use in the modern, developed world enhances every aspect of quality of life. From its effects on work productivity, to the climate controlled rooms that people sleep in; from the means of transportation people use for going to work or school, to the way people spend their leisure time. For most people, all of these aspects of life would be radically different without access to abundant, cheap, and reliable energy.

Picture New York City, Shanghai, or Paris at night. All of the human activity that takes place around the clock in large, metropolitan cities in the developed world is a fairly recent development in human civilization, and its benefits are not homogeneously distributed around the globe. A photograph of nighttime in a rural village in sub-Saharan Africa, or south-east Asia will tell a different story than those of the first world cities. For most individuals in these areas, there are few, if any, activities after sunset. Refrigerated foods and medicines are a luxury. Modern telecommunications such as cell phones, televisions, and internet access are scarce and unreliable. Transportation can be extremely costly in terms of both time and money. Massive disparities exist in terms of access to energy sources around the world. The question to be answered is to what extent this disparity impacts the quality of life of those in energy-poor regions.

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Energy poverty is defined as "the absence of sufficient choice in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development" (Masud, Sharan, & Lohani, 2007). The United Nations Development Program (UNDP) gives a more narrow definition as the "inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read or for other household and productive activities at sunset" (Gaye, 2007). As of 2010, the UNDP's Human Development Report states that 1.4 billion people around the world suffer from a complete lack of access to electricity.

A lack of access to modern forms of energy challenges the developing world in many specific ways. Providing a 21st century standard of education, schooling, access to information, clean water, sanitation, medical care, food, shelter, and income are all made more difficult without cheap, plentiful, and reliable energy. Many of the problems facing the developing world's poor are exacerbated by a deficiency in energy access. Further, solutions to these problems are hampered by the same lack of access to energy.

A lack of access to modern energy sources heavily impacts education. Without electricity, little-to-no school work may be done after dark. Schools that do not have access to electricity are not able to tap into modern technology, such as computers, which severely limits access to information.

Energy poverty also influences health outcomes in developing countries in several ways. Unpredictable and unreliable electricity makes it difficult to power health centers and refrigerate medicines, greatly affecting the quality of health services available (Birol, 2007). Energy poverty affects health outcomes at the household level as well. Without electricity, households must turn to biofuels such as wood and dung to cook, light, and warm their homes. Not only is collecting biofuels costly in time and danger of injury, but also burning biofuels indoors is one of the greatest health concerns facing the developing world (Sagar, 2005). Air pollution has disastrous effects on health and life-expectancy (Pope et al., 2002). More specifically, indoor biofuel burning in the developing world is linked to tuberculosis, lung cancer, and respiratory infections. More people die from indoor air pollution in these regions than the use of drugs, alcohol, and tobacco, unsafe sex, and malaria combined (Sovacool, 2012). Furthermore, these health risks are largely imposed on women and children, who traditionally spend much of their day gathering fuel and burning it indoors.

A predominant aspect of how a lack of access to modern energy may affect quality of life is through income via labor productivity. Abundant, affordable energy defines nearly every aspect of daily work: no electric tools and machines for construction, farm work, or cottage industry; no illumination for any type of work after sunset; no cell phones to enhance communications; and no computers for acquiring information, organization, and bookkeeping, among other things. Without modern energy, goods have to be transported either on foot or by animal labor. Without widespread, affordable energy, it is difficult for households to climb out of the poverty cycle.

Lately there has been growing interest in the field of energy poverty, and rubrics have been developed to measure and define it (Gaye, 2007; Masud et al., 2007; Pachauri & Spreng, 2004; Reddy, 1999). Studies have been done exposing the health risks, educational detriments, and productivity challenges of energy poverty (Birol, 2007; Reddy, 1999; Sagar, 2005; Sovacool, 2012). The positive impact of per capita electricity consumption on macro-level growth has been established (Shahbaz, Khan, & Tahir, 2013). Bridge, Adhikari, and Fontenla (2013) examine the simultaneously determined interrelationship of consumption and electricity access in Nepal. Khandker, Barnes, and Samad (2013) use 2002–2005 panel data for Vietnam to estimate the household-level effects of electricity on welfare. They use fixed effects methods, and find positive impacts of households connected to the grid on income, expenditures, and schooling.

This paper follows a similar approach to Bridge et al. (2013) and Khandker et al. (2013). We look at the effect of electricity on income, education, health, and labor productivity in Nepal. Our data come from the Nepal Living Standards Survey-III, conducted in 2010–2011. To account for endogeneity issues, we estimate a simultaneous system of equations via the three-stage least squares (3SLS) method. We find that a household being connected to electricity has a very large and significant effect on income, educational attainment, and agricultural productivity. We find a positive but not significant effect of electricity on health. The effect of electricity on income is measured both directly and through the intermediaries of education, health, and agricultural productivity. The highly significant magnitude of electricity's impact on quality of life makes a powerful argument for the importance of including energy poverty in the development conversation.

2. Modeling approach

The simultaneous relationship between macro-level GDP growth and macro-level electricity use has been well documented, as discussed above. However, the majority of our understanding of the impact of access to electricity on the micro-level comes through intuition and anecdotal evidence. Our research questions are (1) whether household access to electricity is interrelated with consumption levels in a statistically significant way, (2) how exactly electricity access and consumption levels are interrelated, and (3) what the relevant magnitudes are of these relationships.

The intuitive and anecdotal explanation for electricity's impact on consumption is that electricity improves health, education, and labor productivity outcomes (Birol, 2007). Fig. 1 displays a conceptual framework for these relationships.

Notice in Fig. 1 that there are several double-sided arrows indicating that causality in theory runs both ways. For example, it is understood that an increase in education will lead to an increase in income through higher earning potential. It is also true, however, that an increased amount of income enables a household to seek both higher quantities and qualities of education. Because of these bi-directional causalities, estimation of these relationships