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Impact of Electrification on Children's Nutritional Status in Rural Bangladesh

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Summary. — Access to electricity has the potential to improve the nutritional status of children by a variety of pathways such as increased wealth, reduced fertility through the change in time use, spread of information through technology such as TV, and improved health care services. Yet, the relationship between electrification and children's nutritional status is rarely explored in the literature. We attempt to fill this lacuna by offering microeconometric evidence from rural Bangladesh, where a rapid expansion of electrification and significant improvement in children's nutritional status were observed in the past two decades. We find that access to electricity has a positive impact on the nutritional status of children under five as measured by height-for-age *Z*-score (HAZ) by around 0.1–0.2 points using five rounds of Bangladesh Demographic and Health Survey from 2000 to 2014. Our results also appear to indicate that the quality of electricity may influence the size of this positive impact. While our analysis of causal pathways is limited by the data availability, it suggests that the positive impact of electrification partially comes from increased wealth. For some years, the positive impact can also be attributed to reduced fertility and information exposure through TV viewing. On the contrary, we find little evidence that the impact is attributable to the improvement of local health facilities. Our findings underscore the importance of evaluating infrastructure programs such as rural electrification from a broad perspective as their impacts may go well beyond the economic benefits considered in a typical cost–benefit analysis. This in turn may encourage governments to invest more in basic infrastructure, which is still severely lacking in Bangladesh and many other countries in the rest of South Asia and sub-Saharan Africa.

Key words — electrification, height-for-age *Z*-score, malnutrition, television, wealth, Bangladesh

1. INTRODUCTION

Access to electricity can potentially play a significant role in poverty reduction and the promotion of economic growth in developing countries. [1] It is an essential element for the adoption of information and communications technology, provision of improved education and health care services, and a range of industrial activities. Moreover, one can use electric lights at night and the extended hours with light can be used to engage in various gainful activities that were previously difficult. Despite this importance, the coverage of electricity supply still remains low in many parts of the developing world, even though recent decades have witnessed a significant expansion in access to electricity.

In Bangladesh, recognizing the importance of electrification for rural development, the Rural Electrification Board (REB) was established as early as 1977 to provide access to affordable and reliable electricity in rural areas. However, because of lack of resources and capacity, the availability of electricity in rural areas remained limited until the end of the last century. The Bangladesh Demographic and Health Survey (BDHS) for the year 2000 shows that only 21% of rural households had access to electricity in Bangladesh (NIPORT, MA, & ORC Macro, 2001). However, the coverage increased substantially thereafter and 51% of rural households had access to electricity from the national grid in 2014 (NIPORT, MA, & ICF International, 2016).

This significant improvement in the access to electricity coincided with a noticeable improvement in the nutritional status of children. In the year 2000, about 47% of rural children under five were stunted, or abnormally short for their age and gender (NIPORT *et al.*, 2001). The prevalence of stunting in rural areas dropped to 38% in 2014 (NIPORT *et al.*, 2016).

One may argue that the spread of access to electricity and improvement in children's nutritional status have simultaneously occurred because of the continuous development efforts by the Government of Bangladesh or possibly by pure coincidence. However, there are at least four reasons to believe that a causal relationship may exist between them. First, access to electricity may create new income opportunities. As a result, households may be able to have more and better food and medication, which in turn leads to better nutritional status. Second, the use of electric lights allows people to use time differently, particularly at night. This in turn may have an impact on fertility (Fujii & Shonchoy, 2017) and improve the nutritional outcome through the effect of the quantity–quality trade-off for children.

Third, nutritional status may improve through the spread of information. In particular, mass media such as TV could act as a powerful device for spreading important information about child care and nutrition to rural households. [2] Finally, the quality of health care service provided in local clinics and

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hospitals may improve as a result of electricity access, because many of the basic equipments in modern medicine require electricity.

Using five rounds of the individual-level BDHS data from 2000 to 2014, we study the impact of rural electrification on the nutritional status of children under five by comparing the children in households with and without access to electricity after controlling for various covariates. One obvious issue here is the potential endogeneity of the households' access to electricity. To address this, we adopt the instrumental variable (IV) approach and also check the robustness of our main results with respect to plausible levels of selection on unobservables. Our results consistently indicate that rural electrification positively affects children's nutritional status in Bangladesh.

We then investigate the importance of the four possible causal channels discussed above, even though our analysis is speculative due to the data limitation. Our results appear to indicate that the household's wealth is an important channel through which the household's access to electricity affects children's nutritional status. Fertility and TV channels also appear to matter, even though the evidence for these channels is weaker. In contrast, we find little evidence that the positive impact of electrification on children's nutritional status is due to improved local health facilities.

As discussed further in Section 8, there may be other causal channels. The data limitation does not permit us to test the relevance of each of these channels, but they may explain why unexplained positive impact of electrification remains even after controlling for a rich set of covariates. To the best of our knowledge, this is one of very few studies on the impact of rural electrification on the nutritional status of children and the first study to analyze four distinct channels of causality going from rural electrification to improved nutritional status of children.

This paper is organized as follows. Section 2 reviews related studies and discusses our study's relevance to and difference from existing studies. Section 3 provides some background information on rural electrification in Bangladesh. Section 4 describes the data and presents key summary statistics. Section 5 discusses the econometric specification and identification strategy. Section 6 presents our main empirical finding and conducts a range of robustness and reality checks. Section 7 explores the channels through which electrification affects children's nutritional status and Section 8 concludes.

2. REVIEW OF RELATED LITERATURE

The motivation for this study partly comes from Fay, Leipziger, Wodon, and Yepes (2005), who ran regressions of child health indicators on, among others, a basic infrastructure index—a principal component made from indices of floor material, sanitation, and access to water and electricity—using aggregate data from 39 countries and five asset quintiles. They find broadly positive effects of basic infrastructure on child health, even though their results are not robust (Ravallion, 2007) and do not directly show the impact of rural electrification. In a study of a number of developing countries, World Bank (2008) also reports that the impacts of rural electrification on nutrition is largely positive, if not always statistically significant.

However, as documented by Bernard (2012) in the context of Africa, the impacts of rural electrification on health and education, among others, remain largely undocumented. His point also applies to many other parts of the developing world. From a macroeconomic perspective, it is in general unclear whether a large infrastructure investment has a positive effect because it may be done at the expense of current expenditures and could become unproductive (Devarajan, Swaroop, & fu Zou, 1996). As Straub (2011) argues, the productivity-boosting effect of infrastructure may materialize only in the presence of certain conditions such as the right set of incentives and a critical mass of suitable human capital. Therefore, more research is clearly needed to fully understand the impact of basic infrastructure. We contribute to the literature on the impact of basic infrastructure by providing microeconometric evidence.

In particular, this study contributes to a growing body of literature on the impact of rural electrification in developing countries. In this literature, researchers have investigated various aspects of the socioeconomic impact of rural electrification. For example, positive employment or income effects were found in Bangladesh (Khandker, Barnes, & Samad, 2009), Kenya (Kirubi, Jacobson, Kammen, & Mills, 2009), Benin (Peters, Vance, & Harsdorff, 2011), South Africa (Dinkelman, 2011), and Nicaragua (Grogan & Sadanand, 2013). Several studies show that rural electrification is associated with lower fertility in Bangladesh (Fujii & Shonchoy, 2017), Brazil (Potter, Schmertmann, & Cavenaghi, 2002), Colombia (Grogan, 2016), Indonesia (Grimm, Sparrow, & Tasciotti, 2015), and Côte d'Ivoire (Peters & Vance, 2011). Studies also indicate that the schooling of children is positively associated with rural electrification in Bangladesh (Khandker *et al.*, 2009), Brazil (Lipcomb, Mobarak, & Barham, 2013), and Colombia (Grogan, 2016). Improved quality of electricity is associated with higher vaccination coverage in India (Chen, Chindarkar, & Xiao, 2016). In Brazil, rural electric access is found to reduce deforestation (Tanner & Johnston, 2017). Our study adds to this growing body of literature by examining a new dimension of impact that was not previously studied.

This study also makes a contribution to the extensive literature on the determinants of the nutritional status of children. Our nutrition model is underpinned by the UNICEF conceptual framework for child nutrition (Black *et al.*, 2008; UNICEF, 1990), which has been widely used for more than two decades. This framework identifies three layers of causes. The immediate causes of malnutrition are inadequate dietary intake and disease. These causes are affected by underlying causes such as food insecurity, inadequate care, and unhealthy household environment and lack of health services, which in turn are affected by basic causes such as lack of human and physical capital.

Our nutrition model draws from existing studies on child nutrition in Bangladesh such as Headey, Hoddinott, Ali, Tesfaye, and Dereje (2015), Headey, Hoddinott, and Park (2016) and Srinivasan, Zanello, and Shankar (2013) that are consistent with the UNICEF framework. The covariates in our model reflect the underlying and basic causes and include those covariates that were found to be among the most important determinants such as indicators of parental education, sanitary condition, demographic information, vaccination, antenatal care (ANC) visits, and asset index. We also include community-level characteristics in most specifications as these variables are also potentially important (e.g., Alderman, 2000; Banerjee, Deaton, & Duflo, 2004). Our models are also broadly consistent with existing models of malnutrition (e.g., Frongillo, de Onis, & Hanson, 1997; Haughton & Haughton, 1997; Li *et al.*, 1999; Victora, de Onis, Hallal, Blössner, & Shrimpton, 2010).

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