Utilities Policy xxx (2017) 1–9

Contents lists available at ScienceDirect

Utilities Policy

journal homepage: www.elsevier.com/locate/jup

Access to infrastructure services: Global trends and drivers

Jan Christoph Steckel [a, b, c, *], Narasimha D. Rao [d], Michael Jakob [a, c]

[a] Mercator Research Institute on Global Commons and Climate Change, Torgauer Straße 12–15, 10829 Berlin, Germany
[b] Technical University Berlin, Straße des 17. Juni 145, 10623 Berlin, Germany
[c] Potsdam Institute for Climate Change Impact Research, Telegrafenberg, 14473 Potsdam, Germany
[d] International Institute of Systems Analysis, Ecosystems Services and Management, Schlossplatz 1, A-2361 Laxenburg, Austria

ARTICLE INFO

Article history:
Received 30 September 2016
Received in revised form
1 March 2017
Accepted 1 March 2017
Available online xxx

Keywords:
Infrastructure access
Basic needs
SDGs
Fractional logit model
Global panel data

ABSTRACT

Infrastructure services are essential to human development. Yet, the drivers of service access at a global scale remain largely unexplored. This paper presents trends and global patterns in access to water, sanitation, electricity, and telephony services. Using a panel data set from 1990 to 2010, we empirically explore plausible determinants of access rates to key infrastructure services. Although per-capita GDP is correlated with access rates, access still varies significantly at comparable income levels. Much of this variation is explained by differences in population density. Access levels are higher for urban areas and highest for water, followed by sanitation, electricity, and telephony.

1. Introduction

Poverty is increasingly being understood and characterized as multi-dimensional rather than just in terms of income (Ravallion, 2011; Tsui, 2002). This view of poverty is fundamental to the United Nations Millennium Development Goals (UN, 2000) and prominent in discussions regarding the post-2015 development goals (Fukuda-Parr, 2012) that aim to refine and extend the Millennium Development Goals for the period 2015–2030 (Griggs et al., 2013). Frequently discussed goals to advance human well-being include universal primary education, gender equality, child mortality, and AIDS/HIV and malaria eradication. It has further been argued that correcting under-provision of the material foundations necessary to fulfil basic human needs through expanded access to infrastructure for, *inter alia*, water, sanitation, electricity, telephony, education, and healthcare, should be regarded as one of the central aims of public policy (Jakob and Edenhofer, 2014). This view is consistent with a broader view in social policy of a universal entitlement to basic goods (Reinert, 2011).

Against this background, it comes as a surprise that the literature related to infrastructure (reviewed in Section 2) has largely neglected its role in the provision of services to fulfil basic needs. In particular, previous studies have mostly examined infrastructure as an explanatory variable to study other development indicators, such as economic growth and inequality, instead of seeking to understand the determinants and patterns of infrastructure access. By conceiving infrastructure services as ends in themselves instead of means to achieve other policy objectives, this paper aims to fill this gap. Using a panel data set from 1990 to 2010, we explore plausible determinants of access rates to four key infrastructure services: water, sanitation, electricity, and telephony. It is to our knowledge the first study that provides a comprehensive account of global patterns and trends in infrastructure provision for a global sample of 194 countries across more than two decades. In particular, it provides an empirical analysis of the determinants of access rates to these four key infrastructure services.

This paper proceeds as follows. Section 2 reviews the literature and discusses the motivation for our inquiry. Section 3 describes stylized facts that can be derived from existing data and develops key hypotheses, which we test using a fractional logit model introduced in Section 4. Section 5 presents and discusses results and Section 6 concludes.

2. Literature

Several contributions have analysed the importance of

* Corresponding author. Mercator Research Institute on Global Commons and Climate Change, Torgauer Straße 12–15, 10829 Berlin, Germany.
E-mail address: steckel@mcc-berlin.net (J.C. Steckel).

http://dx.doi.org/10.1016/j.jup.2017.03.001
0957-1787/

infrastructure for economic growth and development outcomes (see Romp and Haan (2007) for a survey). A seminal contribution by Aschauer (1989) identified the lack of public infrastructure, such as roads, sewers, and piped water, as one of the main reasons for declining productivity growth in the US. Even though this finding has been challenged by subsequent analyses (Gramlich, 1994), cross-country comparisons have frequently found positive effects of infrastructure on productivity (Irmen and Kuehnel, 2009). Agenor and Moreno-Dodson (2006) provide a discussion of the potential mechanisms that translate infrastructure into economic growth. For a sample of OECD countries, Demetriades and Mamuneas (2000) find positive effects of public infrastructure on productivity and employment, and Calderon and Serven (2014) note that on average, higher levels of infrastructure are related to higher rates of economic growth and lower economic inequality. This general finding is confirmed by a meta-review of similar studies by Straub (2011), who also found significant heterogeneity across countries and time. Other recent studies have refined the analysis by considering *inter alia* the direct consumption benefits of public infrastructure (Haughwout, 2002), taking into account the inter-regional productivity spill-overs of infrastructure (Cohen and Paul, 2004), as well as analysing the impacts of specific infrastructure policies, such as the effect of electrification programs on wages and employment in South Africa (Dinkelman, 2011) or on the performance of micro and small enterprises in Burkina Faso (Grimm et al., 2013). Peters and Sievert (2016) recently reviewed the development effects of rural electrification across different African countries. Others have investigated the effect of dams on agricultural productivity (Duflo and Pande, 2007) or the consequences of privatizing water services on child mortality in Argentina (Galiani et al., 2005).

These studies have in common the treatment of infrastructure as an explanatory variable for a certain set of outcomes, such as economic growth. By contrast, the question of which factors determine the stock of a certain infrastructure or the extent of access to associated services has received surprisingly scant attention in the literature. Estache and Fay (2007) provide a broad descriptive overview of infrastructure investments, access rates, and policy debates related to infrastructure. Birdsall and Nellis (2003) examine the distributional effects of privatization of formerly public infrastructure on *inter alia* access to associated services. Castells and Sole-Olle (2005) observe that for the case of Spain, regional specific infrastructure needs and political factors seem to have more explanatory power for the geographical distribution of public infrastructure investment. Some authors also point out that public infrastructure investment is frequently employed as a vehicle for rent-seeking (Keefer and Knack, 2007) or a particularly inefficient redistribution device (Robinson and Torvik, 2005).

The paper closest to our study is Onyeji et al. (2012). Their empirical analysis focuses on the determinants of electricity access for a cross-section of sub-Saharan African countries, including poverty levels, gross domestic savings, energy-related gross fixed capital formation, rural population and population density. They highlight the importance of the size of the rural population and government effectiveness, finding that the latter plays a bigger role for electricity access in Sub-Saharan Africa compared to other world regions.

Our study goes beyond the existing literature in at least three ways. First, we analyse the determinants of access to (i) water, (ii) sanitation, (iii) electricity, and (iv) telephony instead of focusing on one particular infrastructure service. Second, we employ a broad sample of 194 countries, which allows us to derive inter-regional comparisons of infrastructure developments. Third, instead of relying on a cross section of data, we employ panel data for the time period 1990–2011, which enables us to analyse the evolution of access rates over time and also circumvent econometric issues related to unobserved heterogeneity (country-specific effects correlated with explanatory variables) that would introduce bias to cross-sectional estimates.

3. Stylized facts and hypotheses

In this section, we first describe stylized facts and patterns for individual infrastructure services without necessarily implying any causality. We then develop hypotheses about causal determinants, which we examine more deeply in the next sections.

3.1. Data and definitions

We consider access to water, sanitation, electricity, and telephony. Access to water is defined as access to an improved water source (piped household water, public tap, tube well/borehole, protected dug wells, protected springs, rainwater collection); access to sanitation is improved sanitation facilities (flushed latrine, ventilated improved pit latrine, pit latrine with a slab or a composting toilet); access to electricity implies a physical connection to an electric grid; and telephony entails ownership of a mobile phone or landline. For water, sanitation and electricity, we can rely on existing and compiled data sets. The water and sanitation infrastructure indicators are taken from the World Development Indicators (WDI) (World Bank, 2014). For electricity access, we use a compilation of sources, including the WDI, generated for the Global Energy Assessment (GEA, 2012).[1] For telephony, we use data from the International Telecommunications Union (ITU), which provides landline penetration for the entire period but mobile phone penetration only from 2000 onward (ITU, 2014). We construct a new dataset on telephony access out of available data for (household) access to fixed lines and mobile phones. Comparing the separate data sets, we take access to mobile phones as soon as it exceeds access rates for fixed lines, and interpolate missing values. We consider this approach to be robust and to be a rather conservative estimate of telephony access. We interpolate between years for the infrastructure indicators, since data are sparse for many countries, and infrastructure access levels typically trend only upward.[2]

3.2. Patterns of infrastructure access

Access to different infrastructure services is distributed unevenly across different countries, regions within countries, and income groups. Generally, we find that access to infrastructure increases with income (Fig. 1). However, the degree of income dependence varies across the different infrastructure services. While water access is generally available to a broad range of the population at low income levels, electricity and telephony show higher levels of access only at higher levels of income. Access to sanitation, even though correlated with income, seems to be distributed more widely. In addition to pure income effects, Fig. 1 also indicates more general regional differences. While African countries tend to have lower access levels, Asian and Latin American countries seem to provide higher access levels at comparable income levels.

Fig. 2 shows the temporal evolution of access rates to electricity, water, and sanitation in urban and rural areas separately by region:

[1] www.globalenergyassessment.org.

[2] Wars or natural disasters may lead to loss of infrastructure, which would reduce access levels. However, we assume that ignoring these cases would have a negligible impact on the integrity of the overall data.

Please cite this article in press as: Steckel, J.C., et al., Access to infrastructure services: Global trends and drivers, Utilities Policy (2017), http://dx.doi.org/10.1016/j.jup.2017.03.001