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Is Electricity Supply a Binding Constraint to Economic Growth in Developing Countries?

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Abstract

Is electricity supply a binding constraint to economic growth in developing countries? And to what degree is a binding constraint of inadequate electricity supply problems reflected by very high average prices for electricity? There is a large empirical literature on "binding constraints," much of it using the Hausmann-Rodrik-Velasco (2005) framework and applying it to particular countries. There is also a large literature on the quality of the investment climate, much of which draws on the World Bank enterprise surveys. Our paper undertakes a systematic review of the published and grey literature that has applied the HRV framework at the country level in order to ascertain how frequently electricity supply is identified as a binding constraint to growth (and differentiating between access, reliability and price). It also examines the rankings of constraints provided in the World Bank's Enterprise Surveys in order to assess the extent to which businesses regard electricity as a major constraint. We find strong evidence that electricity is a constraint to growth in several developing countries with over 40% of the studies reviewed identifying electricity as a binding constraint. But high electricity prices are not necessarily a signal of electricity being a binding constraint, although they do tend to be associated with poor quality and reliability of supply.

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Introduction

Electricity supply is considered an important constraint to growth in the large majority of developing countries. A lack of electricity can affect growth in myriad ways. Most obviously, a lack of electricity prevents the use of appliances and machinery that can immensely increase the productivity of economic activities, particularly in manufacturing and services. According to the World Bank Enterprise Surveys, in 2015 firms in South Asia and Sub-Saharan Africa lost 10.9% and 8.8% of sales respectively due to electrical outages.[3]

Electricity also influences growth through its impact on health, education, and communication: lighting can enable children to study for longer, improving education; electricity allows refrigeration of vaccines and the effective operation of health facilities; and electricity powers phones, radios and televisions providing communication, entertainment and education to millions of people (United Nations Development Programme and World Health Organization 2009). However, an estimated 1.2 billion people – 17% of the global population – did not have access to electricity in 2013 and many more suffer from supply that is of poor quality. More than 95% of those living without electricity are in countries in sub-Saharan Africa and developing Asia, and they are predominantly in rural areas (around 80% of the world total) (World Energy Outlook 2015). Hence it seems likely that improved access to reliable electricity could boost economic growth both directly and indirectly by enhancing knowledge and building human capital.

However, it is not clear that an inadequate or poor quality supply of electricity is necessarily a constraint to growth in all countries. Several countries which have severe electricity problems have registered rapid growth in recent years. For example, Tanzania has registered growth above 7% per year for the last few years despite an electrification rate of 24% (4% in rural areas); the world's fastest growing countries in recent years include Ethiopia, Cote D'Ivoire, Mozambique, Myanmar, Tanzania and Papua New Guinea – all known to have extremely poor access to electricity. Moreover, economic growth itself increases demand for electricity thereby accentuating shortages. Hence it is not always clear whether electricity shortages are a constraint on growth or the result of growth.

Cross-country (and time series) evidence regarding the causal relationship between energy use and growth will be reviewed in detail in Stern et al (forthcoming). This paper takes a different approach. The concept of there being one or more country specific "binding constraints" to growth became extremely popular in the development policy literature in the mid-2000s after the publication of the seminal paper by Hausman, Rodrik and Velasco (2005). Hausman et al. (2005) (henceforth HRV) put forward a methodology for attempting to systematically diagnose the constraints to growth at the country level. This approach was subsequently adopted by many donors, including the World Bank and DFID, to assess the key constraints to growth for the countries in which they work. Much of this literature is not published in the academic literature, appearing only in donor working papers and reports. However, it is important because it has had a significant impact on the allocation of aid resources towards particular sectors in selected countries and regions.

[3] Value lost due to electrical outages (% of sales). Data retrieved July 29, 2016, from http://data.worldbank.org/indicator/IC.FRM.OUTG.ZS

We therefore undertake an informal systematic review of the available published and grey literature using the HRV methodology for developing countries to ascertain in how many cases (and in which countries) electricity is seen as a binding constraint. This paper therefore provides a complement to Stern et al (forthcoming) which reviews the literature providing quantitative evidence about the causal linkages between energy use and economic growth.

To further ground the diagnostic judgements from the binding constraints literature, we examine the evidence from the World Bank's Enterprise Survey datasets regarding the importance of electricity as a binding constraint – with a particular focus on Sub-Saharan Africa and South Asia where electricity constraints are particularly severe.[4] This cross-country firm-level dataset explicitly asks firms in several developing countries to compare the relative importance of the constraints that they face across a range of different issues, including electricity supply and reliability. We review papers that have explicitly used this data to assess the impact of electricity constraints on firm performance and assess the extent to which the firm level data from the Enterprise Survey datasets coincides with the judgements arising from the binding constraints literature above.

One of the principles of the diagnostic methodology proposed by HRV is the importance of looking for market evidence that something is indeed a constraint. In practice, this often implies looking at prices (or proxies for shadow prices where prices are not easily available). Unfortunately, data on electricity prices is not available in a comprehensive fashion across a large number of developing countries over an extended period. We briefly review the available data on electricity prices (see the paper by Munuera et al. (forthcoming) for more detail on energy related data) and the literature that links prices to perceptions of electricity being a binding constraint. We draw on electricity price data from the World Bank's Doing Business survey to provide a very preliminary impression of the extent to which electricity being a binding constraint is reflected in higher electricity prices.

We conclude by attempting to identify important gaps in the literature and areas which may be worthy of further exploration going forward.

The Binding Constraints Approach

The "binding constraints approach" arose out of a concern in the literature of the late 1990s, after the East Asian crisis that growth theory had failed to explain many of the growth experiences of a wide range of developing countries. The World Bank undertook a comprehensive analysis of the lessons of the 1990s (World Bank 2005), reviewing the evidence about the impact of standard "Washington Consensus" recommendations on growth. Easterly provided a popular and widely read critique of policy approaches to promoting growth (Easterly 2001). From 2006 to 2009, the Commission on Growth and Development brought together leaders from government, business, and academia across the developing and industrialized worlds to try and understand the determinants of sustained growth (Growth Commission 2008). These, together with academic analysis of growth accelerations (Hausmann, Pritchett, and Rodrik 2005) pointed to the very weak association between

[4] See http://www.enterprisesurveys.org/ for details.

standard prescriptions for growth and actual performance and the importance of history and context in explaining actual outcomes.

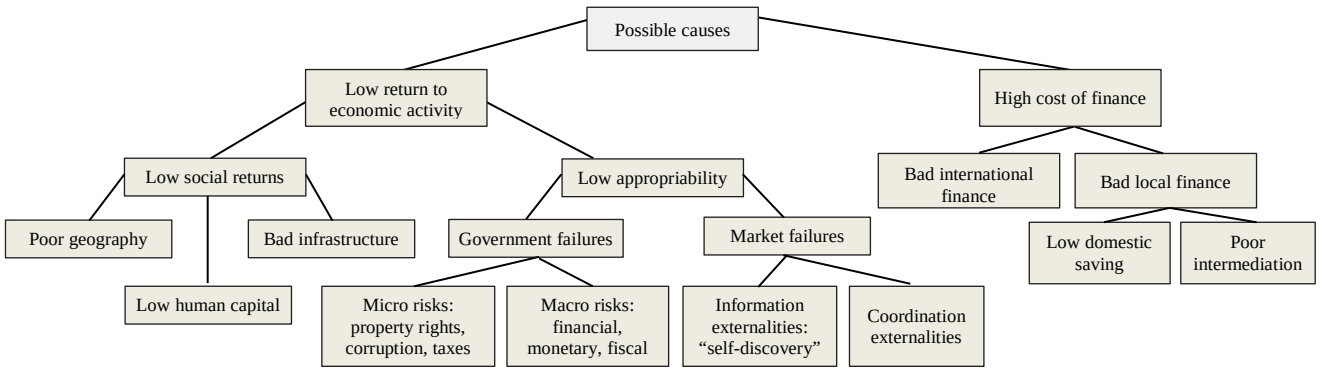
Whilst these studies injected a welcome focus on context specificity, they also provided a challenge for policymakers and donors alike, in that every country was unique. Into this debate arrived a paper by HRV (2005) that tried to lay out a diagnostic methodology for identifying the "binding" constraints. The idea was that, whilst there are lots of problems, at any point in time only one, or a handful of constraints are actually binding.

This was an attractive explanation since it explained how countries might make progress on some areas and not have growth – whilst other countries ignored seemingly important problems and yet experienced fast growth. It suggested that the countries that succeed are the ones that manage to identify their "binding" constraints at that point in time and address them (and then, as those constraints bind less, move onto the next binding constraint).

There are numerous expositions of the "binding constraints methodology" (Hausmann, Pritchett, and Rodrik 2005, 2008; International Monetary Fund 2006). Below we provide a brief overview of the method for those unfamiliar with it.

The core idea is that it is possible to use a diagnostic process in order to generate evidence about what are likely to be the binding constraints to growth for any country at a particular point in time. Specifically HRV propose a decision tree methodology to help identify the relevant short-run binding constraints for each country. The original decision tree is shown in Figure 1.

Figure 1: Binding Constraints Decision Tree



Source: Hausmann, Rodrik and Velasco (2005)

The idea of the decision tree is that low growth is caused by one of two fundamental causes – a high cost of finance, or low returns to economic activity. Each of these can be explored in turn; if finance is very costly then this is either due to a lack of access to international markets, or poor local finance, which in turn could result from either low domestic saving or poor inter-mediation. Evidence is gathered at each point in the tree in order to assess which of the pathways is the likely explanation for slow growth. If low growth is not due to a high cost of finance, this suggests that there are low returns to economic activities. If that is the

case this could be a result of low social returns, or restrictions on the ability of actors to appropriate the returns from such activities. The latter could result from market failures, including information or coordination externalities, or government failures, either micro or macro. Similarly low social returns might result from poor geography, low human capital or bad infrastructure. The aim is to provide a diagnostic tool with which to pinpoint the likely causes of slow growth and facilitate better prioritisation of reform efforts – rather than starting with a set of things which are believed to be good in all circumstances, HRV and the subsequent literature argued for "diagnosis before prescription" (Rodrik 2010).

The approach proposed by HRV has been subject to substantial criticism. Felipe and Usui (2008) highlight a large number of limitations of the approach ranging from the difficulties in identifying price and non-price signals to the (lack of) independence of the different branches in the decision tree. Habermann and Padrutt (2011) argue that, while growth diagnostics is a useful tool to inform growth strategies in developing countries, the framework's flexibility is both its strength and its main weakness since it makes the outcome of the diagnosis very dependent on diagnostic process. Rodrik and Hausman have responded with guidance on how best to use the methodology responsibly[5] – as a diagnostic tool, rather than a recipe. Also Hausman, Klinger and Wagner (2008) have produced a comprehensive "mindbook" on how the technique should be applied in practice.

The binding constraints methodology was most rapidly adopted in the World Bank. The then Poverty Reduction and Economic Management (PREM) Network of the Bank undertook a series of diagnostic growth studies using the approach for: Armenia, the Baltic States, Bangladesh, Brazil, Cambodia, Egypt, India, Madagascar, Morocco, Tanzania and Thailand.[6] In addition, several other World Bank country offices conducted similar such studies. More recently, the approach has evolved. Currently, a Systematic Country Diagnostic (SCD) forms the basis for the development of the new Country Partnership Strategies agreed between the Bank and member countries. To date 33 SCDs have been completed, including 8 in Sub-Saharan Africa and 4 in South Asia.[7]

In addition to studies by the World Bank, other donors have adopted similar methodologies based on the original HRV approach. The IADB has conducted a similar analysis for Latin American countries (Inter-American Development Bank 2009). Similarly, DFID have conducted Inclusive Growth Diagnostics for 25 countries as well as three regional and five international level diagnostics. Like the World Bank's SCD's, these studies attempt to take a holistic, but evidence based, view about the key constraints facing economic growth in each country. Other donors have tended to do growth diagnostic studies on a more ad hoc basis e.g. the synthesis of binding constraints facing Mongolia commissioned by DFATD (Osborne et al. 2015). Finally, the academic community has conducted a wide range of growth diagnostic exercises in several countries which will also be reviewed.

[5] See Rodrik's comments on "Doing Growth Diagnostics Well" at http://rodrik.typepad.com/dani_rodriks_weblog/2007/11/doing-growth-di.html

[6] See http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/ORGANIZATION/EXTPREMNET/0,,contentMDK:20611476~menuPK:4833683~pagePK:64159605~piPK:64157667~theSitePK:489961~isCURL:Y,00.html

[7] See http://www.worldbank.org/en/projects-operations/country-strategies#3 for details.

Literature Review Methodology

Identification and collection of literature

To identify and analyse the relevant literature, we followed the principles and methodology of a systematic review. Systematic review is used to map the evidence making an additional effort to avoid bias, assess the quality of the evidence and synthesize it.[8] Using a systematic review process makes the review more transparent, rigorous and replicable than an unsystematic review process (Badger et al. 2000). A systematic review identifies the most relevant research studies answering a particular question by using a clear search process for finding research studies and stating explicit criteria for selecting research to be included in the review. It also applies systematic processes for retrieving data from selected research studies and analysing that data.[9,10,11]

To produce the list of relevant research studies, we set study inclusion and exclusion criteria. We included studies that referred to the "binding constraints to economic growth" framework formulated by HRV (2008). But we excluded studies that referred to binding constraints in general but not referring to economic growth specifically. We also excluded studies that focused on binding constraints in particular sectors within the economy but which did not compare binding constraints across multiple areas.

More precisely, we chose the keywords: "Hausmann OR Rodrik OR Velasco AND binding AND constraints AND growth" to find research studies. We limited our search to studies performed in 2004 or later since Hausmann, Rodrik and Velasco first articulated their binding constraints theory in 2004. Further, we have only looked at articles and studies published in the English language. To obtain relevant research studies, we used numerous social science research databases, including EconLit, Social Science Research Network (SSRN), EBSCOhost, Google Scholar and Google search engines, institutional websites and databases and multilateral and bilateral international development organization websites. This initial search produced a list of 152 articles.

After generating the initial list, we then checked in more detail whether the papers selected met the predefined criteria. This was done by reading abstracts (if available), introductions, executive summaries, conclusions and conducting relevant word searches (i.e. "HRV", "methodology", "HRV problem/decision tree," etc.) to ensure that the studies were focussed on the binding constraints to growth at a country level, used the HRV approach and applied it in a professional manner. This process narrowed down the initial list of 152 articles to 55 research studies. The final list of selected studies included a compilation of academic studies, reports produced by bilateral and multilateral international development organizations, reports produced by donor governments and growth self-diagnostics performed by the governments of countries themselves or in partnerships with other interested institutions or organizations.

[8] Department for International Development, "Systematic Reviews in International Development," *Publications - GOV.UK*, August 13, 2013, https://www.gov.uk/government/publications/systematic-reviews-in-international-development.
[9] Julian PT Higgins, Sally Green, and others, *Cochrane Handbook for Systematic Reviews of Interventions*, vol. 5 (Wiley Online Library, 2008), http://onlinelibrary.wiley.com/doi/10.1002/9780470712184.fmatter/summary.
[10] 3ie: International Initiative for Impact Evaluation, "Synthesis and Reviews Programme," accessed June 9, 2016, http://www.3ieimpact.org/en/about/what-3ie-does/systematic-reviews-programme/.
[11] Cochrane, "About Cochrane Systematic Reviews," accessed June 9, 2016, http://www.cochranelibrary.com/about/about-cochrane-systematic-reviews.html.

Data extraction and methods for synthesizing the selected studies

After selecting the studies for review, we created a framework for data extraction and synthesis. The HRV Binding Constraints Decision Tree (Figure 1) was converted into a table, where each row is one country study and the columns are each one of the decision boxes of the diagnostic decision tree (Table 1). We clustered the studies at a regional level and extracted the findings of those studies using the table. Within the table, we recorded where the binding constraints for a particular country were identified within the HRV framework according to a given country study. If several country-level studies were available for a particular country, we recorded all findings distinguishing them as separate studies in the table. After recording the overall binding constraints findings in the table, we then further analysed the evidence presented in each study about the extent to which electricity is a binding constraint on economic growth. Specifically, for each paper we asked the following questions:

1. Is electricity mentioned? How often?
2. Is electricity mentioned as a binding constraint?
3. What are the top 5 binding constraints for the country?
4. Is there any indication of the importance of electricity relative to other constraints e.g. ranking and if so, what is its ranking?
5. Is there analysis of electricity prices and/or subsidies? What is said?
6. Is there analysis of electricity access? What is said?
7. Is there analysis of electricity reliability? What is said?
8. Are other energy issues raised as binding constraints – if what and in what way?

In addition, HRV (2008) suggest the use of four questions to conduct a differential diagnosis of whether or not something is a binding constraint. For each study, we, therefore looked to see whether any evidence was presented that might support such diagnosis. The four questions are:

- Are the shadow prices of electricity as a constraint high?
- Do movements in the electricity constraint produce significant movements in the objective function?
- Are agents in the economy attempting to overcome or bypass the electricity constraint?
- Are agents less intensive in the electricity constraint more likely to survive and thrive in the economy? (Conversely, are agents more intensive in the electricity constraint more likely to fail?

Review of Binding Constraints Studies

Overview of binding constraints studies

After reviewing 55 studies covering 48 countries, we produced a matrix of binding constraints outlined in each study (Appendix Table A.1). Numerous studies argued that the country in question faced several binding constraints at the same time. In such cases, we recorded all of the top binding constraints in the matrix. As shown in the matrix, most of the binding

constraints to private investment and entrepreneurship result from low returns to economic activity rather than a high cost of finance. Looking across all of the country studies, we see that the top three binding constraints in these countries are: 1. micro risks; 2. poor infrastructure; and 3. low human capital (Figure 2). While micro risks arising because of government failure result in low appropriability of returns from investment, poor infrastructure, and low human capital reduce the social returns from private investment and entrepreneurship.

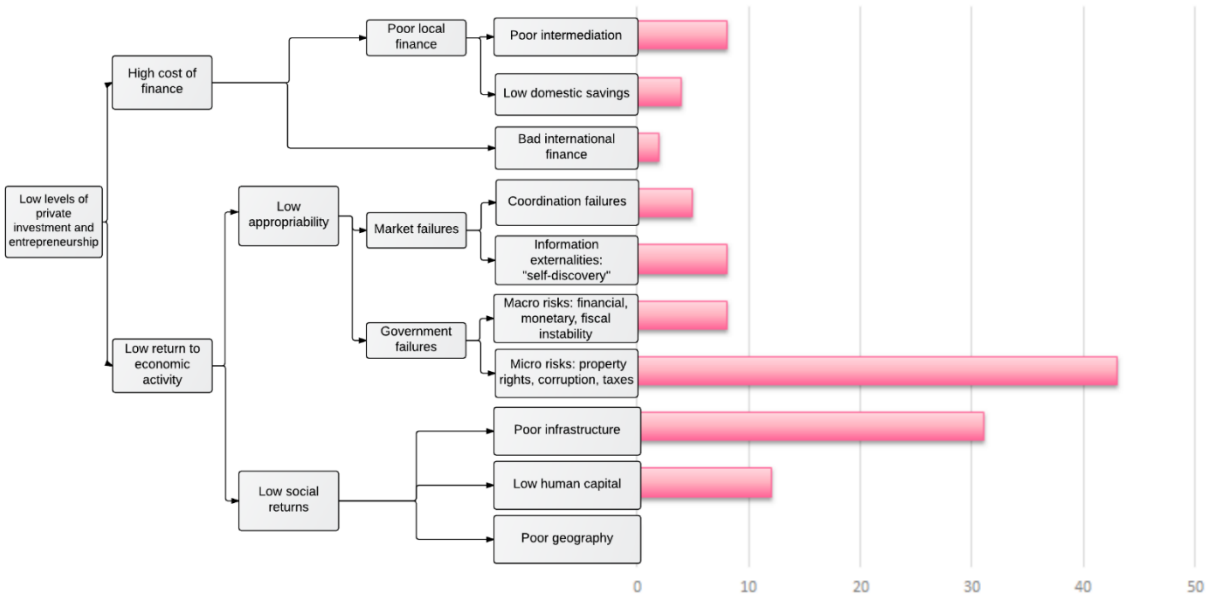
Out of the 55 studies, 87% pointed to constraints which lower the appropriability of returns to economic activity. Moreover, 45 out of the 55 studies argued that government failures were one of the causes of low appropriability of returns and 78% of studies identified various micro risks such as corruption, property rights, and taxation issues as binding constraints. Macro risks, such as fiscal instability were less common as binding constraints, occurring in only 14% of country studies. By contrast, only 10 country studies stated that low appropriability arose because of market failures caused by information externalities (8 studies) and coordination failures (5 studies).[12]

Almost two-thirds of the studies (65%) argued that the binding constraints to private investment and entrepreneurship were low social returns. The key constraint identified was poor infrastructure which was the second most frequently mentioned binding constraint (after micro risks) occurring in 56% of country studies. Within infrastructure, poor road networks and the quality and reliability of electricity were the most frequently mentioned problems. Other reasons for low social returns included low human capital – mentioned in 12 studies as a binding constraint. Depending on the country, different factors were felt to cause low human capital accumulation; unsurprisingly, poor supply and quality of education featured prominently. None of the studies distinguished poor geography among the most binding constraints. This is surprising given that the list of countries includes some known to suffer from significant geographical challenges (e.g. DRC, Sudan, Zambia, Afghanistan, Nepal). It likely reflects the manner in which the binding constraints approach has been used as a way of identifying constraints which the country can do something about rather than assessing the impact of characteristics that are fixed.

Interestingly, relatively few studies see a high cost of finance as a binding constraint (12 studies). In almost all cases, this is felt to arise due to poor local finance (11 studies) rather than as a result of bad international finance (2 studies – with one study highlighting both). Poor local finance, in turn, is more commonly due to poor intermediation (8 studies) than low domestic saving (4 studies).

[12] In three studies (Vietnam, Guyana and Peru) both coordination failures and information externalities were considered binding constraints with the result that the overall number of studies pointing to market failures was only ten.

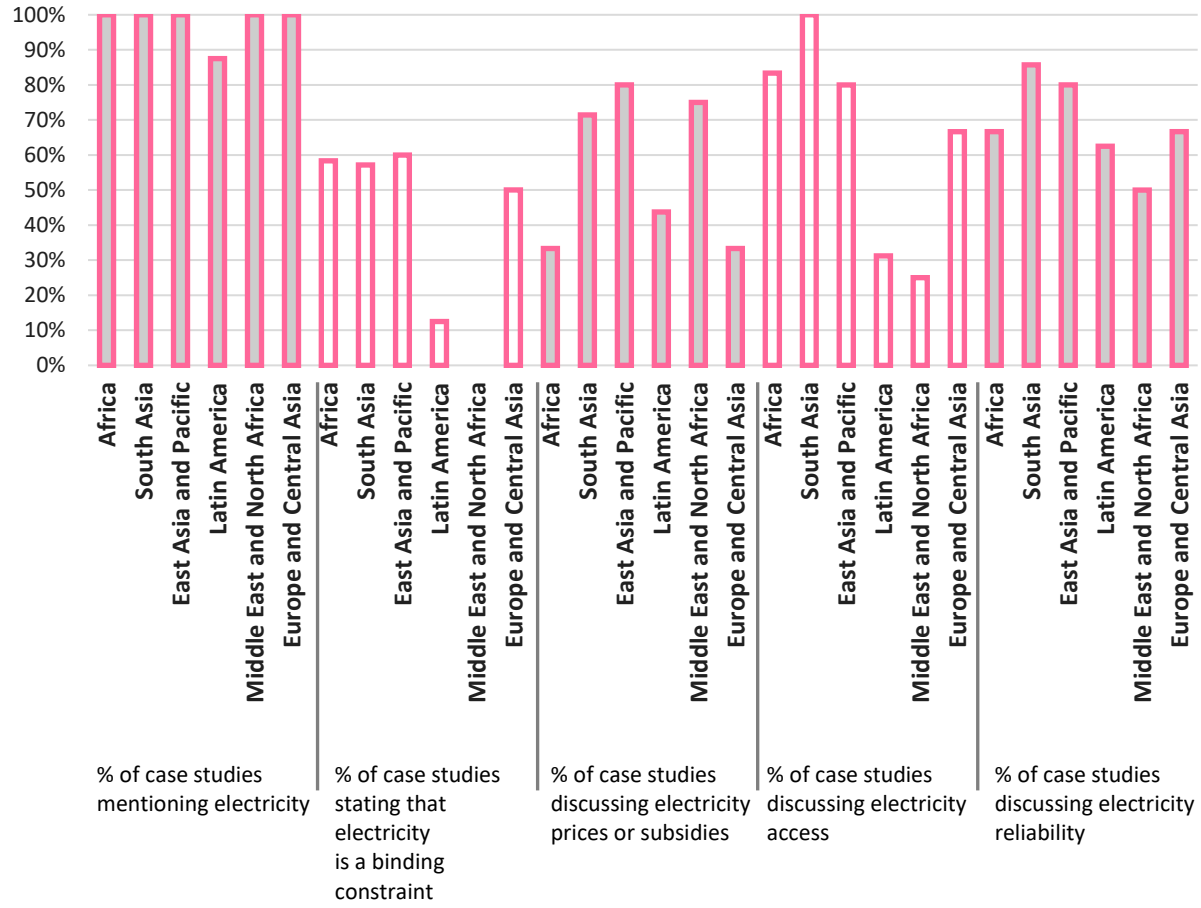
Figure 2: Frequency of binding constraints in country studies



How electricity features in the binding constraints literature

Electricity features prominently in the binding constraints studies selected. This is significant because electricity was not a selection criterion for these studies. Rather the studies are all of the binding constraints studies that meet the selection criteria and so the prominence of electricity is strong evidence of its importance as a constraint. Overall, 96% of the studies mention electricity (in fact, the word "electricity" occurs roughly every 3 pages across all studies). Importantly, 40% of the reviewed studies state that electricity is one of the binding constraints to economic growth. While some studies only mention electricity briefly as part of a reference to infrastructure, others discuss power related obstacles to growth at considerable length, often covering electricity access, reliability, and prices and subsidies: 53% of studies discuss electricity prices or subsidies, 64% of studies discuss electricity access and 69% of studies discuss electricity reliability at least to some extent (Figure 3).

Figure 3: The treatment of electricity in the selected case studies



There were also regional differences in the findings. Far fewer studies from Latin America identified electricity as a constraint than other regions. There were also regional variations in the percentage of studies mentioning prices, which may reflect the availability of data. Similarly far fewer studies from Latin America and the Middle East and North Africa discussed electricity access, reflecting better general access in those regions. We summarise below the key messages on access, reliability, and prices of electricity that arose from the country studies reviewed.

Access to electricity

Access to electricity is a major challenge globally but it is an especially critical issue in Sub-Saharan Africa and South Asia. Electrification rates are staggeringly low in some Sub-Saharan economies often leaving out huge portions of rural population altogether. For example, a World Bank study of binding constraints in Namibia (World Bank 2008c) showed that most households still use wood for cooking and heating and a large portion of households use candlelight for lighting. Tanzania, although endowed with abundant energy resources, suffers from particularly limited electricity access. In 2010, the overall electrification rate was 14.5% and the rural electrification rate was only 2% (Partnership for Growth 2011d).[13] Similarly, in Uganda, access to electricity is limited as a result of delays in implementing

[13] Installed capacity has risen significantly in recent years to 1501 MW in 2014.

hydropower projects, significant distribution losses, rising demand and low water levels affecting hydropower supply (World Bank 2007). Many areas are not even connected to the national grid - South Kordofan province of Sudan is not connected and has an overall current electricity capacity of only 4.76 megawatts (World Bank 2008a).

In South Asia, the studies reviewed show a mixed record for extending access to electricity. Bhutan and the Maldives have achieved universal or almost universal electrification (Asian Development Bank 2013; Asian Development Bank 2015b). In contrast, despite its vast hydropower potential, Nepal suffers from severe electricity shortages and its per capita power consumption is the lowest in South Asia (Asian Development Bank, International Labour Organization, and Department for International Development 2009; Government of Nepal and MCC 2014).

In South East Asia and the Pacific, access to electricity is extremely varied across regions within different countries. Cambodia is suffering from an acute deficit in electricity supply. Access to electricity is only 51% - with large differences in access between urban and rural areas (Asian Development Bank 2014a). Indonesia also has dramatic intra-country differences in access to electricity - half of the population without access to electricity live outside Java and Bali with approximately 80% living in rural areas (Anderson et al. n.d.).

Access to electricity is not a major issue in Latin America and the Caribbean, the Middle East and North African regions and Europe and Central Asia. However, the procedures for gaining access to electricity are sometimes onerous in some of the Central Asian economies. For example, it could take 159 days, 7 procedures and the equivalent of 24 times the per capita gross national income to install an electricity connection for business in the Kyrgyz Republic (Asian Development Bank 2014b).

Reliability of electricity

The selected studies reveal that reliability is a universal problem, with more countries experiencing power quality and reliability issues than limited access ones. Sub-Saharan Africa and South Asia have especially poor electricity quality and reliability characterized by frequent power outages and load shedding which severely affect businesses and the general population. For example, Ghana experienced 9.65 power outages per month on average in 2007 (Partnership for Growth 2011b); Kenya saw power outages increase from an average of 16.4 hours per month in 2002 to 24.5 hours in 2006 (World Bank 2008b); and Nigeria experiences power outages more than 320 days per year (International Labour Organization 2015).

Some South Asian countries suffer from unreliable electricity due to seasonal changes. In Nepal electricity becomes especially unreliable during the dry season; load shedding lasts up to 18 hours daily during the dry winter months due to low water levels. Forecasting the outages proved to be challenging. For instance, power outages were expected to last 4 hours a day in January 2009 but lasted up to 12-16 hours instead (Asian Development Bank, International Labour Organization, and Department for International Development 2009 & Government of Nepal 2014).

In Latin America, electricity reliability is not a critical concern. Some countries such as Colombia and Guatemala increased the quality of electricity supply (Meléndez and Harker 2008; Artana et al. 2009a). However, other countries are experiencing a deterioration of the quality and efficiency of power supply. Ecuador experiences significant energy losses: up to 42% of the transmitted and distributed energy was lost in 2004 (Cueva, Albornoz, and Avellán 2009).

East Asian, Pacific and Middle Eastern, North African, European and Central Asian countries vary significantly in terms of reliability. Central Asian countries suffer significantly from unreliable electricity. The Kyrgyz Republic suffers particularly acute power reliability challenges aggravated by low water levels and severe problems with its nearly obsolete electricity infrastructure; for example, in 2012 the distribution company supplying Bishkek said that 85% of its 0.4-kilovolt lines and equipment needed urgent repairs. Distributors reported 43 outages per day on average from 2009 to 2012 due to low water levels in the Toktogul Reservoir and breakdowns in the system (Asian Development Bank 2014b).

Electricity prices

Pricing of electricity varies dramatically across regions as well as across countries within regions. Electricity tariffs in Sub-Saharan Africa tend to be lower than energy generation costs. Tariffs vary greatly across South and East Asian and the Pacific countries with Bhutan and Indonesia having lower tariffs (below the cost of supply) and Nepal and Cambodia significantly higher ones. Similar variations exist in the Middle East and North African and Central Asian regions while tariffs in Latin America tend to be high.

In Sub-Saharan Africa, several countries suffer from below cost pricing of electricity. The majority of the studies that discuss power pricing argue that power tariffs are too low. The under-pricing of electricity is becoming a critical constraint since it generates significant financial losses for the power sector in several countries (Trimble et al, 2016). For example, in Ghana, under-pricing, power system losses and incomplete collections equalled 3.8 % of GDP in 2009 (Partnership for Growth 2011b). Tanzania is also faces significant losses since the Tanzania Electric Supply Company (TANESCO) charges its customers less than it has to pay its suppliers for generation. Under-pricing, inefficient collection and distribution losses equalled 2.1% of Tanzania's GDP in 2008 (Partnership for Growth 2011d).

South Asian countries experience similar power pricing challenges. Bhutan has the lowest domestic electricity tariffs in Asia at $0.016–$0.044 per kilowatt-hour (kWh), but these rates fall dramatically below the cost of supply at approximately $0.03–$0.08 per kWh (Asian Development Bank 2013). Nepal, despite relying on hydropower, has the highest power tariffs in the region. Nepalese consumers paid $0.093 per kWh – 115% higher than in India and Bangladesh, 43% higher than in Pakistan and 18% higher than in Sri Lanka. Furthermore, the government provides subsidies for rural consumers – an issue especially salient during election periods (Asian Development Bank, International Labour Organization, and Department for International Development 2009).

In the East Asia and the Pacific region, Cambodia has one of the highest electricity costs because of high import, transmission and distribution costs and reliance on petroleum for 60% of electricity generation (Hang 2013; Asian Development Bank 2014a). In Indonesia, tariffs

are set by the legislature and fall below the cost of supply resulting in some of the lowest electricity tariffs in the region and discouraging investment (Anderson et al. n.d. & Barron et al. 2009). In Fiji, though electricity rates are rather low compared to the rest of the region, they are higher than in other countries in the region that use a similar level of hydropower in their generation mix (Asian Development Bank 2015a). Meanwhile, in Papua New Guinea, electricity tariffs are higher than many other countries in Southeast Asia and the Pacific – and the highest in all the binding constraints studies reviewed – although they are reported to be among the lowest in the Pacific Islands (Asian Development Bank 2012).

Some of the studies from Latin America present an interesting contrast as high tariffs are the reason for concern. Ecuador has relatively high electricity tariffs due to shifting dependence from hydroelectric to thermoelectrically generated electricity (Cueva et al. 2009). In Nicaragua, despite the subsidies to certain types of consumers, the electricity tariffs are high as it experiences high energy losses and theft and relies heavily on oil and its derivatives for power generation (Agosin, Bolaños, and Delgado 2009).

Studies of countries in the Middle East and North Africa present conflicting challenges in electricity pricing. In Egypt and Morocco, governments have engaged in large subsidy efforts (currently being unwound in Egypt), while Lebanon had some of the highest tariffs in the region (Enders 2007; Berthélemy, Dessus, and Nahas 2007 & African Development Bank Group 2015). Conversely, in Central Asia, the Kyrgyz Republic has some of the lowest electricity tariffs in the world due to historical political considerations (Asian Development Bank 2014b).

Differential analysis of electricity as a binding constraint

Whilst the evidence on access, reliability, and prices above shows that electricity supply is likely to be a cause for concern, it doesn't show that electricity is a binding constraint to growth or investment. To assess this we use the four differential diagnosis questions proposed by HRV Wagner (2008) described above.

Shadow prices of electricity

According to Hausmann et al. (2008), if a constraint is binding, the shadow price of the constraint should be high. It is challenging to obtain accurate estimates of shadow prices but the size of shadow prices can be inferred from observations, such as the willingness to pay for electricity provision through own generation. Of the selected studies, the strongest evidence for high shadow prices comes from countries in Sub-Saharan Africa, South Asia, and Central Asia. For example, Kwakwa et al. (2008) note that some firms in Nigeria engaging in own energy generation incur generation related staff costs of up to 10 to 15 % of total payroll. It is estimated that $13 billion is spent on fuel for generators in the country (International Labour Organization 2015). In Tanzania, average private generation costs more than three times than grid power (Partnership for Growth 2011d). Using a private generator in Uganda costs two to six times more than receiving electricity from the national grid (World Bank 2007). Similarly, large firms in Nepal self-generate 40% of their electricity use even though privately generated electricity is three to four times more expensive than electricity from the grid (Government of Nepal 2014). In the Kyrgyz Republic, 40% of firms reported willing to pay

25% to 100% more for better power supply (Asian Development Bank 2014b). These represent *prima facie* evidence for the existence of high shadow prices in these countries.

Production sensitivity to the constraint

If electricity is a binding constraint, then releasing the constraint should see significant changes in output. From the selected studies, we do find some evidence that economic output is sensitive to the availability and reliability of electricity in some countries. For instance, Benin suffers an average output loss of 6.5% because of unreliable electricity supply (World Bank 2009). According to Partnership for Growth (2011b), Ghana experiences losses of at least 5.6% of GDP as a result of limited and unreliable electricity, whilst Nigeria loses 3.5% of GDP because of power outages (International Labour Organization 2015).

In Pakistan, power shortage is estimated to have cost approximately 2% of GDP in 2012 (Lopez-Calix and Touqeer 2013) while in the Philippines small and medium enterprises lose up to 8% of production because of unreliable electricity supply. Furthermore, power outages in the Philippines cause small and medium enterprises to lose up to 11% and large enterprises up to 6% of production (Asian Development Bank 2007; Partnership for Growth 2011c). Finally, Ecuador is estimated to lose 5.04% of sales due to electricity outages (Cueva et al. 2009) and the Kyrgyz Republic loses 4% of annual sales on average because of electricity outages (Sydykova 2015).

Agent behaviour to avoid the constraint

In the studies we review, we see substantial evidence that economic agents take steps to avoid or overcome the constraint that electricity imposes. The main way in which this occurs is through self-generation by the use of generators, even though self-generation is a significantly more costly alternative to grid power. For example, in the Democratic Republic of Congo (DRC), electric generator imports have been rising since 2001 and nearly doubled between 2005 and 2006. The DRC imported generators worth US$15 million in 2006, rising from US$ 2.5 million in 2000 (Ulloa, Katz, and Kekeh 2009). In Nigeria, approximately 60% of businesses own an electric generator (International Labour Organization 2015).

It is estimated that 17% of Tanzanian firms obtain electricity from generators (Partnership for Growth 2011d). In Cambodia, firms often use diesel generators to generate additional electricity; in 2013, 44% of rural households got lighting from batteries and 16% from kerosene lamps (Asian Development Bank 2014a). Due to the unreliable supply of electricity in Indonesia, industrial and manufacturing firms generate approximately 33% of the country's electricity. Moreover, almost 60% of large businesses in Indonesia own a generator (Anderson et al. n.d.). In East Java approximately 22% of businesses reported to have used private generators (World Bank 2011). In Brazil, 15% of businesses engage in own power generation (Blyde et al. 2010).

Firms also try to avoid the constraint in other ways. For example, in Guyana a large market has emerged for smuggled fuel to lower the cost of self-generated electricity (Armendariz et al. 2007). In Mexico, many firms rely on self-generated electricity as backup energy during the peak use periods (Hausmann and Klinger 2009b) while in the Kyrgyz Republic, many

firms not only use their own generators but also change their operation hours to night-time to benefit from access to more electricity voltage (Asian Development Bank 2014b).

Overall, therefore, we find extensive evidence of economic agents attempting to avoid the constraints on electricity provision. Not all of these actions are due to the unreliability of supply. For example, Foster and Jevgenijs (2009) document the prevalence of in-house generation of electric power by firms in Sub-Saharan Africa and conclude that the prevalence of own generation would remain high even if power supplies were perfectly reliable, suggesting that other factors, such as emergency back-up and export regulations, play a critical role in the decision to own a generator. However, the widespread use of self-generation and related actions is further evidence that in many countries electricity is a binding constraint to growth.

Differential performance of electricity intensive sectors

Finally, if electricity is a binding constraint, then we would expect that agents less intensive in electricity should perform better than those that are more intensive in electricity. The selected studies provide only limited insights into the differential performance of electricity intensive sectors. For example, in Benin economic growth arises mainly from agriculture, trade, and transport, while industrial growth – typically a much more electricity intensive sector - stalled in the last decade (World Bank 2009). Similarly, World Bank (2007:126) shows that firms in Uganda use relatively low amounts of electricity and that "firms and industries that require it, simply don't seem to open up in Uganda." Barron et al. (2009) argue that in Indonesia's Aceh region manufacturing and agro-processing firms are especially negatively impacted by electricity outages while Hausmann et al. (2007b) show that, in Paraguay, less infrastructure-intensive sectors such as soybean production boomed compared to other sectors.

Of course, the reasons for the performance of different sectors in any particular country will be many and varied and none of the studies conduct the kind of rigorous analysis that could provide strong evidence for a causal connection between electricity and sector performance. However, the limited evidence that exists suggests that sectors that are intensive in electricity do indeed perform worse in countries where electricity is a binding constraint than sectors that are less electricity dependent.[14]

Comparison with Enterprise Survey Data

The analysis presented above of the binding constraints literature, suggests that electricity is an important constraint on economic growth in several countries, particularly many in Sub-Saharan Africa and South Asia. It is valuable to compare the findings from this approach with other important sources of information about constraints to growth.

The most widely available cross-country data on constraints to growth are the World Bank's Enterprise Surveys. These are firm-level surveys of a representative sample of an economy's private sector. The surveys cover a broad range of business environment topics including

[14] An important related issue is whether improved electricity provision for particular sectors or for particular regions (e.g. rural vs urban) would be more or less able to promote economic growth. Unfortunately, although some of the studies reviewed focus on sub-regions, none provide significant evidence on this issue.

access to finance, corruption, infrastructure, crime, competition, and performance measures. Since 2002, the World Bank has collected this data from face-to-face interviews with top managers and business owners in over 130,000 companies in 135 economies; since 2005-06, most data collection efforts have been conducted using an internationally comparable Global Methodology.[15] The manufacturing and service sectors are the primary business sectors of interest.[16] Formal (registered) companies with five or more employees are targeted for interview and firms with 100% government/state ownership are not eligible to participate.

Of principal interest to us is the fact that the Enterprise Surveys contain a set of questions about electricity including: the frequency, duration and losses resulting from interruptions of electricity supply; the percentage of firms with generators and the share of their electricity that comes from this source; the number of days required to obtain an electricity connection; and the share of firms that regard electricity as a major constraint on their activities. Furthermore, firms were asked which of a list of elements of the business environment represents the biggest obstacle they face[17], making it possible to compare the relative importance of different constraints to firms within an economy.

It is important to recognise some important weaknesses of the Enterprise Surveys for the purpose of assessing electricity's importance as a binding constraint to economic growth. First, and most obviously, it only surveys enterprises. Whilst the economic activities undertaken by enterprises are clearly a very important part of most economies, they are not the only component of a country's economy. In most countries, there are valuable economic activities undertaken by organisations which are not classified as enterprises, including cooperatives and non-profit organisations of various kinds. Second, and importantly, the enterprise survey only covers *private* enterprises - it explicitly excludes firms which are 100% state-owned. However, in some countries, state-owned enterprises conduct very significant economic activities including often being responsible for electricity generation, transmission and distribution. Moreover, the surveys focus on manufacturing and services. However, it is still the case that, in most poor countries, the majority of the labour force (and a very large share of the poor) are employed in agriculture. Similarly, the surveys typically do not include mining and other extractive industries which can constitute a very important part of some economies.

The Enterprise Surveys also only survey registered firms with five employees or more. However, the vast majority of people working in the private sector in sub-Saharan Africa and South Asia work in very small firms of one or two people in the informal sector (Page and Söderbom 2015).[18] Also, importantly, the surveys can only cover firms that exist – they are therefore unable to represent the views of entrepreneurs who may have wished to set up a business in a particular sector, but were dissuaded from doing so due to electricity constraints.

[15] More detailed information about the Enterprise Surveys and the methodology they use can be found on the on the methodology page of www.enterprisesurveys.org

[16] Specifically, firms classified with ISIC codes 15-37, 45, 50-52, 55, 60-64, and 72 (ISIC Rev.3.1). Services firms include construction, retail, wholesale, hotels, restaurants, transport, storage, communications, and IT.

[17] The list was: access to finance; access to land; business licensing and permits; corruption; courts; crime, theft and disorder; customs and trade regulations; electricity; inadequately education workforce; labor regulations; political instability; practices of the informal sector; tax administration; tax rates; and transportation.

[18] Whilst the World Bank also undertaken additional surveys of the informal sector, these are not currently available for cross-country comparison.

Although there is no way of knowing the size of this selection bias, the direction of bias is clear – the views of existing businesses are likely to underestimate the true level of constraint.

Finally, although the Enterprise Surveys focus on the collection of objective data on constraints and firm performance, their measures of the relative importance of different constraints are based on the perceptions of firm owners and managers. Whilst these perceptions are extremely informative, they are inevitably subject to the biases typically associated with perceptions surveys (see Gelb et al. 2007; Carlin, Schaffer, and Seabright 2006; Dethier, Hirn, and Straub 2008).

It is possible that the weaknesses of the Enterprise Survey may bias the preceptions of electricity as a constraint. For example, enterprises may be more dependent on electricity and therefore more critical than other respondents might be. If government firms have better access than private firms, then the perception of constraints may be biased upwards. If agriculture is less electricity intensive, then the focus on manufacturing and services may create an upward bias in perceptions of constraints (although in some regions, e.g. South Asia, agricultural use for water pumping is very high and so the bias may be the other way; the same applies to the omission of mining and extractives). The bias from focussing on registered firms of more than 5 employees isn't obvious – informal firms tend to have worse access and quality, but the constraints on larger firms may have larger implications for the profitability of the businesses. As noted, the selection bias of focussing only on existing firms will be downwards. It is impossible to assess the net effect of these potential biases, but useful to be conscious of them in reviewing the analysis.

Notwithstanding these weaknesses for our specific purpose, the Enterprise Surveys represent the most comprehensive cross-country data measuring constraints faced by a major part of the private economy. We therefore briefly summarise the major findings regarding electricity as a constraint that arise from the enterprise surveys and then compare these to the results obtained from our systematic review of HRV studies.[19] For brevity, we focus on Sub-Saharan Africa and South Asia where the constraints are most severe.[20]

Figure 4 shows in a graphical format the percentage of firms in each country in sub-Saharan Africa which see each of the elements of the business environment as their biggest obstacle. Figure 5 shows the same information for countries in South Asia.

[19] See Alby et al. (2012) for a more detailed analysis of the impact of electricity on firms using the Enterprise Survey data.
[20] Similar analysis for other countries is available on request.

Figure 4: Biggest obstacle as perceived by firms in sub-Saharan Africa

Economy	Year	Access to finance	Access to land	Business licensing and permits	Corruption	Courts	Crime, theft and disorder	Customs and trade regulations	Electricity	Inadequately educated workforce	Labor regulations	Political instability	Practices of the informal sector	Tax administration	Tax rates	Transportation
All Countries		15.7	3.5	2.6	7.2	1.1	4.0	3.6	9.4	7.3	3.3	11.6	12.4	3.4	12.1	2.9
Sub-Saharan		25.6	5.9	2.3	7.5	0.5	2.5	4.6	13.7	2.5	1.1	8.8	10.0	4.3	7.9	2.4
Angola	2010	13.1	16.3	7.9	28.9	0.6	1.3	6.9	6.3	4.3	1.6	3.5	5.0	0.8	1.6	1.8
Burundi	2014	9.4	0.2	1.9	11.6	0.5	0.0	3.6	21.7	0.0	0.4	14.2	1.5	4.5	30.4	0.2
Benin	2009	25.1	2.5	0.0	8.0	0.1	4.5	4.8	11.2	2.3	0.2	5.3	10.7	8.8	9.6	6.9
Burkina Faso	2009	35.5	2.7	0.1	9.7	0.3	1.0	6.8	6.1	1.3	1.7	0.6	10.8	4.9	17.7	0.8
Botswana	2010	12.8	12.8	7.3	10.1	1.3	8.3	3.9	5.6	18.0	2.8	0.8	9.4	1.0	3.9	1.9
Central	2011	19.1	0.8	0.8	5.9	0.7	2.7	7.7	40.6	0.7	0.0	3.6	7.2	2.7	3.1	4.6
Côte d'Ivoire	2009	45.2	3.9	0.0	7.5	0.4	1.3	0.6	1.6	0.5	2.9	28.0	5.5	0.2	1.1	1.2
Cameroon	2009	16.6	1.2	0.0	7.4	0.5	5.1	3.4	13.6	0.8	0.7	2.0	24.9	19.4	3.8	0.6
Congo, Rep.	2009	15.6	2.9	2.1	8.7	1.0	0.9	5.4	31.9	2.9	1.0	15.5	3.6	3.1	1.6	3.7
Cabo Verde	2009	13.1	7.2	2.9	8.0	0.4	11.0	5.9	11.0	7.3	0.5	0.0	17.1	4.7	9.5	1.5
Eritrea	2009	0.0	17.0	28.7	0.0	0.0	0.0	1.7	6.0	3.7	0.6	24.1	0.0	1.1	8.5	8.6
Ethiopia	2015	40.4	4.6	0.0	7.1	0.5	0.9	9.9	10.1	1.7	0.4	0.4	5.8	6.6	7.6	3.9
Gabon	2009	8.6	1.7	0.8	10.3	0.0	5.2	6.5	23.4	9.6	1.4	0.0	9.0	6.7	2.2	14.6
Ghana	2013	49.5	6.2	0.5	3.9	0.5	0.6	6.6	18.7	0.8	0.8	1.3	2.9	1.3	5.3	1.2
Guinea	2006	8.3	1.9	0.5	3.1	0.4	1.7	0.8	64.3	0.0	0.0	1.8	2.6	0.4	3.9	10.3
Gambia, The	2006	11.7	6.5	1.2	0.6	2.3	2.4	2.4	54.5	1.7	0.0	2.1	4.1	1.7	6.5	2.3
Guinea-Bissau	2006	20.1	0.0	0.0	7.5	1.4	0.7	0.7	47.1	0.0	0.0	7.7	4.5	0.7	6.0	3.6
Kenya	2013	9.6	4.7	2.7	12.3	0.4	4.6	4.5	9.6	1.6	1.2	9.8	23.9	2.8	9.4	2.9
Liberia	2009	39.8	2.5	2.4	11.9	4.1	17.4	2.3	13.3	1.0	0.0	0.0	2.3	2.4	0.7	0.0
Lesotho	2009	15.9	9.7	1.7	14.7	2.2	8.7	3.9	7.1	3.1	4.4	9.1	1.6	1.6	11.2	5.3
Madagascar	2013	5.5	0.2	0.2	4.9	0.0	6.8	0.4	15.5	0.9	2.7	48.1	2.7	4.8	6.1	1.1
Mali	2010	43.9	6.1	0.7	4.3	1.3	2.7	3.3	8.0	0.2	0.9	1.6	13.6	9.0	3.5	0.9
Mozambique	2007	23.2	5.2	1.7	4.1	0.6	7.8	4.2	9.1	5.2	0.8	0.6	21.4	1.4	8.9	6.0
Mauritania	2014	31.3	1.9	1.0	2.8	0.5	2.7	3.2	14.3	5.9	0.9	10.8	14.3	4.4	6.2	0.0
Mauritius	2009	30.2	2.1	2.5	2.3	0.2	8.0	3.8	11.3	6.9	2.0	1.1	18.0	1.5	2.5	7.7
Malawi	2014	29.9	7.1	3.6	10.7	0.6	3.2	2.5	14.2	1.9	0.4	4.2	7.6	1.2	10.1	2.7
Namibia	2014	47.6	20.5	1.8	10.2	0.8	1.7	1.6	2.5	1.1	1.1	0.0	1.4	1.1	1.4	0.5
Niger	2009	20.3	2.1	0.0	13.8	0.0	0.0	0.6	5.7	2.5	0.0	15.6	21.2	2.6	12.8	2.8
Nigeria	2014	30.2	2.6	0.7	12.7	0.0	1.0	2.2	27.2	0.4	1.1	4.4	4.3	1.6	5.9	5.7
Rwanda	2011	23.0	5.4	1.6	0.5	1.1	2.7	4.6	0.6	4.6	0.3	1.3	16.1	9.2	21.0	8.0
Sudan	2014	5.7	3.2	2.5	7.8	0.0	0.7	21.9	0.6	1.7	2.9	14.3	4.8	21.0	9.3	3.6
Senegal	2014	38.6	4.9	0.1	4.1	0.1	2.4	6.2	8.1	1.1	0.7	0.2	23.2	6.1	3.5	0.7
Sierra Leone	2009	14.8	7.6	2.6	8.6	0.8	1.5	2.8	14.3	2.3	3.2	6.9	10.0	0.0	17.1	7.5
South Sudan	2014	15.3	7.2	2.3	6.8	0.8	2.8	2.6	9.9	1.7	1.1	30.4	4.8	1.6	7.5	5.3
Swaziland	2006	10.3	2.7	5.4	5.2	1.0	18.5	3.4	6.8	2.5	0.4	0.6	25.4	1.7	15.4	0.7
Chad	2009	3.2	0.0	0.0	13.5	0.4	3.6	9.6	23.8	0.0	0.0	29.5	5.0	3.0	1.9	6.6
Togo	2009	23.7	1.4	1.4	9.0	0.1	0.4	4.6	9.5	0.0	0.0	23.3	11.2	7.5	7.1	0.8
Tanzania	2013	37.9	5.1	3.1	2.5	0.0	1.9	3.2	24.9	1.7	1.2	1.1	6.1	1.3	8.3	1.9
Uganda	2013	12.3	6.6	7.7	2.6	0.0	0.7	1.7	23.4	0.4	0.2	1.6	19.7	1.2	18.5	3.4
South Africa	2007	7.5	2.7	2.9	7.1	1.2	40.4	1.1	14.7	6.7	5.6	1.1	4.9	0.1	1.7	2.3
Congo, Dem.	2013	13.5	4.2	0.1	11.5	1.2	5.0	4.0	19.1	3.9	1.5	13.4	11.7	6.1	4.7	0.1
Zambia	2013	27.5	8.6	3.7	2.5	0.0	2.6	0.9	13.1	2.6	2.3	0.5	22.5	6.9	5.2	1.1
Zimbabwe	2011	46.8	0.7	0.9	1.5	0.0	0.9	0.2	6.8	0.0	0.1	27.4	12.0	0.0	2.2	0.5

Note: Percentage of firms saying that the constraint is the biggest obstacle. Source: Authors analysis of Enterprise Survey data.

Figure 5: Biggest obstacle as perceived by firms in South Asia

Economy	Year	Access to finance	Access to land	Business licensing and permits	Corruption	Courts	Crime, theft and disorder	Customs and trade regulations	Electricity	Inadequately educated workforce	Labor regulations	Political instability	Practices of the informal sector	Tax administration	Tax rates	Transportation
All Countries		15.7	3.5	2.6	7.2	1.1	4.0	3.6	9.4	7.3	3.3	11.6	12.4	3.4	12.1	2.9
South Asia		12.4	5.3	1.8	9.3	0.4	2.6	1.9	20.3	3.4	5.1	17.9	6.2	2.7	6.9	3.6
Afghanistan	2014	12.1	13.5	0.6	16.2	0.3	6.0	2.4	10.2	2.5	0.3	24.9	1.0	0.7	5.0	4.4
Bangladesh	2013	13.8	2.9	0.4	7.9	0.0	0.9	1.4	27.8	4.0	0.4	36.7	1.2	0.5	1.4	0.6
Bhutan	2015	23.8	3.1	1.5	0.9	0.4	2.0	2.2	6.9	3.8	22.6	1.8	9.6	1.1	12.1	8.1
India	2014	11.7	4.6	2.1	19.9	1.6	1.1	1.2	15.3	3.4	4.9	3.5	12.1	3.7	13.0	2.1
Sri Lanka	2011	14.1	9.8	6.4	2.0	0.5	2.1	2.7	11.4	6.4	6.6	1.0	16.0	6.1	11.9	3.1
Nepal	2013	8.6	2.9	1.3	0.8	0.0	0.0	1.3	25.6	0.9	0.4	48.9	3.0	0.1	1.0	5.1
Pakistan	2013	2.7	0.6	0.2	17.3	0.2	6.2	2.4	45.3	3.1	0.5	8.7	0.6	6.8	3.6	1.7

Note: Percentage of firms saying that the constraint is the biggest obstacle. Source: Authors analysis of Enterprise Survey data.

Figure 4 shows two striking results. First, by far the most important constraint perceived by firms in sub-Saharan Africa is access to finance. Over a quarter of firms identify this as their biggest obstacle compared to 15.7% globally. Indeed for 10 of the 43 African economies included, more than a third of firms saw access to finance as their biggest constraint. However, the second striking result is that, after access to finance, electricity is the next most important constraint faced by firms. Fully 13.7% of firms in sub-Saharan Africa said that this was their most important constraint, larger than the share for corruption, political instability and informal sector practices (and much larger than the share of firms pointing to issues such as access to land, customs and tax). In six of the 43 African economies included[21], more than a quarter of firms rated electricity as their top concern (compared, for example, to only five that had a similar percentage arguing that political instability was the key constraint).

Figure 5 presents an even stronger confirmation of the extent to which electricity is a constraint in the South Asian economies. Here electricity is the top constraint with more than a fifth of firms across the region arguing that it is the biggest obstacle (compared to only 12.4% for access to finance). In three of the seven economies (Pakistan, Nepal and Bangladesh), more than a quarter of firms see electricity as their biggest obstacle – in Pakistan 45% of firms see this as the top obstacle. Electricity even trumps political instability, the second most frequently mentioned obstacle.

Given this striking affirmation of the importance of electricity as a constraint, it is worth exploring in more detail the nature of the constraint faced by firms in both regions. Appendix Table A.2 shows data on the full range of electricity related variables collected by the Enterprises Surveys for sub-Saharan Africa; Appendix Table A.3 provides the same information for South Asia.

Table A.2 shows that sub-Saharan African economies typically face 8.5 electricity outages each month, but with some countries experiencing outage on daily basis. Typically outages last for over 5 hours and lead to losses of 5.5% of annual sales. Consequently, more than half of the firms surveyed own or share a generator – in the Central African Republic and the Republic of Congo, more than 80% of firms own or share a generator, with more than 30% of their electricity coming from this source (despite it being many times more expensive than grid electricity). One of the reasons is the difficulty in obtaining an electricity connection – which typically takes 33 days, but can be up to 194 days in Ethiopia. Unsurprisingly, 38% of firms across the region said that electricity was a major constraint.

The challenges faced by firms with electricity appear to be even worse in South Asia. Outages occur 25 times a month (although this figure is biased by the extremely high number of outages in Bangladesh (64.5) and Pakistan (75.2)). Although the duration of outages is slightly shorter than in sub-Saharan Africa, the losses are typically higher with a similarly high share of firms owning or sharing generators. Obtaining an electricity connection is even more difficult in South Asia than in most sub-Saharan African countries. As a consequence, 46% of firms see electricity as a major constraint (75% in Pakistan).

[21] Central African Republic, Rep. of Congo, Guinea, The Gambia, Guinea-Bissau, Nigeria.

Having provided a brief review of the findings of the Enterprise Surveys on electricity as a constraint, it is useful to compare these with the results of the systematic review of the 55 HRV papers presented in Appendix 1. Two major conclusions can be drawn.

First and most significant for our core research question – is that there is strong agreement between the review of the literature and firm perceptions that poor electricity supply is a major constraint in many countries. As noted above, the systematic review suggests that in most countries slow growth is the result of low returns to economic activity. This, in turn, is driven by failures in the microeconomic and sectoral policies pursued by governments, and low social returns, predominantly caused by poor infrastructure. The dominant complaint about poor infrastructure concerns access to and the unreliability of electricity. Thus the firm level data strongly corroborates the findings of the systematic review with regard to electricity.

Second, there is a marked difference between the perceptions of firms about the importance of access to finance and the conclusions of the binding constraints literature. The enterprise survey data show this as the most important constraint for businesses in sub-Saharan Africa and in the top three for South Asia. However, the systematic review rarely finds that finance is the binding constraint to growth. Only 12 of the 55 studies suggest that the high cost of finance is a binding constraint to growth, including only two in Africa (DRC, Ghana) and three in South Asia (Bhutan, Maldives and one of the Pakistan studies). This may be because firms typically complain about difficulties in access to finance both for viable investments and for non-viable ones, potentially creating an upward bias the perceptions of finance as a constraint.

Relationship Between Electricity as a Binding Constraint and Electricity Prices

In addition to our core question of whether electricity is a binding constraint to growth, we also explore briefly a subsidiary question about whether, in places where electricity *is* a binding constraint, this is reflected in electricity prices. Clearly, if by "electricity prices" we are referring to shadow prices, then the answer is obviously "yes", since high shadow prices are evidence for electricity being a binding constraint. Whilst a high shadow price does not guarantee that electricity is a binding constraint (since there may be other constraints that matter even more), if electricity is a binding constraint then, by definition, the value associated with releasing the constraint i.e. the shadow price, must be high. Hence a high shadow price is not a sufficient condition, but it is a necessary condition for being a binding constraint.

However, it is not immediately obvious therefore that electricity being a binding constraint is associated with high prices paid by customers. If markets function effectively then being a binding constraint would certainly imply high electricity prices; however, markets and prices for electricity are strongly regulated in most countries. As a result it cannot be concluded that high prices are reflective of electricity being a binding constraint. Indeed, the reverse could be the case; that is, the binding constraint on electricity supply could well be the solvency of the national utility which is often required to sell electricity for significantly less than its cost of production. In such a situation, high prices might be reflective of an attempt to improve the financial standing of the utility. In such a situation high prices might be reflective of a

better functioning electricity system, whilst lower tariffs might be more likely to reflect the existence of a binding constraint.

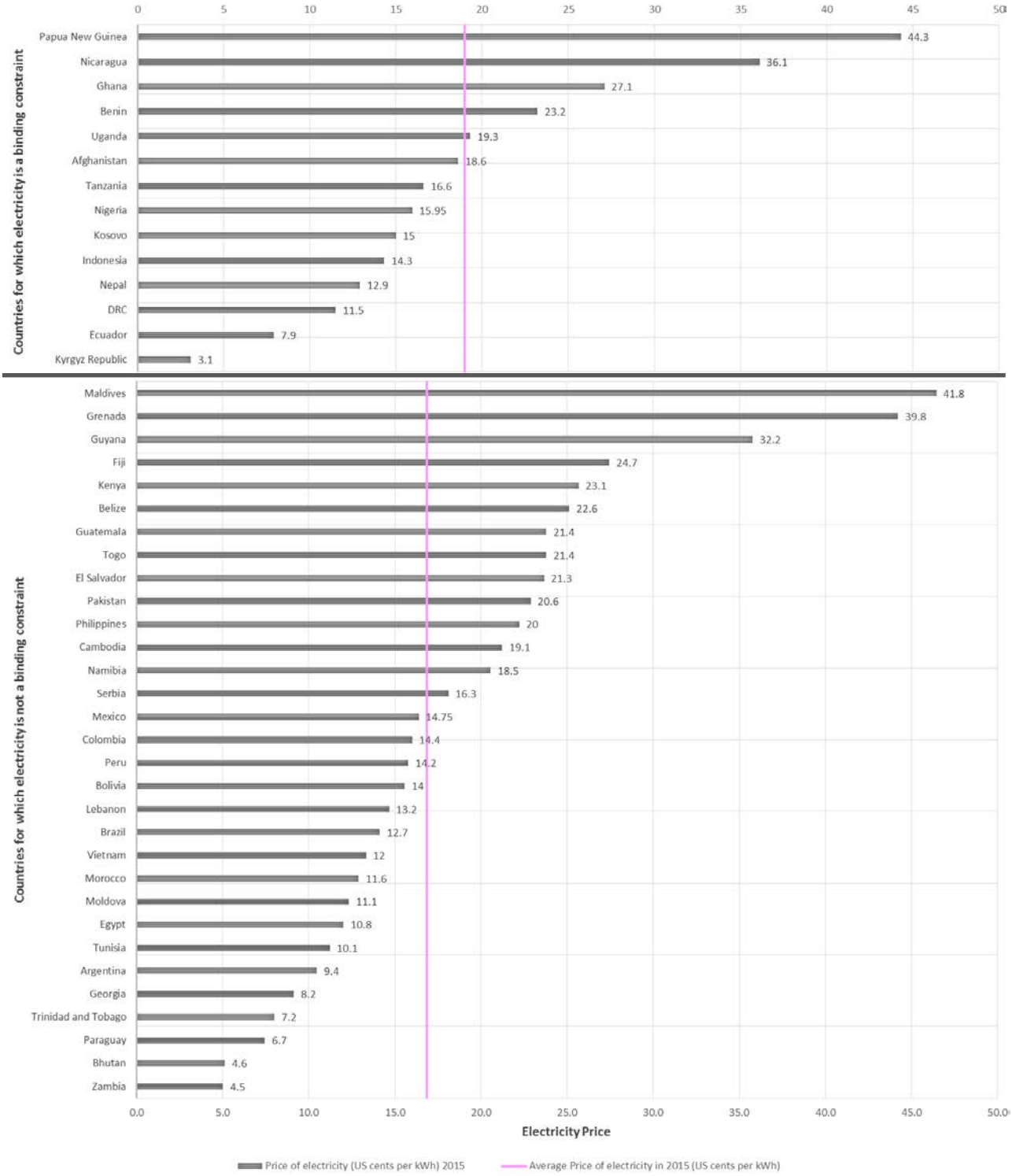
Unfortunately, the literature on the relationship between growth constraints and electricity prices – other than that reviewed above – is extremely sparse. There is a range of papers that look at electricity prices, but principally in the context of how reform of the sector influences such prices (Steiner 2001; Hattori and Tsutsui 2004). A handful of papers have explored the impact of regulatory reform on electricity prices in developing countries (e.g. Nagayama 2007, Estache et al. 2006) and Zhang et al. (2008) explores the impact of privatization and regulation on economic performance in developing and transitional countries - but their work does not look at the impact on prices.

Fortunately, the World Bank's Doing Business survey (2016) added an additional module over the last few years to estimate the cost of electricity for a standardised firm in a very large number of countries.[22] Whilst this represents only the *de jure* costs faced by a the imaginary firm and therefore may not be reflective of the actual costs faced by typical firms[23] in each country, it is, to our knowledge, the only dataset with comprehensive coverage of electricity prices in developing countries, particularly Sub-Saharan Africa and South Asia. We therefore collated the prices per KWh for each of the countries in our review, separating them into countries where electricity had been identified as a binding constraint and those where it was not. The results are shown in Figure 6.

[22] The World Bank Doing Business survey collects data on Price of electricity consumption in selected survey city by estimating a cost for a standardised firm. In this case, the firm is actually defined as a warehouse that "operates daily from 9:00am to 5:00pm (not for 24 hours), without electricity cuts (assumed for simplicity reasons), has a subscribed capacity of 140 kVA, a power factor of 1 (1 kVA = 1 kW), and a monthly consumption of 26,880 kWh. The warehouse is locally owned by an entrepreneur and is operated for commercial purposes 30 days a month. Therefore, the hourly consumption is (26,880 kWh/ 30 days/ 8 hours) = 112 kWh." If there are multiple electricity suppliers, the survey assumes that the cheapest supplier per customers served is used. Finally, the estimates are based on the tariffs of March 2015 and March 2014.

[23] In particular, many firms deal with unreliability of grid supply by running generators at much higher cost than grid electricity or tariffs. Hence the cost of electricity estimates in the Doing Business survey are likely to significantly underestimate the true costs faced by firms.

Figure 6: Price per KWh for review countries with and without electricity as a binding constraint



As highlighted in Figure 6 above, we observe slightly higher average electricity prices per KWh in the countries where electricity is one of the binding constraints compared to the countries where electricity is not a binding constraint. The average price of electricity in 2015 (2016) was 18.99 (19.42) US cents per KWh in the countries where electricity is binding compared to 16.85 (15.78) US cents per KWh in those countries where it is considered non-binding. However, there is clearly no statistically significant difference between the two groups as the variation within each group far exceeds the variation between them. For example, electricity is a binding constraint in Papua New Guinea where the electricity price, at 44.3 US cents per KWh in 2015, was substantially higher than in any other country in the sample. Similarly, electricity is binding in Nicaragua where the price was 36.1 US cents per KWh in 2015 due to very poor public and private infrastructure and ineffective pricing and subsidy policies resulting in very high cost to non-subsidized users (Agosin et al. 2009). At the same time, Asian Development Bank (2015b) argues that electricity is not a binding constraint in the Maldives despite having one of the highest electricity costs in the sample (41.8 US cents per KWh in 2015). Similarly, although the electricity sector is inefficient, electricity was not regarded as a binding constraint in Guyana despite a price of 32.2 US cents per KWh in 2015 (Armendariz et al. 2007). These examples illustrate that a high price, in and of itself, does not necessarily mean that electricity is a binding constraint to growth – much depends on the other constraints that the country faces.

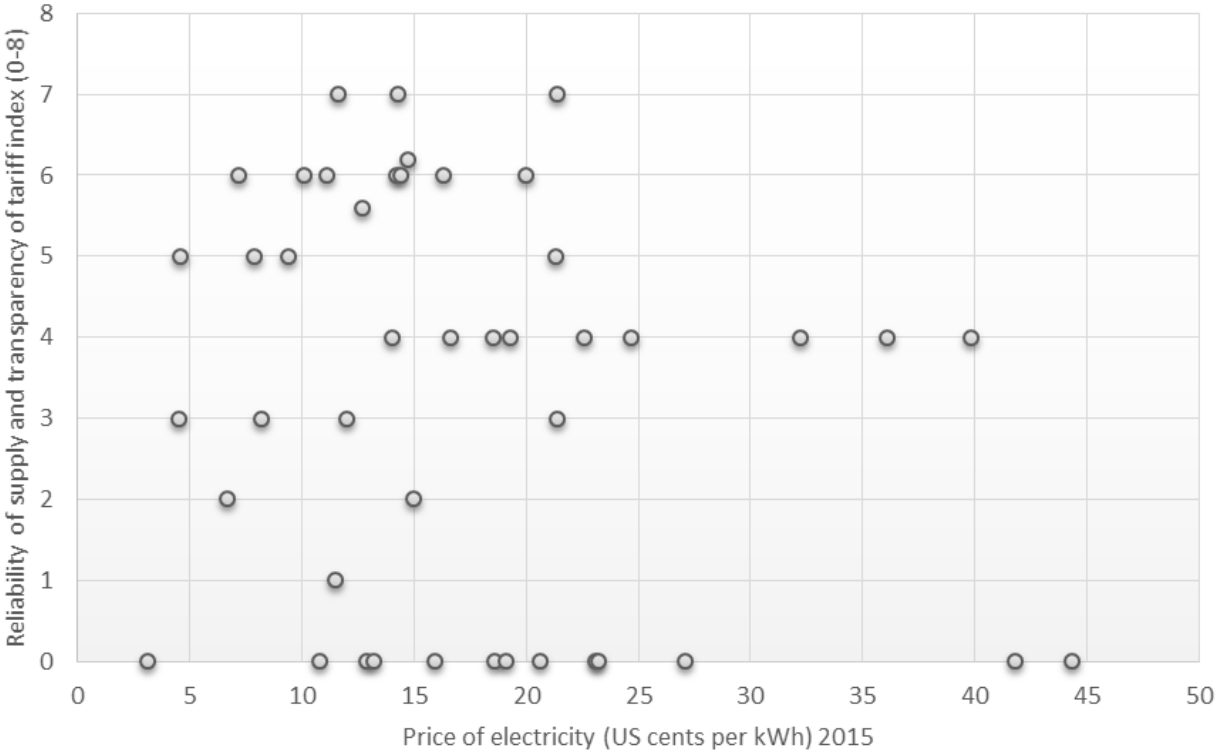
Equally, a low electricity price is not a guarantee that there is not a constraint. Electricity was 3.1 US cents per KWh in the Kyrgyz Republic in 2015. However, the Asian Development Bank (2014b) argue that electricity is one of the top constraints to economic growth in the country. This is because the low prices in the Kyrgyz Republic reflect tightly controlled electricity tariffs which do not reflect the actual costs of production. But the existence of low prices is not a reliable indicator of the existence of a binding constraint either. Bhutan had one of the lowest electricity costs at 4.6 US cents per KWh in 2015, but electricity was not deemed a binding constraint by the Asian Development Bank (2013), even though prices were set well below the average cost of supply. Similarly, electricity is not considered binding in Zambia (Ianchovichina and Lundstrom 2008) where prices were only 4.5 US cents per KWh in 2015. Thus having electricity as a binding constraint does not automatically imply either a high or a low electricity price; and a high or low electricity price by itself is not a reliable indicator of whether electricity supply is a binding constraint to growth – although, as noted before, there may be a tighter relationship between the (unknown) true costs faced by firms and whether electricity is deemed a binding constraint.

There is also a rather weak relationship between electricity prices and the reliability and quality of supply. Figure 7 shows the relationship between the World Bank's reliability of supply and transparency of tariffs index and electricity prices for all the countries in our sample.[24] There is a high degree of variation in electricity reliability for countries with similar electricity prices. For example, the Democratic Republic of Congo scores 1 in the index with an electricity price of 11.5 US cents per KWh, while Morocco scores 7 at almost exactly the same price (11.6 US cents per KWh). Such contrasts can be found at all prices levels between 5-20 US cents/KWh. This said, there is an overall negative correlation between reliability and price (with a coefficient of -0.22) driven in part by the fact that, for prices above 22 US cents/KWh, the overall reliability of electricity and transparency of tariffs index scores never rises above 4 (and

[24] The index ranges from 0 to 8, with higher values indicating greater reliability of electric supply and greater transparency of tariffs. See http://www.doingbusiness.org/methodology/getting-electricity for details.

is zero for a large number of countries including Papua New Guinea, Maldives Benin, Kenya, and Ghana).

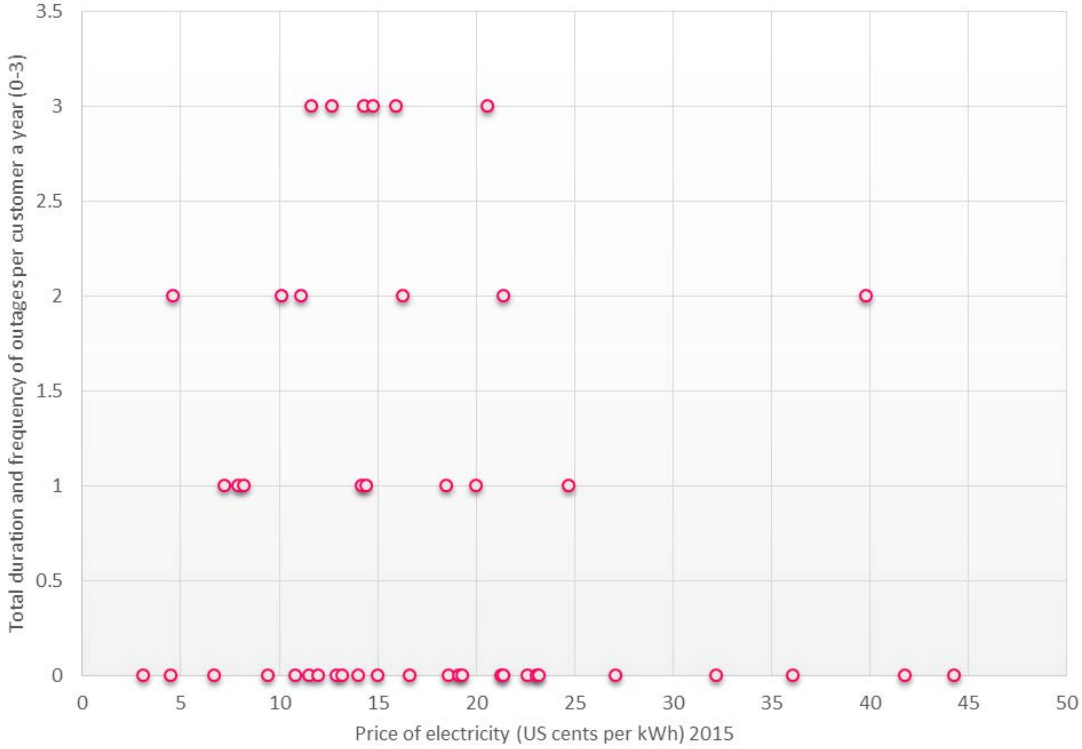
Figure 7: The relationship between the price of electricity, reliability of supply and transparency of tariffs



A similar picture emerges when looking at the relationship between the duration and frequency of outages and electricity prices for the countries in our sample (Figure 8).[25] Prices of between 10-22 US cents per KWh are associated with a very wide range of performance, whereas very high prices are typically associated with poor and unreliable service.

[25] The Doing Business survey uses the system average interruption duration index (SAIDI) and the system average interruption frequency index (SAIFI) to estimate the duration and frequency of power outages in the largest business city of each country. If SAIDI and SAIFI are below 12 (equivalent to an outage of one hour each month), a score of 1 is assigned. If SAIDI and SAIFI are below 4 (equivalent to an outage of one hour each quarter), 1 additional point is assigned. Finally, if SAIDI and SAIFI are below 1 (equivalent to an outage of one hour per year), 1 more point is assigned. Hence a score of zero indicates a poor quality of service, while a score of 3 indicates a highly reliable service.

Figure 8: The price of electricity and the total duration and frequency of outages per customer a year



While the Doing Business data provides an indication of the relationship between electricity as a binding constraint and prices, it is based on the calculation of prices that should be payable by a stylised reference firm. More recently, the World Bank have undertaken an analysis of the financial viability of electricity sectors in 39 countries in Sub-Saharan Africa based on data compiled from utilities (Trimble et al, 2016). This shows a major gap between electricity costs and tariffs, with only two countries in Africa (Uganda and Seychelles) having financially viable electricity sectors. There is a significant gap between the average tariff charged in many countries and the costs of supply, making tariffs an unreliable guide to whether or not electricity constitutes a binding constraint.[26]

However, understanding the relationship between binding constraints and the true cost of supply, it is not the same as determining the relationship between electricity being a binding constraint and the prices paid and costs incurred by users. There is, to our knowledge, no systematic data on the costs of electricity to households across Africa and South Asia. One reason for this is that determining costs to users is extremely difficult because it depends not only on the official tariffs but also on the honesty and efficiency of bill collection and the ability of households to obtain electricity from more than one source. Yet obtaining such information is important because, without it, it is extremely difficult to conduct credible analysis of the impact of electricity sector reforms on poverty and the distribution of income or consumption. This should be an important focus for data collection going forward.

[26] Indeed, the average tariff for the five African countries for which binding constraints studies suggest electricity is a major constraint have lower average tariffs than the three countries for three African countries for which we have binding constraints studies suggesting that electricity is not a major constraint.

Summary and opportunities for further research

This review of the literature on the binding constraints to economic growth has shown that electricity is one of the top constraints to growth in developing countries. Almost all of the 55 studies reviewed mentioned electricity with around two-thirds discussing electricity access and reliability. Well over half of the studies cited infrastructure as a binding constraint to growth (second only to "micro risks" as a constraint) and 40% of all studies identified electricity as a binding constraint. The studies make clear the particularly low levels of access in Sub-Saharan Africa and South Asia, especially in rural areas and the poor quality and reliability of supply. The existence of electricity as a binding constraint is revealed in several countries through high shadow prices, significant economic costs associated with outages, widespread attempts to avoid the constraint – notably by the use of generators, and, in all likelihood, the relatively poor performance of energy intensive sectors (although the evidence for this in this review is thin). Moreover, the importance of electricity as a constraint is confirmed by data from the World Bank's Enterprise Survey which suggests that it is the second most important obstacle for firms in Sub-Saharan Africa and the most important obstacle in South Asia. Finally, the limited data available on electricity prices suggests that prices are slightly higher on average in countries where electricity is a binding constraint, but that prices are a poor proxy for electricity being a binding constraint. However, very high prices do appear to be associated with poor quality and reliability.

Going forward, we suggest three areas where we believe that research could play a useful role in generating evidence useful for policy and one area where, perhaps controversially, we suggest that less effort should be put.

First, the literature reviewed has provided a picture of the extent to which electricity is a constraint at the country level. However, such analysis is very generic and doesn't, in itself, provide clear guidance to policymakers. To make further research more useful for policy it needs to be more granular – for example, understanding how access to and the quality of electricity affects firms and households. There is also a clear need for better data on who has access to electricity (including disaggregation by gender – a subject barely mentioned in the studies reviewed), how much, where they obtain it from and how much they actually pay. Such data is essential to understand the microeconomic constraints to income growth at the household and firm level.

Second, at a macro level, there is a need to understand what drives electricity prices. Our study has shown the enormous variation in prices across countries (and we also uncovered some evidence for similar wide variations in costs within countries). Prices are not a reliable indicator of whether electricity is a binding constraint, nor in general of quality and reliability. Rather prices are driven by a combination of cost factors, including geography and resource endowments, as well as policy and implementation variables, such as the efficiency of generation, transmission and distribution, the extent of theft, and the pricing policies adopted by governments. Trimble et al. (2016) has started to assess the relative contribution of such influences in Sub-Saharan Africa and therefore the right policy balance between efforts to reduce costs and improve efficiency and attempts to put in place appropriate pricing policies for sustainable improvements in supply. But we do not have this information for other areas of the developing world, nor a clear link between tariffs and the actual prices paid by

consumers. To achieve this would require a comprehensive programme of data gathering on electricity prices akin to that which has already exists for fossil fuel prices.

Third, and perhaps most important, there is a need to understand why the low levels of access and poor quality persist. Much effort has focused on measuring the extent of access and quality and the impact of power sector reforms (e.g. Jamasb, Nepal and Timilsina, 2015). There is also an important literature which attempts to learn lessons about power sector reform (see Choynowski 2004, Besant-Jones 2006, Dornan 2014a) and work which explores the political economy of reform (Kojima, Bacon and Trimble, 2014, Dornan 2014b, see McCulloch, Ward and Sindou, forthcoming, for a review). However, further work is needed to understand the underlying motivations and constraints faced by different groups of actors since this could help to explain why progress is difficult as well as potentially identify context specific ways in which progress can be made. Research could usefully explore instances where rapid progress has been made in either access or quality or both and unpick the factors and approaches that enabled such progress to be made. This could be assessed through coordinated case studies designed to explore both the persistence of failure and the triggers for success.

The area in which we suggest less effort should be placed is in further refinement of "binding constraints" studies. This may be surprising – many such studies are of poor quality and even those that were selected were not always consistent in the quality of their analysis. It is clearly a good thing for there to be a methodology which attempts to objectively assess the relative importance of different constraints for a country's growth. However, in our view, the binding constraints methodology is too generic to provide operationalisable recommendations for energy policy. In most situations, it is relatively easy to determine whether electricity provision is a significant constraint or not using readily available data on access and reliability, along with the views of the business community. The key challenge is not to further refine that judgement, but to explore in more detail why the problem exists in each country and what are the most effective approaches to addressing it.

References

Agosin, Manuel, Eduardo Fernández-Arias, and Fidel Jaramillo. 2009. *Growing Pains-Binding Constraints to Growth in Latin America*. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Alby, Philippe, Jean-Jacques Dethier, and Stéphane Straub. 2013. "Firms Operating under Electricity Constraints in Developing Countries." *World Bank Economic Review* 27 (1): 109–32. doi:10.1093/wber/lhs018.

Badger, D., J. Nursten, P. Williams, and M. Woodward. 2000. "Should All Literature Reviews Be Systematic?" *Evaluation and Research in Education* 14: 220–30.

Besant-Jones J.E. 2006. "Reforming power sector markets in developing countries: what have we learned." Energy and Mining Sector Board discussion paper. Washington D.C.: The World Bank Group; 2006.

Carlin, Wendy, Mark E. Schaffer, and Paul Seabright. 2006. "Where Are the Real Bottlenecks? A Lagrangian Approach to Identifying Constraints on Growth from Subjective Survey Data." SSRN Scholarly Paper ID 923634. Rochester, NY: Social Science Research Network. https://papers.ssrn.com/abstract=923634.

Choynowski P. 2004. "Restructuring and regulatory reform in the power sector: review of experience and issues." In: E.a.R. Department (editor.). ERD working paper series. Manila: Asian Development Bank; 2004.

Commission On Growth and Development. 2008. "The Growth Report: Strategies for Sustained Growth and Inclusive Development." Washington, D.C.: Commition On Growth and Development.

Dethier, Jean-Jacques, Maximilian Hirn, and Stéphane Straub. 2011. "Explaining Enterprise Performance in Developing Countries with Business Climate Survey Data Business Climate Survey Data." *World Bank Research Observer* 26 (2): 258–309. doi:10.1093/wbro/lkq007.

Dornan, Matthew. 2014a. "Access to electricity in Small Island Developing States of the Pacific: Issues and challenges", *Renewable and Sustainable Energy Reviews*, Volume 31, March 2014, Pages 726-735.

Dornan, Matthew. 2014b. "Reform despite politics? The political economy of power sector reform in Fiji, 1996–2013." *Energy Policy* 67 (2014): 703-712.

Easterly, William, and William Russell Easterly. 2001. *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. Cambridge, MA: MIT press.

Estache, Antonio, Ana Goicoechea, and Lourdes Trujillo. 2006. "Utilities Reforms and Corruption in Developing Countries." World Bank Policy Research Working Paper No. 4081. World Bank. http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-4081.

Felipe, Jesus, and Norio Usui. 2008. "Rethinking the Growth Diagnostics Approach: Questions from the Practitioners." ADB Economics Working Paper Series Working Paper No. 132. Asian Development Bank. http://www.adb.org/publications/rethinking-growth-diagnostics-approach-questions-practitioners.

Foster, Vivien, and Jevgenijs Steinbuks. 2009. "Paying The Price For Unreliable Power Supplies: In-House Generation Of Electricity By Firms In Africa." Policy Research Working Papers No. 4913. World Bank. http://elibrary.worldbank.org/doi/citedby/10.1596/1813-9450-4913.

Gelb, Alan, Ginger Turner, Manju Kedia Shah, and Vijaya Ramachandran. 2007. "What Matters to African Firms ? The Relevance of Perceptions Data." WPS4446. The World

Bank. http://documents.worldbank.org/curated/en/980061468010497193/What-matters-to-African-firms-the-relevance-of-perceptions-data.
Habermann, Harald, and Pablo Padrutt. 2011. “Growth Diagnostics: Strengths and Weaknesses of a Creative Analytical Framework to Identify Economic Growth Constraints in Developing Countries.” *Journal of Knowledge Management, Economics and Information Technology* 1 (7): 1–25.
Hattori, Toru, and Miki Tsutsui. 2004. “Economic Impact of Regulatory Reforms in the Electricity Supply Industry: A Panel Data Analysis for OECD Countries.” *Energy Policy* 32 (6): 823–832.
Hausmann, Ricardo, Bailey Klinger, and Rodrigo Wagner. 2008. “Doing Growth Diagnostics in Practice: A ‘mindbook.’” Center for International Development Working Paper No. 177. Harvard University.
Hausmann, Ricardo, Lant Pritchett, and Dani Rodrik. 2005. “Growth Accelerations.” *Journal of Economic Growth* 10 (4): 303–329.
Hausmann, Ricardo, Dani Rodrik, and Andrés Velasco. 2008. “Growth Diagnostics.” In *The Washington Consensus Reconsidered: Towards a New Global Governance*, 324–355. Oxford University Press. https://books.google.co.uk/books?hl=en&lr=&id=wq_ltPYWKegC&oi=fnd&pg=PA324&dq=hausmann+growth+diagnostics&ots=am5z2FGwpb&sig=QasHlrW-O6Tbn-o4hJ3a2rnK6_o.
International Monetary Fund. 2006. “Finance and Development.” *Finance and Development | F&D* Volume 43 (Number 1). http://www.imf.org/external/pubs/ft/fandd/2006/03/.
Jamasb, Tooraj, Rabindra Nepal, Govinda R. Timilsina. 2015. “A Quarter Century Effort Yet to Come of Age - A Survey of Power Sector Reforms in Developing Countries”, Policy Research Working Paper 7330, Development Research Group, Environment and Energy Team, World Bank, June 2015, WPS7330, Washington D.C.
Kojima, Masami, Robert Bacon, Chris Trimble. 2014. “Political Economy of Power Sector Subsidies: A Review with Reference to Sub-Saharan Africa”, World Bank Energy and Extractives Group 89547, July 2014.
McCulloch, Neil, John Ward and Esmerelda Sindou. 2017. “The Political Economy of Aid for Power Sector Reform”, Energy and Economic Growth Research Programme State of Knowledge Paper, Center for Effective Global Action, University of California, Berkeley.
Munuera, L., R. Quadrelli, and E. Masanet. Forthcoming. “Energy Data in the 21st Century: Challenges and Opportunities for Developing Countries.” State of Knowledge Paper for Energy and Economic Growth Applied Research Programme. London: Department for International Development.
Nagayama, Hiroaki. 2007. “Effects of Regulatory Reforms in the Electricity Supply Industry on Electricity Prices in Developing Countries.” *Energy Policy* 35 (6): 3440–3462.
Osborne, David, Isabel Cane, Mel Cousins, and Enkhzaya Chuluunbaatar. 2015. “Integrated Report: An Integrated Analysis of Economic, Political and Social Issues That Support or Hinder Growth and Poverty Reduction in Mongolia.” Adam Smith International. https://dfat.gov.au/about-us/publications/Documents/mongolia-economic-political-social-analysis-report.pdf.
Page, John, and Måns Söderbom. 2015. “Is Small Beautiful? Small Enterprise, Aid and Employment in Africa.” *African Development Review* 27 (S1): 44–55.
Rodrik, Dani. 2010. “Diagnostics Before Prescription.” *The Journal of Economic Perspectives* 24 (3): 33–44.

Rodrik, Dani, Ricardo Hausmann, and Andrés Velasco. 2005. “Growth Diagnostics.” Cambridge, MA: Harvard University.
Steiner, Faye. 2001. “Regulation, Industry Structure and Performance in the Electricity Supply Industry.” OECD Economic Studies OECD Economic Studies No. 32. Organisation for Economic Co-operation and Development. http://econpapers.repec.org/article/oececokaa/5lmqcr2k29d1.htm.
Stern, David, Paul Burke, and Stephan Burns. Forthcoming. “The Impact of Energy on Economic Development from a Macro Perspective.” State of Knowledge Paper for Energy and Economic Growth Applied Research Programme. London: Department for International Development.
The World Energy Outlook (WEO). 2015. “WEO 2015 Electricity Access Database.” *World Energy Outlook (WEO)*. http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/.
Trimble, Christopher, Masami Kojima, Ines Perez Arroyo, Farah Mohammadzadeh. (2016). “Financial Viability of Electricity Sectors in Sub-Saharan Africa - Quasi-Fiscal Deficits and Hidden Costs”, Policy Research Working Paper 7788, World Bank, Washington D.C.
World Bank. 2005. *Economic Growth in the 1990s: Learning from a Decade of Reform*. The World Bank. http://elibrary.worldbank.org/doi/abs/10.1596/0-8213-6043-4.
World Bank. 2016. “Historical Data - Doing Business- World Bank Group.” http://www.doingbusiness.org/Custom-Query.
World Health Organization, and United Nations Development Programme. 2009. “The Energy Access Situation in Developing Countries.”
Zhang, Yin-Fang, David Parker, and Colin Kirkpatrick. 2008. “Electricity Sector Reform in Developing Countries: An Econometric Assessment of the Effects of Privatization, Competition and Regulation.” *Journal of Regulatory Economics* 33 (2): 159–178.

Annexes

Annex 1: Articles Selected at the Initial Systematic Review Process

We defined keywords as “Hausmann OR Rodrik OR Velasco AND binding AND constraints AND growth” to find research studies. We limited our search to studies performed in 2004 or later. Further, we have only looked at articles and studies published in the English language. To obtain relevant research studies, we used numerous social science research databases, including EconLit, Social Science Research Network (SSRN), EBSCOhost, Google Scholar and Google search engines, institutional websites and databases and multilateral and bilateral international development organization websites. This initial search produced the following list of 152 articles.

Abdel-Latif, Abla, and Hubert Schmitz. 2011. “The Politics of Investment and Growth in Egypt: Experimenting with a New Approach.” Development Policy Review 29 (4): 433–58. http://onlinelibrary.wiley.com/doi/10.1111/j.1467-7679.2011.00541.x/abstract.

African Development Bank Group. 2015. “Morocco’s Growth Diagnostic: Addressing Constraints to Leverage Economic Potential.” African Development Bank Group. http://www.afdb.org/en/news-and-events/article/moroccos-growth-diagnostic-addressing-constraints-to-leverage-economic-potential-14080/.

Aghion, Philippe. 2012. “From Growth Theory to Growth Policy Design.” Economic & Social Research Council, LSE. http://www.lse.ac.uk/researchandexpertise/units/growthcommission/documents/pdf/aghion_growthdoc_apr2012.pdf.

Agosin, Manuel R., Rodrigo Bolaños, and Félix Delgado. 2009. “Chapter 7. Nicaragua: Remembrance of Growth Past.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Anderson, Steve, Kishori Kedlaya, James Whitaker, Whitney Dubinsk, Brandon Fenley, Sait Mboob, Caroline Smith, and John Thurow. n.d. “Inclusive Growth Diagnostic for Indonesia.” United States Agency for International Development.

Armendariz, Edna, Paloma Baena, Marlon Bristol, Anneke Jessen, Matthew Shearer, and Christian Schneider. 2007. “Identifying Binding Constraints to Economic Growth in Guyana.” IABD Working Paper GY-P1030. Inter-American Development Bank.

Artana, Daniel, Sebastián Auguste, and Mario Cuevas. 2009. “Chapter 5. Tearing Down the Walls: Growth and Inclusion in Guatemala.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Artana, Daniel, Sebastián Auguste, Ramiro Moya, Sandra Sookram, and Patrick Watson. 2009. “Chapter 8. Trinidad and Tobago: Economic Growth in a Dual Economy.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Asian Development Bank, International Labour Organization, and Department for International Development. 2009. “Nepal: Critical Development Constraints.” Asian Development Bank. Nepal. http://www.adb.org/publications/nepal-critical-development-constraints.
Asian Development Bank. 2007. “Philippines: Critical Development Constraints.” Asian Development Bank. Philippines. http://www.adb.org/publications/philippines-critical-development-constraints.
Asian Development Bank. 2012. “Papua New Guinea: Critical Development Constraints.” Asian Development Bank. Papua New Guinea. http://www.adb.org/publications/papua-new-guinea-critical-development-constraints.
Asian Development Bank. 2013. “Bhutan: Critical Development Constraints.” Asian Development Bank. Bhutan. http://www.adb.org/publications/bhutan-critical-development-constraints.
Asian Development Bank. 2014. “Myanmar: Unlocking the Potential.” Asian Development Bank. Myanmar. http://www.adb.org/publications/myanmar-unlocking-potential.
Asian Development Bank. 2014a. “Cambodia: Diversifying Beyond Garments and Tourism.” Asian Development Bank. Cambodia. http://www.adb.org/publications/cambodia-diversifying-beyond-garments-and-tourism.
Asian Development Bank. 2014b. “The Kyrgyz Republic Strategic Assessment of the Economy Promoting Inclusive Growth.” Asian Development Bank.
Asian Development Bank. 2015. “Thailand: Industrialization and Economic Catch-Up.” Asian Development Bank. Thailand. http://www.adb.org/publications/thailand-industrialization-and-economic-catch-up.
Asian Development Bank. 2015a. “Fiji: Building Inclusive Institutions for Sustained Growth.” Asian Development Bank. Fiji. http://www.adb.org/publications/fiji-building-inclusive-institutions-sustained-growth.
Asian Development Bank. 2015b. “Maldives: Overcoming the Challenges of a Small Island State.” Asian Development Bank. Maldives. http://www.adb.org/publications/maldives-overcoming-challenges-small-island-state.
Ayyagari, Meghana, Asli Demirgüç-Kunt, and Vojislav Maksimovic. 2008. “How Important Are Financing Constraints? The Role of Finance in the Business Environment.” The World Bank Economic Review 22 (3): 483–516. https://wber.oxfordjournals.org/content/22/3/483.full.
Babych, Yaroslava, and Michael Fuenfzig. 2012. “An Application of the Growth Diagnostics Framework: The Case of Georgia.” https://ideas.repec.org/p/tbs/wpaper/12-001.html.
Barbier, Edward B. 2004. “Water and Economic Growth.” Economic Record 80 (248): 1–16. http://onlinelibrary.wiley.com/doi/10.1111/j.1475-4932.2004.00121.x/full.
Barnebeck Andersen, Thomas, and Peter Sandholt Jensen. 2014. “Is Africa’s Recent Growth Sustainable?” International Economic Journal 28 (2): 207–23. http://www.tandfonline.com/doi/abs/10.1080/10168737.2013.825308.
BenYishay, Ariel, and Franck S. Wiebe. 2010. “Diagnostics in Transition-Analyzing the Constraints to Economic Growth in Moldova.”

Berthélemy, Jean-Claude, Sébastien Dessus, and Charbel Nahas. 2007. “Exploring Lebanon’s Growth Prospects.” World Bank Policy Research Working Paper No. 4332. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1010517.
Besley, Timothy J., and Maitreesh Ghatak. 2009. “Property Rights and Economic Development.” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1372563.
Bhattacharjee, Jayanti, and Sushil K. Haldar. 2015. “Economic Growth in South Asia: Binding Constraints for the Future.” Journal of South Asian Development 10 (2): 230–49. doi:10.1177/0973174115588847.
Blyde, Juan, Armando Casterlas Pinneiro, Christian Daude, and Eduardo Fernández-Arias. 2010. “Competitiveness and Growth in Brazil.” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1814686.
Bogetic, Zeljko, and Johannes W. Fedderke. 2005. “Infrastructure and Growth in South Africa: Benchmarking, Productivity and Investment Needs.” In ESSA Conference. https://www.researchgate.net/profile/Johannes_Fedderke/publication/228671297_Infrastructure_and_Growth_in_South_Africa_Benchmarking_productivity_and_investment_needs/links/00b495168194232c00000000.pdf.
Bourguignon, François, and Mark Sundberg. 2006. “Constraints to Achieving the MDGs with Scaled-up Aid.” New York: United Nations. http://siteresources.worldbank.org/EXTDECPROSPECTS/Resources/476882-1190137832134/4192984-1190137901387/Bourguignon-Sundberg-2006-Constraints-MDGs-Aid-UNDESA.pdf.
Brach, Juliane. 2008. “Constraints to Economic Development and Growth in the Middle East and North Africa.” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1286047.
Bräutigam, Deborah A., and Stephen Knack. 2004. “Foreign Aid, Institutions, and Governance in Sub-Saharan Africa.” Economic Development and Cultural Change 52 (2): 255–85. http://www.jstor.org/stable/10.1086/380592.
Briones, Roehlano M. 2009. “Asia’s Underachiever: Deep Constraints in Philippine Economic Growth.” Development, Natural Resources & the Environment, 226. http://cemuplb.net/Development,%20Natural%20Resources%20and%20the%20Environment_Ver1.pdf#page=238.
Calderón, César, and Rodrigo J. Fuentes. 2012. “Removing The Constraints for Growth: Some Guidelines.” Journal of Policy Modeling 34 (6): 948–70. http://www.sciencedirect.com/science/article/pii/S016189381200052X.
Calvo, Sara. 2006. “Applying the Growth Diagnostics Approach: The Case of Bolivia.” World Bank. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.121.5451&rep=rep1&type=pdf.
Canlas, Dante, Muhammad Ehsan Khan, and Juzhong Zhuang. 2010. Diagnosing the Philippine Economy: Toward Inclusive Growth. Anthem Press. https://books.google.co.uk/books?hl=en&lr=&id=h7-Xh6rGhK0C&oi=fnd&pg=PA1&dq=Hausmann+AND+binding+AND+growth+AND+Africa+OR+Asia&ots=1WjcuocM8K&sig=CHcZtLUkqWDyGTzI2TYML2rrDNI.

Carlin, Wendy, Mark E. Schaffer, and Paul Seabright. 2006. “Where Are the Real Bottlenecks? A Lagrangian Approach to Identifying Constraints on Growth from Subjective Survey Data.” Discussion Paper CEPR Discussion Paper No. 5719. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=923634.

Chao, Hung-po, and Hillard G. Huntington. 2013. Designing Competitive Electricity Markets. Vol. 13. Springer Science & Business Media. https://books.google.co.uk/books?hl=en&lr=&id=HzvSBwAAQBAJ&oi=fnd&pg=PP8&dq=binding+constraints+economic+growth&ots=DzMy_WlD9t&sig=zqc4uByNuJxWqYLNJolYx8gGlW4.

Chisari, Omar O., Eduardo A. Corso, José M. Fanelli, and Carlos A. Romero. 2007. “Growth Diagnostics for Argentina.” Buenos Aires, Argentina.: Centro de Estudios de Estado y Sociedad. http://www.iadb.org/res/files/GDM/FinalPapers/AR_CEDES.pdf.

Coulibaly, Souleymane. 2012. “Shifting Comparative Advantages in Tajikistan: Implications for Growth Strategy.” Policy Research Working Paper WPS6125. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2104035.

Cueva, Simón, Vicente Albornoz, and Leopoldo Avellán. 2009. “Chapter 4. Ecuador: Binding Constraints to Growth.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Department for International Development. 2008. “DFID Understanding Afghanistan Growth Diagnostic Scoping Study: Policy Discussion Paper.” 3.4.2 Final Report. The Recovery and Development Consortium. Department for International Development.

Devarajan, Shantayanan, and Ijaz Nabi. 2006. “Economic Growth in South Asia: Promising, Unequalising, Sustainable?” Economic and Political Weekly, 3573–80. http://www.jstor.org/stable/4418586.

Devarajan, Shantayanan. 2005. “South Asian Surprises.” Economic and Political Weekly, 4013–15. http://www.jstor.org/stable/4417133.

Dinh, Hinh T., Dimitris Mavridis, and Hoa Nguyen. 2010. “The Binding Constraint on Firms’ Growth in Developing Countries.” Policy Research Working Paper WPS5485. World Bank.

Dobronogov, Anton, and Farrukh Iqbal. 2005. “Economic Growth in Egypt: Constraints and Determinants.” World Bank MENA Working Paper No. 42. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=872328.

Donge, Jan K. van. 2012. “Governance and Access to Finance for Development: An Explanation of Divergent Development Trajectories in Kenya and Malaysia.” Commonwealth & Comparative Politics 50 (1): 53–74. doi:10.1080/14662043.2012.642120.

Dube, Oeindrila, Ricardo Hausmann, and Dani Rodrik. 2007. “South Africa: Identifying the Binding Constraint on Shared Growth.” CID South Africa Project, Harvard University. http://ricardohausmann.com/wp-content/uploads/2013/01/SouthAfricaCaseDubeHausmannRodrik.pdf.

Duclos, Jean-Yves, and Stephen A. O’Connell. 2009. “Is Poverty a Binding Constraint on Growth in Sub-Saharan Africa?” African Economic Research Consortium. https://books.google.co.uk/books?hl=en&lr=&id=UbeYCgAAQBAJ&oi=fnd&pg=PA54&dq=%22binding+constraints%22+growth&ots=7N0JpKjFp6&sig=WjV5n0XayWSvAm8lYQHOZAcbKEc.

Duncan, Ron, and Emele Duituturaga. 2014a. “Chapter 4: Binding Constraints to Economic Growth in the Cook Islands.” Identifying Binding Constraints in Pacific Island Economies, Pacific Islands Development Series, , no. No. 18 (November). http://www.pidp.org/pireport/special/pidp-wp-18.pdf#page=41.

Duncan, Ron, and Emele Duituturaga. 2014b. “Chapter 5: Binding Constraints to Economic Growth in Samoa.” Identifying Binding Constraints in Pacific Island Economies, Pacific Islands Development Series, , no. No. 18 (November). http://www.pidp.org/pireport/special/pidp-wp-18.pdf#page=41.

Duncan, Ron, and Raijieli Bulatale. 2014. “Chapter 3: Binding Constraints to Economic Growth in Fiji.” Identifying Binding Constraints in Pacific Island Economies, Pacific Islands Development Series, , no. No. 18 (November). http://www.pidp.org/pireport/special/pidp-wp-18.pdf#page=41.

Duncan, Ron. 2014. “Kiribati: A Political Economy Analysis of Constraints to Economic Growth.” Identifying Binding Constraints in Pacific Island Economies, 111. http://www.eastwestcenter.org/system/tdf/private/pidpwp018_1.pdf?file=1&type=node&id=34925#page=125.

Easterly, William. 2007. “Was Development Assistance a Mistake?” The American Economic Review 97 (2): 328–32. http://www.jstor.org/stable/30034470.

Elmaleh, David, Harry Masyrafah, Patrick Barron, and Enrique Blanco Armas. 2009. “Aceh’s Growth Diagnostics: Identifying the Binding Constraints to Growth in a Post-Conflict and Post-Disaster Environment. Expenditure of Aceh Post-Conflict Response.” In International Conference on Aceh and Indian Ocean Studies II–Civil Conflict and Its Remedies.

Enders, Klaus-Stefan. 2007. “Egypt--Searching for Binding Constraints on Growth.” International Monetary Fund.

Fogel, Robert W. 2006. “Why China Is Likely To Achieve Its Growth Objectives.” Working Paper W12122. National Bureau of Economic Research. http://www.nber.org/papers/w12122.

Frede, Julian. 2016. “Regional Integration and National Binding Constraints-ECOWAS’ Capability and Potential to Solve Constraints to Growth of Its Member States.” Accessed June 8. http://www.pegnet.ifw-kiel.de/event/conferences/conference-2012/program-2012/Frede_Poster.pdf.

Gelb, Alan, Vijaya Ramachandran, Manju Kedia Shah, and Ginger Turner. 2007. “What Matters to African Firms? The Relevance of Perceptions Data.” Working Paper World Bank Policy Research Working Paper No. 4446. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1075902.

Gray, Hazel. 2007. “Governance for Economic Growth and Poverty Reduction: Empirical Evidence and New Directions Reviewed.” LSE Research Online. http://eprints.lse.ac.uk/50334/1/Gray_Governance_economic_growth_2007.pdf.

Grenade, Kari H. 2012. “On Growth Diagnostics and Grenada.” Journal of Eastern Caribbean Studies 37 (2): 46–83.

Guariglia, Alessandra, Xiaoxuan Liu, and Lina Song. 2011. “Internal Finance and Growth: Microeconometric Evidence on Chinese Firms.” Journal of Development Economics 96 (1): 79–94. http://www.sciencedirect.com/science/article/pii/S0304387810000805.

Habermann, Harald, and Pablo Padrutt. 2011. “Growth Diagnostics: Strengths and Weaknesses of a Creative Analytical Framework to Identify Economic Growth Constraints in Developing Countries.” Journal of Knowledge Management, Economics and Information Technology, no. 7 (December): 27–51. doi:http://www.scientificpapers.org.

Hang, SAING Chan. 2013. “Binding Constraints on Economic Growth in Cambodia: A Growth Diagnostic Approach.” Working Paper Series No. 80. CDRI Working Paper Series.

Hausmann, Ricardo, and Bailey Klinger. 2007a. “Growth Diagnostic: Belize.” Center for International Development, Harvard University. http://www.belize1.com/pages/town/art/BelizeGrowth.pdf.

Hausmann, Ricardo, and Bailey Klinger. 2007b. “Growth Diagnostic: Paraguay.” Center for International Development, Harvard University. http://www.iadb.org/res/publications/pubfiles/pubCSI-144.pdf.

Hausmann, Ricardo, and Bailey Klinger. 2009a. “Chapter 6. Growth Diagnostic: Peru.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Hausmann, Ricardo, and Bailey Klinger. 2009b. “The Mexico Competitiveness Report.”

Hausmann, Ricardo, Dani Rodrik, and Andres Velasco. 2006. “Getting the Diagnosis Right: A New Approach to Economic Reform.” Finance and Development 43 (1): 12–15. doi:http://www.imf.org/external/pubs/ft/fandd/2001/03/index.htm.

Hausmann, Ricardo, Dani Rodrik, and Andrés Velasco. 2008. “Growth Diagnostics.” The Washington Consensus Reconsidered: Towards a New Global Governance, 324–55. https://books.google.co.uk/books?hl=en&lr=&id=wq_ltPYWKegC&oi=fnd&pg=PA324&dq=binding+constraints+economic+growth&ots=am3C4xyBtd&sig=2-BsMy5ZVqw9XnbuIoG2D6kRXJU.

Hausmann, Ricardo, Rodrigo Wagner, and Bailey Klinger. 2008. “Doing Growth Diagnostics in Practice: A ‘Mindbook.’” CID Working Paper No. 177. Center for International Development, Harvard University. https://www.google.co.uk/webhp?hl=en&authuser=0#hl=en&authuser=0&q=Doing+Growth+Diagnostics+in+Practice:+A+%E2%80%98Mindbook%E2%80%99+Ricardo+Hausmann%2C+Bailey+Klinger%2C+Rodrigo+Wagner+CID+Working+Paper+No.+177+September+2008+.

Hausmann, Ricardo. 2006. “Economic Growth: Shared Beliefs, Shared Disappointments?” Center for International Development Working Paper No. 125. Center for International Development, Harvard University. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=939647.

Hausmann, Ricardo. 2008. “Final Recommendations of the International Panel on the Accelerated and Shared Growth Initiative for South Africa (Asgisa).” HKS Working Paper No. RWP08-032. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1124292.

Hausmann, Ricardo. 2008. “In Search of the Chains That Hold Brazil Back.” CID Working Paper No. 180. Center for International Development, Harvard University.

Ianchovichina, Elena, and Susanna Lundstrom. 2008. “What Are the Constraints to Inclusive Growth in Zambia?” 44286. World Bank. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.585.2115&rep=rep1&type=pdf.

Ianchovichina, Elena. 2007. Growth Diagnostics for a Resource-Rich Transition Economy: The Case of Mongolia. Vol. 4396. World Bank Publications. https://books.google.co.uk/books?hl=en&lr=&id=U0G73rfhl4wC&oi=fnd&pg=PA2&dq=%22binding+constraints%22+growth&ots=fS1x17n1oA&sig=619oAWkEGpZILZ_xrd1AKwP_hl4.

International Labour Organization. 2015. "Binding Constraints to Inclusive and Job-Rich Growth in Nigeria." Publication. International Labour Organization. http://www.ilo.org/addisababa/information-resources/publications/WCMS_444655/lang--en/index.htm.

Johnson, Simon, Jonathan Ostry, and Arvind Subramanian. 2007. "The Prospects for Sustained Growth in Africa: Benchmarking the Constraints." Working Paper NBER Working Paper No. 13120. National Bureau of Economic Research Cambridge. http://www.nber.org/papers/w13120.

Khan, Shahrukh Rafi. 2011. "Growth Diagnostics: The Puzzle of Pakistan's Lagging Economic Growth." Global Economy Journal 11 (4). doi:http://www.degruyter.com/view/j/gej.

Kharel, Paras. 2011. "Remittances as Development Resource: The Experience of Nepal." In Asia-Pacific Regional Meeting on "Implementing the Istanbul Programme of Action", ESCAP, Bangkok, 14–16. http://www.unescap.org/sites/default/files/Remittance-as-development-resource.pdf.

Kuzmanović, Marija, and Peter Sanfey. 2014. "Diagnosing Growth Contraints in Southeastern Europe: The Case of Serbia." http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.432.261&rep=rep1&type=pdf

Kuzmanović, Marija, and Peter Sanfey. 2014. "Diagnosing Growth Contraints in Southeastern Europe: The Case of Serbia." http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.432.261&rep=rep1&type=pdf

Kwakwa, Victoria, Adeola Adenikinju, Peter Mousley, and Mavis Owusu-Gyamfi. 2008. "Binding Constraints to Growth in Nigeria." In Economic Policy Options for a Prosperous Nigeria, 13–43. Springer. http://link.springer.com/chapter/10.1057/9780230583191_2.

Lea, Nicholas, and Lucia Hanmer. 2009. "Constraints to Growth in Malawi." SSRN Scholarly Paper ID 1498971. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=1498971.

Lee, Keun, and Byung-Yeon Kim. 2009. "Both Institutions and Policies Matter But Differently For Different Income Groups of Countries: Determinants of Long-Run Economic Growth Revisited." World Development 37 (3): 533–49. http://www.sciencedirect.com/science/article/pii/S0305750X08002301.

Leipziger, Danny, and Roberto Zagha. 2006. "Getting out of the Rut." Finance and Development 43 (1): 16. http://198.62.77.13/res/publications/pubfiles/pubS-851.pdf.

Lin, Justin Y., and Volker Treichel. 2011. "Applying the Growth Identification and Facilitation Framework: The Case of Nigeria." doi:http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2011/08/23/000158349_20110823153627/Rendered/PDF/WPS5776.pdf.

Lin, Justin Yifu. 2011. "New Structural Economics: A Framework for Rethinking Development." The World Bank Research Observer 26 (2): 193–221. https://wbro.oxfordjournals.org/content/26/2/193.full.

Lopez-Calix, José, and Irum Touqeer. 2013. “Revisiting the Constraints to Pakistan’s Growth.” 86257. World Bank.
Lundström, Susanna, and Leonardo Garrido. 2010. “Togo Growth Diagnostics.” Policy Research Working Paper WPS5509. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1732388.
Meléndez Arjona, Marcela, and Arturo Harker. 2008. “Revisiting Economic Growth in Colombia: A Microeconomic Perspective.” Inter-American Development Bank. https://publications.iadb.org/handle/11319/3706.
Middlebrook, Peter J., and Sharon M. Miller. 2006. “Lessons in Post Conflict Reconstruction from the New Afghanistan Compact.” Foreign Policy in Focus. http://184.73.243.18:8080/jspui/bitstream/azu/13816/1/azu_acku_pamphlet_ds371_4_m533_2006_w.pdf.
Moore, David, and Athanasios Vamvakidis. 2007. Economic Growth in Croatia: Potential and Constraints. 7-198. International Monetary Fund. https://books.google.co.uk/books?hl=en&lr=&id=RjxMErotPi8C&oi=fnd&pg=PR1&dq=%22binding+constraints%22+growth&ots=j90i-8ox5m&sig=O72H---Zyr25ERa4o_9bVNxxiys.
Mthimkhulu, A.m., and M.j. Aziakpono. 2015. “What Impedes Micro, Small and Medium Firms’ Growth the Most in South Africa? Evidence from World Bank Enterprise Surveys.” South African Journal of Business Management 46 (1): 15–28. http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=111596647&site=ehost-live.
Mupimpila, Christopher, and Nettimi Narayana. 2009. “The Role of Vocational Education and Technical Training in Economic Growth: A Case of Botswana.” International Journal of Education Economics and Development 1 (1): 3–13. http://www.inderscienceonline.com/doi/abs/10.1504/IJEED.2009.028935.
Nabi, Ijaz, Abdul Malik, Rabin Hattari, Turab Husain, Adeel Shafqat, Sana Anwaar, and Ammar Rashid. 2010. “Economic Growth and Structural Change in South Asia: Miracle or Mirage?” http://eprints.lse.ac.uk/36389/.
Naudé, Wim. 2010. “Entrepreneurship, Developing Countries, and Development Economics: New Approaches and Insights.” Small Business Economics 34 (1): 1–12. http://link.springer.com/article/10.1007/s11187-009-9198-2.
Naudé, Wim. 2011. “Entrepreneurship Is Not a Binding Constraint on Growth and Development in the Poorest Countries.” World Development 39 (1): 33–44. http://www.sciencedirect.com/science/article/pii/S0305750X10001208.
Ndulu, Benno J. 2007. Challenges of African Growth: Opportunities, Constraints, and Strategic Directions. World Bank Publications. https://books.google.co.uk/books?hl=en&lr=&id=crNh8RvloxUC&oi=fnd&pg=PR11&dq=%22binding+constraints%22+growth&ots=RGO1_qyzna&sig=fRIA5BfVLYo2R4k69w4P0du-eww.
Neumayer, Eric, and Laura Spess. 2005. “Do Bilateral Investment Treaties Increase Foreign Direct Investment to Developing Countries?” World Development 33 (10): 1567–85. http://www.sciencedirect.com/science/article/pii/S0305750X05001233.
Ohno, Izumi, and Kenichi Ohno. 2012. “Dynamic Capacity Development: What Africa Can Learn from Industrial Policy Formulation in East Asia.” Chapter 7: 221–45. https://books.google.co.uk/books?hl=en&lr=&id=5cnCtkFi7EUC&oi=fnd&pg=PA221&dq=HRV+AND+binding+AND+growth+AND+Africa+OR+Asia&ots=JN5tW_6_Ch&sig=MtYKhaLYBzS-1BE7vesoqXpSPvg.

Organisation for Economic Co-operation and Development. 2015. “Multi-Dimensional Review of Peru.” Paris: Organisation for Economic Co-operation and Development. http://www.oecd-ilibrary.org/content/book/9789264243279-en.
Organisation for Economic Co-operation and Development. 2016a. “Multi-Dimensional Review of Kazakhstan.” Paris: Organisation for Economic Co-operation and Development. http://www.oecd-ilibrary.org/content/book/9789264246768-en.
Organisation for Economic Co-operation and Development. 2016b. “Multi-Dimensional Review of Uruguay.” Paris: Organisation for Economic Co-operation and Development. http://www.oecd-ilibrary.org/content/book/9789264251663-en.
Partnership For Growth. 2011a. “Partnership For Growth: El Salvador Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011b. “Partnership For Growth: Ghana Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011c. “Partnership For Growth: Philippines Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011d. “Tanzania Growth Diagnostic-Partnership for Growth.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Pickard, Duncan, and Todd Schweitzer. 2012. “Overcoming the Binding Constraint to Economic Growth in Post-Revolution Tunisia.” John F. Kennedy School of Government. http://promotunisia.com/TAYP/tunisiaPickardSchweitzer.pdf.
Prasad, Eswar S., Raghuram G. Rajan, and Arvind Subramanian. 2007. “Foreign Capital and Economic Growth.” National Bureau of Economic Research. http://www.nber.org/papers/w13619.
Pritchett, Lant, and Preya Sharma. 2008. “Implementing Growth Analytics: Motivation, Background, and Implementation.” In Growth Analytics Training Workshop. Department for International Development, London, September, 4–5. http://www.hks.harvard.edu/FS/lpritch/Economic%20Growth%20-%20docs/Economic%20Growth%20NEW/Implementing%20Growth%20Analytics.pdf.
Qayyum, Abdul, Idrees Khawaja, and Asma Hyder. 2008. “Growth Diagnostics in Pakistan.” European Journal of Scientific Research 24 (3): 433–450.
Raju, Sudhakar, and Brian Fitzpatrick. 2010. “Financial Market Development, Economic Development and Growth Diagnostics: An Application to Peru.” The International Business & Economics Research Journal 9 (9): 39. http://search.proquest.com/openview/16e043afe3d130f4dd44c07ed5a8de49/1?pq-origsite=gscholar.
Rattsø, Jørn, and Hildegunn E. Stokke. 2007. “Growth Constraints and Income Distribution in South Africa.” http://www.svt.ntnu.no/iso/Jorn.Rattso/Papers/jrhs_JME.pdf.
Reppen, Stefan. 2015. “Finding Obstacles to Growth: Is Infrastructure a Binding Constraint on African Light-Manufacturing Firms?” International Journal of Economics and Financial Issues 5 (3).

Richter, Kaspar. 2006. “Thailand’s Growth Path: From Recovery to Prosperity.” doi:http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2006/05/05/000016406_20060505105823/Rendered/PDF/wps3912.pdf.
Rodriguez, Francisco. 2008. “What Can We Really Learn from Growth Regressions?” Challenge 51 (4): 55–69. http://www.tandfonline.com/doi/abs/10.2753/0577-5132510403.
Rodrik, Dani, and Arvind Subramanian. 2009. “Why Did Financial Globalization Disappoint?” IMF Staff Papers 56 (1): 112–38. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1621157.
Rodrik, Dani. 2004a. “Getting Institutions Right.” CESifo DICE Report 2 (2004): 2–4. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.298.4947&rep=rep1&type=pdf.
Rodrik, Dani. 2004b. “Rethinking Growth Policies in the Developing World.” presented at the The Luca d’Agliano Lectures in Development Economics. http://law.wisc.edu/gls/documents/institutions4.pdf.
Rodrik, Dani. 2006a. “Development Lessons for Asia from Non-Asian Countries.” Asian Development Review 23 (1): 1. http://search.proquest.com/openview/9d6871e13c885066a5d6b1eb11d27452/1?pq-origsite=gscholar.
Rodrik, Dani. 2006b. “Goodbye Washington Consensus, Hello Washington Confusion? A Review of the World Bank’s Economic Growth in the 1990s: Learning from a Decade of Reform.” Journal of Economic Literature 44 (4): 973–87. http://www.ingentaconnect.com/content/aea/jel/2006/00000044/00000004/art00003.
Rodrik, Dani. 2007a. “The World Too Complex for One-Size-Fits-All-Models.” Post Autistic Economics Review 44 (9): 73–74. http://www.paecon.net/PAEReview/issue44/Rodrik44.pdf.
Rodrik, Dani. 2007b. “What Produces Economic Success?” In Economic Growth with Equity, 27–43. Springer. http://link.springer.com/chapter/10.1057/9780230800915_2.
Rodrik, Dani. 2008a. “A Practical Approach to Formulating Growth Strategies.” From the Washington Consensus towards a New Global Governance. https://books.google.co.uk/books?hl=en&lr=&id=Os0Gvs9I8Z8C&oi=fnd&pg=PR42&dq=%22binding+constraints%22+growth&ots=o0L-x5wXxc&sig=VNhIM64UFJZp4BBHscdLG7b5mmY.
Rodrik, Dani. 2008b. “Second-Best Institutions.” National Bureau of Economic Research. http://www.nber.org/papers/w14050.
Rodrik, Dani. 2009a. Growth After the Crisis. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1507477.
Rodrik, Dani. 2009b. “The Turkish Economy After the Crisis.” Discussion Paper. Turkish Economic Association. http://www.econstor.eu/handle/10419/81581.
Rodrik, Dani. 2010. “Diagnostics Before Prescription.” The Journal of Economic Perspectives 24 (3): 33–44. http://www.ingentaconnect.com/content/aea/jep/2010/00000024/00000003/art00003.
Sánchez, Gabriel, and Inés Butler. 2009. “Chapter 2. Identifying the Most Binding Constraints to Growth and Competitiveness in Argentina.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Sen, Kunal, and Colin Kirkpatrick. 2011. “A Diagnostics Approach to Economic Growth and Employment Policy in Low Income Economies: The Case of Kosovo.” Journal of International Development 23 (1): 132–154.
Sennoga, Edward B., and John Matovu. 2010. “Public Spending Composition and Public Sector Efficiency: Implications for Growth and Poverty Reduction in Uganda.” Research Series No. 66. Economic Policy Research Centre. http://ageconsearch.umn.edu/bitstream/93808/2/series66.pdf.
Sirimaneetham, Vatcharin, and Jonathan RW Temple. 2009. “Macroeconomic Stability and the Distribution of Growth Rates.” The World Bank Economic Review 23 (3): 443–79. https://wber.oxfordjournals.org/content/early/2009/09/16/wber.lhp008.full.
Ssewanyana, Sarah, John Mary Matovu, and Evarist Twimukye. 2011. “Building on Growth in Uganda.” Yes Africa Can 3 (1.65): 51. https://openknowledge.worldbank.org/bitstream/handle/10986/2335/634310PUB0Yes0061512B09780821387450.pdf?sequence=1&isAllowed=y#page=67.
Stern, David I. 2011. “The Role of Energy in Economic Growth.” Annals of the New York Academy of Sciences 1219 (1): 26–51. http://onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.2010.05921.x/full.
Suzuki, Yui. 2012. “Binding Constraint on Economic Growth Under Export-Oriented Industrialization and Globalization.” Applied Economics 44 (20): 2569–76. http://www.tandfonline.com/doi/abs/10.1080/00036846.2011.566185.
Sydykova, Meerim. 2015. “Diagnosing Growth Constraints in Central Asia: The Case of the Kyrgyz Republic.” http://www.econstor.eu/handle/10419/124845.
Thanh, Nguyen Duc, and Pham Van Dai. 2016. “Economic Growth Constraints in Vietnam: A Study Using the Growth Diagnostic Approach.” Ekonomski Horizonti 18 (1): 35. doi:10.5937/ekonhor1601033T.
Thanoon, Marwan Abdul-Malik, Ahmad Zubaidi Baharumshah, and Abd Aziz Abd Rahman. 2005. “Malaysia: From Economic Recovery to Sustained Economic Growth.” Journal of Post Keynesian Economics 28 (2): 295–315. http://www.tandfonline.com/doi/abs/10.2753/PKE0160-3477280207.
The Government of Nepal, and The Millennium Challenge Corporation. 2014. “Nepal Growth Diagnostic.” The Government of Nepal & the Millennium Challenge Corporation.
Thirlwall, Anthony. 2011. Economics of Development. https://ideas.repec.org/b/pal/hebook/1.html.
Treichel, Volker, Francis Teal, and Peter Mousley. 2010. Putting Nigeria to Work: A Strategy for Employment and Growth. World Bank Publications. https://books.google.co.uk/books?hl=en&lr=&id=FYXZZIgHPScC&oi=fnd&pg=PR5&dq=%22binding+constraints%22+growth&ots=Z10CYtrxzG&sig=3qHYGD2Xw8MY9q-FStCXRpX2E0E.
Ulloa, Alfie, Felipe Katz, and Nicole Kekeh. 2009. “Democratic Republic of the Congo: A Study of Binding Constraints.” https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=DRC+growth+diagnostic+Ulloa.
Vargas, Mauricio. 2015. “Identifying Binding Constraints to Growth: Does Firm Size Matter?” Working Paper Working Paper No. 15/3. International Monetary Fund. Availability Note: Information provided in collaboration with the RePEc Project: http://repec.org.

Vargas, Oscar-René, Lupe García, and María R. Escamilla. 2013. “Inclusive Growth Analytics: Case Study of Nicaragua.” In Proceedings of Global Business and Finance Research. Http:// Www. Wbiworldconpro. Com/ Uploads/ Taiwan-Conference-2013/ Economics/ 1382454030_. http://www.wbiworldconpro.com/uploads/taiwan-conference-2013/economics/1382454030_220-Oscar.pdf.

Vujović, Dušan. 2012. “Serbia: Policies to Enhance Competitiveness.” Ekonomika Preduzeća 60 (5-6): 261–74. http://scindeks.ceon.rs/article.aspx?artid=0353-443X1206261V.

World Bank. 2007. “Moving Beyond Recovery: Investment and Behavior Change, For Growth: Volume II: Overview.” Report No. 39221-UG. World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTDEBTDEPT/0,,contentMDK:23004336~pagePK:64166689~piPK:64166646~theSitePK:469043,00.html.

World Bank. 2008a. “Sudan - South Kordofan: A Growth Diagnostic.” 69668. World Bank. http://documents.worldbank.org/curated/en/2008/03/16350039/sudan-south-kordofan-growth-diagnostic.

World Bank. 2008b. “Kenya: Accelerating and Sustaining Inclusive Growth.” Report No. 42844-KE. World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTDEBTDEPT/0,,contentMDK:21974084~pagePK:64166689~piPK:64166646~theSitePK:469043,00.html.

World Bank. 2008c. “Republic of Namibia - Addressing Binding Constraints to Stimulate Broad Based Growth : A Country Economic Report.” World Bank.

World Bank. 2009. “Benin - Constraints to Growth and Potential for Diversification and Innovation : Country Economic Memorandum.” World Bank.

World Bank. 2011. “East Java Growth Diagnostic : Identifying the Constraints to Inclusive Growth in Indonesia’s Second-Largest Province.” 60959. World Bank. http://documents.worldbank.org/curated/en/2011/02/14042468/east-java-growth-diagnostic-identifying-constraints-inclusive-growth-indonesias-second-largest-province.

Zettelmeyer, Jeromin. 2006. “Growth and Reforms in Latin America: A Survey of Facts and Arguments.” Working Paper WP/06/210. International Monetary Fund. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=941272.

Annex 2: Selected Country Studies

After the search criteria above generated an initial list of 152 articles (Annex 1), we then checked in more detail whether the papers selected met the predefined criteria. This was done by reading abstracts (if available), introductions, executive summaries, conclusions and conducting relevant word searches (i.e. "HRV", "methodology", "HRV problem/decision tree," etc.) to ensure that the studies: 1. focused on applying Hausmann, Rodrik and Velasco (2005) binding constraints on economic growth framework; 2. focused on binding constraints on overall economic growth and not one sector in particular; 3. were written in 2004 or later and; 4. were published in the English language. This process narrowed down the initial list of 152 articles to the following 55 research studies.

African Development Bank Group. 2015. "Morocco's Growth Diagnostic: Addressing Constraints to Leverage Economic Potential." African Development Bank Group. http://www.afdb.org/en/news-and-events/article/moroccos-growth-diagnostic-addressing-constraints-to-leverage-economic-potential-14080/.

Agosin, Manuel R., Rodrigo Bolaños, and Félix Delgado. 2009. "Chapter 7. Nicaragua: Remembrance of Growth Past." In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Anderson, Steve, Kishori Kedlaya, James Whitaker, Whitney Dubinsk, Brandon Fenley, Sait Mboob, Caroline Smith, and John Thurow. n.d. "Inclusive Growth Diagnostic for Indonesia." United States Agency for International Development.

Armendariz, Edna, Paloma Baena, Marlon Bristol, Anneke Jessen, Matthew Shearer, and Christian Schneider. 2007. "Identifying Binding Constraints to Economic Growth in Guyana." IABD Working Paper GY-P1030. Inter-American Development Bank.

Artana, Daniel, Sebastián Auguste, and Mario Cuevas. 2009. "Chapter 5. Tearing Down the Walls: Growth and Inclusion in Guatemala." In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Artana, Daniel, Sebastián Auguste, Ramiro Moya, Sandra Sookram, and Patrick Watson. 2009. "Chapter 8. Trinidad and Tobago: Economic Growth in a Dual Economy." In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.

Asian Development Bank. 2007. "Philippines: Critical Development Constraints." Asian Development Bank. Philippines. http://www.adb.org/publications/philippines-critical-development-constraints.

Asian Development Bank. 2012. "Papua New Guinea: Critical Development Constraints." Asian Development Bank. Papua New Guinea. http://www.adb.org/publications/papua-new-guinea-critical-development-constraints.

Asian Development Bank. 2013. "Bhutan: Critical Development Constraints." Asian Development Bank. Bhutan. http://www.adb.org/publications/bhutan-critical-development-constraints.

Asian Development Bank. 2014a. “Cambodia: Diversifying Beyond Garments and Tourism.” Asian Development Bank. Cambodia. http://www.adb.org/publications/cambodia-diversifying-beyond-garments-and-tourism.
Asian Development Bank. 2014b. “The Kyrgyz Republic Strategic Assessment of the Economy Promoting Inclusive Growth.” Asian Development Bank.
Asian Development Bank. 2015a. “Fiji: Building Inclusive Institutions for Sustained Growth.” Asian Development Bank. Fiji. http://www.adb.org/publications/fiji-building-inclusive-institutions-sustained-growth.
Asian Development Bank. 2015b. “Maldives: Overcoming the Challenges of a Small Island State.” Asian Development Bank. Maldives. http://www.adb.org/publications/maldives-overcoming-challenges-small-island-state.
Asian Development Bank, International Labour Organization, and Department for International Development. 2009. “Nepal: Critical Development Constraints.” Asian Development Bank. Nepal. http://www.adb.org/publications/nepal-critical-development-constraints.
Babych, Yaroslava, and Michael Fuenfzig. 2012. “An Application of the Growth Diagnostics Framework: The Case of Georgia.” https://ideas.repec.org/p/tbs/wpaper/12-001.html.
BenYishay, Ariel, and Franck S. Wiebe. 2010. “Diagnostics in Transition-Analyzing the Constraints to Economic Growth in Moldova.”
Berthélemy, Jean-Claude, Sébastien Dessus, and Charbel Nahas. 2007. “Exploring Lebanon’s Growth Prospects.” World Bank Policy Research Working Paper No. 4332. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1010517.
Blyde, Juan, Armando Casterlas Pinneiro, Christian Daude, and Eduardo Fernández-Arias. 2010. “Competitiveness and Growth in Brazil.” http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1814686.
Calvo, Sara. 2006. “Applying the Growth Diagnostics Approach: The Case of Bolivia.” World Bank. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.121.5451&rep=rep1&type=pdf.
Chisari, Omar O., Eduardo A. Corso, José M. Fanelli, and Carlos A. Romero. 2007. “Growth Diagnostics for Argentina.” Buenos Aires, Argentina.: Centro de Estudios de Estado y Sociedad. http://www.iadb.org/res/files/GDM/FinalPapers/AR_CEDES.pdf.
Cueva, Simón, Vicente Albornoz, and Leopoldo Avellán. 2009. “Chapter 4. Ecuador: Binding Constraints to Growth.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.
Department for International Development. 2008. “DFID Understanding Afghanistan Growth Diagnostic Scoping Study: Policy Discussion Paper.” 3.4.2 Final Report. The Recovery and Development Consortium. Department for International Development.
Elmaleh, David, Harry Masyrafah, Patrick Barron, and Enrique Blanco Armas. 2009. “Aceh’s Growth Diagnostics: Identifying the Binding Constraints to Growth in a Post-Conflict and Post-Disaster Environment. Expenditure of Aceh Post-Conflict Response.” In International Conference on Aceh and Indian Ocean Studies II–Civil Conflict and Its Remedies.
Enders, Klaus-Stefan. 2007. “Egypt--Searching for Binding Constraints on Growth.” International Monetary Fund.
Grenade, Kari H. 2012. “On Growth Diagnostics and Grenada.” Journal of Eastern Caribbean Studies 37 (2): 46–83.

Hang, SAING Chan. 2013. “Binding Constraints on Economic Growth in Cambodia: A Growth Diagnostic Approach.” Working Paper Series No. 80. CDRI Working Paper Series.
Hausmann, Ricardo. 2008. “In Search of the Chains That Hold Brazil Back.” CID Working Paper No. 180. Center for International Development, Harvard University.
Hausmann, Ricardo, and Bailey Klinger. 2007a. “Growth Diagnostic: Belize.” Center for International Development, Harvard University. http://www.belize1.com/pages/town/art/BelizeGrowth.pdf.
Hausmann, Ricardo, and Bailey Klinger. 2007b. “Growth Diagnostic: Paraguay.” Center for International Development, Harvard University. http://www.iadb.org/res/publications/pubfiles/pubCSI-144.pdf.
Hausmann, Ricardo, and Bailey Klinger. 2009a. “Chapter 6. Growth Diagnostic: Peru.” In Growing Pains-Binding Constraints to Growth in Latin America. Inter-American Development Bank. http://198.62.77.13/res/publications/pubfiles/pubB-634.pdf#page=17.
Hausmann, Ricardo, and Bailey Klinger. 2009b. “The Mexico Competitiveness Report.”
Ianchovichina, Elena, and Susanna Lundstrom. 2008. “What Are the Constraints to Inclusive Growth in Zambia?” 44286. World Bank. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.585.2115&rep=rep1&type=pdf.
International Labour Organization. 2015. “Binding Constraints to Inclusive and Job-Rich Growth in Nigeria.” Publication. International Labour Organization. http://www.ilo.org/addisababa/information-resources/publications/WCMS_444655/lang--en/index.htm.
Kuzmanović, Marija, and Peter Sanfey. 2014. “Diagnosing Growth Contraints in Southeastern Europe: The Case of Serbia.” http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.432.261&rep=rep1&type=pdf.
Kwakwa, Victoria, Adeola Adenikinju, Peter Mousley, and Mavis Owusu-Gyamfi. 2008. “Binding Constraints to Growth in Nigeria.” In Economic Policy Options for a Prosperous Nigeria, 13–43. Springer. http://link.springer.com/chapter/10.1057/9780230583191_2.
Lopez-Calix, José, and Irum Touqeer. 2013. “Revisiting the Constraints to Pakistan’s Growth.” 86257. World Bank.
Lundström, Susanna, and Leonardo Garrido. 2010. “Togo Growth Diagnostics.” Policy Research Working Paper WPS5509. World Bank. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1732388.
Meléndez Arjona, Marcela, and Arturo Harker. 2008. “Revisiting Economic Growth in Colombia: A Microeconomic Perspective.” Inter-American Development Bank. https://publications.iadb.org/handle/11319/3706.
Partnership For Growth. 2011a. “Partnership For Growth: El Salvador Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011b. “Partnership For Growth: Ghana Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011c. “Partnership For Growth: Philippines Constraints Analysis.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.
Partnership For Growth. 2011d. “Tanzania Growth Diagnostic-Partnership for Growth.” Partnership for Growth. http://www.state.gov/e/eb/ifd/odf/pfg/countries/.

Pickard, Duncan, and Todd Schweitzer. 2012. “Overcoming the Binding Constraint to Economic Growth in Post-Revolution Tunisia.” John F. Kennedy School of Government. http://promotunisia.com/TAYP/tunisiaPickardSchweitzer.pdf.
Qayyum, Abdul, Idrees Khawaja, and Asma Hyder. 2008. “Growth Diagnostics in Pakistan.” European Journal of Scientific Research 24 (3): 433–450.
Sen, Kunal, and Colin Kirkpatrick. 2011. “A Diagnostics Approach to Economic Growth and Employment Policy in Low Income Economies: The Case of Kosovo.” Journal of International Development 23 (1): 132–154.
Sydykova, Meerim. 2015. “Diagnosing Growth Constraints in Central Asia: The Case of the Kyrgyz Republic.” http://www.econstor.eu/handle/10419/124845.
Thanh, Nguyen Duc, and Pham Van Dai. 2016. “Economic Growth Constraints in Vietnam: A Study Using the Growth Diagnostic Approach.” Ekonomski Horizonti 18 (1): 35. doi:10.5937/ekonhor1601033T.
The Government of Nepal, and The Millennium Challenge Corporation. 2014. “Nepal Growth Diagnostic.” The Government of Nepal & the Millennium Challenge Corporation.
Ulloa, Alfie, Felipe Katz, and Nicole Kekeh. 2009. “Democratic Republic of the Congo: A Study of Binding Constraints.” https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=DRC+growth+diagnostic+Ulloa.
World Bank. 2007. “Moving Beyond Recovery: Investment and Behavior Change, For Growth: Volume II: Overview.” Report No. 39221-UG. World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTDEBTDEPT/0,,contentMDK:23004336~pagePK:64166689~piPK:64166646~theSitePK:469043,00.html.
World Bank. 2008a. “Sudan - South Kordofan: A Growth Diagnostic.” 69668. World Bank. http://documents.worldbank.org/curated/en/2008/03/16350039/sudan-south-kordofan-growth-diagnostic.
World Bank. 2008b. “Kenya: Accelerating and Sustaining Inclusive Growth.” Report No. 42844-KE. World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTDEBTDEPT/0,,contentMDK:21974084~pagePK:64166689~piPK:64166646~theSitePK:469043,00.html.
World Bank. 2008c. “Republic of Namibia - Addressing Binding Constraints to Stimulate Broad Based Growth : A Country Economic Report.” World Bank.
World Bank. 2009. “Benin - Constraints to Growth and Potential for Diversification and Innovation : Country Economic Memorandum.” World Bank.
World Bank. 2011. “East Java Growth Diagnostic : Identifying the Constraints to Inclusive Growth in Indonesia’s Second-Largest Province.” 60959. World Bank. http://documents.worldbank.org/curated/en/2011/02/14042468/east-java-growth-diagnostic-identifying-constraints-inclusive-growth-indonesias-second-largest-province.

Appendix Tables

Table A.1: HRV Diagnostic Framework Matrix

Region	Country	Name of paper	Low return to economic activity	High cost of finance	Low social returns	Low appropriability	Poor geography	Low human capital	Poor infrastructure	Government failures	Market failures	Micro risks	Macro risks	Information externalities	Coordination externalities	Bad international finance	Poor local finance	Low domestic saving	Poor intermediation
Africa	Benin	World Bank (2009). Benin -Constraints to Growth and Potential for Diversification and	X		X	X			X	X	X	X		X					
	DRC	Alfie Ulloa, Felipe Katz, & Nicole Kekeh. (2009). Democratic Republic of the Congo: A study of	X	X	X	X			X	X		X					X		X
	Ghana	Partnership For Growth. (2011). Partnership For Growth: Ghana Constraints Analysis	X	X	1X	2X			1X	2X		2X					1X		1X
	Kenya	World Bank. (2008). Kenya: Accelerating and Sustaining Inclusive Growth (No. Report No.	X			X				X		X							
	Namibia	Bank, W. (2008). Republic of Namibia - Addressing Binding Constraints to Stimulate Broad	X		X	X		X		X		X							
	Nigeria	Kwakwa, V., Adenikinju, A., Mousley, P., & Owusu-Gyamfi, M. (2008). Binding constraints to	X		X				X										
		ILO. (2015). Binding Constraints to inclusive and Job-rich growth in Nigeria (Publication).	X		X				X										
	Sudan (South Kordofan)	World Bank. 2008. Sudan - South Kordofan : a growth diagnostic. Washington, DC: World	X		X	X			X	X		X							
	Tanzania	Partnership For Growth. (2011). Tanzania Growth Diagnostic-Partnership for Growth	X		X	X			X	X		X							
	Togo	Lundström, S., & Garrido, L. (2010). Togo growth diagnostics. World Bank Policy Research	X			X				X		X							
	Uganda	World Bank. (2007). Moving Beyond Recovery: Investment and Behavior Change, For Growth:	X		X				X										
	Zambia	Ianchovichina, E., & Lundström, S. (2009). Inclusive growth analytics: Framework and	X			X					X				X				
South Asia	Afghanistan	Alfie Ulloa, Felipe Katz, & Nicole Kekeh. (2009). Democratic Republic of the Congo: A study of	X		2X	1X			2X	1X		1X							
	Bhutan	Asian Development Bank (ADB). (2013). Bhutan: Critical Development Constraints. Asian	X	X	X	X		X	X	X	X		X	X		X	X	X	X
	Maldives	Asian Development Bank (ADB). (2015). Maldives: Overcoming the Challenges of a Small	X	X	X	X		X	X	X			X				X		X
	Nepal	Asian Development Bank (ADB), Department for International Development (DFID), & and	X		X	X			X	X		X							
		The Government of Nepal. (2014). Nepal Growth Diagnostic.	X		X	X			X	X		X							
	Pakistan	Qayyum, A., Khawaja, I., & Hyder, A. (2008). Growth diagnostics in Pakistan. European	X			X				X	X	X		X					
		Lopez-Calix, J., & Touqeer, I. (2013). Revisiting the Constraints to Pakistan's Growth.	X	X	X	X			X	X	X	X	X	X		X	X		X
East Asia and Pacific	Cambodia	Hang, S. C. (2013). Binding constraints on economic growth in Cambodia: a growth diagnostic	X		X	X			X	X	X	X			X				
		Asian Development Bank (ADB). (2014). Cambodia: Diversifying Beyond Garments and	X		X	X		X	X	X		X							
	Fiji	Asian Development Bank (ADB). (2015). Fiji: Building Inclusive Institutions for Sustained	X		X	X			X	X		X							
	Indonesia	Steve Anderson, Kishori Kedlaya, James Whitaker, Whitney Dubinsk, Brandon Fenley, Sait	X		X	X			X	X		X							
	Indonesia (Aceh)	Barron, P., Armas, E. B., Elmaleh, D., & Masyrafah, H. (2009). Aceh's Growth Diagnostics:	X		X	X			X	X		X							
	Indonesia (East Java)	Bank, T. W. (2011). East Java growth diagnostic : identifying the constraints to inclusive	X		X	X			X	X		X							
	Papua New Guinea	Asian Development Bank (ADB). (2012). Papua New Guinea : Critical Development	X		X	X		X	X	X		X							
	Philippines	Asian Development Bank (ADB). (2007). Philippines: Critical Development Constraints. Asian	X		X	X			X	X		X	X						
		Joint USG-GPH Technical Team. (2011). Partnership For Growth: Philippines Constraints	X			X				X		X	X						
	Vietnam	Thanh, N. D., & Dai, P. V. (2016). Economic Growth Constraints in Vietnam: A Study Using the	X	X	X	X			X	X	X	X		X	X		X		X
Latin America	Argentina	Chisari, O. E., Corso, E. A., Fanelli, J. M., & Romero, C. A. (2007). Growth Diagnostics for	X	X		X				X		X					X		X
	Belize	Hausmann, R., & Klinger, B. (2007). Growth Diagnostic: Belize. Center for International		X													X	X	
	Bolivia	Calvo, S. (2006). Applying the growth diagnostics approach: the case of Bolivia. The World	X	X		X				X		X	X						
	Brazil	Hausmann, R. (2008b). Is Search of the Chains That Hold Brazil Back.		X													X	X	
		Blyde, J., Pinneiro, A. C., Daude, C., & Fernández-Arias, E. (2010). Competitiveness and	X		X	X		X		X		X							
	Colombia	Meléndez Arjona, M., & Harker, A. (2008). Revisiting Economic Growth in Colombia: A	X			X				X		X							
	Ecuador	Simón Cueva, Vicente Albornoz, & Leopoldo Avellán. (2009). Chapter 4. Ecuador: Binding	X		X	X			X	X		X							
	El Salvador	Partnership For Growth. (2011). Partnership For Growth: El Salvador Constraints Analysis	X			X				X		X							
	Grenada	Grenade, K. H. (2012). On Growth Diagnostics and Grenada. Journal of Eastern Caribbean	X		X	X		X		X	X	X		X					
	Guatemala	Daniel Artana, Sebastián Auguste, & Mario Cuevas. (2009). Chapter 5. Tearing Down the	X		1X	2X		1X	2X	2X		2X							
	Guyana	Armendariz, E., Baena, P., Jessen, A., Shearer, M., Schneider, C., & Bristol, M. (2007).	X			X				1X	2X	1X		2X	2X				
	Mexico	Ricardo Hausmann, & Bailey Klinger. (2009). Chapter 2.1. Growth Diagnostic: Mexico. In The	X		X			X											
	Nicaragua	Manuel R. Agosin, Rodrigo Bolaños, & Félix Delgado. (2009). Chapter 7. Nicaragua:	X		X				X										
	Paraguay	Hausmann, R., Klinger, B., & others. (2007). Growth Diagnostic: Paraguay. Centre for	X		X	X			X	X		X							
	Peru	Ricardo Hausmann, & Bailey Klinger. (2009). Chapter 6. Growth Diagnostic: Peru. In Growing	X			X					X			X	X				
	Trinidad and Tobago	Daniel Artana, Sebastián Auguste, Ramiro Moya, Sandra Sookram, & Patrick Watson. (2009).	X			X				X			X						
Middle East and North Africa	Egypt	Enders, K. (2007). Egypt-searching for binding constraints on growth. IMF Working Papers,	X			X				X		X							
	Lebanon	Berthélemy, J.-C., Dessus, S., & Nahas, C. (2007). Exploring Lebanon's growth prospects.	X			X				X		X	X						
	Morocco	African Development Bank Group. (2015). Morocco's growth diagnostic: Addressing	X		X	X		X				X							
	Tunisia	Pickard, D., & Schweitzer, T. (2012). Overcoming the Binding Constraint to Economic Growth	X			X				X		X							
Europe and Central Asia	Georgia	Babych, Y., Fuenfzig, M., & others. (2012). An application of the growth diagnostics	X			X				X		X							
	Kosovo	Sen, K., & Kirkpatrick, C. (2011). A diagnostics approach to economic growth and	X	X	X	X			X	X		X					X		X
	Kyrgyzstan	Sydykova, M. (2015). Diagnosing Growth Constraints in Central Asia: The Case of the Kyrgyz	X		X	X		X	X	X		X							
		Asian Development Bank. (2014). The Kyrgyz Republic Strategic Assessment of the Economy	X		2X	1X		2X	2X	1X		1X							
	Moldova	Ariel Ben Yishay, & Franck S. Wiebe. (2010). Diagnostics in Transition.	X	X	X	X			X	X		X					X	X	
	Serbia	Marija Kuzmanović, & Peter Sanfey. (2014). Diagnosing growth constraints in southeastern	X			X				X		X							

Table A.2: Electricity Data from Enterprise Surveys in Sub-Saharan Africa

Economy	Year	Number of electrical outages in a typical month	Duration of a typical electrical outage (hours)	If there were outages, average duration of a typical electrical outage (hours)	Losses due to electrical outages (% of annual sales)	If there were outages, average losses due to electrical outages (% of annual sales)	Percent of firms owning or sharing a generator	Proportion of electricity from a generator (%)	If a generator is used, average proportion of electricity from a generator (%)	Days to obtain an electrical connection (upon application)	Percent of firms identifying electricity as a major constraint
All Countries		6.4	2.4	4.4	2.6	4.7	32.6	7.3	20.3	31.5	30.9
Sub-Saharan Africa		8.5	4.2	5.6	5.5	8.8	50.2	13.7	26.5	33.0	38.3
Angola	2010	4.7	11.8	13.5	8.8	12.6	79.0	20.8	27.3	7.7	35.7
Burundi	2014	16.6	4.0	4.8	2.6	3.4	64.2	11.0	17.5	25.3	46.9
Benin	2009	4.9	1.9	3.0	3.1	6.2	42.3	8.2	26.1	86.6	56.4
Burkina Faso	2009	9.8	3.0	3.3	3.2	5.8	28.3	2.5	10.4	23.1	53.9
Botswana	2010	4.1	2.5	2.7	2.9	3.7	34.5	2.3	7.4	39.2	34.8
Central African Republic	2011	29.0	7.2	8.1	22.1	25.1	81.4	30.3	37.5	11.8	76.1
Côte d'Ivoire	2009	2.0	2.4	4.5	2.2	5.0	6.5	1.0	17.0	20.9	39.8
Cameroon	2009	9.8	2.8	3.0	4.3	4.9	34.8	4.5	15.1	17.6	58.6
Congo, Rep.	2009	21.5	29.6	34.3	9.6	16.4	81.8	43.2	56.3	8.5	71.1
Cabo Verde	2009	3.2	5.1	9.2	2.5	5.5	48.8	10.9	24.4	30.5	53.1
Eritrea	2009	0.5	0.5	2.8	0.0	0.2	36.8	1.0	3.4	…	0.2
Ethiopia	2015	8.2	4.6	5.8	4.6	6.9	49.1	21.5	48.9	194.3	33.3
Gabon	2009	4.6	3.6	5.4	0.9	1.7	22.9	1.8	9.6	34.5	58.0
Ghana	2013	8.4	6.6	7.8	11.5	15.8	52.1	10.5	21.5	44.7	61.2
Guinea	2006	31.5	6.3	6.8	13.0	13.9	59.9	35.4	59.2	16.1	83.6
Gambia, The	2006	21.0	6.1	6.9	9.8	11.8	63.9	20.7	32.3	63.9	78.1
Guinea-Bissau	2006	5.2	10.1	17.9	2.5	5.2	68.4	53.6	78.3	20.5	74.1
Kenya	2013	6.3	5.0	5.6	5.6	7.0	57.4	7.8	14.0	43.0	22.2
Liberia	2009	1.7	1.5	4.7	0.8	2.8	66.5	60.6	91.1	…	59.1
Lesotho	2009	4.1	3.1	5.5	3.3	6.7	30.9	0.0	…	13.9	44.2
Madagascar	2013	6.7	1.6	1.9	6.8	13.6	19.3	6.0	32.2	24.0	25.5
Mali	2010	2.7	3.1	5.8	1.2	4.1	20.1	2.1	22.3	32.9	33.5
Mozambique	2007	1.6	2.2	4.3	1.2	2.4	12.6	1.3	10.8	12.7	24.8
Mauritania	2014	5.3	2.1	2.6	1.2	2.4	42.2	5.1	17.2	16.1	57.9
Mauritius	2009	1.2	1.2	3.2	0.5	2.2	24.5	0.8	3.4	18.6	42.9
Malawi	2014	6.7	3.5	4.3	5.1	7.2	40.9	10.3	27.3	50.4	24.8
Namibia	2014	0.6	1.2	5.8	1.2	4.8	18.0	3.8	25.5	20.3	14.2
Niger	2009	18.5	1.5	1.6	1.1	1.9	34.5	5.2	20.1	37.1	63.2
Nigeria	2014	32.8	8.0	11.6	10.8	15.6	70.7	41.2	58.8	9.4	48.4
Rwanda	2011	4.0	2.7	4.3	1.0	2.6	48.8	3.0	7.8	31.4	15.4
Sudan	2014	3.4	2.3	2.5	1.1	1.2	54.1	3.8	7.2	5.8	7.6
Senegal	2014	6.0	1.1	1.8	1.7	2.8	64.2	4.7	9.0	24.8	48.2
Sierra Leone	2009	13.7	8.8	10.2	5.5	6.6	81.8	36.6	44.8	14.8	53.4
South Sudan	2014	1.5	0.5	4.7	1.8	13.6	73.3	68.9	94.2	9.7	58.6
Swaziland	2006	1.8	1.5	2.0	1.6	2.5	36.8	3.7	10.2	16.9	12.4
Chad	2009	19.6	7.5	8.8	2.3	3.3	75.4	52.0	69.7	10.6	74.6
Togo	2009	7.2	4.3	5.7	6.1	10.5	63.6	9.3	17.3	53.9	50.8
Tanzania	2013	8.9	5.1	6.3	5.5	15.1	43.0	8.2	24.5	52.6	45.8
Uganda	2013	6.3	6.8	10.1	6.3	11.2	52.2	8.4	17.6	18.1	26.8
South Africa	2007	0.9	2.0	4.5	0.7	1.6	18.4	1.9	10.9	15.8	20.8
Congo, Dem. Rep.	2013	12.3	4.9	5.6	6.2	7.8	59.5	21.7	37.2	16.0	52.2
Zambia	2013	5.2	2.1	2.8	5.5	7.5	27.3	4.4	17.7	18.9	27.1
Zimbabwe	2011	6.7	5.0	5.9	6.9	8.8	53.0	5.4	10.4	30.0	46.8

Table A.3: Electricity Data from Enterprise Surveys in South Asia

Economy	Year	Number of electrical outages in a typical month	Duration of a typical electrical outage (hours)	If there were outages, average duration of a typical electrical outage (hours)	Losses due to electrical outages (% of annual sales)	If there were outages, average losses due to electrical outages (% of annual sales)	Percent of firms owning or sharing a generator	Proportion of electricity from a generator (%)	If a generator is used, average proportion of electricity from a generator (%)	Days to obtain an electrical connection (upon application)	Percent of firms identifying electricity as a major constraint
All Countries		6.4	2.4	4.4	2.6	4.7	32.6	7.3	20.3	31.5	30.9
South Asia		25.4	3.1	5.3	6.6	10.9	45.4	12.4	24.4	55.1	46.1
Afghanistan	2014	11.5	2.6	3.8	5.1	9.6	48.0	18.1	38.3	111.3	65.8
Bangladesh	2013	64.5	0.9	1.2	3.7	5.5	62.8	16.3	26.1	84.7	52.0
Bhutan	2015	0.4	1.6	8.1	1.5	3.7	9.5	0.9	10.2	21.3	14.1
India	2014	13.8	1.1	2.0	2.0	3.7	46.5	4.0	8.8	21.9	21.3
Sri Lanka	2011	4.1	1.1	1.5	2.0	3.0	35.1	1.6	4.8	42.4	25.6
Nepal	2013	8.7	1.2	3.6	10.5	17.0	50.5	20.9	41.3	21.3	68.8
Pakistan	2013	75.2	13.2	16.9	21.2	33.8	65.4	25.2	41.4	82.8	75.3