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Cost Recovery and Financial Viability of the Power Sector in Developing Countries

Insights from 15 Case Studies

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Abstract

This paper analyzes power utilities in 15 jurisdictions to understand the determinants of success for reforms aimed at improving financial viability and cost recovery in the power sector and the impacts of these reforms on metrics of sector performance. The analysis finds that electricity tariffs are rarely high enough to cover the full costs of service delivery, even where the cost of service is low, and that few countries adequately manage volatile costs and maintain cost recovery levels over time. Almost everywhere, power utilities often impose a substantial fiscal burden and contingent liabilities on government budgets. Over the past 30 years, cost recovery levels have increased on average, but progress has been uneven, with over half of the case study jurisdictions experiencing a decline compared with the pre-reform period. The record of reforms of price formation, especially tariff setting through regulatory agencies, is mixed. On average, countries that have made more progress on utility governance and decision making perform better on cost recovery. The paper concludes with proposed modifications to the conceptual framework underpinning the economic analysis of power sector reforms as well as immediate, practical implications for understanding cost recovery as part of the overall power sector reform agenda.

This paper is a product of the Energy and Extractives Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/prwp. The authors may be contacted at jhuenteler@worldbank.org.

Cost Recovery and Financial Viability of the Power Sector in Developing Countries: Insights from 15 Case Studies[1]

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1. Introduction

1. Financial viability of the power sector has long been considered a prerequisite for ensuring universal access to affordable, reliable, and sustainable electricity and the transition towards clean energy (The World Bank and IEG, 2016, 2014a). However, chronic poor financial performance of electricity utilities is pervasive in the developing world—resulting from underpricing, excessive losses, and bill collection failure—and has for decades been a main driver of investment shortfalls, under-maintenance of infrastructure, power shortages, poor quality of supply (Huenteler et al., 2017). Electricity subsidies needed to keep utilities afloat have long-term macroeconomic, fiscal, social ramifications, as they limit the fiscal resources available for other public services, including clean water, education, health and social protection (Komives et al., 2007; Saavalainen and ten Berge, 2006; Sdralevich et al., 2014). Underpricing of electricity also increases levels of pollution and other environmental impacts (Badiani et al., 2012; IEA et al., 2010; Monari, 2002; Rentschler and Bazilian, 2016).

2. Making electricity services financially viable and recovering the cost of service have long been core objectives of power sector reform in developing countries (The World Bank, 1993a, 1993b). Public utilities' limited ability to finance expansion of capacity to meet growing demand was a main argument for power sector reform in the developing world in the 1990s and raising tariffs to cost recovery levels has therefore been a *sine qua non* of the 'standard menu' for power sector reform (ESMAP, 1999). In some countries, tariff reforms were part of a homegrown reform program to improve macro-economic and service conditions. In many other countries, raising tariffs was a condition for assistance by the donors and multilateral institutions to reduce the fiscal burden from the power sector (The World Bank, 1996; Williams and Ghanadan, 2006).

3. However, underpricing of electricity is popular with many governments and voters, because it has immediate and tangible impacts on end-consumers' disposable income. Reform experience across the globe demonstrates that, once introduced, underpricing is difficult for governments to remove. In a review of the World Bank's lending to the power sector, Covarrubias (1996) found that electricity tariff increases were the single most resisted conditionality linked to the institution's projects. In view of this limited popularity, much of the literature on cost recovery and financial viability has been devoted to establishing why these issues should matter to policy makers.

4. Almost four decades have passed since Chile began its power sector reform efforts in the 1980s and three since the reform agenda swept through much of the rest of the developing world in the 1990s. Cost recovery and financial viability remain core focus areas for institutions such as the World Bank in the power sector.[2] However, overall reform outcomes have often fallen short of expectations and many countries have chosen to adopt hybrid reform models different from the standard prescription (Besant-Jones, 2006; Jamasb et al., 2015). A renewed debate among policy makers and in the literature is emerging on the validity of the 'standard menu' of the 1990s and the need for a new, more empirically grounded

[2] For example, a recent review found that between 2000 and 2015, the World Bank included sector financial conditions in at least 41 project loans in 25 different countries (total volume US$5,193mn) as well as 49 development policy loans covering 25 different countries (US$10,680mn) (The World Bank and IEG, 2016).

reform paradigm (Jamasb et al., 2015; Vagliasindi and Besant-Jones, 2013; Williams and Ghanadan, 2006). As in the 1980s and 1990s, the financial performance of the power sector remains at the heart of this debate.

5. This paper aims to inform these debates in policy and academic circles.[3] It draws on case studies from 17 jurisdictions (14 countries and three Indian states) to understand progress of cost-recovery reforms, what factors have contributed to the success or failure in achieving cost recovery, and what impacts the level of cost recovery has on the sector.

2. Study Background and Methodology

6. This paper is part of the World Bank's "Rethinking Power Sector Reform" project, a multiyear global initiative of the Energy & Extractives Global Practice that provides an updated assessment of power sector reform experiences across the developing world. The initiative aims to revisit and refresh thinking on power sector reform approaches, in the light of accumulated evidence about the performance of countries undertaking different types of reforms. The goal is to reignite the policy debate around reform approaches by articulating a new vision that incorporates lessons learned over the past 25 years. It also reflects on how recent technological trends and business models that are disrupting the sector may call for a new thinking on reform strategies.

7. Supported by the World Bank's Energy Sector Management Assistance Program (ESMAP) and the Public – Private Infrastructure Advisory Facility (PPIAF), the initiative works with different partners and experts across the World Bank Group (WBG) and beyond to generate evidence, analysis and insights on five key themes of interest to power sector reform practitioners and decision makers globally: financial viability and cost recovery; utility governance and restructuring; power markets; regulation; and political economy.

8. This paper is based on a literature review (Huenteler et al., 2017) and an in-depth exploration of the 25-year power sector reform journey of 15 World Bank Group client countries that represent a wide diversity of geographies, income levels, and approaches to reform. The selected countries are Colombia, the Dominican Republic, the Arab Republic of Egypt, India, Kenya, Morocco, Pakistan, Peru, the Philippines, Senegal, Tajikistan, Tanzania, Uganda, Ukraine, and Vietnam. The purpose of the case studies is to reflect upon the experiences of individual countries with a view to extracting lessons of broader interest to the global community. It is not the role of these papers to recommend any particular way forward for the countries in question.

9. Each case study was prepared by a team that included independent external experts and World Bank staff, using a combination of primary and secondary sources. Primary sources included interviews with government officials and other sector stakeholders. Secondary sources included, among others, the World Bank's archival documents, government publications and utility reports. Each case study was

[3] For a synthesis of the World Bank's policy guidance on energy subsidy reform, see also the *Energy Subsidy Assessment Framework* (https://www.esmap.org/node/3043).

synthesized in a stand-alone paper published in the Policy Research Working Paper series of the World Bank.

3. Methodology and Analytical Framework

3.1. What Do We Mean by Cost Recovery and Financial Viability?

10. The paper focuses on the cost recovery level of electricity tariffs, the financial viability of electric utility services, and the fiscal sustainability of subsidies for electric utility services. These three concepts are closely related and sometimes used interchangeably: Underpricing of electricity often leads to poor financial viability of a utility, which, in turn, results in explicit or implicit government subsidies. But conceptually the terms are not identical. The following paragraphs lay down how these concepts are defined in this paper and how they relate to each other.

11. 'Cost recovery' is understood as an attribute of electricity tariffs and is fulfilled when the average electricity tariff aligns with the average cost of service, usually measured as the ratio between tariffs and costs (often expressed as a percentage).[4] While the definition of tariffs in the analysis of cost recovery in a specific sector or a utility is relatively straightforward (average tariffs are calculated by dividing total revenue from electricity sales by the volume of electricity sales in kWh), there are various definitions of costs that can be useful in different circumstances. Therefore, while cost recovery is sometimes reported in binary terms, the reality – particularly in the developing world – is that there is a continuum of degrees of cost recovery, and that cost recovery can be analyzed from different perspectives. The basic formula for calculating the cost recovery levels is:

Cost Recovery = Average Effective Electricity Tariff / Reference Cost

12. The World Bank's framework to define different levels of cost recovery is summarized in Table 1. The definitions include three levels—operating cost recovery, limited capital cost recovery and full-cost recovery—from three different perspectives—financial, fiscal and economic—to yield a total of nine different cost recovery definitions (A1-A3, B1-B3 and C1-C3).

13. The literature on cost recovery has gradually moved from a financial to an economic perspective on cost of service over the past decades, reflecting the literature's increasing focus on the macroeconomic and environmental implications of the under-recovery of costs (Huenteler et al., 2017). In line with these findings, this paper starts off with a comprehensive, economic definition of the cost of electricity service

[4] Conceptually, cost recovery can be viewed from the perspective of the power utility/sector, fiscal perspective or overall economic perspective. In each case, the full costs would be defined differently, and which perspective is appropriate depends on the research question. Further, depending on the purpose, cost recovery may include "full costs" with any inefficiencies (including excess losses) the power company/sector has or cost recovery assuming efficient operation of the company/sector. The latter approach is ideally that taken by the regulators so as not to pass inefficiencies to consumers. Importantly, full cost recovery of tariffs for the sector does not necessarily mean that all individual parts of the supply chain (generation, transmission and distribution) recover their costs, depending on how tariffs are set for the different services. Furthermore, some studies in the literature approximate tariffs with revenues and cost with actual cost incurred by the utilities, bringing the concept of 'cost recovery' closer to the common understanding of 'financial viability'.

(levels C1 and C3). This analysis is then complemented by an analysis of cost recovery from a financial perspective (A1, A2 and A3).

Table 1: Cost Recovery Ladder from Financial, Fiscal and Economic Perspective

	A. Financial perspective	**B. Fiscal perspective**	**C. Economic perspective**
Level 1: Operating cost recovery	**Level A1**: Only those operating costs that are covered by the utility/sector (excluding various reserves, such as depreciation, bad debt allowance, and revaluation of assets).	**B1:** Operating costs that are covered on behalf of the utility/sector by the government through budgetary transfers and provision of subsidized goods and services.	**C1:** Operating costs (excluding various reserves, such as depreciation, bad debt allowance, and revaluation of assets) irrespective of who bears them required to adequately run the utility.
Level 2: Operating and limited capital cost recovery	**A2:** A1 plus any financing costs (to the utility) for existing capital expenditure, such as debt service (interest and principal), required equity payments, and internally funded investments.	**B2:** B1 plus the financing costs (assessed at the cost of existing capital incurred by the government) for the capital expenditure covered through sovereign funding/guarantee.	**C2:** C1 plus existing capital expenditure (incorporated based on the weighted average cost of commercial capital assessed at the opportunity cost of debt and equity).
Level 3: Full cost recovery of current and future costs	**A3:** A2 plus financing costs (to the utility) and the associated O&M costs for new capital investments (based on an adequate investment prioritization framework) required to meet future demand.	**B3**: B2 plus financing costs (to the government) for new capital investments (based on an adequate investment prioritization framework) required to meet future demand.	**C3:** C2 plus new capital investments required to meet future demand (incorporated based on weighted average cost of commercial capital assessed at the opportunity cost of debt and equity capital) and the associated externalities.

Source: World Bank staff.

14. Financial viability is an attribute of utility companies[5] and is fulfilled when tariff revenues and other sources of income cover the cost of service. Cost recovery of tariffs is obviously a key determinant, but financial viability also depends on accessible government transfers, ready cash inflows (taking into account collection losses and timely allocation of government transfers), and proper spending priorities (for example, debts and payables are settled in a timely manner, or utilities pay out large dividends or lend to other SOEs). Therefore, while the two mutually reinforce each other and the literature sometimes uses them interchangeably, a utility can be financially viable even when cost recovery is below 100 percent—for example, if tariffs are set below cost-recovery level but reliable fiscal transfers are made to compensate for the shortfall. Similarly, a utility may not be financially viable when tariffs are at cost-recovery level, for example, when the utility uses its cash flows to finance new investments while accumulating arrears to its suppliers and financiers. Further, analyses of financial viability usually do not differentiate between revenues from electricity sales and revenue not related to the sale of electricity (for

[5] Financial viability is also an attribute of investment projects and in fact early World Bank studies of financial viability in the power sector were primarily interested in the ability of individual investments to make adequate returns. But this view has evolved (see Huenteler and others 2017) and now the primary unit of analysis in the literature is the utility. This is reflected in the term's usage in this paper given the focus on leveraging private solutions and improving utility performance.

example, government transfers); take input cost at invoiced value (for example, fuels, capital, land or labor at subsidized prices); and count SOEs' contribution to the government's revenues—for example, in the form of taxes, duties, and, for SOEs and any mandatory allocations from profits—as costs. When discussing the financial viability in sectors with multiple utility companies, the term can apply to each company separately or as an aggregate of all companies in the sector.

15. Electricity subsidies are understood as an attribute of the sector or the economy. Electricity subsidies can be defined as deliberate government policy actions targeting electricity services that (i) reduce the net cost of electricity or fuels purchased; (ii) reduce the cost of electricity production or service delivery; or (iii) increase the revenues retained by the electricity producer or service provider (Kojima 2017). This means that electricity can be subsidized whether or not the utility incurs a visible cash shortfall, and whether or not a visible cash shortfall is covered by fiscal transfers from the budget (as opposed to commercial borrowing, deferred depreciation and so forth.).

16. The quasi-fiscal deficit (hidden costs in the case of private utilities) is a measure of implicit fiscal costs of the power sector (or hidden losses in the case of private utilities). The quasi-fiscal deficit is measured as the difference between the cash collected by the existing utility and the revenues that would be collected without bill collection losses by a utility applying cost-recovery tariffs (in this analysis, using cost benchmark level C3) and achieving commercial and operational efficiency. In general, power utilities in most developing countries are state-owned and can be considered quasi-fiscal entities. Typically, these utilities display poor financial performance in part because they channel various transfers to consumers through underpricing, uncollected bills, and unmetered consumption. But the total cost of such transfers is not reflected in the public budget because it is implicit or involuntary (for example, theft). The resulting financial gap in the public utility has been called in the literature quasi-fiscal deficit, typically expressed as percentage of GDP, or hidden cost, expressed in absolute terms.[6] The quasi-fiscal deficit can usefully be disaggregated to clarify how much is attributable to three main factors: (a) System losses: The cost of electricity injected into the transmission system but not metered/billed, minus the cost of electricity lost for technical reasons within the normative level of 10 percent; (b) Collection losses: The value of electricity billed but not collected from customers; and (c) Underpricing: The difference between the amount billed to customers and the cost of the corresponding amount of electricity.[7]

QFD = Cost of Underpricing of Electricity + Cost of Nonpayment of Bills + Cost of Excessive System Losses

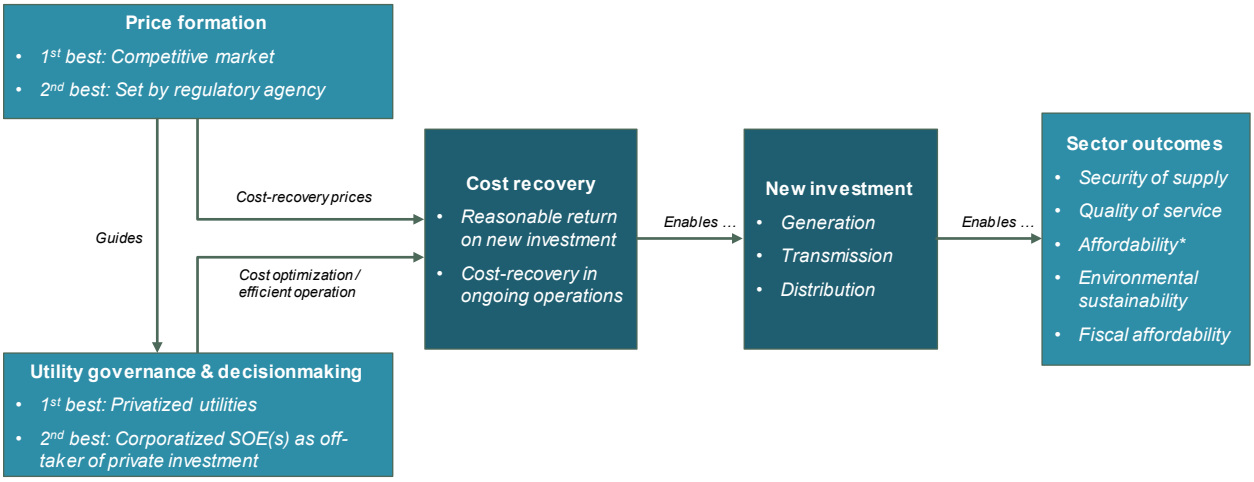
[6] According to the most common definition, QFD is the difference between the actual revenue charged and collected at regulated electricity prices and the revenue required to fully cover prudently incurred operating costs of service provision and capital depreciation: QFD (as % of GDP) = Cost of Underpricing of Electricity + Cost of Nonpayment of Bills + Cost of Excessive Technical Losses (Alleyne and others 2013).

[7] In the literature, there are relatively minor variations of this generally accepted QFD formula. For example, Briceño-Garmendia and others (2008) and Kojima and Trimble (2016) introduced overstaffing as an additional "hidden cost" item.

3.2. How Were Cost Recovery and Financial Viability Reflected in the 'Standard Model'?

17. Cost recovery was and remains closely linked to broader normative conceptions about power sector reform since the debate emerged in the 1980s and 1990s (the 'Standard Model'). At the center of the reform agenda was the policy of unbundling state-owned monopoly utility companies to allow for private entry and competition, the benefits of which would accrue not only to the owners of the private capital, but ultimately also to consumers.

Figure 1: Stylized model of reform thinking under the 'Standard Model'



Source: World Bank staff.

18. With regard to cost recovery, the stylized reform model had three underlying (and often implicit) hypotheses (illustrated in Figure 1):

1. **Price formation:** Cost recovery is most likely in liberalized/competitive markets for electricity, and more likely in countries with regulatory agency than in countries with government-determined prices;

2. **Utility governance & decision-making:** Cost recovery is most likely in countries with privately-owned utilities and more likely in countries with corporatized SOEs than in cases where the utility remained part of the administrative structure of the government;

3. **Outcomes:** Higher cost recovery is associated with higher levels of private investment in the sector, which in turn is associated with better sector outcomes (security of supply and quality of service).

3.3. How Does This Paper Analyze Cost Recovery and Financial Viability?

19. The paper analyzes the power sector reform journey from the late 1980s and 1990s through the period 2010-17 of 17 jurisdictions[8] (14 countries and 3 Indian states) that represent a wide diversity of geographies, income levels, and approaches to reform. The analysis consisted of three steps:

1. **Post-reform cost-recovery level of electricity tariffs (2010-17) at the country/state and utility levels.** Data on tariff levels during 2010-17 (or a subset of years) were collected for all 17 jurisdictions on the country / state-level and the utility level and compared to corresponding estimates of six cost recovery levels (A1-A3 and C1-C3[9]). The total sample of the utility-level analysis includes 18 majority publicly-owned and 7 privately-owned utilities. Where possible, the analysis included actual cash collected besides the billed revenue. The data was compiled from the financial statements of all utilities in the sector to obtain a full picture of cost and revenues in the jurisdictions, complemented with information on indirect government support (e.g., in the form of subsidized fuels). Exceptions were made for independent power producers and small power producers, the cost of which were approximated by the electricity purchase cost of the off-taking utility. The only two cases where such a holistic picture of costs and revenues in the sector was not possible were the Dominican Republic, where the analysis focused only on the utility Edesur, and Morocco, where the analysis relied on a previous study by The World Bank (2017) for information on full-cost recovery levels in the sector. All data presented in the paper is expressed in 2017 US$ to adjust for inflation. An overview of data compiled for the case studies, the years covered, and the data sources is provided in Table 2.

2. **Pre-reform cost-recovery level of electricity tariffs (1980s-1990s).** Data on tariff levels during the 1980s and 1990s were collected for all 17 jurisdictions and compared to LRMC estimates, which reflect the long-run marginal cost of supply that would need to be covered to expand the system, taking into account shadow prices for inputs such as fuels, labor and capital. Comparable LRMC estimates are available for most countries for the 1980s and 1990s, when the World Bank financed numerous LRMC studies across the world. For 12 jurisdictions, the tariff and cost data are for 1987 and based on The World Bank (1990) and based on a strictly comparable methodology. For two further jurisdictions, the data is based on the same LRMC methodology but for different years, 1991 (Tanzania) and 1993 (Vietnam) (The World Bank, 1993c, 1995). For the remaining three cases, the assessment compares tariffs and current cost-of-service estimates (as opposed to LRMC) for 1991 (Senegal), 1994 (Ukraine), and 2003 (Tajikistan) (The World Bank, 1994, 1998, 2004). The results of this second analytical step provide a baseline for the assessment of reform impacts and allowed to assess if countries were able to raise tariffs or reduce costs compared to the pre-reform period; which types of sector reforms and other factors were

[8] The cases are Colombia, Dominican Republic, Egypt, Arab Rep., India (Rajasthan, Andhra Pradesh and Odisha), Kenya, Morocco, Pakistan, Peru, Philippines, Senegal, Tajikistan, Tanzania, Uganda, Ukraine, and Vietnam.
[9] Externalities were not assessed as part of C3 because of data availability issues.

conducive to cost recovery; and what the impact of cost recovery or under-recovery has been on sector outcomes.

3. **Qualitative analysis of power sector reforms' impact on cost recovery and sector outcomes.** The quantitative analysis was complemented by a review of the reform narratives and case-specific descriptive statistics to (a) substantiate the conclusions from steps 1 and 2 through additional evidence; (b) identify the mechanisms behind failures and successes not captured by the quantitative data; (c) better understand the characteristics of outliers in the quantitative analysis. This step also involved comparing the results from the 17 case studies to findings from a recent literature review on cost recovery and financial viability in the power sector (Huenteler et al., 2017) to situate the findings in the broader global reform experiences.

20. The analysis presented in this paper distinguishes itself from the existing literature on cost recovery in two main ways (see Annex 1 for an overview of systematic studies): First, the comparison to pre-reform cost recovery levels is unique and allows to identify reform impacts over a 20-30-year period. Second, the combination of qualitative and quantitative evidence allows to better understand outliers and draw conclusions regarding the validity of the underlying analytical framework.

Table 2: Coverage of Quantitative Cost-Recovery Analysis undertaken for this Paper

Country/State	Year of Data for Pre-Reform Analysis	Years Covered in the Post-Reform Analysis	Scope of Utility-level Analysis (Ownership[b])
Colombia	1987	2010-2016	Codensa (Private)
Dominican Republic[a]	1987	2010-2015	Edesur (Public)
Egypt, Arab Rep.	1987	2011-2016	EEHC (Public)
India - Andhra Pradesh	1987	2011-2015	APEPDCL (Public), APSPDCL (Public)
India - Odisha	1987	2011-2015	CESCO (Public), WESCO (Public)
India - Rajasthan	1987	2011-2015	AVVN (Public), JDVVN (Public), JVVN (Public)
Kenya	1987	2010-2016	KPLC (Public)
Morocco	1987	2013	ONEE (Public)[c]
Pakistan	1987	2013-2016	K-Electric (Private), LESCO (Public)
Peru	1987	2010-2016	Hidrandina (Public), Luz del Sur (Private)
Philippines	1987	2010-2016	Beneco (Private), Meralco (Private)
Senegal	1991	2010-2016	SENELEC (Public)
Tajikistan	2003	2010-2016	Barki Tojik (Public)
Tanzania	1991	2012-2016	TANESCO (Public)
Uganda	1987	2012-2016	UMEME (Private)
Ukraine[d]	1994	2012-2017	Dniprooblenergo (Private), Khmelnytskoblenergo (Public)
Vietnam	1993	2010-2016	NPC (Public)

Notes: [a]Approximated by data for Edesur as full-country data was not available. [b]Indicates majority ownership. [c]Approximated by sector-wide data. [d]C1-C3 cost recovery is approximated by A1-A3 as systematic information on government support to the utilities was not available. *Source:* World Bank staff.

4. Ten Observations on Cost Recovery and Financial Viability of the Power Sector

#1: Electricity tariffs are rarely high enough to cover the full costs of service delivery, even where cost of service is low

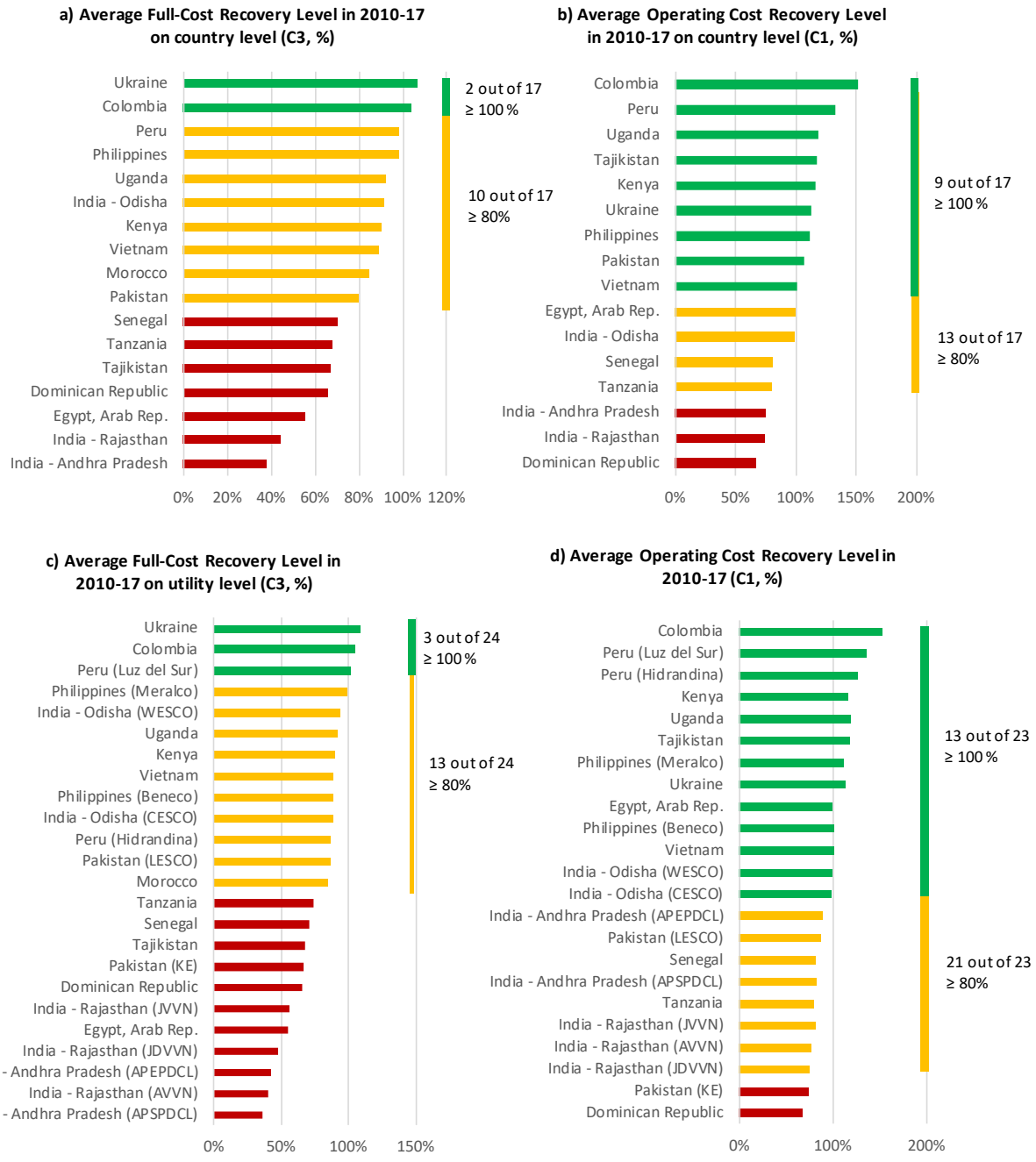
21. The following analysis starts with results for the full cost of service from an economic perspective (C3). This perspective is in line with the recent literature, which has tended toward a more economic perspective on cost recovery when considering the broader implications of the under-recovery of costs, including economic distortions, climate change and pollution (Huenteler et al., 2017). However, this paper also provides results for cost recovery levels A1 and A2, which are the most immediate determinants of the financial and fiscal viability of electricity service.

22. Overall, the findings from the 17 case studies suggest that cost recovery remains an elusive goal for many power sectors. Governments in all studied cases made significant efforts to improve cost recovery, often along the lines of the standard model. Cost recovery can be achieved through cost reduction and/or tariff adjustments. However, cost reduction takes time since it requires significant changes in generation sources and efficiency improvement. The case studies suggest that tariff adjustments remain the most politically difficult power sector reform and their implementation is patchy despite continued pressure from investors and financiers. This is reflected in a continued pattern of under-recovery of costs in most cases.

23. On the country level, the analysis of post-reform cost recovery levels suggests that tariffs in only 2 out of 17 case studies cover the full cost of service delivery (C3). Tariffs in 7 out of 17 case studies do not even recover operating costs of electricity service. Ukraine (109 percent on average in 2010-17) and Colombia (104 percent) are the top performers in this sample. Egypt, Rajasthan and Andhra Pradesh are the lowest performers. In addition, in several cases, bill collection losses introduce additional financial burden on utilities. Bill collection losses are particularly high in Tajikistan and Egypt. These findings are broadly in line with recent studies (see Annex 1), suggesting that the sample of cases is representative of developing countries more broadly.

24. On the utility level, the analysis of post-reform cost recovery suggests that tariffs in only 3 out of 24 case studies cover the full cost of service delivery (C3). Tariffs in 10 out of 23 case studies do not even recover operating costs of electricity service. Ukraine (109 percent on average in 2010-17) and Colombia (104 percent) are the top performers in this sample. Egypt, Rajasthan (all 3 utilities) and Andhra Pradesh (both utilities) are the lowest performers.

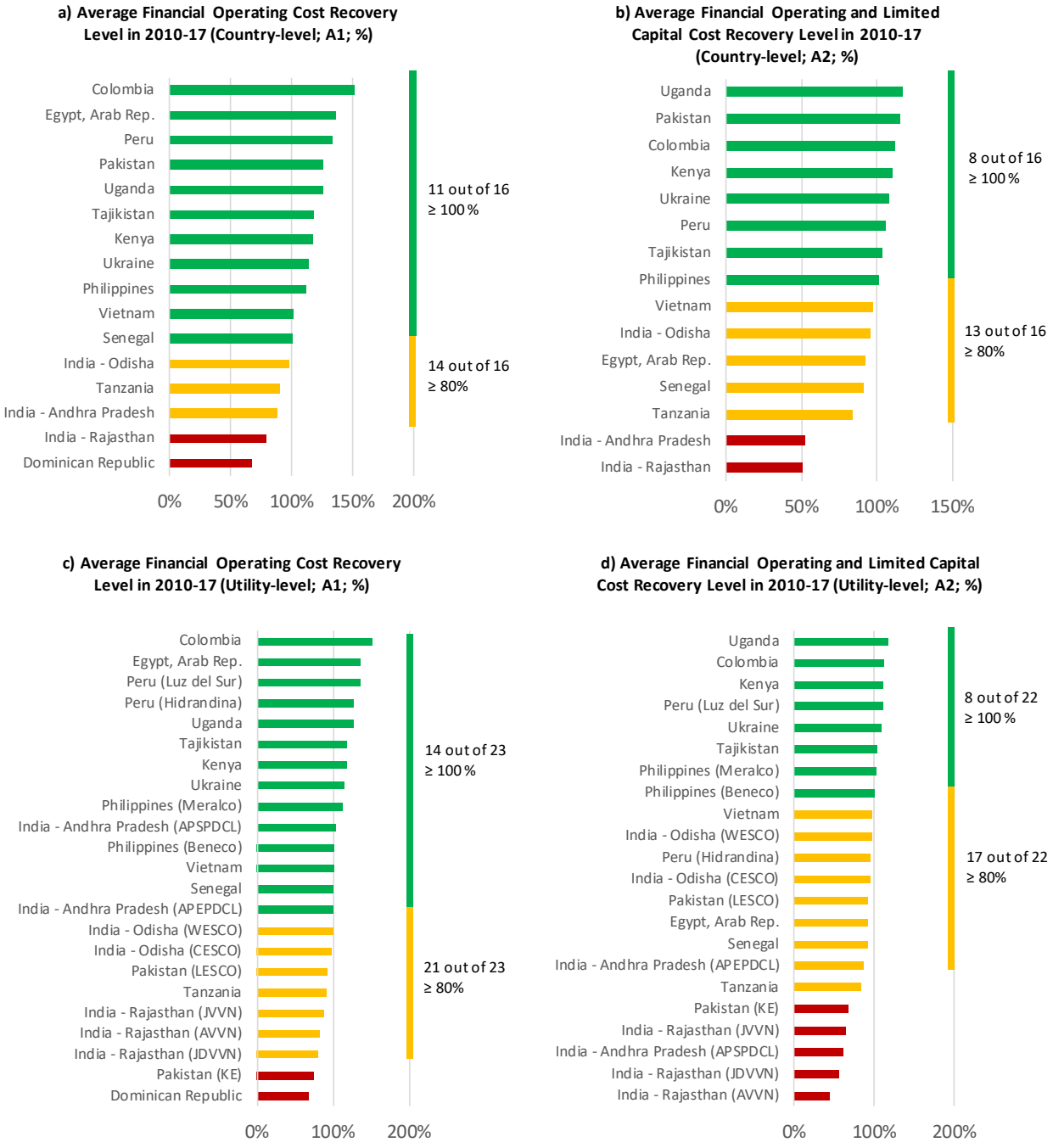
Figure 2: Post-Reform Cost Recovery Levels C1 and C3 in 17 Case Studies (24 utilities)



Source: World Bank staff.

25. From a financial perspective, which excludes many implicit and 'hidden' costs, the picture looks slightly better. Eleven out of 16 countries or states and 14 utilities out of 23 utilities are recovering their financial operating costs (A1; see Figure 3a and c). Eight out of 16 countries or states and 8 out of 23 utilities are meeting their operating and existing-capital expenditures from a financial perspective (see Figure 3b and d).

Figure 3: Post-Reform Cost Recovery Levels A1 and A2 in 16 Case Studies (23 utilities)

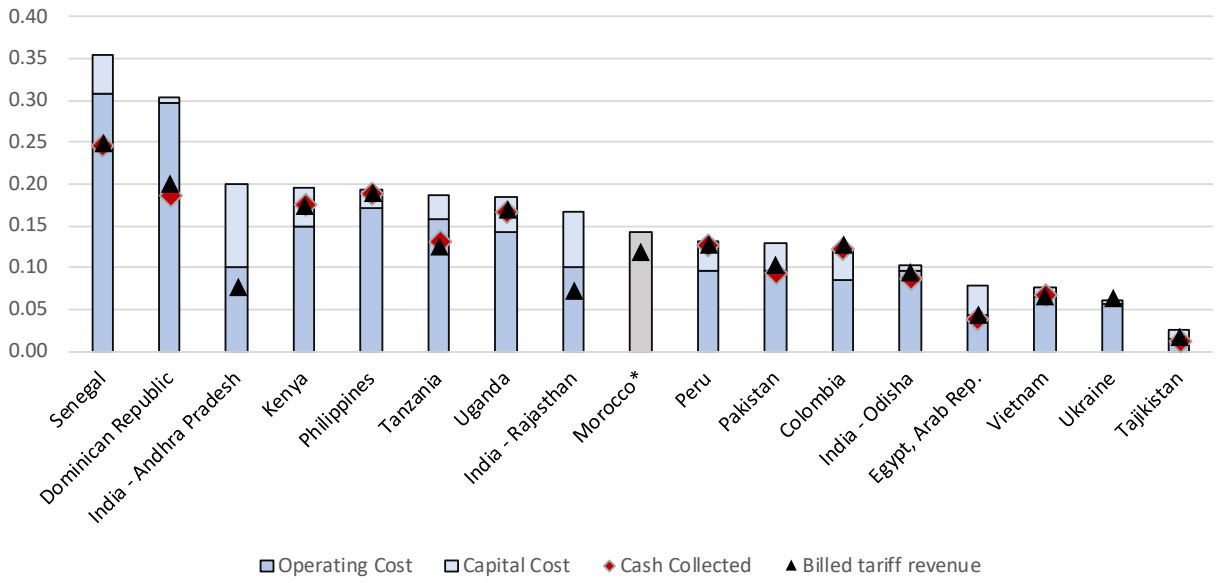


Source: World Bank staff.

26. It is notable that cost recovery appears unrelated to the absolute level of costs. The cost of electricity service differs by an order of magnitude between the case studies, but under-recovery of costs is an issue at both ends of the cost spectrum (see Figure 4). When costs are high, either due to the legacy of expensive generation sources and high-cost take or pay contracts (Senegal, Philippines, Uganda) or high system losses (Dominican Republic, Kenya, Odisha, Rajasthan, Tanzania), it is difficult to raise tariffs to

cover the full cost of service. Nevertheless, even when cost is low such as in Egypt and Vietnam, the high public sensitivity toward electricity pricing prevents the government from removing subsidies completely. In Vietnam, while end user tariffs follow cost, tariff increases above 7 or 10 percent require the approval of the Ministry of Industry and Trade or the Prime Minister, respectively. In Egypt, bold tariff adjustments of up to 40 percent were enacted in 2016 and 2017, but the low tariff base means that more substantial increases are needed to cover costs. Political pressure to provide subsidized or free power to certain groups of consumers (e.g. agriculture sector) also undermine the cost recovery effort.

Figure 4: Tariffs, Collection and Costs of 17 Case Studies (average for 2010-17, in 2017 US$/kWh)



Notes: *Split of operating and capital cost for Morocco is not available. *Source:* World Bank staff.

#2: Few countries adequately manage volatile costs and maintain cost recovery levels over time

27. None of the cases maintained full cost recovery throughout the entire period of observation. Six of the cases reached full-cost recovery in at least one of the observed years, but even when tariffs attain cost recovery levels for certain periods of time, the sustainability of this outcome is challenged due to cost volatility faced by the sector. This is true for countries at both ends of the cost recovery spectrum (e.g., for both Colombia and Tanzania), as well as countries that are completely relying on fossil-fuels (e.g., Dominican Republic) and countries relying entirely on renewable energy (e.g., Tajikistan). The full data are presented in Table 8 in Annex 2. Year-on-year volatility of cost recovery is particularly high in Rajasthan (coefficient of variation of 16 percent), Pakistan (17 percent), Senegal (16 percent), Tajikistan (19 percent) and Tanzania (23 percent). The only two exceptions with low volatility in cost recovery levels are Andhra Pradesh and Odisha.

28. The sources of volatility most often observed are exchange rate, fuel cost, fuel mix and debt service costs (see Table 3). Colombia, for example was above full capital cost recovery in 2011-2016, but below that level in 2010 because of the impact of drought on hydropower costs. Kenya's KPLC experienced worse financial performance in 2009-2012 because of a drought that reduced hydro capacity. Tanzania's

TANESCO has been consistently loss-making in recent years but ran an operating profit in FY2013/14 and 2014/15 because of favorable hydrological conditions which reduced the cost of sales substantially and reduced the need for power purchases from third parties. Fuel prices have been a major factor in cost variations seen in the Philippines, which benefitted from declining fuel prices since 2013. Senegal was also able to achieve greater levels of cost recovery despite tariffs being frozen at 2009 levels, as fuel purchase costs declined 44 percent between 2012 and 2016. Since most materials and equipment are imported, Tajikistan's Barki Tojik is highly susceptible to the devaluation of its local currency.

Table 3: Volatility in Full-Cost Recovery during 2010-2017

Country/State	Average	Min	Max	Coeff. of Var[b]	Main sources of Volatility
Colombia	104%	94%	117%	7.0%	Fuel mix (hydro availability), debt service costs, FEX rate.
Dominican Republic	66%	62%	73%	7.0%	Fuel prices.
Egypt, Arab Rep.	55%	49%	68%	**14.3%**	Fuel mix (gas availability), FEX rate, fuel prices.
India - Andhra Pradesh	38%	36%	44%	8.9%	Debt service costs.
India – Odisha	91%	90%	94%	1.7%	n.a.
India – Rajasthan	45%	38%	57%	**16.0%**	Debt service costs.
Kenya	90%	80%	101%	9.0%	Fuel mix (hydro availability), capital costs.
Morocco[a]	84%	n.a.	n.a.	n.a.	Fuel prices.
Pakistan	80%	66%	97%	**17.0%**	Fuel prices (major factor), tariff increases (minor).
Peru	98%	93%	102%	3.6%	n.a.
Philippines	98%	95%	100%	1.7%	Fuel prices.
Senegal	70%	55%	87%	**16.0%**	Fuel prices.
Tajikistan	67%	52%	83%	**18.7%**	FEX rate.
Tanzania	68%	56%	90%	**22.6%**	Fuel mix (hydro availability), FEX rate, fuel prices.
Uganda	92%	81%	110%	**12.2%**	Capital costs, fuel prices, FEX rate.
Ukraine	106%	93%	115%	7.1%	FEX rate, fuel prices.
Vietnam	89%	86%	91%	2.1%	n.a.

Notes: [a]Data for Morocco is only available for one year (2013). [b]Coefficient of variation (standard deviation divided by the geometric mean). *Source:* World Bank staff.

#3: Losses due to the under-recovery of costs are absorbed by the sector in different ways, and some countries manage to maintain utilities' financial viability better than others

29. The case studies illustrate that there are different mechanisms to absorb the under-recovery of costs, with different implications for the utilities' ability to adequately serve their customers. Table 4 summarizes indicators of how losses are absorbed. Notably, government support falls short of restoring utilities' financial viability in almost all cases.

Table 4: Indicators of Financial Viability of Power Sectors and Utilities in 17 Case Studies

Power utility	Type	A3 Cost Recovery	A1 Cost Recovery	Large govt transfers	Subsidized fuels	Sustained net losses	Large debt service	Excessive payables	Excessive receivables	Sust. neg. operating CF
Colombia (Codensa)	Private	104%	152%	No	No	No	No	No	No	Yes
Dominican Republic (Edesur)	Public	66%	67%	No	No	Yes	*	*	*	Yes
Egypt, Arab Rep. (EEHC)	Public	55%	135%	No	Yes	No	No	Yes	Yes	No
India - Andhra Pradesh (APEPDCL)	Public	36%	103%	*	No	Yes	No	*	*	No
India - Andhra Pradesh (APSPDCL)	Public	42%	100%	*	No	Yes	No	*	*	No
India - Odisha (CESCO)	Public	95%	99%	*	No	Yes	No	*	*	No
India - Odisha (WESCO)	Public	89%	98%	*	No	Yes	No	*	*	No
India - Rajasthan (AVVN)	Public	40%	82%	*	No	Yes	Yes	No	No	No
India - Rajasthan (JDVVN)	Public	48%	81%	*	No	Yes	Yes	No	No	No
India - Rajasthan (JVVN)	Public	56%	87%	*	No	Yes	Yes	No	No	No
Kenya (KPLC)	Public	90%	117%	No	No	No	No	No	No	Yes
Morocco (ONEE)	Public	84%	*	*	*	*	*	*	*	*
Pakistan (KE)	Public	86%	92%	*	No	No	No	Yes	Yes	No
Pakistan (LESCO)	Private	66%	74%	No	No	No	No	No	No	Yes
Peru (Hidrandina)	Private	102%	135%	*	No	No	Yes	No	*	No
Peru (Luz del Sur)	Public	87%	127%	*	No	No	No	No	*	No
Philippines (Beneco)	Private	99%	111%	*	No	No	No	No	No	Yes
Philippines (Meralco)	Private	89%	101%	*	No	No	No	No	No	No
Senegal (SENELEC)	Public	70%	100%	No	Yes	No	No	Yes	No	No
Tajikistan (Barki Tojik)	Public	67%	118%	No	No	Yes	Yes	Yes	No	No
Tanzania (TANESCO)	Public	74%	90%	Yes	No	Yes	Yes	Yes	No	No
Uganda (UMEME)	Private	92%	126%	No	No	No	No	No	No	No
Ukraine (Khmelnytskoblenergo)	Mixed	109%	113%	*	Yes	*	*	*	*	*
Vietnam (NPC)	Public	89%	101%	No	No	No	No	*	*	No

Note: *Data not available. *Definitions:* Large government transfers: If total government transfers exceed 10% of C3 cost recovery. Subsidized fuels: If utility receives fuels below market prices (qualitative information). Sustained net losses: If net losses exceed 5% of revenue (average of last three years). Large debt service: If total debt service (interest and principal payments) exceed 20% of C3 cost recovery. Excessive payables: Payables exceed 50% of annual revenues. Excessive receivables: Receivables exceed 50% of annual revenues. Sustained negative operating cash flow: Negative net operating cash flow of more than 5% of revenue. *Source*: World Bank Staff.

30. Elelven of the 15 jurisdictions below full cost recovery receive fiscal support in the form of operational and/or capital transfers. Fiscal support is more common in the jurisdictions with lower levels of cost recovery, and less common for private utilities. Tanzania's TANESCO is an example of heavy reliance on government grants to finance investments. The government provided grants for investment, totaling US$ 833 million in 2016 (1.72 percent of GDP). In addition, TANESCO does not always pay its loans from the Ministry of Finance, which then become pseudo-grants. Pakistan's KE is an example of heavy reliance on operational transfers. Subsidies are provided to distribution companies in the form of a tariff differential subsidy (TDS), totaling US$ 418 million to KE in 2015, which compensates distribution companies for the difference between the regulator-determined cost-based tariff (accounting for only efficient costs) and the uniform tariffs (based on the costs of the most efficient distribution company). The government envisioned that as distribution companies were privatized, the efficiencies of private management would result in lower costs and therefore lower subsidies. However, after almost 10 years of privatization, KE is still receiving a subsidy. Total TDS subsidies provided to the sector in 2016 (including KS and XWDISCOs) comprised 0.4 percent of GDP.

31. Fiscal support meant to compensate for shortfalls in tariff revenue often falls short of required levels. In Senegal, tariffs were frozen at their 2009 level, with the government agreeing to make quarterly payments to compensate SENELEC. However, these payments were not timely and resulted in SENELEC taking on expensive commercial debt. In 2011, SENELEC's concession contract was updated so that if the government is unable to make payments, resulting in SENELEC needing to borrow from commercial banks, the government must then take on responsibility for all financial fees and principal repayment.

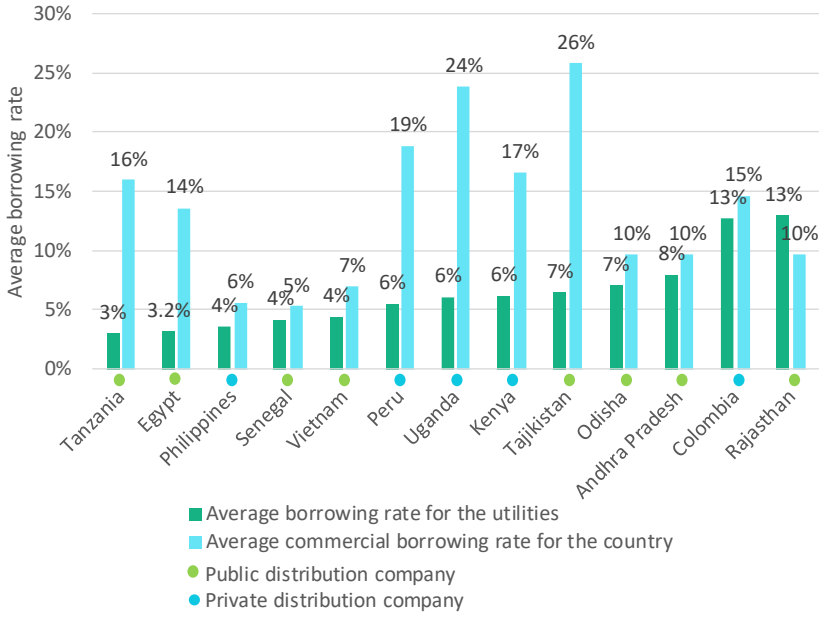
32. The problem of insufficient government transfers is often exacerbated by non-payment of electricity bills by public institutions. The government is a major contributor to receivables in Pakistan, Tanzania, and Senegal. The issue of non-payment is especially important in Pakistan, where collection losses make up 47 percent of the QFD. Pakistan has the highest receivable days in the country sample (190 days). As an illustration, Pakistan's K-Electric (KE) is contractually obligated to provide uninterrupted service to Karachi Water & Sewerage Board and City District Government Karachi, but their unpaid bills have been accumulating before 2010. Taken together, government and autonomous bodies make up 56 percent of KE's trade receivables. In Tanzania, government non-payment used to be a major problem. However, in recent years the mainland government and TANESCO have taken steps to substantially reduce accounts payable, settling US$ 71 in unpaid invoices in 2015. Currently collections losses make up 6 percent of Tanzania's QFD.

33. The utilities that do not receive government support and/or face large amounts of unpaid bills must use other coping strategies to deal with underpricing. Often, insufficient bill payment leads to utilities falling into arrears with suppliers, creating contingent liabilities for the government**.** Typically, energy providers and goods and services providers make up the majority of utilities' payables. Pakistan experiences this problem of "circular debt". Distribution companies often do not have the cash to pay the National Transmission and Dispatch Company (NTDC) because of low collections, shortages in cost recovery (even with the subsidies), or lack of timely payment of subsidies. NTDC then cannot pay power producers, and power producers cannot pay fuel suppliers. Tanzania similarly has had difficulty making loan payments, with payable days of 299.

34. The described issues with utilities' financial viability have severe impacts on utilities' creditworthiness and ability to raise capital. As a result, many utilities in developing countries are over-reliant on high-cost short-term debt and have difficulty servicing this debt. Debt repayment has been particularly problematic for utilities facing very high investment needs due to efforts to increase electrification, such as Tanzania and Kenya. TANESCO's inability to pay its debts is apparent in its low debt service coverage ratio (0.16 in 2014/15 and -0.11 in 2015/16). In 2015, TANESCO's financial reports also show that it defaulted on loans from both the government and World Bank loans on-lent by the Ministry of Finance, which represented approximately 19 percent of its 2016 capital expenditure. For countries with detailed loan information available (Kenya, Senegal, and Tajikistan), the average tenor of debt is between 5 and 13 years. These countries rely primarily on long-term loans but do utilize some short-term financing.

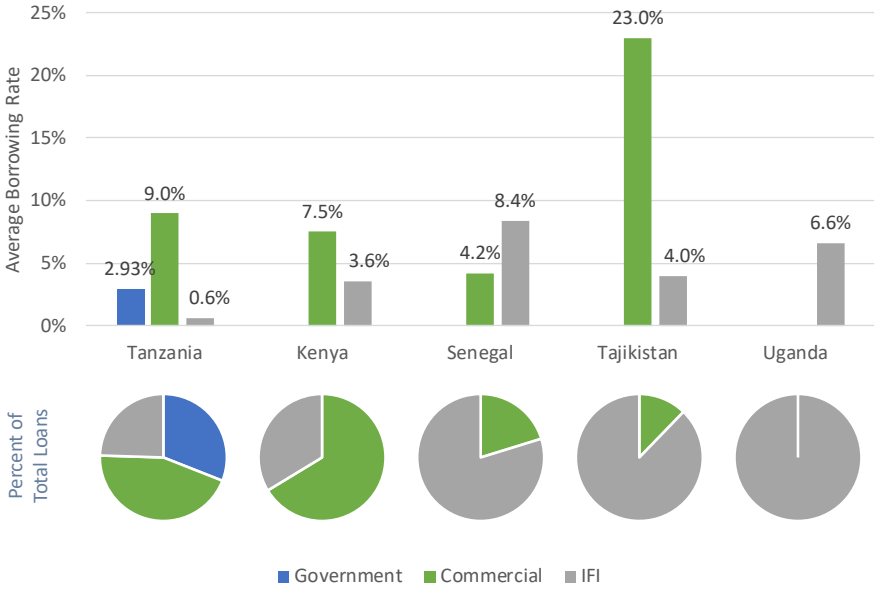
35. Short-term financing tends to be significantly more expensive. For example, KPCL has one short-term loan on record with an interest rate of 16 percent, well above its average commercial loan rate of 3.6 percent (otherwise comprised of medium- and long-term loans). This is despite utilities typically benefitting from substantial subsidies on investment financing that reduce the effective cost of capital that they face relative to the true cost of either public or private finance. The average cost of debt is 6 percent across the 13 jurisdictions with available data. This cost of debt is less than half the average commercial rate for these jurisdictions (14 percent). In fact, every jurisdiction except Rajasthan receives lower cost loans than the average commercial borrowing rate in each country (see Figure 5). Government and IFI loans have even lower rates than the commercial loans, as shown in Figure 6 (except for Senegal's IFI loans, the majority of which are from the West African Development Bank and have a standard 8.5 percent rate). Uganda is entirely dependent on IFI loans, while the majority of Senegal and Tajikistan's loans are from IFIs, and the majority of Tanzania and Kenya's loans are from commercial sources. Vietnam's EVN benefit from preferential treatments such as privileged access to credit, land and contracts.

Figure 5: Average Utility Borrowing Rates vs. the Jurisdictions' Commercial Rates



Source: Utility financial statements; World Development Indicators.

Figure 6: Loan Sources and Average Borrowing Rates

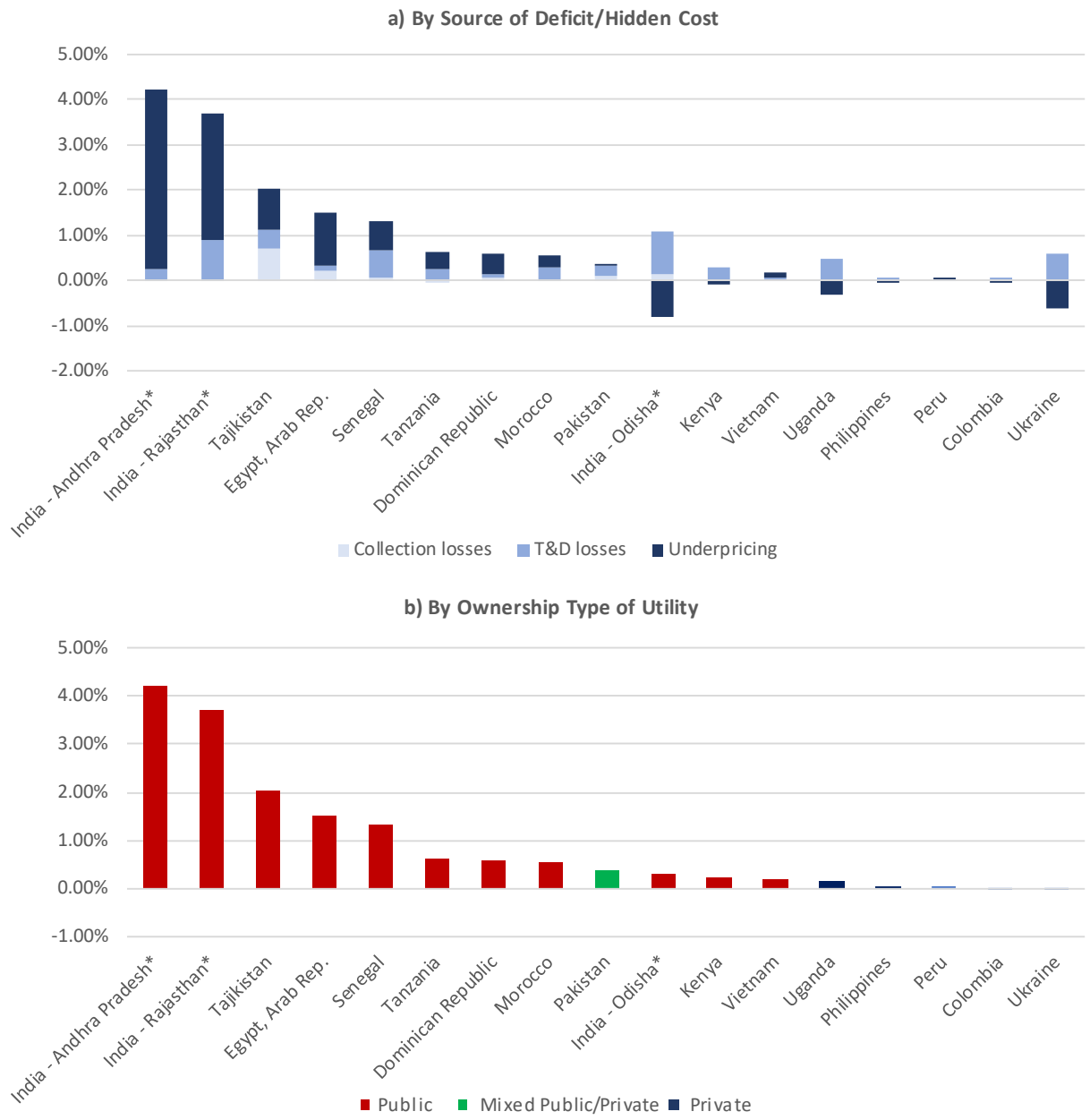


Source: Utility financial statements; World Development Indicators.

#4: Power utilities often impose a substantial fiscal burden and contingent liabilities on government budgets

36. Estimates of the quasi-fiscal deficit of power utilities—or hidden losses in the case of privately-owned utilities—provide a strong reminder of the macroeconomic significance of the under-recovery of the cost of electricity service. The QFD of the power sector stand at 0.93 percent of GDP on average (see Figure 7a). Again, these figures are broadly in line with the literature (see Annex 1), suggesting that the sample is sufficiently representative of the situation in developing countries overall.

Figure 7: Quasi-Fiscal Deficit/Hidden Cost of the Power Sector, broken down by Source and Type of Utility



Source: World Bank staff.

37. Separating the analysis by ownership of the utility suggests that the problem of QFD/hidden costs is concentrated in the cases were utilities are SOEs (see Figure 7b). The average QFD of sectors with publicly owned distribution is 1.38 percent of GDP, compared to 0.12 percent for mixed public/private and 0.07 percent for fully private distribution utilities.

38. Below cost recovery tariffs are the leading contributor to the QFD in 9 out of 17 cases, which suggests that tariff reforms or cost reductions would be needed in most cases to reach cost recovery. However, while the lack of cost recovery tariffs is usually the main cause of power sector deficits, it is further exacerbated by inefficiencies in transmission and distribution and revenue collection.[10] Several of the studied utilities could reach or get substantially closer to cost recovery by improving efficiency. Both Pakistan and Odisha would have achieved full-cost recovery in the most recent year of data if they would have achieved full bill collection and reduced transmission and distribution losses to a level of 5 percent of power fed into the transmission grid. Tajikistan and Uganda would have both been 11 percentage points closer to full cost recovery with these changes, though neither would reach full cost recovery with these improvements alone. Tanzania, Rajasthan, Kenya, Senegal, and Vietnam would also see moderate improvements in cost recovery (all between 1 and 9 percentage points).

39. Another source of inefficiencies which may push up cost is the high allowed return for investment to private concessionaires (Uganda) and expensive cost of power purchase due to lack of competitive procurement (Senegal).

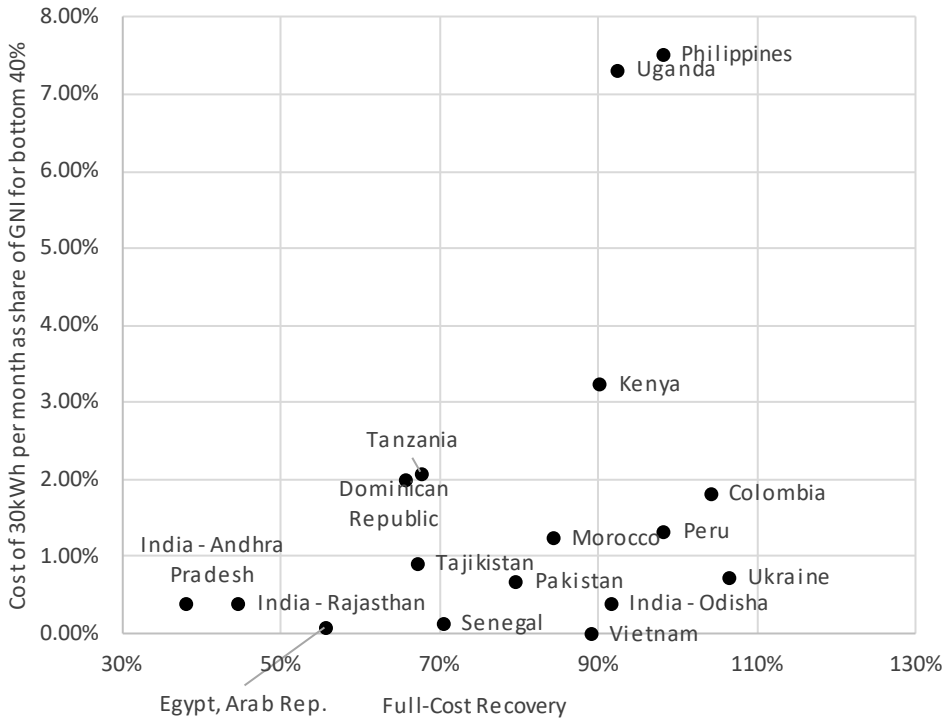
#5: Tariff levels are highly differentiated and in many cases make service affordable to certain consumer groups, but large cross-subsidies are often associated with low levels of cost recovery

40. In a clear pattern across the 17 countries and states, due to the extensive practice of cross-subsidies in tariff structures,[11] industrial and commercial customers are much more likely to be paying at cost recovery levels than residential and agricultural customers. Industrial and commercial customers often pay a significant tariff premium even though the costs they impose on the network are no higher (and potentially lower) than those imposed by residential customers. Fewer countries have cross-subsidies from industrial to commercial customers, and these cross-subsidies tend to be smaller. Through such cross-subsidization a number of countries make electricity affordable to politically favored groups, typically including but not limited to the poor and vulnerable. As can be seen in Figure 8, several countries manage to make subsistence consumption (30 kWh per month per household) very affordable to the bottom 40 percent of the income spectrum. In 8 cases—Andhra Pradesh, Rajasthan, Egypt, Tajikistan, Senegal, Pakistan, Odisha and Ukraine—this consumption costs less than 1 percent of gross national income (GNI) of the bottom 40 percent.

[10] Due to lack of information, the paper does not assess labor cost inefficiencies.

[11] The term tariff structure is used here to describe the composition of end-consumer prices (e.g., one aggregate service tariff compared to separate tariffs for generation, transmission and distribution) as well as the differentiation of end-consumer tariffs by consumer groups (do tariffs differ between groups and by how much?).

Figure 8: Full-Cost Recovery and Affordability of Subsistence Consumption for the Bottom 40%



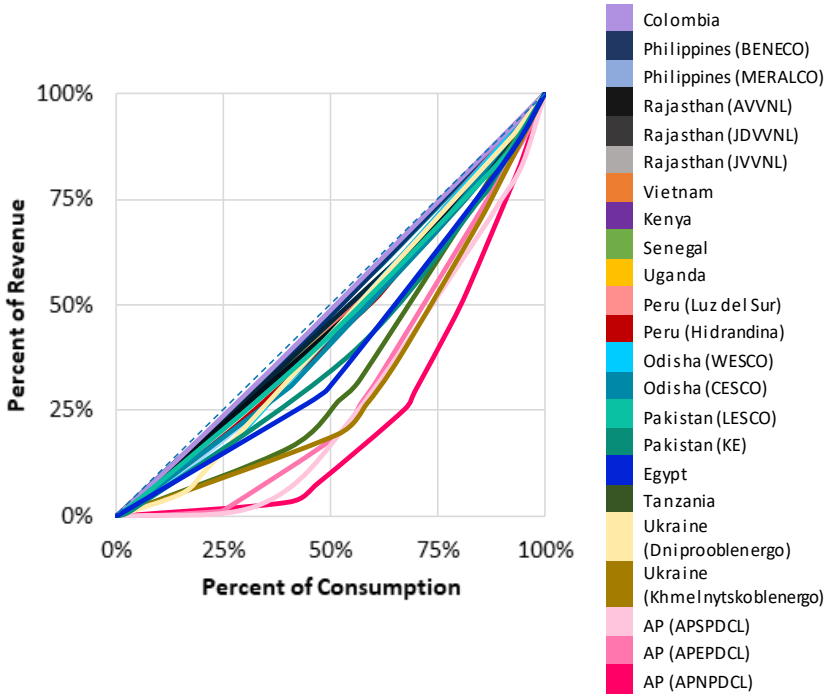
Source: World Bank staff.

41. Such cross-subsidies are important means for governments to maintain affordability and political legitimacy of power sector reforms. The critical question is starting from what level cross-subsidization starts impeding cost recovery. One way to quantify cross-subsidization is to look at the area under a Lorenz curve, which shows cumulative shares of consumption and revenue by customer class (see Figure 9).[12] A straight diagonal would mean that all customers contribute shares of revenue equal to their shares of consumption, and a high degree of curvature would mean that customers' shares of revenues are not well aligned with their shares of consumption. Many utilities show a relatively even distribution of shares of revenue and consumption by customer class. This even distribution does not mean that cost recovery is being met or that there are no cross-subsidies; it only means that all customer classes are paying similar tariff rates for their consumption. Some countries with flatter distributions may not be recovering costs through tariffs on any customer class (as is the case with Rajasthan). In addition, it is appropriate for customers which impose lower costs on the system (such as industrial customers) to pay lower tariffs than other customer groups, so a completely flat curve is not ideal. A high degree of curvature, however, can point to a serious misalignment of costs incurred to serve each customer group and the customers who are paying those costs. The three Andhra Pradesh distribution companies show the greatest disparity in the share of consumption and the share of revenue contributed by each customer class. The distribution

[12] Specifically, the level of cross-subsidization is quantified here as the area between the 45-degree line and the curve defined by the cumulative shares of consumption and revenue by customer class. The formula is the same as that of a 'Gini-Coefficient' of inequality.

companies of Ukraine, Tanzania, Egypt, and Pakistan's KE also show curves that bow more noticeably outward than the rest of the sample.

Figure 9: Level of Cross-Subsidization



Note: Data for latest available year. *Source*: World Bank staff.

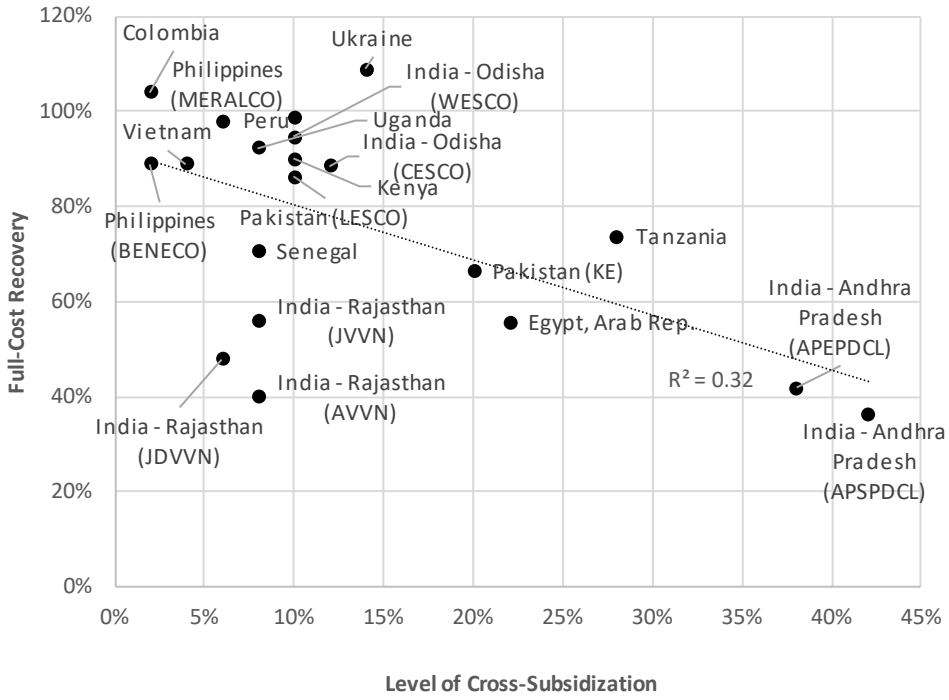
42. Comparing the level of cross-subsidization to realized full-cost recovery (C3) suggests that there is a limit to 'acceptable' levels of cross-subsidization at around 15 percent, using the quantification of cross-subsidization defined above. Specifically, the analysis suggests that no country with a cross-subsidization indicator above 15 percent comes even close to full-cost recovery (all five cases are below 80 percent). Pakistan, Egypt, Tanzania, and Andhra Pradesh all feature large cross-subsidies and low-cost recovery; the opposite is true for Colombia, the Philippines, and Vietnam. The converse is not true; Rajasthan in particular is an exception, with low cross-subsidization and low-cost recovery. This suggests that limiting cross-subsidization is a necessary but not sufficient condition to achieve cost recovery.

43. Cross-subsidization specifically aimed to protect the poor often takes the form of so-called 'lifeline' tariffs up to a certain number of kWh per month. Notably, several of the countries with the highest lifeline tariff block thresholds, such as Colombia (130-173 kWh), the Philippines (100 kWh), and Ukraine (100 kWh or higher, based on household type) are all on the high end of cost recovery. This suggests that targeted cross-subsidies to protect the poor can be part of a sustainable electricity pricing strategy.

44. Another form of cross-subsidization is to maintain uniform tariffs across the country across regions and distribution companies with differences in cost of service. These forms of implicit cross-

subsidization are very common because differentiated tariffs, particularly across urban and rural areas, often pose challenges to rural electrification due to the higher cost of connections and lower income levels in rural areas. Kenya Power and Lighting Company has a uniform tariff for all domestic customers, despite rapid expansion of its network into lower-demand regions, with over a million new customers connected in both the 2015/2016 and 2016/2017 financial years.

Figure 10: Cross-Subsidization Levels and Full-Cost Recovery



Source: World Bank staff.

45. On a related but more technical level, the qualitative evidence from the case studies also suggests that electricity tariffs structures must be carefully designed in order to avoid incentivizing 'grid defection' in view of recent developments in distributed energy. Most low-income countries rely on energy charges as the primary means of recovering costs. As a result, consumers can self-generate to save almost the entirety of their electricity bill, while still benefiting from the back-up services provided by the grid. If fixed costs are bundled into the per kWh energy charges, rather than reflected in a separate fixed charge, each grid defection shifts these costs onto a smaller group of customers and further incentivizes grid defection. Given that the costs of distributed generation may be even lower for non-residential customers consuming at larger scales, cross-subsidies further exacerbates the incentive for grid defection. Odisha provides an illustrative example of how cross-subsidies can lead to grid defection. After privatization, support to low-income residential customers in the form of free connections was reduced in favor of cross-subsidies from industrial customers, which led these industrial customers to seek out alternative sources to avoid paying higher tariffs. This sort of grid defection combined with residential tariffs that are kept artificially low, can put utilities in increasing financial distress as they are unable to recover their costs of service.

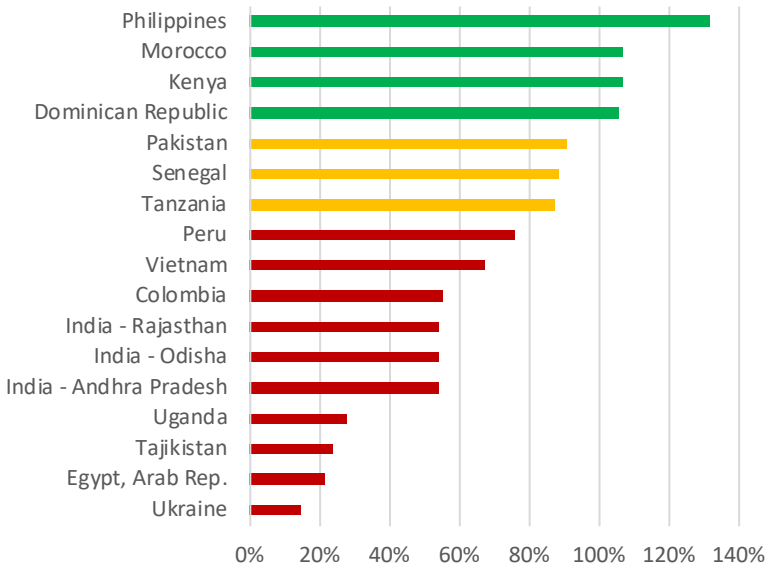
#6: Cost recovery levels have increased on average, but progress has been very uneven, with over half of the case studies experiencing a decline compared to the pre-reform period

46. This section compares pre-reform cost recovery benchmarks from the late 1980s and early 1990s with cost recovery for 2010-2017 to understand the impact of reforms. As laid out in Section 3, the pre-reform benchmarks are based on a comparison of actual pre-reform tariffs and pre-reform estimates of long-run marginal costs.

47. The pre-reform cost recovery benchmarks can be understood as a *counterfactual of today's cost recovery levels if real tariffs remained the same and actual costs materialized exactly as anticipated in estimates of LRMC.* Comparing these benchmarks to actual cost recovery levels in 2010-17 allows to draw conclusions about (a) the change in electricity tariffs in real terms compared to the pre-reform period; (b) if actual costs are now higher or lower than expected in the LRMC estimates from the late 1980s and 1990s; and (c) if the combination of changes in real tariffs compared to the pre-reform actuals and changes in real costs compared to pre-reform estimates of LRMC led to a net increase or decrease in cost recovery compared to the counterfactuals.

48. A comparison of the findings presented under Observation #1 with pre-reform cost-recovery levels (see Figure 11) suggests that there has been convergence in full-cost recovery levels across countries. As shown in Figure 12, the largest improvements were made by countries that had low cost recovery in the pre-reform period, and vice versa (see Figure 11). The largest improvements in cost recovery were observed in ECA (Ukraine +92 percentage points; Tajikistan +43 percentage points) and LAC (Colombia +49; Peru +22), with SAR and EAP seeing, on average, relatively little change compared to the pre-reform period.

Figure 11: Pre-Reform Levels of Full-Cost Recovery (C3 approximation, %)



Source: World Bank staff.

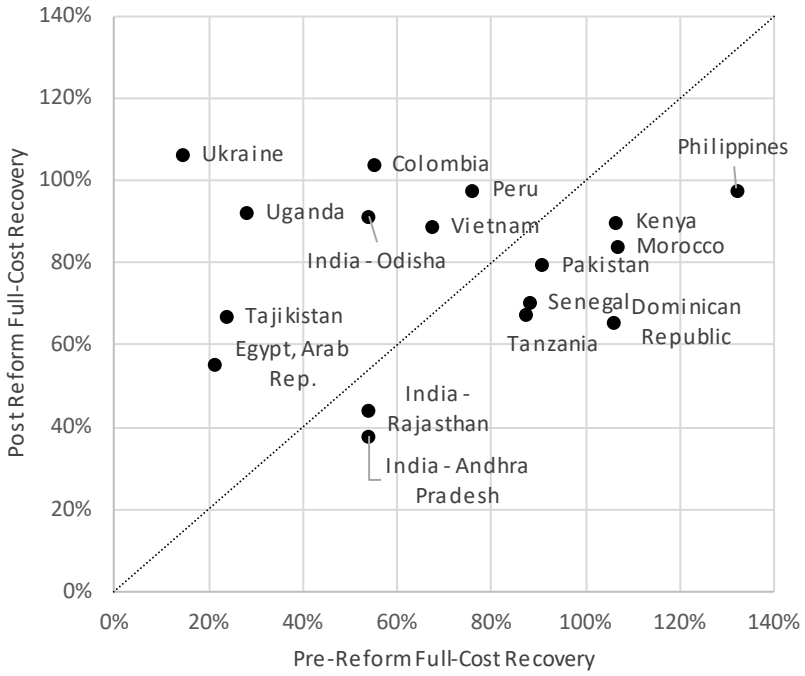
49. Average full-cost recovery increased from 69 percent around 1990 to 79 percent in 2010-17, but the increase was driven by a few strong performers and over half saw a decline (9 out of 17). These findings are broadly in line with the literature which suggests that, despite the increasing awareness of the broad negative impacts of electricity subsidies, the aggregate level of cost recovery and financial viability in developing countries has hardly improved between the late 1980s and the early 2010s (Huenteler et al., 2017).

50. The lack of improvement or decline in cost recovery could be due to two factors. One is the increase in cost partly driven by the expansion of generation and distribution networks to catch up with demand and meet access targets, and partly as a result of the privatization process. Tanzania's TANESCO (-20 percentage point decline in cost recovery) has made increasingly large investments in recent years, totaling USD 435.6 million in 2015/2016 (69 percent of revenues) to fulfil its requirements of funding distribution expansion and some of the cost of new connections. These large investments coupled with low tariffs resulted in accounts payable exceeding revenues in 2015/2016. Kenya's KPLC (-16 percentage points) is in a similar situation, making large investments to expand its network, despite poor cashflow. Investments totaled USD 481 million in 2016 (about 45 percent of its revenue). Another cause of decline in cost recovery is a reversal of tariff reforms or stalling of tariff increases due to sociopolitical pressure. The Government of Senegal (-18 percentage points) has been reluctant to authorize tariff increases and instead subsidizes SENELEC for the difference between tariffs and the cost of service determined at quarterly tariff revisions. These subsidies were not provided in 2015 and 2016, and in 2017 tariffs were reduced 10 percent. In Andhra Pradesh (-16 percentage points), the regulator was unable to increase tariffs from 2004 to 2010, and in 2004 the government also announced a policy of free power to agriculture.

51. The largest improvements in cost recovery compared to the pre-reform period were the result of both cost reductions and real tariff increases: 5 out of 8 countries that saw an improvement in cost recovery, including three out of the four best performers, witnessed both an increase in tariffs and a decline in costs. Findings are in line with the literature (see Annex 1). Notably, cost recovery improved in four cases — Vietnam, Peru, Egypt and India —without substantial increases in real tariffs. Kenya, on the other hand, saw a decline in cost recovery despite substantial increases in tariffs.

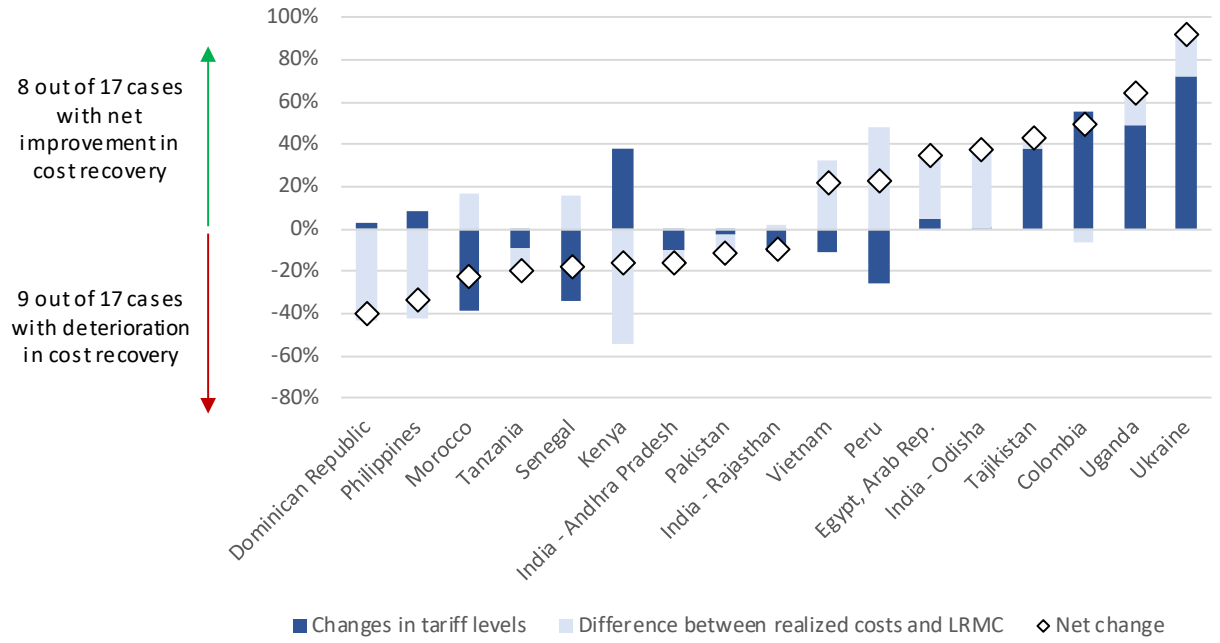
52. Reforms toward cost recovery were motivated by crisis. Countries started to adopt drastic cost reductions and tariff increases after having experienced large power deficits that require extensive investments which can no longer be supported by the government alone. Uganda's UMEME (+64 percentage point increase in cost recovery) has taken on aggressive investments (totaling USD 93 million in 2016) which have allowed it to upgrade the distribution grid to keep up with increasing access and demand; improve operating efficiency; and reduce losses and operating costs. Uganda's tariffs have allowed UMEME to keep up with debt service payments, as tariffs are updated annually and are subject to quarterly automatic adjustments for inflation, exchange rate, and oil price fluctuations. Investments that improve service delivery are vital to sustain cost recovery improvements, as efficiencies in service delivery will reduce costs and, if tariffs are not yet at cost recovery level, improved quality of service eases the social/political pressure that might otherwise suppress increases.

Figure 12: Pre- versus Post-Reform Full-Cost Recovery (%)



Source: World Bank staff.

Figure 13: Composition of Changes in Full-Cost Recovery Compared to Pre-Reform Period (Percentage Points)



Source: World Bank staff.

#7: The record of reforms to price formation, especially tariff-setting through regulatory agencies, is decidedly mixed

53. The following three observations explore the determinants of cost-recovery levels observed in the case studies: reforms relating to price formation (Observation #7); reforms relating to utility governance and decision-making (Observation #8), and boundary conditions (Observation #9).

54. The first determinant of cost-recovery levels investigated in this analysis is reform progress relating to price formation. Almost all of the 17 case studies undertook reforms in in the power sector in line with the Standard Model's hypothesis on (see Table 5). A total of 16 out of 17 countries or states established regulatory entities—albeit with various degrees of independence and different mandates—to improve electricity retail price formation. Two countries—Colombia and the Philippines—also established competitive wholesale markets, but none of the cases saw a transition to liberalized retail. The analysis below therefore focuses on the impact of the establishment of regulatory entities.

Table 5: Main Reforms of Price Formation in the Power Sector in 17 Case Studies

Country/State	Main Reforms to Price Formation in the Power Sector
Colombia	1994: Creation of sector regulator; 1995: Creation of wholesale market.
Dominican Republic	1998: Creation of sector regulator, but the regulator has no actual authority over tariff level, tariffs are not set according to regulatory framework and are not adjusted as mandated in the Law.
Egypt, Arab Rep.	1997: Regulatory agency established; 2015: Electricity law reestablished regulator but partially restricted regulator's independence.
India - Andhra Pradesh	1999: Independent, autonomous regulator formed
India – Odisha	1996: Establishment of regulatory commission (but with little political independence)
India – Rajasthan	2000: Establishment of Rajasthan Electricity Regulatory Commission (but with little political independence)
Kenya	1997: Electricity Regulatory Board (ERB) established; 2007: Energy Regulatory Commission (ERC) created, replacing ERB
Morocco	2016: New law established a regulator, ANRE, but without price setting function. Price regulation remains a direct government responsibility.
Pakistan	1997: Creation of a regulatory authority to calculate tariffs for generation and T&D; actual tariffs set by Ministry of Water and Power
Peru	1993: Electricity regulatory agency created
Philippines	1987: Regulatory body with pricing authority created; 2001: Transformed into independent regulatory agency; 2006: Wholesale electricity market created
Senegal	1998: Creation of regulatory agency, but without pricing authority
Tajikistan	No independent regulator
Tanzania	2001: Independent regulator established, operationalized in 2006, but recently its independence is vanishing
Uganda	2000: Electricity Regulatory Authority established
Ukraine	1994: Regulatory entity (NERC) created; 1996: Wholesale electricity market created [tbc]
Vietnam	2005: Regulator established, although limited independence

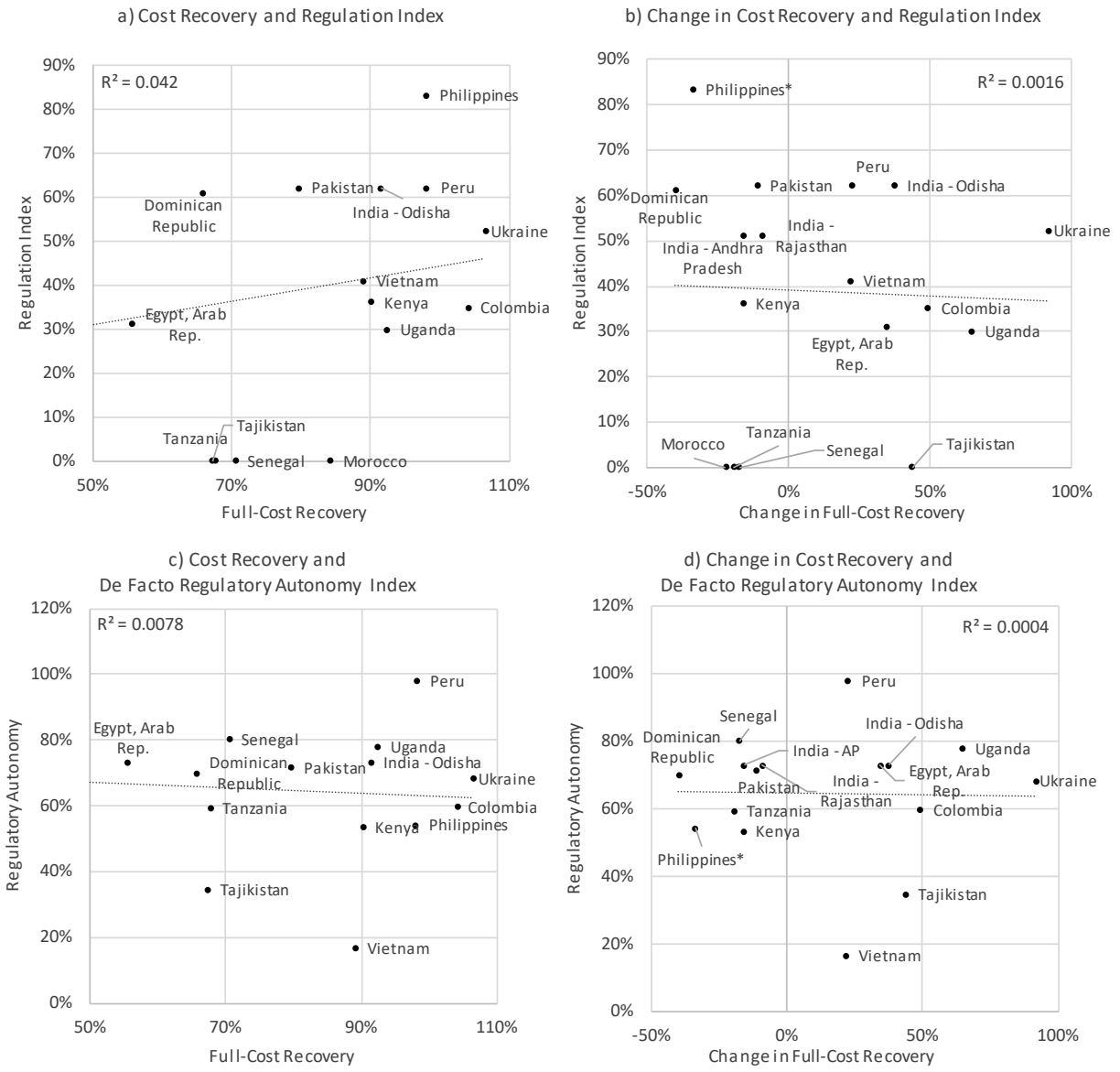
Source: World Bank Staff.

55. The prevalence of regulatory agencies as opposed to market-based pricing in the 17 case studies is in line with the fact that more generally, in contrast to majority of the OECD countries where the Standard Model originated, pricing reforms in the developing world relied much more on regulated prices (Huenteler et al., 2017). In the OECD, the paradigm can be viewed as "competition where possible, regulation where not;" regulation was seen as a last resort, appropriate only where competition was unlikely to be applicable (Besant-Jones, 2006; Littlechild, 2005). In the developing world, the reform paradigm envisioned a much more central and permanent role for independent regulators in setting prices in view of limited energy access and realism about speed of and practical limitations to full liberalization. Hence, the relatively strong focus on different options for regulated tariffs, including tariff structures and cross-subsidies, in the literature on developing countries.

56. In contrast to the standard model, however, reforms to introduce independently regulated retail prices appear to have had little impact on cost recovery levels. The empirical relationship between indices of regulation (which shows the level of sector unbundling) and autonomy is weak when looking at absolute levels of cost recovery in the 17 cases (Figure 14a and c). This is especially true for regulatory autonomy, long held as an important tenet of reforms to improve cost recovery. The relationship essentially disappears when looking at the change in cost-recovery levels compared to pre-reform (Figure 14b and d).

57. This could be partly because, despite the existence and even the autonomy of regulatory agency, tariffs continue to be influenced by political factors. For example, in Vietnam, tariff increases according to the methodology are allowed up to a threshold, beyond which the decisions are taken by the government. In Uganda, the regulator ERA sets tariffs through a multi-year tariff setting process (of three-years duration) that is based on revenue requirements, but a significant limitation of the tariff-setting process is the absence of regulatory accounting standards to structure the submission of cost information from the regulated companies. Andhra Pradesh Electricity Regulatory Commission ('APERC'), although regular in evaluating annual revenue requirements and publishing tariff orders, did not offer any tariff increase across categories from 2004 until 2010, postponing the problem until it assumed serious proportions from 2011 onwards. This was a reflection of the institution coming under strain in an over-politicized environment in the power sector. Kenya's regulator ERC is meant to conduct a tariff review every three years but only three tariff reviews took place – in 1999, 2008 and 2013 – because reviews are highly political, making them near impossible to conduct in the run up to or just after elections as politicians predictably include promises around reducing electricity tariffs in their election campaigns.

Figure 14: Reform Indicators on Price Formation and Full-Cost Recovery (C3)

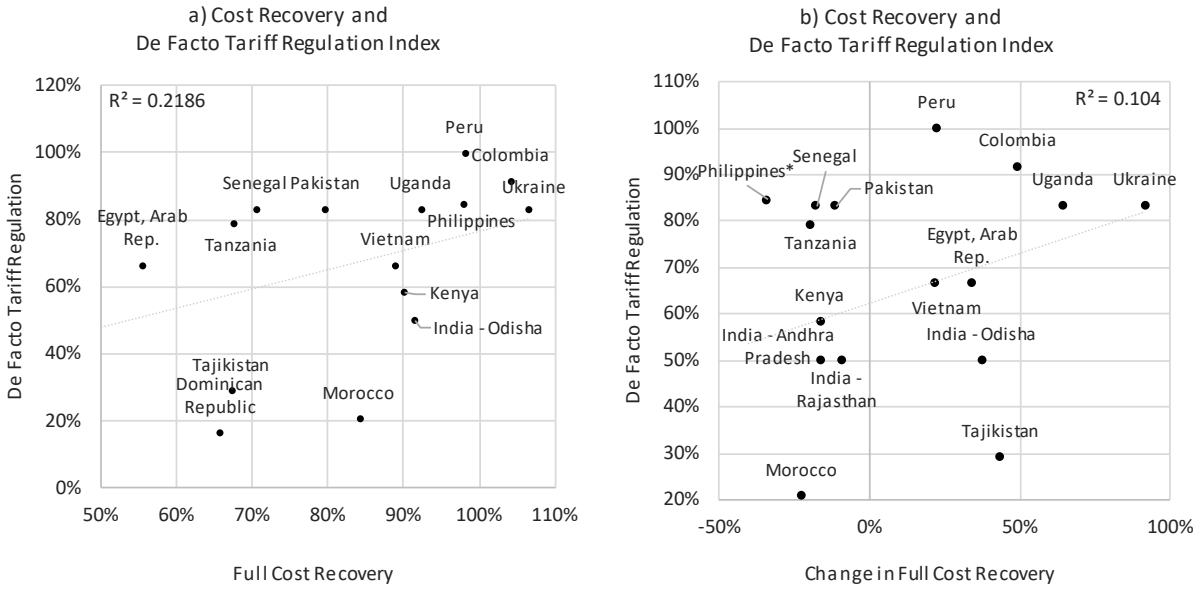


Notes: *The Philippines saw a decline in cost recovery, but post-reform cost recovery was still close to 100 percent on average. *Source:* World Bank staff.

58. The relationship between the de facto tariff regulation index (capturing what tariff regulations are enforced in practice) and absolute levels of cost recovery or improvement in cost recovery is stronger (Figure 14a and b) This suggests that the structure of the sector—i.e., if an independent regulator exists and whether or not it is autonomous—is less important than the tariff regulation implemented in practice. For example, Colombia, which has reached full cost recovery, scores lower than the sample average on the regulation index (35 percent) and regulatory autonomy index (60 percent), but scores high on the de facto tariff regulation index (92 percent). The country has been able to achieve cost reflective tariffs with regular adjustments that are promptly implemented, despite having a regulator that is exposed to

pressure from organized interest groups, incomplete vertical unbundling and no horizontal unbundling of the sector.

Figure 15: Reform Indicators on Price Formation and Full-Cost Recovery (C3)



Notes: *The Philippines saw a decline in cost recovery, but post-reform cost recovery was still close to 100 percent on average. *Source:* World Bank staff.

#8: Countries that have made more progress on utility governance and decision-making perform, on average, better on cost recovery

59. The second determinant of cost-recovery levels investigated in this analysis is reform progress relating to utility governance and decision-making. 6 out of the 17 case studies reformed ownership of at least part of their distribution utilities, in line with the Standard Model's hypothesis (see Section 3.2). These include Colombia (Codensa), Pakistan (KE), Peru (Luz del Sur), Philippines (Meralco and Beneco), Uganda (UMEME) and Ukraine (Dniprooblenergo). Table 6 provides an overview.

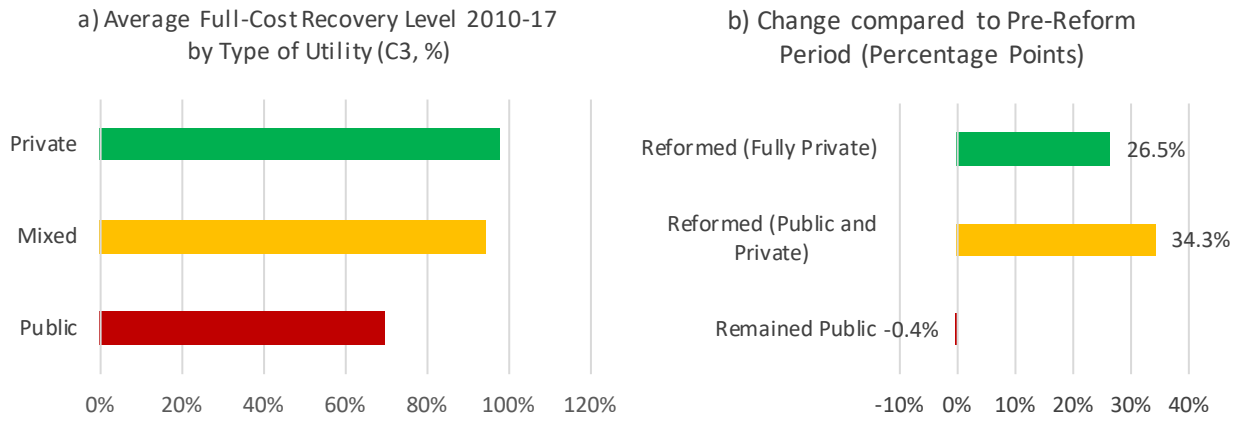
Table 6: Main Reforms of Utility Governance and Decision-Making in the Power Sector in 17 Case Studies

Country/State	Main Reforms to Utility Governance and Decision-Making in the Power Sector
Colombia	1995: Creation of wholesale market; subsequently privatization of one distribution utility (CODENSA); continuation of nationally and regionally state-owned vertically integrated utilities.
Dominican Republic	Between 1997-98: Unbundling and privatization of distribution utilities; Privatization of two utilities reversed in 2003 and of the third in 2009.
Egypt, Arab Rep.	2001 onwards: Limited private sector participation in generation, otherwise no privatization
India - Andhra Pradesh	1999: State electricity board unbundled in generation, transmission, and four distribution companies; no privatization.
India – Odisha	1996: Unbundling into two generation and one T&D entities; establishment of regulatory commission (but with little political independence); 1999: Privatization of four distribution companies; 2001: One of the discoms walked out of the contract; 2015: Revocation of license of the private operator of remaining three discoms.
India – Rajasthan	2000: Unbundling of Rajasthan State Electricity Board; No privatization.
Kenya	1995: Tendering initiated for the first two IPPs; 1997: Partial vertical unbundling (Generation – KenGen - separated from KPLC); 2008: KETRACO; 2006: KenGen 30% stocks IPO.
Morocco	Partial unbundling: generation opened to IPPs and distribution utilities largely privatized, although the state-owned transmission and system operation company—ONE—still remained in parts of generation and distribution, and also continued to be the single buyer of electricity.
Pakistan	1992-1998: Unbundling of the Water and Power Development Authority into 12 state owned entities (3 GENCOs, 1 transmission and dispatch, and 8 DISCOs); later 1 more GENCO and 2 DISCOs created; 1994: Generation opened up to IPPs; 2005: Privatization of one of the distribution utilities (KESCO).
Peru	1993: Electricity regulatory framework;; 1994-97: Vertical and horizontal unbundling and privatization of the power sector; by 1997, ~70 percent of generation, 100 percent of transmission and 45 percent of distribution was transferred to private ownership; creation of a power market and system operator; adoption of a 4-year distribution tariff setting methodology; 2003/4 onwards: Reorganization of system operator; Reform in generation and transmission planning and regulation; Improvements in the administration of the electricity market; Regular auctions for generation supply
Philippines	Unbundling and partial privatization.
Senegal	IPPs in generation; failed attempts to privatize vertically integrated state-owned utility SENELEC.
Tajikistan	No substantial institutional reform; state-owned vertically integrated utility.
Tanzania	Vertically integrated state-owned utility; IPPs in generation; 2002-2006: Private Management Contract for the utility, discontinued afterwards.
Uganda	2001: Vertical unbundling of utility; 2003: Private concession for generation company (Eskom); 2005: Private concession for distribution company (Umeme); 2012: Umeme listed on the Uganda Stocks Exchange.
Ukraine	1995: Vertical and horizontal unbundling; 1996: Wholesale electricity market created; 1998: Beginning of privatization of some distribution and supply companies.
Vietnam	Partially unbundled utility – most of generation and nearly all of transmission and distribution under a national holding company (EVN), which is also the single buyer of electricity; IPP participation in generation (~39% of generation capacity in 2015).

Source: World Bank Staff.

60. In line with the Standard Model, the analysis finds that countries with private-sector participation in distribution are more likely to have achieved cost recovery. Indeed, the country case studies show a distinct trend of cases with private sector participation in distribution companies achieving higher full-cost recovery levels and being responsible for almost all of the net improvement since the pre-reform period (see Figure 16a-b).

Figure 16: Utility Ownership and Cost Recovery



Notes: 'Mixed' refers to the presence of both privately and publicly owned distribution companies in the country/state. *Source:* World Bank staff.

61. This quantitative finding is borne out by the qualitative evidence, which suggests several underlying mechanisms including improved efficiency and commercialization (and thus depoliticization) of the power sector. Colombia's privatization of utilities resulted in lower losses, higher collections, and full financial cost recovery for CODENSA (one of the privatized utilities). In Uganda, the private sector participation in UMEME under a concession contract brought immediate results as collections rose and distribution losses declined, improving cost recovery. The concession also guaranteed the investor 14 percent ROR, so the government increased tariffs to reflect costs. The impact of utility governance reforms on cost-recovery is robust also when looking at broader indicators of sector-wide private-sector participation and comprehensive indicators of utility governance (see Figure 17a-b). This is in line with the (still relatively limited) empirical literature on the impact of power sector reforms on utility finances, which finds correlations between independent regulators, vertical unbundling, competition, and private sector participation on the one side and tariffs and cost recovery on the other (Huenteler et al., 2017).

Figure 17: Reform Indicators on Utility Governance and Decision-making and Full-Cost Recovery

Notes: *The Philippines saw a decline in cost recovery, but post-reform cost recovery was still close to 100 percent on average. *Source:* World Bank staff.

62. However, privatization as a stand-alone measure is not always a successful strategy for improving utility performance, as was the case in Odisha and the Dominican Republic, where all privatized utilities had their licenses revoked for nonperformance.[13] In Odisha, the Regulator revoked WESCO's distribution

[13] It also has to be noted that some level of operational or limited capital cost recovery may be necessary to attract private sector participation. In many developing countries the performance of the vertically integrated state-owned enterprise is so poor that it would be hard to attract bids for the entire utility, so unbundling or improving performance would be a prerequisite

license (along with those of 3 other distribution companies owned by Reliance Infrastructure Ltd.) 15 years after privatization because of the utilities' poor financial health, failure to reduce distribution losses, continued high rates of electricity theft, and failure to run the organization in a financially viable manner. This suggests that private-sector participation is not a panacea by itself but needs to be complemented by sector-wide reforms that allow the privately-owned utilities to operate on a commercial basis. Performance contracts can also make a large impact on cost recovery if they set the right incentives and can be enforced. The performance contracts between SENELEC and the Government of Senegal incentivize cost reduction, resulting in a 48 percent reduction in total costs and a 31 percent increase in full cost recovery under the first performance contract (2013-2015). The operator retains the difference between revenues based on projected and actual costs. The performance contract also includes rewards and penalties based on indicators evaluated by an external auditor.

63. Furthermore, several countries managed to improve cost recovery over time without major private sector participation. The same is true for reforms in utility governance (see Figure 17c-d). Egypt, which has nine public distribution companies under the Egyptian Electricity Holding Company, put a tariff reform program into effect in 2014, resulting in a 30 percent increase in average tariffs that year. Andhra Pradesh has state-owned distribution companies and has made substantial improvements in the sector. Small tariff increases (typically 4-6 percent) occurred in every year 2011-2015 in addition to automatic adjustments for fuel, power purchase, and procurement price surcharge, with a larger increase of 15 percent in 2013/2014 when the government was unable to increase subsidies to distribution companies. The tariff increases resulted in an 8 percent increase in cost recovery during those years.

#9: Economy-wide governance quality and purchasing power are important boundary conditions that enable better performance on cost recovery

64. The last determinant of cost recovery investigated in this analysis is sector-external boundary conditions, which were not explicitly taken into account in the Standard Model.

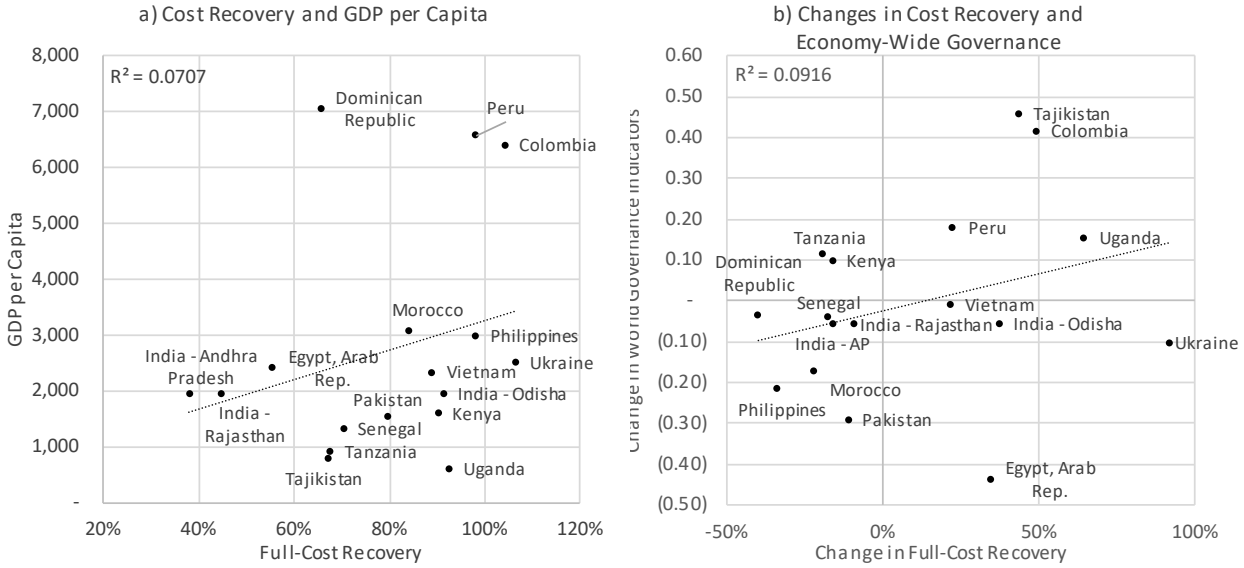
65. Despite their absence from the original reform thinking, the present analysis suggests that consumers' purchasing power and economy-wide governance institutions are important predictors of full-cost recovery levels. Specifically, as can be seen in Figure 18a, GDP per capita is a better indicator for cost recovery levels than many indicators of power sector reform (see Figure 18b). Similarly, improvements in economy-wide governance quality since the 1990s is a better predictor of improvements in cost recovery than most of the reform indicators, especially those related to price formation (see Figure 18b; c.f., Figure 14 and Figure 17). This suggests that power sector reforms have a higher chance of achieving improved outcomes if they take these factors into account.

66. Stable government and political buy-in are also critical to pushing through difficult subsidy reforms. Egypt's regulator is currently implementing tariff reforms that will lift subsidies and raise tariffs to cost recovery level by June 2019. The five-year program had a planned tariff increase of 78 percent and

for privatization. There are efficient, fully integrated, private sector electricity companies but there is limited experience with this model in developing countries.

was applied as proposed through 2016 (the last year of our data set), with the exception of increases for the first three residential blocks, to protect vulnerable consumers. There has been less government buy-in on reforms in Kenya, where tariffs planned by the Regulator have been delayed three times in the past five years, due to the insistence of the government. In 2013, the government chose to provide a subsidy to the distribution utility (KPLC) instead of allowing an increase in connection charges.

Figure 18: Economy-wide Factors and Cost Recovery



Source: World Bank staff.

#10: Full-cost recovery is less strongly associated with investment levels and improvements in sector outcomes than financial cost recovery

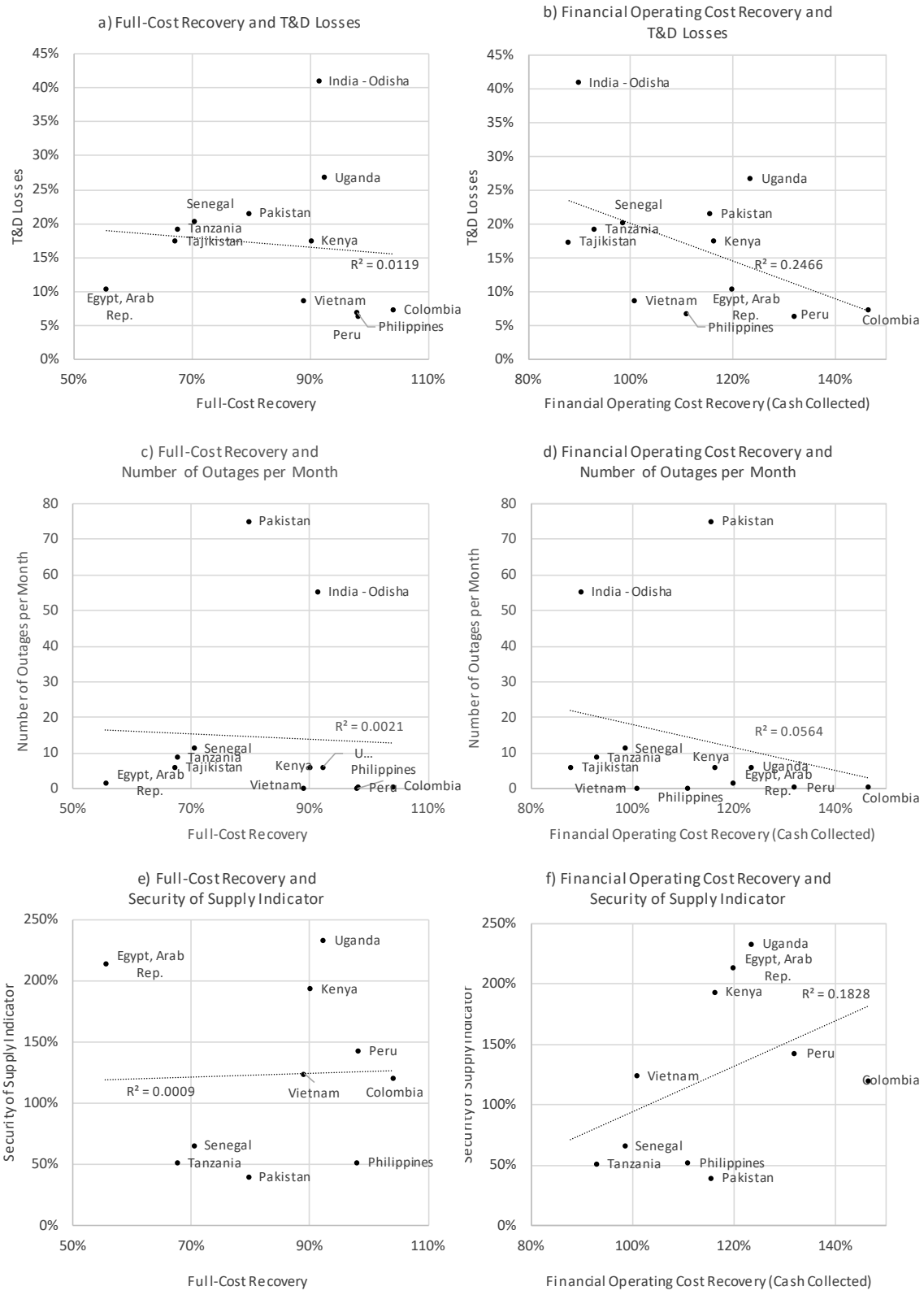
67. The last part of the analysis focuses on the original objectives of cost-recovery reforms: Attracting investment to meet growing demand and improving service outcomes.

68. In contrast to the Standard Model's logic, the analysis of the 17 case studies finds a much stronger link between sector outcomes and the most basic indicator of utilities' cost recovery—financial operating cost recovery (A1) adjusted for bill collection losses—than full-cost recovery and sector outcomes. This is true for all three major indicators of sector outcomes analyzed for this study: (a) Transmission and distribution losses (Figure 19a-b), the number of outages per month (Figure 19c-d), and an indicator of the country's or state's ability to meet growing demand (Figure 19e-f). This suggests that financial viability of power utilities should be elevated as a reform objective by itself—as opposed to a side-effect of cost recovery reforms—particularly in power sectors that (i) are going through periods of high investment needs, e.g., to meet demand growth or expand access to electricity service; (ii) are facing issues in efficiency and quality of service; or (iii) are situated in economies with low consumer purchasing power and low overall governance quality, where full-cost recovery is inherently harder to achieve (see discussion of boundary conditions under Observation #9).

69. This observation is further corroborated when looking at the Standard Model's underlying logic. The link between cost recovery and sector outcomes assumed that cost recovery would attract investment. However, the cases suggest that there is no clear trend between investment levels (as a percent of revenues) and cost recovery. Figure 20a shows for example that Tanzania is able to invest at high levels despite low cost recovery and Odisha is investing at relatively low levels compared to other jurisdictions at similar levels of cost recovery (Vietnam, Senegal, Uganda, and Kenya). Tanzania maintains its high levels of investment through government grants (totaling USD 833 million or 48 percent of investments in 2016), in addition to loans which it does not always pay and therefore become pseudo-grants. Odisha's low levels of investment (14 percent of revenues for CESCO and 1 percent for WESCO in 2015) are attributed to the utilities being loss-making each year.

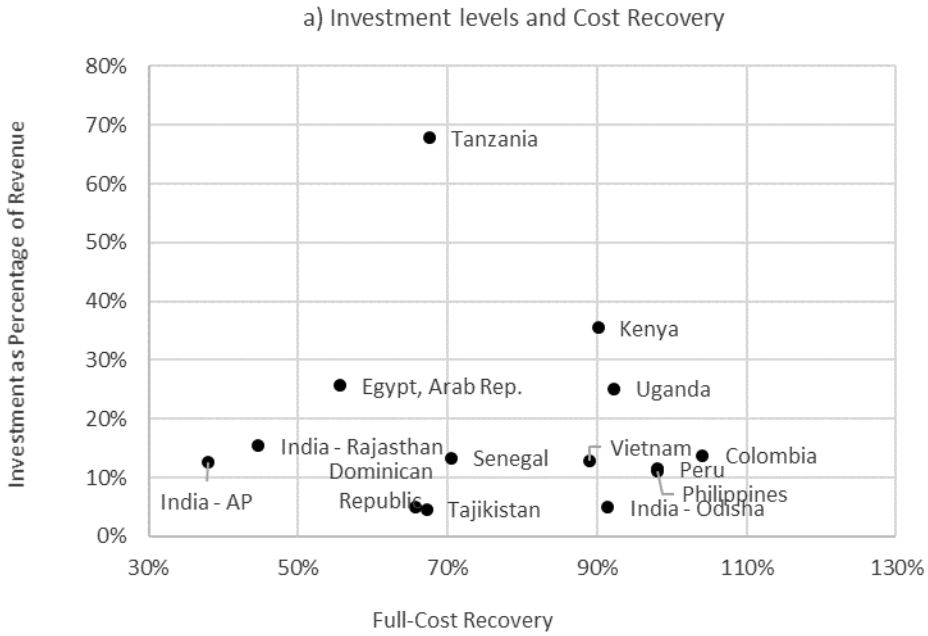
70. In line with the above, the qualitative evidence suggests that countries that have mobilized large investment amounts in recent years --- Tanzania, Uganda, and Kenya --- have done so through public investment that was mobilized despite under-recovery of costs. In line with this observation, full-cost recovery levels appear largely unrelated to progress in electrification (as shown through no significant correlation between these variables in the jurisdictions studied), indicating a strong role for public investment (see Figure 20b).

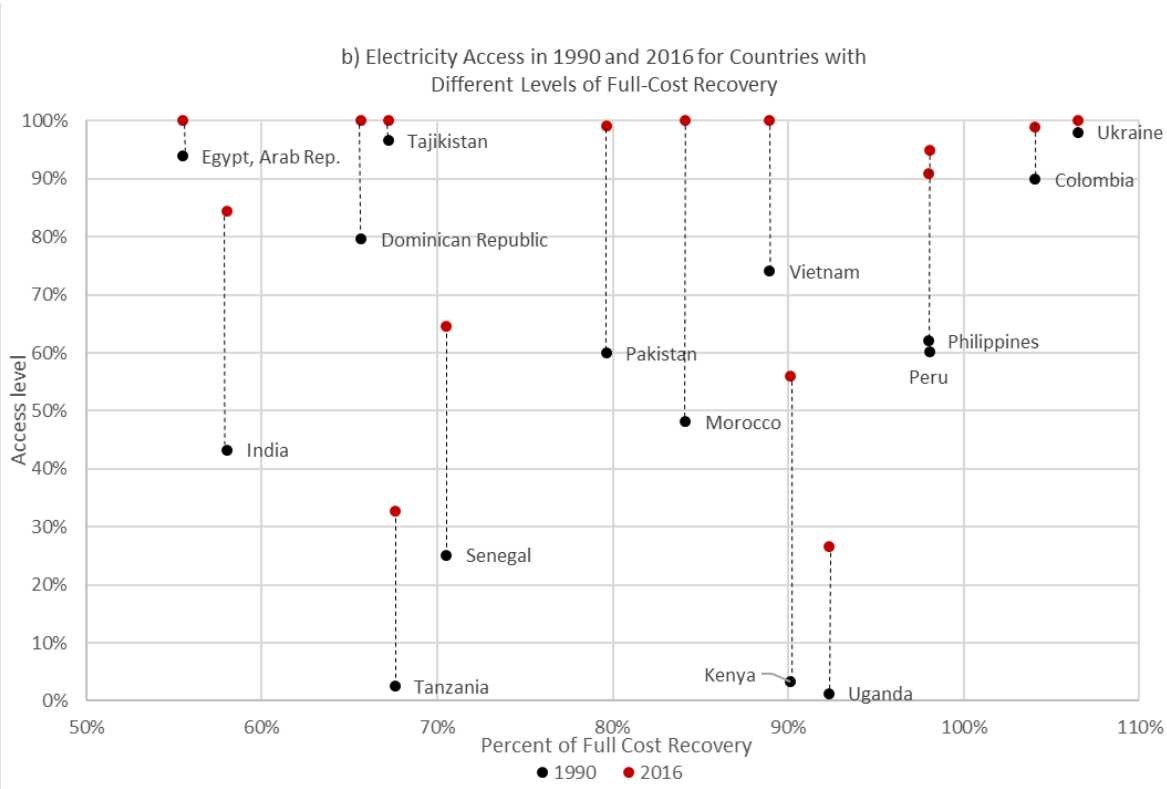
Figure 19: Relationship between Outcomes and Full-Cost Recovery and Financial Operating Cost Recovery



Note: Graphics only show subset of cases for which data is available. *Source:* World Bank staff.

Figure 20: Full-Cost Recovery and (a) Investment Levels and (b) Progress in Electrification





Source: World Bank staff.

5. Conclusion: Rethinking Cost-Recovery Reforms to Improve Sector Outcomes

71. Cost recovery was and remains closely linked to broader normative conceptions about power sector reform since the debate emerged in the 1980s and 1990s (the 'Standard Model'). This paper took a critical look at those elements of the 'Standard Model' that tackled the issue of cost recovery and utility financial viability. It analyzed case studies from 17 jurisdictions to understand the progress of cost-recovery reforms, what factors have contributed to the success or failure in achieving cost recovery, and what impacts the level of cost recovery has on the sector. With regard to the Standard Model's three underlying hypotheses relating to cost recovery, the findings of the analysis are as follows:

- Little evidence supports the Standard Model's original hypothesis on regulatory agencies as a key means to improve cost recovery (not enough cases had liberalized retail markets to be able to assess the hypothesis on competitive markets). Jurisdictions with capable and autonomous regulators were found to be neither more likely to (a) have achieved cost recovery during 2010-17 nor to (b) have improved their cost recovery levels compared to the pre-reform period. This does not mean that regulation per se is irrelevant for cost recovery; on the contrary, we find that de-facto implementation of tariff regulation is correlated with cost recovery levels. Rather, the conclusion is that the institutional structures for tariff regulation—whether or not it is done by a separate agency or if that agency is institutionally independent from the rest of the government's sector administration—matters much less for cost recovery than if the technical framework of tariff regulation is implemented in practice. The qualitative evidence suggests that price setting improved over time and was insulated from day-to-day political pressures even in the absence of fully autonomous regulatory agencies—and vice versa—depending on wider economy-wide institutions.

- Strong evidence was found in support of the Standard Model's original hypothesis on utility governance and decision-making as a key means to improve cost recovery. Jurisdictions with more private sector participation in distribution or reformed SOE governance and decision-making were found to be more likely to (a) have achieved cost recovery during 2010-17 and (b) have improved their cost recovery levels compared to the pre-reform period. However, the opposite is true for cases that attempted private-sector participation in distribution but reversed the reforms later. This suggests that private-sector participation is not a panacea by itself but needs to be complemented by sector-wide reforms that allow the privately-owned utilities to operate on a commercial basis.

- Solid evidence was found that financial viability of utilities is associated with better sector outcomes (including efficiency, security of supply and quality of service). However, the same cannot be said of full-cost recovery tariffs, which were the focus of the Standard Model's original hypothesis.

- Lastly, the cases provide evidence that full-cost recovery is generally more likely in countries with higher purchasing power and better overall governance quality, and power

sector reforms have a higher chance of achieving improved outcomes if they take these factors into account.

72. The findings from the analysis are summarized in a revised framework for thinking about cost recovery reforms (see Figure 21), which is built around four main hypotheses:

- **Price formation:** Full-cost recovery is more likely when price setting is technically sound and insulated from day-to-day political pressures, but this can be achieved by different institutional arrangements (e.g., competitive markets, independent regulators or regulation by contract), depending on wider economy-wide institutions.

- **Utility governance & decision-making:** Full-cost recovery is most likely in countries with privately-owned utilities and more likely in countries with corporatized SOEs than in cases where the utility remained part of the administrative structure of the government, if the reforms are followed-through and complemented with sector-wide reforms.

- **Outcomes:** Better sector outcomes are likely in countries with financially viable utilities, but this can be achieved even in the absence of full-cost recovery tariffs, through various forms of public support, including public investment, if resource allocation is well governed and financing is transparent and predictable.

- **Boundary conditions:** Full-cost recovery is generally more likely in countries with higher purchasing power and better overall governance quality, and power sector reforms have a higher chance of achieving improved outcomes if they take these factors into account.

73. Besides the modifications to the overall conceptual framework, the analysis has four immediate, practical implications for the understanding of cost-recovery as part of the overall power sector reform agenda:

- **First, focusing on financial viability *and* cost recovery as separate policy objectives ('back to basics').** Full-cost recovery remains critically important to relieve the pressure on government budgets and free up fiscal space for investments in human capital and other government priorities. However, the findings presented in this paper suggest that financial viability of power utilities should be elevated as a reform objective by itself—as opposed to a side-effect of cost recovery reforms. The case studies suggest that financial viability of utilities becomes particularly important in the power sectors that (i) are going through periods of high investment needs, e.g., to meet demand growth or expand access to electricity service; (ii) are facing issues in efficiency and quality of service; or (iii) are situated in economies with low consumer purchasing power and low overall governance quality, where full-cost recovery is inherently harder to achieve (see discussion of boundary conditions below).

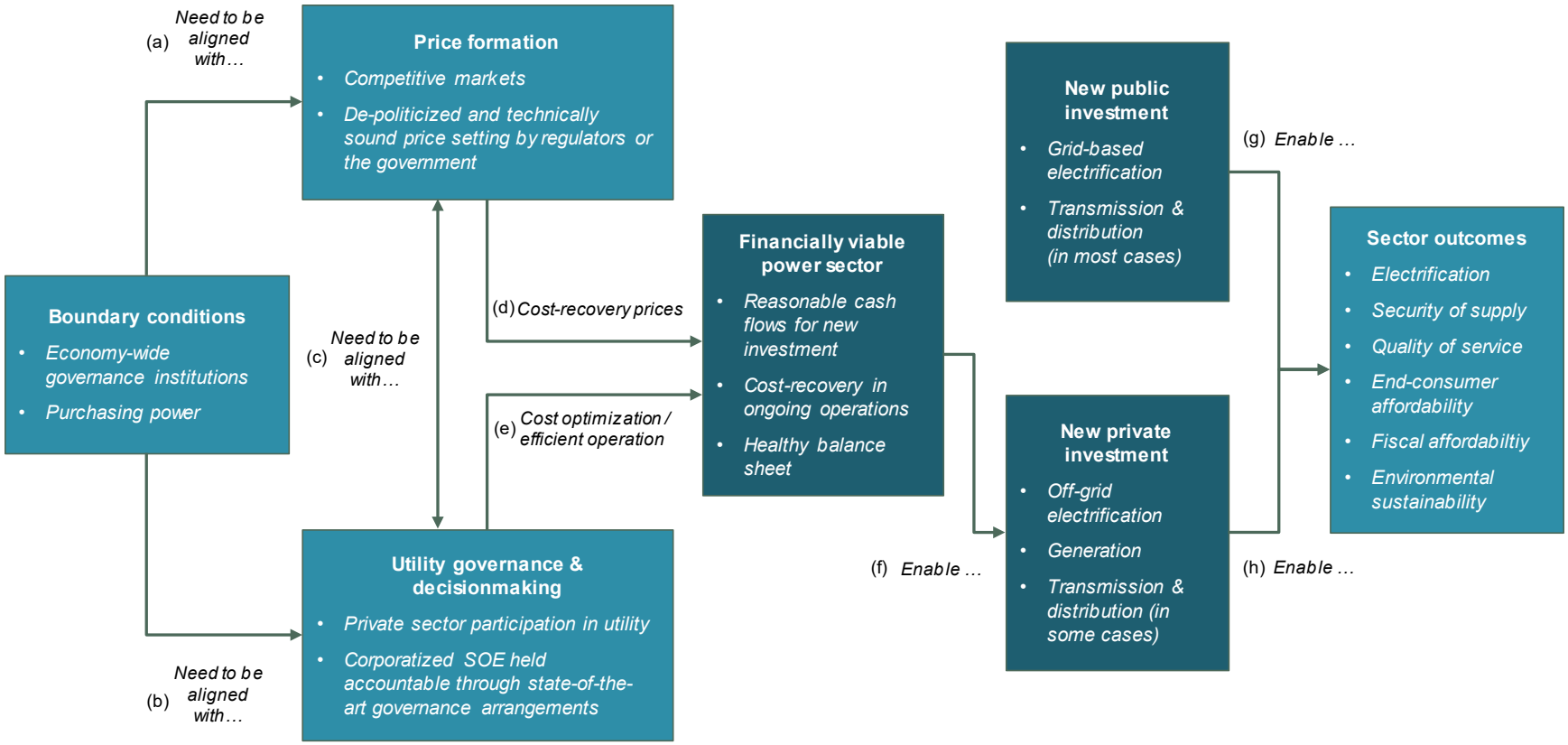
- **Second, addressing cost recovery comprehensively by making cost reductions, efficiency improvements and service quality integral parts of reform programs to improve financial**

viability and cost recovery. This conclusion is based on three findings from the analysis. First, most of the analyzed cases that improved cost recovery levels compared to pre-reform levels did so by increasing tariffs and reducing costs compared to estimates of the incremental cost of supply. Second, a number of cases would come substantially closer to full-cost recovery if they improved bill collection and transmission and distribution losses to international benchmark levels. Third, the qualitative evidence from the cases suggests that tariff reforms are much more tenable to consumers if they are accompanied by improvements in service quality.

- **Third, de-emphasizing independent regulators as a means to de-politicize price formation.** The qualitative evidence suggests that technically sound and depoliticized price setting enable higher cost recovery levels, but that capable and autonomous regulatory institutions by themselves do not have a measurable impact on cost recovery. This suggests that countries should aim to liberalize price formation as far as possible—acknowledging that this process takes time—rather than ending reforms to price formation in the sector with the establishment of the regulator. As pointed out above, such reforms have to be pursued while taking into account the wider economic and institutional context and taking into consideration the limits to poor consumers' ability to afford liberalized power prices.

- **Fourth, making targeted use of tariff structures to protect the poor and vulnerable but limiting cross-subsidies to avoid negative impacts on cost recovery**. Higher purchasing power makes electricity tariffs more affordable to consumers and tariff reforms thus more tenable, and the evidence presented in this paper confirms that full-cost recovery tends to be higher in countries with higher GDP per capita. Developing countries are therefore by definition at a disadvantage when it comes to cost recovery reforms. The case studies suggest that tariff reforms remain the most contentious type of power sector reforms, because of its impact on the affordability of electricity to consumers. Two findings from this paper can help inform tariff reforms that strike a balance between affordability for consumers and fiscal affordability to the government. First, the analysis suggests that cross-subsidization can substantially improve affordability without negatively affecting overall cost recovery. Second, however, the analysis also suggests that cross-subsidization above a certain threshold—0.15 using the definition of a cross-subsidization indicator presented here—is harmful to government efforts to maintain cost recovery. Efforts to protect the poor and vulnerable through electricity tariff differentiation must therefore be well targeted and limited to the most affected groups. "Lifeline" or first block tariffs should also be limited to basic consumption levels, when this mechanism is used to ensure affordability. A high lifeline threshold can disproportionately benefit wealthier households (which consume more energy), thus making the same impact on lower income households as a threshold set at their needs, but at a much higher cost to the utility.

Figure 21: Revised Framework to Inform Reforms on the Financial Viability of Power Sectors



Source: World Bank Staff.

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Annex 1: Major Studies of Cost Recovery and Financial Viability in the Power Sector in Developing Countries

Table 7: Overview of Studies and Findings

#	Study	Coverage	Time	Main KPIs	Main findings	Observed trends
1	The World Bank (1972)	Argentina, Brazil, Colombia, Ethiopia, Ghana, Malaysia, Mexico, Singapore	1955-1970	Rate of return on assets (based on utility financial statements)	All 10 analyzed utilities were profitable during the observation period, with return on assets mostly in the 8-9% range	Significant improvements in 1960s
2	Munasinghe, Gilling, and Mason (1989)	Recipient utilities of 123 World Bank power projects worldwide	1966-1984	Four financial ratios (based on utility financial statements)	Average rate of return for the period 1966-85 was 7.9	Distinct deterioration In the trend of utilities' financial ratios for the period 1973-1985
3	The World Bank (1990)	60 developing countries worldwide, comparison to OECD	1979-1988, with LRMC for 1990s	Comparison of existing tariffs to LMRC with shadow prices	Tariffs on (weighted) average sufficient to recover 62% of LRMC; average tariff level 55% of the average level in OECD countries	Real average tariffs constant in 1979-1983, then fell sharply until 1988
4	IEA (1999)	China, Russian Federation, India, Indonesia, Islamic Republic of Iran, South Africa, Venezuela RB, Kazakhstan	1998	Price gap between tariffs and reference price (LRMC based on current fuel mix)	Cost recovery ratio ranged between 37% (Venezuela) and >100% (Indonesia); average: 62.3%	n.a.
5	Foster and Yepes (2006)	83 OECD and non-OECD countries worldwide	1994-2002	Average tariff compared to global benchmark values	15% of countries did not cover O&M costs, 59% did not cover total cost; strong correlation with income per capita	Slight real increase in tariffs in some regions but no significant trend across sample
6	Ebinger (2006)	20 countries in Eastern Europe and Central Asia	2000-2003	Disaggregated quasi-fiscal deficit: T&D Losses, collection losses, underpricing	QFD between 0.00% (Belarus) and 16.53% (Tajikistan) in 2003; mostly driven by underpricing (67%)	Decline in the QFD in 17 out of 20 countries between 2000 and 2003, by 48% (from $30B to $16B overall.
7	Saavalainen and ten Berge (2006)	8 countries in Eastern Europe and Central Asia	2002	Disaggregated quasi-fiscal deficit: T&D Losses, Collection losses, Underpricing	Cost recovery between 11.21% and 81.6%; QFD between 1.1% and 21.4% of GDP	n.a.

#	Study	Coverage	Time	Main KPIs	Main findings	Observed trends
8	Eberhard et al. (2008)	21 Sub-Saharan African countries	2001–05	Average tariff revenues compared to average historical cost, LRMC	Despite comparatively high power prices only 57% of SSA countries recovered OPEXs; 36% recovered LRMC	Real tariffs almost doubled over the period 2001 to 2005, but cost recovery ratio declined
9	Briceño-Garmendia et al. (2008)	20 Sub-Saharan African countries	2006	Disaggregated quasi-fiscal deficit: T&D Losses, Collection losses, Underpricing	6 out of 20 countries recovered average historic costs; hidden costs of power mispricing amount to about 1% of GDP or 60% of total hidden costs	n.a.
10	Briceño-Garmendia and Shkaratan (2011)	27 Sub-Saharan African countries	2004-08 (latest available)	Average effective tariff and LRMC compared to OPEX (income statements) and CAPEX (LCOE benchmarks)	80% countries recovered OPEX; 30% also recovered CAPEX; 38% recovered LRMC	n.a.
11	Vagliasindi and Besant-Jones (2013)	19 developing countries worldwide + 3 Indian states	Late 1990s to late 2000s	Cost recovery index (average revenue divided by average supply cost)	Cost recovery index correlated with indices of competition and vertical unbundling	Tariffs increased over the period, but cost recovery fluctuated
12	Alleyne et al. (2013)	Large sample of Sub-Saharan African countries (unspecified)	2005-2009 (latest year available)	Disaggregated quasi-fiscal deficit: T&D Losses, Collection losses, Underpricing	Average tariffs were of 70% of cost. QFD was about 1.7 percent of 2009; half of which from underpricing	Average QFD constant at 1.7% of GDP between 2005-06 and 2009-10
13	Mayer, Banerjee, and Trimble (2015)	Residential electricity use in 29 states in India	2005, 2010	Average effective tariff (based on household surveys)	87% of residential consumption was subsidized in 2010; average cost recovery was 68%; 2 out of 29 states had effective tariffs > average cost	In real terms, the net cost of the average household subsidy in 2010 was 70 times larger than in 2005
14	Khurana and Banerjee (2013)	29 states in India	2003-2011	Comparison of average billed tariff was higher than AC	Cost recovery averaged 82% in 2003-2011; 7 states had tariffs below cost in 2003, 14 in 2011	Cost recovery fluctuated within a band of 76–85%; with a low point in 2010
15	Bella et al. (2015)	32 countries in Latin America	2011-13 (average)	Price-gap approach Pre-tax subsidies (% of GDP)	Electricity subsidies in LAC were almost as large as direct fuel subsidies, on average 0.8% of GDP in 2011–13	n.a.

#	Study	Coverage	Time	Main KPIs	Main findings	Observed trends
16	IEA (2015)	40 non-OECD countries worldwide	2012-2014	Price gap approach (based on average cost of production)	All but four countries subsidize electricity (excl. renewable energy subsidies)	Decline in total subsidies by 10.4% in 2012-2014, 5 additional countries reached cost recovery
17	Trimble et al. (2016)	39 countries in Sub-Saharan Africa	2011-2015	Disaggregated quasi-fiscal deficit: Collection losses; T&D losses; over staffing; underpricing	Average cash collected 57% was of cost. 2 countries have a financially viable electricity sector; 19 countries cover OPEX; QFD average 1.5% of GDP	Most of the countries with low QFDs improved over past decade, while most of the countries with high QFDs remained high
18	The World Bank and IEG (2016)	Utilities in 40 developing countries worldwide	2003-2013	Utilities' profitability (based on utility financial statements)	10 out of 40 utilities were profitable; 2 out of 17 SSA utilities were profitable in 2000, 4 in 2013	Share of profitable utilities increased from 10% to 35% in 2010, then fell to 25% in 2013
19	Coady et al. (2015)	153 OECD and non-OECD economies worldwide	2013, 2015	Price-gap approach (reference price including consumption taxes; excl. renewable energy subsidies	79 out of 119 developing countries had electricity subsidies in 2015, compared to 1 out of 34 'advanced economies' (Taiwan, China)	Absolute decline of subsidies by 36.5%; numbers of countries with subsidies from 75% to 66%

Source: Huenteler et al. (2017).

Annex 2: Indicators of Cost Recovery and Financial Viability of Power Sectors and Utilities in 17 Case Studies

Table 8: Full-Cost Recovery for Power Sectors

			Full-Cost Recovery (C3 of approximate)[a]									
Country/State	**Type**	**Region**	**Pre-Reform**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average 2010-17**
Colombia	Private	LAC	55%	94%	109%	117%	103%	100%	105%	102%	n.a.	104%
Dominican Republic[b]	Public	LAC	106%	71%	65%	62%	65%	62%	73%	n.a.	n.a.	66%
Egypt, Arab Rep.	Public	MNA	21%	n.a.	62%	62%	68%	50%	49%	50%	n.a.	55%
India - Andhra Pradesh	Public	SAR	54%	n.a.	36%	36%	38%	37%	44%	n.a.	n.a.	38%
India - Odisha	Public	SAR	54%	n.a.	94%	92%	90%	92%	91%	n.a.	n.a.	91%
India - Rajasthan	Public	SAR	54%	n.a.	38%	41%	47%	43%	57%	n.a.	n.a.	45%
Kenya	Public	AFR	106%	99%	101%	94%	87%	89%	81%	80%	n.a.	90%
Morocco[c]	Public	MNA	107%	n.a.	n.a.	n.a.	84%	n.a.	n.a.	n.a.	n.a.	84%
Pakistan	Public	SAR	91%	n.a.	n.a.	n.a.	66%	75%	87%	97%	n.a.	80%
Peru	Public	LAC	76%	102%	102%	101%	98%	95%	97%	93%	n.a.	98%
Philippines	Public	EAP	132%	98%	99%	100%	96%	98%	99%	95%	n.a.	98%
Senegal	Public	AFR	88%	77%	68%	55%	66%	72%	86%	87%	n.a.	70%
Tajikistan	Public	ECA	24%	n.a.	n.a.	n.a.	52%	73%	83%	70%	n.a.	67%
Tanzania	Private	AFR	87%	n.a.	n.a.	60%	56%	n.a.	90%	71%	n.a.	68%
Uganda[c]	Private	AFR	28%	n.a.	n.a.	110%	96%	91%	85%	81%	n.a.	92%
Ukraine	Public	ECA	15%	n.a.	n.a.	107%	115%	110%	105%	103%	93%	106%
Vietnam	Private	EAP	67%	91%	86%	91%	88%	89%	89%	88%	n.a.	89%

Notes: *Excluding externalities. [b]Approximated by Edesur. [c]Approximated by full-financial cost recovery. *Source:* World Bank Staff.

Table 9: Full Financial Cost Recovery for Power Sectors

				Full Financial Cost Recovery (A3 of approximate)[a]								
Country/State	**Type**	**Region**	**Pre-Reform**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average 2010-17**
Colombia	Private	LAC	n.a.	94%	109%	117%	103%	100%	105%	102%	n.a.	104%
Dominican Republic[a]	Public	LAC	n.a.	71%	65%	62%	65%	62%	73%	n.a.	n.a.	66%
Egypt, Arab Rep.	Public	MNA	n.a.	n.a.	62%	62%	68%	70%	65%	66%	n.a.	65%
India - Andhra Pradesh	Public	SAR	n.a.	n.a.	40%	41%	39%	39%	48%	n.a.	n.a.	41%
India - Odisha	Public	SAR	n.a.	n.a.	94%	92%	90%	92%	91%	n.a.	n.a.	91%
India - Rajasthan	Public	SAR	n.a.	n.a.	40%	44%	51%	44%	59%	n.a.	n.a.	47%
Kenya	Public	AFR	n.a.	100%	101%	95%	88%	90%	83%	83%	n.a.	91%
Morocco	Public	MNA	n.a.	n.a.	n.a.	n.a.	84%	n.a.	n.a.	n.a.	n.a.	84%
Pakistan	Public	SAR	n.a.	n.a.	n.a.	n.a.	76%	89%	96%	104%	n.a.	90%
Peru	Public	LAC	n.a.	102%	102%	101%	98%	95%	97%	93%	n.a.	98%
Philippines	Public	EAP	n.a.	98%	99%	100%	96%	98%	99%	95%	n.a.	98%
Senegal	Public	AFR	n.a.	85%	97%	75%	86%	93%	97%	91%	n.a.	88%
Tajikistan	Public	ECA	n.a.	n.a.	n.a.	n.a.	101%	103%	108%	94%	n.a.	101%
Tanzania	Private	AFR	n.a.	n.a.	n.a.	73%	68%	n.a.	107%	83%	n.a.	81%
Uganda	Private	AFR	n.a.	n.a.	n.a.	114%	105%	100%	94%	88%	n.a.	100%
Ukraine	Public	ECA	n.a.	n.a.	n.a.	107%	115%	110%	105%	103%	93%	106%
Vietnam	Private	EAP	n.a.	92%	87%	93%	89%	91%	90%	89%	n.a.	90%

Notes: [a]Approximated by Edesur. *Source:* World Bank Staff.

Table 10: Financial Operating Cost Recovery for Power Sectors (based on Cash Collected)

			Financial Operating-Cost Recovery (A1 of approximate), Adjusted for Bill Collection Losses									
Country/State	**Type**	**Region**	**Pre-Reform**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average 2010-17**
Colombia	Private	LAC	n.a.	130%	162%	152%	149%	146%	145%	139%	n.a.	147%
Dominican Republic[a]	Public	LAC	n.a.	67%	62%	58%	61%	59%	71%	n.a.	n.a.	62%
Egypt, Arab Rep.	Public	MNA	n.a.	n.a.	143%	125%	100%	103%	128%	119%	n.a.	120%
India - Andhra Pradesh	Public	SAR	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
India – Odisha	Public	SAR	n.a.	n.a.	88%	88%	89%	92%	92%	n.a.	n.a.	90%
India – Rajasthan	Public	SAR	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Kenya	Public	AFR	n.a.	112%	114%	115%	113%	115%	123%	124%	n.a.	116%
Morocco	Public	MNA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Pakistan	Public	SAR	n.a.	n.a.	n.a.	n.a.	90%	113%	124%	144%	n.a.	116%
Peru	Public	LAC	n.a.	137%	135%	132%	129%	130%	130%	131%	n.a.	132%
Philippines	Public	EAP	n.a.	108%	107%	110%	110%	115%	115%	115%	n.a.	111%
Senegal	Public	AFR	n.a.	89%	105%	93%	97%	105%	104%	102%	n.a.	99%
Tajikistan	Public	ECA	n.a.	n.a.	n.a.	n.a.	68%	84%	108%	98%	n.a.	88%
Tanzania	Private	AFR	n.a.	n.a.	n.a.	81%	87%	n.a.	120%	88%	n.a.	93%
Uganda[c]	Private	AFR	n.a.	n.a.	n.a.	117%	129%	124%	119%	129%	n.a.	123%
Ukraine	Public	ECA	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Vietnam	Private	EAP	n.a.	99%	98%	104%	102%	101%	102%	100%	n.a.	101%

Notes: [a]Approximated by Edesur. *Source:* World Bank Staff.

Table 11: Full-Cost Recovery for Power Utilities

		Full-Cost Recovery (C3 of approximate)[a]								
Power utility	**Type**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average 2010-17**
Colombia (Codensa)	Private	94%	109%	117%	103%	100%	105%	102%	n.a.	104%
Dominican Republic (Edesur)	Public	71%	65%	62%	65%	62%	73%	n.a.	n.a.	66%
Egypt, Arab Rep. (EEHC)	Public	n.a.	62%	62%	68%	50%	49%	50%	n.a.	55%
India - Andhra Pradesh (APEPDCL)	Public	n.a.	35%	35%	34%	36%	44%	n.a.	n.a.	36%
India - Andhra Pradesh (APSPDCL)	Public	n.a.	42%	35%	48%	42%	44%	n.a.	n.a.	42%
India - Odisha (CESCO)	Public	n.a.	94%	97%	94%	94%	94%	n.a.	n.a.	95%
India - Odisha (WESCO)	Public	n.a.	94%	87%	86%	90%	87%	n.a.	n.a.	89%
India - Rajasthan (AVVN)	Public	n.a.	37%	37%	46%	32%	56%	n.a.	n.a.	40%
India - Rajasthan (JDVVN)	Public	n.a.	34%	43%	49%	56%	64%	n.a.	n.a.	48%
India - Rajasthan (JVVN)	Public	n.a.	57%	53%	57%	53%	61%	n.a.	n.a.	56%
Kenya (KPLC)	Public	99%	101%	94%	87%	89%	81%	80%	n.a.	90%
Morocco (ONEE) [a]	Public	n.a.	n.a.	n.a.	84%	n.a.	n.a.	n.a.	n.a.	84%
Pakistan (KE)	Public	n.a.	n.a.	n.a.	76%	86%	90%	94%	n.a.	86%
Pakistan (LESCO)	Private	n.a.	n.a.	n.a.	53%	61%	71%	89%	n.a.	66%
Peru (Hidrandina)	Private	105%	107%	104%	100%	96%	101%	101%	n.a.	102%
Peru (Luz del Sur)	Public	91%	86%	91%	93%	90%	85%	74%	n.a.	87%
Philippines (Beneco)	Private	99%	100%	101%	98%	98%	100%	96%	n.a.	99%
Philippines (Meralco)	Private	96%	88%	88%	88%	88%	87%	88%	n.a.	89%
Senegal (SENELEC)	Public	77%	68%	55%	66%	72%	86%	87%	n.a.	70%
Tajikistan (Barki Tojik)	Public	n.a.	n.a.	n.a.	52%	73%	83%	70%	n.a.	67%
Tanzania (TANESCO)	Public	n.a.	n.a.	60%	56%	n.a.	108%	93%	n.a.	74%
Uganda (UMEME)	Private	n.a.	n.a.	110%	96%	91%	85%	81%	n.a.	92%
Ukraine (Khmelnytskoblenergo)	Mixed	n.a.	n.a.	107%	115%	110%	105%	103%	110%	109%
Vietnam (NPC)	Public	91%	86%	91%	88%	89%	89%	88%	n.a.	89%

Notes: *Excluding externalities. [b]Approximated by sector-wide cost recovery. *Source:* World Bank Staff.