KYRGYZ REPUBLIC

SELECTED ISSUES

July 2019

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KYRGYZ REPUBLIC

CONTENTS

FIGURES

TABLES

APPENDICES

CONSTRAINTS TO PRIVATE INVESTMENT AND ECONOMIC GROWTH IN THE KYRGYZ REPUBLIC[1]

This paper identifies constraints to economic growth in the Kyrgyz Republic, using the Hausmann-Velasco-Rodrik diagnostic approach[2]. It finds that large infrastructure gaps, weak governance and rule of law, and high cost of finance appear to be the most binding constraints to private investment and growth. Additional critical factors are the quality of education and onerous regulations.

A. Background

1.   **Private investment has been relatively low and the growth performance subpar, resulting in lower improvement in living standards than in peer countries** (Figure 1)**.** The Kyrgyz Republic has experienced economic transformation over the last two decades, as the economy has integrated regionally and with the rest of the world, and there is strong entrepreneurial spirit. There are numerous examples of successful "conglomerates" of micro and small companies in trade, textiles, services, tourism, construction and food production, which in aggregate would constitute medium to large players. While such micro and small companies are easy to set up, they remain informal and small to avoid onerous regulations and minimize interactions with the tax authorities. New formal business entry is a major challenge (especially to open a small formal business or to turn an informal micro/small business into a formal business to grow further, while opening an informal business is relatively easy), and private investment—at about 9 percent of GDP in 2015-17—is much lower in the Kyrgyz Republic compared to its peers in the Caucasus and Central Asia (CCA) or Emerging Market Developing Economies (EMDEs). While private investment ratios in the Kyrgyz Republic were only slightly below those in the CCA oil importers and EMDEs in 2000-10, they are now about half of those in EMDEs. Growth has averaged 4 percent over the last two decades, compared to 6.5 percent in other CCA countries and 5.3 percent in EMDEs. Income per capita has increased less than in comparator countries over the last two decades, and the income gap with emerging market countries has been increasing. At the forecast growth (3.8 percent on average over 2020-23), it would take 23 years for the Kyrgyz Republic ($1,268 GDP per capita) to reach middle-income GDP per capita levels ($2,370). With higher growth (4.8 percent) fueled by reforms to address growth constraints, the income gap would be 5 years shorter.

2.   **To understand why, the paper proceeds as follows.** The next section lays out the methodology for growth diagnostic developed by Hausmann, Velasco, and Rodrik (2005). The last section uses it to identify the most binding constraints in the Kyrgyz Republic.

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[1] Prepared by Iulia Ruxandra Teodoru, with research assistance of Jimmy Hatem.

[2] Hausmann, Ricardo, Dani Rodrik, and Andrés Velasco, *Growth Diagnostics,* John F. Kennedy School of Government, Harvard University (Cambridge, Massachusetts), 2005.

Figure 1. Private Investment and Business Climate

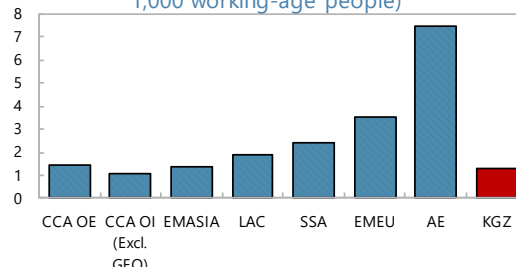*Income per capita has increased less than in comparators over the last two decades.*

Evolution of GDP per Capita
(Thousands USD)

- CCA Oil Importers
- CCA Oil Exporters
- EMDEs
- Kyrgyz Republic
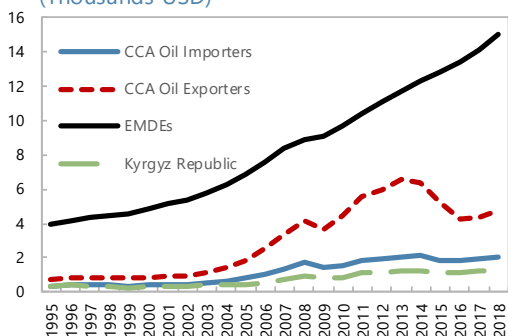
Source: United Nations and IMF staff calculations.

New business entry is a challenge.

Business Entry Density Rate
(Number of newly registered firms per 1,000 working-age people)

Source: World Bank Doing Business Report, and IMF staff calculations.
Note: Data correspond to most recent value within the period 2014–16. All CCA countries are 2016 values. OE= oil exporters, OI = oil importers.

Private investment is relatively low and declining...

Private Gross Fixed Capital Formation
(Percent of GDP, simple averages)

- 2000–10
- 2011–14
- 2015–18
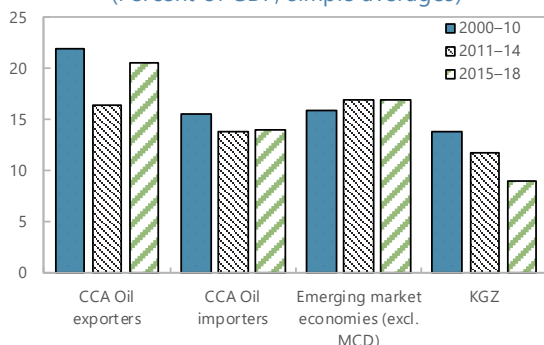
Sources: National authorities and IMF staff calculations.

... and its contribution to growth has shrunk.

Decomposition of Real GDP Growth
(Simple averages, percentage points)

- Private investment
- Other
- Real GDP growth (percent)
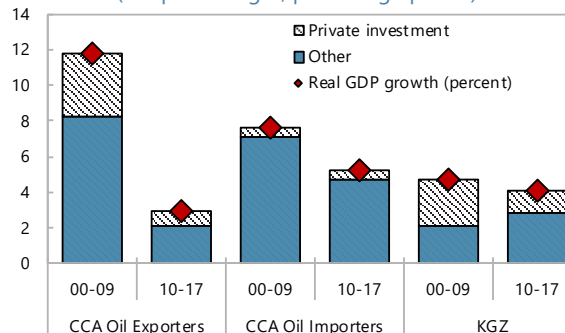
Sources: World Economic Outlook, and IMF staff calculations.

Contract enforcement, electricity, and tax administration are areas for improvement ...

Doing Business Ranking, 2019 1/
(1 = best, 190 = worst)

- KGZ
- CCA
- EMEU

Source: World Bank Doing Business Indicators, 2019

...as well as infrastructure quality, labor and product market efficiency, and access and cost of finance.

Global Competitiveness Ranking, 2018 1/
(1 = best, 140 = worst)

- KGZ
- CCA
- EMEU
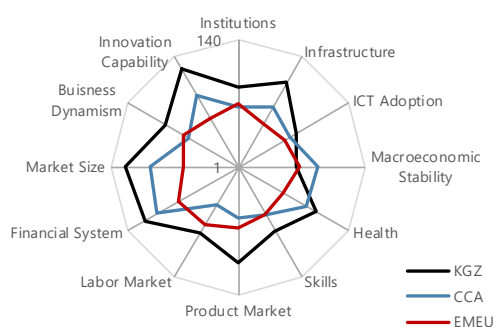
Source: WEF Global Competitiveness Indicators, 2018.

Note: Emerging Europe (EMEU), Emerging Asia (EMASIA), Sub-Saharan Africa (SSA), and Latin America and the Caribbean (LAC) country groupings use World Economic Outlook (WEO) definition. CCA Oil Importers include Armenia, Georgia, Kyrgyz Republic, and Tajikistan. CCA Oil Exporters include Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan.

1/ The World Bank Doing Business Indicators are survey-based indicators reflecting investors' perceptions on the business environment. The Global Competitiveness Index combines both official data and survey responses from business executives on several dimensions of competitiveness. As some indicators reflect perceptions, they should be interpreted with caution.

B.   Growth Diagnostic Methodology

3.   **Hausmann, Velasco, and Rodrik propose a decision tree methodology to identify the most binding growth constraints.** Their methodology identifies short-run constraints that inevitably emerge as an economy expands. The idea behind this strategy is that, since the full list of requisite reforms is unknowable or impractical, it is best to focus on the reforms that alleviate the most binding constraints and, hence, produce the biggest bang for the reform buck.

4.   **The decision tree presents a basic but powerful taxonomy** (Figure 2). In a low-income country, economic activity must be constrained by at least one of the following two factors: a high cost of finance, or a low private return to investment. If the problem is with low private returns, that in turn must be due either to low economic (social) returns or to a large gap between social and private returns (referred to as low private appropriability). If the problem is with a high cost of finance, it may be either due to absence of or high cost of international finance, or high local finance. The first step in the diagnostic analysis is to figure out which of these conditions more accurately characterizes the economy in question. With the help of cross-country comparisons, the remainder of the paper analyzes to what extent the constraints to growth highlighted by this decision tree are present in the Kyrgyz Republic.
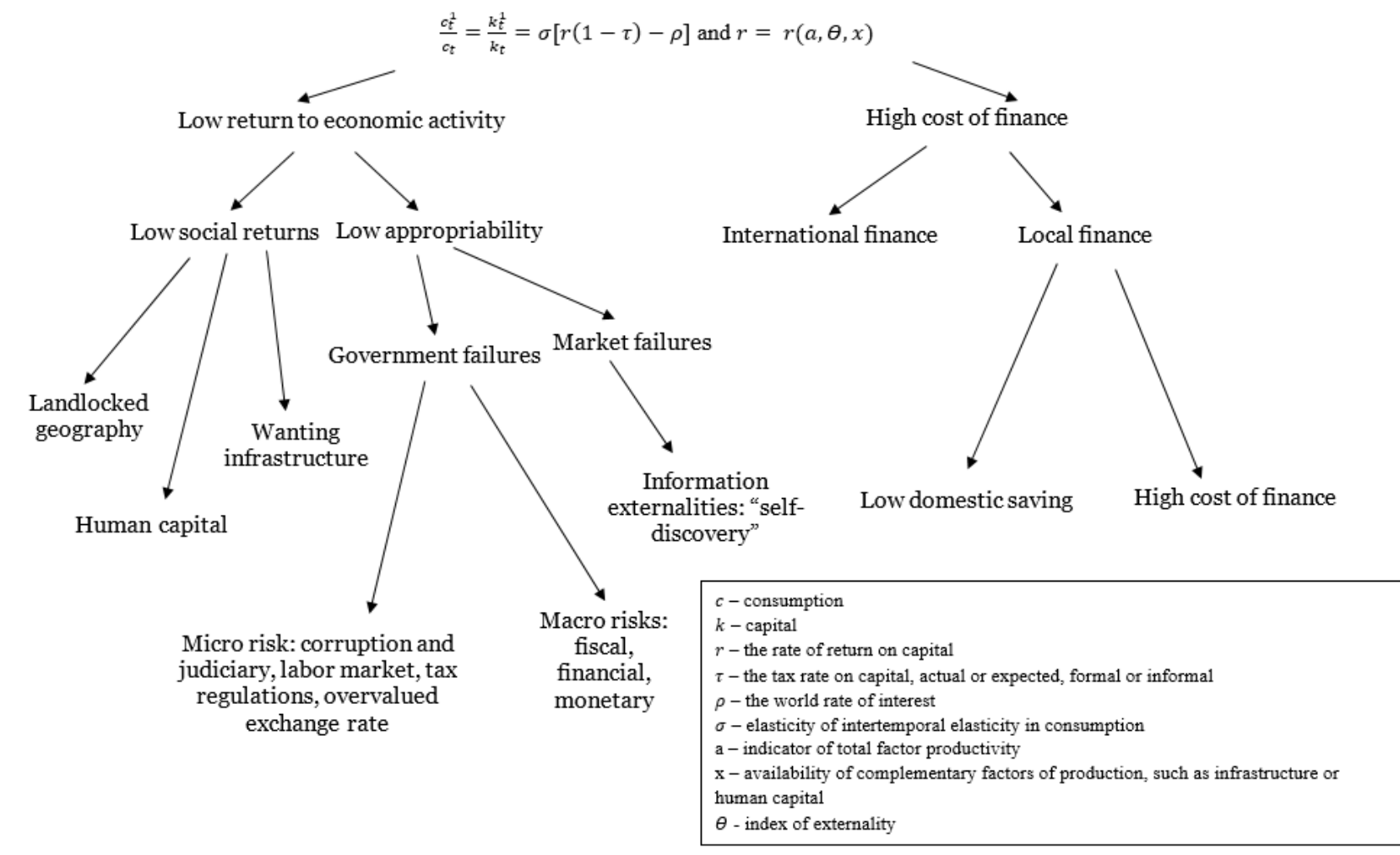
C.   Private Sector Growth Constraints in the Kyrgyz Republic

Human Capital and Labor Market

5.   **There is room to improve both the quality and cost/efficiency of education spending** (Figure 3, upper right chart). Average years of schooling is 12.5 years, comparable to Kazakhstan, Georgia, and upper middle-income countries, but low scores on The Trends in International Mathematics and Science Study (TIMSS) raise issues related to the quality of education. Thus, learning-adjusted years of school drop to only 8.4 years. The human capital index of the World Bank (measuring the productivity as a future worker of a child born today relative to the benchmark of full health and complete education) highlights that a child born in the Kyrgyz Republic today will be 58 percent as productive as she or he could have been if she or he received a full education and comprehensive health care (Figure 3, lower left figure). On the measure of human capital quality, the Kyrgyz Republic fares worse than some of its regional peers, but in line with upper middle-income countries. However, in terms of efficiency of education spending and the poor education outcomes (i.e., test scores), the Kyrgyz Republic is the farthest from the efficiency frontier in the CCA. Spending is skewed towards primary and secondary levels, while spending on tertiary education is disproportionly less. In addition, most spending is on wages (70 percent), while investment is very small. It is essential to improve predictability of the wage bill, avoid ad-hoc wage increases, better align pay to teachers' productivity or performance evaluations, and consolidate support staff (World Bank, Public Expenditure Review, Public Wage Bill and Education, 2014).

6.   **While relatively low, labor costs have exceeded productivity growth and there is room to improve labor market efficiency** (Figure 3). While wage levels are relatively low, wage growth has exceeded productivity growth in industry and services (National Statistical Committee). Since

Figure 2. Decision Tree of Growth Diagnostic Methodology

$$\frac{c_t^1}{c_t} = \frac{k_t^1}{k_t} = \sigma[r(1-\tau) - \rho] \text{ and } r = r(a,\theta,x)$$

Low return to economic activity

High cost of finance

Low social returns   Low appropriability

International finance   Local finance

Government failures   Market failures

Landlocked geography   Wanting infrastructure

Human capital

Information externalities: "self-discovery"

Low domestic saving   High cost of finance

Micro risk: corruption and judiciary, labor market, tax regulations, overvalued exchange rate

Macro risks: fiscal, financial, monetary

c – consumption
k – capital
r – the rate of return on capital
τ – the tax rate on capital, actual or expected, formal or informal
ρ – the world rate of interest
σ – elasticity of intertemporal elasticity in consumption
a – indicator of total factor productivity
x – availability of complementary factors of production, such as infrastructure or human capital
θ - index of externality

mid-2016, the real effective exchange rate has appreciated, reflecting the stability of the KGS vis-à-vis the U.S. dollar and its appreciation, vis-à-vis the ruble and tenge. Labor market inefficiencies are more pronounced in the areas of reliance on professional management, hiring and firing practices, redundancy costs, cooperation in labor-employer relations, and active labor policies (WEF, Global Competitiveness Index). Furthermore, women labor participation has become relatively low (IMF Country Report No. 18/53, Kyrgyz Republic, 4th and 5th ECF Review, Annex V).
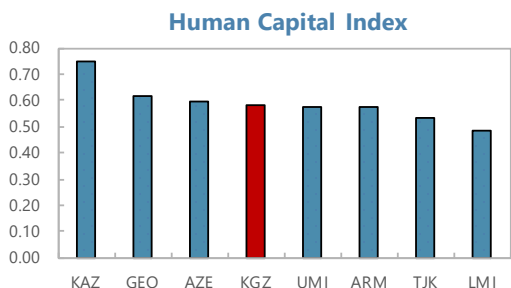
Infrastructure

7. **Despite important investments, the infrastructure gap remains large and the country ranks relatively low on infrastructure quality** (Figure 3, upper left chart). The country ranks lower than its regional peers in the World Economic Forum (WEF) Global Competitiveness Index in terms of roads, rail, and air infrastructure. Inferior quality of logistics and low efficiency of customs clearance, as well as poor timeliness and high costs of shipments are further obstacles for businesses. At the same time, 45 percent of generation capacity in the power sector is beyond its useful life and the lack of maintenance/rehabilitation has undermined reliability and increased risk of breakdowns (i.e. the Bishkek Heat and Power Plant failed in January 2018). Tariffs below cost have deterred private investment. While non-residential electricity tariffs are above cost recovery levels, residential tariffs (representing 53 percent of consumption) are 44 percent below cost recovery (Figure 5, lower right chart). Thus, the private sector is hurt by higher electricity costs and electrical outages (i.e. losses represent 4 percent of annual sales) than would have otherwise been the case if residential consumers shared the burden and if adequate investment was made to rehabilitate the energy sector and make it more efficient (World Bank, Systematic Country Diagnostic, 2018, and Energy Sector Analysis, 2017).

Figure 3. Infrastructure, Human Capital, and Labor Market

There is room to improve infrastructure quality...

... as well as the efficiency of education spending ...

Source: World Economic Forum, and IMF staff calculations.

Source: TIMSS and PISA evaluations, and IMF staff calculations.

The present education and health provision will only deliver 60 percent of potential labor productivity.

Nominal wages are relatively low but have grown relatively strongly in the past few years.

Figure 3. Infrastructure, Human Capital, and Labor Market (Concluded)

Human Capital Index

Source: World Bank, and IMF staff calculations.
Note: The HCI calculates the contributions of health and education to worker productivity. The final index score ranges from zero to one, and measures the productivity as a future worker of child born today relative to the benchmark of full health and complete education. UMI = Upper middle income, LMI = Lower middle income.
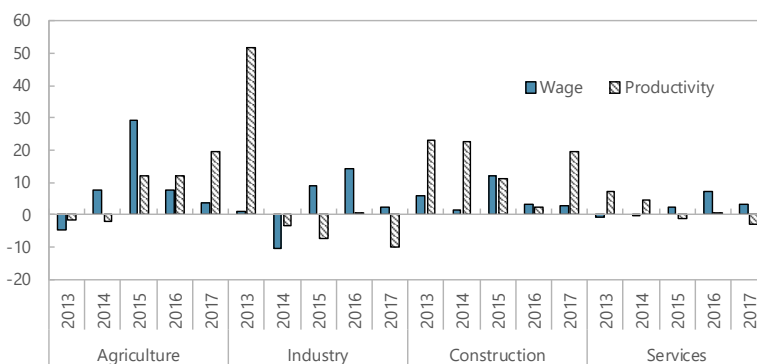
Monthly Nominal Wages and Real Wage Growth
(US$, 2017 and percent, local currency, average 2015-17)
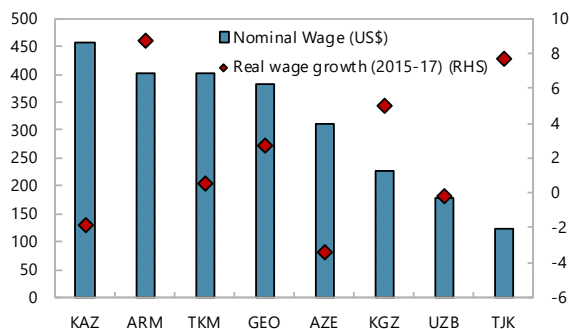
Source: ILO, and IMF staff calculations.

Wage growth exceeds productivity growth in industry and services...

Wage growth and productivity growth by sector, 2013-2017

Source: National Statistical Committee.

...and the real exchange rate has appreciated (+15 percent over the past three years).

Nominal and Real Effective Exchange Rate
(December 2009 = 100)
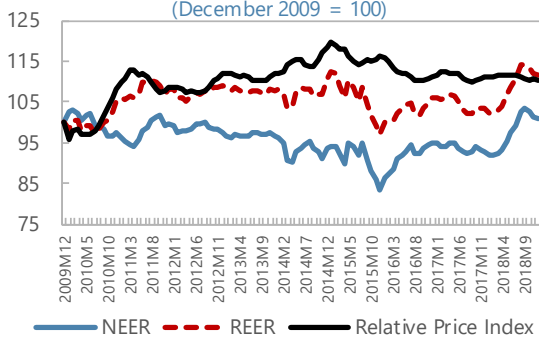
Source: WEO, and IMF staff calculations.

More efficient labor markets could be achieved through more reliance on professional management, more flexible hiring and firing practices, and active labor policies.

Labor Market Efficiency Ranking, 2018 1/
(1 = best, 140 = worst)
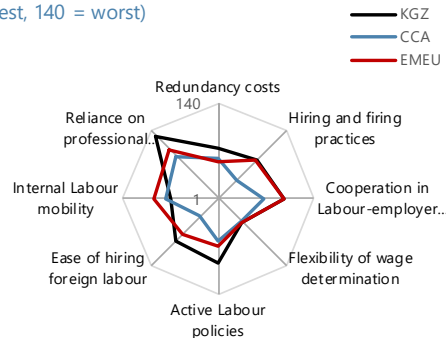
Source: WEF Global Competitiveness Indicators, 2018.

Note: 1/ The infrastructure quality and labor market efficiency indices are part of the Global Competitiveness Index, which combines both official data and survey responses from business executives on several dimensions of competitiveness. As some indicators reflect perceptions, they should be interpreted with caution.

Governance—Micro Risks

8.   **Weak governance undermines growth through various channels: investment, human capital, and productivity.** Weak institutions increase the cost of doing business and make the appropriation of investment returns less certain, overall reducing investor's risk appetite to invest. Poor governance subtracts from government credibility and acts as an impediment to revenue mobilization, hence inadequate provision of public goods such as health and education—most important for human capital. Mauro (1998) and Gupta, Davoodi, and Tiongson (2000) demonstrate that higher levels of corruption impacts negatively in the provision of health and education. Weak institutions affect productivity through different channels. First, they act as a barrier to entry, even bigger than taxes, regulations, or infrastructure (Campos, Estrin and Proto 2010). Second, firm-level evidence suggests that weak governance hinders employment growth and innovation (Aterido, Hallward-Driemeier and Pagés 2007; De Rosa, Gooroochurn, and Görg 2010),[3] lowering firms' overall efficiency (Dal Bo and Rossi, 2006).[4] Third, weak governance slows procurement and public investment execution or leads to uncompetitive tenders, with low quality infrastructure, constraining in turn the productivity of private inputs.
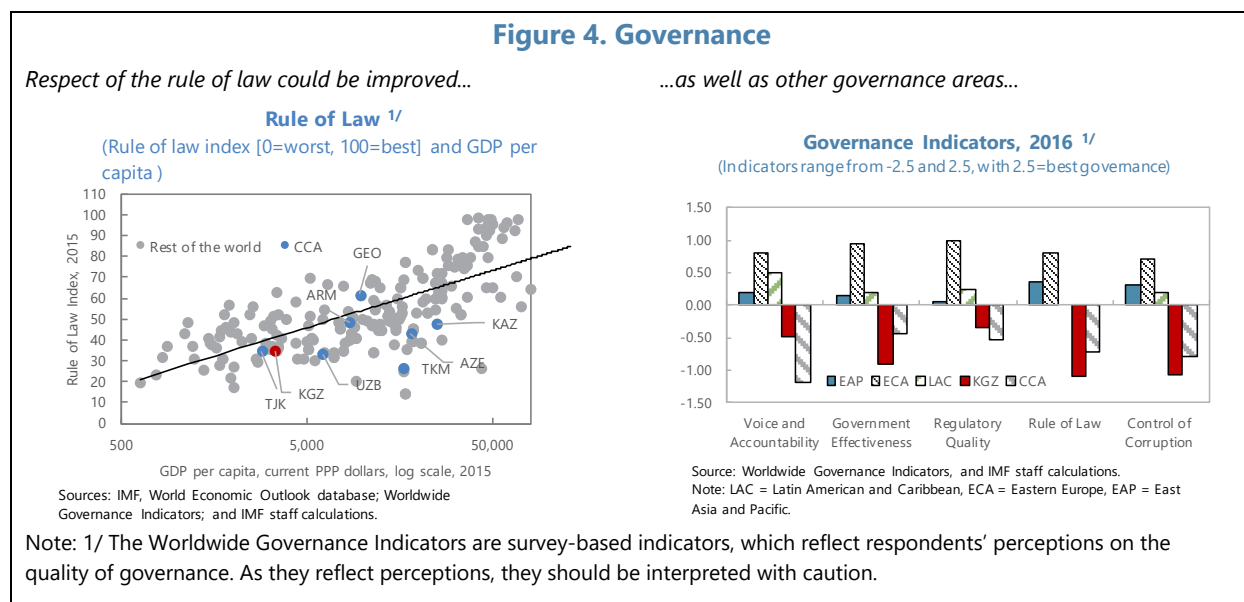
9.   **Respect of the rule of law is a concern raised by business executives in the Kyrgyz Republic** (WEF, Global Competitiveness Indicators, 2018, and EBRD and World Bank, Enterprise Surveys, 2016, Figure 4). Respect of the rule of law, control of corruption, and overall government effectiveness are areas where there is room for improvement. Companies and private businesses are frequently requested to make informal payments to secure government contracts, get a construction permit, get an import license or an operating license (World Bank, Systematic Country Diagnostic, 2018). Based on the World Bank Incidence of Graft index, 53.5 percent of firms are expected to give gifts, which is higher compared to Eastern Europe and Central Asia, as well as low income countries (LICs). Doing Business "Trading across Borders" indicator, and the WTO's Trade Policy Review note that licenses are non-automatic and the decision to issue a license rests with the licensor which takes about 30 days to issue or deny the license. Only about 9 percent of firms believe that the court system is fair, impartial, and uncorrupted. Contract enforcement through the courts is protracted and costly. The relatively high incidence of investor-state disputes taken to international arbitration indicates a lack of trust in the domestic judicial process. The relations between the government and the largest foreign investor which have been marked by perpetual contract renegotiations, lawsuits, prosecution of expatriate staff and withdrawal of licenses, cast an unfavorable light on the business environment (Press, July and November 2018).

10.   **Tax rates are light, but tax regulations and administration are heavy**. The tax system is made up of a formal regime with a corporate income tax of 10 percent, a simplified regime with a sales tax of 4 and 6 percent for cash payment (2 and 3 percent for non-cash payment) depending on

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[3] The first study, comprising 69,305 firms in 107 countries, showed that corruption created employment growth bottlenecks for medium and large firms over 2000–2006. The second study, based on enterprise data for Central and Eastern Europe and CIS, documented the association between corruption and firms' innovation and overall performance.

[4] Based on a dataset comprising 80 electricity distribution firms from 13 Latin American countries, the study finds a positive association between firms' inefficiency levels and corruption.

the sector of activity, and a patent regime with a flat payment for individual entrepreneurs in 83 types of activities. Despite the simplicity of the

Figure 4. Governance

Respect of the rule of law could be improved...   *...as well as other governance areas...*

Rule of Law [1]
(Rule of law index [0=worst, 100=best] and GDP per capita)

Governance Indicators, 2016 [1]
(Indicators range from -2.5 and 2.5, with 2.5=best governance)

Sources: IMF, World Economic Outlook database; Worldwide Governance Indicators; and IMF staff calculations.

Source: Worldwide Governance Indicators, and IMF staff calculations.
Note: LAC = Latin American and Caribbean, ECA = Eastern Europe, EAP = East Asia and Pacific.

Note: 1/ The Worldwide Governance Indicators are survey-based indicators, which reflect respondents' perceptions on the quality of governance. As they reflect perceptions, they should be interpreted with caution.

tax system, the Kyrgyz Republic ranks low compared to LICs and emerging market developing economies (EMDEs) in the Doing Business "Paying Taxes" indicator, including number of tax payments per year, and time it takes to make tax payments, as well as due to low usage of e-filing and cumbersome practices on VAT returns. In addition, a high share of firms expects to have to make informal payments to tax inspectors (World Bank and IFC, Investment Climate, 2015). The government plans for electronic filing of tax payments offers opportunities to reduce the administrative cost of filing for tax payers.

Governance—Macro Risks

11.   **Public debt is on the high side and the composition of spending is tilted towards current spending** (Figure 5)**.** High fiscal deficits and public debt on an upward trajectory can presage the need for implicit taxation or expropriation through surprise inflation, depreciation, default, or banking crises. In anticipation, country risk and interest rates rise, depressing investment. While the fiscal deficit in 2018 was reduced significantly to 1.3 percent of GDP (from 4.6 percent of GDP in 2017) and the government's 2019 budget reflects a more conservative fiscal policy stance than the historical average, public debt is on the high side (56 percent of GDP) and it is largely denominated in foreign currency, exposing the country to foreign currency risk. The composition of spending is tilted towards wages, subsidies, and untargeted social benefits, and efficiency of spending and of public investment is low. Subsidies aggravate fiscal imbalances, crowd out priority public spending, and depress private investment, including in the energy sector.

Figure 5. Fiscal Policy

*Public debt is relatively high, and mostly denominated in foreign currency.*

Gross General Government Debt and Debt in Foreign Currency
(Percent of GDP)

■ Debt in local currency
■ Debt in foreign currency or linked to the exchange rate
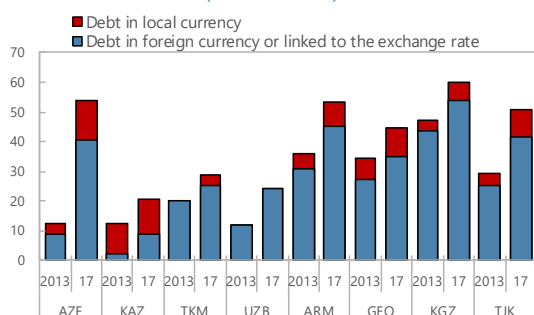
Source: National authorities, and IMF staff calculations.

The composition of spending is tilted towards current spending...

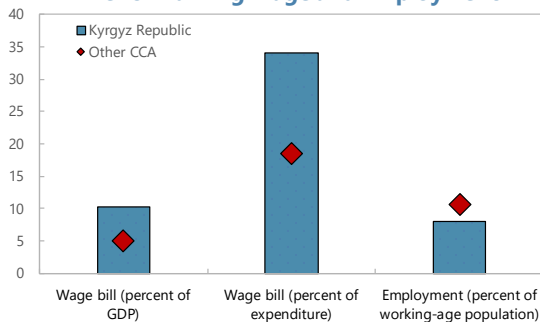**General Government Expenditure**
(Percent of GDP)

■ Other spending   ▦ Social benefits
▨ Gross capital formation   ■ Compensation of employees
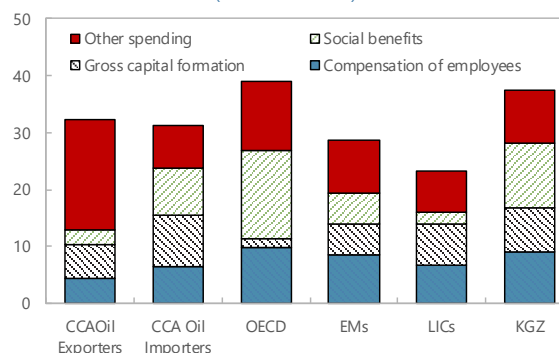
Source: World Economic Outlook, and IMF staff calculations.

...with the wage bill surpassing peers...

Benchmarking Wage and Employment

■ Kyrgyz Republic
◆ Other CCA
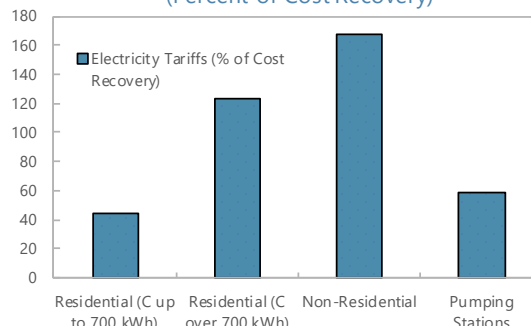
Sources: IMF FAD Expenditure Assessment Tool (EAT), based on 2015 or latest available data. Excluding Uzbekistan.

...and residential energy tariffs below cost recovery.

Electricity Tariffs
(Percent of Cost Recovery)

■ Electricity Tariffs (% of Cost Recovery)

Source: World Bank, 2017.

Cost of Finance

12.   **While domestic savings do not appear to be a key constraint to private investment, high cost of credit is** (Figure 6). While domestic savings have gone down from 25 percent of GDP in 2011-14 to 22 percent in 2015-17, they are higher compared to CCA oil importers and even EMDEs, and only lower than in CCA oil exporters. Lending-deposit spreads are among the highest in the CCA and much higher compared to upper middle-income countries, as well as the world. This could reflect bank-specific and market-structure factors, regulation costs, as well as weaknesses in institutional quality and financial infrastructure. Bank-specific determinants in the Kyrgyz Republic likely include high operating costs for banks due to inefficient operations. High spreads could potentially reflect market power, given relatively high bank concentration (3 largest banks hold about 70 percent of the market), and low bank diversification (i.e. low non-interest income). The high operating costs may be due to market dominance of the large players which have little incentive to trim their cost structure and/or diversify their portfolio. In addition, barriers to medium-term funding for banks, prudential barriers for banks and institutional investors to invest in local currency corporate bonds, a lack of foreign exchange hedging instruments, inability to mobilize

credit claims between banks, private investors, and central bank, and the absence of local rating infrastructure, further constrain supply of cheaper financing.
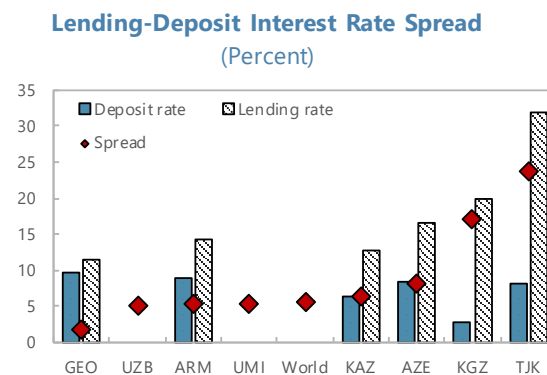
Figure 6. Cost of Finance

Savings are higher compared to peers...

National Savings
(Percent of GDP, simple averages)
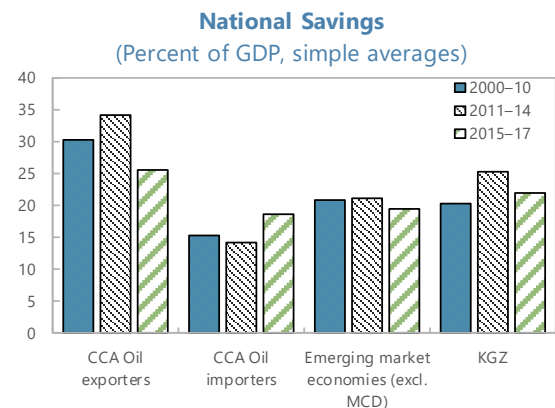
Sources: National authorities and IMF staff calculations.

...but interest rate spreads and the cost of credit are relatively high ...

Lending-Deposit Interest Rate Spread
(Percent)

Source: World Development Indicators, and IMF staff calculation.
Note: UMI = Upper middle income.

...likely due to a lack of bank competition ...

3-Bank Asset Concentration
(Percent)
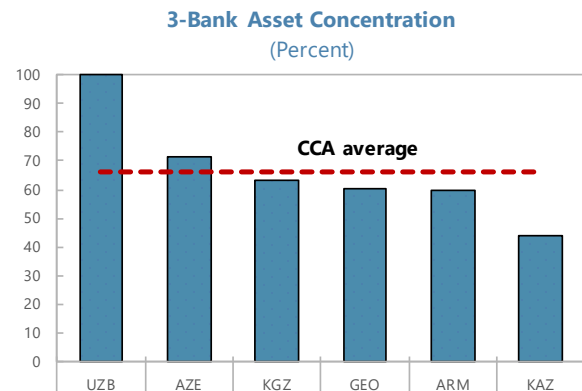
Source: World Bank Finstats Database, 2016, and IMF staff calculations.

... and high operating costs.

Banks' Non-Interest Expense
(Percent of gross income)
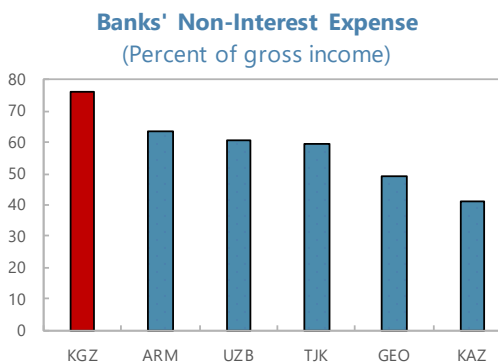
Source: FSIs, and IMF staff calculations.

Collateral requirements exceed loan value ...
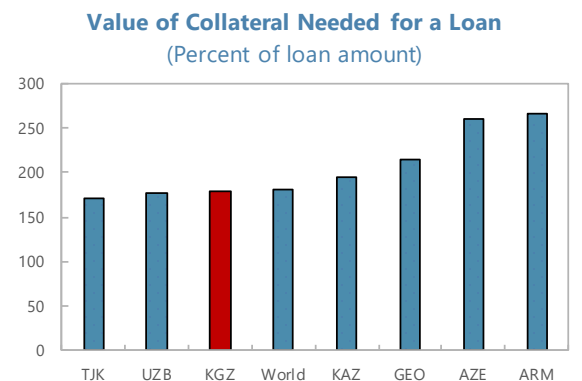
Value of Collateral Needed for a Loan
(Percent of loan amount)

Sources: World Bank Enterprise Survey, World Development Indicators, and IMF staff calculations.

...while access to bank loans has room for improvement.
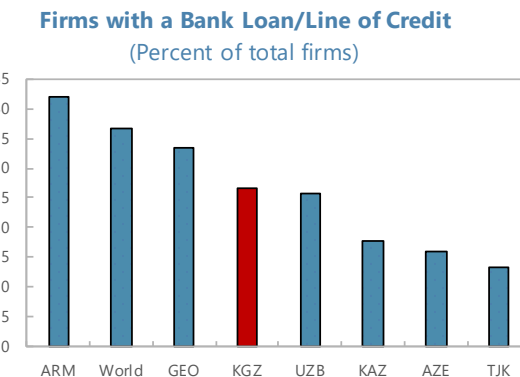
Firms with a Bank Loan/Line of Credit
(Percent of total firms)

Sources: World Bank Enterprise Survey, World Development Indicators, and IMF staff calculations.

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New games around Kumtor. What they may lead to in Kyrgyzstan, July, 2018.

Sensitive points of investment climate in Kyrgyzstan. What are we doing wrong?, November, 2018.

KYRGYZ REPUBLIC: UNLEASHING THE POTENTIAL OF THE ELECTRICITY SECTOR[1]

Endowed with ample hydroelectric resources, the electricity sector in the Kyrgyz Republic has great growth and export potential as recognized by the National Development Strategy for 2018–40. However, below-cost tariffs have led to a dire financial condition of the energy firms and chronic under-maintenance and under-investment in the sector, eroding the already limited productive capital. Reforming the current tariff policy soon is indispensable to restore the viability of the sector and unleash its economic potential. International experience indicates that successful reforms are usually accompanied by a comprehensive strategy and information campaign, enhanced governance of the regulatory bodies and energy companies, and mitigation measures to protect the poor and the vulnerable.

A. Overview and Potential Economic Benefit of Electricity Sector Reforms

1.   **The Kyrgyz Republic is endowed with abundant hydroelectric potential that is currently under-utilized.** Over the last decade, around 90 percent of electricity has been generated from hydropower, with an annual average production equal to 12–13 terawatt hour (TWh), and the balance has been generated by thermal power. The country has produced on average enough electricity to cover domestic demand and some export to neighboring countries. However, the misalignment of peak generation period (late spring and summer for hydro plants) and consumption period (winter) has given rise to seasonal shortages (¶7). Even so, it is estimated that less than 10 percent of the country's hydro power potential has been exploited.[2] Considering that countries with more developed hydropower sectors utilize over 30 percent of hydropower potential, there remains significant room for development for the Kyrgyz energy sector. This section aims to provide preliminary insights into how energy sector is related to general economic development relying on cross-country evidence. The discussion starts with an overview of several aspects relevant for the performance of the energy sector—using the Kyrgyz Republic as an example—and introduces a composite index that will facilitate subsequent regression analysis.

2.   **Electricity sector policy has focused on universal access and low tariff, but this has led to significant supply and demand side weakness, affecting the quality and quantity of service** (Figure 1 bottom panels). The following issues are visible from a cross-country comparison based on 2014 data: (i) transmission and distribution losses that are among the largest in the sample of 81 emerging market and low-income countries, (ii) sizable cost to obtain electricity as both the monetary cost and the required days and procedures are in the top quartile, and (iii) unsatisfactory service quality illustrated by the significant share of firms experiencing outages and the high reported lost value. In fact, according to the enterprise survey, the share of firms considering

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[1] Prepared by Wei Shi and Christian Josz with research assistance of Jimmy Hatem. This paper benefited of the comments of the World Bank.

[2] According to the International Hydropower Association, the hydropower potential in the Kyrgyz Republic amounts to 140–170 TWh annually.

electricity as a major constraint or even the biggest obstacle in the Kyrgyz Republic is much higher than a typical country in the sample and stands at around the 75th percentile.

3.   **Overall performance of the Kyrgyz electricity sector is weak in cross-country comparison and shows only modest improvement over the past two and half decades**. A composite index is constructed by extracting a common trend of the aforementioned aspects together with the electricity generation and consumption pattern.[3] According to the index (Figure I top panel), the performance of the Kyrgyz Republic has been trapped in the bottom half among all countries considered and has deteriorated over time. Major driving factors of such dynamics are worsening transmission and distribution losses that only recently started improving, as well as stalled electricity generation and consumption in per capita terms. These findings are consistent with one of the main challenges discussed in the next section, namely decaying productive capital that is insufficient to meet the rising demand.

4.   **Empirical analysis suggests a significantly positive relation between the electricity sector performance measured by the composite index and general economic development** (Table 1)**.** The analysis measures economic development by per capita GDP and includes other variables typical in the growth regression, such as population growth, the investment ratio (gross fixed capital formation to GDP), inflation (change of consumer price index), and the size of government (proxied by general government final consumption expenditure to GDP as the investment aspect would be captured by the investment ratio).[4] The panel estimation yields a significantly positive coefficient associated with the electricity sector composite indicator (with a one-year lag) which diminishes in both magnitude and statistical significance as the number of lags increases. For the Kyrgyz Republic, the estimation implies that closing 10 percent of the gap with the median country could raise per capita GDP the following year by 1.1 percent.

5.   **As there is no obvious way to relate the composite index to its components, the panel regressions are repeated for selected individual indicators to illustrate their possible influences on per capita GDP** (Figure 2)**.**[5] As expected, per capita GDP is positively associated with per capita electricity generation and consumption, and negatively associated with transmission and distribution losses. The negative coefficients for access to electricity appear counter-intuitive at first sight, but closer scrutiny reveals that they reflect the highly uneven electricity access across countries. While a few countries with moderate per capita GDP enjoy almost universal access

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[3] Detailed data, country coverage, and methodology are explained in Appendices I and II. A greater value of the composite index indicates better performance. Doing business indicators and the enterprise survey are survey-based data, and some indicators reflect perceptions and should be interpreted with caution.

[4] The regression also includes time and country fixed effects to capture a common time trend and time-invariant country-specific factors. Other typical explanatory variables that were tried but eventually excluded from the baseline panel regression include education attainment (percent of male with at least secondary education) and trade openness (trade to GDP). The education indicator consists of short time series with missing values in between, and if included, would reduce the number of observations by half. Trade openness is insignificant and does not change much the estimated coefficient of the energy sector indicator. Given endogeneity concern, all these explanatory variables enter the regression with lags.

[5] As fixed effect panel regression is to be estimated, variables displaying variations over time within each country are selected. Point estimates with respect to logarithmic per capita electricity generation/consumption indicate the elasticities, i.e., percentage changes in per capita GDP that are associated with one-percent change in per capita electricity generation/consumption.

Figure 1. Kyrgyz Republic: Electricity Sector Performance
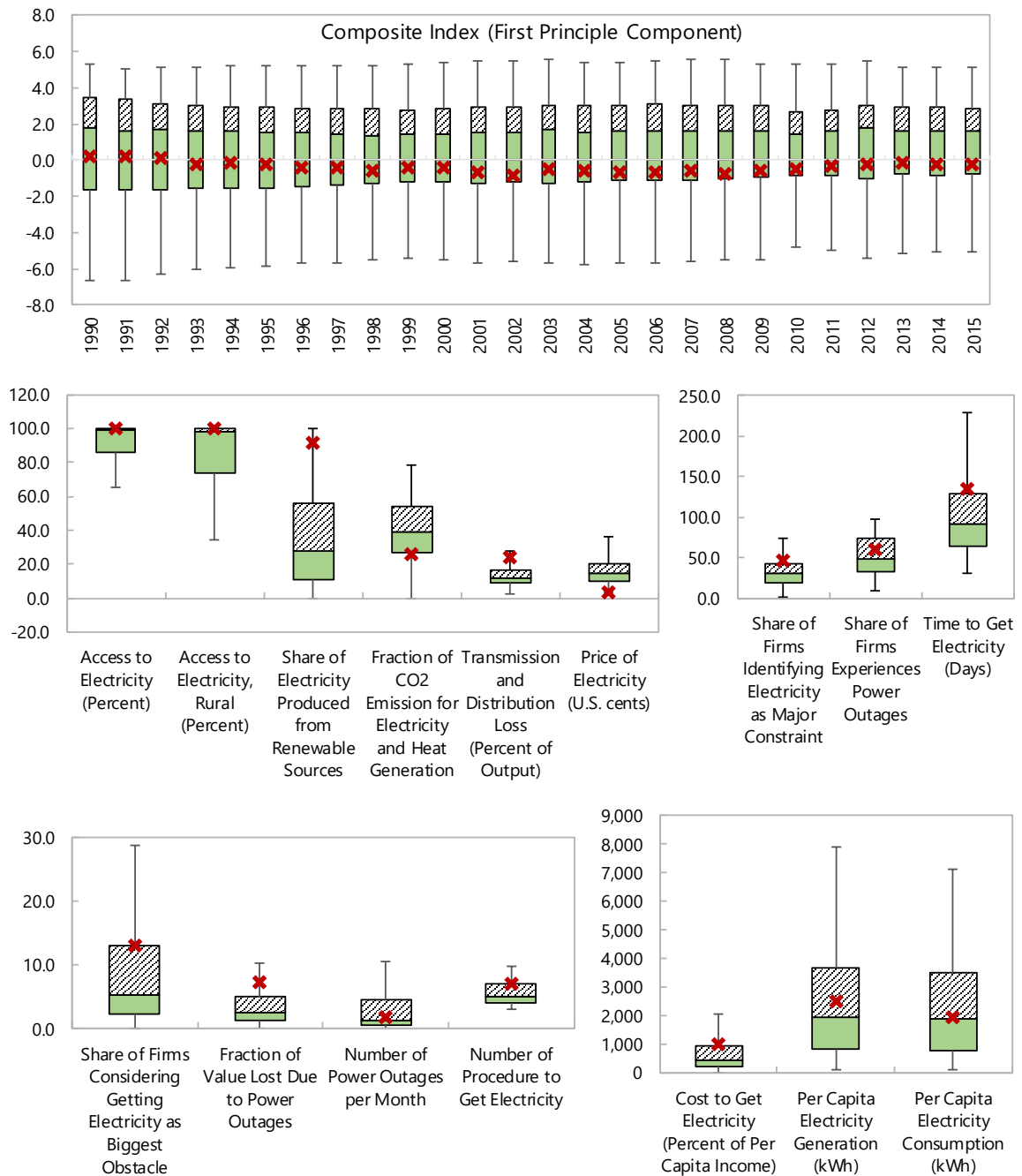
Sources: World Bank World Development Indicators, Doing Business Indicators, Enterprise Survey, Sustainable Energy for All, and IMF staff estimates.

Note: Boxplots are based on data for 81 countries, mostly emerging markets and low-income countries (Appendix 2). The two whiskers mark the minimum and maximum of the sample (excluding outliers), while the green-shaded and black-lined areas mark the second and third quartiles. Kyrgyz indicators are shown by the red crosses. Bottom four panels refer to 2014 (latest historical data for most countries). All the shares are measured in percent. Refer to footnote 3 and Appendix 1 for more details.

to electricity, others with higher per capita GDP might still have considerable room to improve their access. The Kyrgyz Republic is a notable example of the former group, where access for both overall population and rural population is almost universal and significantly higher than some higher-income countries.

B. Challenges Facing the Kyrgyz Electricity Sector

6.   **The potential of the electricity sector to boost growth and welfare is hampered by a few inter-connected challenges.** Productivity of the ageing capital is deteriorating, adding to the difficulties in keeping up with fast-growing domestic demand, especially the rising residential demand during winter heating seasons. The problem is exacerbated by tariffs for residential users that are too low to generate enough revenue to cover not only the cost of service (Table 2) but also adequate operating and maintenance expenditure or invest in new generation, transmission, and distribution facilities. Higher exports at prices exceeding the cost of service helped narrow the gap between tariffs and cost of service in recent years. However, going forward, exports are expected to decline. Moreover, debt repayment will increase sharply. Therefore, the financial deficit of the sector, excluding investment, is expected to deteriorate to about 1 percent of GDP in 2023 without tariff increases[6] and reach about 2.2 percent of GDP, including investment financed by the state budget. Residents, however, resist tariff increases as the sector has not delivered satisfactory service. There is also the concern about whether higher tariffs would be affordable for poor households. Drawing from the World Bank and the IMF technical assistance, this section reviews these challenges. Reform recommendations will be made in the following section.[7]

Demand Trend and Supply Bottlenecks

7.   **The Kyrgyz Republic on average produces enough electricity to cover its annual domestic consumption, but seasonal shortages are frequent.** There is a widening winter supply shortage, estimated by the World Bank to increase from 581 gigawatt hours in 2015 to almost 900 gigawatt hours in 2030, under existing capacity. A key driving factor of this supply gap is surging winter demand for heating purposes, as households that are not connected to district heating or hot water services increasingly use electricity to produce heat. In addition, the low residential tariff does not seem to provide an adequate incentive for households to save energy: Kyrgyz households consume more electricity on average than their peers in countries with similar weather conditions (Figure 3 top-left panel).

8.   **Under current circumstances, there is limited scope for a significant increase in electricity generation which plateaus at the early 2000s level** (Figure 3 mid-left panel)**.** Existing

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[6] World Bank, *The State of the Kyrgyz Energy Sector, Bishkek, December 2018*, slide 8, available at: http://www.worldbank.org/en/country/kyrgyzrepublic/brief/energy-sector.

[7] References include: (i) World Bank, *Power Sector Policy Note for the Kyrgyz Republic*, April 2014; (ii) World Bank*, Keeping Warm: Urban Heating Options in the Kyrgyz Republic Summary Report*, March 2015; (iii) World Bank*, Analysis of the Kyrgyz Republic's Energy Sector*, May 2017; (iv) IMF, Fiscal Affairs Department, *Kyrgyz Republic: Government Subsidies Review Energy Subsidy and Social Protection*, May 2017; and (iv) World Bank, *The State of the Kyrgyz Energy Sector*, presentation, Bishkek, December 2018.

Table 1. Impact of Electricity Sector Development on Per Capita GDP

Dependent variable: Per capita GDP PPP in 2011 international dollars, logarithmic					
VARIABLES	(1)	(2)	(3)	(4)	(5)
Population, annual change, L1	3.0901	3.2120	3.3280	3.3944	3.2559
	(2.9646)	(2.9876)	(3.0136)	(3.0287)	(3.0170)
Gross fixed capital formation, ratio to GDP, L1	0.8011**	0.8103**	0.8192**	0.8221**	0.8136**
	(0.3096)	(0.3109)	(0.3151)	(0.3192)	(0.3220)
Inflation, annual change, L1	-0.0492**	-0.0503**	-0.0502**	-0.0490**	-0.0464**
	(0.0223)	(0.0224)	(0.0230)	(0.0232)	(0.0222)
Government final consumption expenditure, ratio to GDP, L1	-1.1220*	-1.1505*	-1.1532*	-1.1515*	-1.1226*
	(0.5821)	(0.5891)	(0.5946)	(0.5982)	(0.5969)
Energy sector index: First principle component					
L1	0.1131**				
	(0.0478)				
L2		0.0947**			
		(0.0455)			
L3			0.0787*		
			(0.0435)		
L4				0.0491	
				(0.0419)	
L5					0.0120
					(0.0383)
Time	0.0273***	0.0280***	0.0287***	0.0298***	0.0310***
	(0.0034)	(0.0033)	(0.0034)	(0.0033)	(0.0031)
Constant	-45.7542***	-47.2099***	-48.5509***	-50.7688***	-53.1710***
	(6.8042)	(6.6857)	(6.6977)	(6.5540)	(6.2640)
Observations	1,437	1,437	1,437	1,437	1,437
Number of countries	78	78	78	78	78
Adjusted R-square	0.7317	0.7288	0.7269	0.7245	0.7230

Sources: World bank and IMF staff estimate.

Note: Panel regressions include country fixed effect. Robust standard errors in parenthese. ***, **, and * denote statistical significance at 1 percent, 5 percent, and 10 percent level.

Figure 2. Impact of Individual Electricity Sector Indicators on Per Capita GDP

Sources: World Bank and IMF staff estimate.

Note: Dependent variable is the logarithm of per capita GDP PPP in 2011 international dollars. Other variables in the regression are the same as in Table 1. First lags are used. Red bars denote the 95-percent confidence interval.
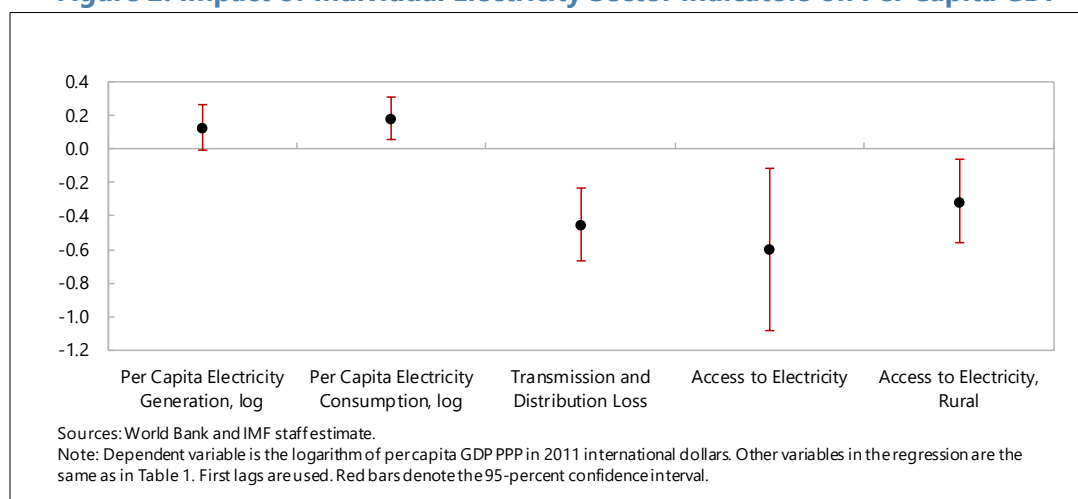
assets are ageing and largely under-maintained. Around 45 percent of available capacity is beyond the useful life of 25 years, including the Toktogul hydropower plant (HPP)—the largest one whose generation capacity is about 30 percent of the total Kyrgyz power system—and the Bishkek combined heat and power plant (CHP), both of which play a vital role for winter electricity supply. The transmission and distribution network is also in decay, resulting in high technical losses (17 percent of 2016 total generation, Figure 3 top-right panel).[8] New investment and rehabilitation of existing facilities have been carried out in recent years with donor support, but only gradually given the weak financial situation of the sector. The underspending on maintaining and improving existing capital could accelerate capital decay and lead to higher spending needs for the future.

Financial Situation of the Electricity Sector

9.   **The electricity sector is in financial distress mainly because of highly subsidized residential tariffs** (Table 2). Over half of electricity users—mostly residential customers with monthly usage below 700 kWh[9]—pay tariffs that are too low to cover the cost of service.[10] For 81 percent of residential consumption, tariffs cover only 40 percent of the cost of service. Though large residential customers and non-residential customers cross-subsidize other users, the domestic segment of the electricity service runs a chronic deficit which amounted to over KGS 2.4 billion in 2017 (0.4 percent of GDP). Other factors contributing to the deficit include technical and commercial losses, i.e. unpaid electricity bills; however, both combined account for only 20 percent of the deficit during 2007–12. In years with favorable weather conditions (such as 2017), revenue from electricity exports helps to narrow the deficit, but this provides only temporary relief. Considering the need for new investment, the gap between current tariffs and those consistent with sustainable sector development would be even greater than shown in the following table.

Table 2. Kyrgyz Republic: Cost of Services versus Revenue by Customer Class, 2017							
	Domestic Consumption						*Exports*
	Residential		**Non-**	**Pumping**	**Other**	**Total**	**Total**
	≤700 kWh	>700 kWh	**Residential**	**Stations**			
Percent of Consumption	52.9%	11.9%	29.5%	5.4%	0.4%	100%	
Tariff (KGS per kWh)	0.77	2.16	2.24	0.779	0.088	1.37	1.57
Consumption (billion kWh)	5.30	1.19	2.96	0.539	0.039	10.0	1.2
Revenue (billion KGS)	**4.08**	**2.58**	**6.63**	**0.420**	**0.003**	**13.71**	**1.9**
Cost of Service (CoS, KGS per kWh)	1.75	1.75	1.55	1.330	1.750	1.67	
Consumption (billion kWh)	5.30	1.19	2.96	0.539	0.039	10.0	
Full Cost of Service (billion KGS)	**9.29**	**2.09**	**3.94**	**0.717**	**0.068**	**16.11**	
Difference between CoS and Revenue (billion KGS)	**-5.21**	**0.49**	**2.69**	**-0.297**	**-0.064**	**-2.40**	**1.9**
Memo: Deficit (percent of 2017 GDP)	-0.94	0.09	0.48	-0.053	-0.012	-0.43	0.34

Source: World Bank and IMF staff estimates.

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[8] For comparison, the average electricity loss in transmission and distribution is about 5 percent in the United States. See https://www.eia.gov/tools/faqs/faq.php?id=105&t=3.

[9] For residents in high altitude and mountainous areas, the low tariff applies to monthly consumption up to 1000 kWh.

[10] Cost of service as calculated by the World Bank includes operation and maintenance, as well as debt service costs to finance investment.

10.   **As a result, the sector relies on significant budget support, especially for capital spending.** Most capital expenditure in the sector is financed by international financial institutions and is on-lent through the budget (Figure 3 mid-right panel). In 2016, the debt of electricity companies reached almost 20 percent of GDP (32 percent of overall public debt). Loan repayments are projected to pick up and exceed one percent of GDP on average during 2019–23. They will likely be fully assumed by the budget given the sector's financial distress. Fiscal support also extends to district heating and hot water. A recent subsidy review by IMF experts (IMF, 2017) estimated that total subsidy to electricity, district heating, and hot water amounts to 3 percent of GDP.

Affordability and Willingness to Pay Higher Tariffs

11.   **As a social policy, energy subsidies are by nature regressive because the benefits are received disproportionately by well-off households** (Figure 3 bottom-left panel). In the Kyrgyz Republic, the consumption pattern as displayed in the 2015 Integrated Household Survey indicates that almost half of the subsidies to electricity, district heating, and hot water go to the 30 percent richest households, while the bottom 30 percent of households receive barely 20 percent of the subsidies.

12.   **Efforts are needed to foster more public support for higher residential tariffs.** According to a recent World Bank survey (2017), consumers identify the high electricity prices, the government efforts to stop corruption and stealing, electricity cutoffs, and the quality of service as priority areas for reform (Figure 3 bottom-right panel). One concern with higher tariff is affordability, as per capita income is low (25 percent of the population is poor, with per capita income less than $2.5 per day in 2015, and another 70 percent vulnerable, with per capita income less than $10 per day),[11] and the current social safety net offers few instruments for the government to mitigate the impact of a tariff increase on the poor.[12] Another concern is the willingness to pay a higher tariff, as better-off households may resent higher tariffs considering the unstable supply, the repeated cutoffs including during the winter, the problematic quality of services to consumers, and the perceived corruption in the sector.

C. A Reform Roadmap

13.   **The authorities have taken commendable steps to reform the electricity sector.** In 2014, they established an independent sector regulatory agency. In 2015, they created a mechanism to settle claims among, and allocate revenue across, sector entities. They also developed a medium-term tariff policy for 2014–17 with the goal to achieve cost recovery for the sector, and raised electricity tariffs accordingly for non-residential, commercial and industrial users. However, they have kept the residential tariff unchanged since increases in 2014–15. Therefore, overall tariffs remain insufficient to cover the cost of service. The distribution companies recently started installing smart meters, which has reduced commercial losses. This section discusses what remains to

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[11] World Bank, 2018, *Kyrgyz Republic, From Vulnerability to Prosperity, A Systematic Country Diagnostic*, Figure 2.4, page 9.

[12] The authorities abolished the only means-tested social benefit in 2017 and replaced it by universal child benefits. Existing social assistance programs largely aim at categories of beneficiaries without explicit income requirement, such as families with children, residents in mountainous areas, etc.
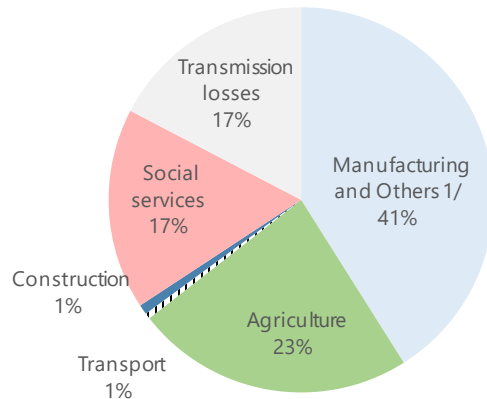
Figure 3. Kyrgyz Republic: Electricity Sector Indicators

**Average Household Electricity Consumption, 2014**
(In kWh per month)
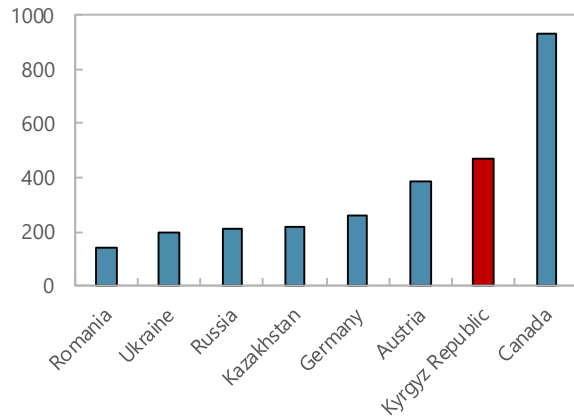
Sources: World Energy Council, and World Bank.

Domestic Electricity Consumption, 2016
(In percent of total consumption)

Sources: National Statistical Committee and IMF staff calculation.
1/ Including electricity distributed for household needs.

Electricity Generated by Hydropower, 1992-2017
(In gigawatt hours)
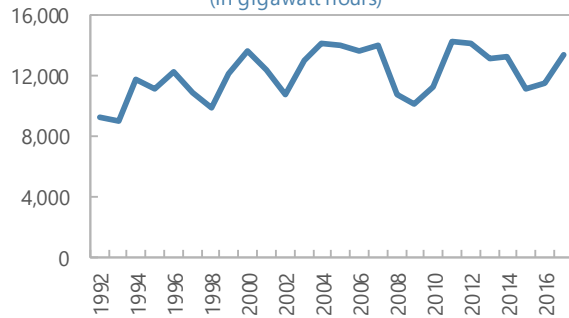
Sources: National Statistic Committee, and International Hydropower Association.

Loans on-lent to Energy Sector, 2014-18
(In percent of GDP)
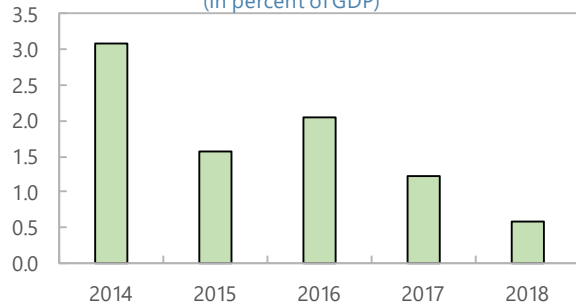
Sources: Ministry of Finance and IMF staff estimate.

Distribution of Energy Subsidies across Income Deciles
(In percent of total subsidy, 2015)
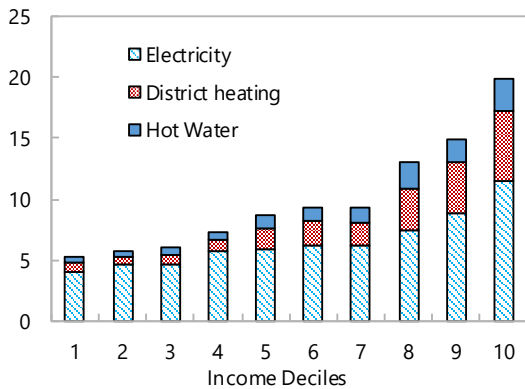
Sources: IMF staff estimates based on 2015 Kyrgyz Integrated Household Survey.

Consumers' Opinions on Priority Areas in the Energy Sector

Source: M-Vector, "Survey on Public Awareness of the Energy Sector Reforms in the Kyrgyz Republic", 2017.

be done to reform the electricity sector and finishes with a brief survey of reform experiences in several countries that successfully implemented subsidy and other electricity sector reforms.[13]

14. **Given the wide-ranging challenges facing the electricity sector, a holistic reform approach should be considered.**

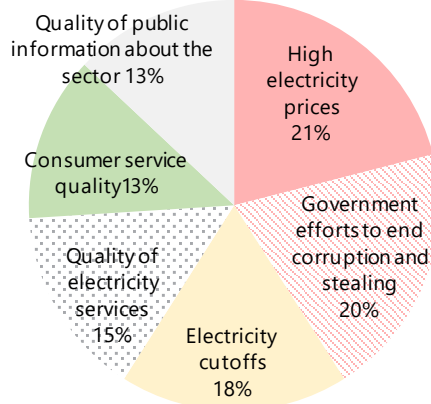- On the supply side, it is important to continue cooperating with development partners to rehabilitate existing assets and enhance their productivity. Improving transmission and distribution network could help mitigate the seasonal shortage by reducing technical losses. However, given the sizable investment needs that seem to go beyond the public sector's financial capacity, the authorities should create a friendly business environment including tariffs achieving full cost recovery, i.e. covering all operational expenditures (the costs of operation and maintenance, power purchases, debt obligations, taxes, insurance, …) and capital expenditures (full capital costs including coverage of future investment projects), to attract private investors. In this respect, good governance and policy certainty will be key to generate the confidence that private investors need to commit long-term resources to the energy sector in the Kyrgyz Republic. The authorities should also develop alternative sources of energy than hydroelectricity to diversify the sources of electricity generation and strengthen energy security.

- Equally important is to address the electricity users' concerns and build social support for reforms. This includes improving the energy efficiency of residential and public buildings and upgrading the heating system to mitigate the supply shortage during the winter, enhancing customer service's quality, simplifying the procedures to get access to electricity, and strengthening the social safety net to protect the poor and the vulnerable.

15. **Tariff increases to restore the electricity sector's financial viability should be the corner stone of the electricity sector development strategy.** Counting on higher export revenue to reducing the cash deficit of the sector as in recent years is not sustainable because exports are projected to decline over the medium term. Without tariff increase, rising debt repayment obligations will increase the cash deficit of the sector. Moreover, given that electricity is an important input for all sectors, the current policy of cross-subsidizing the residential sector by non-residential users and exports could feed into higher costs of Kyrgyz products and undermine the competitiveness of the country. Therefore, to restore the financial viability of the electricity sector, the authorities should elaborate and implement a new medium-term tariff strategy, so that all relevant stakeholders—the electricity companies, electricity users, and the regulator—have a clear vision about what to expect and can adjust their own behaviors accordingly. The following actions are called for:

- *Communicate the challenges faced by the electricity sector and the government's strategy to address them.* The government should explain the sources of the structural losses of the electricity sector, their consequences on the deteriorating quality of the capital stock and the quality of service, and the strategy to eliminate losses that should include both gradual residential tariffs increases and measures to reduce costs and strengthen governance.

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[13] See Benedict Clements and others, *Energy Subsidy Reform Lessons and Implications*, IMF 2013.

- *Disclose the amount of electricity sector subsidies and their distributional impact to the public.* These subsidies include the transfers to the loss-making energy sector companies to finance their investment, which are currently recorded as acquisition of financial assets but should rather be recorded as capital transfers that increase the budget deficit, according to the IMF Government Finance Statistics Manual. Electricity sector subsidies also include the implicit transfers to residential consumers who pay less for electricity than what it costs to produce and distribute it.[14] The distribution of energy subsidies (Figure 3 bottom-left panel) should be updated with the most recent household survey and communicated to the public.

- *Prepare a package of mitigation measures to protect the poor.* This involves identifying the vulnerable groups and designing compensatory measures to protect them from higher electricity tariffs, such as cash transfers, while taking the available fiscal space into account. The implementation of such targeted transfers should be part of an overall strategy of moving social assistance from category-based (families, veterans) to income-related transfers (IMF, 2017).

- *Gradually increase tariffs to achieve full cost recovery.* This could be done through a combination of lowering the social tariff consumption threshold and increasing residential tariffs.[15] Planned tariff adjustment should be carefully calibrated according to the sector's financial needs and the households' ability to pay. The implementation should also be gradual and predictable so that households and other users have time to adapt their consumption pattern to the new tariffs.

16.   **Despite the political and social sensitivity, many countries have successfully reformed their electricity sector** (Box 1). The reform episodes of these countries share several common features, namely, clear long-term objectives from the onset, ex-ante impact assessment of the impact on the revenue distribution and mitigation measures to compensate the poor, and active consultations with all stakeholders. The successful reforms have also included communication campaigns to ensure transparency and foster public support, and measures to depoliticize tariff-setting, i.e. allocate tariff decision to an independent regulator rather than elected officials to avoid reform reversals. All these international experiences could help shape the Kyrgyz authorities' own reform strategy.

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[14] According to IMF staff estimates (IMF, 2017), the outstanding loans accumulated by the energy companies amount to 18 percent of GDP as of end-2016, while the implicit subsidies calculated from the price gap is around 3 percent of GDP (including electricity, district heating, and hot water).

[15] The World Bank Report *Analysis of the Kyrgyz Republic's Energy Sector*, May 2017 presents illustrative examples of tariffs increases that achieve cost recovery.

Box 1. International Experiences on Reforming Electricity Subsidies

Armenia's electricity sector suffered from large implicit consumer subsidies and low collection rates before the reform, and relied heavily on various forms of public support, such as direct budgetary loans, state guarantees, and arrears to tax authorities. The authorities have implemented comprehensive reforms since the mid-1990s to reform the sector and attract private investment. They deployed meters to improve revenue collection, and gradually implemented the payment of the utility bills through banks and post offices to reduce corruption risks associated with cash payments to the electricity companies. They strictly enforced a policy of cutting power to customers who did not pay their electricity bills. These actions led to a significant increase in the collection rate. Following a communication campaign that emphasized the linkage between paying utility bills and more reliable service, the authorities more than doubled tariffs, including the residential tariffs, over 1995–99 to reach cost-recovery level, signaling to the private sector and the donor community their commitment to reforms. The authorities also abolished the lifeline tariff which was susceptible to misuse, and instead strengthened the targeted social programs to shield the poor from higher tariffs. They set up an independent regulator in 1997, with the legal mandate to ensure that tariffs fully cover medium-term costs, including depreciation, debt service, and other capital costs. The tariff increases in the 1990s effectively eliminated the bulk of subsidies, and the authorities only needed to further increase tariffs in 2009 to reflect the higher price of gas supplied by Russia. Overall, the reforms restored the financial viability of the sector and improved its efficiency thanks to private sector participation.

Brazil started an ambitious privatization program of the electricity sector in the 1990s to deal with the legacy problems—large deficit, high external debt, and severe under-investment—of the suppressed electricity tariffs in the previous decade, which the authorities put in place to rein in hyperinflation. Privatization efforts started with the distribution companies as their financial soundness had ripple effects for upper-stream transmission and generation companies. The authorities liberalized tariffs and unbundled them into generation, transmission and distribution segments to enhance the transparency of prices, while they implemented conditional cash transfer programs and targeted low tariff for poor families as mitigation measures. They garnered public support for the reform by enhancing rural access to electricity—they introduced a program to provide free power to rural areas in 2003—and gained political capital by eliminating hyperinflation.

Kenya undertook a series of reforms in the electricity sector starting in the mid-1990s to maintain its financial sustainability and attract investment. Starting in 2005, the authorities raised electricity tariffs and achieved cost recovery by 2008. They coupled the tariffs reform to measures improving the technical and administrative efficiency of the state-owned energy companies, expanding access, improving service quality, and establishing a sound regulatory framework. They introduced an automatic pricing formula to link tariffs to long-term marginal costs and other factors such as exchange rate rather than to political influence. The authorities maintained transparency by regularly updating prices on the regulator's website. They adopted several mitigation measures, including a lifeline supply of 50 kWh per month, financial assistance to cover connection fees, and a rural electrification program.

Philippines started reforming its electricity sector in the early 2000s. At first, limited capacity of the new regulator and the lengthy process to privatize generation and transmission assets led to a deterioration of the financial conditions of the sector. Yet, the strong political will of the government as well as the urgent need to avert a fiscal crisis made a sizable tariff increase (about 30 percent) possible during 2004–05, which the authorities communicated as an important measure of their fiscal consolidation strategy. The gradual privatization reduced the exposure of the government budget to the energy sector. The authorities succeeded in implementing well-functioning wholesale electricity markets. Overtime, they have succeeded to depoliticize tariffs setting, as the regulator has become more capable, and they have largely eliminated cross-subsidization among consumers, except for a lifeline for poor families and small subsidies for inhabitants in remote and under-developed regions.

Turkey has implemented a sequence of reforms in the electricity sector since the 1980s in the context of its transition from a state-dominated to a more market-oriented economy. Initially the authorities mainly aimed

Box 1. International Experiences on Reforming Electricity Subsidies (Concluded)

to implement structural changes, such as unbundling the vertically integrated state-owned energy companies into different business activities, promoting privatization, and introducing a wholesale electricity market. They pushed for tariff reform when it became clear that the low tariffs impeded proper maintenance and investment and generated excess demand. The authorities adopted a cost-based pricing mechanism in early 2008 to allow automatic tariff adjustment to costs and implemented multiple price increases during 2008–09. Economic growth, improving living standards, and a well-functioning social safety net protecting the poor softened resistance to the tariff reform.

Uganda managed to push through significant electricity tariff increases in 2012 largely on the back of the government's reform determination and effective communications with all stakeholders. The government convinced the latter that they lacked fiscal space to continue subsidizing electricity (explicit subsidy amounted to 1.1 percent of GDP in 2011), that benefits of such subsidies accrued disproportionately to the rich, and that removing them would be pro-poor. They maintained a lifeline tariff (for monthly consumption below 15 kWh).

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Appendix I. Construction of Electricity Sector Index

The electricity sector composite index used in the cross-country regression analysis is constructed by extracting the common trend of a set of key electricity sector indicators using principle component analysis (PCA). Below is a brief account of the underlying data and their treatment before feeding into the PCA, as well as how the thus constructed index compares with indicators compiled by the Global Competitiveness Report and the Doing Business Report. All the raw data series are retrieved from the World Bank online data platform, the databank.

1.   **Data.** The PCA is performed for 81 countries[1] covering 1990–2015. Appendix Table 1 lists the source and treatment of the individual indicators in the PCA. Variables based on firm-level survey have only a few sparsely located non-missing observations over the whole sample period, and therefore the country-specific sample averages instead of original variables are used in PCA, with the purpose to account for cross-country level difference. The time-series dimension of the composite index mainly captures the evolution of electricity generation, consumption, access to electricity, and transmission and distribution losses.[2] All variables are normalized so that their values are between 0 and 1, and that greater values correspond to better performance (for instance, higher value for the normalized transmission and distribution losses means lower losses).

Appendix Table 1. Data Used in the Principle Component Analysis

Database	Indicators	Inclusion in PCA
Sustainable Energy for All	Total electricity output, access to electricity, rural access to electricity	Yes. Electricity output is converted into per capita
	Share of electricity produced from renewable resources	No. Low sample adequacy according to Kaiser-Meyer-Olkin (KMO) measures
World Development Indicators	Per capita electricity consumption, transmission and distribution losses, share of firms experiencing electricity outages, power outages in a typical month, value lost due to electric outages	Yes
	CO_2 emission from electricity and heat production	No. Low sample adequacy according to KMO measures
Doing Business	Cost to get electricity	Yes
	Price of electricity, number of procedures, and time to get electricity	No. Short sample and low sample adequacy according to KMO measures
Enterprise Survey	Percent of firms choosing electricity as biggest obstacle, percent of firms considering electricity as a major constraint	Yes.

Source: IMF staff.

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[1] In addition to countries shown in Appendix Table 2, the PCA also includes Argentina, Trinidad and Tobago, and Uzbekistan, which are excluded in the panel regression analysis due to missing data on other explanatory variables.

[2] Missing observations of these series are replaced with the nearest non-missing values if they appear in the beginning or the end of each individual country series, and with the arithmetic averages if they appear between two non-missing observations.

2.   **Performance of the PCA.** The composite index is calculated as the first principle component which explains over 50 percent of variation of the eleven variables in the PCA. All variables have Kaiser-Meyer-Olkin (KMO) measures above 0.7, and two thirds of the variables have KMO measures above 0.8, suggesting acceptable sample adequacy for using the PCA. As expected, the index positively correlated to each individual variable, with the lowest correlation equal to 0.46 (transmission and distribution losses) and above 0.6 for all other variables. Regarding cross-country differentiation, the index also corroborates relatively well with assessment in the Global Competitiveness Report (GBR) and Doing Business (DB) Report, as can be seen from Appendix Table 2 which presents cross-sectional correlation between the composite index and the GBR/DB indicators for a given year.

	Global Competitiveness		**Doing Business: Getting Electricity**	
	Quality of electricity supply	Electricity and telephone infrastructure	10-15 methodology	16-19 methodology
2007	0.72	n.a.	n.a.	n.a.
2008	0.72	n.a.	n.a.	n.a.
2009	0.72	n.a.	0.32	n.a.
2010	0.75	0.86	0.26	n.a.
2011	0.76	0.87	0.24	n.a.
2012	0.76	0.87	0.22	n.a.
2013	0.79	0.88	0.42	n.a.
2014	0.78	0.88	0.44	0.67
2015	0.76	0.87	n.a.	0.69

Appendix Table 2. Cross-Sectional Correlation with Alternative Indicators, 2007–15

Sources: Global Competitiveness Report, Doing Business Report, and IMF staff calculation.

Appendix II. List of Countries Used in Empirical Analysis

Euro Area	Emerging and Developing Europe	Commonwealth of Independent States	Emerging and Developing Asia	Latin America and the Caribbean	Middle East, North Africa, Afghanistan, and Pakistan	Sub-Saharan Africa
Czech Republic	Albania	Armenia	Bangladesh	Bolivia	Egypt	Angola
Slovak Republic	Bosnia and Herzegovina	Azerbaijan	China	Brazil	Iraq	Botswana
Slovenia	Bulgaria	Belarus	India	Chile	Israel	Cameroon
	Croatia	Georgia	Indonesia	Colombia	Jordan	Côte d'Ivoire
	Estonia	Kazakhstan	Malaysia	Costa Rica	Lebanon	Gabon
	FYR Macedonia	Kyrgyz Republic	Myanmar	Dominican Republic	Morocco	Ghana
	Hungary	Moldova	Pakistan	Ecuador	Sudan	Kenya
	Latvia	Mongolia	Philippines	El Salvador	Yemen	Mauritius
	Lithuania	Russia	Sri Lanka	Guatemala		Namibia
	Poland	Tajikistan	Vietnam	Honduras		Nigeria
	Romania	Ukraine		Jamaica		Senegal
	Serbia			Mexico		South Africa
	Turkey			Nicaragua		Tanzania
				Panama		Zambia
				Paraguay		Zimbabwe
				Peru		
				Uruguay		
				Venezuela		

Source: IMF staff.