



# **COVID-19**

## **Response and Recovery**

### Mobilizing financial resources for development

DA-COVID-19 project led by Debt and development  
Finance Branch, Division on Globalization and  
Development Strategies (DDFB/DGDS)

# Kyrgyzstan's Fiscal Path to Sustainable Recovery

**Pankhuri Dutt**

**ESCAP Macroeconomic Policy and  
Financing for Development Division**

*This document has not been formally  
edited and does not necessarily represent  
the views of the UN, UNCTAD, ECA,  
ESCAP or ECLAC*



## About the COVID-19 Response and Recovery project

This paper is an output from the project “Response and Recovery: Mobilising financial resources for development in the time of COVID-19”, which is co-ordinated by the Debt and Development Finance Branch of UNCTAD and jointly implemented with ECA, ECLAC and ESCAP. This project is one of the five UN Development Account short-term projects launched in May 2020 in response to the COVID-19 crisis.

The project aims to enable low-income and middle-income developing countries (LICs and MICs) from Africa, Asia-Pacific, and Latin America and the Caribbean to diagnose their macro-financial, fiscal, external financial and debt fragilities in the global context, and design appropriate and innovative policy responses to the COVID-19 pandemic leading toward recoveries aligned with the achievement of the Sustainable Development Goals (SDGs).

## Abstract

This study assesses Kyrgyzstan’s fiscal stimulus response to the COVID-19 pandemic and its future plans to ensure a sustainable, green and forward-looking path towards recovery. As a country reliant on remittances and trade, the country experienced significant economic contraction and a rise in fiscal deficit due to both the health impact of the pandemic and the consequences of mitigating measures including lockdowns. The paper discusses Kyrgyzstan’s present national policies and their alignment with commitments to the Sustainable Development Goals. Post-pandemic recovery policies are examined under socially inclusive, green, and digital policy heads; additionally, pre- and post-COVID-19 gaps in implementation and financing that require attention are highlighted. The UNESCAP Macroeconomic Model, which allows for in-depth quantitative modelling of future policy proposals based on realistic regional simulations, is used to present policy strategies under different funding and priority scenarios. Finally, potential revenue sources to fund the suggested policies are discussed, including grants, public and private sector reforms, remittances and taxation on non-renewable energy.

## Contents

|   |          |
|---|----------|
| <b>Abstract .....</b>   | <b>3</b> |
| 1. Introduction .....   | 5        |
| 2. Impact of COVID-19 on Kyrgyzstan's economy.....                              | 6        |
| 3. Kyrgyzstan's COVID-19 measures mapped against the new recovery strategy..... | 8        |
| a. Social and inclusive policies.....   | 9        |
| b. Green development.....   | 12       |
| c. Digital access.....  | 12       |
| 4. Policy actions for to a resilient, inclusive, and green Kyrgyzstan .....     | 13       |
| a. Social development policy gaps.....  | 15       |
| b. Green development policy gaps.....   | 18       |
| c. Digital development policy gaps .....  | 20       |
| d. Partnership for goals .....  | 20       |
| 5. Fiscal impact of the proposed policy changes.....                            | 21       |
| 6. ESCAP macroeconomic model estimates .....                                    | 26       |
| a. The ESCAP Macroeconomic Model .....  | 26       |
| b. Short-term policy response.....  | 29       |
| c. Broadening social support measures .....                                     | 31       |
| d. Financing social support through public sector efficiency gains .....        | 33       |
| e. Investing in digital access and green development .....                      | 34       |
| f. Financing investment through grants and concessional loans .....             | 36       |
| g. Taxing carbon to help finance the programme.....                             | 38       |
| 7. Resource mobilization for additional financing needs.....                    | 41       |
| Annex: ESCAP Macroeconomic Model equation listing.....                          | 43       |
| References.....   | 66       |



## 1. Introduction

More than 18 months after the start of the COVID-19 pandemic, the world is still fighting new strains of the virus, and countries are still using lockdowns, sealing borders, or restricting air travel in severe situations as ways of breaking the chain of transmission. As advanced countries start rolling out their programs for the third or booster shots of the vaccines, large sections of the population in emerging economies are still not vaccinated. This health shock not only resulted in millions of deaths globally but also an unprecedented decline in global growth in 2020. Moreover, the uncertainties around the virus and vaccination access still present a high downside risk, especially in low- and middle-income economies.

In addition to impacting growth negatively, the pandemic has also challenged and tested the healthcare systems and their capacity in several countries. As a result, efforts to reduce extreme poverty have been impacted negatively. According to World Bank estimates, the pandemic led 97 million more people into poverty across the globe. This is an unprecedented increase in global poverty (World Bank, 2021). Growth recovery in 2021 is likely to reduce these poverty numbers to some extent. As a result, most governments are now focusing on directing their revenues toward growth-related sectors. If growth remains the main focus of recovery, it could have a direct impact on the investments in the social sector and the commitments of the countries towards the Sustainable Development Goals (SDGs) under the Agenda 2030.

Kyrgyzstan was hit hard by the pandemic. However, the quick government response through policy action and communication, especially in the health sector, helped cushion the impact of the pandemic. At the same time, political instability within the country and existing cross-border challenges disrupted the recovery. The new government has promised bold new reforms in the public sector and a fight against corruption which will help them attract foreign investment and support of the international community. This investment is likely to be crucial for their development and growth.

Accordingly, this report discusses the policy actions introduced by the government of Kyrgyzstan as a response to the pandemic and the likely impact the developments since then have had on their path towards the SDGs. The second section briefly discusses the impact of the pandemic on the economy. The third section lists the policy responses of the country to social and inclusive, green, and digital policy imperatives. The fourth section of the report

discusses the existing government policies, their alignment with the SDGs and the gaps that future policies must address. These could be pre- and post-COVID gaps that need attention so that the country can be on track to achieve its own strategic targets as well as those under Agenda 2030. The fifth session discusses the fiscal impact of the policy changes. The sixth section presents the modelling estimates for measures to bridge the gaps discussed in section four. The seventh and last section discusses the potential revenue sources that can be mobilised to support the additional financing needs.

## 2. Impact of COVID-19 on Kyrgyzstan's economy

Kyrgyzstan's economy was severely impacted due to the severity of the lockdown along with a significant decline in trade (non-gold), remittances, and tourism. According to official estimates, the economy contracted by 8.6 percent in 2020. Sectors like transportation, mining, construction, and trade were affected significantly due to the lockdown and global restrictions. Amidst the pandemic induced shocks, the Kyrgyz government implemented several policies that ranged from complete lockdown, to increased investments in the healthcare sector, tax deferrals, firm liquidity support, transfers to low-income households, and support to the small and medium enterprises. The decline in economic activity and increased priority expenditures severely constrained the public finances of the country. Consequently, GDP, per capita income, deficit, and debt were negatively impacted. According to the IMF's 2021 Article IV consultations, growth will rebound in 2021 and 2022 but uncertainties and risks remain high. Their GDP per capita fell significantly to USD 1224 in 2020, which is below their per capita levels in 2018. Per capita income is likely to reach 2019 levels only by 2025.

The IMF Article IV report (2021) estimates that the fiscal deficit increased to 3.3 percent in 2020 and will continue to increase in 2021-22, likely breaching 4 percent in both years. Cuts in capital and goods and services expenditure helped reduce the deficit but the political instability in the country increased costs of both domestic and external financing. General government revenue decreased by 1.4 percentage points as a share of GDP to 31 percent in 2020. This was mostly due to a sharp decline in tax revenues from international trade and transactions and value-added transactions indicating a lower consumption. The pandemic also derailed the efforts of the government in ramping up expenditure and efforts to strengthen the social sectors as most of the budgetary expenses had to make way for

increased spending on pandemic related expenses. An analysis of the actual and projected sectoral expenditure as a share of total expenditure each year reveals that an increase in expenditures in health care and education came at a cost of a reduction in expenditure on environmental protection, housing and utilities, recreation, and social protection (MoF, 2020).

**Table 2.1 – Share of government expenditure by sectors**

| <b>Expenditure (percent of current expenditure)</b> | <b>2019</b> | <b>2020 (E)</b> | <b>2021 (P)</b> |
|---|-------------|-----------------|-----------------|
| General public services                             | 40.44       | 39.60           | 30.13           |
| Economic issues                                     | 8.84        | 9.88            | 26.39           |
| Defence   | 14.24       | 14.24           | 11.62           |
| Environmental protection                            | 0.57        | 0.44            | 0.37            |
| Housing and utilities                               | 1.42        | 1.12            | 0.62            |
| Health care   | 2.20        | 3.08            | 4.11            |
| Recreation, sports, culture, and religion           | 2.67        | 2.14            | 1.51            |
| Education   | 20.95       | 21.82           | 19.23           |
| Social protection                                   | 8.67        | 7.69            | 6.02            |

However, share of expenditure on all these sectors are likely to remain lower than 2019 levels in 2021 as well. For instance, the share of expenditure on education will decline from 21 percent in 2019 to 19 percent in 2021, even though there is an absolute increase in the total expenditure on education. This absolute increase in education budget is on account of salaries of teachers that will be added to support the expected increase in student enrolment. Despite the challenges associated with reduced revenue potential and the limited scope of increasing public debt, the decline in total expenditure share on social sectors is worrying. In comparison, the expenditure for the health care sector as a share of total expenditure and in absolute terms is budgeted for an increase in 2021. This increase in health care sector expenditure will mostly be on account of an increase in public investments. But even though the health sector is likely to gain in the short run, it was already underfunded in 2019 and needs more investment going forward (MoF, 2020).

Public debt rose by 16.5 percentage points to 68 percent of GDP in 2020. The IMF estimates that the country's public debt outlook is vulnerable to export and GDP growth shocks but is sustainable (2021). However, it is necessary to consolidate expenditure, avoid non-concessional borrowing and improve public investment management to reduce vulnerabilities.

According to IMF estimates, exports that had seen a 13.8 percent increase in 2019, declined by 22 percent in 2020. Non-gold exports fell by 14 percent while tourism declined by 77 percent. Remittances that fell sharply in the initial months following the lockdown recovered and surpassed 2019 levels. Exports are likely to grow in 2021 but at a much slower rate of 5.7 percent. Imports also were affected due to lockdown and pandemic induced restrictions, and they decreased by 29.7 percent in 2020.

The consumer price index had increased by 10 percent for all goods and services and by 17 percent for all staple foods in May 2021, compared to the same period last year. According to government sources, food prices are expected to increase till the end of 2021 (Reliefweb, 2021). Tariff and non-tariff regulations in Kazakhstan and export quotas in Russia on food grains like wheat could directly impact food prices in Kyrgyzstan. Kyrgyzstan is a net importer of wheat, a staple grain of the country. Food imports can be further affected negatively by any further depreciation in the national currency.

### 3. Kyrgyzstan's COVID-19 measures mapped against the new recovery strategy

There is an acute demand for a green and inclusive post-pandemic global economic growth trajectory. The forthcoming recovery period is being seen as an opportunity for governments to ensure their future expenditures and investments to support social inclusion and climate action. The impact of the pandemic was felt beyond the healthcare sector and adversely impacted equality, gender, and environmental policies. An inclusive and green fiscal stimulus is not only critical for a resilient recovery but also to mitigate the impact of future risks. Such measures could include removal of harmful fuel subsidies, carbon taxation, support to sustainable social and economic infrastructure investments, alignment of the private sector participation with development goals, energy-efficient transport solutions, reduction in digital divide, and support to the most vulnerable population groups. According to the UNESCAP Building Forward Better policy package, fiscal recoveries in countries must focus on three main areas – improving coverage of social services, implementing green development, and improving digital access (UNESCAP, 2021). The first area includes improving access to healthcare services and ensuring a social protection system in place for the vulnerable sections of the population. Green development policies should focus on biodiversity, removing fuel subsidies, investing in climate-resilient infrastructure, levying carbon taxes, and

improving clean and green energy efficiency. Digital access policies should cater towards increasing ICT investments and spending on education. These policy measures will provide greater social and environmental benefits.

With more than 183,000 positive cases and more than 2700 deaths as of December 1, 2021, the country has experienced significant losses due to the pandemic. The uncertainties around growth remain high due to plausible recurrences of epidemic waves and a slow vaccination schedule in the country. As of July 28, 2021, 6.2 percent of the country's total population had received at least one dose of the vaccine, and only 1.8 percent of the total population was fully vaccinated. Around USD16 million (0.2 percent of the GDP) was allocated to emergency health sector expenditure for procuring personal protective equipment and medical tests and communication policies. Because of this, the fiscal stimulus package that was introduced by the government in 2020, seems to have had a limited impact on negating the economic shock due to the pandemic as most measures were for short-term relief and focused more on improving immediate firm liquidity issues and tax deferrals than providing social protection or enhancing the digital ecosystem. These budgetary and externally financed measures amounted to almost 7.4 percent of the country's GDP amounting to almost USD 500 million. The health sector contingency plan amounted to 0.2 percent of the GDP and cost around USD 16 million. Most of this expenditure was to train and equip the health sector to combat the pandemic. The temporary price controls on food items, tax deferrals and cancellations under the anti-crisis measures amounted to an additional USD15 million (0.2 percent of the GDP). A large share of the fiscal stimulus - almost 7 percent - was directed towards providing liquidity support through tax exemptions and subsidized loans to small and medium enterprises as well as food security to vulnerable groups (IMF, 2021). The policy measures undertaken by the country can be grouped as social and inclusive, green, and digital as shown below.

#### a. Social and inclusive policies

**COVID-19 healthcare provisions** – Testing and treatment under a free basic package of primary care and emergency services are a part of the government provision and provided free of charge under the State Guaranteed Benefit Package. The State Guaranteed Benefit Package is a part of the Mandated Health Insurance Fund which can source funds from the public budget as well as private donors. These provisions were used well during the pandemic. Budgetary amendments in May 2020 allocated USD 71.4 million (5692 million soms) for COVID-19 related emergency response and an additional USD 25.93 million (2061.6



million soms) directly to health. Development partners also pledged an additional USD 45 million to support the health sector over a period of 2-3 years from the onset of the pandemic. This support was mostly directed towards the purchase of medical devices, medicines, training, and laboratory services needed as an emergency response to the pandemic. Hospitalized patients with COVID-19 were treated as emergency cases, without co-payments or out-of-pocket payments. The MHIF also reimbursed patients for medicines, utilities and food, PPE, tests, and salaries of health care workers. It also paid the allocated budget expenses to hospitals even though hospitals were not providing the planned services (WHO, 2021).

**Food security** – The provision of food kits was the main source of government aid provided directly to households. It prepared a targeted list of vulnerable groups for food distribution, budgeted for necessary food reserves in the state reserves, and organized and coordinated with the neighbouring countries and trade partners for necessary freight movement. 175 thousand beneficiaries received 4,300 metric tonnes of food in exchange for participation in several community projects. The ration distribution included 150 kg of fortified wheat flour and 15 litres of vegetable oil per family. People living in social inpatient institutions were also assisted. In addition, 80,000 school children received 440 metric tonnes of wheat flour in August 2020. Vulnerable farmers and households were supported through seeds for spring and winter sowing, agriculture inputs, and information (UN, 2020). According to the MICS report, one in three households in urban and one in four households in rural areas received social support from the government during the pandemic. While the households found the quantity and quality sufficient, the targeting of the program was weak as the support to households in two poorest income quartiles was lower than that to the two richest quintiles (MICS, 2021).

**Social protection** - Targeted cash transfers were made to beneficiaries of the existing MBPFC and Monthly Social Benefit programs as a part of the first response package. On September 1, 2020, the government also announced a pension increase that was in line with a former demand from pre-COVID times. However, these transfers are not sufficient and do not have enough coverage to address growing income insecurities (SERF, 2021).

**Education** – All schools were closed in April and May 2020 as the first response to the pandemic by the Ministry of Education and Science. This affected over 1.7 million children in 6426 schools in the country. The education ministry also put in place an anti-crisis

action plan to ensure continued education during the lockdown. Priority lessons were identified to be aired through national channels on television and by early April 2020, 1300 video lessons had been recorded for distribution. The ministry also obtained special permission to mobilize teachers for these recordings during the lockdown (UN, 2020). The new academic year from September 2020 saw Grade 1 students returning to school while all others continued on the remote learning platforms. The regulations were revised to re-open schools on a case-by-case basis based on the epidemiological situation in their district. As of December 2020, 89 percent of schools had reopened (UNICEF, 2020).

**Support to small and medium enterprises** - As of 2018, there were 14,520 small and 769 medium scaled businesses in Kyrgyzstan. In addition, there were 401,658 individual entrepreneurs and 439, 602 peasant farms. Together, this sector employed 492.7 thousand people in the country. The small and medium scale business and individual entrepreneurs' amount to almost 20 percent of the total employment in the country. In the first quarter of 2020 (Jan-March 2020), this sector accounted for one-third of the country's GDP. In Kyrgyzstan, the slowdown in the United States, China and European Union is most likely to affect exports in sectors like precious metals (gold), leather goods, cotton, and wool and animal hair among others. Almost 74 percent of the small and medium scale enterprises in the country operate in this sector. Moreover, 33 percent of the female workforce employed in these sectors will be affected negatively. The government offered relief through tax measures and cash transfers to affected MSMEs, but several MSMEs also shut shop during the pandemic, impacting some SDG goals directly. The Anti-Crisis Fund under the Act on New Economic Freedom was set up in April 2020 to support export-oriented SMEs. This was because medium-sized firms that constitute only 0.2 percent of total firms contribute to 14.5 percent of the country's exports (IFC, 2021).

According to an IFC report (IFC, 2021), the country's private sector was severely impacted as more than 80 percent of respondents to a survey reported a revenue loss of 75 percent. Early in the lockdown, most respondents had put their employees on leave without pay, and 2 in every 3 respondents did not have more than a month's resources to cover operational expenditure of their enterprises.

**Vaccination strategy** – The government of Kyrgyzstan aims to vaccinate 45 percent of its total population free of charge. The country is a part of the Covid-19 Vaccine Global Access (COVAX) Advanced Market Commitment facility and will receive 20 percent of its

vaccine needs from this channel. For the remaining part, the country is relying on international organizations like the World Bank to help them secure vaccines at an affordable rate (World Bank, 2021).

### b. Green development

**Air quality** - The limited economic activity did have a positive impact on the environment. On an average, PM2.5 levels remained below those of 2019 throughout the lockdown period and in the following months of 2020. Despite a spike in December 2020, the PM2.5 levels have remained below 2019 levels so far. At the same time, the frequency of checks of enterprises by government enterprises were reduced to

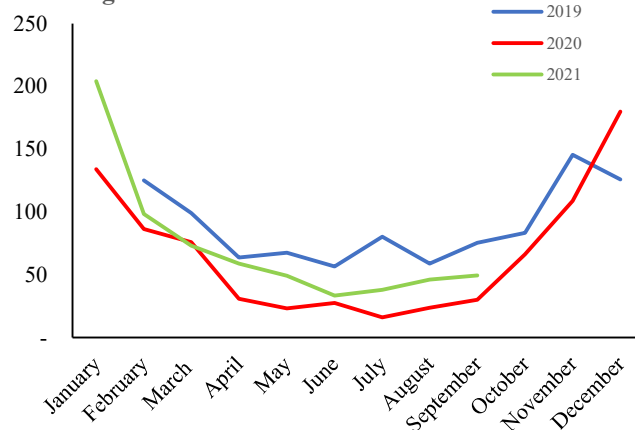
aid economic recovery. This could have led to regulatory breaches, especially with environmental and social policies as businesses grappled to survive the after-effects of the lockdown. For instance, government data shows that expenditure of enterprises and organizations for environmental protection decreased by almost 11 percent from 6128 million soms in 2019 to 5465.7 million soms in 2020. The most significant cuts were made to expenditures on waste management and protection and rational use of land. The moratorium on the state inspections was further extended till January 1, 2022 (Ministry of Economy of the Kyrgyz Republic, 2020).

**Policy stance** - Kyrgyzstan government also pledged to strengthen the existing Action Plan of Comprehensive Measures to Improve the Environmental Situation in selected regions in 2020-23 with a focus on reducing air pollution.

### c. Digital access

**Remote education** - The MICS survey reports that almost 82 percent of children were enrolled in distance learning. They could access educational material and classes mostly through mobile phones or tablets and television broadcasts. However, one in every two children had poor access due to low quality of internet connection or lacked time to

Fig. 3.1 : PM2.5 levels in Bishkek



Source: AirNow, US Department of State.

watch television broadcasts and one in three lacked funds for continued mobile connectivity. This caused dissatisfaction among parents and led to poor knowledge dissemination among students. Almost 37 percent students reported having limited access to proper equipment for effective remote education (MICS, 2021).

**Remote healthcare access** - Kyrgyzstan government also had a hotline, dedicated WhatsApp number, and a telephone number for all COVID-19 related concerns. Mobile health applications were also updated to integrate COVID-19 related information.

**Nutrition information dissemination** - An information campaign called “School Meals at Home” was launched to share social media-friendly material containing nutritious recipes, menus and other resources on child nutrition and health with families. Awareness-raising and behaviour-changing materials on the topics of child health and nutrition were shared on social media platforms such as YouTube, Instagram, and Facebook (UN, 2020).

**Other digital efforts** – Online support to farmers, a web portal for accessing social protection provisions, a fairy-tale website to improve parent-child interaction were some other digital initiatives introduced by the pandemic to support vulnerable groups (UN, 2020).

## 4. Policy actions for to a resilient, inclusive, and green Kyrgyzstan

Kyrgyzstan has prioritized a people-centred national policy approach on its path towards attaining the Sustainable Development Goals. Currently, the government’s strategies are well aligned (82 percent) with 16 Sustainable Development Goals (VNR, 2020). The Government of Kyrgyzstan had introduced a roadmap to support resilient and inclusive growth before the pandemic. In its vision document for a period from 2018 to 2040 called the “National Development Strategy”, the country emphasized the need for a politically stable, economically strong, and socially responsible state (Government of Kyrgyzstan, 2018). The document focuses on four strategic areas – economic policies to support employment, stable income, and job creation; social policies to improve quality and standard of living for its people; public administration policies to provide a strong and stable public administration system; and competitive policies to develop a digital economy to support entrepreneurs, applications, and innovations. Even in its document on macroeconomic outlook for 2021, the

Ministry of Finance emphasizes both economic growth and development through Unity, Trust, and Creation, which is the first phase of its national development strategy for the period between 2018 and 2022 (MoF, 2020). The country is part of the Paris Agreement on Climate, and the government has committed to reducing greenhouse emissions and also launched a cross-sectoral process by updating the nationally determined contributions to tackle climate change (VNR, 2020). The government has adopted the Concept of Comprehensive Protection of the Population and Territory of the Kyrgyz Republic against Emergency Situations that will be implemented between 2018 and 2030 (VNR, 2020). The country also has a Digital Kyrgyzstan 2019-2023 strategy (known as “Sanarip Kyrgyzstan”) to improve the digital footprint in the country and improve digital connectivity of services. To further strengthen the alignment of government strategies with the Agenda 2030, the Mainstreaming, Acceleration, and Policy Support (MAPS) review of the country policies in 2019 identified 9 priority Sustainable Development Goals and classified them under three pillars – sectoral reforms, governance and new public management, and a resilient society – as key focus areas that could be foundational for longer term development (UN, 2019).

**Fig. 4.1: 9 Sustainable Development Goals under the three MAPS pillars**



UN’s MAPS recommendations on priority SDG pillars and the existing government programs also closely align with the kind of growth and development that is necessary – social, green, and digital. These pillars can further be supplemented to recognize the digital efforts of the government and their intention to improve employment opportunities within the country by encouraging competition and innovation. Accordingly, these 9 priority SDGs when mapped into the growth model that is social, green, and digital will need to be supplemented by Goal 9 (Industry, innovation, and infrastructure).



Fig. 4.2: 10 Priority Sustainable Development Goals for Inclusive, Green, and Digital Growth



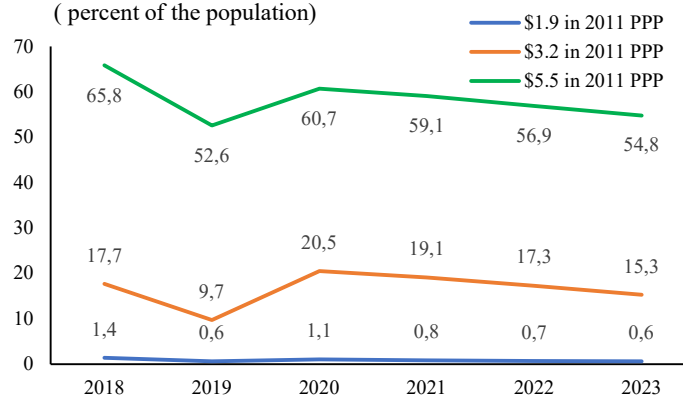
However, the pandemic has exposed various gaps in the path towards achieving these goals. This section discusses these challenges to the 10 priority Sustainable Development Goals categorized under the three pillars of desirable growth. Goal 17 that encourages partnership for goals is an overarching action that would be required for all pillars.

#### a. Social development policy gaps

**Poverty** – The country had made significant progress in reducing extreme poverty since 2000. However, the pandemic induced slowdown in economic activity within the country and in neighbouring countries like China and Russia have had a significant impact on all poverty levels in the country.

Only 0.6 percent of the total population was living under extreme poverty in 2019. According to World Bank estimates, around 1.1 percent of the total population was pushed into extreme poverty in 2020 due to the pandemic. This means almost 33,000 more people were

**Fig. 4.3: Poverty estimate**  
( percent of the population)



Source: World Bank, Poverty & Equity and Macroeconomics.

pushed below the international poverty line of 1.9 dollars a day. More than 700,000 people were pushed below the 3.9 dollars a day poverty line as the share of population living under this value increased from 9.7 percent to 20.5 percent. Moreover, almost 60 percent of the total population, almost 3.3 million people, now live under 5.5 dollars per day. Despite forecasted economic growth, these numbers are not likely to revert to pre-pandemic levels

before 2023. Moreover, a combined study by World Bank and UNICEF estimates that almost 55 percent of children under the age of 16 could be living in poverty due to the pandemic (UNICEF, 2020). Households have also reported either selling productive assets or reducing expenses on health and education due to the pandemic, which can have long term implications on the country's poverty levels.

As indicated by World Bank estimates, poverty levels are likely to increase in the country unless corrective measures are adapted to introduce new, impactful change. Poverty levels are significant among the working groups, children, and the elderly on pension. Poor quality of employment opportunities and lack of decent jobs is the main reason behind high poverty levels among the working class. A household survey on the impact of COVID-19 on women and children conducted by the National Statistics Committee shows that almost 76 percent of households were affected adversely due to the pandemic that led to income loss, affected education access, forced displacements, or impacted their health adversely. According to the survey, almost 51 percent households faced income loss, out of which, 24 percent households reported at least one member lost a job during the pandemic as a reason of income loss (MICS, 2021). Kyrgyzstan had 1.3 million households in 2020, which means, using the survey estimates, at least 319 thousand people were unemployed due to the pandemic. According to official estimates, 60 percent of the 6.6 million population was a part of the labour force out of which 3 percent, or 118.8 thousand people were unemployed before the pandemic. This means, a total of 437 thousand people were unemployed post pandemic, which is almost 11 percent of the labour force.

Inadequate social support to pensioners is the main reason of poverty in this group. The existing social protection system does not provide enough coverage to significantly impact the living standards of the recipients. Moreover, challenges like income concealment lead to poor targeting issues that result in the exclusion of those in need. Low average incomes, increased unemployment, and high food prices are likely to further dampen the effects of existing social policies. Remittances were mainly responsible for reducing extreme poverty in the country quickly and effectively. However, the slowdown in source countries like Russia, Kazakhstan, and China is likely to impact the inflows which mainly benefited lower-income households and those in rural areas. These trends indicate that there is a need to increase income levels within the country on an average (IMF, 2021). It also means that there is an urgent demand for scaling up the coverage of social protection, making the population more resilient, and adding features like unemployment benefits.

**Hunger** - Almost 70 percent of the household respondents of a rapid assessment survey by the World Food Program reported taking new loans to cover consumption and over 29 percent reported using their savings during the lockdown period (SERF, 2021). Moreover, in July 2021, consumer price index for staple food increased by 18.4 percent. New tariffs on imports, increased administrative costs and a warmer than usual summer that impacted domestic production are the likely causes of the price increase in addition to the effects of the pandemic. Rising food prices is likely to affect poverty and inequality levels in the country as currently, households living below the international poverty line spend around 70 percent of their income to buy basic food needs (WFP, 2021).

**Health** - Public health expenditure, whose main source is the budget, was already on a decline before the pandemic hit the country and government health programs were already underfunded. It was the highest at 4.2 percent in 2012 and has declined over the years to 2.8 percent in 2018. With much of healthcare services and funding being diverted towards pandemic related cases, there were disruptions in essential healthcare provisions. The pandemic also exposed the weak primary health care system of the country and the declining public financing that is reflected in the high out of pocket expenditure for patients. Out of pocket expenditures have been more than 50 percent of the current health expenditure since 2014 while public spending has declined to less than 50 percent (WHO, 2021). Pandemic induced job losses and reduced incomes have affected people's ability to manage health care risks. High out of pocket expenditures with low incomes increases the probability of people to fall into the poverty trap due to sickness which then becomes a vicious cycle. It is important to increase the funding on healthcare and especially for primary health care services to ensure continuity of other essential healthcare services. To better combat the high out of pocket expenditures, especially for the vulnerable groups like those in the informal economy, WHO also recommends reviewing and expanding the State Guaranteed Benefits Package to cover high priority services for everyone (WHO, 2021).

**Education** – The pandemic presented a unique challenge of providing continued education during lockdown and a quick transition to remote learning platforms. The country's initial policy response and the subsequent re-opening of schools based on district level analysis is commendable. However, this transition can be seen as an opportunity to further strengthen infrastructure in public schools and delivery of digital pedagogical methods. This might be especially useful in improving access to education for children with disabilities, in rural areas, and for those in the new settlements around Bishkek. For those students who

have access to traditional education in schools, the quality of curriculum and infrastructure needs improvement. According to a UNICEF report, 25.7 percent of schools do not have access to clean drinking water, 74.4 percent of schools do not have internal sanitary facilities, and 68.2 percent schools do not have access to hot water facilities. There is also a shortage of soaps, detergents, and disinfectants that are essential for maintaining sanitation and hygiene. Most schools are also not well-equipped to practice social distancing to help reduce the transmission of COVID-19 (SERF, 2021). Upper secondary education, which is not compulsory like primary education, shows a gender gap, and a strong association of access with wealth and geographic location. Moreover, it is essential to improve access of vocational, technical, and tertiary education among youth aged between 15 and 24 years to improve their employment prospects (UN, 2019).

**Peace, Justice, and strong institutions** – The challenging economic conditions, the domestic political events from the second half of 2020, and the continued waves of the pandemic have depleted the confidence of people in the government to some extent. A poll by International Republic Institute shows that almost 67 percent of respondents were dissatisfied with the government's response to the pandemic (SERF, 2021). The lockdown and associated job losses and business and social life disruptions increased tensions between communities, government, and regions. The availability of vaccines can strengthen re-opening programs and help people go back to their normal lives. Moreover, funding sources must be explored to ensure quicker access to vaccines.

#### b. Green development policy gaps

**Clean water supply and sanitation services** – Access to clean water and sanitation services is a necessity under green development initiatives. It is also closely linked with the health sector and can directly impact health outcomes among children. The pandemic has also highlighted the importance of hand washing in limiting the spread of infection. The country's existing water system is aging and needs an investment boost. For instance, water losses in agriculture are around 21.1 billion metric tonnes annually, which means, one-fourth of water extracted that could be used to improve agricultural productivity, is wasted due to losses. The irrigation system requires support to be more climate-friendly and yet ensure regular supply for sustainable agricultural practices. It is reported that during the pandemic, 25 percent of farmers had difficulty accessing irrigation water in 2020 compared to 14 percent in 2018 (UNDP; ADB, 2020).

**Affordable and clean energy** - Around 92 percent of the country's electricity is produced from hydroelectricity power plants which are considered green. All domestic production is consumed. However, electricity consumption has been on the rise and has increased by 83 percent since 2010. This means that there is a growing need for increasing its energy production that is now being met through coal instead of renewable or other green energy sources. Moreover, more than half of the existing electrical infrastructure in the country requires urgent upgrading or replacement (UNDP; ADB, 2020). The electricity sector has also been running deficits due to low tariffs for residential consumers and the inability of commercial tariffs to compensate for cost recovery in total. This sector is supported through budget subsidies, amounting to 3 percent of the GDP (IMF, 2021). Increasing residential tariffs would mean increasing support for vulnerable households for their additional expenditure. Moreover, the country has long winters, especially in its mountainous regions, but access to heating in the winter months is limited to Bishkek and other urban centres only. Almost 80 percent of households use traditional heating methods like coal, animal dung, wood, or rubber to meet their heating requirements. This leads to high indoor air pollution and consequently, the country has the highest number of mortalities in the world from lung diseases. On an average, poor households on a per capita basis, spend 12 percent of their monthly expenditure on heating, while middle income households spend around 9 percent while the wealthiest households spend 7 percent in comparison (World Bank, 2020).

**Climate action** – Most of Kyrgyzstan's budgeted expenditure is allocated towards salaries of and deductions for social funds. Consequently, expenditure on environment, biodiversity and climate action usually takes a back seat as was visible during the pandemic. Expenditure on environment related costs were reduced to accommodate increased expenditure on health. On an average, the funds allocated for environmental protection has been around 0.5 percent of the total budget expenditure in the recent years which have reduced in 2020 and 2021. Moreover, almost 85 percent of these budget expenses are spent on current expenditures like salaries. In addition to subsidies to the electricity sector, the government allocates subsidies to the mining sector, transport sector and the agriculture sector which might not have the intended social impact for vulnerable groups and in addition might be affecting the environment negatively (BIOFIN, 2019).

The country is vulnerable to climate change. Rural households and the agriculture sector are particularly sensitive to climate-induced water stresses that can reduce income



generation and increase poverty. Hydroelectricity generation has been impacted recently due to low levels of water in some national reservoirs that resulted in loss of export revenues and additional expenditure on electricity import to match domestic demands. Kyrgyzstan is also susceptible to avalanches, mudflows, flooding, and landslides. Incidences of such hydrological disasters have increased in the recent past. More than 80 settlements where approximately 75 percent of the population resides, are in seismically hazardous zones that are prone to high intensity earthquakes (VNR, 2020). Consequently, it is important for the country to mitigate the negative impacts of climate change that could directly impact its growth trajectory.

#### c. Digital development policy gaps

**Industry, innovation, and infrastructure** – Globally, businesses that could pivot to a digital model quickly were able to survive the shocks due to the covid-19 breakout and lockdown and cater to the increased demand of digital services. It is expected that the ICT sector in Kyrgyzstan grew by 10 percent in 2020 (UNDP; ADB, 2020). Public sector digitalization began before the pandemic through the Tunduk registry system for the social protection schemes and online payments in the banking system. However, poor internet connectivity and infrastructure are a big challenge in the way of the country's digital and innovation-led growth. Efforts are also needed in some areas to improve regulatory support for financial services and e-governance. Digitation can also improve efficiencies in the operations of the MSME sector and boost competitiveness. Most households do not have access to affordable internet within the country which directly impacts the demand for digital services uniformly and limit usage. To address demand side challenges, the government not only has to increase access to internet but also needs to improve digital literacy and skills, and access to digital technology. Moreover, it also must strengthen the delivery of digital healthcare and education services to improve their reach and impact in rural areas.

#### d. Partnership for goals

The 17<sup>th</sup> Sustainable Development Goal is an overarching goal that is cross-cutting in action and impact. Partnerships are needed not only between the public and private sector, but also civil societies, development partners, and international organizations. This is especially important for Kyrgyzstan's vaccination strategy and plans for financing its development programs. The pandemic has negatively impacted tax revenues of the country which could lead to lower or delayed expenditure on environmentally or socially relevant strategies. Moreover, Kumtor mine, which contributes approximately 10% of the country's GDP, is

scheduled for a shut down in the near future which will add to further revenue losses. Remittance flows are highly vulnerable to shocks in Russian and Chinese economy. The country must find ways of reducing its huge reliance on remittances. All these challenges underscore the importance of partnerships so that the country can grow and achieve the Agenda 2030 in a timely fashion.

## 5. Fiscal impact of the proposed policy changes

Implementing changes for the 10 SDG goals discussed above will require substantial fiscal expenditure. However, some policy changes need prudence and cost cutting, which can help balance out the fiscal impact of implementing new changes. It is important to note here that some of this expenditure is likely to have positive spill overs on other SDG goals and likely to support the government's 2040 growth strategies. For instance, providing social protection like unemployment benefits could help provide income support to poor households that can be used for tackle hunger or towards a skill training programs to gain future employment. A universal healthcare system can improve access of poor households and reduce their out-of-pocket expenditures which will leave a higher share of disposable income in their hands. As an example, the UNDP-ADB report noted that an additional expenditure of 0.6 percent of the country's 2020 GDP could result in a cash transfer of 1000 soms per month to additional 500,000 people who need help like unemployment benefits and healthcare access for at least six months (UNDP; ADB, 2020). Similarly, between 2012 and 2018, the country has spent up to 0.53 percent of its GDP on material damage due to emergency situations from disasters. This is almost equal to the amount budgeted for the environment ministry each year. These numbers can be seen as potential additional expenditures towards Sustainable Development Goals. To get a better estimate of additional expenditures, the UNESCAP estimates can be used. According to their estimates, spending 24 cents per person per day can affect the living conditions of people living in extreme poverty, spending 19 cents per person per day can help provide universal healthcare and quality education; 12 cents per person per day can deliver better transport, ICT, and water and sanitation services; 27 cents can furnish reliable access to clean energy and climate-related action; and 10 cents can protect and restore nature. In Kyrgyzstan's case, mapping these expenditures to the essential SDG goals means spending an additional 78 cents per day – 24 cents on poverty and malnutrition, 19 cents on universal healthcare and quality education, assuming an equal split – 4 cents each on ICT and water and sanitation services, and 27 cents for reliable access to clean energy and

climate action. If the government targets only the population living under USD 1.9 per day, this is what the expenditure per annum and as a share of 2020 GDP would look like for the country:

**Table 5.1: Fiscal impact of providing benefits to Kyrgyz people living under USD 1.9 per day**

| <b>For people living under USD 1.9 per day</b>     | Extreme poverty and malnutrition | Universal health coverage and education | ICT, clean water | Reliable and accessible energy and climate action | Total    |
|--|----------------------------------|---|------------------|---|----------|
| Suggested amount to spend per day per person (USD) | 0.24                             | 0.19                                    | 0.08             | 0.27  | 0.78     |
| Suggested amount to spend per annum (million soms) | 871.20                           | 413.01                                  | 173.90           | 586.91  | 2,045.01 |
| Percent of 2020 GDP                                | 0.15%                            | 0.07%                                   | 0.03%            | 0.10%   | 0.34%    |

If the government targets only the 1.1 percent of the population living under USD 1.9 per day as per World Bank estimates in 2020, the country needs to spend an additional 0.78 cents per day (64.7 soms per day) per person till 2030. This is equivalent to a total of 0.34 percent of the 2020 GDP per annum which amounts to 2045 million som (USD 24.6 million) per annum. In addition, if we also target the unemployed people of the country in 2020, which is estimated to be around 437 thousand in 2020, to provide them with a 500 som unemployment benefit per day for 6 months, the country needs to spend an additional amount of 1311 million soms (USD 15.76 million) or 0.22 percent of its 2020 GDP.

**Table 5.2: Unemployment benefit for 6 months**

|  |                     |
|--|---------------------|
| Number of people unemployed post-pandemic (thousand)       | 437                 |
| Suggested unemployment benefit per month per person (soms) | 500                 |
| Suggested amount to spend per annum (million soms)         | 1311                |
| <b>percent of 2020 GDP</b>                                 | <b>0.22 percent</b> |

This means a total additional expenditure of 0.56 percent of the GDP till 2030, specifically targeting 1.1 percent of the extremely poor. However, if the same expenses are spent on all people living under USD 3.2 dollar per day, the estimated expenditures increase significantly to 5.3 percent of the 2020 GDP. Nevertheless, it is important to target this section of population because approximately 20 percent of the population is likely to be living within this bracket by 2020. This assumption also means that this expenditure will be over and above the existing expenditure on health, education, and other social protection schemes. This is essential as the current level of social benefits are not adequate in targeting, coverage, and value. If unemployment benefits are added to this expenditure, then an expenditure amounting to 5.5 percent of the 2020 GDP (31.6 billion soms or USD 395 million) is needed per year till 2030.

**Table 5.3: Fiscal impact of providing benefits to Kyrgyz people living under USD 3.2 per day**

| <b>For people living under USD 3.2 per day</b>     | Extreme poverty and malnutrition | Universal health coverage and education | Better transport, ICT, water | Reliable and accessible energy | Total       |
|--|----------------------------------|---|------------------------------|--------------------------------|-------------|
| Suggested amount to spend per day per person (USD) | 0.24                             | 0.19                                    | 0.08                         | 0.27                           | 0.78        |
| Suggested amount to spend per annum (million soms) | 9,722.51                         | 7,696.98                                | 3,240.84                     | 10,937.82                      | 31,598.15   |
| <b>Percent of 2020 GDP</b>                         | <b>1.63</b>                      | <b>1.29</b>                             | <b>0.54</b>                  | <b>1.83</b>                    | <b>5.28</b> |

Almost 60 percent of the population lives under USD 5.5 per day according to World Bank numbers. This is a huge share of the population and to provide the same amount of expenditure to this entire group means an additional expenditure of 15.64 percent of the GDP per annum till 2030. With unemployment benefits, it means an additional expenditure of 15.86 percent of the 2020 GDP which amounts to 94,872 million soms (USD 1140.70 millions). This is a huge expenditure for the country to absorb for the next 9 years, especially after the pandemic when the overall growth of the country has been impacted negatively and as long as the uncertainty around the pandemic and the vaccine strategy remains uncertain.

**Table 5.4: Fiscal impact of providing benefits to Kyrgyz people living under USD 3.2 per day**

| <b>For people living under USD 5.5 per day</b>     | Extreme poverty and malnutrition | Universal health coverage and education | Better ICT, water | Reliable and accessible energy | Total        |
|--|----------------------------------|---|-------------------|--------------------------------|--------------|
| Suggested amount to spend per day per person (USD) | 0.24                             | 0.19                                    | 0.08              | 0.27                           | 0.78         |
| Suggested amount to spend per annum (million soms) | 28,788.10                        | 22,790.58                               | 9,596.03          | 32,386.62                      | 93,561.34    |
| <b>Percent of 2020 GDP</b>                         | <b>4.81</b>                      | <b>3.81</b>                             | <b>1.60</b>       | <b>5.41</b>                    | <b>15.64</b> |

However, increasing expenditure on dedicated programs to target the 20 percent of population living under USD 3.2 dollars per day seems achievable. A large share of the 5.5 percent of 2020 GDP target can be absorbed through cost reductions and efficiency gains from improvements in energy sector, some public sector reforms, and wage bill rationalization. This is also very close to the UNESCAP average additional expenditure recommendation for Asia and the Pacific region, which is stated at 5 percent of the 2018 GDP (UNESCAP, 2019).

While it is not practical to suggest an immediate 5.5 percent increase in expenditure dedicated to the SDG Goals aligned projects, the country can begin with by targeting 1.1 percent the population living in extreme poverty. Direct cash transfers to overcome challenges of extreme poverty and hunger, a universal health coverage, and investment in education of the extremely poor in the short run can be targeted with an expected outgo of 0.16 percent of the 2020 GDP which is equivalent to 1284 million soms (USD 15 million). In the meanwhile, it can seek private sector and international donor support for investments in ICT and improve operational efficiencies in the public sector and electricity sector. Another immediate and effective policy would be to provide unemployment support for at least 6 months of the next fiscal cycle or if possible, till the economy bounces back. This can also be an effective strategy to reduce the rate of labour migration to foreign countries and address challenges associated with high informal employment rates in the country. As more jobs are created, the share of unemployment and informal employment is likely to reduce and the financial outlay for this program is likely to reduce in the future.



An additional expenditure that has to be accounted for in the short run in on acquiring vaccines. The government of Kyrgyzstan aims to vaccinate 45 percent of its total population free of charge. Assuming that 75 percent of the population is above the age of 14, and the country targets to vaccinate 45 percent of its total population free of charge, the country has to incur the cost of vaccinating 2.2 million people, or 4.4 million shots. As of July 28, 2021, 6.2 percent of the country's total population had received at least one dose of the vaccine, and only 1.8 percent of the total population was fully vaccinated.

The country is a part of the Covid-19 Vaccine Global Access (COVAX) Advanced Market Commitment facility and will receive 20 percent of its vaccine needs from this channel. For the remaining part, the country is relying on international organizations like the World Bank to help them secure vaccines at an affordable rate. The World Bank has committed USD 20 million through its Strategic Preparedness and Response Program (SPRP) to provide additional financing of up to USD 10 million to support the government in the purchase and deployment of COVID-19 vaccines. The World Bank program is likely to cover an additional 8 percent of the country's population by accessing vaccines through the COVAX channel or direct contracts with manufacturers. Their program will also provide technical and financial support for vaccine deployment for 28 percent of their population (World Bank, 2021).

In addition, the country has received 150,000 doses of Sinopharm from China as humanitarian aid and 10,000 doses of Sputnik from Russian Federation as donation. These vaccines are likely to be used for the health sector personnel. This means that the country needs to find resources to vaccinate an additional 17 percent of the target population. 4 vaccines are approved and available in the country – 1 doze Sputnik Light, 2 doze Sputnik, 2 doze QazVac, and 2 doze Sinopharm. GAVI/COVAX estimates an expenditure of USD 18.2 million for assessing the implementation capacity, providing vaccine to cover the first 20 percent of the population, and provide financial and technical assistance for vaccine deployment and cold chain needs (World Bank, 2021). This means an additional expenditure between USD 20 million (assuming cost reduction due to capacity and previous assessment) and USD 25 million, which amounts to approximately 0.3 percent of the 2020 GDP.

## 6. ESCAP macroeconomic model estimates

In this section, we apply the ESCAP Macroeconomic Model (Holland & Sirimaneetham , 2021) to assess some of the macroeconomic, social and environmental impacts of the proposed policy changes discussed in sections 4 and 5. First, we provide a brief overview of the model. We then consider a series of scenarios to illustrate the potential impacts on key indicators from:

- a. a short-term policy response targeting the 1.1 per cent of the population living in extreme poverty (see figure 4.3 above), as well as providing temporary unemployment support for up to 6 months and financing the vaccination programme
- b. gradually expanding social support measures to cover the 20 per cent of the population living on less than \$3.20 per day (see figure 4.3 above)
- c. partially financing scenario (2) through public sector efficiency gains
- d. gradually increasing the policy package to include investment in green development and digital access
- e. partially financing the investment from scenario (4) through grants and concessional loans
- f. adding a small rise in carbon tax, or reduction in energy subsidies, to help finance the programme

### a. The ESCAP Macroeconomic Model

The ESCAP Macroeconomic Model is a global model and comprises 46 individual full-country models for the Asia-Pacific region, including a model of Kyrgyzstan, smaller models of 9 key trading partners outside of the region, plus aggregate models for the remaining world's economies grouped into 4 regions. The individual country models are linked together via trade, remittances, financial markets, and global energy markets. A full description of the model equations is included in the Annex.

The country models are characterized by a short-run Keynesian demand side and a long-run neo-classical supply side. In the model, households consume, save and supply labour, while

firms produce output, hire labour and invest. Governments pursue fiscal policy by spending and taxing, while monetary authorities conduct monetary policy by setting the short-term interest rate and exchange rate policy. The balance of demand and supply, together with tax policy, global commodity prices and other imported prices, determine inflation. Higher prices constrain consumption and dampen the net trade balance. Most of the key behavioural relationships are specified in an error-correction framework, which allows us to distinguish short- and long-term relationships between variables.

In the short run, GDP is driven by aggregate demand, which comprises private and public consumption, private and public investment and net foreign trade. Household consumption depends on real personal disposable income, financial inclusion (proxied by the share of population with a bank account) and the gap between actual and expected inflation rates. Private investment is determined by potential output, user cost of capital, financial inclusion and gross domestic income (which captures terms-of-trade shocks). Public consumption and investment and policy variables, and are disaggregated into spending on health, environmental protection and other areas. Exports depend on external demand and relative non-commodity export prices, both of which are derived from a global bilateral trade matrix. Finally, imports depend on domestic demand, the output gap, the relative price of imported goods and oil imports.

In the long term, each country's potential output level is driven by its aggregate supply, which is determined by the labour force, capital stock, energy use, energy efficiency, trend productivity growth and damage from climate shocks. The labour force depends on demographic factors and the labour force participation rate. The capital stock is driven by the accumulation of investment, after allowing for depreciation. The capital depreciation rate depends on global carbon emissions to capture the impact of climate change on the erosion of capital. Total energy demand depends on output, energy prices and energy efficiency. The energy mix depends on relative prices of oil, gas, coal and renewables. Trend productivity growth is modelled as a function of the global productivity frontier (which is related to global trade), inequality, risk perceptions, air pollution and government expenditure on health. Finally, damage from climate shocks is exogenous, although in this study it is linked to spending on climate-resilient infrastructure.

Deviations of actual output from potential output will activate adjustment processes that bring the economy back to potential in the long run. Among other channels, the gap between

demand and supply, or output gap, feeds through prices. For example, a positive output gap will put upward pressure on prices, resulting in slower consumption growth and a deterioration of the trade balance, so that demand falls towards available supply.

In the fiscal module, government spending is disaggregated into spending on social protection, spending on health, spending on environmental protection, fossil fuel subsidies, other government consumption, other government investment and interest payments. Spending on education is modelled through a rise in spending on other government consumption and other government investment. Government revenue is disaggregated into income tax revenue, corporate tax revenue, indirect tax revenue, taxes on international transactions, carbon tax revenue, commodity revenue and other net revenue. The fiscal deficit is financed by an increase in government debt, and debt service payments flow back onto the fiscal balance. In the model, an increase in the government debt-to-GDP ratio leads to a higher risk premium for that country. In this way, running a large fiscal deficit for an extended period of time can cause government debt to spiral and become unsustainable. Countries with a higher initial level of risk premium are more sensitive to any rise in public debt. A rise in the risk premium pushes up inflation and increases borrowing costs, which results in lower investment.

In addition to economic relationships, the model has additional channels to capture interactions with key social and environmental variables, such as poverty, income inequality, carbon emissions and air quality. Relationships between variables are econometrically estimated where appropriate or guided by the academic literature. For example, losses associated with climate shocks are underpinned by benchmarks contained in World Bank (2019), in which an investment in resilience valued at 1 per cent of GDP reduces annual damage by 5 per cent. Other major studies that are used for developing relationships among the variables include Botev, Égert, & Jawadi (2019), Briceño-Garmendia, Estache and Shafik (2004), ECB (2017), (Griscom, et al., 2017), IEA (2019; 2020), OECD (2019) and Wang (2015).

The poverty model assumes that income follows approximately a log-normal distribution. The cumulative density function of log income is calculated based on estimates of mean income and income inequality and evaluated at the poverty benchmarks of \$1.90/day and \$5.50/day. Income inequality is measured according to the after-tax Gini coefficient. It declines in response to a rise in government spending on social protection, or a rise in financial inclusion.

Carbon emissions depend on the composition of energy consumption, which in turn depends on the relative (after carbon tax) price of coal, gas, oil and renewables. Air pollution (PM2.5) also depends on the composition of energy consumption, especially the consumption of coal and oil. Air pollution feeds into trend productivity growth to reflect the relationship between pollution, health and productivity.

#### b. Short-term policy response

In a resource constrained country such as Kyrgyzstan, it may not be practical to suggest a large immediate rise in government expenditure. A small, immediate, well-targeted package can help to alleviate the burden on the most vulnerable sector, which has been particularly hard hit by the pandemic. This scenario considers the potential returns from a small package targeting the 1.1 percent of the population living in extreme poverty, those unemployed as a result of the pandemic, and financing the vaccine programme.

**Social protection** - Direct cash transfer to overcome challenges of extreme poverty and hunger is estimated to cost approximately 0.09 per cent of GDP per annum. This scenario allows for a permanent rise in spending on social protection of this magnitude. This increase in social protection spending will raise real personal disposable incomes of households, which in turn will increase personal consumption spending and GDP. It will reduce inequality and poverty, as a redistribution of income towards the poorest households. It will also worsen government finances, although the rise in GDP will partially offset some of the costs of the programme. In addition to the permanent rise in expenditure, we include a temporary rise in spending on unemployment support, to provide 500 soms in unemployment benefit per day for 6 months. This is estimated to cost 0.22 per cent of GDP in the first year of the scenario.

**Health** - To provide health coverage to the extreme poor, expenditure on health in Kyrgyzstan will need to rise by approximately 0.035 per cent of GDP per annum. The social returns of investment in health are well-documented. A healthy workforce is more productive, which translates into higher levels of GDP, higher levels of government revenue, lower unemployment, and higher real personal disposable incomes. Additional spending on health acts as a short-term stimulus to economic activity as well as delivering longer-term benefits. The longer-term impacts will depend partly on how the spending is split between consumption (for example salaries of health personnel) and investment (for example building hospitals). Both raise GDP in the short-term, but investment also accumulates as capital

stock, raising potential output over the longer-term. For the purpose of these scenarios, we treat roughly half of the investment in health as investment and half as consumption. In addition to the permanent rise in spending on health, this scenario includes a temporary rise in spending of 0.3 per cent of GDP to ensure that the vaccine programme is fully financed.

**Education** - To provide adequate access to education for the extremely poor, expenditure on education in Kyrgyzstan needs to rise by an estimated 0.035 per cent of GDP per annum. We treat roughly half of the spending as investment (i.e. building schools) and the other half as consumption (i.e. teacher salaries). The returns to education have been widely studied in academic literature. We can assume a benchmark estimate that a 1% of GDP rise in spending on education adds about 0.1 percentage points to trend productivity growth per year, calibrated with reference to the social returns to education reported by Botev, Égert, Smidova and Turner (2019). Broader access to education is also expected to reduce income inequality. The modelling assumption applied is that a 1% of GDP rise in spending on education delivers a 0.1 percentage point decline in the Gini coefficient, which in turn raises trend productivity by roughly 0.13%.

**Model-based results** - The social protection, health and education programmes outlined above will cumulatively cost the government roughly 0.16 per cent of GDP per annum, with additional spending equivalent to 0.52 per cent of GDP needed in the first year. Table 6.1 reports the expected short-run impacts of the policy package. GDP growth would be expected to rise by 0.4 percentage points in the first year relative to a baseline that excludes the package. Inflation may rise by about 0.1 percentage points temporarily, and nearly 3 thousand jobs would be created, while the rest of the unemployed would receive a temporary benefit to ensure a basic standard of living.

**Table 6.1 Impact of short-term policy response on key indicators relative to a baseline that excludes the programme**

|                                  |                        |
|----------------------------------|------------------------|
| <b>GDP growth</b>                | +0.4 percentage points |
| <b>Inflation</b>                 | +0.1 percentage points |
| <b>Jobs</b>                      | +2.9 thousand          |
| <b>Household consumption</b>     | +0.2 per cent          |
| <b>Number in extreme poverty</b> | -66 thousand           |
| <b>Government debt</b>           | +0.3 per cent of GDP   |
| <b>CO<sub>2</sub> emissions</b>  | +0.1 per cent          |

Source: UN ESCAP Macroeconomic model scenario

The rise in social benefits would increase household consumption by about 0.2 per cent and pull 66 thousand people out of extreme poverty. The programme would allow government debt to rise slightly – by about 0.3 per cent of GDP. A rise in debt of this magnitude is expected to have negligible impact on the borrowing premia in the first year, although as debt continues to accumulate it could push borrowing costs up by up to 28 basis points in later years. CO<sub>2</sub> emissions would be expected to rise slightly in the absence of additional measures to raise energy efficiency or shift the energy mix.

### c. Broadening social support measures

In this scenario we build on the initial short-term policy response described above, to gradually extend the social support measures above to cover the 20 per cent of the population living on less than \$3.20 per day. The first-year shocks applied are identical to those described in section 6.b. From the second year, expenditure on social protection, health and education rises gradually over a 4-year period, as described below.

**Social protection** - Tackling extreme poverty and malnutrition for those living on less than \$3.20 per day is expected to cost 1.63 per cent of GDP per annum. This scenario allows social protection spending to rise gradually, reaching 1.63 per cent of GDP by 2025.

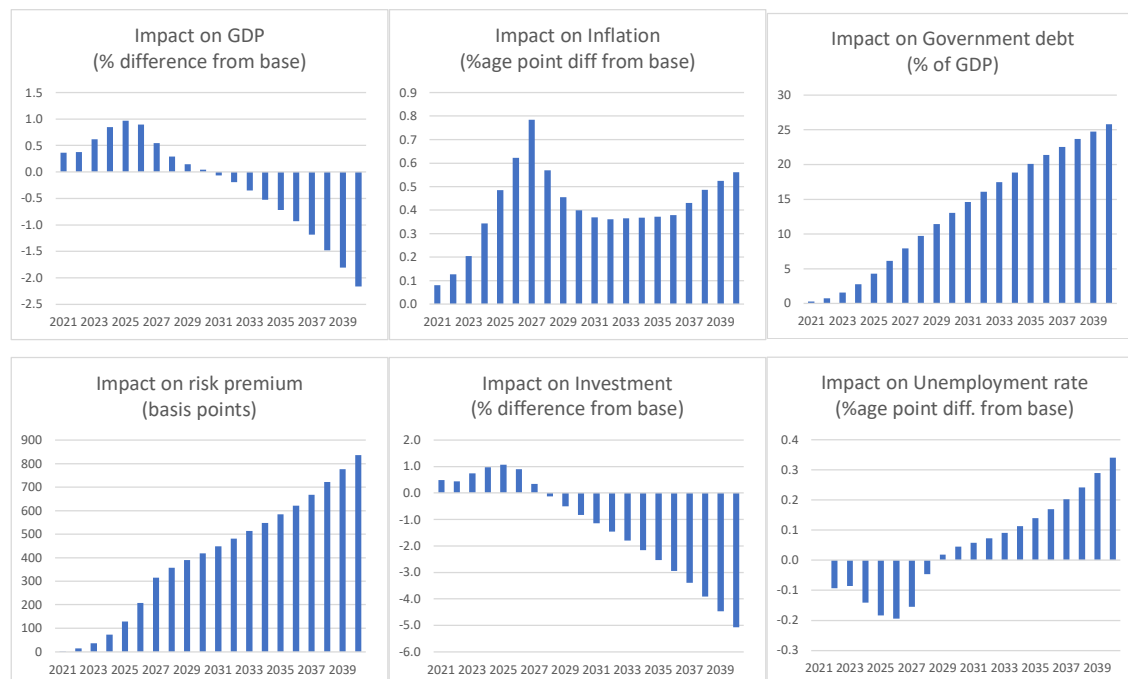
**Health** - To provide health coverage to the poor living on less than \$3.20 per day, expenditure on health in Kyrgyzstan will need to rise by approximately 0.645 per cent of GDP per annum. As before, we treat half of the additional spending as consumption and half as investment. The increase in spending is introduced gradually, rising to 0.645 per cent of GDP by 2025. Based on estimates from Wang (2015), a 0.645% of GDP rise in spending on health would be expected to increase labour productivity by about 1.1% by 2030. This rise in long-run potential and government revenue will partially offset some of the costs associated with expanding access to healthcare over the longer term.

**Education** - To provide adequate access to education for the poor living on less than \$3.20 per day, expenditure on education in Kyrgyzstan needs to rise by an estimated 0.645 per cent of GDP per annum. We treat roughly half of the spending as investment (i.e. building schools) and the other half as consumption (i.e. teacher salaries). The increase in spending is introduced gradually, rising to 0.645 per cent of GDP by 2025.



**Model-based results** - The social protection, health and education programmes outlined above will cumulatively cost the government roughly 2.92 per cent of GDP per annum, with additional spending equivalent to 0.52 per cent of GDP needed in the first year. This is clearly a large jump in spending for a resource constrained economy. According to the “business as usual” methodology developed in ESCAP (2021)<sup>1</sup>, based on past trends in financial resources, which include government revenue, official aid and development assistance received, net fiscal borrowing, domestic credit to the private sector, and net foreign inflows, Kyrgyzstan may struggle to raise funds in excess of 1.8 per cent of GDP. If this programme is financed entirely by government borrowing, government debt would rise steadily, driving the risk premium on Kyrgyzstan assets and borrowing costs upward. This, in turn, would curtail investment and put upward pressure on inflation, potentially fully offsetting the potential returns from the package. Figure 6.1 illustrate the expected impact of the policy package on key indicators, where the rise in government borrowing triggers a rise in the risk premium.

**Figure 6.1 Impact of broadening social support measures, financed fully by government debt**



Source: UN ESCAP Macroeconomic model scenario

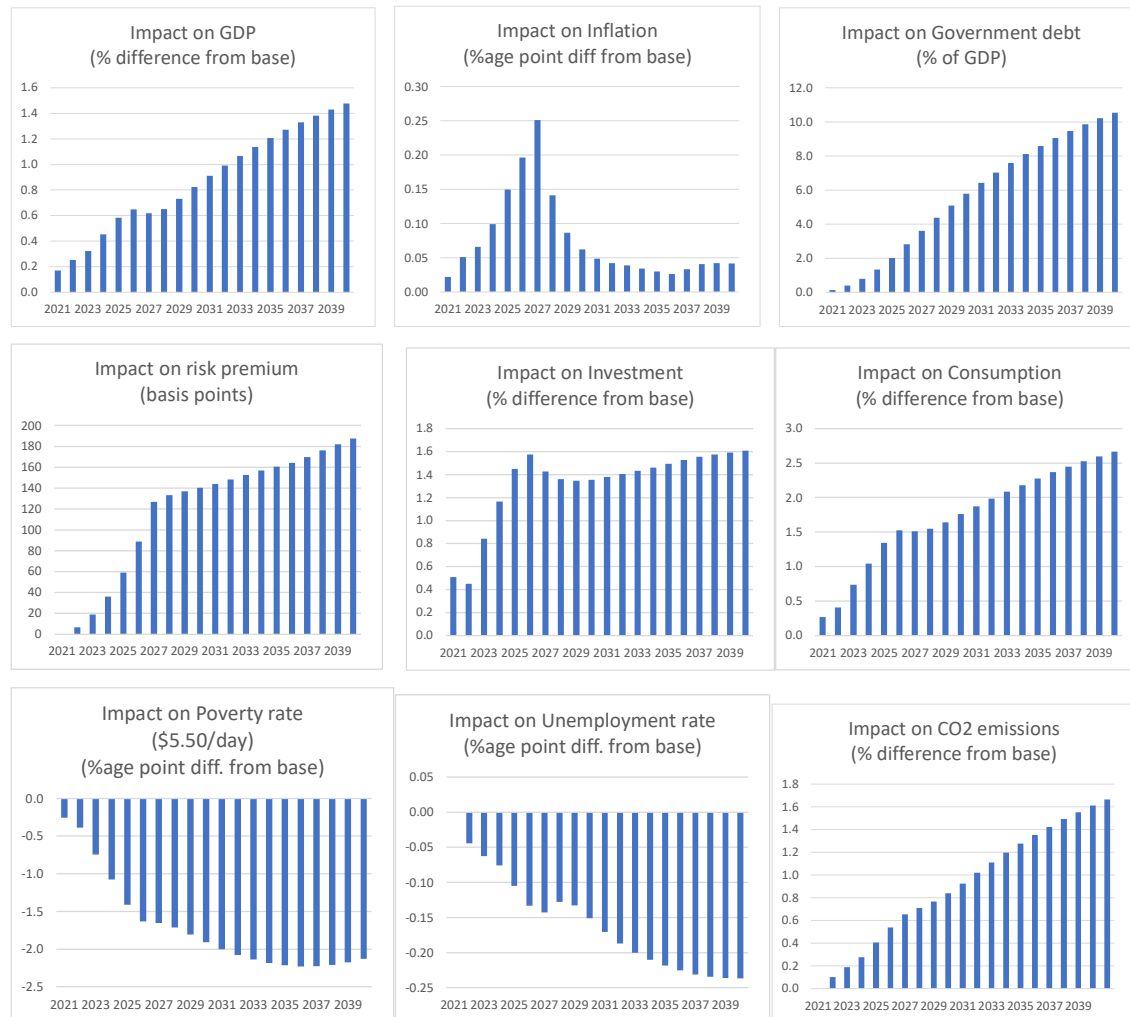
<sup>1</sup> Economic and Social Survey of Asia and the Pacific 2021: Towards Post-Covid-19 Resilient Economies, Annex 5.

GDP would be expected to rise initially, but as debt continues on an upward trajectory this would trigger a steady rise in the risk premium. By 2030, government debt would be expected to rise by 13 per cent of GDP, pushing the risk premium up by 400 basis points. This would sharply curtail investment spending, and the model suggest this would fully offset the economic returns from the programme by 2030. Inflation would remain elevated, and the unemployment rate would begin to rise. Clearly, introducing an important fiscal programme of this magnitude will require additional fiscal space to be created, either by cutting expenditure elsewhere or identifying additional sources of revenue.

#### d. Financing social support through public sector efficiency gains

A large share of the costs in the social support programme can be absorbed through cost reductions and efficiency gains from improvements in energy sector, some public sector reforms, and wage bill rationalization. In this scenario, we repeat the same scenario discussed in section 6.c, but assume that half of the additional spending is financed through public sector efficiency gains. This effectively halves the costs of the programme but reprioritizes spending towards high priority areas that also have high long-term returns.

**Model-based results** - Figure 6.2 illustrates the expected impacts on key indicators. While government debt would continue to rise in this scenario, the magnitude of the rise is much more gradual, remaining below 6 per cent of GDP by 2030 and beginning to stabilize by 2040. The risk premium may increase by over 100 basis points but does not trigger the spiral observed in the previous scenario. GDP is expected to rise steadily, reaching a level that is 1½ per cent higher by 2040 that would have been the case in the absence of the policy initiatives. This is supported by both higher levels of investment and higher levels of consumption. Higher consumption translates into lower levels of poverty. Without additional measures to strengthen energy efficiency gains or encourage a shift in the energy mix, CO<sub>2</sub> emissions would be expected to rise in line with the higher level of economic activity.

**Figure 6.2 Impact of broadening social support measures, financed through efficiency gains**

Source: UN ESCAP Macroeconomic model scenario

#### e. Investing in digital access and green development

Investing in digital access and green development has the potential to deliver high returns to Kyrgyzstan across the environment, health and economic potential. The country's aging water system is in need of investment, especially given the close links between clean water and sanitation services and health. More than half of the existing electrical infrastructure in the country requires urgent upkeep, while rising electricity demand must also be met. Most households rely on traditional heating methods like coal, animal dung, wood, or rubber, leading to high indoor air pollution and significant health consequences. Most households do not have access to affordable internet and many lack digital literacy and skills. This scenario builds on section 6.4, introducing a gradual increase in investment in digital access and green

development. For the purpose of this scenario, we consider a situation where the rise in expenditure is financed entirely via government debt. As in section 6.3, this is likely to put heavy pressure on government debt and the borrowing premium.

**Transport, ICT and clean water** - Improving transport, access to ICT and the quality of water and sanitation services is expected to cost approximately 0.54 per cent of GDP per annum. The programme is introduced gradually over the horizon to 2025. Investment in transport, ICT and water services can raise economy-wide productivity by improving access to information, facilitating business-to-business interactions, reducing transport costs and improving health. This in turn pushes up potential output and personal income. Improvements in the ease of doing business may also attract higher levels of inward FDI. Wider broadband access may also improve access to finance through greater use of online financial services. Improved broadband access would speed up financial transactions, while better access to finance would reduce liquidity constraints of both households and firms and reduce inequality.

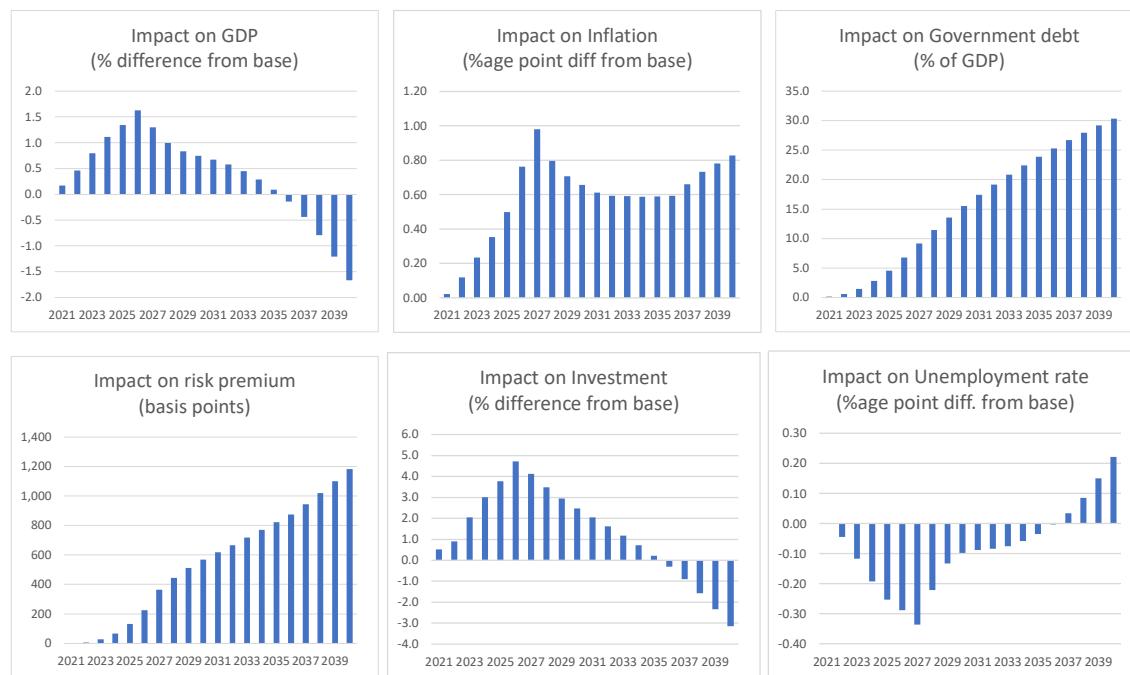
The impact of this investment on trend productivity in Kyrgyzstan is calibrated with reference to academic literature. Briceño-Garmendia, Estache, & Shafik (2004) estimate a 20% social rate of return to investment in ICT. Meanwhile, Bogetic & Fedderke (2009), who estimate the elasticity of TFP to infrastructure investment to be 0.04, with the estimate robust across different specifications. Our final model is calibrated so that a 1% of GDP rise in investment in transport, ICT and water services raises the trend growth rate of labour productivity by 0.15 percentage points and raises the index of financial inclusion by 0.4 percentage points.

**Reliable and accessible energy and climate action** - Providing reliable access to clean energy and investing in climate action is expected to cost approximately 1.83 per cent of GDP. The programme is introduced gradually over the horizon to 2025.

The rise in spending on energy and environmental protection is expected to deliver improvements in energy efficiency, a decline in pollution as more homes have access to clean heating, and a shift in the relative cost of renewables to fossil fuels, so that a greater share of new energy demand can be met with clean energy. This will deliver health benefits, lower levels of emissions and ultimately a higher potential growth rate in the economy – as long as the programme is financed sustainably.

**Model-based results** - Figure 6.3 illustrates the estimated impacts of this scenario on key indicators in Kyrgyzstan. This scenario increases government spending by an equivalent of 2.37 per cent of GDP relative to the scenario presented in section 6.5. This added stimulus raises GDP in the short-term, but, as in section 6.3, we see government debt rising on a rapid upward trajectory. This pushes the risk premium up by nearly 600 basis points by 2030, squeezing out private sector investment and fully offsetting the economic gains of the programme by 2035. Inflation remains elevated and the unemployment rate begins to rise. Clearly a more sustainable financing model is needed to ensure the success of this programme.

**Figure 6.3. Impact of digital access and green development, financed via government debt**



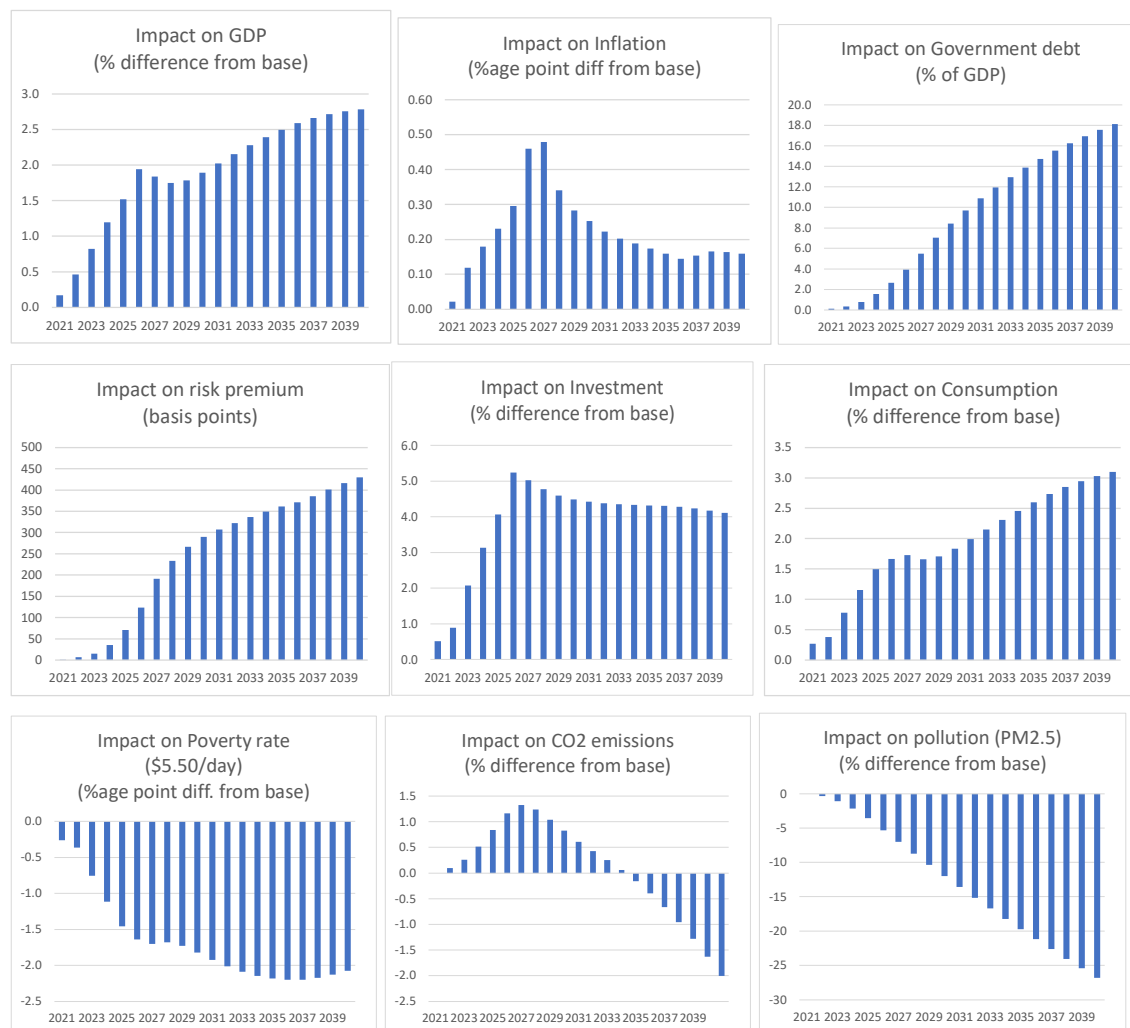
Source: UN ESCAP Macroeconomic model scenario

#### f. Financing investment through grants and concessional loans

Kyrgyzstan is eligible for grants, concessional loans and postponement in debt servicing provisions that could help reduce the costs of development programmes. In this section we repeat the same scenario discussed in section 6.e but assume that half of the investment in digital access and green development is financed through grants or concessional loans, and so do not put pressure on the domestic borrowing premium.

**Model-based scenarios** - Figure 6.4 illustrates the expected impacts on key variables. GDP is expected to rise by nearly 3 per cent relative to the baseline scenario without the social support measures and investment in digital access and green development. Pollution is expected to decline by 25 per cent as more homes are provided with access to clean heating. The long-term impacts are supported by rising productivity levels as health indicators improve, financial inclusion broadens, energy efficiency rises and connectivity facilitates transactions. Carbon emissions may rise temporarily in response to stronger economic activity, but ultimately would be expected to decline as energy efficiency gains take hold and more energy needs are met by renewables.

**Figure 6.4. Impact of digital access and green development, partly financed via grants**



Source: UN ESCAP Macroeconomic model scenario

While government debt would continue to rise in this scenario, the magnitude of the rise is much more gradual than in the scenario discussed in section 6.5. The risk premium may increase by over 300 basis points. This leaves the economy vulnerable but is not necessarily expected to trigger the spiral observed in the previous scenario.

#### g. Taxing carbon to help finance the programme

In this final scenario, we consider the introduction of a small carbon tax to help finance the social support, digital access and green development programmes. While the scenario discussed in section 6.f may prove sustainable, it would leave government debt at a significantly higher level. The sensitivity of risk premia to government debt varies significantly across countries and over time. There is a high level of uncertainty regarding the magnitude of these impacts. If, the risk premium were to rise further, this could fully offset the potential economic returns, as shown in some of the previous examples. It may also be difficult to secure the level of long-term concessional financing that would be required. Generating a new revenue stream could create the fiscal space needed to ensure the programme is sustainably financed over a long horizon.

**Taxing carbon** - Putting a tax on carbon dioxide increases the costs of production. Part of the rise in production costs are passed on through higher consumer prices, pushing up inflation and constraining consumer spending. The other part is absorbed by firm profit margins, which constrains investment. A carbon tax also increases the costs of burning fossil fuels, encouraging a shift in the composition of energy towards lower-carbon energy sources and renewables. A \$1 carbon tax adds about 9.6 cents to the price of coal, about 5.7 cents to the price of gas and about 6.7 cents to the price of oil. Using cleaner energy will reduce carbon emissions and reduce air pollution, with important health benefits. The revenue from a carbon tax also creates fiscal space that can be used to finance the new spending programmes.

An alternative to a carbon tax would be to reduce energy subsidies, which amount to 3 per cent of GDP. The macroeconomic transmission channels would be very similar to the introduction of a carbon tax. In addition to subsidies in the electricity sector, the gradual withdrawal of distortionary subsidies in the mining, transport and agriculture sectors have potential to generate additional fiscal space. In this scenario, a carbon tax of \$21.43 per tonne of CO<sub>2</sub> emitted is introduced gradually over a 5-year period.

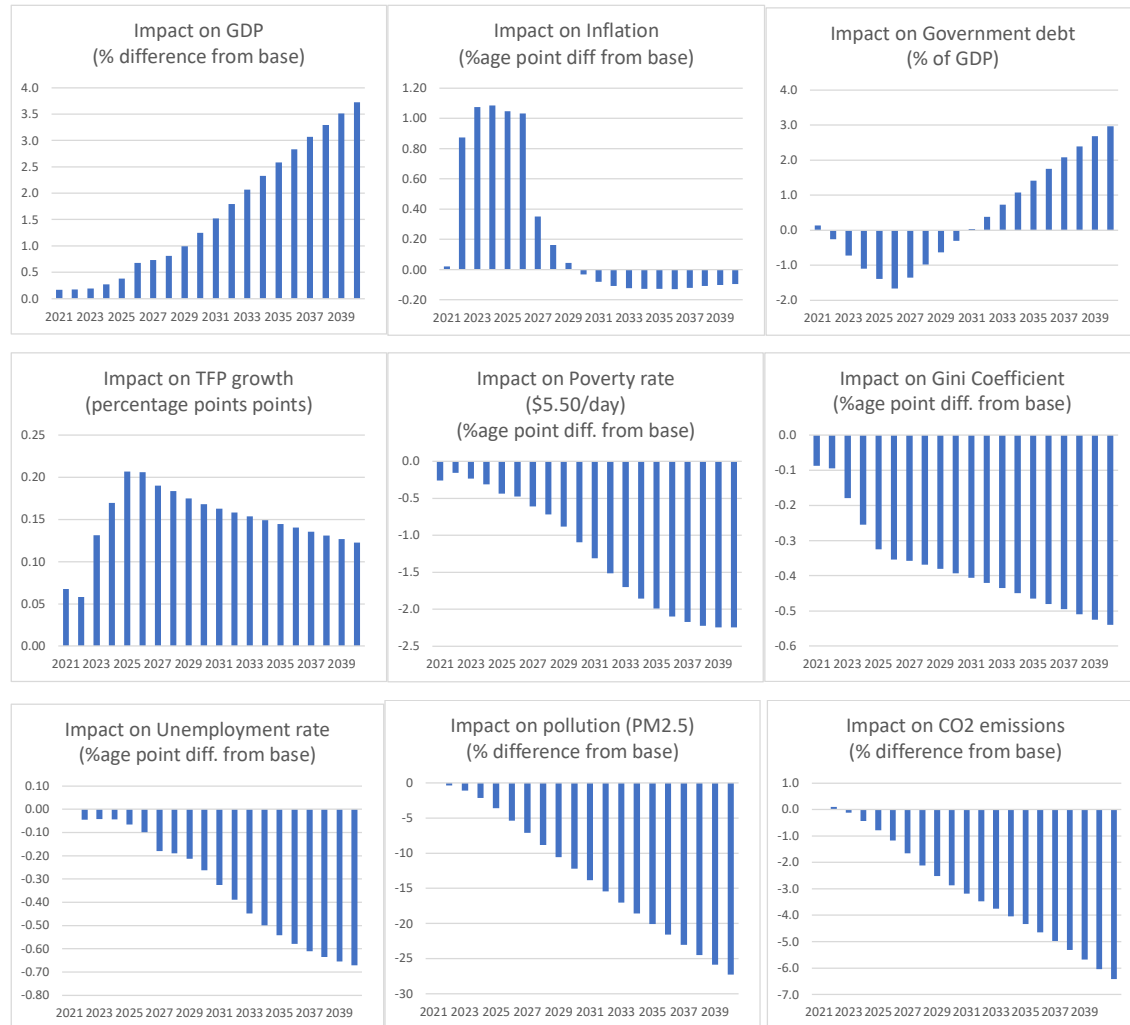


**Model-based results** - Figure 6.5 illustrates the expected impact on key variables of this scenario. The level of GDP would be expected to rise steadily, supported by a permanent rise in TFP growth in response to improvements in education, health and connectivity. This will create jobs and reduce the unemployment rate by about 0.7 percentage points. Inflation would rise by about 1 percentage point for the first five years in response to the carbon tax, but would then return to previous levels.

Government debt would initially decline relative to GDP as a result of both stronger growth and the rise in carbon tax revenue. Over time, carbon revenue would decline in line with carbon emissions, and debt may begin to rise. A slightly higher carbon tax would fully offset this rise in debt.

Inequality is expected to decline in response to the rise in social protection spending, the improvements in educational access and the rise in financial inclusion. Together with the rise in economic growth, this would push poverty levels down. Extreme poverty would be essentially eradicated, while moderate poverty, measured as the share of the population living on less than \$5.50 per day, would also decline by over 2 percentage points. CO<sub>2</sub> emissions are expected to fall by over 6 per cent relative to the baseline. This reflects the shift in energy mix towards renewables as well as energy efficiency gains. Pollution is expected to decline by over 25 per cent, which in turn could raise labour productivity growth by up to 1.8 percentage points.

**Figure 6.5. Impact of policy measures, partly financed via efficiency gains, grants and concessional loans, and a carbon tax**



Source: UN ESCAP Macroeconomic model scenario

## 7. Resource mobilization for additional financing needs

**Grants and concessional lending** - Kyrgyzstan's debt management has been credible in the last few years. The IMF suggests that the debt servicing of the country will remain manageable in the medium term. Moreover, it is estimated that the government budget deficit of 4.2 percent of the GDP will reduce the public debt by 1 percent in 2021. Majority of Kyrgyzstan's debt for the 2020 fiscal was financed from external sources like the World Bank, China, Asian Development Bank, and the European Central Bank. China's International Development Association (IDA) and the ADB are the largest creditors of the country. Kyrgyzstan is eligible for grants, concessional loans and postponement in debt servicing provisions that could help reduce its cost of borrowing. For instance, Kyrgyzstan, which has a moderate risk of debt distress, did not avail itself of the Debt Service Suspension Initiative during its period of availability, even though it was eligible for this facility. However, downside risks associated with vaccine rollout strategy, lower gold prices, decline in remittances could impact the public debt negatively and limit the size and impact of countercyclical policies.

**Public sector reforms** - Cyclical recovery is expected in tax revenues as the economic activity and cross-border trade increases. Public sector reforms like digitalization of tax filings, decline in public sector wage bills, and improvements in the energy sector are likely to aid growth and have a positive impact of the fiscal space of the country. Wage bill levels for the public sector in the Kyrgyz Republic are high compared to the other ECA countries. They amount to almost 33 percent of the total government expenditure (UN, 2019). Reducing expenditure on wages by streamlining pay structure and recruitment requirements can help improve investments in other sectors. In addition, direct and indirect budget subsidies amount to almost 3 percent of the GDP per annum. The sector's debt to the central government amounts to almost 20 percent of the country's GDP (IMF, 2021). The aviation sector also needs strategic reforms to address regulatory strategies, infrastructure issues, and poor management which can help attract foreign investments in the sector and increase tourism, which contributes to 4 percent of the GDP and employs 3.6 percent of the workforce (IFC, 2021).

**Private sector reforms** – An important area for reforms is the large size of informal private sector business that exists within the country. It is reported that most informal sector businesses chose to stay away from formal business practices to avoid the cost of social security and compliance. Agriculture, retail, and wholesale trade sectors is dominated by the

informal sector with mostly micro or small-sized enterprises. Medium-sized industries that constitute 0.2 percent of the total number of firms contribute to 14 percent of the country's exports. Therefore, it is imperative to support small businesses to grow and encourage them to formalize. Digitalization of tax filing and returns processes lead to efficiency gains, not only for the government but also for businesses. However, small businesses often do not have the capacity to immediately move to digital filing. Third-party digital accounting and handholding support at this point can help small businesses formalize and improve the government's revenue resources.

**Remittances** – The country has one of the highest dependences on remittances in the world. While the current demographic and economic structure results in a high share of labour migration it also results in consequential remittances flowing back to the country. In the recent past, remittances have played a major role in reducing extreme poverty levels within the country. However, most of the remittances are directed towards consumption and imports of consumer goods. Moreover, the World Bank estimates that poor formal financial investment opportunities often redirect a share of remittances to the construction sector through informal routes (UN, 2019). While this high reliance in the long run is not desirable, in the short run, it is likely to support several households to fight extreme poverty. As economic activities pick up and travelling and working in Russia and China become feasible again, remittances are going to be a likely channel that can supplement indirect investments towards reducing extreme poverty and reducing hunger.

**Taxing non-renewable energy consumption** – The increasing energy needs of the country are being met mostly through coal or oil and gas imports. The government can consider adding a small tax on such imports for a limited period. This will help generate additional revenue for the government and will also help promote investments and the use of renewable energy resources.

## Annex: ESCAP Macroeconomic Model equation listing

### Consumer Price Index, Period Average, 2015 = 100 (HIC)

$$\Delta \ln(HIC_t) = \beta_1 \Delta \ln(HIC_{t-1}) + \beta_2 \Delta \ln(MTD_t) + (1 - \beta_1 - \beta_2) \left( \frac{INFT_t}{100} \right) + \beta_3 \left( \frac{YER_t}{YFT_t} - \frac{YER_{t-1}}{YFT_{t-1}} \right) + \Delta \ln(1 + ITAXR_t) + 0.5 * \Delta \ln \left( 1 + \frac{GCARB_t}{0.6 * YEN_{t-1}} \right) + \beta_4 \frac{PREM_t - PREM_{t-1}}{100}$$

|       |   |
|-------|---|
| MTD   | Deflator for Imports of Goods and Services, National currency, 2015 = 100               |
| INFT  | Inflation target (not necessarily explicit)   |
| YER   | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency          |
| YFT   | Trend output, Constant 2015 prices, Billions National Currency                          |
| ITAXR | Tax rate on goods and services  |
| GCARB | General government net (after subsidies) carbon tax revenue, Billions National Currency |
| YEN   | Gross Domestic Product (GDP), Current prices, Billions National Currency                |
| PREM  | Country-specific risk premium, basis points.  |

### Deflator for GDP, National Currency, 2015 =100 (YED)

$$YED_t = YED_{t-1} * \frac{HIC_t}{HIC_{t-1}}$$

|     |  |
|-----|--|
| HIC | Consumer Price Index, Period Average, 2015 = 100 |
|-----|--|

### Monetary Policy-Related Interest Rate, Percent per annum (INT)

$$INT_t \equiv INT_{t-1} + [INT_t^{USA} - INT_{t-1}^{USA}]$$

|                    |   |
|--------------------|---|
| INT <sup>USA</sup> | Monetary Policy-Related Interest Rate, Percent per annum, USA |
|--------------------|---|

### Long-term bond yield, per cent (LTI)

$$LTI_t \equiv LTI_{t-1} + \beta_1 * (INT_t - INT_{t-1}) + \frac{PREM_t - PREM_{t-1}}{100}$$

|      |  |
|------|--|
| INT  | Monetary Policy-Related Interest Rate, Percent per annum |
| PREM | Country-specific risk premium, basis points.             |

### Country-specific risk premium, basis points. (PREM)

$$PREM_t = PREM_{t-1} * \left( 1 + \beta_1 * \frac{GDNRATIO_{t-1} - GDNRATIO_{t-2}}{100} \right)$$

|          |                                 |
|----------|---------------------------------|
| GDNRATIO | Gross government debt, % of GDP |
|----------|---------------------------------|

### Employment, 1000s (LNN)

$$\Delta \ln(LNN_t) = \beta_1 \Delta \ln(LFN_t) - \beta_2 * (\ln(LNN_{t-1}) - \ln(LFN_{t-1})) + \beta_3 * \Delta \ln(YER_{t-1})$$

|     |  |
|-----|--|
| LFN | Labour Force, 1000s  |
| YER | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency |

**Female employment, 1000s (LNNF)**

$$\Delta \ln(LNNF_t) = \Delta \ln(LNN_t)$$

LNN Employment, 1000s

**Income tax rate (TAXR)**

$$TAXR_t = TAXR_{t-1} + \beta_1 * \frac{GLNT_{t-1} - GLNRATIO_{t-1}}{100} * \frac{YEN_{t-1}}{RPDI_{t-1} * HIC_{t-1}} * SOLV_t$$

GLNT General government fiscal balance target, % GDP  
 GLNRATIO General government net lending (fiscal balance), % GDP  
 YEN Gross Domestic Product (GDP), Current prices, Billions National Currency  
 RPDI Real personal disposable income, Constant 2015 prices, Billions National Currency  
 HIC Consumer Price Index, Period Average, 2015 = 100  
 SOLV Solvency rule switch

**Corporate tax rate (CTAXR)**

$$CTAXR_t = CTAXR_{t-1} + \beta_1 * \frac{GLNT_{t-1} - GLNRATIO_{t-1}}{100} * \frac{YEN_{t-1}}{PROF_{t-1}} * SOLV_t$$

GLNT General government fiscal balance target, % GDP  
 GLNRATIO General government net lending (fiscal balance), % GDP  
 YEN Gross Domestic Product (GDP), Current prices, Billions National Currency  
 PROF Profits, Billions National Currency  
 SOLV Solvency rule switch

**Other general government consumption expenditure, Billions National Currency (OGC)**

$$OGC_t = OGC_{t-1} * \left( \frac{YFT_t}{YFT_{t-1}} * \frac{YED_t}{YED_{t-1}} \right)$$

YFT Trend output, Constant 2015 prices, Billions National Currency  
 YED Deflator for GDP, National Currency, 2015 =100

**User cost of capital, per cent (USER)**

$$USER_t = \frac{LTI_t - INFT_t + DEP_t * 100}{1 - CTAXR_t} + \beta_1 * \left( \frac{GCARB_t}{YEN_{t-1}} \right) * 100$$

LTI Long-term bond yield, per cent  
 INFT Inflation target (not necessarily explicit)  
 DEP Depreciation rate of capital stock  
 CTAXR Corporate tax rate  
 GCARB General government net (after subsidies) carbon tax revenue, Billions National Currency  
 YEN Gross Domestic Product (GDP), Current prices, Billions National Currency

**Exports of goods and services, Current prices, Billions National Currency (XTN)**

$$XTN_t \equiv XTD\$_t * \frac{EXR_t}{EXR_{2015}} * XTR_t$$

|       |   |
|-------|---|
| XTD\$ | Deflator for Export of Good & Services, US\$, 2015 =100                         |
| EXR   | Exchange rate (national currency / US\$)  |
| XTR   | Exports of goods and services, Constant 2015 prices, Billions National Currency |

#### **Gross Domestic Product (GDP), Current prices, Billions National Currency (YEN)**

$$YEN_t \equiv YER_t * YED_t$$

|     |  |
|-----|--|
| YER | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency |
| YED | Deflator for GDP, National Currency, 2015 =100                                 |

#### **Imports of goods and services, Current prices, Billions National Currency (MTN)**

$$MTN_t \equiv MTD_t * MTR_t$$

|     |   |
|-----|---|
| MTD | Deflator for Imports of Goods and Services, National currency, 2015 = 100       |
| MTR | Imports of goods and services, Constant 2015 prices, Billions National Currency |

#### **Exports of goods and services, Current prices, Billions US\$ (XTN\$)**

$$XTN\$_t \equiv \frac{XTN_t}{EXR_t}$$

|     |   |
|-----|---|
| XTN | Exports of goods and services, Current prices, Billions National Currency |
| EXR | Exchange rate (national currency / US\$)                                  |

#### **Gross Domestic Product (GDP), Current prices, US\$ billion (YEN\$)**

$$YEN\$_t \equiv \frac{YEN_t}{EXR_t}$$

|     |  |
|-----|--|
| YEN | Gross Domestic Product (GDP), Current prices, Billions National Currency |
| EXR | Exchange rate (national currency / US\$)                                 |

#### **Imports of goods and services, Current prices, US\$ (MTN\$)**

$$MTN\$_t \equiv \frac{MTN_t}{EXR_t}$$

|     |   |
|-----|---|
| MTN | Imports of goods and services, Current prices, Billions National Currency |
| EXR | Exchange rate (national currency / US\$)                                  |

#### **Imports of goods and services, Constant 2015 prices, US\$ billion (MTR\$)**

$$MTR\$_t \equiv MTR\$_{t-1} * \frac{MTR_t}{MTR_{t-1}}$$

|     |   |
|-----|---|
| MTR | Imports of goods and services, Constant 2015 prices, Billions National Currency |
|-----|---|



**Exports of goods and services, Constant 2015 prices, Billions US\$ (XTR\$)**

$$XTR\$_t \equiv XTR\$_{t-1} * \frac{XTR_t}{XTR_{t-1}}$$

XTR Exports of goods and services, Constant 2015 prices, Billions National Currency

**Gross Domestic Product (GDP), Constant 2015 prices, US\$ billion (YER\$)**

$$YER\$_t \equiv YER\$_{t-1} * \frac{YER_t}{YER_{t-1}}$$

YER Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

**Trend output, Constant 2015 prices, Billions US\$ (YFT\$)**

$$YFT\$_t \equiv YFT\$_{t-1} * \frac{YFT_t}{YFT_{t-1}}$$

YFT Trend output, Constant 2015 prices, Billions National Currency

**Total population, 1000s (POPT)**

$$POPT_t = POPT_{t-1} - LIVES_t$$

LIVES Lives lost from climate shocks

**Population aged 15-64, 1000s (POPWA)**

$$POPWA_t = POPWA_{t-1} * \frac{POPT_t}{POPT_{t-1}}$$

POPT Total population, 1000s

**Accumulation of inventories, Constant 2015 prices, Billions National Currency (SCR)**

$$SCR_t = SCR_{t-1} + |SCR_{t-1}| * \left( \frac{YFT_{t-1}}{YER_{t-1}} - \frac{YFT_{t-2}}{YER_{t-2}} \right)$$

YFT Trend output, Constant 2015 prices, Billions National Currency  
YER Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency

**Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency (ITR)**

$$ITR_t \equiv IGR_t + IPR_t$$

IGR Public gross fixed capital formation, Constant 2015 prices, Billions National Currency  
IPR Private gross fixed capital formation, Constant 2015 prices, Billions National Currency

**Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency (YER)**

$$YER_t \equiv PCR_t + GCR_t + ITR_t + SCR_t + XTR_t - MTR_t$$

|     |  |
|-----|--|
| PCR | Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency |
| GCR | General government final consumption expenditure, Constant 2015 prices, Billions National Currency   |
| ITR | Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency       |
| SCR | Accumulation of inventories, Constant 2015 prices, Billions National Currency  |
| XTR | Exports of goods and services, Constant 2015 prices, Billions National Currency  |
| MTR | Imports of goods and services, Constant 2015 prices, Billions National Currency  |

### Profits, Billions National Currency (PROF)

$$PROF_t \equiv (YEN_t - ITAX_t) * (1 - LABSH_t)$$

|       |  |
|-------|--|
| YEN   | Gross Domestic Product (GDP), Current prices, Billions National Currency   |
| ITAX  | General government taxes on goods and services, Billions National Currency |
| LABSH | Share of labour compensation in GDP at current national prices             |

### Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency (GDI)

$$GDI_t \equiv YER_t - XTR_t + MTR_t + \frac{XTN_t}{\frac{YEN_t - XTN_t + MTN_t}{YER_t - XTR_t + MTR_t}} - \frac{MTN_t}{\frac{YEN_t - XTN_t + MTN_t}{YER_t - XTR_t + MTR_t}}$$

|     |   |
|-----|---|
| YER | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency  |
| XTR | Exports of goods and services, Constant 2015 prices, Billions National Currency |
| MTR | Imports of goods and services, Constant 2015 prices, Billions National Currency |
| YEN | Gross Domestic Product (GDP), Current prices, Billions National Currency        |
| XTN | Exports of goods and services, Current prices, Billions National Currency       |
| MTN | Imports of goods and services, Current prices, Billions National Currency       |

### Real personal disposable income, Constant 2015 prices, Billions National Currency (RPDI)

$$RPDI_t \equiv LABSH_t * \beta_1 * (YER_{t-1} + GDI_{t-1}) * \frac{YED_{t-1}}{HIC_{t-1}} * \left( \frac{LNN_t}{LNN_{t-1}} + TECHL_t - TECHL_{t-1} \right) + \frac{REMIT_t}{HIC_t} + \frac{EXPSP_t}{HIC_t} - \frac{TAX_t}{HIC_t}$$

|       |   |
|-------|---|
| LABSH | Share of labour compensation in GDP at current national prices                                    |
| YER   | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency                    |
| GDI   | Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency |
| YED   | Deflator for GDP, National Currency, 2015 = 100   |
| HIC   | Consumer Price Index, Period Average, 2015 = 100  |
| LNN   | Employment, 1000s   |
| TECHL | Labour augmenting technical progress trend, indexed to GDP per employee                           |

|       |   |
|-------|---|
|       | in 2015   |
| REMIT | Inflow of personal remittances, Billions National Currency  |
| EXPSP | General government expense on social benefits, Billions National Currency   |
| TAX   | General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency |

### **Trend output, Constant 2015 prices, Billions National Currency (YFT)**

$$\Delta \ln(YFT_t) = (1 - ALPHA_t - LABSH_t) * \Delta \ln\left(\frac{K_{t-1}}{LFN_{t-1}}\right) + (1 - ALPHA_t) * \Delta \ln(LFN_t) + LABSH_t * \Delta(TECHL_t) + ALPHA_t * (\Delta \ln(EC_t) + \Delta(EFF_t)) - \left(\frac{CLIMLOSS_t}{CLIMLOSS_{t-1}} - 1\right) * \left(\frac{DAMAGE_t}{100}\right)$$

|          |   |
|----------|---|
| ALPHA    | Energy share of production costs  |
| LABSH    | Share of labour compensation in GDP at current national prices                    |
| K        | Capital stock, Constant 2015 prices, Billions National Currency                   |
| LFN      | Labour Force, 1000s   |
| TECHL    | Labour augmenting technical progress trend, indexed to GDP per employee in 2015   |
| EC       | Primary energy consumption, Exojoules   |
| EFF      | Energy efficiency index   |
| CLIMLOSS | Financial losses from climate shocks, Constant prices, Billions National Currency |
| DAMAGE   | Average annual damages from weather-related shocks, % GDP                         |

### **Capital stock, Constant 2015 prices, Billions National Currency (K)**

$$K_t \equiv K_{t-1} * (1 - DEP_t) + ITR_t$$

|     |  |
|-----|--|
| DEP | Depreciation rate of capital stock   |
| ITR | Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency |

### **Deflator for Imports of Goods and Services, National currency, 2015 = 100 (MTD)**

$$\Delta \ln(MTD_t) = (1 - OMS_t) * (\Delta \ln(CMUD_t) + \Delta \ln(EXR_t)) + OMS_t * (\Delta \ln(POIL_t^{WLD}) + \Delta \ln(EXR_t))$$

|                     |  |
|---------------------|--|
| OMS                 | Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports |
| CMUD                | Non-oil import price, US\$, 2015 = 1   |
| EXR                 | Exchange rate (national currency / US\$)   |
| POIL <sup>WLD</sup> | World oil price (\$ per barrel)  |

### **Deflator for Export of Good & Services, US\$, 2015 =100 (XTD\$)**

|                     |  |
|---------------------|--|
|                     | $XTD\$_t = (1 - OXS_t) * \Delta \ln(XTDNO\$_t) + OXS_t * \Delta \ln(POIL_t^{WLD})$   |
| OXS                 | Exports of Petroleum, petroleum products and related materials as a share of Total Merchandise exports plus Total Services exports |
| XTDNO\$             | Non-oil export price deflator, US\$, 2015 =100   |
| POIL <sup>WLD</sup> | World oil price (\$ per barrel)  |

### **Inflation target (not necessarily explicit) (INFT)**

$$INFT_t = \beta_1 * INFT_{t-1} + (1 - \beta_1) * 2$$

**Exports of Petroleum, petroleum products and related materials as a share of Total Merchandise exports plus Total Services exports (OXS)**

$$OXS_t = OXS_{t-1}$$

**Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports (OMS)**

$$OMS_t = OMS_{t-1} * \left( \frac{OILC_{t-1} * POIL_{t-1}^{WLD} * \frac{EXR_{t-1}}{MTN_{t-1}}}{OILC_{t-2} * POIL_{t-2}^{WLD} * \frac{EXR_{t-2}}{MTN_{t-2}}} \right)^{\beta_1}$$

|                     |   |
|---------------------|---|
| OILC                | Oil consumption, Exojoules  |
| POIL <sup>WLD</sup> | World oil price (\$ per barrel)   |
| EXR                 | Exchange rate (national currency / US\$)                                  |
| MTN                 | Imports of goods and services, Current prices, Billions National Currency |

**Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports (CXS)**

$$CXS_t = CXS_{t-1}$$

**Benchmark index for financial inclusion. (FINC)**

$$FINC_t = FINC_{t-1}$$

**Current Account Balance, US\$ billion (CAN)**

$$CAN_t \equiv \frac{XTN_t}{EXR_t} - \frac{MTN_t}{EXR_t} + \frac{REMIT_t}{EXR_t} + CANOTH_t$$

|        |   |
|--------|---|
| XTN    | Exports of goods and services, Current prices, Billions National Currency         |
| MTN    | Imports of goods and services, Current prices, Billions National Currency         |
| REMIT  | Inflow of personal remittances, Billions National Currency                        |
| EXR    | Exchange rate (national currency / US\$)  |
| CANOTH | Other items for current account, including net ODI and other grants, US\$ billion |

**Derived as ratio of current account balance to nominal GDP in US\$ (CANRATIO)**

$$CANRATIO_t \equiv \frac{CAN_t}{YEN\$_t} * 100$$

|       |  |
|-------|--|
| CAN   | Current Account Balance, US\$ billion                      |
| YEN\$ | Gross Domestic Product (GDP), Current prices, US\$ billion |

**Other items for current account, including net ODI and other grants, US\$ billion (CANOTH)**

$$CANOTH_t = CANOTH_{t-1} + |CANOTH_{t-1}| * \left( \frac{YEN\$_t}{YEN\$_{t-1}} - 1 \right) + \frac{REVG_t}{EXR_t} - \frac{REVG_{t-1}}{EXR_{t-1}}$$

|       |  |
|-------|--|
| YEN\$ | Gross Domestic Product (GDP), Current prices, US\$ billion     |
| REVG  | General government revenue, grants, Billions National Currency |
| EXR   | Exchange rate (national currency / US\$)                       |

**Effective exchange rate, 2015 = 1 (EFEX)**

$$\ln(EFEX_t) \equiv -\ln\left(\frac{EXR_t}{EXR_{2015}}\right) + \sum_{i \in \{AFG, ARM \dots\}} \beta_i * \ln\left(\frac{EXR_t^i}{EXR_{2015}^i}\right)$$

EXR Exchange rate (national currency / US\$)

EXR<sup>i</sup> Exchange rate (national currency / US\$), for country *i*

**Real effective exchange rate, 2015 = 1 (REFEX)**

$$\ln(REFEX_t) \equiv -\ln\left(\frac{\frac{EXR_t}{EXR_{2015}}}{\frac{HIC_t}{HIC_{2015}}}\right) + \sum_{i \in \{AFG, ARM \dots\}} \beta_i * \ln\left(\frac{\frac{EXR_t^i}{EXR_{2015}^i}}{\frac{HIC_t^i}{HIC_{2015}^i}}\right)$$

EXR Exchange rate (national currency / US\$)

EXR<sup>i</sup> Exchange rate (national currency / US\$), for country *i*

HIC Consumer Price Index, Period Average, 2015 = 100

HIC<sup>i</sup> Consumer Price Index, Period Average, 2015 = 100, for country *i*

**Inflow of personal remittances, Billions National Currency (REMIT)**

$$REMIT_t = \frac{REMIT_{t-1}}{EXR_{t-1}} * \left( \sum_{i \in \{AFG, ARM \dots\}} \beta_i * \frac{YEN\$^i_t}{YEN\$^i_{t-1}} \right) * EXR_t$$

EXR Exchange rate (national currency / US\$)

YEN\$<sup>i</sup> Gross Domestic Product (GDP), Current prices, US\$ billion, for country *i*

**General government average interest rate on outstanding debt (GINT)**

$$GINT_t = GINT_{t-1} + \beta_1 * (LTI_t - LTI_{t-1})$$

LTI Long-term bond yield, per cent

**General government gross debt, Billions National Currency (GDN)**

$$GDN_t = GDN_{t-1} * \left( GDFXSH_t * \left( \frac{EXR_t}{EXR_{t-1}} \right) + (1 - GDFXSH_t) \right) - GLN_t$$

GDFXSH Foreign currency share of general government gross debt

EXR Exchange rate (national currency / US\$)

GLN General government net lending (fiscal balance), Billions National Currency

**Gross government debt, % of GDP (GDNRATIO)**

$$GDNRATIO_t \equiv \frac{GDN_t}{YEN_t} * 100$$

GDN General government gross debt, Billions National Currency

YEN Gross Domestic Product (GDP), Current prices, Billions National Currency

**Foreign currency share of general government gross debt (GDFXSH)**

$$GDFXSH_t = \frac{GDFXSH_{t-1} * \left( \frac{EXR_t}{EXR_{t-1}} \right)}{GDFXSH_{t-1} * \left( \frac{EXR_t}{EXR_{t-1}} \right) + 1 - GDFXSH_{t-1}}$$

EXR Exchange rate (national currency / US\$)

### Change in stringency of measures introduced to contain the pandemic (LOCK)

$$LOCK_t = 0$$

General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO<sub>2</sub>. (GCARBR)

$$GCARBR_t = GCARBR_{t-1}$$

Tax rate on international trade and transactions (GTRADER)

$$GTRADER_t = GTRADER_{t-1}$$

Tax rate on goods and services (ITAXR)

$$ITAXR_t = ITAXR_{t-1}$$

General government revenue, Billions National Currency (REV)

$$REV_t \equiv TAX_t + CTAX_t + ITAX_t + GTRADE_t + REVG_t + GCARB_t + GCOM_t + GOTH_t$$

|        |   |
|--------|---|
| TAX    | General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency |
| CTAX   | General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency                           |
| ITAX   | General government taxes on goods and services, Billions National Currency  |
| GTRADE | General government taxes on international trade and transactions, Billions National Currency  |
| REVG   | General government revenue, grants, Billions National Currency  |
| GCARB  | General government net (after subsidies) carbon tax revenue, Billions National Currency   |
| GCOM   | General government resource-related revenue, Billions National Currency   |
| GOTH   | Government other net revenue, Billions National Currency  |

General government taxes on income, profits, and capital gains, payable by individuals, plus social contributions, Billions National Currency (TAX)

$$TAX_t \equiv TAXR_t * \left( LABSH_t * \beta_1 * (YER_{t-1} + GDI_{t-1}) * YED_{t-1} * \left( \frac{LNN_t}{LNN_{t-1}} + TECHL_t - TECHL_{t-1} \right) + REMIT_t + EXPSP_t \right)$$

|       |   |
|-------|---|
| TAXR  | Income tax rate   |
| LABSH | Share of labour compensation in GDP at current national prices                                    |
| YER   | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency                    |
| GDI   | Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency |
| YED   | Deflator for GDP, National Currency, 2015 =100  |
| LNN   | Employment, 1000s   |
| TECHL | Labour augmenting technical progress trend, indexed to GDP per employee in 2015                   |

|       |   |
|-------|---|
| REMIT | Inflow of personal remittances, Billions National Currency                |
| EXPSP | General government expense on social benefits, Billions National Currency |

**General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency (CTAX)**

$$CTAX_t \equiv CTAXR_t * PROF_t$$

|       |                                     |
|-------|-------------------------------------|
| CTAXR | Corporate tax rate                  |
| PROF  | Profits, Billions National Currency |

**General government taxes on goods and services, Billions National Currency (ITAX)**

$$ITAX_t \equiv ITAXR_t * \left( PCR_t * \frac{HIC_t}{HIC_{2015}} \right)$$

|     |  |
|-----|--|
| PCR | Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency |
| HIC | Consumer Price Index, Period Average, 2015 = 100   |

**General government taxes on international trade and transactions, Billions National Currency (GTRADE)**

$$GTRADE_t \equiv GTRADER_t * XTN_t$$

|         |   |
|---------|---|
| GTRADER | Tax rate on international trade and transactions                          |
| XTN     | Exports of goods and services, Current prices, Billions National Currency |

**General government revenue, grants, Billions National Currency (REVG)**

$$REVG_t = REV_{G_{t-1}} * \left( \left( \sum_{i \in \{USA, DEU \dots TWN\}} \beta_i * \frac{YEN\$^i_t}{YEN\$^i_{t-1}} \right) - \beta_1 * \left( \frac{\frac{YER\$_t}{POPT_t}}{\frac{YER\$^{WLD}_t}{POPT^{WLD}_t}} - \frac{\frac{YER\$_{t-1}}{POPT_{t-1}}}{\frac{YER\$^{WLD}_{t-1}}{POPT^{WLD}_{t-1}}} \right) \right) * \frac{EXR_t}{EXR_{t-1}}$$

|                      |  |
|----------------------|--|
| YEN\$ <sup>i</sup>   | Gross Domestic Product (GDP), Current prices, US\$ billion, for country <i>i</i> |
| YER\$                | Gross Domestic Product (GDP), Constant 2015 prices, US\$ billion                 |
| POPT                 | Total population, 1000s  |
| YER\$ <sup>WLD</sup> | Gross Domestic Product (GDP), Constant 2015 prices, US\$ billion, World          |
| POPT <sup>WLD</sup>  | Total population, 1000s, World   |

**General government net (after subsidies) carbon tax revenue, Billions National Currency (GCARB)**

$$GCARB_t \equiv GCARBR_t * CO2_t * \frac{EXR_t}{1000}$$

|                 |  |
|-----------------|--|
| GCARBR          | General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO <sub>2</sub> . |
| CO <sub>2</sub> | Territorial carbon dioxide emissions, MtCO <sub>2</sub>  |
| EXR             | Exchange rate (national currency / US\$)   |

**General government resource-related revenue, Billions National Currency (GCOM)**



$$GCOM_t = GCOM_{t-1} * \left( \frac{OILC_t}{OILC_t + GASC_t + COALC_t} * \frac{OILC_t^{WLD} * POIL_t^{WLD}}{OILC_{t-1}^{WLD} * POIL_{t-1}^{WLD}} + \frac{GASC_t}{OILC_t + GASC_t + COALC_t} * \frac{GASC_t^{WLD} * PG_t^{WLD}}{GASC_{t-1}^{WLD} * PG_{t-1}^{WLD}} + \frac{COALC_t}{OILC_t + GASC_t + COALC_t} * \frac{COALC_t^{WLD} * PC_t^{WLD}}{COALC_{t-1}^{WLD} * PC_{t-1}^{WLD}} \right)$$

|                      |   |
|----------------------|---|
| OILC                 | Oil consumption, Exojoules  |
| GASC                 | Natural gas consumption, Exojoules                                      |
| COALC                | Coal consumption, Exojoules   |
| OILC <sup>WLD</sup>  | Oil consumption, Exojoules, World                                       |
| POIL <sup>WLD</sup>  | World price of oil, inclusive of net carbon tax, US\$ per Mn kJ         |
| GASC <sup>WLD</sup>  | Natural gas consumption, Exojoules, World                               |
| PG <sup>WLD</sup>    | World price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ |
| COALC <sup>WLD</sup> | Coal consumption, Exojoules, World                                      |
| PC <sup>WLD</sup>    | World price of coal, inclusive of net carbon tax, US\$ per Mn kJ        |

#### Government other net revenue, Billions National Currency (GOTH)

$$GOTH_t = GOTH_{t-1}$$

#### General government expenditure, Billions National Currency (EXP)

|       |  |
|-------|--|
|       | $EXP_t \equiv EXPE_t + EXPH_t + EXPSP_t + OGC_t + OGI_t + GIP_t$                       |
| EXPE  | General government expenditure on environmental protection, Billions National Currency |
| EXPH  | General government expenditure on health, Billions National Currency                   |
| EXPSP | General government expense on social benefits, Billions National Currency              |
| OGC   | Other general government consumption expenditure, Billions National Currency           |
| OGI   | Other general government investment expenditure, Billions National Currency            |
| GIP   | Gross government interest payments, Billions National Currency                         |

#### General government expenditure on environmental protection, Billions National Currency (EXPE)

$$EXPE_t = EXPE_{t-1} * \left( \frac{YED_t}{YED_{t-1}} \right)$$

YED Deflator for GDP, National Currency, 2015 =100

#### General government expenditure on health, Billions National Currency (EXPH)

$$EXPH_t = EXPH_{t-1} * \left( \frac{YED_t}{YED_{t-1}} \right)$$

YED Deflator for GDP, National Currency, 2015 =100

#### General government expense on social benefits, Billions National Currency (EXPSP)

$$EXPSP_t = EXPSP_{t-1} * \left( \frac{YED_t}{YED_{t-1}} \right) * \frac{POPT_t - LNN_t}{POPT_{t-1} - LNN_{t-1}}$$

YED Deflator for GDP, National Currency, 2015 =100

|      |                         |
|------|-------------------------|
| POPT | Total population, 1000s |
| LNN  | Employment, 1000s       |

### Other general government investment expenditure, Billions National Currency (OGI)

$$\Delta \ln(OGI_t) = \Delta \ln(YED_t)$$

|     |  |
|-----|--|
| YED | Deflator for GDP, National Currency, 2015 =100 |
|-----|--|

### General government final consumption expenditure, Constant 2015 prices, Billions National Currency (GCR)

$$GCR_t = GCR_{t-1} + \left( \frac{OGC_t}{YED_t} - \frac{OGC_{t-1}}{YED_{t-1}} \right) + 0.5 * \left( \frac{EXPH_t}{YED_t} - \frac{EXPH_{t-1}}{YED_{t-1}} \right) + 0.5 * \left( \frac{EXPE_t}{YED_t} - \frac{EXPE_{t-1}}{YED_{t-1}} \right)$$

|      |  |
|------|--|
| OGC  | Other general government consumption expenditure, Billions National Currency           |
| YED  | Deflator for GDP, National Currency, 2015 =100   |
| EXPH | General government expenditure on health, Billions National Currency                   |
| EXPE | General government expenditure on environmental protection, Billions National Currency |

### Public gross fixed capital formation, Constant 2015 prices, Billions National Currency (IGR)

$$IGR_t = IGR_{t-1} + \left( \frac{OGI_t}{YED_t} - \frac{OGI_{t-1}}{YED_{t-1}} \right) + 0.5 * \left( \frac{EXPH_t}{YED_t} - \frac{EXPH_{t-1}}{YED_{t-1}} \right) + 0.5 * \left( \frac{EXPE_t}{YED_t} - \frac{EXPE_{t-1}}{YED_{t-1}} \right)$$

|      |  |
|------|--|
| OGI  | Other general government investment expenditure, Billions National Currency            |
| YED  | Deflator for GDP, National Currency, 2015 =100   |
| EXPH | General government expenditure on health, Billions National Currency                   |
| EXPE | General government expenditure on environmental protection, Billions National Currency |

### Gross government interest payments, Billions National Currency (GIP)

$$GIP_t = \left( GIP_{t-1} + (GDN_{t-1} - GDN_{t-2}) * \frac{GINT_{t-1}}{100} + \frac{GDN_{t-6}}{5} * \left( \frac{GINT_{t-1}}{100} - \frac{GINT_{t-6}}{100} \right) \right) * \left( GDFXSH_t * \left( \frac{EXR_t}{EXR_{t-1}} \right) + (1 - GDFXSH_t) \right)$$

|        |  |
|--------|--|
| GDN    | General government gross debt, Billions National Currency    |
| GINT   | General government average interest rate on outstanding debt |
| GDFXSH | Foreign currency share of general government gross debt      |
| EXR    | Exchange rate (national currency / US\$)                     |

### General government net lending (fiscal balance), Billions National Currency (GLN)

$$GLN_t \equiv REV_t - EXP_t$$

|     |  |
|-----|--|
| REV | General government revenue, Billions National Currency     |
| EXP | General government expenditure, Billions National Currency |

### General government net lending (fiscal balance), % GDP (GLNRATIO)

$$GLNRATIO_t \equiv \frac{GLN_t}{YEN_t} * 100$$

GLN      General government net lending (fiscal balance), Billions National Currency  
YEN      Gross Domestic Product (GDP), Current prices, Billions National Currency

#### General government fiscal balance target, % GDP (GLNT)

$$GLNT_t = \beta_1 * GLNT_{t-1} + (1 - \beta_1) * (-2)$$

#### Trend TFP growth rate, expressed as log change (TFP)

$$TFP_t = LABSH_t * (TECHL_t - TECHL_{t-1})$$

LABSH      Share of labour compensation in GDP at current national prices  
TECHL      Labour augmenting technical progress trend, indexed to GDP per employee in 2015

#### Share of labour compensation in GDP at current national prices (LABSH)

$$LABSH_t = LABSH_{t-1}$$

#### Labour Force, 1000s (LFN)

$$LFN_t \equiv LRX_t * POPWA_t$$

LRX      Participation ratio  
POPWA      Population aged 15-64, 1000s

#### Participation ratio (LRX)

$$LRX_t = LRX_{t-1} + \beta_1 * \ln \left( \frac{YER_{t-1}}{YFT_{t-1}} \right)$$

YER      Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency  
YFT      Trend output, Constant 2015 prices, Billions National Currency

#### Unemployment Rate (ILO definition) (URX)

$$URX_t \equiv \left( 1 - \frac{LNN_t}{LFN_t} \right) * 100$$

LNN      Employment, 1000s  
LFN      Labour Force, 1000s

#### Female unemployment Rate (ILO definition) (URXF)

$$URXF_t = URXF_{t-1} * \frac{URX_t}{URX_{t-1}} * \frac{\frac{LNN_t}{LNNF_t}}{\frac{LNN_{t-1}}{LNNF_{t-1}}}$$

URX      Unemployment Rate (ILO definition)  
LNN      Employment, 1000s  
LNNF      Female employment, 1000s

#### Survey mean consumption or income per capita, total population (2011 PPP \$ per day)

**(YBAR)**

$$\Delta \ln(YBAR_t) = \beta_1 * \Delta \ln\left(\frac{PCR_t}{POPT_t}\right)$$

|      |  |
|------|--|
| PCR  | Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency |
| POPT | Total population, 1000s  |

**Standard deviation of log income (SDLI)**

$$SDLI_t = 2 * erf^{-1}[GINI\_DISP_t]$$

|           |  |
|-----------|--|
| erf       | Inverse error function (approximated with gamma quantile function)   |
| GINI_DISP | Estimate of Gini index of inequality in equivalized household disposable (post-tax, post-transfer) income. |

**Poverty headcount ratio at \$1.90 a day (2011 PPP) (% of population) (HEAD19)**

$$HEAD19_t = HEAD19_{t-1} * \frac{[CDF_{LOGNORMAL}(\$1.90, \ln(YBAR_t) - 0.5 * SDLI_t^2, SDLI_t)]}{[CDF_{LOGNORMAL}(\$1.90, \ln(YBAR_{t-1}) - 0.5 * SDLI_{t-1}^2, SDLI_{t-1})]}$$

|                   |  |
|-------------------|--|
| $CDF_{LOGNORMAL}$ | Log normal cumulative distribution, evaluated at \$1.90                              |
| YBAR              | Survey mean consumption or income per capita, total population (2011 PPP \$ per day) |
| SDLI              | Standard deviation of log income   |

**Poverty headcount ratio at \$5.50 a day (2011 PPP) (% of population) (HEAD55)**

$$HEAD55_t = HEAD55_{t-1} * \frac{[CDF_{LOGNORMAL}(\$5.50, \ln(YBAR_t) - 0.5 * SDLI_t^2, SDLI_t)]}{[CDF_{LOGNORMAL}(\$5.50, \ln(YBAR_{t-1}) - 0.5 * SDLI_{t-1}^2, SDLI_{t-1})]}$$

|                   |  |
|-------------------|--|
| $CDF_{LOGNORMAL}$ | Log normal cumulative distribution, evaluated at \$5.50                              |
| YBAR              | Survey mean consumption or income per capita, total population (2011 PPP \$ per day) |
| SDLI              | Standard deviation of log income   |

**Exports of goods and services, Constant 2015 prices, Billions National Currency (XTR)**

$$\Delta \ln(XTR_t) = \Delta \ln(WDR_t) + (1 - CXS_t) * \left( \beta_1 * \Delta \ln\left(\frac{XTDNO\$}{CXUD_t}\right) \right) + \beta_2 * TOURSH * \frac{LOCK_t^{WLD}}{100}$$

|              |   |
|--------------|---|
| WDR          | Trade-weighted external demand, Constant 2015 prices, US\$ billion  |
| CXS          | Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports |
| XTDNO\$      | Non-oil export price deflator, US\$, 2015 =100  |
| CXUD         | Global non-oil export price, US\$, 2015 = 1   |
| TOURSH       | Travel and transport services exports as a share of nominal GDP   |
| $LOCK^{WLD}$ | Change in stringency of measures introduced to contain the pandemic, World  |

**Non-oil export price deflator, US\$, 2015 =100 (XTDNO\$)**

$$XTDNO\$_t = XTDNO\$_{t-1} * \left[ \beta_1 * \left\{ \Delta \ln \left( \frac{YED_{t-1}}{EXR_{t-1}} \right) + 1 \right\} + (1 - \beta_1) * \{ \Delta \ln(CXUD_{t-1}) + 1 \} \right] \\ * \frac{1 + GTRADER_t}{1 + GTRADER_{t-1}}$$

|         |  |
|---------|--|
| YED     | Deflator for GDP, National Currency, 2015 =100   |
| EXR     | Exchange rate (national currency / US\$)         |
| CXUD    | Global non-oil export price, US\$, 2015 = 1      |
| GTRADER | Tax rate on international trade and transactions |

**Labour augmenting technical progress trend, indexed to GDP per employee in 2015 (TECHL)**

$$\Delta(TECHL_t) = \Delta(TECHL_t^{WLD}) + \beta_1 * \left( \frac{EXPH_{t-1}}{YEN_{t-1}} \right) - \beta_2 * \left( \frac{EXPH_{t-1}}{YEN_{t-1}} \right)^2 - \beta_3 * \Delta(GINI\_DISP_t) - \beta_4 \\ * \Delta(PM25_t) - \beta_5 * PREM_t$$

|                      |   |
|----------------------|---|
| TECHL <sup>WLD</sup> | Labour augmenting technical progress trend, indexed to GDP per employee in 2015, World                    |
| EXPH                 | General government expenditure on health, Billions National Currency                                      |
| YEN                  | Gross Domestic Product (GDP), Current prices, Billions National Currency                                  |
| EXPH                 | General government expenditure on health, Billions National Currency                                      |
| GINI_DISP            | Estimate of Gini index of inequality in equivalized household disposable (post-tax,post-transfer) income. |
| PM25                 | PM2.5 air pollution, mean annual exposure, micrograms per cubic meter                                     |
| PREM                 | Country-specific risk premium, basis points.  |

**Relative redistribution parameter (percentage difference between Gini Coefficients measures in terms of gross and disposable income) (REL\_RED)**

$$REL\_RED_t = \beta_0 + \beta_1 * \left( \frac{EXPSP_t}{YEN_t} \right)$$

|       |   |
|-------|---|
| EXPSP | General government expense on social benefits, Billions National Currency |
| YEN   | Gross Domestic Product (GDP), Current prices, Billions National Currency  |

**Estimate of Gini index of inequality in equivalized household disposable (post-tax,post-transfer) income. (GINI\_DISP)**

$$\Delta \ln(GINI\_DISP_t) = \beta_1 * \Delta \ln \left( 1 - \frac{REL\_RED_t}{100} \right) + \beta_2 * (FINC_t - FINC_{t-1})$$

|         |  |
|---------|--|
| REL_RED | Relative redistribution parameter (percentage difference between Gini Coefficients measures in terms of gross and disposable income) |
| FINC    | Benchmark index for financial inclusion.   |

**Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency (PCR)**

$$\Delta \ln(PCR_t) = \beta_0 + \beta_1 * (\ln(PCR_{t-1}) - \ln(RPDI_{t-1}) - \beta_2 * (FINC_{t-1})) + \beta_3 * \Delta \ln(RPDI_t) \\ + (1 - \beta_3) * \Delta \ln(POPT_t) + \beta_4 * \left( \Delta \ln(HIC_t) - \frac{INFT_t}{100} \right) - \beta_5 * \frac{LOCK_t}{100} - \beta_5 * \beta_6 \\ * \frac{LOCK_{t-1}}{100} + \beta_7 * (\ln(YFT_{t-1}) - \ln(YER_{t-1}))$$

|      |   |
|------|---|
| RPDI | Real personal disposable income, Constant 2015 prices, Billions National Currency |
| FINC | Benchmark index for financial inclusion.  |
| POPT | Total population, 1000s   |
| HIC  | Consumer Price Index, Period Average, 2015 = 100                                  |
| INFT | Inflation target (not necessarily explicit)                                       |
| LOCK | Change in stringency of measures introduced to contain the pandemic               |
| YFT  | Trend output, Constant 2015 prices, Billions National Currency                    |
| YER  | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency    |

**Private gross fixed capital formation, Constant 2015 prices, Billions National Currency (IPR)**

$$\Delta \ln(IPR_t) = \beta_0 - \beta_1 * \left( \ln \left( \frac{IPR_{t-1}}{YFT_{t-1}} \right) + \beta_2 * USER_{t-1} - \beta_3 * FINC_{t-1} \right) + \beta_4 \\ * \Delta \ln \left( PCR_t + GCR_{t-1} + IGR_{t-1} + \frac{XTN_t}{YED_t} \right) + \beta_5 * \Delta \ln(IPR_{t-1}) - \beta_6 \\ * (USER_t - USER_{t-1}) - (\beta_7 * TOURSH + \beta_8 * (1 - FUELSH - TOURSH)) \\ * \frac{LOCK_t}{100} - \beta_9 * (\beta_7 * TOURSH + \beta_8 * (1 - FUELSH - TOURSH)) * \frac{LOCK_{t-1}}{100} \\ + \beta_{10} * (\ln(YFT_{t-1}) - \ln(YER_{t-1}))$$

|        |  |
|--------|--|
| YFT    | Trend output, Constant 2015 prices, Billions National Currency   |
| USER   | User cost of capital, per cent   |
| FINC   | Benchmark index for financial inclusion.   |
| PCR    | Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency |
| GCR    | General government final consumption expenditure, Constant 2015 prices, Billions National Currency   |
| IGR    | Public gross fixed capital formation, Constant 2015 prices, Billions National Currency   |
| XTN    | Exports of goods and services, Current prices, Billions National Currency  |
| YED    | Deflator for GDP, National Currency, 2015 =100   |
| IPR    | Private gross fixed capital formation, Constant 2015 prices, Billions National Currency  |
| FUELSH | Fuel exports (SITC 3) as a share of nominal GDP  |
| TOURSH | Travel and transport services exports as a share of nominal GDP  |
| LOCK   | Change in stringency of measures introduced to contain the pandemic  |
| YER    | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency   |

**Imports of goods and services, Constant 2015 prices, Billions National Currency (MTR)**

$$\Delta \ln(MTR_t) = \beta_0 - \beta_1$$

$$* \left( \ln(MTR_{t-1}) - \ln(PCR_{t-1} + ITR_{t-1} + GCR_{t-1} + XTR_{t-1}) + \ln\left(\frac{YFT_{t-1}}{YER_{t-1}}\right) + \beta_2 \right.$$

$$* \ln\left(CMUD_{t-1} * \frac{EXR_{t-1}}{YED_{t-1}}\right) - \beta_3 * OMS_t * \ln(OILC_{t-1}) \left. + \beta_4 * \Delta \ln(XTR_t) + \beta_5 \right.$$

$$* \Delta \ln(PCR_t) + \beta_6 * \Delta \ln(IPR_t) + \beta_7 * \Delta \ln(GCR_t + IGR_t)$$

|      |  |
|------|--|
| PCR  | Household consumption expenditure (including Non-profit institutions serving households), Constant 2015 prices, Billions National Currency |
| ITR  | Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency       |
| GCR  | General government final consumption expenditure, Constant 2015 prices, Billions National Currency   |
| XTR  | Exports of goods and services, Constant 2015 prices, Billions National Currency  |
| YFT  | Trend output, Constant 2015 prices, Billions National Currency   |
| YER  | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency   |
| CMUD | Non-oil import price, US\$, 2015 = 1   |
| EXR  | Exchange rate (national currency / US\$)   |
| YED  | Deflator for GDP, National Currency, 2015 =100   |
| OMS  | Imports of Petroleum, petroleum products and related materials as a share of Total Merchandise imports plus Total Services imports         |
| OILC | Oil consumption, Exojoules   |
| IPR  | Private gross fixed capital formation, Constant 2015 prices, Billions National Currency  |
| IGR  | Public gross fixed capital formation, Constant 2015 prices, Billions National Currency   |

### Territorial carbon dioxide emissions, MtCO<sub>2</sub> (CO<sub>2</sub>)

$$\Delta \ln(CO_2_t) = \Delta \ln(\beta_1 * COALC_t + \beta_2 * GASC_t + \beta_3 * OILC_t) - \beta_4$$

$$* [\ln(CO_2_{t-1}) - \ln(\beta_1 * COALC_{t-1} + \beta_2 * GASC_{t-1} + \beta_3 * OILC_{t-1})]$$

|       |                                    |
|-------|------------------------------------|
| COALC | Coal consumption, Exojoules        |
| GASC  | Natural gas consumption, Exojoules |
| OILC  | Oil consumption, Exojoules         |

### Domestic price of oil, inclusive of net carbon tax, US\$ per Mn kJ (POIL)

$$POIL_t = POIL_{t-1} * \frac{POIL_t^{WLD}}{POIL_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

|                     |  |
|---------------------|--|
| POIL <sup>WLD</sup> | World price of oil, inclusive of net carbon tax, US\$ per Mn kJ  |
| GCARBR              | General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO <sub>2</sub> . |

### Domestic price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ (PG)

$$PG_t = PG_{t-1} * \frac{PG_t^{WLD}}{PG_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

|                   |  |
|-------------------|--|
| PG <sup>WLD</sup> | World price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ                                    |
| GCARBR            | General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO <sub>2</sub> . |

**Domestic price of coal, inclusive of net carbon tax, US\$ per Mn kJ (PC)**

$$PC_t = PC_{t-1} * \frac{PC_t^{WLD}}{PC_{t-1}^{WLD}} + \beta_1 * (GCARBR_t - GCARBR_{t-1})$$

$PC^{WLD}$  World price of coal, inclusive of net carbon tax, US\$ per Mn kJ

$GCARBR$  General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO<sub>2</sub>.

**Domestic price of renewable energy, US\$ per Mn kJ (PR)**

$$\Delta \ln(PR_t) = \Delta \ln(PR_t^{WLD})$$

$PR^{WLD}$  World price of renewable energy, US\$ per Mn kJ

**Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ (PE)**

$$PE_t = PE_{t-1} * \left( \frac{OILC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{POIL_t}{POIL_{t-1}} + \frac{GASC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PG_t}{PG_{t-1}} + \frac{COALC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PC_t}{PC_{t-1}} + \frac{RC_{t-1}}{OILC_{t-1} + COALC_{t-1} + GASC_{t-1} + RC_{t-1}} * \frac{PR_t}{PR_{t-1}} \right)$$

$OILC$  Oil consumption, Exojoules

$COALC$  Coal consumption, Exojoules

$GASC$  Natural gas consumption, Exojoules

$RC$  Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules

$POIL$  Domestic price of oil, inclusive of net carbon tax, US\$ per Mn kJ

$PG$  Domestic price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ

$PC$  Domestic price of coal, inclusive of net carbon tax, US\$ per Mn kJ

$PR$  Domestic price of renewable energy, US\$ per Mn kJ

**Depreciation rate of capital stock (DEP)**

$$\Delta(DEP_t) = \beta_1 * \Delta \ln(CO2_t^{WLD})$$

$CO2^{WLD}$  World carbon dioxide emissions, MtCO<sub>2</sub>

**PM2.5 air pollution, mean annual exposure, micrograms per cubic meter (PM25)**

$$\Delta \ln(PM25_t) = \beta_1 * \left( \frac{COALC_{t-1}}{EC_{t-1}} - \frac{COALC_{t-2}}{EC_{t-2}} \right) + \beta_2 * \left( \frac{COALC_{t-2}}{EC_{t-2}} - \frac{COALC_{t-3}}{EC_{t-3}} \right) + \beta_3 * \left( \frac{OILC_{t-1}}{EC_{t-1}} - \frac{OILC_{t-2}}{EC_{t-2}} \right) + \beta_4 * \left( \frac{OILC_{t-2}}{EC_{t-2}} - \frac{OILC_{t-3}}{EC_{t-3}} \right)$$

$COALC$  Coal consumption, Exojoules

$EC$  Primary energy consumption, Exojoules

$OILC$  Oil consumption, Exojoules

**Primary energy consumption, Exojoules (EC)**



$$\begin{aligned}\Delta \ln(EC_t) = & \beta_1 * \Delta \ln(YER_t) + \beta_2 * \Delta \ln(YER_{t-1}) + \beta_3 * \Delta \ln(YER_{t-2}) + \beta_4 * \Delta \ln(YER_{t-3}) - \beta_5 \\ & * \beta_1 * \Delta \ln\left(PE_t * \frac{EXR_t}{HIC_t}\right) - \beta_5 * \beta_2 * \Delta \ln\left(PE_{t-1} * \frac{EXR_{t-1}}{HIC_{t-1}}\right) - \beta_5 * \beta_3 \\ & * \Delta \ln\left(PE_{t-2} * \frac{EXR_{t-2}}{HIC_{t-2}}\right) - \beta_5 * \beta_4 * \Delta \ln\left(PE_{t-3} * \frac{EXR_{t-3}}{HIC_{t-3}}\right) - (EFF_t - EFF_{t-1})\end{aligned}$$

|     |  |
|-----|--|
| YER | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency |
| PE  | Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ          |
| EXR | Exchange rate (national currency / US\$)                                       |
| HIC | Consumer Price Index, Period Average, 2015 = 100                               |
| EFF | Energy efficiency index  |

### Coal consumption, Exojoules (COALC)

$$\Delta \ln(COALC_t) = \Delta \ln(EC_{t-1}) - \beta_1 * \left( \ln\left(\frac{COALC_{t-1}}{EC_{t-1}}\right) - \ln\left(\frac{PE_{t-1}}{PC_{t-1}}\right) \right)$$

|    |   |
|----|---|
| EC | Primary energy consumption, Exojoules                                 |
| PE | Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ |
| PC | Domestic price of coal, inclusive of net carbon tax, US\$ per Mn kJ   |

### Natural gas consumption, Exojoules (GASC)

$$\Delta \ln(GASC_t) = \Delta \ln(EC_{t-1}) - \beta_1 * \left( \ln\left(\frac{GASC_{t-1}}{EC_{t-1}}\right) - \ln\left(\frac{PE_{t-1}}{PG_{t-1}}\right) \right)$$

|    |  |
|----|--|
| EC | Primary energy consumption, Exojoules                                      |
| PE | Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ      |
| PG | Domestic price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ |

### Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules (RC)

$$\Delta \ln(RC_t) = \Delta \ln(EC_{t-1}) - \beta_1 * \left( \ln\left(\frac{RC_{t-1}}{EC_{t-1}}\right) - \ln\left(\frac{PE_{t-1}}{PR_{t-1}}\right) \right)$$

|    |   |
|----|---|
| EC | Primary energy consumption, Exojoules                                 |
| PE | Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ |
| PR | Domestic price of renewable energy, US\$ per Mn kJ                    |

### Oil consumption, Exojoules (OILC)

$$OILC_t = EC_t - COALC_t - GASC_t - RC_t$$

|       |  |
|-------|--|
| EC    | Primary energy consumption, Exojoules  |
| COALC | Coal consumption, Exojoules  |
| RC    | Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules |
| GASC  | Natural gas consumption, Exojoules   |

### Exchange rate (national currency / US\$) (EXR)

$$EXR_t = EXR_{t-1} * \left( \frac{INFT_t^{KGZ} - INFT_t^{USA}}{100} + 1 \right)$$

INFT Inflation target (not necessarily explicit)  
 INFT<sup>USA</sup> Inflation target (not necessarily explicit), USA

#### Non-oil import price, US\$, 2015 = 1 (CMUD)

$$CMUD_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * XTDNO_t^i$$

XTDNO<sup>\$</sup><sub>*i*</sub> Non-oil export price deflator, US\$, 2015 =100, for country *i*

#### Global non-oil export price, US\$, 2015 = 1 (CXUD)

$$CXUD_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * XTDNO_t^i$$

XTDNO<sup>\$</sup><sub>*i*</sub> Non-oil export price deflator, US\$, 2015 =100, for country *i*

#### Trade-weighted external demand, Constant 2015 prices, US\$ billion (WDR)

$$WDR_t = \sum_{i \in \{AFG, ARM \dots\}} \beta_i * MTR_t^i$$

MTR<sup>\$</sup><sub>*i*</sub> Imports of goods and services, Constant 2015 prices, US\$ billion, for country *i*

#### Model Mnemonics

|          |   |
|----------|---|
| ALPHA    | Energy share of production costs (constant)   |
| CAN      | Current Account Balance, US\$ billion   |
| CANOTH   | Other items for current account, including net ODI and other grants, US\$ billion   |
| CANRATIO | Derived as ratio of current account balance to nominal GDP in US\$  |
| CLIMLOSS | Financial losses from climate shocks, Constant prices, Billions National Currency (exogenous)   |
| CMUD     | Non-oil import price, US\$, 2015 = 1  |
| CO2      | Territorial carbon dioxide emissions, MtCO2   |
| COALC    | Coal consumption, Exojoules   |
| CTAX     | General government taxes on income, profits, and capital gains, payable by corporations, Billions National Currency                       |
| CTAXR    | Corporate tax rate  |
| CXS      | Exports of Primary commodities, precious stones and non-monetary gold as a share of Total Merchandise exports plus Total Services exports |
| CXUD     | Global non-oil export price, US\$, 2015 = 1   |
| DAMAGE   | Average annual damages from weather-related shocks, % GDP (exogenous)   |
| DEP      | Depreciation rate of capital stock  |
| EC       | Primary energy consumption, Exojoules   |
| EFEX     | Effective exchange rate, 2015 = 1   |
| EFF      | Energy efficiency index (exogenous)   |
| EXP      | General government expenditure, Billions National Currency  |
| EXPE     | General government expenditure on environmental protection, Billions National Currency  |
| EXPH     | General government expenditure on health, Billions National Currency  |
| EXPSP    | General government expense on social benefits, Billions National Currency   |

|           |  |
|-----------|--|
| EXR       | Exchange rate (national currency / US\$)   |
| FINC      | Benchmark index for financial inclusion.   |
| FUELSH    | Fuel exports (SITC 3) as a share of nominal GDP (constant)   |
| GASC      | Natural gas consumption, Exojoules   |
| GCARB     | General government net (after subsidies) carbon tax revenue, Billions National Currency  |
| GCARBR    | General government net (after subsidies) carbon tax rate, expressed as US\$ per tonne of CO2.  |
| GCOM      | General government resource-related revenue, Billions National Currency  |
| GCR       | General government final consumption expenditure, Constant 2015 prices, Billions National Currency                                   |
| GDFXSH    | Foreign currency share of general government gross debt  |
| GDI       | Gross domestic income (terms of trade adjusted), Constant 2015 prices, Billions National Currency                                    |
| GDN       | General government gross debt, Billions National Currency  |
| GDNRATIO  | Gross government debt, % of GDP  |
| GINI_DISP | Estimate of Gini index of inequality in equivalized household disposable (post-tax, post-transfer) income.                           |
| GINT      | General government average interest rate on outstanding debt   |
| GIP       | Gross government interest payments, Billions National Currency   |
| GLN       | General government net lending (fiscal balance), Billions National Currency  |
| GLNRATIO  | General government net lending (fiscal balance), % GDP   |
| GLNT      | General government fiscal balance target, % GDP  |
| GOTH      | Government other net revenue, Billions National Currency   |
| GTRADE    | General government taxes on international trade and transactions, Billions National Currency   |
| GTRADER   | Tax rate on international trade and transactions   |
| HEAD19    | Poverty headcount ratio at \$1.90 a day (2011 PPP) (% of population)   |
| HEAD55    | Poverty headcount ratio at \$5.50 a day (2011 PPP) (% of population)   |
| HIC       | Consumer Price Index, Period Average, 2015 = 100   |
| IGR       | Public gross fixed capital formation, Constant 2015 prices, Billions National Currency   |
| INFT      | Inflation target (not necessarily explicit)  |
| INT       | Monetary Policy-Related Interest Rate, Percent per annum   |
| IPR       | Private gross fixed capital formation, Constant 2015 prices, Billions National Currency  |
| ITAX      | General government taxes on goods and services, Billions National Currency   |
| ITAXR     | Tax rate on goods and services   |
| ITR       | Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant 2015 prices, Billions National Currency |
| K         | Capital stock, Constant 2015 prices, Billions National Currency  |
| LABSH     | Share of labour compensation in GDP at current national prices   |
| LFN       | Labour Force, 1000s  |
| LIVES     | Lives lost from climate shocks (exogenous)   |
| LNN       | Employment, 1000s  |
| LNNF      | Female employment, 1000s   |
| LOCK      | Change in stringency of measures introduced to contain the pandemic  |

|         |  |
|---------|--|
| LRX     | Participation ratio  |
| LTl     | Long-term bond yield, per cent   |
| MTD     | Deflator for Imports of Goods and Services, National currency, 2015 = 100          |
| MTN     | Imports of goods and services, Current prices, Billions National Currency          |
| MTN\$   | Imports of goods and services, Current prices, US\$                                |
| MTR     | Imports of goods and services, Constant 2015 prices, Billions National Currency    |
| MTR\$   | Imports of goods and services, Constant 2015 prices, US\$ billion                  |
| OGC     | Other general government consumption expenditure, Billions National Currency       |
| OGI     | Other general government investment expenditure, Billions National Currency        |
| OILC    | Oil consumption, Exojoules   |
|         | Imports of Petroleum, petroleum products and related materials as a share of Total |
| OMS     | Merchandise imports plus Total Services imports                                    |
|         | Exports of Petroleum, petroleum products and related materials as a share of Total |
| OXS     | Merchandise exports plus Total Services exports                                    |
| PC      | Domestic price of coal, inclusive of net carbon tax, US\$ per Mn kJ                |
|         | Household consumption expenditure (including Non-profit institutions serving       |
| PCR     | households), Constant 2015 prices, Billions National Currency                      |
| PE      | Domestic price of energy, inclusive of net carbon tax, US\$ per Mn kJ              |
| PG      | Domestic price of natural gas, inclusive of net carbon tax, US\$ per Mn kJ         |
| PM25    | PM2.5 air pollution, mean annual exposure, micrograms per cubic meter              |
| POIL    | Domestic price of oil, inclusive of net carbon tax, US\$ per Mn kJ                 |
| POPT    | Total population, 1000s  |
| POPWA   | Population aged 15-64, 1000s   |
| PR      | Domestic price of renewable energy, US\$ per Mn kJ                                 |
| PREM    | Country-specific risk premium, basis points.                                       |
| PROF    | Profits, Billions National Currency  |
| RC      | Consumption of non-fossil fuel energy (nuclear, hydro and renewables), Exojoules   |
| REFEX   | Real effective exchange rate, 2015 = 1   |
|         | Relative redistribution parameter (percentage difference between Gini Coefficients |
| REL_RED | measures in terms of gross and disposable income)                                  |
| REMIT   | Inflow of personal remittances, Billions National Currency                         |
| REV     | General government revenue, Billions National Currency                             |
| REVG    | General government revenue, grants, Billions National Currency                     |
|         | Real personal disposable income, Constant 2015 prices, Billions National           |
| RPDI    | Currency   |
| SCR     | Accumulation of inventories, Constant 2015 prices, Billions National Currency      |
| SDLI    | Standard deviation of log income   |
| SOLV    | Solvency rule switch (exogenous)   |
|         | General government taxes on income, profits, and capital gains, payable by         |
| TAX     | individuals, plus social contributions, Billions National Currency                 |
| TAXR    | Income tax rate  |
|         | Labour augmenting technical progress trend, indexed to GDP per employee in         |
| TECHL   | 2015   |
| TFP     | Trend TFP growth rate, expressed as log change                                     |
| TOURSH  | Travel and transport services exports as a share of nominal GDP (constant)         |
| URX     | Unemployment Rate (ILO definition)   |
| URXF    | Female unemployment Rate (ILO definition)  |
| USER    | User cost of capital, per cent   |

|         |  |
|---------|--|
| WDR     | Trade-weighted external demand, Constant 2015 prices, US\$ billion                   |
| XTD\$   | Deflator for Export of Good & Services, US\$, 2015 =100                              |
| XTDNO\$ | Non-oil export price deflator, US\$, 2015 =100                                       |
| XTN     | Exports of goods and services, Current prices, Billions National Currency            |
| XTN\$   | Exports of goods and services, Current prices, Billions US\$                         |
| XTR     | Exports of goods and services, Constant 2015 prices, Billions National Currency      |
| XTR\$   | Exports of goods and services, Constant 2015 prices, Billions US\$                   |
| YBAR    | Survey mean consumption or income per capita, total population (2011 PPP \$ per day) |
| YED     | Deflator for GDP, National Currency, 2015 =100                                       |
| YEN     | Gross Domestic Product (GDP), Current prices, Billions National Currency             |
| YEN\$   | Gross Domestic Product (GDP), Current prices, US\$ billion                           |
| YER     | Gross Domestic Product (GDP), Constant 2015 prices, Billions National Currency       |
| YER\$   | Gross Domestic Product (GDP), Constant 2015 prices, US\$ billion                     |
| YFT     | Trend output, Constant 2015 prices, Billions National Currency                       |
| YFT\$   | Trend output, Constant 2015 prices, Billions US\$                                    |

## References

- ADB, & UNDP. (2020). *COVID-19 in the Kyrgyz Republic: Socioeconomic and Vulnerability Impact Assessment and Policy Response*. ADB, UNDP.
- BIOFIN. (2019). *Environmental Finance Policy and Institutional Review in the Kyrgyz Republic*. UN Environment.
- Bogetic, Z., & Fedderke, J. (2009). Infrastructure and Growth in South Africa: Direct and Indirect Productivity Impacts of 19 Infrastructure Measures . *World Development*.
- Botev, J., Égert, B., & Jawadi, F. (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies. *International Economics*, 3-13.
- Botev, J., Égert, B., Smidova, Z., & Turner, D. (2019). A new macroeconomic measure of human capital with strong empirical links to productivity. *OECD Economics Department Working Papers* 1575.
- Briceño-Garmendia, C., Estache, A., & Shafik, N. (2004). *Infrastructure Services in Developing Countries : Access, Quality, Costs and Policy Reform*. Washington, D.C.: World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/14721>
- Cerra, V., & Saxena, S. (2008). Growth Dynamics: The Myth of Economic Recovery. *American Economic Review*, 98(1), 439-57.
- ECB. (2017). *Annual Report* . Frankfurt: European Central Bank.
- Government of Kyrgyzstan. (2018). *National Development Strategy of the Kyrgyz Republic*. Bishkek: Government of Kyrgyzstan.
- Griscom, W. B., Adams, J., Ellis, P. W., Houghton, R. A., Lomax, G., Miteva, D. A., . . . Siikamäki, J. V. (2017). Natural climate solutions. *PNAS*, 11645-11650 .
- Holland, D., & Sirimaneetham , V. (2021). *MPFD Working Paper on Policy Scenarios to build forward better in Asia and the Pacific* . Retrieved from <https://www.unescap.org/kp/2021/mpfd-working-paper-policy-scenarios-build-forward-better-asia-and-pacific>
- Huang, Z., & Saxena, S. (2020). *Can this time be different? Challenges and Opportunities for Asia Pacific economies in the aftermath of COVID-19*. Bangkok: UNESCAP.
- IEA. (2019). *World Energy Outlook 2019*. Paris : IEA. Retrieved from <https://www.iea.org/reports/world-energy-outlook-2019>
- IEA. (2020). *World Energy Outlook 2020*. Paris: IEA. Retrieved from <https://www.iea.org/reports/world-energy-outlook-2020>
- IFC. (2021). *Creating markets in the Kyrgyz Republic*. Washington DC: International Finance Corporation.
- IMF. (2020). *World Economic Outlook, October 2020*. Washington DC: International Monetary Fund.
- IMF. (2021). *Article IV report*. Washington DC: International Monetary Fund.
- IMF PCS. (2020). *IMF Primary Commodity Prices*. Washington DC: International Monetary Fund.
- International Transactions Reporting System. (2020). *Remittances made through money transfer system*. Bishkek: National Bank of the Kyrgyz Republic.
- Intracen. (2020). *SME Competitiveness Outlook 2020 - COVID-19: The Great Lockdown and its Effects of Small Business*. International Trade Center.
- MICS. (2021). *Follow-up assessment of COVID-19 impact on children in Kyrgyzstan*. UNICEF.

- Ministry of Economy of the Kyrgyz Republic. (2020, July 24). *What measures were taken to help businesses during the pandemic*. Retrieved from <http://mineconom.gov.kg/>.
- MoF. (2020). *Kyrgyz Republican Budget Explanatory Letter*. Bishkek: Ministry of Finance.
- MoF. (2021). *Macroeconomic Outlook Development 2021-23*. Bishkek: Ministry of Finance.
- NBKR. (2020). *Bulletin of the National Bank of Kyrgyz Republic*. Bishkek: Financial Statistics and Survey Department.
- NSC Open Data . (2020). *Open Data*. Bishkek: National Statistical Committee of the Kyrgyz Republic.
- OECD. (2018). *Social Protection System Review of Kyrgyzstan*. OECD.
- OECD. (2019). *Biodiversity: Finance and the Economic and Business Case for Action*. Organisation for Economic Co-Operation and Development. Retrieved 2021
- Reliefweb. (2021, August 5). Retrieved from [Reliefweb.int](https://reliefweb.int/):  
<https://reliefweb.int/report/kyrgyzstan/price-monitoring-food-security-kyrgyz-republic-issue-42-02-july-2021>
- SERF. (2021). *United Nations COVID-19 Socioeconomic Response Framework for the Kyrgyz Republic*. Bishkek: United Nations.
- UN. (2019). *A REPORT ON KYRGYZSTAN'S PROGRESS ON SUSTAINABLE DEVELOPMENT GOALS - MAPS REVIEW*. Bishkek: UN Interagency MAPS Mission Team .
- UN. (2019). *A report on Kyrgyzstan's progress on Sustainable Development Goals*. UN Interagency MAPS Mission Team.
- UN. (2020). *COVID-19 response and early recovery plan*. United Nations.
- UN VNR. (2020). *Voluntary National Review on the Implementation of the Sustainable Development Goals in Kyrgyz Republic*. Bishkek: UN.
- UNDP; ADB. (2020). *COVID19 in Kyrgyzstan - Socioeconomic and Vulnerability Impact Assessment and Policy response*. UNDP, ADB.
- UNESCAP. (2019). *Economic and Social Survey of Asia and the Pacific - Ambitions Beyond Growth*. UNESCAP.
- UNESCAP. (2021). *Economic and Social Survey of Asia and the Pacific - Towards Post COVID-19 resilient economies*. Bangkok: UNESCAP.
- UNICEF. (2020). *Response-covid-19-kyrgyzstan*. Retrieved from UNICEF:  
<https://www.unicef.org/kyrgyzstan/response-covid-19-kyrgyzstan>
- VNR. (2020). *Voluntary National Report on the Implementation of Sustainable Development Goals in the Kyrgyz Republic*. Bishkek: Government of Kyrgyz Republic.
- Wang, F. (2015). More health expenditure, better economic performance? Empirical evidence from OECD countries. *Inquiry*, 52, 1-5.
- WFP. (2021). *Food security situation in the Kyrgyz Republic*. Rome: World Food Programme.
- WHO. (2021). *Health financing in Kyrgyzstan: Obstacles and opportunities in the response to COVID-19*. Copenhagen: World Health Organization.
- WHO. (2021, December 12). *Kyrgyzstan*. Retrieved from WHO Emergency Dashboard:  
<https://covid19.who.int/region/euro/country/kg>
- World Bank. (n.d.).
- World Bank. (2020). *Fueling Kyrgyzstan's Transition to Clean Household Heating Solutions*. Washington DC: World Bank.
- World Bank. (2021). *Kyrgyzstan Emergency COVID-19 Project Restructuring and Additional Financing* . World Bank.
- World Bank. (2021, June 10). *The Kyrgyz Republic's COVID-19 Vaccination Rollout Gets Boost with \$20 million in World Bank Financing*. Retrieved from World Bank:

<https://www.worldbank.org/en/news/press-release/2021/06/10/further-covid-19-vaccination-rollout-in-the-kyrgyz-republic-supported-by-the-world-bank-s-20-million-in-additional-financing>

World Bank. (2021, June 24). *Updated estimates of the impact of COVID-19 on global poverty: Turning the corner on the pandemic in 2021?* Retrieved from <https://blogs.worldbank.org/opendata/updated-estimates-impact-covid-19-global-poverty-turning-corner-pandemic-2021>

Yamano, T., Hill, H., Ginting, E., & Samson, J. (2019). *Kyrgyz Republic - Improving Growth Potential*. Manila: Asian Development Bank.