Annex 2 – Report on IFs Scenario modeling

Scenario analysis for Kyrgyzstan

Human capital
Governance
Economy

September 26th, 2018

IFs model version 7.36

1 Executive summary

Alternative future development pathways are explored for Kyrgyzstan - based on key policy priorities and development plans incl. the SDGs - using the integrated modelling system IFs.

KGZ is a young but quickly aging country and human capital investments should be prioritized urgently to reduce future societal costs and maximize benefits in terms of quality of life, economic productivity, peace and stability. Adding to the urgency is the rise in non-communicable diseases (NCDs), but analysis shows that NCDs could be reduced significantly and at relatively low costs. Likewise the country should prioritize reductions in children's health burden (infant mortality and malnutrition/stunting). Targeted interventions on these parameters (NCDs, malnutrition and infant mortality) under the human capital scenario show significant contributions to quality and quantity of human capital by reductions to DALY and increases to life expectancy, and thus the country's ranking on the Human Development Index.

Enrollment and completion of primary school for both girls and boys is set to reach close to universal levels by 2030. However, secondary level enrollment and completion is lacking. Targeted interventions accomplish universal enrollment, completion and gender parity at all primary and secondary levels of education by 2030. The human capital interventions (health and education) undertaken in the analysis will improve quality on life on many different measures in the short to medium term. But, one important conclusion that must be emphasized is that HC investments are long-term investments, significant economic benefits of which will not materialize until decades later. That's why they should be prioritized urgently. Broader gender inequality issues and persistent poverty remain key concerns for Kyrgyzstan. Poverty is only forecasted to reduce slightly by 2030 from current levels. No attempts have been made in this analysis to more directly target poverty reductions - e.g. via increasing social transfers. This is because data suggest there are large spending inefficiencies within government, problems with targeting the poor, and adverse effects from the fiscal system.

Kyrgyzstan is falling behind on a number of key governance indicators related to quality of governance and political and economic inclusion. Governance indicators are strongly linked to socio-economic indicators and can result in more immediate economic gains (relative to HC investments). Under the governance scenario, interventions for select governance indicators (corruption, effectiveness, regulatory quality and civic and political freedom) are benchmarked using the impressive improvements realised in Georgia the past decades which has helped the country improve significantly on several socio-economic indicators. The implemented governance improvements lets Kyrgyzstan catch up to Georgia on the governance indicators by 2030 and doing so will have contributed significantly to both GDP per capita growth and reductions to the informal economy and poverty by 2030.

Real GDP per capita is forecasted to grow only slowly for Kyrgyzstan under the baseline, and the gap to the Lower Middle Income group (LMI) to widen significantly. Under the economic scenario, focus is on raising (post loss) agricultural output, improving the business environment, increasing manufacturing exports and renewable energy production whilst reducing the significant electricity production losses. The interventions will contribute significantly to economic growth and reductions in the informal labor share and poverty rates. It will also significantly improve the country's trade balance, mostly through the increase in agricultural production and exports, but also due higher (lower) energy exports (imports).

An 'All' scenario combines all three scenarios to illustrate the strong impacts on all the dimensions of development from an 'integrated policy push". The scenario will raise the annual real GDP growth rate from 3.8% to 5.1% and the annual real GDP per capita growth rate from 2.6% to 3.8% from 2018-2030. It will have added more than four years to life expectancy, raised adult (year 15+) educational attainment by 0.5 years and made significant reductions in both the informal economy and labor share, and in poverty rates.

2 Introduction

IFs is a large-scale, long-term, integrated global modeling system using a variety of modeling approaches and methodologies.[1] IFs is developed and maintained by the Pardee Center at the University of Denver and consists of 12 different interlinked models/systems[2] which let the user model a wide range of policy interventions, and an extensive interface system including an SDG dashboard/module allowing users to assess SDG improvements and trade-offs from interventions.

Every scenario analysis will have to be designed based on country-specific reform priorities, identified national SDG-accelerators or shocks. The first step of an analysis is to identify the relevant indicators and parameters in the model corresponding to the desired reform/policy objective. The second step is often the most challenging and involves the benchmarking of the magnitude of implemented interventions. Often, so-called *"brute force"* interventions will be implemented. The advantage of the brute-force approach is that it is simple to implement and will quantify the potential benefits of obtaining a specific objective/goal, i.e. "the benefits of getting there". The disadvantage is that it only offers little insight into *"how to get there"*, including any (budgetary) cost of the implemented intervention (see footnote for example).[3]

This analysis for Kyrgyzstan looks into some key government development ambitions. The purpose of the analysis is to illustrate how IFs can be used to deliver analytical insights on policy coherence, integration and trade-offs by assessing policy impacts on multiple dimensions of development. The analysis is not meant to be used for sector specific policy conclusions or recommendations which would require more in-depth analysis and consultations with national experts to guide each intervention and scenario - and in some cases to update the different datasets used in the system.

For the purpose of this analysis, several different benchmarking approaches are adopted based on how KGZ performs on key variables compared to other countries in the region and/or "top improvers" on the particular dimensions of development the government wishes to prioritize. The analysis is not an attempt to model the entire national policy agenda, nor is it an attempt to undertake an in-depth analysis of a few select priorities. Instead, the analysis assesses the possible development pathways – benefits and trade-offs - for the country from a number of broad-based and often loosely defined policy objectives, and most often through "brute-force" interventions (see footnote 3). Going forward, the Government, national counterparts and other partners could identify specific policy priorities and objectives, which could then be modelled with greater precision and accuracy to gain deeper analytical insights on the possible development pathways.

Like all International Futures analysis two cautions apply. First, a significant amount of data is missing for Kyrgyzstan. In International Futures this means that many current data points are estimates (based on projections from a few, and potentially far back, historical values and/or cross-country comparisons/regressions). Second, outside of education, infrastructure and some health elements, the model only offers little insight on the costs of reaching said policy objectives. In that sense many interventions are "free" in the model. However, any externally derived cost estimates of key reform priorities could be entered exogenously to "government expenditure" in the model to produce cost-benefit estimates if that is the objective.

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[1] See annex A for details.

[2] Demographics, health, HIV/aids, education, economic, infrastructure, agriculture, energy, environment, governance, international politics and through a partnership with UNDP also an "SDG module".

[3] An example might suffice; if one goal for the country is to reduce "infant mortality", this can be done in the model by directly reducing "infant mortality" by reducing its multiplier (i.e. by "brute force"). This approach offers no insight into "how" this is accomplished, and can thus broadly be interpreted as "any policy intervention that reduces the health burden for children". Alternatively, one can chose to impact the model's "drivers" of "infant mortality" by e.g. increasing the access rate to "safe water and sanitation" which reduces childhood exposure to diarrheal disease, malnutrition and premature death. However, there are a multiple of other possible interventions that are likely to impact infant mortality, why a combination of intervention approaches (indirect or direct interventions) might often be the preferable, or only solution.

The analysis consists of three “policy scenarios” modelled separately; governance, human capital and the economy, and finally a results and conclusions section which includes an ‘All’ scenario that combines all three scenarios into one to show the impacts of an “integrated policy push”.

3 Country SDG performance and SDGs in IFs

Kyrgyzstan is at the lower end of the Lower Middle Income (LMI) group of countries. Based on its level of GDP (or GNI) per capita, Kyrgyzstan is performing above expectations on many key development indicators. One example is a country study from the World Bank using their SDG Diagnostics framework analysis (which uses GNI per capita as the reference) from 2015.[4] The preliminary findings suggested that the country performed *above expectations* on all SDGs measured, except for the indicator on Co2-emissions which suggested a large scope for energy efficiency improvements. For more on the study see Box 1.

Box 1: World Bank 2015 SDG diagnostics study – Kyrgyzstan

Despite the overall good performance described above, the study found that the country’s ranking among other low- and middle-income countries had deteriorated for the majority of indicators and mostly so for; *shared prosperity, secondary enrollment and HIV prevalence.* One suggestion why was limited capacity to reach out to the relatively small disadvantaged groups without access to services and infrastructure often situated in the rural parts of the country.

Indicators where the country ranking had improved the most were; *poverty, under-5 mortality, and road density.*

The study concluded that the country is well underway to considerably improve on a number of indicators by 2030 and reach the post-2015 ambition on; *Poverty, primary completion rate, ratio of female to male primary completion, ratio of female to male secondary enrollment, maternal mortality, malaria, HIV prevalence, and access to electricity*.

The study also noted that as the country has a higher than expected tax revenue to GDP level, and simultaneously high external debt stock, the focus should be on improving spending efficiency especially in the energy and health sector.

The table below shows the SDG indicators assessed in the WB study and how the country performs on each.

Cross-country relationship with GNI/cap	Overperforming	As expected	Underperforming
Tight	• Poverty (+) • Pre-primary school enrollment (–) • Primary completion (–) • Secondary school enrollment (–) • Ratio of female to male secondary enrollment (–) • Under-5 mortality (+) • Maternal mortality (x) • Malaria (x) • Access to improved water source (x) • Access to improved sanitation (–) • Internet users (–)	• Road density (+)	• CO_2 emissions (–)
Loose	• Shared prosperity (–) • Secondary completion rate • Ratio of female to male primary completion (–) • HIV prevalence (–)		

Note: (+) = larger country rank increase, 2000–12, or smaller deterioration than for GNI per capita; (–) = smaller increase or a decreased country rank 2000–12 compared to GNI per capita; (×) = the same country rank change 2000–12 as for GNI per capita (+/– 2 percentile points).

Source: Trajectories for SDGs – Framework and country applications, World Bank, 2015.

SDGs in International Futures

[4] http://documents.worldbank.org/curated/en/946601467999387915/Trajectories-for-sustainable-development-goals-framework-and-country-applications. The SDG diagnostics methodology has been updated since, see here.

Most adopted SDG indicators do not translate one-to-one into IFs, but in total 94 different IFs measures which are either precisely an SDG indicator or a proxy for an SDG indicator can be calculated and tracked in the model under 14 different goals.[5] Oftentimes there are several alternative proxies for the same indicator, why the net number of SDG indicators calculated and tracked in IFs is 48 – *i.e. IFs tracks 48 SDG indicators through 94 different measures*. As an example; SDG target 1.1 states; *"By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day"*. The associated indicator 1.1.1 is; *"Proportion of population below the international poverty line, by sex, age, employment status and geographical location (urban/rural)".* As evident from Table 2 below, IFs has two default measures for this indicator denominated "indicator 1.1.1a and 1.1.1b" depending on whether one would like to measure poverty at the $1.90 or $3.20 ($2011 PPP) threshold (the model allows the user to calculate any threshold).

International Futures allows users to enter SDG targets at discretion, e.g. if any national SDG targets and indicators have been adopted. If no country-specific targets are entered, the model will per default include a number of "global targets" where possible (and a blank cell where not). Some global default targets are straightforward to enter as they are explicitly mentioned in the SDG framework. E.g. target 3.2 states; *"By 2030, end preventable deaths of new-borns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births".* So, the 2030 target value for indicator 3.2.2 in IFs is set to 12, unless the country is already below 12, then that value will remain the 2030 target.

Other times where it is more difficult, but not impossible, to put a target value in International Futures (based on the SDG framework text) the user will have some degree of freedom to interpret the text. Returning to the example of target 1.1, "eradicate" is in the example above in IFs interpreted as 3% under the global default. Another example is the smoking rate. SDG target 3.a states; *"Strengthen the implementation of the World Health Organization Framework Convention on Tobacco Control in all countries, as appropriate."* and indicator 3.a.1; *"Age-standardized prevalence of current tobacco use among persons aged 15 years and older".* The target refers to WHO's framework which states as a global target; *"A 30% relative reduction in prevalence of current tobacco use in persons aged 15+ years by 2025."*[6] The global default target set in IFs is then assumed to be a 50% relative reduction 5 years longer down the line, i.e. by 2030.

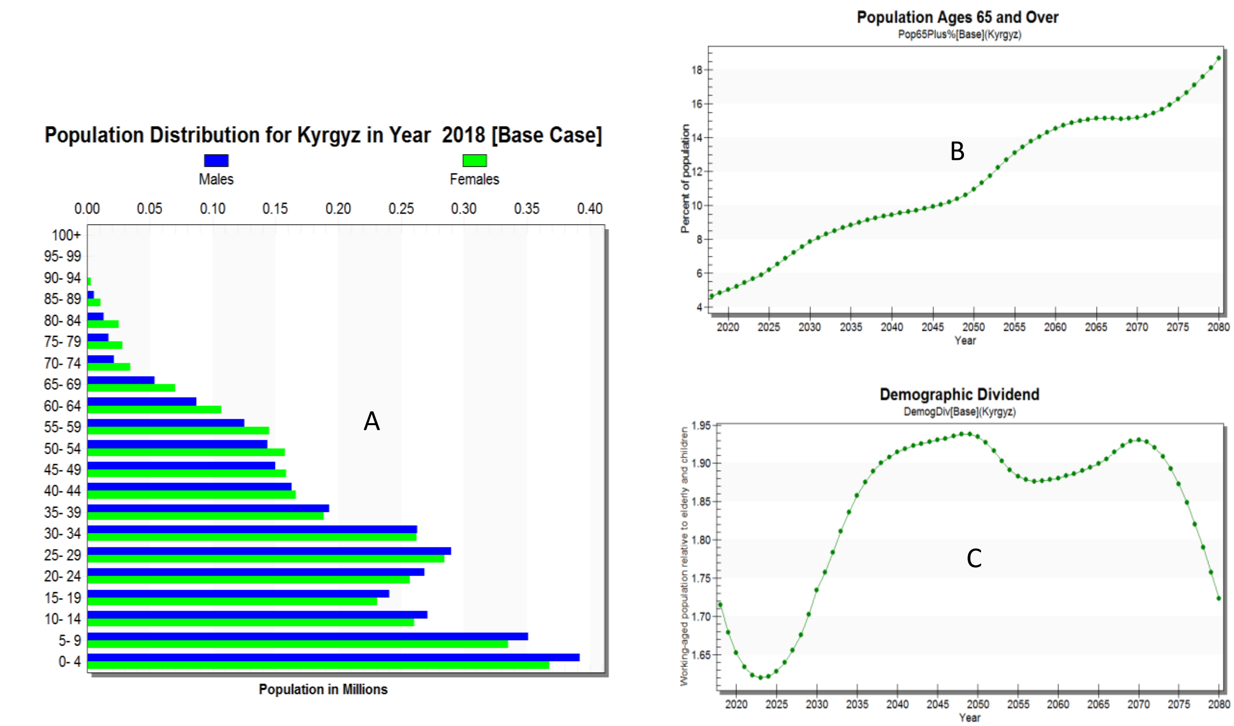
4 Scenario 1 – Human capital

Kyrgyzstan is a relatively young country, but with a quickly and steadily aging population; the population share of 65+ year olds is almost set to double and reach 9% of the population by 2035, cf. Figure 1 panel B. Despite this steadily aging population, Kyrgyzstan demographic dividend will start to improve (rise) by 2023 and continue to improve till about 2050 and remain favourable till about 2070 from where it will start a steep decline, cf. Figure 1 panel C. Taking advantage of this relatively high demographic dividend that the country will have for many years to come and prepare for the aging society will require significant investments in human capital today and going forward as a higher growth and productivity of the labor force is needed to support the growing number of older people as they exit the workforce.

Figure 1: Demographics – Kyrgyzstan, 2018-2080.KGZ population and forecast.

[5] There are 169 SDG targets and 232 indicators 93 of which are categorized as Tier 1. A Tier 1 indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.

[6] Click here



Note: Panel A shows the current population age and gender composition in mio people. Panel B shows the % of population aged 65 years and over till 2080. Panel C shows the demographic-dividend as the ratio of working age population to people 65+ years and children till 2080

Table 1 provides a snapshot on how Kyrgyzstan – based on the data projections in International Futures- was performing in 2015 and how the country is expected to perform under the baseline[7] in 2030 based on indicators under SDGs 1, 2, 3 and 4 which track human capital progress. International Futures is not able to calculate and track any of the adopted SDG 5 indicators as of yet due to methodological and data issues (only 2.5 of the total 14 SDG 5 indicators are currently classified as tier 1).

[7] Baseline refers to the forecast in International Futures under the assumption of "business as usual", i.e. without any (policy) interventions implemented in the model.

Table 1: Kyrgyzstan SDG 1,2,3 and 4 performance, 2015 vs. 2030

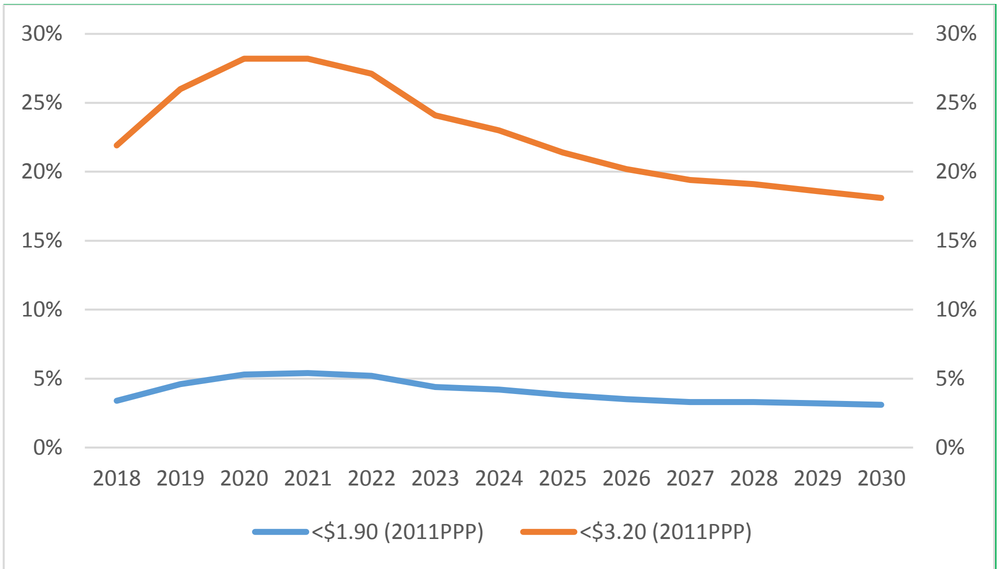
Indicators	2015 Value	Baseline 2030
------------------- **Goal 1: POVERTY** -------------------		
Indicator 1.1.1b - Percentage of population below $1.90 (2011$ PPP) per day; Lognormal	2.5	3.128
Indicator 1.2.1b - Percentage of population below $3.20 (2011$ PPP) per day; Lognormal	17.03	16.69
Indicator 1.a.1a - Transfers (welfare and pensions) as % of total government expenditures	30.01	35.45
Indicator 1.a.1b - Transfers (welfare and pensions) as % of GDP	11.19	14.45
Indicator 1.a.1c - Transfers in Billion $	0.8274	1.86
Indicator 1.a.2a - Percentage of total government spending on essential services (education; health)	25.81	31.48
Indicator 1.a.2b - Government spending on essential services (education; health) as % of GDP	9.625	12.83
Indicator 1.a.2c - Government spending on essential services (education; health) in Billion $	0.7115	1.652
------------------- **Goal 2: HUNGER** -------------------		
Indicator 2.1.1a - Percentage of undernourished population	6.4	4.366
Indicator 2.2.1a - Prevalence of stunting (height for age <-2 SD) among total population	2.924	3.08
Indicator 2.2.1b - Prevalence of stunting (height for age <-2 SD) in working age population	2.924	3.114
Indicator 2.2.2a - Percentage of malnutrition (weight for height <-2 SD) among children under 5	3.427	2.903
Indicator 2.2.2c - Severe Acute Malnutrition (weight for height <-3 SD) among children under 5	0.8	0.7648
Indicator 2.4a - Percentage of land dedicated to crop	7.069	7.052
Indicator 2.4b - Percentage of land dedicated to grazing	47.97	51.46
------------------- **Goal 3: HEALTH** -------------------		
Indicator 3.2.2 - Infant mortality rate in deaths per thousand newborns	18.33	14.96
Indicator 3.3.1a - HIV cases as percentage of population	0.16	0.27
Indicator 3.3.1b - AIDS death rate as percentage of population	0.01	0.01
Indicator 3.3.3 - Malaria death rate per thousand	0.00	0.00
Indicator 3.4.1a - Cardiovascular disease death rate per thousand	3.19	3.46
Indicator 3.4.1b - Cancer death rate per thousand	0.66	0.76
Indicator 3.4.1c - Digestive disease death rate per thousand	0.06	0.08
Indicator 3.4.1d - Respiratory disease death rate per thousand	0.28	0.34
Indicator 3.4.1e - Diabetes death rate per thousand	0.05	0.06
Indicator 3.4.1f - Mental Health death rate per thousand	0.29	0.32
Indicator 3.4.1g - Other Non Communicable disease death rate per thousand	0.62	0.64
Indicator 3.6.1 - Road traffic injuries death rate per thousand	0.18	0.19
Indicator 3.7.1 - Contraception use as percentage of fertile women	42.00	51.93
Indicator 3.a.1 - Smoking Rate - Total	26.90	27.27
------------------- **Goal 4: EDUCATION** -------------------		
Indicator 4.1.1a - Primary education net enrollment rate - Total	86.74	94.09
Indicator 4.1.1b - Primary education gross enrollment rate - Total	107.40	101.40
Indicator 4.1.1c - Primary education gross completion rate - Total	103.80	99.86
Indicator 4.1.1d - Lower secondary education gross enrollment rate - Total	96.89	98.27
Indicator 4.1.1e - Lower secondary education graduation rate - Total	91.21	96.04
Indicator 4.1.1f - Upper secondary education gross enrollment rate - Total	80.90	83.17
Indicator 4.1.1g - Upper secondary education graduation rate - Total	63.39	70.93
Indicator 4.3.1a - Vocation as % of enrollment in all programs for lower secondary education - Total	0.00	0.00
Indicator 4.3.1b - Vocation as % of enrollment in all programs for upper secondary education - Total	35.06	35.08
Indicator 4.5.1a - Primary education net enrollment rate parity index (female/male)	0.99	0.99
Indicator 4.5.1b - Primary education gross enrollment rate parity index (female/male)	0.99	1.00
Indicator 4.5.1d - Primary education gross completion rate parity index (female/male)	0.98	1.00
Indicator 4.5.1f - Lower secondary education gross enrollment rate parity index (female/male)	1.00	1.01
Indicator 4.5.1g - Lower secondary education graduation rate parity index (female/male)	1.01	1.01
Indicator 4.5.1i - Upper secondary education gross enrollment rate parity index (female/male)	1.07	1.05
Indicator 4.5.1j - Upper secondary education graduation rate parity index (female/male)	1.10	1.10
Indicator 4.5.1k - Years of education obtained by population 15+ parity index (female/male)	0.99	1.02
Indicator 4.5.1l - Years of education obtained by population 25+ parity index (female/male)	0.99	1.01

Kyrgyzstan achieved great reductions to poverty from 2000-2009 with the $3.2 ($2011 PPP) poverty rate falling from 77.2% to 21.1 %. But, poverty has shown high persistence since and is at 19.1% based on the latest WB data from 2016 and expected to decrease to only 16.7% by 2020 underpinned by an increase in pension transfers and continued inflow of remittances reaching the poor.[8] It can be noted that the country is one of the most remittances dependent countries in the world with personal remittances received almost as high as a third of GDP in 2017. In International Futures, poverty rates are set to increase in the short run,

[8] http://www.worldbank.org/en/country/KGZgyzrepublic/overview#3

before they start a (slow) decline from 2021 - cf. Figure 2 - and will have reached 16.7% ($3.2) and 3.1% ($1.9) by 2030 as also shown in the last column of Table 2.

Figure 2: Forecasted poverty rates for Kyrgyzstan, 2018-2030



On a number of important health indicators Kyrgyzstan performs relatively well. Malnutrition as measured solely based on "underweight" (weight for age) in children under 5 was 2.8% based on most recent data from 2014 (and estimated at 3.4% for 2018 in International Futures), significantly below the average of 21% for the LMI-average based on 2017 data.[9] Measured as the sum of both wasting (weight for height) and overweight (weight for height), malnutrition prevalence is 7.8% of children under 5 based on most recent data from 2014 data, and 15.4% for LMI based on 2017 data.

Based on most recent data the stunting rate for children under 5 was 13% in 2014, and 31% for LMI in 2017. Stunting is not only an important health variable because the measure captures well the health-burden of children, but it is also an important economic variable in IFs through economic productivity from its human capital component. Users should be aware that the current model version of IFs significantly underestimates the working age population stunting rate for Kyrgyzstan (and several other former soviet countries). Something that will be corrected in a later model update.[10] This is important because the estimates in IFs suggests that there is little scope for KGZ to improve human capital (and thus also multifactor productivity through the human capital component) through further reductions to children's health burden which is not correct as data form the World Bank shows.

[9] The measure of malnutrition in International Futures is an "underweight" measure solely, i.e. "the prevalence of underweight (weight for age). Underweight = weight for age measure, wasting = weight for height measure, stunting=median height for age measure.

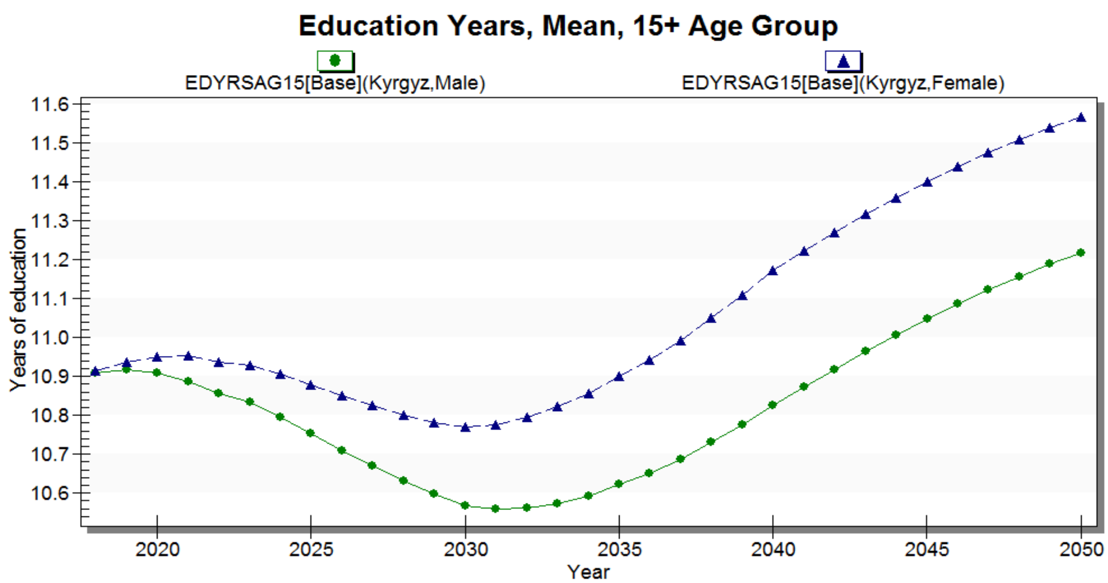
[10] Stunting in the adult population is estimated at 2.93% for Kyrgyzstan in 2018 and as high as 29.3% for LMI-average. The problem in International Futures is; i) stunting forecasts were introduced before the availability of decent stunting data and are therefore initialized using recent malnourished children values and 1990 estimates from a function using GDP per capita. Like many former Soviet states, Kyrgyzstan's GDP per capita from the early 1990s is unreliable, and the relatively high 1990 values results in a relatively low stunting initialization ii) moving forward, stunting is driven by malnourished children. Since the share of malnourished children are initially higher than the share of stunted population, stunting rates gradually increase for Kyrgyzstan in International Futures. Given that better child stunting data now exists (from the WB) International Futures will be updated accordingly (TBD) so that; i) actual child stunting data now becomes the core initialization series ii) International Futures will be able to forecast child stunting since it is one of the SDG indicators and the indicator most people are familiar with regarding stunting. iii) Child stunting will be used to forecast adult and working-age population stunting which is used in the calculation of MFP from the human capital component.

Access to quality water and sanitation services is lacking behind in rural parts of the country and are key determinant of health outcomes through e.g. water-borne disease reductions.[11] The country is rolling out an access to water rural programme. In International Futures access levels on both measures are forecasted to be close to universal by 2030.

The overall smoking rate in Kyrgyzstan is high at 27% and on the rise, and more than half of all men smoke. In comparison the smoking rate for LMI is 18.5% for UMI 24.1%. Smoking is strongly linked to NCDs.

The average educational attainment level[12] in the country is estimated at 10.9 years and higher than both the UMI and LMI averages (note; there is no quality of education measure in International Futures, why one should be careful with cross-country comparisons). Figure 3 shows that attainment is forecasted to decrease till around early 2030s from where it rises steadily. It can also be noted that male and female educational attainment is estimated at parity today, but with female educational attainment to surpass male in the future especially driven by more girls enrolling and graduating from secondary level education and thus beyond.

Figure 3: Educational attainment (mean years of completed schooling, age 15+), male vs. female, 2018-2030



Women might soon be more educated than men in Kyrgyzstan, but educational attainment is only one measure of gender equality, and Kyrgyzstan women face many challenges incl. human rights violations. According to data from the World Bank (from 2012) 17.1% of women (aged 15-49) reported having been "subjected to physical and/or sexual violence in the last 12 months", and women's decision-making power in public and political life is weak. Forced and early marriage is a major concern in the country and not only affecting women, but also their children as an empirical country study shows that that children born in forced marriages have lower birth weight.[13]

Box 2 provides some more details on forecasting human capital (education and health) in International Futures.

[11] http://www.worldbank.org/en/news/press-release/2017/06/22/kyrgyz-republic-to-improve-water-and-sanitation-services-with-world-bank-support
[12] Average years of education for age group 15+
[13] https://www.ncbi.nlm.nih.gov/pubmed/28770502

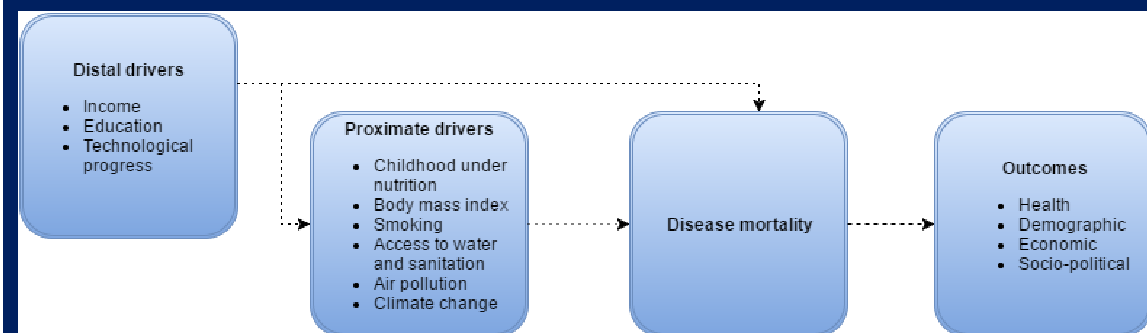
Box 2: On forecasting health and education in IFs[14]

Health

IFs forecasts morbidity and mortality for 15 specific causes. These causes are grouped according to the WHO's International Classification for Disease structure: communicable (infectious) diseases, non-communicable diseases, and accidents. Accidents is further broken down into traffic fatalities, unintentional injuries or death, and intentional injuries or death (murder, suicide, etc.). Data on mortality/morbidity for each of these causes is taken from the WHO Global Burden of Disease Project.

Mortality and morbidity rates are forecast using a distal and proximate driver structure in the model. Distal drivers are those that change over a long period of time and are associated with the social determinants of health. They are systemic and draw from sectors outside the immediate purview of health. Examples of these drivers include levels of education, levels of income and technology. The Global Burden of Disease (GBD) identified income levels, education and technological progress as proxies that drive the incidence and prevalence of disease distally.[15] IFs uses these proxies as distal drivers to forecast health outcomes.

Proximate drivers affect the burden of disease more directly. IFs makes use of childhood undernutrition, the Body Mass Index (BMI), access to water and sanitation, and climate change as proximate drivers when forecasting disease mortality and health outcomes (Hughes et al., 2011). IFs also forecasts various demographic, economic and socio-political outcomes of reduction in disease mortality. Below is a simple diagrammatic description of the drivers of disease in IFs**:**



Education

The IFs model has a well-developed education sub-module which simulates patterns of education participation and attainment for 186 countries to 2100. The education module is closely connected to the demographics module such that the rates of entrance, enrollment and graduation, forecast by the education module, can be multiplied with the number of children in the relevant age group to obtain student headcounts. Student counts are multiplied by per student costs — driven mostly by level of national income — to obtain total educational spending. This allows IFs to forecast intake rates, enrollment levels, and graduation rates for primary, secondary (lower and upper) and tertiary education by age and sex.

The number of entrants at the primary level is calculated from the intake demand, which is driven by household income and other non-income factors that are applied to the total number of children of that age group. A certain portion of primary level students survive to the final grade, a portion of those graduate, and a portion of those students "transition" from primary to lower secondary school. Separate transition rates exist for lower to upper secondary. Year-to-year progression through the schooling system primary school also accounts for both students who dropout and those who repeat grades. Education progression is also affected by dynamics in other areas of the model, including: demographic change, economic development, spending on public education (constrained by spending in other sectors) and supply and demand factors for education funds.

[14] Content of this box is based on Boxes 5 and 6 pages 21 and 24 of Pardee Center's Sustainable Development Goals Report: Moldova 2030, September 8th, 2017.

[15] Murray, C. J., & Lopez, A. D. (1996). The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020: summary. Retrieved from http://apps.who.int/iris/bitstream/10665/41864/1/0965546608_eng.pdf

Education participation rates across time result in a measure of national educational attainment, or the average number of years a student remains in school. The IFs model calculates average years of education for different aggregations of the adult population, commonly defined as the percent of the population aged 15+. Educational attainment data is initialized using data on national educational attainment estimates from Barro and Lee (2015)[16].

Source: Based on Boxes 5 and 6 pages 21 and 24 of Pardee Center's Sustainable Development Goals Report: Moldova 2030, September 8th, 2017.

A (short) note on financial costs in International Futures and Kyrgyzstan's fiscal space

All interventions undertaken in this analysis will require financial resources (some many some maybe only few), and the International Futures modelling system does not automatically take into account all such financial costs. However, the user can enter cost estimates directly through the government finance module given that such estimates have been produced externally. This has not been done in this analysis.

Data on Kyrgyzstan's government finances suggests that significant spending inefficiencies could exist as not only government revenue to GDP, but also government debt, are at relatively high levels. So is the level of government to household transfers (welfare and pension) and this is despite significant persistence in poverty rates as described above, and in a World Bank report from 2017; *"Existing social safety nets are fragmented, offering only modest support to the poor".*[17] An OECD report also concludes that while the fiscal framework reduces inequality it only has little impacts on poverty, and that the burden of taxes exceeds the monetary benefits poor individuals receive. Furthermore, the report concludes that the potential to increase revenue to fund social protection is limited, but that …*" The high proportion of spending already allocated to social protection creates the possibility for reprioritisation of resources within the sector"*. [18]

According to the World Bank, the energy sector, its antiquated assets and a costly energy subsidy policy are negatively affecting government finances. Strains on public spending has led Kyrgyzstan to fund energy infrastructure upgrades and repairs through concessional lending from IFIs which burdens public debt and accumulated debt in the energy sector is more than 20% of GDP. With the right investments and subsidy/tariff regulation the energy sector could free up government resources and earn revenue through increased energy exports from underutilized hydro which could help fund education, health and social protection services.[19]

4.1 Programming scenario 1

Health

Cardiovascular disease (CDV) account for 50% of deaths in the country and more than 20% of DALY[20]. A WHO-UNDP 'NCD investment case' study concluded that there are significant returns on investments from funding health interventions that reduce noncommunicable diseases (NCDs), and that given the young population and rising NCD rates, investments in prevention now would have large positive implications for the future workforce, see Box 3 for more.

Box 3: On NCDs in KGZ

NCDs such as cancer, cardiovascular disease (CVD), diabetes and chronic respiratory disease and their risk factors (tobacco use, harmful use of alcohol, unhealthy diet and physical inactivity) are an increasing public health and development challenge in Kyrgyzstan. NCDs are responsible for 80% of all deaths in the country.

[16] http://barrolee.com/data/oup_download_c.htm

[17] World Bank and PPIAF, "Analysis of the Kyrgyz Republic's Energy Sector, Final report, May 2017

[18] SOCIAL PROTECTION SYSTEM REVIEW OF KYRGYZSTAN, chp. 4, OECD

[19] See footnote 14 and; http://blogs.worldbank.org/europeandcentralasia/energy-challenges-in-the-kyrgyz-republic

[20] The disability-adjusted life year (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.

The probability of premature death (death before the age of 70 years) from one of the four major NCDs for a person living in Kyrgyzstan was one in four in 2015. Although almost half of the adult population (43%) has hypertension, the majority (79%) of these are not taking anti-hypertensive medication. Further, 45% of men smoke tobacco, one in five of the population is obese and Kyrgyzstan is estimated to have one of the highest salt intakes in the world. Strong policy and legislative frameworks for NCDs are in place with the Den Sooluk National Health Reform Programme, the National Programme on NCDs 2013–2020 and the National Public Health Programme 2020.

Nevertheless, there are gaps in implementation of the WHO-recommended cost-effective NCD preventive and clinical interventions. The premature death, morbidity and disability associated with NCDs have a negative impact on socioeconomic development. As in many parts of the world, NCDs in Kyrgyzstan are causing a surge in health care costs and social care and welfare support needs, as well as putting an increasing burden on school and work absenteeism, with resulting reduced productivity and employee turnover. The increasing and relatively young population of Kyrgyzstan (currently 6 million and projected to rise to 7–9 million by 2050), as well as the increasing prevalence of NCD risk factors, suggests that unless action is taken rapidly, the costs of NCDs will grow even further, putting a huge drag on the country's economy.[21]

Source: Prevention and control of non-communicable diseases in Kyrgyzstan, the case for investment 2017, UNDP and WHO

A number of interventions are undertaken and will directly increase life expectancy and reduce DALY.

- Four NCD interventions are implemented; reducing by 40% the death rates from CVDs, cancer, chronic respiratory disease and diabetes relative to the 2030 baseline value by 2030.
- As alluded to above the adult stunting rate is currently estimated too low in International Futures. To reduce it as much as possible in the model forecast, malnutrition among children under 5 is eliminated in the model by 2030.
- The mortality rate for children under 5 is also reduced by about 50% relative to the 2030 baseline value by 2030.

Education

Interventions are undertaken to;

- Achieve universal rates for primary and secondary level of education by 2030 while keeping gender parities at all levels.

Table 2 summarizes the interventions. The second column 'Baseline 2018' shows the current values, next column 'Baseline 2030' the 2030 baseline ("business as usual") values and the last column 'Scenario 2030' the 2030 value after the implemented interventions. As an example it can be seen that the interventions will have raised life expectancy in 2030 from 72.3 to 76.6 years and reduced DALY from 1.78 to 1.41 mio years.

Table 2: Scenario 1 – Human capital

Variable	Baseline		Scenario
	2018	2030	2030
Education			
Educational attainment (average years of education), adult population	*10.91*	*10.67*	11.12

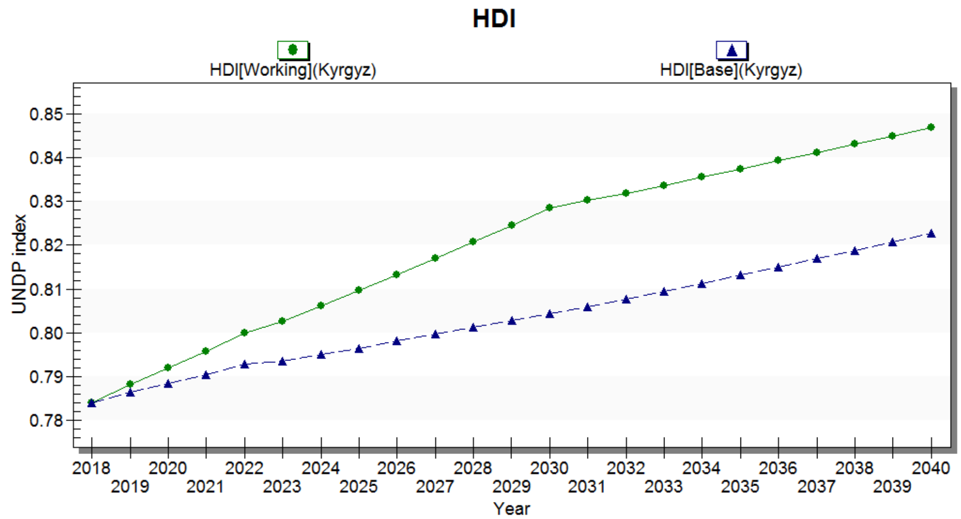
[21] Prevention and control of non-communicable diseases in Kyrgyzstan, the case for investment 2017.

Variable	Baseline		Scenario
	2018	**2030**	**2030**
Health			
Life expectancy	**71.09**	**72.31**	**76.61**
Infant mortality (per 1,000 live births)	17.48	14.96	7.51
Malnourished children (% of children)	3.33	2.90	0.03
Cardiovascular, (deaths per 1,000)	3.16	3.46	2.31
DALY (mio. years)	*0.38*	*0.49*	0.31
Cancer (deaths per 1,000)	0.67	0.76	0.47
DALY (mio. years)	*0.12*	*0.15*	0.09
Diabetes, (deaths per 1,000)	0.05	0.06	0.04
DALY (mio. years)	*0.02*	*0.02*	0.01
Respiratory, (deaths per 1,000)	0.29	0.34	0.23
DALY (mio. years)	*0.05*	*0.07*	0.04
DALY (mio. Years), total	**1.62**	**1.78**	**1.41**

Where governance improvements and e.g. building of infrastructure can translate into economic gains more immediately, investments in human capital such as education and health will produce significant and increasing economic returns, but only decades later. Therefore, it is of utmost importance that policymakers not only prioritize shorter term growth objectives, but also adopt a longer term policy horizon beyond 2030 and undertake the necessary human capital investments urgently to support long-term sustainable economic growth, stability and security in the future. This is part of the rationale behind UNDP's Human Development Index (HDI), and also behind the World Bank's Human Capital Project[22]. Figure 4 below shows the HDI index development under the baseline (blue line) versus under this human capital scenario (green line).

[22] http://www.worldbank.org/en/news/feature/2017/10/20/countries-commit-to-strong-action-on-human-capital-to-drive-economic-growth

Figure 4: Human Development Index – baseline (blue) vs intervention (green) scenario, 2018-2040



5 Scenario 2 – Governance

Under this scenario, a number of interventions under the governance module are undertaken to improve the quality and inclusiveness of governance. The interventions are aligned with the so-called 'new citizen compact' with a focus on responsive and accountable institutions and stable democracy with access to rule of law and human rights.

The governance model quantifies the performance of governments along three interconnected dimensions; security, capacity and inclusion, each of which have their own International Futures index and also a Total Governance Index - all ranking between 0-1 (higher is better). The modelling process builds on a large number of data series and governance indices constructed by various research groups, mostly in academia, non-profit organizations, and international organizations, cf. Box 4 for details on International Futures governance model.

Box 4: On forecasting governance in IFs

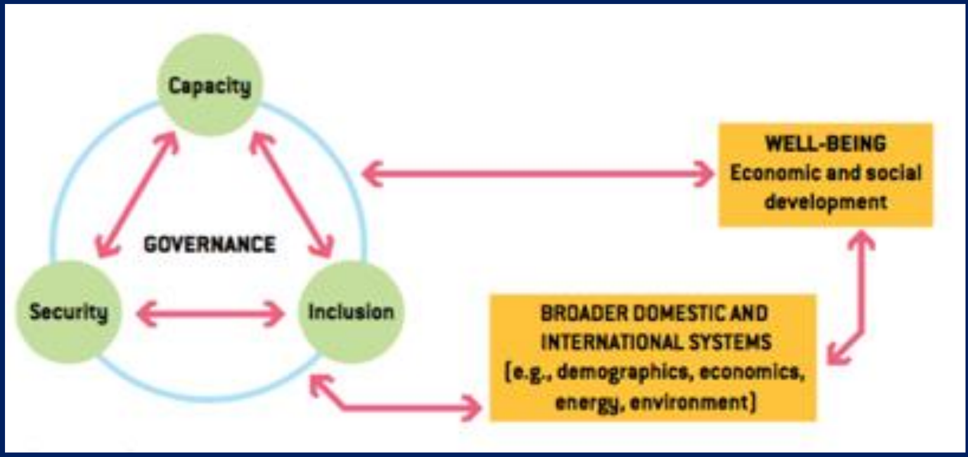
Governance in IFs is conceptualized and forecast along three major transitions, namely: a security transition, a capacity transition, and an inclusion transition.

The security transition begins with the movement from anarchy to sovereignty as states consolidate territory, establish a monopoly on the legitimate use of force, and achieve international recognition by other states. The security transition is focused on maintaining stability and reducing internal conflict within a bounded territorial area as states begin to develop administrative capacity.

The capacity transition follows the development and professionalization of the state bureaucracy and the ability of the state to administer the territory it controls. Developing governance capacity requires things like an effective public administration, a system of taxation and revenue generation, a legitimate system of laws and rules applied equally and a professional military and police force. These elements help the state deliver public services.

The final transition is towards one of inclusion. The process of moving towards inclusive governance includes free movement of information, association, pluralistic decision-making, and a cooperative political culture.

The diagram below details the conceptualization of the governance model and how it interacts with other modules in IFs.



IFs measures governance along each transition as an index score from 0 to 1 for each country.

The security score is initialized using data on state failure, adverse regime change and internal conflict (politicide, genocide, ethnic, or civil war) from the Political Instability Task Force project. Rather than forecasting discrete conflict events, IFs forecasts both the probability of intrastate conflict and vulnerability to intrastate conflict for any country-year pair. Probability of conflict is a function of past conflict, neighbourhood effects, economic growth rates (inverse), trade openness (inverse), youth bulge, infant mortality, and regime type. Vulnerability to conflict is a function of a variety of inputs including: energy trade dependence, economic growth rates (inverse), urbanization rate, infant mortality, undernutrition, corruption, and government effectiveness. A full list of drivers can be found in supporting documentation.[23]

The capacity index is forecasted as a function of government revenue and corruption. Government revenue (percent of GDP) comes from World Bank and OECD data, while corruption data are taken from Transparency International's Corruption Perceptions Index.

The inclusion index is conceived as a broad set of variables including regime type (level of democratic governance) and gender empowerment. Regime type data is initialized from the Polity Project's 11-point democracy scale data, while Gender Empowerment is initialized from UN Gender Empowerment Measure.

Source: Based on Box 2 page 12 of Pardee Center's analysis for Moldova; Sustainable Development Goals Report: Moldova 2030, September 8th, 2017.

Most governance interventions for Kyrgyzstan are made under the 'governance capacity' component of the IFs governance model with the objective of improving governance quality where the country performs comparably worse. International Futures' 'governance capacity index' is driven by government revenue and government quality. In International Futures, governance quality equates (inversely) to the level of government corruption as measured by Transparency International. However, a number of additionally important variables represent alternative measures of governance quality (and link forward to economic and infrastructure development processes) and are also improved under this analysis; governance regulatory quality, governance effectiveness and economic freedom.

International Futures 'Governance Inclusiveness Index' is driven by the level of formal democratization measured by the strength of democratic institutions, level of civil formal participation and an element that measures gender empowerment in society. The focus of this analysis is on improving civil and political freedom/participation.

[23] http://pardee.du.edu/wiki/Governance

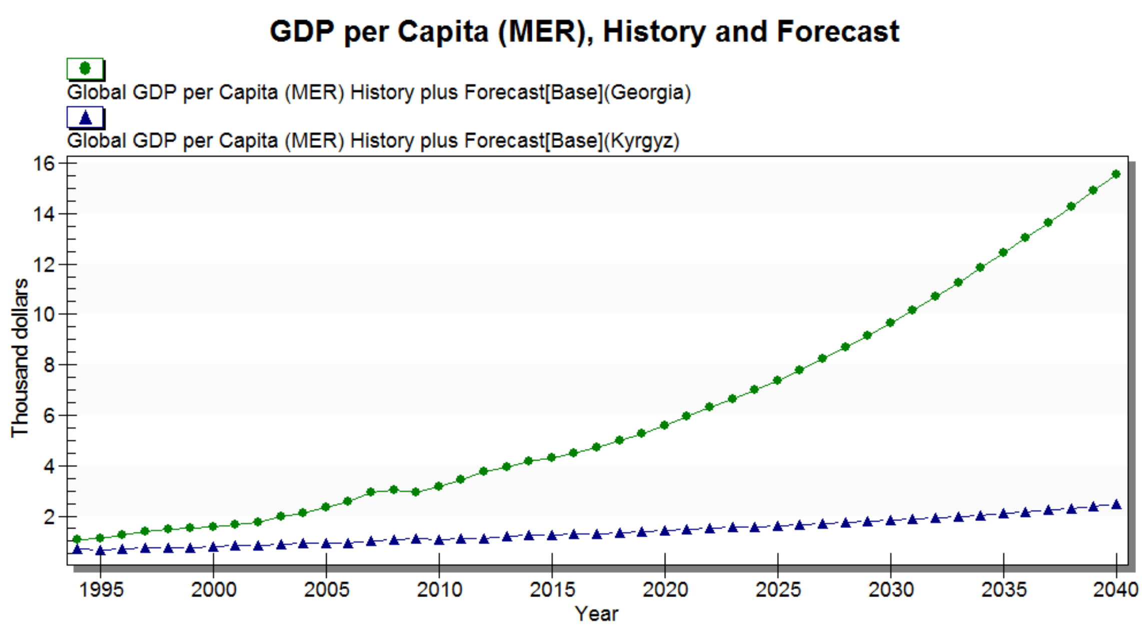
Most governance and economic freedom indicators are interlinked and have strong direct links forward to multifactor productivity and thus economic growth through its social capital component.[24] There are also indirect links to other multifactor productivity components through improvements in electricity access, expansion of ICT technology, reduction of the informal economy and even reductions in malnutrition. Likewise, there are positive feedback mechanisms in the model from rising living standards. As per capita income rises, government inclusiveness and HDI indicators will improve. Citizens' rising living standards will increase pressure on the government to deliver higher levels of democratization. Higher gender equality (through the gender equality measure) also carries forward strong linkages to both government corruption, democracy, effectiveness and higher economic productivity (through its social capital component). Lower levels of government corruption will reduce the informal labor share, which will decrease the informal economy's share of GDP, and thus increase multifactor productivity and economic growth which again leads to a higher pressure for democracy, etc. Outside the modeling framework it can also be argued that enhanced government capacities to mainstream environmental standards, climate and disaster risk management and resilience planning will translate into increased economic growth and reduced losses from climate change and disasters at household and economy-wide levels.

5.1 Programming scenario 2

The performance of Kyrgyzstan relative to Georgia is used as the main benchmark for the governance interventions undertaken. GE is a highly interesting country and benchmark example as it has made impressive progress on many governance and socio-economic indicators the past two decades.

In the early to mid 1990ies the gap between Georgia's and Kyrgyzstan's real GDP per capita ($2011) was relatively small, cf. Figure 5. Today, both countries are LMI countries, but at each their end of the scale. And, while Georgia is forecasted to continue its impressive growth rates and break into the UMI category within a couple of years, Kyrgyzstan will continue to grow slowly under the baseline ("business as usual") and the gap widen between the two countries.[25]

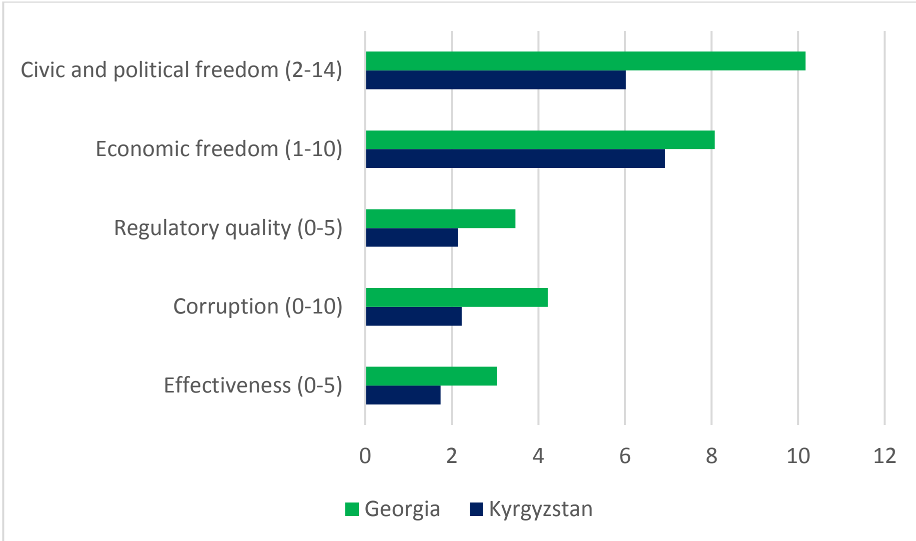
Figure 5: GDP per capita (Ths. $2011), 1995-2040



[24] In IFs MFP is decomposed into a social, human, knowledge and physical capital component.
[25] The World Bank's income categorization is based on GNI per capita and calculated using the ATLAS method. For an explanation and to see the different income groups, visit the link: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Relative to Georgia, Kyrgyzstan performs especially poor on five key governance indicators: Civic and political freedom (inclusiveness); economic freedom (quality); regulatory quality (quality); and corruption (quality); effectiveness (quality) as illustrated in Figure 6.

Figure 6: Performance on key governance indicator, GE vs. KGZ, 2018 (higher is better)



Combatting corruption is mentioned explicitly as part of the President's priorities with an ambition of reaching the top 50 on the TI index. Reaching top 50 by 2030 in International Futures would require that Kyrgyzstan improves by a score of 6.5 over its projected 2030 TI value of 2.61. Since the TI data became available (in 1994), no country has made this kind of improvement over a 12 year period. The top four improvers from 2006-2018 (the most recent 12 years) were the Dominican Republic (2.54), Rwanda (2.45), Poland (2.03) and Georgia (1.42).

Using Georgia as the benchmark means that we aim for Kyrgyzstan to "catch up" to Georgia's current (2018) level of governance on each indicator by 2030. This approach results in strong governance improvements above the 2030 baseline projections on all five indicators shown in Figure 6. As an example;

- Kyrgyzstan today (2018) scores 2.23 on International Futures corruption index (which is based on TI) and is projected to improve only slightly by 2030 under the baseline (business as usual) to a score of 2.6. An intervention is thus implemented to raise Kyrgyzstan 2030 corruption score to Georgia's current (2018) score which is 4.22. A 2030 value of 4.22 would rank Kyrgyzstan number 82 out of 186 countries in IFs on the corruption index. The same benchmarking approach is applied to the four additional interventions.

Georgia has seen the 2nd greatest improvement in the governance regulatory quality index from 2006-2018 moving up 1.1 points to a score of 3.47 ranking the country number 35 today.[26] In International Futures this is a powerful index that links forward to technological improvements through broadband connectivity and other ICT indicators.

- ➢ Kyrgyzstan scores 2.41 today and is set only to improve slightly to 2.31 by 2030. The intervention raises Kyrgyzstan 2030 score to Georgia's current score of 3.47 which will rank Kyrgyzstan as number 43 out of 186 countries in IFs.

[26] As measured by the World Bank's governance indicators that reflect perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. http://databank.worldbank.org/data/reports.aspx?source=worldwide-governance-indicators

Georgia has also seen the 2nd highest improvement in governance effectiveness index from 2006-2018 moving up 0.79 points to a score of 3.05 thus improving its rank from 85 to 47.

- Kyrgyzstan scores only 1.74 today and is set to improve to only 1.93 by 2030. The intervention raises Kyrgyzstan 2030 score to Georgia current score of 3.05 which will rank Kyrgyzstan as number 60 out of 186 countries in International Futures.

Georgia was the 20th best improver on the economic freedom index from 2006-2018 improving by 0.47 points to its current score of 8.07.

- Kyrgyzstan scores 6.92 and is set to improve to only 7.01 by 2030. The intervention raises Kyrgyzstan 2030 score to Georgia current score of 8.07 which will rank Kyrgyzstan as high as number 12 out of 186 countries in IFs.

From the governance inclusiveness model the indicator "civil and political freedom" is also included under this scenario. Georgia scores fairly high both relative to Kyrgyzstan and LMI, and is overall ranked number 83. However, the major improvements on this index took place in Georgia in the early to late 90ies, and from 2006-2018 only 0.17 points have been added to the country score which is currently 10.17.

- Kyrgyzstan only scores 6.02 and is not set to improve under the baseline by 2030. The intervention raises Kyrgyzstan 2030 score to Georgia's current score of 10.17 which constitutes a major improvement. The intervention will rank Kyrgyzstan number 94 out of 186 countries by 2030.

Table 3 below shows the baseline values for Kyrgyzstan and Georgia for 2018 and 2030. The last column shows Kyrgyzstan performance on the indicators by 2030 after the interventions. As evident all Kyrgyzstan 2030 indicators have risen to the Georgia 2018 level/score.

Table 3: Scenario 2 – Governance

Variable	**Baseline**		**Georgia (benchm.)**		**Scenario**
(Higher is better)	**2018**	**2030**	**2018**	**2030**	**2030**
Effectiveness (WB Index, 0-5)	1.74	1.93	3.05	3.33	3.06
Corruption (TI index, 0-10)	2.23	2.60	4.22	4.87	4.22
Regulatory quality (WB index, 0-5)	2.14	2.31	3.47	3.67	3.47
Economic freedom (Fraser Institute index, 1-10)	6.92	7.01	8.07	8.33	8.07
Civil & political freedom (freedom house index, 2-14)	6.02	6.02	10.17	11.11	10.17

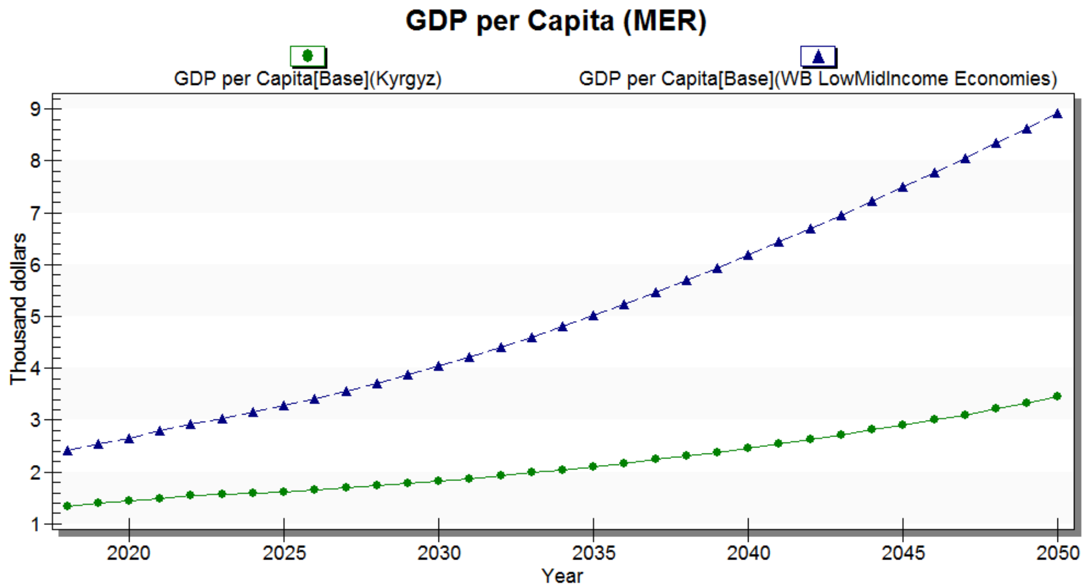
The five governance interventions will send Kyrgyzstan up on a higher growth trajectory. By 2030 real GDP will be $940 mio and real GDP per capita $134 higher than the baseline values – an increase of more than 7%.

6 Scenario 3 – Economy

This scenario looks at the alternative development pathway for Kyrgyzstan from a number of key interventions related to the country's priorities within: Agriculture & food security, business environment, exports and the energy sector.

Under the baseline, Kyrgyzstan real GDP per capita growth will remain slow and the gap between Kyrgyzstan and the LMI group average GDP per capita level will have widened significantly by 2050, cf. Figure 7.

Figure 7: GDP per capita baseline forecasts, LMI vs Kyrgyzstan, 2018-2050

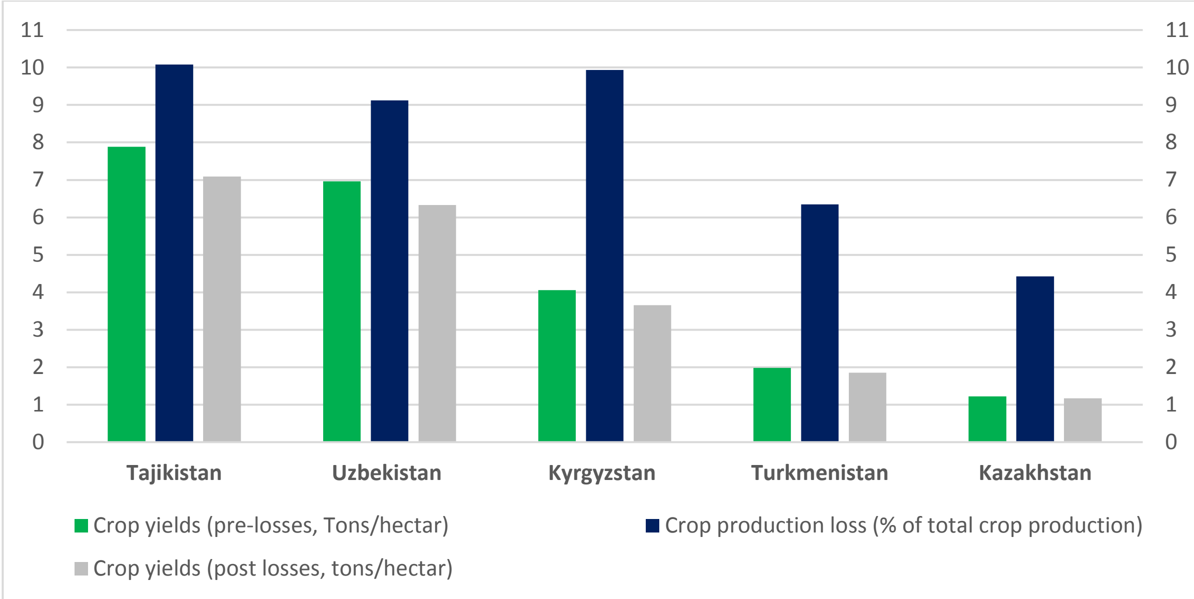


Agriculture and food security

Part of the government's strategy is to develop the agricultural sector and increase food and nutrition security. Specifically, part of the strategy focuses on the expansion of land under irrigation: Commissioning of 66.5 thousand hectares of new irrigated land; increasing water availability of lands for 51.08 thousand hectares; transferring 9.5 thousand hectares from machine to gravity irrigation; and improving ameliorative condition of land by 50 thousand hectares. Such efforts should result in yield (productivity) increases.

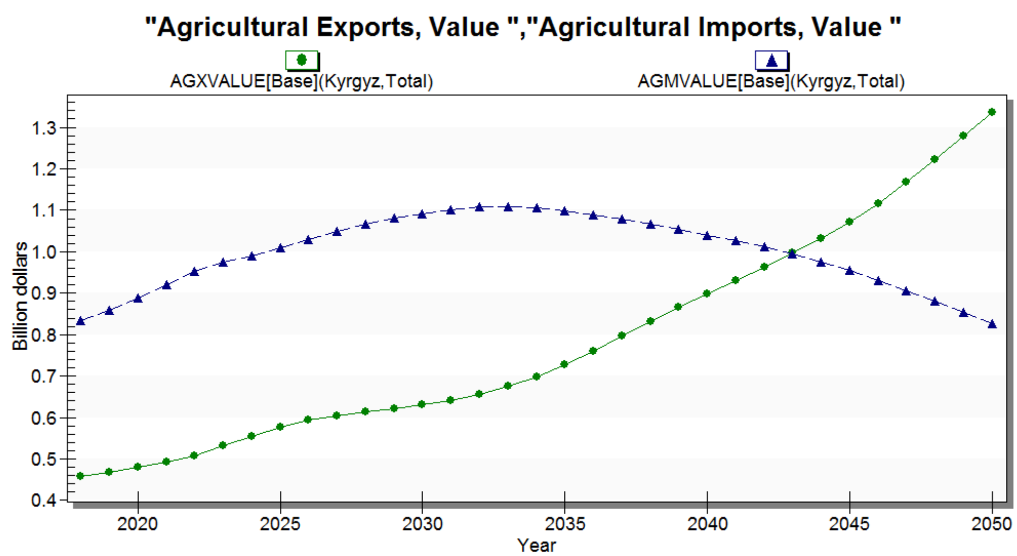
Exactly how much the government strategy will improve agricultural production will have to be assessed by in-depth sectoral analysis. It is evident from looking at Figure 8 that there should be scope to significantly increase crop yields and reduce production losses based on the country's regional performance. Kyrgyzstan pre- and post-loss yields are only between 50-60% of Tajikistan's and Uzbekistan's. According to forecasts, crop yields will have risen from 4 to only 4.6 tons/hectar by 2030 and production losses reduced only from 9.7% to 9.3% of total production.

Figure 8: Crop production losses and pre- and post-losses crop yields, CA countries, 2018



Kyrgyzstan is an agricultural net importer, and changes to agricultural crop production can potentially have large impacts on the country's trade balance as agricultural crop exports account for more than 6% of total exports, and agricultural crop imports about 12% of total imports, and it is the ambition of the government to increase exports of agricultural products. Based on the baseline forecast in International Futures, Kyrgyzstan will remain a net agricultural importer till the mid 2040ies, cf. Figure 9.

Figure 9: Agricultural (total) imports and exports, KGZ, 2018-2050



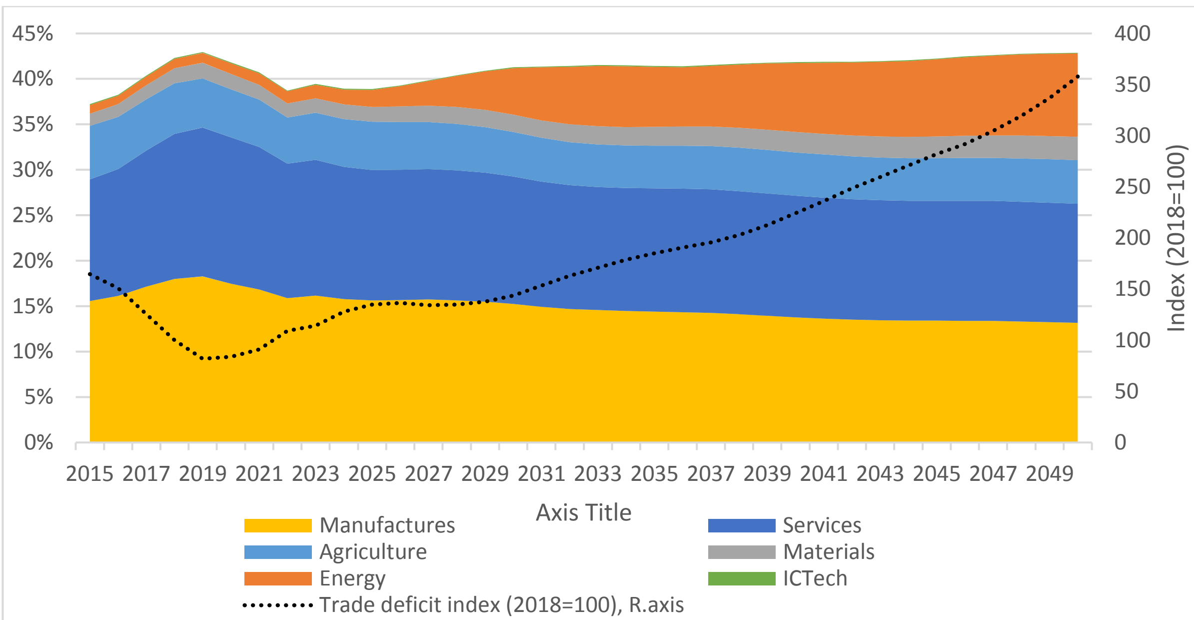
The business environment and manufacturing exports

The government wishes to improve the business environment and conditions for SMEs. One concrete ambition is to break into the top 50 of the World Bank's doing business index where the country currently ranks as number 77 out of 190 countries, and performs worst on the indicators; getting electricity, paying taxes and enforcing contracts.

International Futures has two regulatory indices, one for government business regulation under the informal economy model and one for government regulatory quality under the governance model through which an intervention was made using Georgia as the benchmark under the above governance scenario. The business regulatory index is a powerful index similar (and including components of) to the EoDB, but some of the variables have not been updated by the providers since 2010, and the index will change in a future version - thus one should be careful doing cross-country comparisons.[27] Improvements to the index will predominantly reduce the size of the informal labor share and lead to higher economic productivity. Today Kyrgyzstan ranks number 36 of 186 countries and GE 18. Kyrgyzstan's informal labor share is about 26% of total labor, and masks a large gender disparity as women are significantly overrepresented (37% versus 19%).

Kyrgyzstan is one of the most open economies in the world, but is running a persistent negative trade balance as forecasted under the baseline. One ambition is for Kyrgyzstan to increase manufacturing exports through better regional integration with neighbouring countries. Thus strengthened regional integration is modelled as a manufacturing export shift towards 2030. Figure 10 shows the forecasted export composition by sector as a % of GDP from 2018-2050 under the baseline. Manufacturing exports' share is set to decline slowly whilst energy exports' share increases.

Figure 10: Exports by sector (% of GDP) and trade deficit index, 2018-2050



Energy & electricity

Electricity access rates are already fairly high (both rural and urban), but data masks the fact that Kyrgyzstan is struggling with outdated and inadequate energy and electricity infrastructure and regulation which is negatively affecting both the reliability of access to electricity and the fiscal budget. Energy intensity is very high and exacerbates the problems of energy shortages in periods. As pointed out by the World Bank, energy infrastructure is generally in poor condition and in need of renewed investments and upgrades. The problem is exacerbated by high energy subsidies which means that the country have to finance upgrades through concessional lending from International Futures which burdens public debt. Accumulated debt in

[27] The government business regulation index in IFs is a simple average of different indices; cost of doing business, number of procedures to set up a business, ease of firing an employee from the World Bank, business freedom and property rights as measured by the Heritage Foundation.

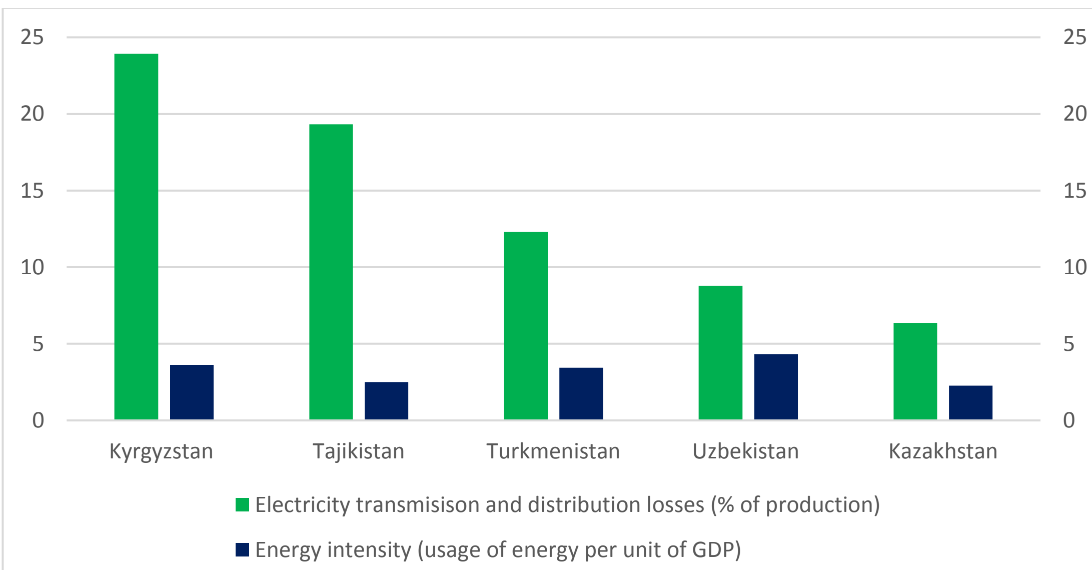
the energy sector amounts to roughly 20% of GDP. The WB suggests that instead of being a drag on the national budget, the energy sector could significantly contribute to the budget by making Kyrgyzstan a net exporter of (hydro) electricity (e.g. to Pakistan[28]) if the right investments are undertaken. Tariffs should be set at cost-recovery levels and the poorest should receive targeted compensation.[29]

The country has large water energy resources and the largest hydro plant is the Toktogul power plant. In IFs already 45% of energy production comes from renewables (incl. hydro), and about 50% from coal, but with coal forecast to increase its dominance so that by 2030 RE will only account for 17% and coal about 80% of total energy production under the baseline. Electricity accounts for about 30% of total energy use, and about 85% electricity production comes from hydro.[30]

Kyrgyzstan is today a net importer of energy set to become a net exporter by the mid 2020ies under the baseline. Investments into the hydro sector and regional electricity infrastructure is likely to change both the forecasted energy mix and could significantly contribute to increase energy exports altering the trade balance. It should also be mentioned that the country has as an ambition to increase the share of renewable energy (small hydropower plants, solar and wind power plants, use of biogas) in the total energy balance to 50% in the long run.

A large problem for the energy sector is the high transmission and distribution losses of the electricity produced/generated. Figure 11 below shows that Kyrgyzstan performs much worse than other countries in the region. A Kyrgyzstan -WB project aims at improving the reliability of electricity supply and reduce transmission losses.[31]

Figure 11: Electricity distribution and transmission losses and energy intensity, 2018



6.1 Programming scenario 3

Agriculture and food security

[28] http://casa-1000.org/
[29] http://blogs.worldbank.org/europeandcentralasia/energy-challenges-in-the-kyrgyz-republic
[30] IEA KGZ factsheet
[31] http://projects.worldbank.org/P133446?lang=en

- The interventions under this scenario will raise Kyrgyzstan's crop yield by 46% relative to the 2030 baseline by 2030 and reduces the production loss as % of total production by 5.1% below the 2030 baseline value by 2030.

As a consequence, total agricultural production rises by 39% over the 2030 base value by 2030, and where Kyrgyzstan under the baseline is set to become a net agricultural exporter by the mid 2040ies this will happen already in the mid 2020ies.

Business environment and manufacturing exports

- The intervention puts Kyrgyzstan at Georgia's current score on the 'business regulation index' by 2030, which is a significant improvement over Kyrgyzstan 2030 baseline value which otherwise is forecasted to deteriorate (rise).

The intervention will move Kyrgyzstan up the ranks by 17 places; from number 36 in 2018 to number 17 by 2030.

- As a representation of higher regional trade integration and manufacturing capacity the interventions raise manufacturing exports by 28% above the 2030 base value by 2030 and going forward.

Energy production and electricity generation

- One intervention reduces the significant electricity production loss as % of total production by 9.5% points below the 2030 baseline value by 2030.

As alluded to above Kyrgyzstan has a lot of potential to expand and increase exports of hydro-electric power in the region during peak hydro production in the summer period. A more detailed analysis of the energy and resource sector could be undertaken in a designated sector models such as CLEWS[32]. For the purpose of this analysis a simple intervention is made to reduce the speed of reductions in the forecasted RE (incl. hydro) share of energy production.

- This is done through exogenously increasing the available hydro resources and reserves which will increase RE (incl. hydro) production – but not increase its share in total energy production – over the baseline forecast; by 2030 RE's share of total energy production will be 26% instead of 17% under the baseline. The main benefits in the model will materialize through lower emissions and higher net energy exports.

Table 4 below summarizes the scenario.

Table 4: Scenario 3 – Economy

Variable	Baseline		Scenario	Change
	2018	2030	2018	2030
Agriculture				
Agricultural output, total (mio met tons)	***6.79***	***7.88***	***10.91***	***38.5%***
Crop yield (tons/hectar)	4.02	4.56	*6.65*	45.8%
Agricultural production losses, crops, (% of total)	9.93	9.7	*4.60*	-5.1% points
Energy and electricity				

[32] http://www.osimosys.org/

Variable	Baseline		Scenario	Change
	2018	2030	2018	2030
RE (incl. hydro) share in total energy production	49.47	17.45	*26.14*	15.6% points
Transmission and distribution loss (% of production)	23.92	18.88	*9.41*	9.47% points
Business environment and manufacturing				
Manufacturing exports (bio $2011)	1.482	1.961	*2.52*	28.3%
Government business regulation index (lower is better)	4.45	4.60	*4.15*	-9.8%

7 Results and conclusion – individual scenarios and an integrated push

Table 5 below shows the impact on a number of key outcome variables from the three scenarios, plus an "All" scenario combining all three scenarios and representing an "integrated policy push".

Table 5: Key outcome variables – Scenario 1, 2, 3 and All (stronger colour = larger impact)

Outcome variable	Current	A. Reference 2030	HC	Gov	Eco	B. All	Change (B-A)
GDP (bio.USD, 2011$)	*8.24*	12.87	13.03	13.81	13.85	14.91	*2.0*
GDP per capita (Ths.USD, 2011$)	*1,342*	1,826	1,838	1,960	1,966	2,106	*280*
HDI (index)	*0.784*	0.804	0.829	0.807	0.807	0.834	*0.04*
Life expectancy (years)	*71.09*	72.31	76.61	72.34	72.35	76.67	*4.4*
Educational attainment (mean years, 15+ age group)	*10.91*	*10.67*	*11.12*	*10.7*	*10.73*	*11.18*	*0.5*
Poverty headcount (% of pop below $1.90)	*3.4*	3.1	3.1	2.7	1.4	1.3	*-1.9*
Poverty headcount (% of pop below $3.20)	*21.9*	18.1	18.0	16.2	11.1	10.6	*-7.5*
Informal economy (% of GDP)	*15.09*	13.51	13.17	11.10	12.55	10.16	*-3.4*
Informal labor share (% of total)	*25.92*	20.23	18.48	19.96	15.58	15.58	*-4.7*

Looking at the individual scenarios, the economic scenario has the largest impact on GDP and GDP per capita. It also has the largest impacts on poverty reductions and reductions in the informal labor share, partially as a consequence of improving business regulations, but also due to the high output growth implemented in both agriculture and manufacturing exports.

Life expectancy and HDI improve the most under the human capital scenario, and mostly as a consequence of the large "brute force" interventions to reduce noncommunicable diseases and children's health burden, but also from raising educational attainment. The human capital scenario has the smallest impact on GDP measures. As alluded to earlier, this is because the economic benefits of human capital investments will first begin to significantly pick up later, as also evident from looking at the rise in educational attainment of the population of only 0.5 years by 2030 (All scenario) due to stocks and flows. This is exactly why human capital interventions should be prioritized urgently to ensure long-term sustained growth, stability, security and quality of life, and this is especially important for Kyrgyzstan given its demographics. Had the human capital scenario included a social protection intervention through increases in welfare or pension transfers, poverty reductions would have been higher. However, as mentioned in the main text such increases in transfers have not been included due to the already relatively high levels of transfers and suggested spending inefficiencies. With more and better information, it is possible that an intervention could be designed to target poverty more directly.

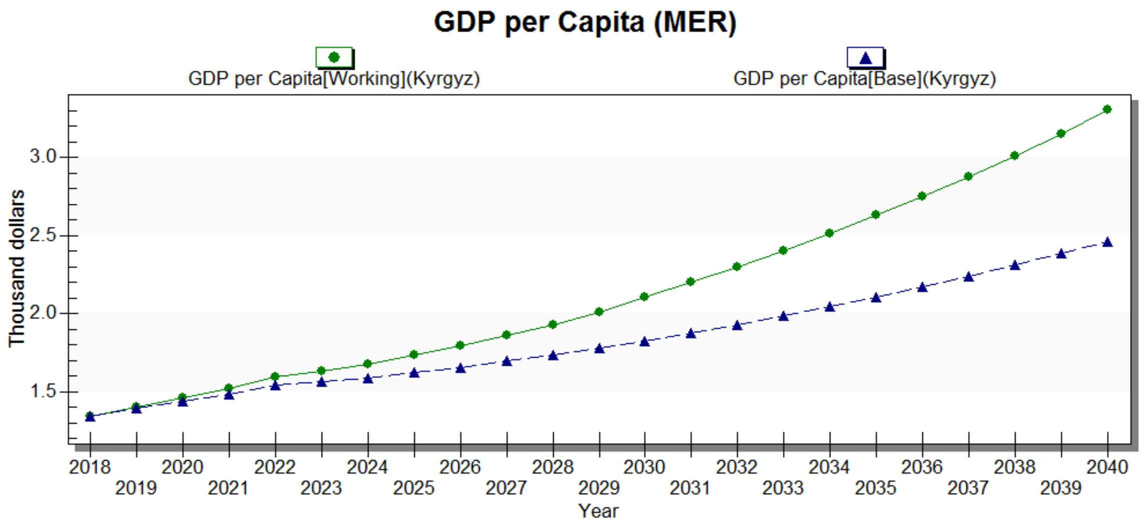
The governance scenario has relatively high economic impacts and also reduces the informal economy a significantly, the latter mostly as a consequence of the implemented reductions in corruption.[33] The scenario also has a fairly high impact on GDP and GDP per capita. There are two main overall reasons why the governance scenario generates strong returns to growth and productivity. First, governance issues represent strong roadblocks towards a more inclusive and sustainable future. Secondly, improvements in governance measures such as corruption, transparency and a leveling of the economic playing field can translate more immediately to impacts on growth than interventions explored under the human capital scenario which take more time to "mature".

The 'All' scenario includes all interventions under the three scenarios and illustrates the importance of an integrated policy approach. The scenario will result in a real GDP and GDP per capita about 16% higher than their baseline values in 2030, or formulate differently; *The scenario will raise the annual average real GDP growth rate from 3.8% to 5.1% and the annual real GDP per capita growth rate from 2.6% to 3.8% from 2018-2030*. Relative to the 2030 baseline values, it will have added an additional 4.4 years to life expectancy, reduced the size of the informal economy by 3.4% points and the informal labor share by 4.7% points, and reduced extreme poverty by 1.9% points and $3.2 poverty by 7.5% points.

Figure 11 depicts the development of real GDP per capita under the baseline (blue line) versus the 'All' scenario (green line) from 2018-2040. The figure also illustrates the importance of 'looking beyond 2030' illustrated by the widening divergence of the series partially driven by the increasing economic returns to the human capital investments. As an example, by 2040 real GDP per capita will be 34% higher than the 2040 baseline value.

[33] The size of the informal economy matters a lot for Multifactor Productivity (MFP) and thus economic growth. A number of variables in the model drives the size of the informal economy; corruption, business regulation and education impact the informal economy's GDP share. Education, business regulation and government transfers impact the informal employment share which then again indirectly impact the informal economy's share of GDP.

Figure 12: Real GDP ($2011) per capita, baseline (blue) versus 'All' scenario (green), 2018-2040



7.1 SDG indicators

Table 6 below shows the impact on a number of selected SDGs and associated indicators for each scenario and the All scenario.

Table 6: SDG output table - selected indicators

	Baseline		Scenarios 2030			
	2015	**Base 2030**	**HC**	**Gov**	**Eco**	**All**
SDG 1						
% of population below $1.90 ($2011 PPP) per day	2.51	3.14	3.06	2.68	1.36	1.266
% of population below $3.20 ($2011 PPP) per day	18.6	18.06	18.04	16.2	11.13	1.266
SDG 2						
% of undernourished population	6.4	4.366	4.338	4.181	4.158	3.976
Prevalence of stunting in working age population	2.924	3.114	3.078	3.115	3.115	3.079
Percentage of malnutrition among children under 5	3.427	2.903	0.029	2.866	2.86	0.0283
SDG 3						
Infant mortality rate in deaths per thousand newborns	18.33	14.96	7.512	14.51	14.45	7.126
Cardiovascular disease death rate per thousand	3.189	3.459	2.305	3.473	3.474	2.321
Cancer death rate per thousand	0.656	0.7595	0.4741	0.7613	0.7615	0.4766
Digestive disease death rate per thousand	0.063	0.0764	0.0784	0.0754	0.0752	0.0763
Respiratory disease death rate per thousand	0.284	0.3434	0.2326	0.3427	0.343	0.2318
Diabetes death rate per thousand	0.05	0.0608	0.038	0.0605	0.0605	0.0376
SDG 4						
Lower secondary education graduation rate - Total	91.21	96.04	100	97.06	97.15	100
Upper secondary education gross enrollment rate - Total	80.9	83.17	103	84.18	84.51	103.1
Upper secondary education graduation rate - Total	63.39	70.93	100	72.44	72.62	100
Educational attainment (mean years, 15+ age group)	10.91	10.67	11.12	10.7	10.73	11.18
SDG 7						
Renewable energy as percentage of total final energy consumption	28.6	23.76	23.59	23.02	35.46	34.33
SDG 8						
Annual growth rate of real GDP per capita	1.912	2.683	2.82	3.928	3.506	4.714
Percentage of informal employment (non-agricultural)	27.37	20.23	18.48	19.96	15.58	15.58
SDG 9						
Manufacturing value added as a % of GDP	23.16	22.27	22.34	22.71	20.65	21.28
CO2 emissions per unit of value added in thousand tons per dollar	0.354	0.2992	0.2976	0.287	0.2637	0.2523
Research and development spending as % of GDP	0.159	0.2329	0.2335	0.2447	0.2458	0.2573
Connections per hundred people to fixed broadband technology	3.306	35.06	35.13	39.11	36.21	40.19
Connections per hundred people to mobile broadband technology	20.48	109.3	109.4	118.2	110.1	118.9
SDG 10						
Foreign direct investment annual inflows in Billion $	0.62	0.8043	0.8289	0.9467	0.9238	1.086
SDG 12						
Loss at the production level	9.98	9.7	9.697	9.652	4.601	4.58
Loss at the supply chain level	7.038	6.91	6.942	6.85	4.487	4.47
SDG 17						
Fixed Internet broadband subscriptions per 100 inhabitants	3.306	35.06	35.13	39.11	36.21	40.19
ICT Infrastructure Index	34.44	69.31	69.35	72.63	69.87	73.16
Share of global exports (Percentage)	0.012	0.0146	0.0147	0.0152	0.0173	0.0175

8 Annex

8.1 International Futures description and models overview[34]

International Futures is a large-scale, long-term, integrated global modeling system.[35] Its broad purpose is to serve as a thinking tool for the analysis of near through long-term country-specific, regional, and global futures across multiple issue areas. Those interacting issue areas include population, economics, education, health, energy, agriculture, infrastructure, the environment, and sociopolitical systems. International Futures represents 186 countries and their interactions. It incorporates a database of more than 3,500 series across the issue areas.

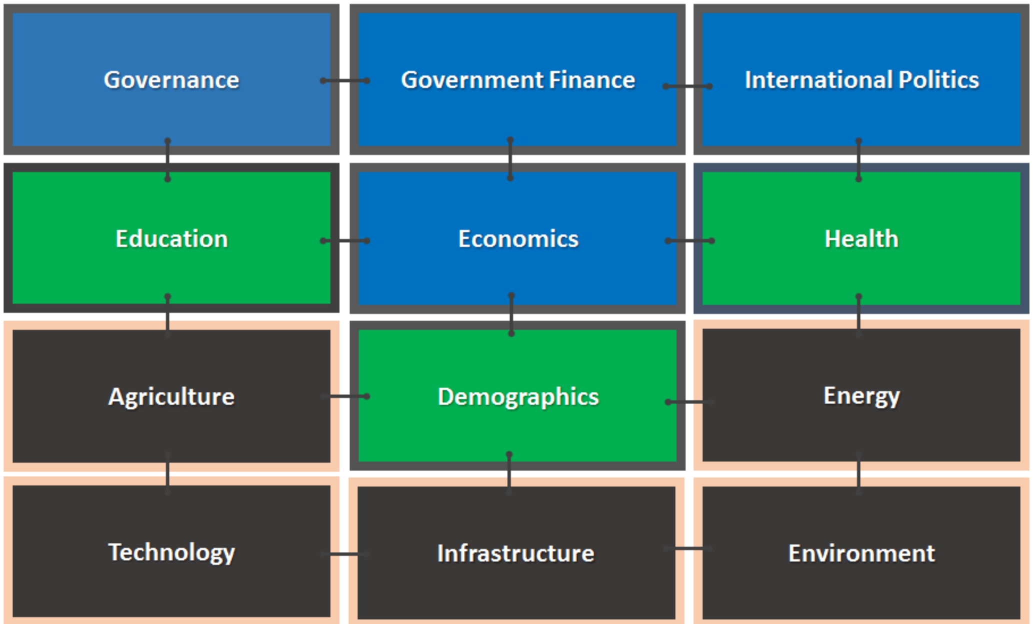
The user interface of International Futures is designed to facilitate interaction with the data analysis, exploration of alternative model runs, and scenario building functionalities of the system, making it quite easy to use. The system has always been freely available for others to use, and the model code itself is available under public license. These characteristics have made the International Futures system a very widely-used global model as an aide to thinking, analysis, and action related to global futures.

Figure 2 identifies the 12 major models within International Futures. Technical documentation on each model is available in the working papers on the Pardee Center web site (http://pardee.du.edu/working-papers). Green indicates models primarily focused on human development; blue represents socioeconomic development; black shows models especially important to sustainable development.

[34] Taken from; Barry B. Hughes, Exploring and Understanding International Futures: Building Global Model Systems, Summer 2018 version. For details on the model readers are referred to this publication and the online documentation which can be found on the following link: http://pardee.du.edu/wiki/Understand_the_Model

[35] International Futures is a hybrid system, and does not fall neatly into econometric, systems dynamics, or any other single model category. It is a structure-based, agent-class driven, dynamic modeling system. Households, governments and firms are major agent-classes. The system draws upon standard approaches to modeling specific issue areas whenever possible, extending those as useful and integrating them across issue areas. Among the important reasons for a hybrid approach is that it allows the combination of close attention to stocks and flows (and differentiation among them, as in systems dynamics) and to data and estimation of relationships. International Futures further combines these traditions with a heavy use of algorithmic or rule-based elements and even, when it comes to equilibration, with some elements of control theory. Maintenance of accounting structures is very important in the overall system, including the use of them to track aging populations (cohort component structure), financial flows among agent classes (social accounting), energy resources and production/demand, land use, and carbon stocks and flows. The overall system runs recursively with single-year time steps and forecast horizons to 2100.

Figure 13: The models of the International Futures forecasting system



Source: The Frederick S. Pardee Center for International Futures

A short introduction to each model is provided below.

The ***demographic model*** uses a standard cohort-component representation, portraying demographics in 5-year categories (adequate for most uses), but building on underlying 1-year categories to be consistent with its computational time steps. Unlike most demographic forecasting systems, it computes both fertility and mortality endogenously (migration is specified exogenously, currently using forecasts from the International Institute of Applied Systems Analysis). The availability in the International Futures system of both education and health models greatly facilitates such endogenous treatment. Data come every two years from the United Nations Population Division's latest revision updates.

The 6-sector ***economic model*** structure is general equilibrium-seeking, in which a Cobb-Douglas formulation drives production and in which multifactor productivity is substantially an endogenous function of human capital, social capital/governance, physical capital, and knowledge capital. Although capital and labor accumulations are very important, in long-term forecasting the formulations around productivity heavily shape dynamics within the economic model and its interaction with other models. There is also a foundational representation of global technology development and diffusion that facilitates further representation of productivity dynamics and intercountry convergence or lack thereof. A linear expenditure system determines household demand. A social accounting matrix structures flows across sectors and agent categories, assuring full financial flow consistency. Data come heavily from the World Bank and the Global Trade Analysis Project. The project has built a treatment of the informal economy.

The ***education model*** represents the progression of students, year-by-year, through primary, lower secondary, upper secondary and tertiary education, with some representation also of vocational education and the portion of tertiary students in science and engineering. Key dynamic elements include the entry (or transition) rates to the various levels and the persistence or survival of students year-by-year. Government spending on education per student and overall are also important. Data are heavily from the UNESCO Institute of Statistics.

The International Futures global ***health model*** represents a hybrid and integrated approach to forecasting health outcomes. It is hybrid because it uses drivers at both distal (i.e., income, education, and technology) and proximate (e.g., risk factors such as smoking rates and undernutrition) levels to produce outcomes, and integrated because both drivers and outcomes are situated within the greater International Futures system, allowing for the incorporation of forward linkages and feedback loops. (The Mathers and Loncar 2006 model of the World Health Organization, upon which International Futures built with the support of Mathers, treats only distal drivers.) Together, this approach enables users to explore dynamic age, sex, and country-specific health outcomes related to 15 individual and clustered causes of mortality through 2100.

The ***energy and agricultural models*** are partial equilibrium with a physical basis that is translated to monetary terms for interface with the economic model. The energy model represents reserves and resources on the production side, which differentiates oil, gas, coal, hydroelectric, nuclear, and other renewable sources. The dynamics around the stocks of fossil resources and their use and those around development of renewable forms are critical. The agricultural model represents land usage on the production side, which differentiates crops, meat and fish. As in the economic model, production-side representations are key to long-term dynamics. Trade in the energy, agricultural, and broader economic models uses a pool approach rather than bilateral flows.

- The **energy model** is driven on the demand side by the size of economies and populations, representing also the continued reduction of energy intensities in most countries. On the supply side, production requires not only resource bases, but also the accumulation of capital stock via investment in competition with other sectors. Trade is responsive to differential cost and price structures across countries. Interventions by the user can represent geopolitically based constraint in the growth of production, as well as decisions to restrain exports. Global prices are normally calculated so as to clear the market, but user interventions can override market prices. Most data are from the International Energy Agency. A recent update of the model added data on and forecasting of contributions from unconventional fossil resources (aggregating shale oil and gas, tight oil, coal-bed methane, etc.).
- Demand in the **agricultural model** is very responsive to population and income levels; assumptions about future meat demand of emerging countries are very important to long-term dynamics. On the supply side, crop yield per hectare is critical. The model also represents meat and fish. Trade and price equilibration are similar to those in energy. Most data are from the UN Food and Agriculture Organization.

The ***infrastructure model*** addresses selected forms for transportation (roads and paved percentage of them), electricity generation and access, water and sanitation, and information and communications technology (land-lines, mobile telephones and broadband connectivity by mobile phone or line). Demand and supply are related through the interaction of financial requirements and availability of private and public funds. Many parameters for setting and pursuing targets of access are available, and data come from many sources.

The **envi*ronmental model*** links closely to energy and agriculture, because both demands from those systems (for fossil fuels, land, fish, and water) and outputs from them (especially carbon dioxide) drive the environmental model. The model represents atmospheric carbon as a stock and feeds its level forward to temperature and precipitation changes that, in turn, affect agriculture. It also represents water supply and demand.

Technology is not a separate model in International Futures. Instead, IFs represents technology across and within all the other models—for instance, in changing cost structures for energy forms and rates of progress in raising agricultural yields.

The ***domestic governance model*** includes three dimensions of governance—security, capacity, and inclusion—each of which has two elaborating sub-dimensions. Variables connected to the sub-dimensions include risk of domestic conflict, corruption, democracy, and gender empowerment. Variables across the other models, especially income and education levels, drive change in governance. Change in the three governance dimensions, in turn, drives other aspects of the integrated system, including economic productivity growth.

Revenues and expenditures are the fundamental elements of the ***government finance model***. Revenues involve streams from firms, households and, for some countries, foreign aid from other governments. Expenditures involve streams to transfer payments and to direct expenditure on the military, education, health, infrastructure, R&D and a residual “other” category. Government revenues and expenditures are fully integrated within the larger social accounting matrix system.

The ***international political model*** calculates national material power from inputs such as economic output, population, military spending, and a proxy for technological advance, but also allows the user flexibility around including and weighting these and other elements. Whether countries pose a threat to each other is a complex function of such power and of a number of other variables, including level of democratization and trade relationships. The variables of the international political model are primarily satellites to the rest of the IFs system, but power dynamics do affect military spending levels directly, and therefore all government finance indirectly. The International Futures team has had a major data-making project to enhance existing series, and build new ones, on international relationships, including those often considered to represent soft power.