

Das, Gouranga G.; Ginting, Edimon; Horridge, Mark; Yamano, Takashi

Working Paper

Growth Constraints and Structural Diversification for Kyrgyzstan Economy: Policy Analysis of Key Reforms and its Implications

GLO Discussion Paper, No. 1250

Provided in Cooperation with:
Global Labor Organization (GLO)

Suggested Citation: Das, Gouranga G.; Ginting, Edimon; Horridge, Mark; Yamano, Takashi (2023) : Growth Constraints and Structural Diversification for Kyrgyzstan Economy: Policy Analysis of Key Reforms and its Implications, GLO Discussion Paper, No. 1250, Global Labor Organization (GLO), Essen

This Version is available at:
<http://hdl.handle.net/10419/270307>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Growth Constraints and Structural Diversification for Kyrgyzstan Economy: Policy Analysis of Key Reforms and its Implications

Gouranga G. Das¹,
Professor,
 Department of Economics,
 Hanyang University,ERICA Campus, South Korea 426-791.
 GLO Fellow (<https://glabor.org/user/dasgouranga/>)
 Email: dasgouranga@gmail.com.
ORCID ID: 0000-0002-3963-8517

Edimon Ginting,
**Country Director, Bangladesh Resident Mission of the Asian Development Bank & former
 Deputy Director General**
 Economic Research and Regional Cooperation Department (ERCD)
 Asian Development Bank (ADB)
 6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
eginting@adb.org

Mark Horridge,
Professor,
 Centre of Policy Studies,
 Victoria University, Melbourne, Australia
mark.horridge@vu.edu.au

Takashi Yamano
Principal Economist,
 Asian Development Bank (ADB)
 6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines

¹ Corresponding author: dasgouranga@gmail.com. Declaration of interest statement: No conflict of interest.
 Acknowledgement: The paper benefited from comments and research feedbacks from the ADB workshop held at Kyrgyzstan. We thank especially Professors Kym Anderson, Prema Athukorala, Hal Hill, and Richard Pomfret apart from other organizers and stakeholders.

ABSTRACT

Kyrgyzstan economy have undergone transition from a different economic system in the 1990s until now. For stimulating a diversified long-run growth in Kyrgyzstan, the region needs to overcome spatial fragmentation by integrating the regions for economic development translating into national growth, and wider welfare gains. For sustained basis and shared prosperity, several policies are necessary for reforming basic services, human development, connectivity via infrastructure, industrial as well as agricultural performance, and a conducive business environment. In this paper, we assess the potential impacts of selected structural reform measures using a newly developed comparative-static forecasting model tailored to suit Kyrgyzstan economy--a computable general equilibrium (CGE) model (KGZORANI)—with a detailed Input-Output table for 34 sectors, and SAM of the national economy as of 2015. Economy is disaggregated into 9 regions. The reform initiatives are designed for enhancement of productivity and efficiency in agriculture, services such as trade, tourism, and transport, logistics, some manufacturing for industrialization, as well as power and energy sector like electricity, and global integration via trade and FDI. Policy reform simulation demonstrates that regional and global integration via improvement in transport and logistics will facilitate modern E-commerce, and boost productivity with real GDP growth. Given the dependence on agriculture and tourism, this kind of diversification is conducive for becoming non-susceptible to external vulnerability. Thus, structural reform facilitates growth across the oblasts (7 regions and 2 cities) in Kyrgyzstan and moves the economy by another 1.41 percentage points annually over the baseline path to 2030.

Keywords: Computable General Equilibrium Models, Growth Diagnostics, Productivity effects, FDI, Trade, Structural Transformation, Economic Reforms, Regional Cooperation, Central Asia

Introduction

For stimulating a diversified long-run growth in Kyrgyzstan, the region needs to overcome spatial fragmentation by integrating the regions for regional economic development translating into national growth, and wider welfare gains. In order to achieve this growth on a sustained basis and for shared prosperity, several policies are necessary for reforming basic services, human development, connectivity via infrastructure, industrial as well as agricultural performance, for fostering a conducive business environment, etc.

In this paper, we assess the potential impacts of selected structural reform measures via quantitative development policy analysis using a customized CGE model of the Kyrgyzstan economy (KGZ-ORANI, hereafter). Based on ORANI-G (DPSV 1982, Horridge 1993), the model is a detailed sectoral and regional analytical construct using Input-Output table and Social Accounting Matrix (SAM) of the national economy as of 2015. It is a customized Computable General Equilibrium (CGE/AGE, interchangeably) 34 sectors comparative-static forecasting model tailored to suit Kyrgyzstan economy. The regional disaggregation into 9 regions allows us for envisaged policy-induced regional repercussions.

Given the constraints the policy analysis quantifies measures to improve performances in agriculture, electricity, logistics and trade, and selected manufacturing via productive efficiency escalation. The reform initiatives are designed for enhancement of efficiency in agriculture, services such as trade, tourism, and transport, logistics, some manufacturing for industrialization, as well as power and energy sector like electricity, and also global integration via trade, FDI, and regional cooperation. Under the baseline (BL, henceforth) we assume that the KGZ economy undertakes the Business-as-usual (BAU) path consistent with the assumptions: (i) A one-shot forecast assuming 4% balanced growth during 2015-2030; (ii) employment increases by 2% per annum; (iii) labor productivity augments by 2% per annum uniformly across categories; (iv) 4% swelling of export demands.

This moves the economy along the baseline path to 2030 *without* impingement of the reform-led shocks that are administered in 2015. The policy shocks enlisted are:

- (i) additional 1% annual technological progress in agriculture showing 2030 full repercussions,
- (ii) extra 1% productive efficiency improvement in the energy/power (electricity) sector,
- (iii) additional improvement in logistics, transport, and infrastructure by 2% per annum,
- (iv) increase in productivity in selected manufacturing by 1% per annum.

Our policy reform simulation demonstrates that participating in regional integration and global integration via improvement in transport and logistics (say, employment of digital technologies such as ICT or 4IR) will facilitate modern E-commerce, and boosting productivity in agriculture (say, via biotechnological innovation) could boost real GDP growth. Given the dependence on agriculture and tourism, this kind of diversification is conducive for becoming non-susceptible to external vulnerability. This implies that boons of structural reform led growth has spread across the oblasts (7 regions and 2 cities) in Kyrgyzstan. Without reforms, there are relatively more regional disparities.

Of late, the development literature focuses on Middle-income trap (MIT) for countries being stuck at a level of high enough income, but not being enough to move forward further. However, for Kyrgyzstan we use the term 'middle-income transition' (MINT) *à la* Spence (2011, p.100) because these Eurasian economies have undergone transition from a different economic system in the 1990s till now,

and the process is incomplete without initiating further reforms. Kyrgyzstan's future growth potential is based on general framework conditions for structural transformation and global integration via trade and regional cooperation. Here we figure out the potentials for growth for the Kyrgyzstan economy and the obstacles that she faces in achieving the growth objectives. In order to achieve this growth on a sustained basis and for shared prosperity, several policies are necessary for reforming basic services, human development, connectivity via infrastructure, industrial as well as agricultural performance, for fostering a conducive business environment, etc. Country-specific attributes or structural factors are important for understanding the growth patterns. These identify the key constraints and prioritize structural reform measures, which set the policy context for impact evaluation of such measures, by building scenarios for policy simulations. This paper evaluates the impact of such policy measures in a CGE framework based on comparative static simulations of baseline – where the economy experiences natural path of growth sans reform—and policy simulations incorporating key policy shocks perturbing the course of the economy in long-run, viz., 2015–2030. In particular, given the constraints faced the policy analysis quantifies measures to improve performances in agriculture, electricity, logistics and trade, and selected manufacturing via productive efficiency escalation.

Section 2 offers a cogent view of the **challenges faced by Kyrgyzstan**. **Section 3** synthesizes based on the literature on the **binding obstacles and relevant policy reform measures**. This situates the discussion in the context of policy simulation designs in **Section 4**, which introduces the economy wide CGE model. **Section 5** presents simulated impacts and regional repercussions of the national impact are discussed in **nutshell**. **Concluding section** offers remarks on the policy impacts, and direction for future policy space.

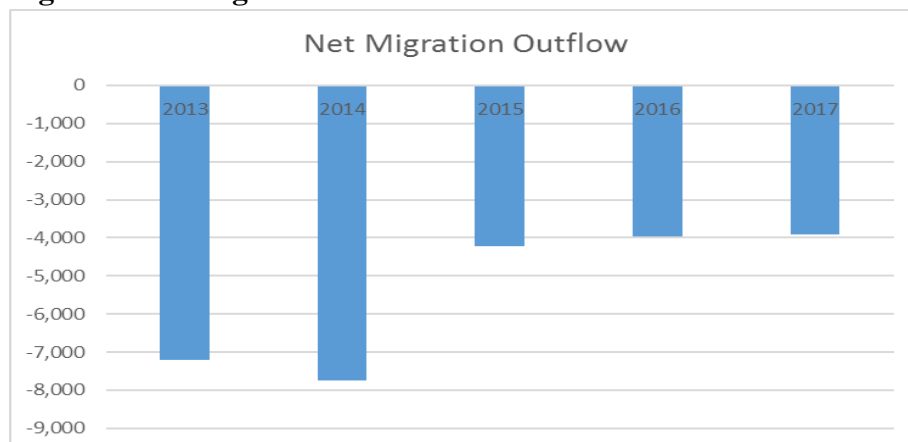
Growth and Diversification Challenges: A Bird's Eye (Re-)view

We see that economic growth varies widely across the regions in Central Asia reflecting differences in stages of development, availability of natural resources, climate, and—finally—political and social stability. Despite resemblances, KGZ is an exception with 'toxic combination' of factors undermining its efforts to diversify. Although compared as the 'Switzerland of Central Asia', as Stronski and Quinn-Judge (2016) has mentioned, it lacks the Swiss virtues of stability of institutions with good governance, and economic stability and high living standards. Despite some achievements after emerging independent from the Soviet Republics (USSR) there are formidable development challenges that is hindering the potentials to be achieved. Given annual per capita income growth of meagre 2%, *without reforms* this is not enough for sustained development especially when this 'small' open economy (trade-GDP ratio is about 80% or more) faces some macroeconomic challenges in medium and long term.

First of all, it is still heavily dependent on remittances (almost one-third employed abroad) as her historical ties with Russia motivates the workers to find jobs outside. This is the most important source of foreign-exchange earnings. That is not conducive for development of active labor market and domestic employment in the absence of generation of employment opportunities. This dependence on external economic environment through this large Kyrgyz diaspora and membership of EAEU poses an obstacle for inclusive growth and poverty alleviation. This is also the cause behind excessive 'dollarization'. As discussed in ADB's Country Diagnostic Study (CDS, 2019), despite evidences of short-term benefits, such as, poverty reduction, increase in capital flows (counter-cyclical), overseas employment, skill transfer, there are long-term costs. These result in an anaemic employment growth, inequality across households, and lack of labour mobility with brain drain. This inhibits development of a dynamic labor market as domestic sectors suffer from efficiency. Also, without financial intermediation or development

of financial instruments, the productive investments are sparse with only cornered by the construction sectors in urban areas like Bishkek.²

Figure 1. Net migration inflow and Outflow in Recent Years



Source: <http://www.stat.kg/en/opendata/category/4/> from NSCKR

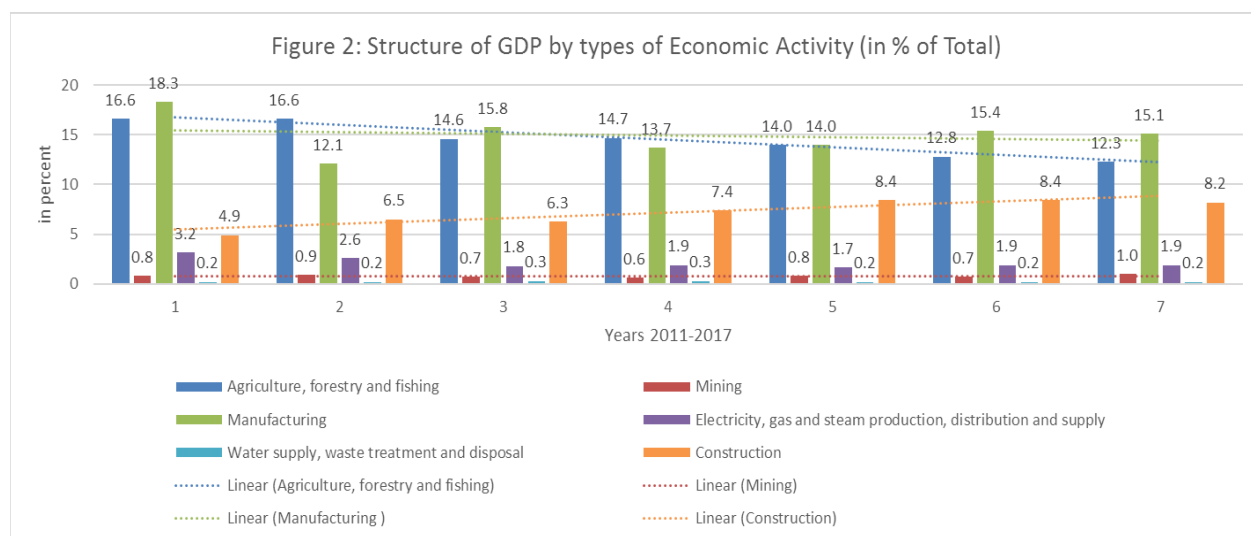
Secondly, in Table 2 when we see the GDP by economic activity, i.e. relative contributions of sectors, such as, Mining, Agriculture, Manufacturing, for the composition of KGZ economy, the share of agriculture in overall economic activity has remained the same on average, while in some years, it has shown bit of declining trend. Informal economy contributes to about 40% of GDP.

Items	2011	2012	2013	2014	2015	2016	2017
Total	100	100	100	100	100	100	100
Agriculture, forestry and fishing	16.6	16.6	14.6	14.7	14	12.8	12.3
Mining	0.8	0.9	0.7	0.6	0.8	0.7	1
Manufacturing	18.3	12.1	15.8	13.7	14	15.4	15.1
Electricity, gas and steam production, distribution and supply	3.2	2.6	1.8	1.9	1.7	1.9	1.9
Water supply, waste treatment and disposal	0.2	0.2	0.3	0.3	0.2	0.2	0.2
Construction	4.9	6.5	6.3	7.4	8.4	8.4	8.2
Trade: repair of transport means	15.1	15.9	16.5	17.8	18.8	17.9	17.9
Transportation and storage	4.6	4.7	3.9	3.7	3.9	3.8	3.9
Accommodation and food service activities	1.4	1.4	1.6	1.8	1.9	1.8	1.7
Accommodation	0.3	0.3	0.4	0.5	0.5	0.5	0.4
Food service activities	1.1	1.1	1.2	1.3	1.4	1.3	1.3
Information and communication	3.9	4.8	4.4	4.3	4.3	3.5	3.6
Financial and insurance activities	3.5	3.7	3.8	3.9	3.6	3.1	2.9
Real estate activities	2.2	2.3	2.3	2.5	2.6	2.5	2.3
Professional, scientific and technical activities	1.8	1.7	1.5	1.7	1.5	1.5	1.3
Administrative and support service activities	0.4	0.4	0.5	0.5	0.4	0.4	0.4
Public administration and defence; social security	5.1	5.1	5	5.3	5.4	5.4	5.5
Education	5.3	6	5.3	4.9	5.3	5.9	6.1
Human health and social work activities	2.9	3.4	3.1	2.8	2.8	2.7	3.3
Arts, entertainment and recreation	0.7	0.6	0.6	0.5	0.5	0.5	0.5
Other service activities	1	1.1	1.1	1	1.2	1.1	1
Indirectly measured services of financial intermediation (FISIM)	-2.9	-3.1	-3	-3.2	-3.1	-2.6	-2.4
Net taxes on products	11	13.1	13.9	13.9	11.8	13.1	13.3

Source: National Statistical Committee of the Kyrgyz Republic (NSCKR) accessed on November 19, 2018 (<http://www.stat.kg/en/opendata/category/36/>).

² Interest rate spread between deposit and lending rates work against the incentive for productive investment. Remittances flows exceeded FDI (and net outflows due to net inward FDI flows).

Being a small open economy, growth volatility (see Figure 1 in Chapter 1 of the CDS) has been due to exogenous shocks, such as, recession in Russia resulting in fall in export-demand, fall in remittances, tourism slack, and banking crisis in 1998-99. However, the most important attribution goes to dependence on mining sector, esp. the Kumtor Gold mines, which caused sharp downturn in 2002 despite some positive contribution. The table and chart shows that still mining and construction sectors' contribution is rising while that of agriculture, services, electricity and manufacturing sectors (composite) have some stable declining trend³. This is also evident from Figures 2 and 3 in Chapter 1.



Source: National Statistical Committee of the Kyrgyz Republic (NSCKR) accessed on November 19, 2018 (<http://www.stat.kg/en/opendata/category/36/>).

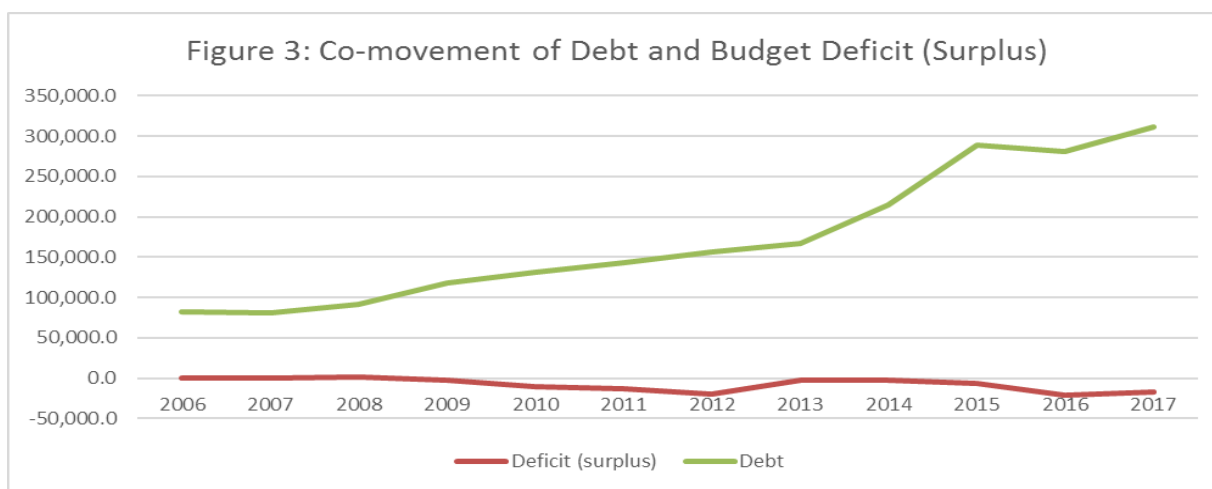
The sectoral picture on compositional changes in GDP provides rationale for undertaking structural change and diversification to reduce volatility. Post-Soviet era saw a decline in manufacturing, industry, and services, with minor revival in agriculture's contribution. Fluctuating performances of mine coupled with remittances flows (as sources of financing for construction sector booms) always dominated the GNP (and GDP) fluctuations. This created challenges for growth of agriculture, development of sectoral complementarities, and employment domestically within the border. Alike other cases of the resource-rich countries endowed with oil, gas and mining, this economy is also prone to Dutch Disease syndrome (or, Natural Resource Curse) as the expansion of the mining and oil sector could cause slowdown in other tradable non-mining sectors, such as evident from agriculture, other industries, services, thus, undermining the scope of diversification (Okonjo-Iwela 2014, Rodrik 2005, Corden and Neary 1982, Albassam 2015, Papageorgiou and Spatafora 2012, Bjornland, Thorsrud and Torvik 2018-to name a few). Looking at the percentage share of the net trade balance of all agricultural products in the country's total imports is negative while net trade balance shares of mining of precious/semi-precious metals have consistently registered the largest share to the country's total export. Therefore, except in 2001 and 2002 agricultural imports have increased making Kyrgyzstan a net importer in agriculture while for mining of precious metals, it's a net exporter. This makes the case of potential '*Dutch Disease*' impact and contraction of dynamic sectors with stagnancy. However, this need not be the case with productive

³ <http://www.stat.kg/en/opendata/category/2314/>

efficiency and appropriately targeted investment (see Allcott and Keniston 2018 in case of USA, and Ito 2017 in case of Russia).

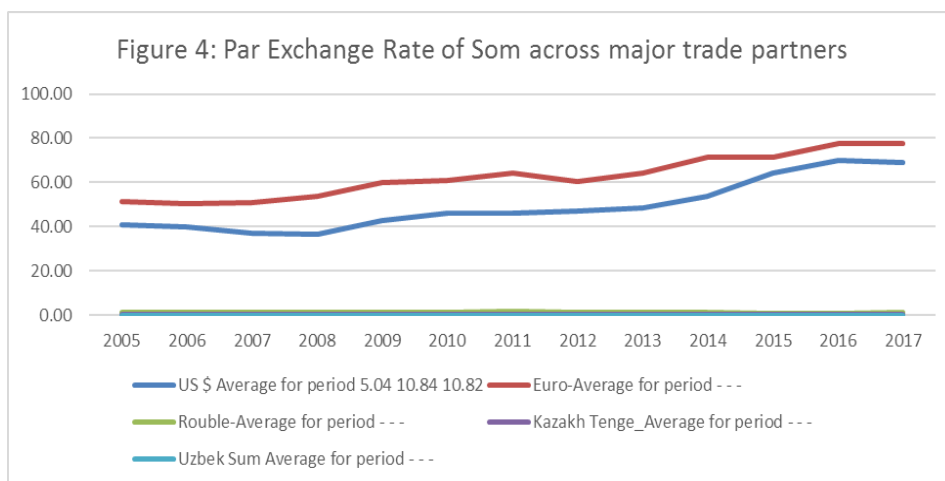
Setting aside the challenges related to the aspects of sectoral diversification, to which we turn in details in Section 3, we see that at the macro level this lack of productive efficiency and eroding competitiveness resulted in large balance of trade deficit. With flows of foreign capital via remittances, ODA, and FDI Kyrgyzstan has twin deficits—current account (10% of GDP), balance of trade deficit, and fiscal deficit—running historically against her macroeconomic management. Remittances are, in fact, the stable dominant form of inward capital flow.

As has been mentioned in the preceding chapters, it is a remittance economy and being included in the ‘Services’, it has registered rapid growth with about 50% of the export (see Figures 8 and 9 in Chapter 1 of the ADB CDS 2019). These long-term capital flows supported consumption levels while savings were low compared to gross domestic capital formation, these helped financing the fiscal deficit, which are usually large in size. However, this is not sustainable in long-run. The external public debts (56% of GDP) are foreign currency denominated, while total external debt is over 100%, with a rising trend (see Figure 6 in Chapter 1). Private sector debt is about 40% of GDP faces contingent liabilities without development of some ‘Strategic Industries’. Fiscal deficit is around 7-10% of GDP, financed by grant aid and concessional borrowing. Main obstacles for fiscal reforms are: poorly targeted subsidies (say, in electricity), share of universal pension contribution for even the non-resident Kyrgyz, and high revenue. Given the fiscal space is highly limited, the deficit spending and resultant high debts accumulated over periods of time would damage the economy although in short-run economic growth might be boosted due to extra liquidity. Without possibilities of increasing tax base via employment generation, or reducing ‘informality’, increasing labor market flexibilization, controlling brain drain via expansion of jobs in other sectors, the deficit will soar while heavy-dependence on mining such as Kumtor gold mine supporting 20% of budget revenue will not be sustainable as the latter is projected to decline. Thus, it triggers a razor-edge instability without structural adjustment. The challenge is to make the tax base buoyant, broad, compliance without laxity, reducing fiscal concessions to firms in Free Economic Zones without ‘sunset clause’. Fiscal sustainability (large deficits with high borrowings) with high expenditure commitments without means testing for the appropriate target is a major challenge for addressing twin deficit and debt issues (see Figure 3 below). With rising global interest rates, this might pose increased debt repayments (dollar-denominated with stronger USD) burden with low returns.



Source: National Statistical Committee of the Kyrgyz Republic (NSCKR) accessed on November 19, 2018 (<http://www.stat.kg/en/opendata/category/36/>).

Trade performance and competitiveness is determined by the value of Som/USD exchange rate and also its exchange rate with Rouble. Dollarization (40%-50% of M2, See Chapter 2 of the CDS 2019) narrows down the potentials of monetary and exchange rate policy for making business environment conducive. Monetary and Exchange rate policy is shaped by National Bank of Kyrgyzstan (NBKR) to adopt inflation targeting and floating exchange rate for weathering shocks such as 2008-09 financial crisis (see figure 4). But volatility of remittance flows due to external shocks, such as, financial crisis and /or, fluctuations in oil and gold have made foreign exchange transactions much more volatile. As tradable sectors like agriculture and manufacturing are growing slowly, this exchange rate volatility and ‘strong ‘Som’ policy erodes competitiveness and foreign exchange reserves management. It is necessary to address three key factors that influences NBKR’s policy: viz., underdeveloped or dualistic financial sector with less access to small enterprises with large interest rate spread; secondly, fiscal deficits are financed by ODA grants, loans, and small bond market with government and NBKR bonds; thirdly, dollarization (50% of M2, and as high as 60%) for financial transactions, making limited monetary policy autonomy. Without curbing circulation of foreign currencies with open international capital account with high shares of trade and remittances flows in GDP, limited space for fiscal and monetary policy makes it harder to improve business and investment climate. Real effective exchange rate (RER) appreciation against the trade members in the EAEU and the Rest-of-the-World reduces competitiveness in the external trading environment. Without addressing these macroeconomic challenges, financing development will be harder to achieve the desired targeted growth.



Recent study by ADB (Hasanova, July 2018) shows that financial inclusion should be part of government’s strategy because the economy suffers from access to finance (more than 60% lacking) and financial literacy. With only 3% of the money being saved by a quarter of adult population, it shows that escaping from poverty and inequality is a big challenge. Even the remittances could not help in this regard to boost formal savings and investment and banking the unbanked⁴. This is also related to development of SMEs via availability of collaterals, long-term credit, creditworthiness and building financial history of the informal sector. For addressing these challenges, it requires implementation of economic reforms—at

⁴ <https://www.adb.org/publications/financial-inclusion-regulation-literacy-education-kyrgyz-republic>

the macro level so that it enables some industries to grow and diversify at the sectoral level—which is discussed below. However, *no* ‘one-size-fits-all’ reform and policy package exists. This necessitates the adoption of growth and efficiency driven second round of reforms with macroeconomic as well as socio-economic development.

Strategies for Economic Diversification: Selected Policy Reforms

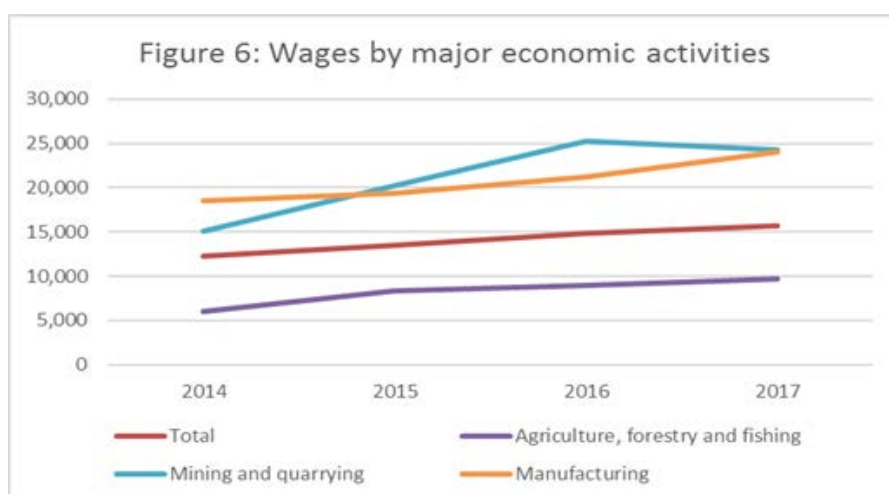
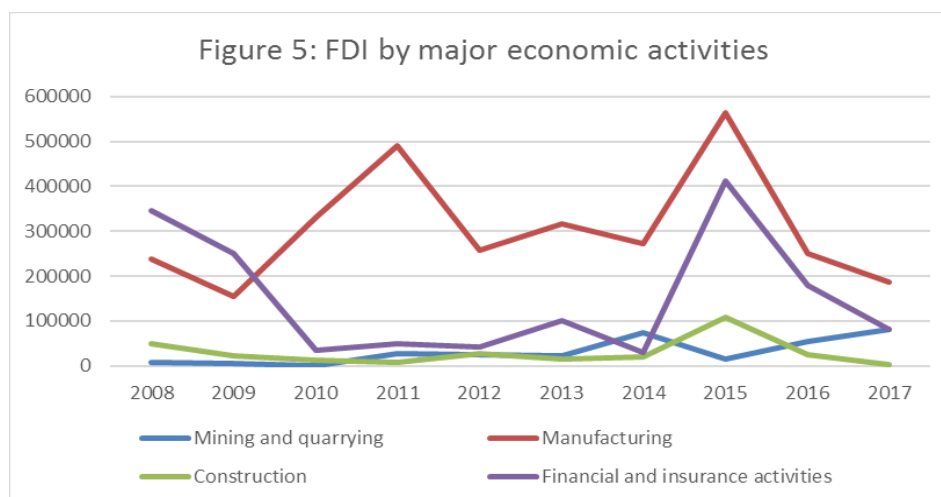
In order to achieve inclusive growth on a sustained basis, National Council for Sustainable Development of the Kyrgyz Republic (NCSDR) has formulated the National Sustainable Development Strategy (also, *Taza Koom—Zhany Door* or Transparent Society—New Epoch) for 2018-2040 (henceforth, Strategy 2040 or **NSDS 2040**, interchangeably) focusing on medium- and long-term development objectives on several fronts⁵. Given the sets of binding constraints, based on the policy recommendations—in line with the Strategy 2040—now we summarize critical behind-the-border reforms in some priority areas, which offers the basis for scenarios in impact analysis using KGZ-ORANI CGE model. In order to diversify, it is necessary to focus on key sectors and their potentials.

In the growth and development literature, for structural diversification the role of different enabling factors for leapfrogging, success in catching-up, and sustainable ‘inclusiveness revolution’ has been discussed. The lessons learnt from these studies about the existence of Middle-income Trap (MIT, henceforth) for the developing Asia throw light on how Kyrgyzstan could benefit from enhancement of factors such as, education, quality-adjusted education, higher skilled labor force, product sophistication, innovation, trade and investment, so that they are not perennially trapped or sliding back from current level to low-level trap via gradual transitioning to upper-middle-income status. To understand the complex dynamics, conventional wisdom stressed the importance of the *key internal ingredients*, such as: education, human capital, infrastructure, institutions, dysfunctional governance, etc. (Spence 2011). In the context of low- and middle-income Asian economies, Estrada et al. (2017) has shown that for the Newly Industrializing Economies (NIES) innovation, human capital, and infrastructure played key role for catching up to high income level. The relatively poor non-sustained growth performance of lagging countries has been attributed to factors such as limited/dilapidated infrastructure and human capital, quality of institutions, limited financial depth, trade orientation, and investment, political and social stability, etc. (McAuliffe, Saxena and Yabara 2012, Acemoglu and Dell 2010). As has been argued by Georgiev, et al (October 2017), these economies in Central Asia has been doing less satisfactorily in terms of the avowed objectives of ‘shared prosperity’ or ‘inclusiveness’ and the slowing down on reforms. Being part of the global economy is a necessary, but not sufficient condition for inclusive and sustainable development. Recent Asian Development Outlook 2018 has highlighted the necessity of educational reforms, labor market flexibilization, strengthening social protection and inclusiveness for harnessing the boons of new technology such as fourth industrial revolution (4IR).⁶

Figures 5 and 6 show that most of the investment and labor productivity changes are taking place in mining, construction, and few manufacturing at the expense of agriculture and other sectors. Thus, there are rooms for improvements on several fronts, such as, agriculture, transport and logistics, boosts in tourism, transport and logistics, electricity, and overall business climate improvement via behind-the-border reform.

⁵ <http://kabar.kg/eng/news/national-development-strategy-of-kyrgyzstan-for-2018-2040-approved/> Decree has been signed in August 2018. (accessed on 12th November, 2018). According to the NSDS 2040, it is ‘the backbone of long-term dynamic development’ based on the 2013-2017 first phase of development strategy initiatives.

⁶ <https://www.adb.org/publications/asian-development-outlook-2018-how-technology-affects-jobs>



Productivity Growth in Agriculture

As discussed above, Kyrgyzstan is consistently a net food importer with modest progress. Although the country has favorable labor-land ratios (arable land per rural inhabitant is only 0.2 ha), trade in agricultural products is not well-developed, thus, showing not reaping the benefits of comparative advantage. In fact, despite small arable land endowment, 30% of total labor-force is employed in this sector, showing low labor productivity. This underutilized potential signifies that compared to international standards, there must be considerable yield gaps with low crop productivity and yield, thanks to backdated agricultural technology and irrigation. Share of industrial crops declined from 11% to 5%, while value of fruit and vegetable production increased from 11% to 24%. Consequently, despite geographical contiguity and membership of EAEU, trade with China, Russia and other East Asian economies remain miniscule.

For inclusive growth and rural-urban shared prosperity, rural development is necessary and improving agricultural productivity can help achieving this objective. NSDS 2040 outlined strategic initiatives for developing some nice export sub-sectors. As discussed in Chapter 3, these are dry kidney beans in Talas (USD 50 million exports) destined for Turkey, Milk and Dairy products from Northern Regions, Cotton (USD 19 million). Also, food safety and standard issues constraints Agricultural export

potential (e.g., in dairy and meat production due to animal disease and hygiene issues, SPS issues for horticultural products), limiting penetration into EAEU and beyond.

Starting from first phase in 1991, Kyrgyzstan is one of the most progressive reformers in this respect while during 2013—2017 several initiatives were undertaken, viz., ‘Food Security and Nutrition Program’, ‘Food Safety Law and Dairy Development Program’ and ‘Forty Steps to New Era 2018-2023’ are adopted. However, given the current level of human capital and backward technology, and the rise of information technology, biotechnology, crop science and robotics opening new vistas for food, agribusiness and logistics firms, joining the segments of agricultural supply chain (value-chain) Kyrgyzstan can take advantage of the ‘disruptive innovation’ and changes in the structure of agriculture and food system. For faster economic development, the only way to move forward is via access to foreign improvement in technology, inputs with embodiment of technology, and institutional changes such as, governance, regulations, (Das 2015, 2020). Joint venture operations, foreign knowledge transfer, agricultural extension services are necessary as the current levels are low compared to other sectors (see Figure 5). For being part of more inclusive value chain to support rural economies and farmers, this transformation can be achieved via increased productivity, resulting in rise in incomes, and better health and nutrition for good quality human capital. Also, development of logistics, such as, expensive air freight for exporting perishable food products, streamlined inspection procedures are severe constraints for developing closer commercial relations beyond Asia. An ADB study has shown how drone and associated benefits like big data (gig economy) could enable vertical farming and boost agriculture productivity, create agro-entrepreneurs, and hence, reorient agricultural sector through enhanced productivity-driven growth.⁷ Followings are the specifics about such efforts:

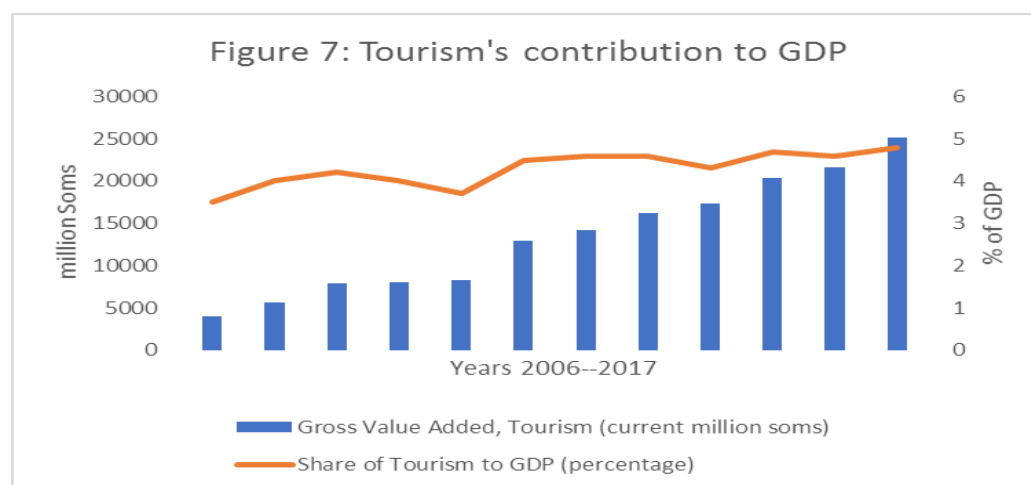
- i) Productivity enhancing steps such as clusters with improved technologies, creating bio laboratories, improved crop varieties, promoting organic agriculture, cooperatives, and livestock breeds so that even with small per rural inhabitant land, yield and productivity is high.
- ii) rapid production expansion of kidney beans in Talas oblast. Identified constraints for scaling up and out of Talas oblast.
- iii) increasing potato productivity through adopting improved potato varieties and production practices. Identified constraints and recommendations for improving the potato value chain.
- iv) increasing milk productivity through adopting improved dairy cows and best production practices. Improving the institutional arrangements for milk marketing, Agribusiness and domestic and international markets.

Tourism Boost

Tourism can be a source of growth-driver in the long-run. However, for developing economies only tourism growth needs to be supplemented by additional policy measures. By taking advantage of the geographical position, if improvements in infrastructure in roads and transport are achieved via use of modern technologies and quality human resources, as mentioned above, the enabling environment could make this sector efficient. Everett, Simpson and Wayne (Everett et al., ADB, 2018) has shown the importance of such reforms in the context of Pacific island economies. For initiating regional economic development integrating spatially fragmented regions, federal government’s establishment of special economic zones (SEZs), Free trade zones (FTZs), Industrial parks, Clusters, etc. are necessary for coordination and collaboration among them (CAREC, ADB, 2018 CDS). This will overcome the constraints of limited infrastructure inhibiting domestic as well as regional markets across neighbourhood

⁷ https://blogs.adb.org/blog/how-gig-economy-can-transform-farms-developing-world?utm_source=newsletter&utm_medium=email&utm_campaign=11apr2018

economies, and enable firms and producers to gain advantage of specialization and economies of scale (i.e, wider market access). Tourism sectors contribution to GDP is more or less stagnant with fluctuations in growth rate, whereas gross value added by tourism has consistent upward trend (see Figure 7).



Source: NSC. <http://stat.kg/en/statistics/turizm/> (accessed October 31, 2018)

As discussed in Chapter 4 of the CDS (ADB, 2019), the service sector is the largest and fastest growing sector with gradual structural shifts from agriculture and manufacturing (industry) to services sector. Between 2000 and 2016 the size of this sector tripled overtaking agriculture and industrial sectors (57% of GDP). It also provides employment mainly to female workers (57.6% share in total service sector job). Tourism has great potential as total number of annual tourist arrivals reached 3 million in 2015. In keeping with the NSDS 2040 and Taza Koom, digitization via ICT is necessary to develop niche tourism. 'Forty Steps' is the five-year plan include such objective through '*Turuktuu tourism*' which could have important positive regional spillover benefits for development. As documented in Chapter 4, rich history, natural attractions ancient Silk Road all contributed to large number of tourist arrivals (3 folds' increase), and thus it accounted for around 4.6% (Average) of GDP, and growth rate of Gross value-added at an average 9.4% per year during 2006-2014. As this sector has direct contributions to GDP, also indirect contributions are not be neglected, via induced effects on other sectors. With upward trajectory of movement of exports (USD 460 million in 2013, about 17.1% of total exports), there are fluctuations due to volatility of exchange rate, financial access, and lack of credit access. Thus, this sector has tremendous potential for boosting employment via trade, exports and indirect benefits in the domestic economy such as in sectors like Food and Beverages, Recreation, Household goods, Housing, etc. The bottlenecks are lack of diversified service offerings, barriers to entry via regulatory procedure such as visa restrictions, lack of ICT connectivity, physical infrastructure, dearth of better health and environment conditions. To achieve the growth objectives, tourism boost is crucial by overcoming the obstacles. Digitization via ICT, human resource development, investment in transport and logistics are all important to further facilitate the productive efficiency in this sector. In a nutshell, tourism is an important driver for turning the service sector as engine of sustainable inclusive growth with significant forward and backward linkages; thus, it is necessary to develop, upgrade and promote this sector's services via robust private-public partnership in various fronts such as, access to credit, reducing barriers to doing business and transaction cost, developing infrastructure such as road, transport, logistics, power, as well as skilled labor force. Although Gold mining is source of main revenue and GDP, KGZ needs to develop alternative complementary measures such as productivity improvement via reducing energy costs and innovation processes, public

policies for aligning TFP with labour productivity, and hence wages of this mining industry (de Solminihaça Hernán et al. 2018). We now turn to these factors as enablers.

Investment in Energy Efficiency

Importance of energy for development can no way be underestimated. As discussed in Chapter 5 of the CDS (ADB, 2019), electricity is the main source of energy (27% of final energy consumption), with 85% is sourced from hydroelectricity, while 39% comes from coal. Of all the total primary energy supply, only 45% is domestically produced and rest is imported. Biggest consumer of energy is residential sector (66%), while share of industry consumption is decreasing.⁸ Being dependent on hydro potential makes it vulnerable to seasonal variations with limited diversification of mix of sources. Lots of untapped potential even in hydro sector makes it net importer while the potential for becoming a net exporter in the region is possible. The sector suffers from two types of constraints, viz., accessibility and supply insecurity, such as, inadequate and inefficient infrastructure, dilapidated assets with old vintages causing losses (20%) in transmission and distribution. It results in significant voltage fluctuations, and frequent black outs esp. in winter when water level sinks down. Bureaucracy for accessibility, and opacity for tariff are also hindrances. Quite evidently, all these lead to lack of trust between private investors and public sector for undertaking investment. All these lowers her rank to 164 for Doing Business ranking of the World Bank. It is recommended that subsidy removal via tariff reforms and replacing backdated assets could improve productive efficiency in power generation, and will induce investment as such reforms would improve business environment. Specifically, energy efficiency improvements could be achieved via: (i) shift to tariff reform methodology via rate-of-return approach and securing long-term financial sustainability; (ii) invest to minimize loss; (iii) improving business-friendly investment climate; (iv) last, but not the least establishment of a ‘social compact’ between government and private sector to mitigate adjustment costs of reforming the 93% state-owned sector through unbundling into action-specific segments, such as, generation, transmission, distribution, etc.

Boost in Transport and logistics for Trade

We see that participation in regional and global value chain is crucial for growth and for that, efficient trade infrastructure, and incentives are needed. For example, as foreign value-added comprises 25% of value-added in exports of a country and share of intermediates in global trade is more than 60%, industrialization strategy focusing on this would facilitate technology diffusion, and opportunities for economies of scale via backward and forward integration. Not only those aspects, role of development of transport via development of rural roads and highways also play an important role for economic development via expansion of opportunities such as non-farm employment, as has been shown in the Indian context (Asher and Novosad 2018). For diversification into agricultural value-chain, as well as in manufacturing-based path for employment and job (that would reduce excessive dependence on remittances coming from ‘brain drain’), Kyrgyzstan needs to reduce transport costs.⁹ Kyrgyzstan opened its border in 1990s and is member of the WTO and EAEU customs union with presumably free flow of goods, services, capital and labor flows. For trade facilitation it is important to overcome her hindrances in poor connectivity threatening market integration and local mobility. For example, Bishkek-Osh is not so well connected. Improving rail, road, and air connectivity is crucial for delivery to export destinations of goods such as agriculture (perishable ones), horticulture, etc. The World Bank-funded Central Asia Regional Links (CARs) program supports the Government’s efforts to develop international transport corridors and rehabilitate and preserve strategic roads. Digital solutions are being introduced to address overloading, prevent damage to roads of international importance, and ensure road preservation. Vehicles

⁸ **Electric Vehicle:** <https://blogs.adb.org/blog/how-kyrgyz-republic-can-become-central-asia-s-electric-vehicle-hub>

⁹ <http://www.worldbank.org/en/country/kyrgyzrepublic/overview#4> --

exceeding the maximum weight limit pose an enormous risk to safety, especially on the country's mountainous terrain. For taking advantage of the Belt-and-Road initiative (BRI), expansion of transport network with investments in soft infrastructure is sine-qua-non for trade-led inclusiveness. One of the crucial differences is the role of digitization, 4th industrial revolution for sustained growth as structural transformation and such changes are complementary to each other. This could unlock the potential for economic development and growth (ADB 2018).¹⁰ For that, ICT and Digitization (*Taza Koom*) is also crucial as Technological progress (and transfer via trade) in High-end Services and IT sector have positive externalities via e-commerce penetration as evidenced from Countries such as Turkey (Ozean, Burcu 2018).¹¹ However, as mentioned in Chapter 5 of this volume for unlocking the potential of digital technologies via Taza Koom, building a solid foundation of human capital is quintessential as it enables to leapfrog development along with the delivery of public services (e.g., e-government) with transparency, reduced transaction costs, better business milieu. Next, we discuss this priority.

Human Capital and Productivity

Productivity and efficiency is contingent on human capital-induced skill, innovative capabilities, R&D intensity, demographic dividends, and exchange rate stability (Kim and Park 2018, Hendricks 2010, Das 2015, 2020 & 2022, Abrigo et al. 2017, ADB). Kim and Park (2018) particularly mentions the necessity of reform-driven innovation via development of National Innovation systems (NIS) and 'redesigning' of education system for the middle-income nations.¹² Although Kyrgyzstan inherited—thanks to legacy of the Soviet era—an universal public education and health benefits with generous social transfers systems, the education is lagging behind what is needed for this high targets under NSDS 2040. Due to lack of fiscal space, educational inequality and increased socio-economic stratification is prevalent. With gradual transition from agriculture to services, the structural shift envisages a skilled labor force; however, private schools are costly burden for a country where 67% are rural inhabitants. Human development index (HDI) score is not so low –77 out of 144 alike upper-middle income nations—with comparator nations, but the education system needs revamping in keeping with the *Taza Koom* and 'Forty Steps'. Not only that, large informal sector with smuggling and non-viable transactions, quality is degrading with consequential outflow of labor across borders. This loss of human capital works against the mission of inclusiveness and growth with shared prosperity. Gender disparity is also an issue. With preference for vocational education and short-term training, the quality higher education is seriously suffering from talent flows. This could hinder development of knowledge-sector with innovative economy. As mentioned before, key issues in the employment generation and possible reforms involve: outlining the key bottlenecks in the labor markets, including migration issues; re-allocation of labor from low to high value-added sectors and making inactive to participate; wider inclusion of life skills into school curriculum; life-long skills training; addressing skills mismatch; teachers' quality improvement; adopting English as vernacular; and also role of private sector in education and skills training.

Business climate reforms

By studying the impact of 'Doing Business Project and Business Environment' and 'Economic Freedom Index', Okey (2011) has found that for a panel of African countries for 2003-2008, institutional

¹⁰ The Role and Impact of Infrastructure in Middle-Income Countries: Anything Special? ADB Working paper 518, 30 May 2018.

¹¹ Ozean, Burcu (2018). ICT and International Trade: Evidence from Turkey. Vol. *(1), pp. 93-113.

¹² Hendricks, Lutz (2010, Journal of Economic Growth 15: 205-233) has shown that skill upgrading within industries is also important for variation in education and skilled labor productivity. Also, Abrigo, Michael R.M. and Lee, Sang-Hyop and Park, Donghyun, Human Capital Spending, Inequality, and Growth in Middle-Income Asia (December 1, 2017). ADBI Working Paper 529. Available at SSRN: <https://ssrn.com/abstract=3187925> or <http://dx.doi.org/10.2139/ssrn.3187925>

reforms significantly influenced the growth rates of GDP as well as FDI, private investment and domestic credit to private sector.

Comparing Botswana and Nigeria, Fosu (2011) has shown that superior institutional quality in the former has resulted in positive terms-of-trade effect while Nigeria languishes for resource-curse. Acemoglu and Robinson (2012) has argued that the different political and economic trajectories led to diverse historical dynamics underlying different forms of institutions, and that shaped the differences in living standards and growth performance across countries. In the context of Kyrgyzstan, as discussed in the preceding chapters several institutional and infrastructural bottlenecks or availability, will impact on the growth process unless reforms are undertaken to address the constraints. Although Kyrgyzstan achieved a 'notable first' in Central Asia and maintained a reasonable achievement, for inclusive development broad-based economic reforms would improve business climate. As per World Bank's 'ease of doing business' indicator (77 out of 183), her corruption perceptions is worse (135/180) although in terms of other parameters the situation is similar to other comparator central Asian nations. Logistics performance is also abysmally low (146/160) but higher than Lao PDR (152/160). Not only that, despite achieving 'political freedom' with high score in 'voice and accountability' her governance indicator score is also low with poor performances in rule of law, government effectiveness, and corruption control. This means existence of opaque regulatory system with complex functioning and problematic procurement procedures. That often results in political meddling in enterprise sectors without surveillance by the government. As educational level is reasonable with need for quality enhancements, democracy is achieved, designing institutional reform along these lines along with the other onset of reforms, as outlined above, will usher in conducive business climate furthering path of progress towards shared prosperity. As regional Development is Integral Part of National Strategy, as mentioned in Chapter 1, sharp division of economic benefits between north (Bishkek) and South (Osh) and hence, to ameliorate the gaps in developments, the regional catch-up or convergence is necessary for neutrality of distributional gains to be shared across the regions. To that pursuit, domestic regional integration schemes are crucial for channelizing the positive externalities via spillover or diffusion of beneficence.

Analytical Framework and Context of Policy Simulations:

In the light of the above discussion, for tracing the impact of policy reforms and ensuing changes in the wake of such policy perturbations in the macroeconomy and its consequential repercussions across sectors and regions, we need to adopt an economy-wide framework where intersectoral linkages are modelled in an economy-wide model. For that purpose, we adopt a framework---Computable General Equilibrium (CGE) or, interchangeably, Applied General Equilibrium (AGE)—capturing such economy-wide and sectoral effects based on microfoundations. Although the historical antecedents are theoretical models based on Walras (1874) and Arrow and Debreu (1954), Scarf (1973), the CGE models have an empirical basis to provide numerical solutions useful in policy analysis. CGE models score over other Input-output and SAM-based models as these are economy-wide models with 'endogenous' relative prices (relative to a numeraire) and systems of simultaneous non-linear equations derived from microfoundations of economics behaviours based on Neo-classical optimisation principles of representative agents of different types, viz, consumers, producers, investors, and government. In other words, optimizing rational agents—producers, consumers, and investors—are interlinked via different respective markets, and interact to determine demand and supply of respective goods and services, including in the factor markets. The markets are perfectly competitive. We invoke market-clearing conditions for determining prices and quantities with flexible price systems and in case of fixity of price and/or, quantity variables, as per the implementation of a particular theoretical conjecture, the variables

are swapped or switched accordingly.¹³ As demands and supply match via iterative simulations, markets clear in equilibrium after each policy shock hits the system. Also, via linkages of intermediate input demands and final demands there are direct and indirect effects due to transmission of shock-induced spillovers in multiple rounds. This kind of analysis is well-suited for stating the changes out of equilibrium of the variables due to some changes of external factors (policy-induced or others) in the short-run, medium-term, and/or, long-run which moves the economy from one to another equilibrium (See DPSV 1982, Dixon and Rimmer 2013, HB, 2013, amongst others). Thus, the models are comparative-static or dynamic. Therefore, to understand the long-run phenomena such as structural diversification entailing sectoral reconfiguration, we need to adopt this framework. For a comprehensive overview of CGE models for policy reform analysis, see Dixon and Jorgenson (2013).

For our current purpose to analyse KGZ economy, we develop a CGE model specifically tailored to study the Kyrgyzstan economy, viz., KGZORANI. This is based on Australian genre of CGE model based on Dixon et al. (1982), Horridge (2000, 2013).¹⁴ ORANI model is based on Johansen class of models (1960) pioneering Multi-sectoral growth model and is extensively used by Australian federal government agencies for wide array of policy studies like tariff reforms, employment, education, environment, etc. (See Powell and Snape 1992 for a historical overview on ORANI). In what follows, we introduce the Kyrgyzstan CGE model features.

Structure of KGZ_ORANI and Model Closure

KGZ_ORANI (henceforth, ‘the model’ interchangeably) is a comparative-static, tops-down, multi-regional model. It is in the genre of Australian school of CGE approach, as best represented by ORANI model and its subsequent development and variations (see Dixon et al 1982, Horridge 2013, Dixon and Jorgenson 2013, amongst others), with systems of linear equations involving endogenous and exogenous variables (i.e., based on closure, on which more to come subsequently). Typically, the policy reform analysis involves shocking the exogenously declared policy variables or, changing the status of variables by swapping or switching between endogenous-exogenous splits. In this model, policy reforms such as efficiency-enhancements or productivity growth, as delineated in the preceding sections, will typically have ripple effects—direct and indirect in first, second, and third rounds as per the case—via intersectoral linkages and spillovers. Each agent, in a perfectly competitive economic environment, is a price-taker. KGZ is a small open economy and hence, the assumption of such ‘atomistic’ behaviour is realistic. The flowchart below (**Figure 8**) captures the interactions between producers (sectors/firms) and the consumers (households) and the corresponding flows of commodities.

As depicted, producers use primary factor inputs with intermediate inputs to add value. Final commodities have two end-uses: consumption demand and intermediate demand. Households are consumers while producers demand commodities for further production, and investors demand goods and services for producing capital goods and hard infrastructure used for future production. Public consumption is meant for providing basic infrastructure, administrative services, and social welfare facilities. Beyond the border, as a small open economy commodities are exported to foreigners to meet their demands (elastic foreign demand), while commodities produced abroad are imported for local consumption. Thus, the categories of agents and their interactions, domestically or internationally, are captured through sets of equations in each block representing material flows.

¹³ This is called closing the model via ‘closure’ specifications, on which more to come.

¹⁴ <http://www.copsmodels.com/ftp/workpaper/op-93.pdf>

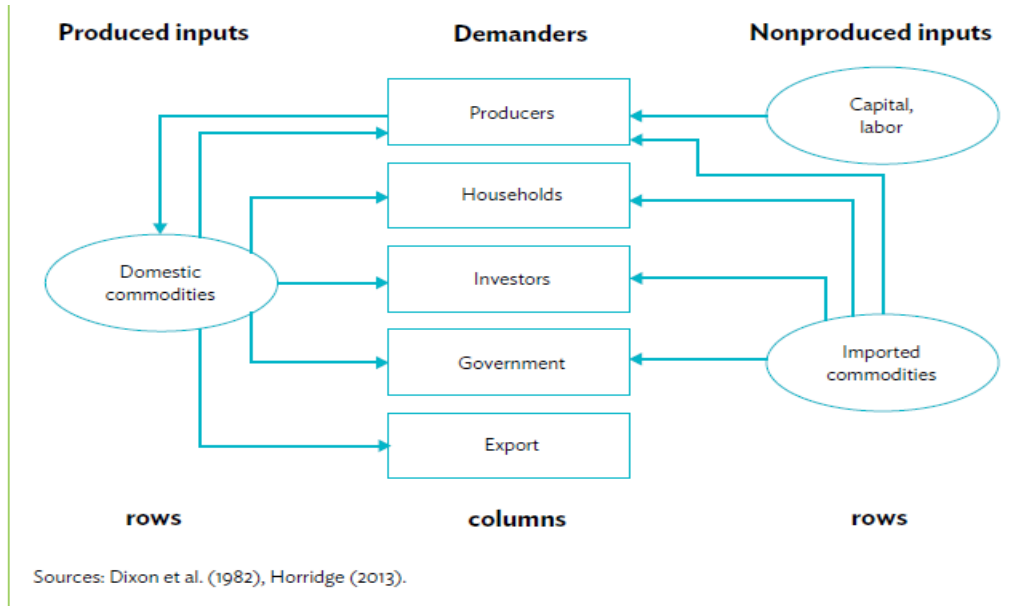


Figure 8: Key Economic Agents and Material Flows

As in ORANI model, it consists of several equation blocks for production, consumption, and macroeconomic identities (Horridge 2013, Dixon and Jorgenson 2013). For production block, theoretical structure is schematically presented below (**Fig AA1 in Appendix**). Producers maximize profits and zero pure-profits condition is satisfied in long run. There is no joint production. Production structure is nested with CES technology while at the top level, production function is Leontief with CRTS in primary inputs, and intermediates. Labors differ across skill types with imperfect substitution among them, but are CES-combined to form a composite one. In case of KGZ, we have one occupational labor type. Elasticities of substitution differs across nesting-see below. The production takes place using intermediate goods—imported as well as domestically sourced—with value-added composite of primary inputs in a Leontief top-nest. Then, via CET function the final goods are destined for local and foreign markets. Households demand goods for private consumption and each representative consumer is assumed rational and maximizes utility subject to budget constraint. The utility function is based on linear expenditure systems.¹⁵ Consumption by agents are distributed on commodities differentiated by source viz., domestic and imported/foreign. The price equations are basically ensuring zero-profit condition in production and also relating domestic prices with international prices via the exchange rate. The market-clearing equations ensure the equality between demand and supply in all markets.

The model consists of more variables than the declared equations associated with them and that's because of the purpose of leaving room for policy analysis with a particular macroeconomic environment. In order to 'solve' the model for a particular policy analysis we need to 'close' the model by decision about the exogenous-endogenous split amongst the set of variables describing the system of equations for the model which contains more variables than the number of equations—that is the 'model closure'-see *Appendix*.

Database, Parameters, and Calibration

¹⁵ Stone-Geary Utility function is the linear expenditure system and with some values of parameters, it reduces to generalized Cobb-Douglas function.

KGZ_ORANI Calibration is done using Supply-use tables for the economy for year 2015 (in million SOMs) as obtained from the Statistics committee of KGZ, comprising 34 sectors (34 industries and 34 products with no multiple or joint products). It has all taxes, tariffs and margins and losses. GDP form income, expenditure, and value-added match each other confirming accuracy. Figure 9 depicts the base year database derived by reorganizing the input-output database into several submatrices corresponding to different blocks. Accuracy of database was checked-see Table AA1 in Appendix.

Model Database

		1	2	3	4	5	6
		Producers	Investors	Household	Export	Government	Inventories
	Size	← I →	← I →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	C×S	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	C×S×M	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	C×S	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	O	V1LAB	C = Number of Commodities I = Number of Industries S = 2: Domestic, Imported O = Number of Occupation Types M = Number of Commodities used as Margins				
Capital	1	V1CAP					
Land	1	V1LND					
Production Tax	1	V1PTX					
Other Costs	1	V1OCT					

Joint Production Matrix	
Size	← I →
↑ C ↓	MAHE

Import Duty	
Size	← 1 →
↑ C ↓	VOTAR

Based on 2015 Supply-Use table

Figure 9

Each cell is a submatrix of the model database with the dimensions specified in Row-Column headings. There are 3 mining sectors. Row wise, for 1st row gives total basic values of 34 commodities demanded by all users represented by 6 columns with headings. Second row 'margins' represents total values of trade and transport margins or logistics for transfer of commodities---sourced domestically or imported---from producers to users. Not all sectors are used as Margin commodities (i.e., subsets of all sectors). For each sector, rows are split into two --Trade and transport--margins added to domestic sales of commodities, and further these are divided into *three* different kinds of categories of margins, viz., Wholesale trade, Retail trade and Motor repair, and Transport activities, cargo, postal and courier (not distinguished into land, water, or air). Domestic taxes on goods are recorded in the third row. In KGZ_ORANI, Total labor payments is included in fourth row with no subdivision into different occupational skill categories while the 5th and 6th rows include rental values of land and capital (user cost) paid by producers. Row 7 includes production taxes and subsidies faced by producers. 'Other cost tickets' in the last row are cost not recorded in the above rows. 'Make matrix' is of dimension '34x34', and equivalent to the supply-use table and gives the production of commodities by domestic producers.

For columns headings representing sales structures, we have 5 key demanders, while the 6th column is the inventories (accumulation) at the end of the base year for unsold part of current GDP. There

are intermediate and investment demand for each industry. For the producers' column, the rows 1—3 represent the cost structure of production, including the costs of the intermediates, margins, and taxes. With intermediate usages, VIBAS matrix captures backward and forward linkages of industries via inter-industry flows (see Table AA2 in Appendix). In order to know the factor-intensity for each sector, we present in **Table 9.1** the cost structure (in the base period of 2015) split into 8 columns in terms of domestic and foreign intermediate input costs, as well as primary factor costs, margins, and production and consumption taxes. Overall production structure is labour-intensive with labour costs being about 27% as compared to capital costs of 22%. For Agriculture, land rent is about 10% as compared to labour payment, but cost of capital is higher (i.e., about 20%) in agriculture. Thus, agriculture is more mechanized, and has *backward linkages* via domestic intermediate input use.

Table9.1 Cost Structure of Industries in 2015 (% of total Costs)									
Industry	1 IntDom	2 IntImp	3 Margin	4 ComTax	5 Lab	6 Cap	7 Lnd	8 ProdTax	9 Losses
COSTMAT									
1 Agriculture	49.3	9.5	10	0.4	15.5	9.9	4.9	0.4	0
2 Coal	34.7	20.2	5	0.5	18	14.3	7.2	0.2	0
3 OilGas	25.3	11.2	1.5	0.1	30	20.9	10.4	0.7	0
4 MetalOres	35.8	37.4	7.9	1.5	18.9	18.9	9.4	0.1	-29.8
5 OthMining	13	39.7	8.1	2.2	10.4	17.6	8.8	0.4	0
6 FoodBevTob	45.5	16.9	9.9	1	8.2	18.3	0	0.3	0
7 ClothLeather	26.6	27.4	7.2	0.2	3	35.6	0	0.1	0
8 WoodPaper	15.9	50.1	4.9	0	15.3	14.7	0	0.1	-1
9 Printing	39.7	21.4	3.1	0.7	30	6.6	0	0.2	-1.8
10 RefinedProd	34.4	29	7.5	1.7	16.2	8.9	0	3.1	-0.8
11 NoMetaRub	32.6	24.5	5	1.5	4.1	31.7	0	0.7	0
12 BasMeta	32.6	19	0.5	0	8	46.4	0	0	-6.5
13 FabMeta	9.2	44	9.2	1.4	29.6	6.2	0	0.4	0
14 CompElectro	20.3	31.1	5.5	0.6	52.1	4.1	0	0.1	-13.9
15 MachineEquip	4.9	49.2	2.7	0.3	83.6	25.4	0	0.8	-66.9
16 Electricity	12	39.7	6.7	2.3	26.5	14.2	0	0.3	-1.7
17 Gas	70.9	78.9	10.3	2.3	94.1	4.8	0	0.1	-161
18 SteamAir	27.3	42.1	8.3	0.5	27.9	4	0	0.5	-10.6
19 WaterWaste	27.3	16.3	3.4	-0.3	45	12.6	0	0.3	-4.6
20 Construction	33.3	28.3	5.5	2.5	3.3	26.7	0	0.4	0
21 Wholesale	15.3	14.2	2.7	0.7	12.9	50	0	4.2	0
22 RetailMoter	12.5	17.9	5	1.3	2.6	60.2	0	0.5	0
23 Repair	15.9	23.8	5.4	1	1.9	51.8	0	0.2	0
24 Hotels	33.6	19.4	6.8	1.3	3.7	34.8	0	0.5	0
25 Transport	13.5	33.2	6.8	1.7	14.3	29.9	0	0.6	0
26 CommuInfo	13.7	23.4	3.2	1.8	15.3	41.8	0	0.8	0
27 Financial	81.9	7.4	0.1	0	41.8	4.6	0	1	-36.8
28 RealScien	26.2	9.5	2.1	0.9	24.5	36.3	0	0.5	0
29 StateAdmin	18.4	10.6	3.8	0.7	55	11.4	0	0.1	0
30 Education	15.1	5.5	2.2	0.4	71.2	5.5	0	0.1	0
31 Health	18.1	8.9	3.1	0.2	55.8	13.5	0	0.3	0
32 ArtRec	24.4	12.3	1.5	0.7	48.8	10.3	0	1.8	0
33 Public	34.7	20.8	2.5	1.1	31.9	8.9	0	0	0
34 Miscellane	22.2	16	2.8	0.8	10.2	46.1	0	1.9	0
Total	31.4	18	5.6	1	16.8	27.4	1.2	0.5	-2
Average	27.53	25.25882	5.005882	0.941176	27.34118	21.96765	1.197059	0.313279	---
Source: KGZ_ORANI Database									

In order to know how the industrial outputs are used as intermediate inputs in the production by other industries, i.e., the *forward linkages*, we need to explore the sales structure—see Table 9.2 where **reported figures need to be multiplied by 100 for % figures**—and the column for ‘intermediate demand’. On the other hand, construction, transport, mining and extractive industries are capital-intensive. For manufacturing, in general it is capital-intensive except machine equipment, computer-electronics, fabricated and base metals. Oil and Gas, transport, most of the services sectors are capital-intensive. Agriculture, and some of the manufacturing uses considerable amount of margins in their production processes. Due to the column of ‘LOSSES’ in especially ‘Financial’, ‘Machine Equipment’, and ‘Gas’, some of the ‘ROW’ figures are not adding up to 100% in terms of cost categories in first 8

Sectoral outputs of Agriculture, Oil and Gas, mining, printing, electricity, Steam air, Repair, Financial services, are used quite considerably for other manufacturing, food, beverage, and other production processes. For the industries which have higher export demands, such as, the metal ores, other mining, base metal, clothing, leather, computer electronic, they are more export-oriented. More than 90% of clothing and leather (light manufacturing), and computer electronics, 80% for machinery equipment, are exported. Community info, Real Science, Education, health, Art and Recreation, and Public services are mainly used by Government and household. Hotels, Electricity, Gas, Steam Air, are used by households. Agriculture, Coal, Food, Beverages, and Tobacco, Wood paper, are used mostly in households. Construction, Electricity, Metal ores are used also in investment demand as well. Now we look at the contributions of each sector and also the components for GDP at factor cost –primary factor bills as well as the ‘Losses’ (**Figure 10**) which shows that Agriculture has high share (16%) while base metal, construction, transport and hotels, and Retail trade of motor vehicles have 10%, 9.5%, 4.4%, 2.1% and 17.6% respectively. This is a ‘macro lens’ view.

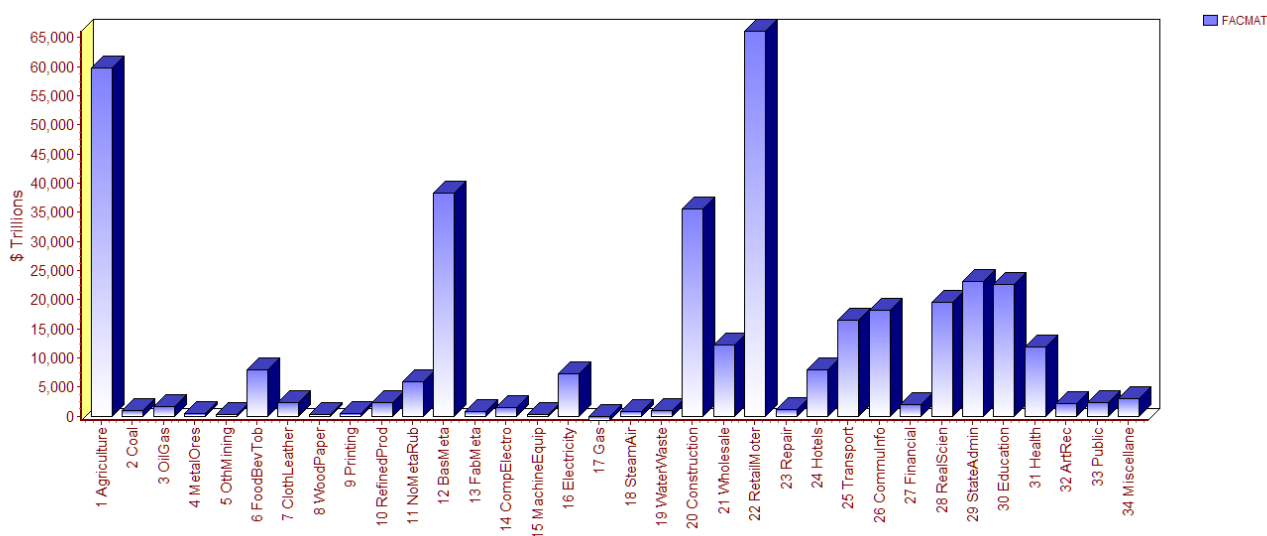


Figure 10

As we are concerned with the regional impacts of policy reforms and the database has some details about regional shares for 9 (7 oblasts and two major cities) including major city of Bishkek and Osh, we now present the ‘micro’ level picture at the regional level. Regional contribution to each industry’s production in the base year (2015) is given in **Figure 11**.

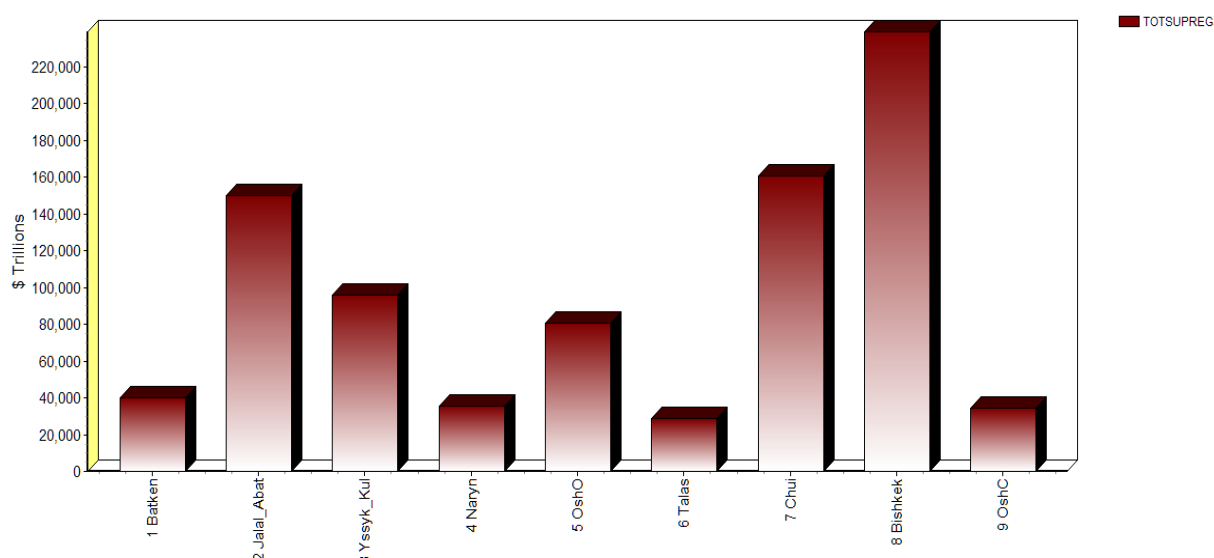


Figure 11

It shows the importance of a region in the economy-wide production of a particular sector. For example, in case of Agriculture contribution of Chui region is highest (31%) in national agricultural production, whereas Bishkek's contribution is highest (50% and above) in Transport, Hotel, Services, Computer-electronics—to name some few. In case of Metal ores, coal, oil and gas, other mining, Jalal Abat has highest (68%) contributions. For Osho, the main contributors are agriculture (21%), education (14%), health (12%), and coal, oil & gas, metal ores as well. gives each of the 9 regions' contribution in total production. However, for each particular region the share of each sector in total regional industrial output is given in **Table AA 3**. In what follows, we now analyze the baseline and policy simulation results.

Simulation Experiments and Analysis of Results:

Consistent with the ORANI-G based models for policy analysis (Horridge, 2014, Dixon et al. 2013), we consider conceptually two kinds of perturbations into the model viz., the baseline scenario as well as policy-induced exogenous shocks based on the preceding sections. For quantifying economy-wide and sectoral effects of ensuing policy reform-led changes, as described above, we consider two-stages of simulated impact: (a) Baseline where the economy naturally evolves over 2015-30 under certain 'normal' dynamic adjustment with the passage of 15 years, such that a new equilibrium database is generated. It captures no policy reforms; (b) Policy reform simulations entailing policy changes after the economy adjusted from one base (2015) to new base (2030), when policy measures are enacted. This captures prospective policy repercussions on the economy as the economy moves to a new equilibrium at 2030, but this time at a particular point of time, i.e., 2030. Deviations of the policy-induced values of the variables in the database in 2030, from the equilibrium values under natural dynamic changes are the 'net' quantified policy impact. The difference between these two changes of the concerned 'endogenous' variables captures the pure policy-induced impacts traced between 2015-2030 as per reform-led initiatives (See figure 12 below).

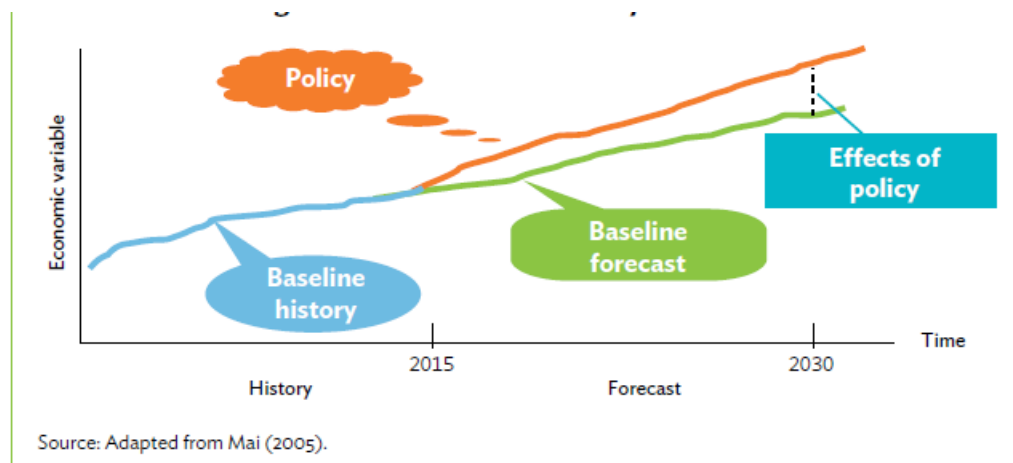


Figure 12: Model Mechanism for Baseline and Policy Reform Simulation

In particular, under the baseline (BL, henceforth) we assume that the KGZ economy... undertakes the Business-as-usual (BAU) path consistent with the assumptions as mentioned below:

- (i) A one-shot forecast assuming 4% balanced growth during 2015-2030 in keeping with what is observed overall in the past trends.
- (ii) employment increases by 2% per annum,
- (iii) labor productivity augments by 2% per annum uniformly across categories,
- (iv) uniform land productivity enhancements by 2% per annum,
- (v) 4% swelling of export demands
- (vi) making stocks to disappear (assumptions for convenience of GE results)

This moves the economy along the baseline path to 2030 without impingement of the reform-led shocks that are administered in 2015 with the updated database of Baseline simulations, but full-fledged policy reforms take “full monty” effects.

The policy shocks enlisted are:

- (i) additional 1% annual technological progress in agriculture showing 2030 full repercussions,
- (ii) extra 1% productive efficiency improvement in the energy/power (electricity) sector,
- (iii) additional improvement in logistics, transport, and infrastructure by 2% per annum,
- (iv) increase in productivity in selected manufacturing by 1% per annum.

Below in Figure 13, the transmission mechanism of policy-reform impacts are depicted.

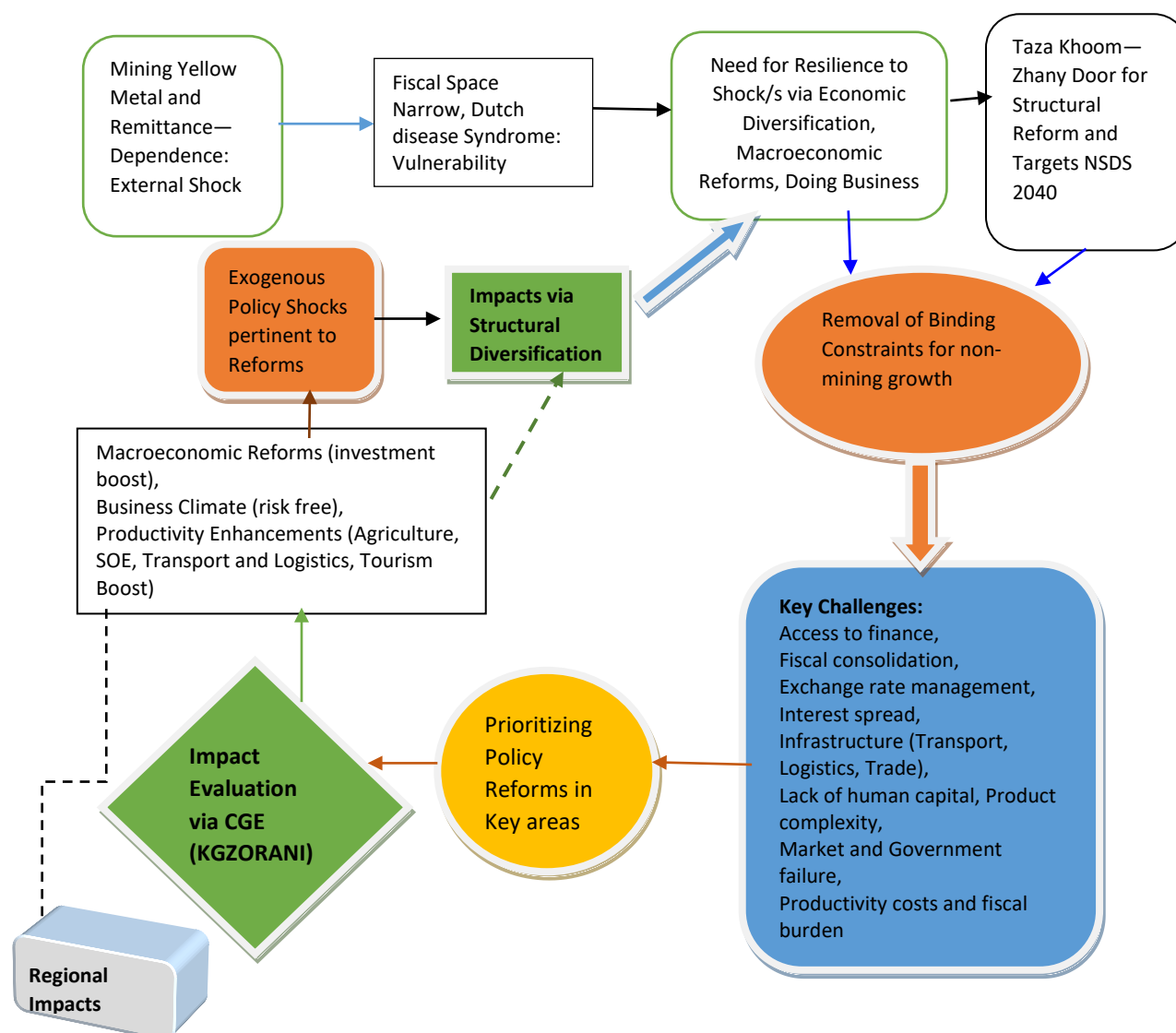


Figure 13: Principal pathways depicting reforms and implementation via KGZORANI

Baseline Simulations: Macroeconomic Impacts

Under this scenario of no-reform, as mentioned above, the dynamic evolution of the economy is assumed as uniform productivity escalation by 1% as well as expansion of export demand by 4%. The basis for the assumptions are rooted in past history as total factor productivity improvement occurred due to reduction in factor-usage per unit of production. Considering CAREC, EAEU and expansion of trade due to trade partners' globalization strategy, export is supposed to fuel demand. Also, employment is assumed to increase by 2% per annum. This will happen due to export demand as well as productivity effects. In this case, the economy is assumed to grow by 4% a year till 2030. Thus, as presented in **Table 9.3**, total GDP is estimated to reach 666.31 billion in 2030 from 375.3 billion in 2015.

Table 9.3 Structure of the Kyrgyzstan Economy, 2015 and 2030 (baseline case)						
	2015			2030		
	SOM billion	Share	%	SOM billion	Share	%
FGDP	FACMAT					
1 Agriculture	59758	0.159	15.9	108172	0.162	16.2
2 Coal	901	0.002	0.2	1579	0.002	0.2
3 OilGas	1694	0.005	0.5	2488	0.004	0.4
4 MetalOres	466	0.001	0.1	1217	0.002	0.2
5 OthMining	237	0.001	0.1	389	0.001	0.1
6 FoodBevTob	7975	0.021	2.1	13848	0.021	2.1
7 ClothLeather	2363	0.006	0.6	4059	0.006	0.6
8 WoodPaper	335	0.001	0.1	589	0.001	0.1
9 Printing	405	0.001	0.1	716	0.001	0.1
10 RefinedProd	2236	0.006	0.6	3957	0.006	0.6
11 NoMetaRub	5912	0.016	1.6	10384	0.016	1.6
12 BasMeta	38252	0.102	10.2	71281	0.107	10.7
13 FabMeta	802	0.002	0.2	1303	0.002	0.2
14 CompElectro	1477	0.004	0.4	2779	0.004	0.4
15 MachineEquip	190	0.001	0.1	376	0.001	0.1
16 Electricity	7191	0.019	1.9	12598	0.019	1.9
17 Gas	-753	-0.002	-0.2	-1463	-0.002	-0.2
18 SteamAir	707	0.002	0.2	1251	0.002	0.2
19 WaterWaste	885	0.002	0.2	1558	0.002	0.2
20 Construction	35596	0.095	9.5	60137	0.09	9
21 Wholesale	12254	0.033	3.3	21495	0.032	3.2
22 RetailMoter	66105	0.176	17.6	115526	0.173	17.3
23 Repair	1077	0.003	0.3	1883	0.003	0.3
24 Hotels	7918	0.021	2.1	13942	0.021	2.1
25 Transport	16519	0.044	4.4	29224	0.044	4.4
26 CommuInfo	18173	0.048	4.8	32207	0.048	4.8
27 Financial	2036	0.005	0.5	3919	0.006	0.6
28 RealScien	19614	0.052	5.2	34255	0.051	5.1
29 StateAdmin	23135	0.062	6.2	42638	0.064	6.4
30 Education	22685	0.06	6	40084	0.06	6
31 Health	11884	0.032	3.2	21044	0.032	3.2
32 ArtRec	2077	0.006	0.6	3679	0.006	0.6
33 Public	2258	0.006	0.6	4019	0.006	0.6
34 Miscellane	2921	0.008	0.8	5174	0.008	0.8
Total GDP (including all 34 sectors)						
	375285	1	100	666306	1	100
Source: KGZ_ORANI Base Year & Post-reform Databases						

The key drivers underlying such growth are: productivity growth in land and labor by 1.0 percentage point, expansion in the workforce by 2%, and export demand of 4 percentage points. As expected, there is minor compositional changes—share of Agriculture increased from 15.9% to 16.2% while share of most of the manufacturing and services remain more or less unaltered, with slight variations. The crucial point here is that there are not much impacts without policy reforms, and the real GDP grows at (AAGR) 3.83%, employment grows at 2%, while real wage changes 1.9%. This is reflected in the following tables---**Tables 9.4, 9.5 and 9.6**--on major macro and sectoral impacts.

Table 9.4 Macroeconomic Impacts: Baseline Simulations as described in this Section

	Cumulative effects	Contribution of each shock to the selected combined macro results						Annual Average Growth
		Baseline	Shock 1	Shock 2	Shock 3	Shock 4	Shock 5	
1 RealHou	78.68	27.52	0.01	28.36	3.08	18.11	1.6	3.95
2 RealInv	76.22	27.13	0	27.94	3.28	17.95	-0.09	3.85
3 RealGov	78.68	27.52	0.01	28.36	3.08	18.11	1.6	3.95
4 ExpVol	75.68	32.19	-0.16	33.16	3.91	6.59	-0.02	3.83
5 ImpVol	76.89	27.28	-0.05	28.11	2.73	18.92	-0.1	3.88
6 RealGDP	75.69	29.01	0	29.87	3.7	13.22	-0.11	3.83
7 Employment	34.59	34.59	0	0	0	0	0	2
8 RealWage	31.86	-8.45	0.01	25.95	2.66	11.61	0.08	1.86
9 AggCapStock	76.22	27.13	0	27.94	3.28	17.95	-0.09	3.85

Source: Authors' Simulations of KGZ_ORANI Model

Table 9.5 Expost Sales Structure of Individual Sectors across sources of Demands (%)

SalesDecomp	1 Interm	2 Invest	3 HouseH	4 Export	5 GovGE	6 Stocks	7 Margins
1 Agriculture	35.13	1.76	28.86	0.88	0.67	-1.09	0
2 Coal	33.76	0.46	24.99	4.99	0	-2.86	0
3 OilGas	55.64	5.08	0.65	0	0	-17.62	0
4 MetalOres	25.11	40.35	0.09	-11.74	1.01	23.97	0
5 OthMining	24.02	0.35	7.3	20.44	0	-0.05	0
6 FoodBevTob	22.7	0.62	39.55	11.09	0	0.05	0
7 ClothLeather	0.35	0.02	3.54	67.69	0	-0.02	0
8 WoodPaper	35.24	0.27	23.11	18.34	0	-0.26	0
9 Printing	59.72	5.22	13.68	0.2	0	0.11	0
10 RefinedProd	12.04	3.64	13.61	49.5	0	-0.52	0
11 NoMetaRub	48.89	2.06	12.26	11.43	0	0.91	0
12 BasMeta	34.32	0.56	0.01	49.15	0	2.55	0
13 FabMeta	27.57	0.74	15.7	27.56	0	-7.64	0
14 CompElectro	2.96	0.01	3.04	85.49	0	0	0
15 MachineEquip	5.87	4.77	8.59	85.35	0	0.36	0
16 Electricity	21.71	44.18	10.59	0.01	0.05	0	0
17 Gas	31.51	17.31	37.57	0	0	-0.12	0
18 SteamAir	36.67	9.14	34.11	0	0	0.5	0
19 WaterWaste	22.64	23.66	30.56	0	0.86	0.18	0
20 Construction	14.96	48.15	3.22	6.01	0	-3.48	0
21 Wholesale	0	0	0	0	0	0	75.54
22 RetailMoter	0	0	0	0	0	0	74.49
23 Repair	59.73	1.99	12.79	0	0	0	0
24 Hotels	27.27	1.91	28.83	17.93	0	0	0
25 Transport	26.05	4.24	15.91	18.74	0.4	0	11.98
26 CommulInfo	29.85	11.36	29.01	7.27	0.25	-0.24	0
27 Financial	96.6	2.11	3.23	8.84	0	0.06	0
28 RealScien	36.21	2.87	29.25	0	7.75	-0.82	0
29 StateAdmin	0.17	0.8	0.07	72.31	12.66	0	0
30 Education	2.16	5.58	8.02	0	62.86	-0.01	0
31 Health	2.44	4.38	9.79	0	62.07	0	0
32 ArtRec	9.28	4.8	8.06	0	56.51	0.1	0
33 Public	1.67	4.04	73.8	0	0	0	0
34 Miscellane	40.39	1.81	33.71	0	1.18	0.14	0

Source: Authors' Baseline Simulations of KGZ_ORANI Model

Table 9.6 Sectoral Impacts (Outputs): Baseline Simulations as described in this Section								
	Cumulative effects	Contribution of each shock to the selected combined macro results						AAGR
	Baseline	Shock 1	Shock 2	Shock 3	Shock 4	Shock 5	Shock 6	
	Output of Sectors							
1 Agriculture	66.27	23.38	0.24	23.96	9.59	10.49	-1.39	3.45
2 Coal	61.37	23.75	-0.03	24.29	12.59	3.21	-2.43	3.24
3 OilGas	43.76	26.89	-0.06	27.4	4.78	7.79	-23.04	2.45
4 MetalOres	78.91	15.48	-0.01	15.98	20.4	7.75	19.31	3.95
5 OthMining	52.08	11.36	-0.03	11.57	21.65	8.02	-0.5	2.83
6 FoodBevTob	74.03	28.36	-0.11	29.14	6.42	9.17	1.05	3.76
10 RefinedProd	78.27	29.01	-0.09	29.84	5.78	9.92	3.81	3.93
12 BasMeta	86.59	26.96	-0.08	27.79	-0.44	28.06	4.29	4.25
13 FabMeta	63.93	33.67	-0.07	34.55	0.44	7.6	-12.26	3.35
14 CompElectro	91.5	59.31	-0.14	61.32	-5.82	-25.79	2.62	4.43
15 MachineEquip	104.92	84.12	-0.13	87.44	-18.78	-48.12	0.38	4.9
16 Electricity	76.53	28.82	-0.04	29.69	3.01	15.2	-0.16	3.86
17 Gas	86.24	49.57	-0.13	51.29	-4.04	-10.83	0.39	4.23
18 SteamAir	80.43	31.72	-0.09	32.78	2.08	12.07	1.86	4.01
20 Construction	68.85	25.84	-0.02	26.55	3.01	19.48	-6.01	3.55
21 Wholesale	75.54	27.44	-0.03	28.25	4.26	15.3	0.33	3.82
22 RetailMoter	74.5	26.11	0.04	26.86	5.4	15.42	0.67	3.78
24 Hotels	75.94	27.1	-0.06	27.89	4.2	16.32	0.48	3.84
25 Transport	77.33	29.79	-0.06	30.68	2.48	14.5	-0.06	3.89
30 Education	78.61	27.9	0	28.77	2.99	17.51	1.43	3.94
31 Health	78.68	27.91	0	28.78	2.98	17.53	1.48	3.95

Source: Authors' Baseline Simulations of KGZ_ORANI Model

Shocks 1 to 6 in each column in Tables 9.4 refer to the shocks in base data in baseline as described in this section. This is same as what the World Bank finds for 2016 (3.8%) and ADB reports for 2018.¹⁶ These are lower than relatively higher growth before 2018. Table 9.5 shows that although it has 'rich endowments' in agriculture, hydropower and tourism, in baseline projections, these are not sufficient. As evident from 9.6, productivity shocks in labor and land augmented sectoral output, registered in higher AAGR.

Policy Reforms: Sectoral and Macro impacts

The structural reforms scenarios, based on Sections 2 and 3, provide the rationale for discussions of simulated impacts---at the sectoral and economy-wide levels---of government's efforts for structural diversification. As mentioned, the reform initiatives are designed for enhancement of productivity and efficiency in agriculture, services such as trade, tourism, and transport, logistics, some manufacturing for industrialization, as well as power and energy sector like electricity, and also global integration via trade, FDI, and regional cooperation. Based on preceding discussions, we simulate 1% annual technical progress (i.e., productivity improvements) in sectors such as Agriculture, Electricity, and assume annual 1.5% technical progress for margin and tourism. This helps us on comparing differential impacts across sectors of the transmitted productivity shocks. As tourism and trade boost is gaining primacy, the magnitudes are higher for them. The reasons governing choice of magnitude of shocks are explorative in the sense that

¹⁶ <http://www.worldbank.org/en/country/kyrgyzrepublic/overview#4> and <https://data.adb.org/dashboard/kyrgyz-republic-numbers>

often the full-blown effects of policy interventions take time to be realized. Table 9.7 reports the macroeconomic impacts where the 2nd column gives the cumulative effects of Four Policy Reforms reported in the next 4 consecutive columns. Obviously, the real GDP registers 23.4% increase by 2030 whereas the annual average growth rate, in the last column, is 1.41% per annum. Thus, conjointly the joint effects of baseline projection (Table 9.4) inclusive of policy-reform impacts is 5.2% (i.e., 3.8%+1.4%). Similarly, with reforms employment and real wage will increase by 0.5% and 0.80% per annum till 2030.

Table 9.7 Simulated Macroeconomic Impacts of Policy Reforms by 2030						
	Cumulative Reform impacts	Agriculture Policy Reform	Electricity Reform	Transport &Logistic s Reform	Tourism Boost	<i>Annual Average Growth</i>
1 RealHou	15.89	4.11	1.11	8.19	2.47	0.988
2 RealInv	13.72	4.27	1.91	4.66	2.87	0.861
3 RealGov	15.89	4.11	1.11	8.19	2.47	0.988
4 ExpVol	45.17	9	2.54	27.35	6.28	2.52
5 ImpVol	18.52	3.92	1.42	10.34	2.85	1.14
6 RealGDP	23.4	6.05	1.64	12.07	3.65	1.41
7 Employment	7.45	1.55	0.37	4.5	1.04	0.48
8 RealWage	12.71	2.64	0.62	7.67	1.78	0.801
9 AggCapStock	13.72	4.27	1.91	4.66	2.87	0.861
Source: Authors' Simulations of KGZ_ORANI Model						

This is exactly the growth rate of 5% projected by the World Bank for 2020 after deceleration to 4.2% in 2018.¹⁷ As mentioned, the growth-drivers are boost in agricultural exports, and trade expansion thanks to increase in market access via Eurasian Economic Union (EAEU) or participation in CAREC program¹⁸; in fact, the baseline shocks incorporate an export-demand shocks proxying such trade integration via CAREC or EAEU. As remittances flow steadily supported household consumption demand, that is crucial for growth along with the trade channel; however, moderate growth in agriculture and services, as noted by the World Bank (ibid.), did not boost the growth rate much beyond 4.2%. The policy reform impacts on aggregate industries are reported in Table 9.8. As envisaged, from table 9.8 it's clear that transport and logistics reform is major driver along with the reforms in improving productive efficiency in electricity and margins.

¹⁷ <http://www.worldbank.org/en/country/kyrgyzrepublic/overview#3>

¹⁸ In a trade model like GTAP, with multi-country-multi-sectoral trade framework with Armington trade elasticity, one can enumerate such regional integration impact. KGZORANI lacks detailed global trade linkages, and hence, this treatment is inadequate in this research. That is in our research agenda. However, export demand boost is a good pointer in that direction.

Table 9.8 Simulated Sectoral Impacts of Policy Reforms by 2030						
	Cumulative impacts	Policy Reform1	Policy Reform2	Policy Reform3	Policy Reform4	Annual Average Growth
		Agriculture	Electricity	margin	tourism	
1 Agriculture	30.35	15.82	0.97	10.67	2.9	1.78
2 Coal	10.68	1.85	1.21	6.53	1.1	0.679
3 OilGas	26.71	2.39	1.67	20.46	2.19	1.59
4 MetalOres	5.04	0.86	1.15	2.84	0.19	0.328
5 OthMining	9.38	0.94	0.89	7.6	-0.05	0.599
6 FoodBevTob	75.54	12.2	2.23	32.74	28.37	3.82
12 BasMeta	5.63	0.33	3.91	3.55	-2.15	0.366
13 FabMeta	26.82	2.59	1.85	23.04	-0.67	1.6
14 CompElectro	-14.13	-4.58	-0.05	-2.07	-7.42	-1.01
15 MachineEquip	-39.99	-8.99	-1.23	-22.06	-7.71	-3.35
16 Electricity	17.46	4.18	2.93	6.91	3.44	1.08
17 Gas	-2.45	-2.67	0.82	-0.97	0.37	-0.165
20 Construction	16.32	4.12	2.06	7.04	3.1	1.01
21 Wholesale	26.8	5.95	1.48	15.26	4.11	1.6
24 Hotels	79.21	8.43	2.55	15.32	52.92	3.97
25 Transport	80.83	4.21	2.23	72.58	1.82	4.03
26 CommuInfo	16.54	3.71	1.62	8.36	2.85	1.03
27 Financial	-23.81	-5.44	-0.98	-15.71	-1.67	-1.8
30 Education	15.3	4.02	1.15	7.65	2.48	0.953
31 Health	15.21	3.99	1.14	7.65	2.43	0.949
32 ArtRec	16.27	4.04	1.18	8.31	2.74	1.01
33 Public	12.42	3.08	1.11	6.16	2.07	0.783
Source: Authors' Simulations of KGZ_ORANI Model						

Our policy reform simulation demonstrates that participating in regional integration and global integration via improvement in transport and logistics (say, employment of digital technologies such as ICT or 4IR) will facilitate modern E-commerce, and boosting productivity in agriculture (say, via biotechnological innovation or nano-bio fields, or green revolution) could boost real GDP growth (see Das 2015). Productivity growth in Electricity is assumed to take place as representing improvement in business climate and investment in infrastructure. As technical progress in respective sectors boost productivity and marginal product of labor in their occupations, it increases the real wages over 15 years by 12.7% (annualized rate at 0.81%) and employment by 7.45% (0.5 annually). This is due to expansion of employment opportunities driven mostly in occupations related to margin (4.5%), followed by agriculture (1.6%), then tourism (1.04%) and electricity (0.32%). Average wage by occupation increases by 4.86% (0.32% annually) contributed mostly by margin (3.41%), agriculture (0.52%), tourism (0.53%), and electricity (0.40%). Thus, productivity boosts employment vis-à-vis real wage. Productivity improvements in these four sectors contribute to the compounded growth over 15 years till 2030 where contribution of tourism, logistics and transport have highest contribution followed by agriculture with 1.41% while contribution of electricity is of lesser extent, although important.

On the trade front, we also see that both aggregate exports and imports increase by 45.2% and 18.5% (see Table 9.7) by 2030. This would cause accumulated exports as percent of GDP to be 35% (agriculture 1.8%, Hotels by 1.14%, Transport by 2.11%, Construction 2.24%, Food-beverage-tobacco 1.7%) 2030, whereas imports to increase by less causing trade surplus (trade balance) accumulate by 5%. In other words, exports increase (2.5% AAGR) by bit more than the imports (1.14% AAGR) and

contribution of exports and imports to real GDP from expenditure side is 15.9% rise and 14.9% fall by 2030.¹⁹

Turning to the sectoral impacts (see Tables 9.8), it is obvious that those benefiting from reform-led productivity benefits—agriculture, electricity, margins, and tourism—record higher growth, and also through spillovers and intersectoral transmission of such induced productivity enhancement, and changes in export composition of sectors. Breakdown among shock components in table 9.7 shows that the main drivers behind cumulative growth effects have been the margin and tourism sectors as improvements in transport and logistics, infrastructure boosts trade and commerce—domestically as well as regionally within CAREC or EAEU—so as to augment production via forward and backward linkages. Large contributions of margins and tourism as compared to agriculture and electricity shows the importance of developing infrastructure as well as human capital for improving business environment. The table shows differential annual average percentage growth in outputs for each sector with some sectors showing more than the targeted sectors of policy reforms; that's due to transmitted benefits via the subsequent inter-industry linkages causing structural diversification. Share of agriculture exports increase by 3.3%, food and beverages by 41%, transport by 56.6% while for hotel not so much (0.04%). And decline occurs for sectors such as, metal ores, mining, base metal, fabricated metal, amongst few others.

Given the dependence on agriculture and tourism, this kind of diversification (under our current conservative policy shocks with just 1% and 1.5%) is conducive for becoming non-susceptible to external vulnerability. In the same vein, looking at the **Table 9.9** we can see that there have been compositional changes in export baskets as envisaged in percentage changes in shares in export basket from base case to baseline simulations to policy reform scenarios. From the table, it is clear that in the without-reform baseline scenario the share of exports for the targeted sectors for reforms (fours such in current implementation) decline a bit by 2030—compare row wise for the bolded sectors---from the base case in 2015. However, due to implementation of reforms these sectors, especially the agriculture, transport, food and beverages under tourism expands. The changes have been modest as we do not implement reforms in the manufacturing sectors at present. Needless to say, these types of compositional changes trigger changes in industry-wise employment and occupation. Under no-reform baseline scenario with employment shock the occupational changes are 34.6% by 2030, with 2% per annum; however, in the presence of policy reforms overall cumulative changes in occupation is 6.5% (0.42% per annum), the prime mover being margin (3.8%), followed by agriculture (1.8%), tourism (0.6%) and electricity (0.32%). Considering changes in employment by occupation we find that this diversification would entail more occupational employment in transport (2.26% annualized rate) and agriculture (0.74%), tourism (mainly, food and beverages –1.84% thanks to forward linkages via agricultural value chain).

¹⁹ Contribution of BOT is 1.01%.

Table 9.9 Simulates impact of changes in export basics demand and the underlying shock-drivers in the baseline and policy reforms by 2030								
	Cumulative impacts	Policy Reform1	Policy Reform2	Policy Reform3	Policy Reform4	Annual Average Growth in Reforms	Cumulative Impacts in Baseline	Annual Average Growth in Baseline
	Agriculture	Electricity	margin	tourism				
1 Agriculture	130.4	123.56	-1.63	24.82	-16.34	5.72	18	1.11
2 Coal	-5.88	-3.99	-0.48	5.04	-6.45	-0.403	36.2	2.08
3 OilGas	-60.51	-5.28	-2.55	-44.66	-8.02	-6.01	58.1	3.1
4 MetalOres	-25.49	-9.42	-3.31	-6.17	-6.59	-1.94	-27	-2.08
5 OthMining	0.32	-2.28	-0.12	5.39	-2.68	0.021	38.9	2.21
6 FoodBevTob	254.6	32.32	5.17	124.97	92.15	8.81	66.6	3.46
11 NoMetaRub	49.53	1.23	5.44	44.45	-1.59	2.72	78.6	3.94
12 BasMeta	3.79	-0.29	4.13	2.89	-2.95	0.248	80.6	4.02
13 FabMeta	39.09	-1.12	2.03	43.41	-5.23	2.22	85.3	4.2
14 CompElectro	-16.21	-5.19	-0.15	-2.79	-8.07	-1.17	92.5	4.46
15 MachineEquip	-51.83	-11.54	-1.81	-28.66	-9.81	-4.75	110	5.07
16 Electricity	75.14	-2.11	81.09	2.03	-5.86	3.81	84.6	4.17
20 Construction	23.25	1.38	4.1	18.25	-0.49	1.4	79.4	3.97
21 Wholesale	435.92	2.05	9.17	430.88	-6.19	11.8	81.2	4.04
22 RetailMoter	476.8	5.88	11.54	455.98	3.4	12.4	77.9	3.92
23 Repair	16.34	0.7	4.36	13.37	-2.08	1.01	79.3	3.97
24 Hotels	242.32	15.79	6.29	29.39	190.85	8.55	73.7	3.75
25 Transport	222.21	-0.37	3.45	224.18	-5.05	8.11	82.7	4.1
30 Education	-31.78	0.23	-1.92	-21.72	-8.37	-2.52	92	4.45
31 Health	-19.41	1.94	-0.17	-14.13	-7.06	-1.43	87.5	4.28
32 ArtRec	-25.27	-2.46	-0.49	-15.4	-6.92	-1.92	92.4	4.46
33 Public	-13.49	-1.82	0.68	-6.5	-5.85	-0.961	88.9	4.33
Source: Authors' Simulations of KGZ_ORANI Model								

All these effects will surely percolate at the bottoms-down level of the nine regions or ‘Oblasts’. Because of concern about inclusiveness or shared prosperity, the impact at the regional level needs attention, which we discussed in the following section.

Regional Spillover of Nation-wide Impact

Regional differences in impacts in the light of National Economic Development is crucial as prosperity offers scope of cooperation and collaboration for economic development across the domestic region, which facilitates beyond the border regional integration via EAEU, CAREC, and other initiatives through institution building. In fact, Government has a Concept Note delineating goals and sub-goals for deconcentrating human and financial resources, regional business climate improvement, infrastructure, agricultural development via irrigation, and socio-economic development.²⁰ First, we present some policy reform impacts (see **Table 9.10**) and then, use a ‘Summary Index’, viz., ‘Relative Mean Deviation’

²⁰ The Concept of the Regional Policy of the Kyrgyz Republic for 2018—2022. Annex. Approved by the Resolution No. 194 of the Government of the Kyrgyz Republic dated March 31, 2017.

(Shankar and Shah 2003, Kakwani 1988)²¹ Despite being ad hoc and determined from outside the model, it is quite a good indicator of relative inequality and deprivation while structural reforms programs are undertaken by less developed economies.

Table 9.10 Simulated Macro Impacts on Gross Regional Products in Baseline vs Policy Reforms								
Regions	Cumulative Policy Impacts	Policy Reform in Agriculture	Policy Reform in Electricity	Policy Reform in margin	Policy Reform in tourism	Annual Average Growth Rate	Cumulative Baseline 2030	Annual Average Growth Rate
Oblasts								
1 Batken	23.25	7.57	1.68	10.43	3.56	1.4	73.9	3.76
2 Jalal_Abat	18.3	5.4	1.94	9.16	1.8	1.13	76.2	3.85
3 Yssyk_Kul	23.56	4.95	2.17	13.17	3.26	1.42	79.4	3.97
4 Naryn	18.96	5.37	1.99	10.22	1.37	1.16	72.9	3.72
5 OshO	24.13	9.21	1.44	10.84	2.64	1.45	72.6	3.7
6 Talas	25.82	10.76	1.06	10.9	3.1	1.54	70.9	3.64
7 Chui	27.84	8.62	1.8	13.93	3.49	1.65	71.3	3.65
8 Bishkek	19.63	3.68	1.24	10.7	4.02	1.2	80.1	4
9 OshC	25.83	5.29	1.33	10.65	8.56	1.54	79.2	3.96
Source: Authors' Simulations of KGZ_ORANI Model								

From Table 9.10 and preceding discussions, we see that in the *baseline case* although real GDP grows at 3.8% per annum, some regions like Bishkek, OshC, Jalal Abat, and Yssyk_Kul regions have higher Gross Regional Product (GRP) per capita and higher annualized real GRP growth—3.9%, 3.8%, 3.7%, and 3.8% respectively—compared to other five regions, with lowest being in Talas oblast. After the policy reforms, the scenario changed to some extent. *Ex post*, as major drivers of such changes in real GDP have been primarily margin, tourism, and agriculture, these five relatively laggard regions managed to improve upon their positions, and thus, registering higher than the annualized growth rate of 1.35% in real GDP. Thus, post reform real GRP growth rates per annum are 1.42% for Yssyk Kul, 1.65% for Chui, Talas with 1.54%, and 1.45% for Osho. If we add up the annual growth rate per annum for the regions, definitely some regional catch-up or convergence could be envisaged. Also, we see that most of the contributions under the reform scenarios originate via margin and agriculture across regions, with differential impacts depending on industry contributions to GRP ex post (See Table 9.11). We see that for Batken, Jalal Abad, Naryn, Osho, Talas, and Chui Agriculture has highest contribution to regional GRP. In case of Yssyk Kul, tourism sector (via Food and Beverage) has much higher contribution while for Bishkek, Transport has highest contribution followed by Motor retail services; just the reverse case is with OshC. In most of the regions except OshC, improvement in margin sectors dominate the changes in regional employment at the aggregative macro level.

²¹ Ginting, et al. (2018) in an ADB Country Diagnostic Study has used this for Kazakhstan.

Table 9.11 Simulated Policy impact on Industry contributions to Regional GRP

Sectors	1 Batken	2 Jalal_Aba	3 Yssyk_Ki	4 Naryn	5 OshO	6 Talas	7 Chui	8 Bishkek	9 OshC
1 Agriculture	8.17	5.46	3.02	5.69	11.3	13.54	9.38	0.06	0.4
2 Coal	0.04	0.1	0	0.07	0.04	0	0	0	0
3 OilGas	0.15	0.42	0	0.3	0.15	0	0.01	0	0
4 MetalOres	0.03	0.08	0	0.06	0.03	0	0	0	0
5 OthMining	0.01	0.02	0	0.02	0.01	0	0	0	0
6 FoodBevTob	0.94	0.29	6.33	0.13	0.22	0.08	2.45	0.52	0.27
12 BasMeta	0.71	1.39	1.56	0.99	0.51	0.03	0.62	0.14	0.07
13 FabMeta	0.06	0.11	0.12	0.08	0.04	0	0.05	0.01	0.01
14 CompElectro	-0.03	-0.01	-0.2	-0.01	-0.01	-0.01	-0.08	-0.13	-0.03
15 MachineEquip	-0.05	-0.03	-0.15	-0.02	-0.04	-0.04	-0.08	-0.05	-0.08
16 Electricity	0.09	1.41	0.05	0.22	0.05	0.61	0.18	0.02	0.08
20 Construction	1.54	0.74	1.32	2.84	0.45	0.57	2.98	1.38	0.79
21 Wholesale	0.68	0.57	0.23	0.4	0.84	1	0.74	0.88	1.81
22 RetailMoter	4.63	3.23	2.61	2.29	5.33	6.09	6.08	4.32	9.85
24 Hotels	1.62	0.57	1.1	0.04	0.38	0.27	0.25	2.48	5.66
25 Transport	0.82	0.62	2.69	2.13	1.12	1.19	1.88	6.03	4.55
26 CommulInfo	0.07	0.05	0.13	0.04	0.01	0.06	0.06	2.29	0.35
30 Education	1.56	0.82	0.63	1.76	1.54	1.21	0.65	0.78	1.48
31 Health	0.68	0.39	0.4	0.66	0.71	0.62	0.35	0.51	0.46
32 ArtRec	0.08	0.05	0.11	0.19	0.06	0.12	0.04	0.12	0.13
33 Public	0.13	0.07	0.06	0.13	0.14	0.12	0.07	0.06	0.06
Source: Authors' Simulations of KGZ_ORANI Model									

In case of relative mean deviation, we calculate using the following weighted mean deviation index (MD_w) using the following formula:

$$MD_w = \left(\sum_{i=1}^n (|Y_i - \bar{Y}|) \frac{P_i}{P} \right) / \bar{Y}$$

where Y_i is the per capita GDP of the i -th region, \bar{Y} is the per capita GDP of KGZ, P_i is the regional population of i -th province, 'n' is the number of provinces, and P is the population of the country. MD_w has the value of 0 for a perfectly egalitarian distribution and varies up to $2P(N-1)/P_i$ for a perfectly unequal distribution. This measure of distribution has been widely used--see Wijerathna et al. 2014, Smith 2004, Williamson 1965, Kakwani 1988, and Shankar and Shah 2003. In some studies (e.g., Shankar and Shah 2003), this measure is called the relative mean deviation.

In the current implementation, we use the Data on regional population from the world bank and Wikipedia²², and use the baseline and policy simulations Summary data features on GDP at factor cost and the regional shares in factor bills to derive values of MD_w . In case, of baseline simulation the value is bit higher (0.406) than that in policy simulation (0.392). Thus, we see a fall of 0.014 percentage points or

²² <http://www.worldbank.org/en/country/kyrgyzrepublic/overview> and

https://en.wikipedia.org/wiki/Regions_of_Kyrgyzstan . Once the national statistics on these figures at the regional level are available, we can achieve accuracy. However, given the objective it does not undermine our purpose.

a fall by 3.45%. This implies that boons of structural reform led growth has spread across the oblasts (7 regions and 2 cities) in Kyrgyzstan. Without reforms, there are relatively more regional disparities.

Concluding Remarks

Kyrgyzstan economy have undergone transition from a different economic system in the 1990s until now. For stimulating a diversified long-run growth in Kyrgyzstan, the region needs to overcome spatial fragmentation by integrating the regions for economic development translating into national growth, and wider welfare gains. For sustained basis and shared prosperity, several policies are necessary for reforming basic services, human development, connectivity via infrastructure, industrial as well as agricultural performance, and a conducive business environment. We see that economic growth varies widely across the regions in Central Asia reflecting differences in stages of development, availability of natural resources, climate, and—last but not least—political and social stability. Despite resemblances, KGZ is an exception with ‘toxic combination’ of factors undermining its efforts to diversify. First of all, it is still heavily dependent on remittances (almost one-third employed abroad) as her historical ties with Russia motivates the workers to find jobs outside. This is the most important source of foreign-exchange earnings. This dependence on external economic environment through this large Kyrgyz diaspora and membership of EAEU poses an obstacle for inclusive growth and poverty alleviation. This is also the cause behind excessive ‘dollarization’. This inhibits development of a dynamic labor market as domestic sectors suffer from efficiency. Also, without financial intermediation or development of financial instruments, the productive investments are sparse with only cornered by the construction sectors in urban areas like Bishkek.²³

Secondly, when we see the GDP by economic activity, i.e. relative contributions of sectors, such as, Mining, Agriculture, Manufacturing, for the composition of KGZ economy, the share of agriculture in overall economic activity has remained the same on average, while in some years, it has shown bit of declining trend. Informal economy contributes to about 40% of GDP. The sectoral picture on compositional changes in GDP provides rationale for undertaking structural change and diversification to reduce volatility. Post-Soviet era saw a decline in manufacturing, industry, and services, with minor revival in agriculture’s contribution. Fluctuating performances of mine coupled with remittances flows (as sources of financing for construction sector booms) always dominated the GNP (and GDP) fluctuations. This created challenges for growth of agriculture, development of sectoral complementarities, and employment domestically within the border. Except in 2001 and 2002 agricultural imports have increased making Kyrgyzstan a net importer in agriculture while for mining of precious metals, it’s a net exporter. This makes the case of potential ‘Dutch Disease’ impact and contraction of dynamic sectors with stagnancy. However, this need not be the case with productive efficiency and appropriately targeted investment (see Allcott and Keniston 2018 in case of USA, and Ito 2017 in case of Russia). Financial inclusion should be part of government’s strategy because the economy suffers from access to finance (more than 60% lacking) and financial literacy. With only 3% of the money being saved by a quarter of adult population, it shows that escaping from poverty and inequality is a big challenge. or addressing these challenges, it requires implementation of economic reforms—at the macro level so that it enables some industries to grow and diversify at the sectoral level—which is discussed below. However, *no ‘one-*

²³ Interest rate spread between deposit and lending rates work against the incentive for productive investment. Remittances flows exceeded FDI (and net outflows due to net inward FDI flows).

size-fits-all’ reform and policy package exists. This necessitates the adoption of growth and efficiency driven second round of reforms with macroeconomic as well as socio-economic development.

Given the sets of binding constraints, based on the policy recommendations—in line with the Strategy 2040—we summarize critical behind-the-border reforms in some priority areas, which offers the basis for scenarios in impact analysis using KGZ-ORANI CGE model. In order to diversify, it is necessary to focus on key sectors and their potentials. There are rooms for improvements on several fronts, such as, agriculture, transport and logistics, boosts in tourism, transport and logistics, electricity, and overall business climate improvement via behind-the-border reform. For inclusive growth and rural-urban shared prosperity, rural development is necessary and improving agricultural productivity can help achieving this objective. Tourism can be a source of growth-driver in the long-run.

However, for developing economies only tourism growth needs to be supplemented by additional policy measures. Importance of energy for development can no way be underestimated. We see that participation in regional and global value chain is crucial for growth and for that, efficient trade infrastructure, and incentives are needed. For example, as foreign value-added comprises 25% of value-added in exports of a country and share of intermediates in global trade is more than 60%, industrialization strategy focusing on this would facilitate technology diffusion, and opportunities for economies of scale via backward and forward integration. Productivity and efficiency is contingent on human capital-induced skill, innovative capabilities, R&D intensity, demographic dividends, and exchange rate stability (Kim and Park 2018, Hendricks 2010, Das 2015 & 2022, Abrigo et al. 2017, ADB).

For our current purpose to analyse KGZ economy, we develop a CGE model specifically tailored to study the Kyrgyzstan economy, viz., KGZORANI. This is based on Australian genre of CGE model based on Dixon et al. (1982), Horridge (2000, 2013). KGZ_ORANI (henceforth, ‘the model’ interchangeably) is a comparative-static, tops-down, multi-regional model.

As mentioned, the reform initiatives are designed for enhancement of productivity and efficiency in agriculture, services such as trade, tourism, and transport, logistics, some manufacturing for industrialization, as well as power and energy sector like electricity, and also global integration via trade, FDI, and regional cooperation. Based on preceding discussions, we simulate 1% annual technical progress (i.e., productivity improvements) in sectors such as Agriculture, Electricity, and assume annual 1.5% technical progress for margin and tourism. This helps us on comparing differential impacts across sectors of the transmitted productivity shocks. As tourism and trade boost is gaining primacy, the magnitudes are higher for them. The reasons governing choice of magnitude of shocks are explorative in the sense that often the full-blown effects of policy interventions take time to be realized. Obviously, the real GDP registers 23.4% increase by 2030 whereas the annual average growth rate, in the last column, is 1.41% per annum. Thus, conjointly the joint effects of baseline projection inclusive of policy-reform impacts is 5.2% (i.e., 3.8%+1.4%). Similarly, with reforms employment and real wage will increase by 0.5% and 0.80% per annum till 2030. This is exactly the growth rate of 5% projected by the World Bank for 2020 after deceleration to 4.2% in 2018. As mentioned, the growth-drivers are boost in agricultural exports, and trade expansion thanks to increase in market access via Eurasian Economic Union (EAEU) or participation in CAREC program; in fact, the baseline shocks incorporate an export-demand shocks proxying such trade integration via CAREC or EAEU. As remittances flow steadily supported household consumption demand, that is crucial for growth along with the trade channel; however, moderate growth in agriculture and services, as noted by the World Bank (ibid.), did not boost the growth rate much beyond 4.2%. The policy reform impacts on aggregate industries are reported in Table 9.8. As envisaged,

from table 9.8 it's clear that transport and logistics reform is major driver along with the reforms in improving productive efficiency in electricity and margins.

Our policy reform simulation demonstrates that participating in regional integration and global integration via improvement in transport and logistics (say, employment of digital technologies such as ICT or 4IR) will facilitate modern E-commerce, and boosting productivity in agriculture (say, via biotechnological innovation or nano-bio fields, or green revolution) could boost real GDP growth. On the trade front, we also see that both aggregate exports and imports increase by 45.2% and 18.5% by 2030. This would cause accumulated exports as percent of GDP to be 35% (agriculture 1.8%, Hotels by 1.14%, Transport by 2.11%, Construction 2.24%, Food-beverage-tobacco 1.7%) 2030, whereas imports to increase by less causing trade surplus (trade balance) accumulate by 5%. In other words, exports increase (2.5% AAGR) by bit more than the imports (1.14% AAGR) and contribution of exports and imports to real GDP from expenditure side is 15.9% rise and 14.9% fall by 2030.

Given the dependence on agriculture and tourism, this kind of diversification (under our current conservative policy shocks with just 1% and 1.5%) is conducive for becoming non-susceptible to external vulnerability. However, due to implementation of reforms these sectors, especially the agriculture, transport, food and beverages under tourism expands. The changes have been modest as we do not implement reforms in the manufacturing sectors at present. Needless to say, these types of compositional changes trigger changes in industry-wise employment and occupation. Regional differences in impacts in the light of National Economic Development is crucial as prosperity offers scope of cooperation and collaboration for economic development across the domestic region, which facilitates beyond the border regional integration via EAEU, CAREC, and other initiatives through institution building. After the policy reforms, the scenario changed to some extent. *Ex post*, as major drivers of such changes in real GDP have been primarily margin, tourism, and agriculture, these five relatively laggard regions managed to improve upon their positions, and thus, registering higher than the annualized growth rate of 1.35% in real GDP. Thus, post reform real GRP growth rates per annum are 1.42% for Yssyk Kul, 1.65% for Chui, Talas with 1.54%, and 1.45% for Osho. This implies that boons of structural reform led growth helps spreading the benefits across the oblasts (7 regions and 2 cities) in Kyrgyzstan, without furthering regional disparities.

References:

ADO (2018). How technology affects Jobs.

ADB CAREC (April 2018). A diagnostic Study of Kyrgyz Republics Free economic Zones and Industrial Parks.

ADB Country Diagnostic Study (CDS, 2019). Kyrgyz Republic: Improving Growth Potential. By Takashi Yamano, Hal Hill, Edimon Ginting, and Jindra Samson. September 2019.

Ahmad, M. and Stephen Hall (2017), Economic growth and convergence: Do institutional proximity and spillovers matter? 39 (6), pp. 1065-1085, Journal of Policy Modeling,
<https://www.sciencedirect.com/science/article/pii/S016189381730073X?via%3Dihub>

Allcott, H., and D. Keniston (2018). Dutch Disease or Agglomeration? The Local Economic Effects of Natural Resource Booms in Modern America. Review of Economic Studies, 85, pp. 695-731.

- Arrow, K.J. and G. Debreu (1954) "Existence of an Equilibrium for a Competitive Economy", *Econometrica*, 22, 265-90.
- Arrow, K.J. and F. Hahn (1971) *General Competitive Analysis*, Edinburgh: Oliver and Boyd, and San Francisco: Holden Day.
- Asher, Samuel Edward and Novosad, Paul Michael, *Rural Roads and Local Economic Development* (June 5, 2018). World Bank Policy Research Working Paper No. 8466. Available at SSRN: <https://ssrn.com/abstract=3192263>
- Bjornland, Hilde. C., L. Thorsrud, and R. Torvik (2018). *Dutch Disease Dynamics Reconsidered*. Norges Bank Research. Working Paper. Pp. 1-41.
- Camanzi, L., et al. (2018). "A structural equation modeling analysis of relational governance and economic performance in agri-food supply chains: evidence from the dairy sheep industry in Sardinia (Italy)." *Agricultural and Food Economics* 6(1): 4.
- Das, G. G. (2015). Why some countries are slow in acquiring new technologies? A model of trade-led diffusion and absorption. *Journal of Policy Modeling*, Volume 37, Issue 1, Pages 65-91,
- Das, G. G., S. Marjit and M. Kar (2020). The Impact of Immigration on Skills, Innovation and Wages: Education Matters more than where People Come from, *Journal of Policy Modeling*, Volume 42, Issue 3, 2020, Pages 557-582.
- Das, G., Ginting, E., Hampel, A., & Horridge, M. (2022). Key binding constraints, structural reform, and growth potential of Azerbaijan via economic diversification: A computable general equilibrium policy impact analysis. *Journal of Eurasian Studies*, 13(2), 119–144.
<https://doi.org/10.1177/18793665221096688>
- Dixon, P. B. and D. Jorgenson, eds. 2013. *Handbook of Computable General Equilibrium Modeling*. Amsterdam: Elsevier.
- Dixon, P. B. and B. R. Parmenter. 1996. *Computable General Equilibrium Modelling for Policy Analysis and Forecasting*. *Handbook of Computational Economics*. 1. pp. 3–85.
- Dixon, P. B., B. R. Parmenter, J. Sutton, and D. P. Vincent. 1982. *ORANI: A Multisectoral Model of the Australian Economy*. Amsterdam: North-Holland.
- Donaldson, D. 2017. Railroads of the Raj: Estimating the Impact of Transportation Infrastructure. *American Economic Review*. 108 (4-5): 899-934.
- Estrada, Gemma, X. Han, D. Park, and Shu Tian (Nov 2017). *Asia's Middle-Income Challenge: An Overview*. WP No. 525. Asian Development Bank, pp. 1—27.
- Everett, Hayden, D. Simpson, and Scott Wayne (June 2018). *Tourism as a Driver of Growth in the Pacific. A Pathway to Growth and Prosperity for Pacific Island Countries*. Pp. 1-26.
- Georgiev, Yordan., P. Nagy-Mohacsi, and Alexander Plekhanov (October 2017). *Structural Reform and Productivity Growth in Emerging Europe and Central Asia*. WP No. 525. Asian Development Bank, pp. 1—38.
- Gillespie, J., et al. (2014). "The adoption of technologies, management practices, and production systems in U.S. milk production." *Agricultural and Food Economics* 2(1): 17.

Horridge, M. (March 2014). ORANI-G: A Generic Single-Country Computable General Equilibrium Model. Australia: Centre of Policy Studies and Impact Project, Monash University.

Ito, Katsuya (2017). Dutch Disease and Russia. *International Economics*, 151, pp. 66-70.

Johansen, L. (1960) *A Multi-Sectoral Study of Economic Growth*, Amsterdam: North-Holland.

Kim, Jungsuk and Park, Jungsoo, The Role of Total Factor Productivity Growth in Middle-Income Countries (November 2017). ADBI Working Paper 527. Available at SSRN: <https://ssrn.com/abstract=3187916> or <http://dx.doi.org/10.2139/ssrn.3187916>

Meroni, Elena Claudia., Esperanza Vera-Toscano, Patricia Costa (2015). Can low skill teachers make good students? Empirical evidence from PIAAC and PISA. *JPM*, 37 (2), pp. 308-323.

Okonjo-Iwela, Ngoji (2014). *Reforming the Unreformable*. MIT Press.

Powell, A.A. and R.H. Snape (1992) "The Contribution of Applied General Equilibrium Analysis to Policy Reform in Australia, Impact Project Working Paper G-98, January, 1-22.

Scarf, H.E. (1973) *The Computation of Economic Equilibria*, New Haven: Yale University Press.

de Solminihaca Hernán, Luis E.Gonzales, Rodrigo Cerdaac (2018) Copper mining productivity: Lessons from Chile, *Journal of Policy Modeling*, Vol. 40, pp. 182-193
<https://www.sciencedirect.com/science/article/pii/S0161893817300911>

Tomohara, Akinori., and Sadayuki Takii (2011). Does globalization benefit developing countries? Effects of FDI on local wages. *Journal of Policy Modeling*. 33(3), pp. 511-521,
<https://www.journals.elsevier.com/journal-of-policy-modeling/most-downloaded-articles>

Wattanukuljarus, Anan, and Ian Coxhead (2008) tourism-based development good for the poor? A general equilibrium analysis for Thailand, *Journal of Policy Modeling*, Vol. 30 (6), pp. 929-955.
<https://www.sciencedirect.com/science/article/pii/S0161893808000264>

Appendix

a. Schematic Theoretical Structure and Closure

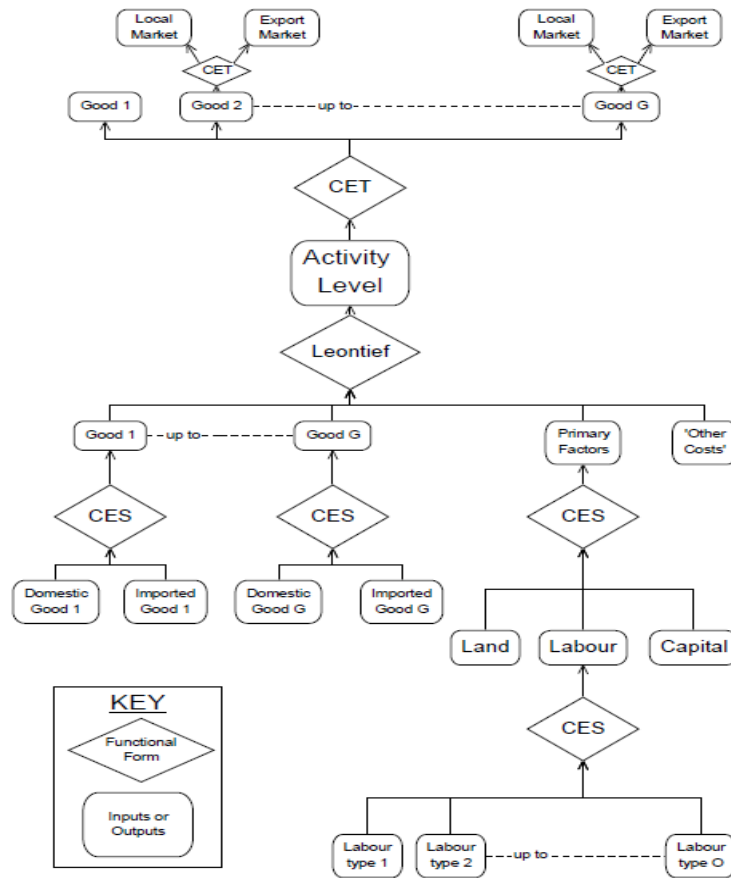


Figure 5. Structure of Production

Fig AA1: ABOVE (to be drawn)

Closure of the Model and Data balance.

Selection of 'Model Closure' hinges upon the decision about which length of run is regarded as suitable for the problem being solved. As such, there is no clear-cut definition of short run and /or, long run; depending on the purpose in hand, one defines the length of run as short or long and accordingly chooses a closure. This is due to the fact that there is no discernible pattern of adjustment of different variables under different, or identical policy shocks. Typically, in the short run, level of capital usage is fixed in each industry and hence, the 'rate of return' is endogenous whilst in the long run, size of the industry capital stocks adjust to policy changes via capital reallocation, and rate of return is exogenously specified, and aggregate level of investment is endogenised. Importantly, although there is some naturally exogenous-endogenous split, depending on policy context such split can be altered, and/or, swapped by switching the status of the variables in original closure. In the *ex post* scenario, post-simulation database encapsulates such policy-induced impacts. In the current context, we analyse the impact of policies by 2030 and hence a long run closure is adopted. In this closure, *ex post* capital reallocation to more productive sectors move the economy in new equilibrium with changes in capital stock in the subsequent periods following the impingement of shocks. With the closure, the validity of the model and the consistency of the model with the database and parameters are checked via performing: (i) real and nominal homogeneity test by shocking the numeraire of the model, viz., the exchange rate (local

currency/dollar); (ii) checking GDP from income and expenditure side to match. Both tests confirm initial data balance and consistency—see below.

Table AA1:

Test for Calibration Accuracy		
• Both Expenditure and Income side GDP calculated through the model agree with the published GDP		
GDP Expenditure - 2015- published		
Final consumption expenditures	466,226.4	
Gross fixed capital formation	140,287.9	
Changes in inventories	7,304.7	
Acquisitions less disposals of valuables	1,664.4	
Exports of goods and services	151,487.5	
Imports of goods and services	-326,190.3	
Statistical discrepancy	-10,293.2	
	430,489.4	
GDP Expenditure - model		
EMAC	EXP GDP	
1 Consumption	390449.4	
2 Investment	142163	
3 Government	78025.78	
4 Stocks	6740.603	
5 Exports	151594.7	
6 Imports	-336484	
Total	430489.1	
GDP Income - model		
IMAC	INC GDP	
1 Land	20195.37	
2 Labour	116286.6	
3 Capital	256170.2	
4 IndirectTax	48666	
5 ProductionTax	4476.9	
6 ImpDuty	5587.3	
7 Subsidy	-3526.3	
8 Losses	-17366.9	
Total	430489.1	
• It passes the Homogeneity Test		

Table AA2 Sectoral Mapping and Aggregated Industries in KGZ_ORANI Database

Sector	Description
1 Agriculture	Agriculture, forestry and fisheries
2 Coal	Mining of hard coal and brown coal (lignite)
3 OilGas	Extraction of crude petroleum and natural gas
4 MetalOres	Mining of metal ores
5 OthMining	Mining of other minerals, mining
6 FoodBevTob	Manufacture of food products (including drinks), and tobacco products
7 ClothLeather	Textile manufacture; manufacture of wearing apparel and footwear, leather and other leather products
8 WoodPaper	Wood processing and manufacture of products of wood and Cork (except furniture), Wicker products manufacture of paper and paperboard
9 Printing	Printing and reproduction of recorded media
10 RefinedProd	Manufacture of coke and refined products, manufacture of chemical products, manufacturing of pharmaceutical products
11 NoMetaRub	Manufacture of rubber and plasmassovyh products, manufacture of non-metallic mineral products
12 BasMeta	Manufacture of basic metals
13 FabMeta	Manufacture of fabricated metal products, except machinery and equipment
14 CompElectro	Manufacture of computer, electronic and optical equipment, electrical equipment, machinery and equipment not included in the other groups
15 MachineEquip	Other manufacturing, repair and installation of machinery and equipment
16 Electricity	Production (output) power, its transmission and distribution
17 Gas	Manufacture of gas; distribution of gaseous fuels through a gas supply system
18 SteamAir	(Supply) and individually-controlled air conditioning
19 WaterWaste	Water, cleaning, waste treatment and obtaining secondary raw materials
20 Construction	Construction

