



Economic Growth and Productivity Performance in Central Asia

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Abstract

This paper analyzes patterns of long-term economic performance in all five Central Asian countries. We first look at sources of economic growth based on a simple growth accounting exercise. Our findings show that under the period of study total factor productivity growth rates were modest ranging from 1.7% for Kazakhstan, 1.4% for Uzbekistan, and 0.8% for Tajikistan and Turkmenistan to—0.4% for the Kyrgyz Republic. The second part of the paper is connected with exploring productivity level analysis across all Central Asian countries by decomposing differences in output per worker into differences in capital intensity and productivity. Results reflect different levels of productivity performance in the region compared with Japan and South Korea as frontier economies for the analysis.

Keywords Economic performance · Growth and productivity accounting · Transition economy · Central Asia

JEL Classifications O11 · O47 · O53 · O57 · P51

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Introduction

About three decades ago the centrally planned economy in the former Soviet Union collapsed leaving newly independent states, in particular, countries in Central Asia to pursue their own path of post-communist economic transformation and destiny. Like other former Soviet republics and countries in Central and Eastern Europe all stan nations of the region, namely Kazakhstan, Kyrgyzstan,¹ Tajikistan, Turkmenistan and Uzbekistan initially seemed to be fairly well prepared for the transition to a market-based economy: they were relatively industrialized, their agricultural sector was operating at a reasonable level of performance, some of them were endowed with sizeable natural resources and there was well educated and healthy labor force in the region (Campos et al. 2002).

Yet, the first years of the transition period remained economically painful and were accompanied by massive output fall, steady increases in overall prices for essential items, and a higher unemployment level (Pomfret 2003). While Central Asian republics shared common pre-independence background, e.g., they had been thoroughly integrated into the Soviet Economy and heavily subsidized by Central Government in Moscow, differences in certain aspects of their transition period were left pronounced (Green et al. 1998). To some extent for Kazakhstan and Kyrgyzstan economic reforms were more successful and sound at the outset compared with Tajikistan and Turkmenistan. Meanwhile, Tajikistan experienced intermittent civil war which disrupted further its economy. Uzbekistan was considered to be the least liberalized economy in the region in terms of its transition to market economy. In comparison to its neighbors, Uzbekistan experienced a smaller GDP contraction in the earlier period of its independence (Pomfret et al. 2001).

Only by the late 1990s Central Asian republics of the former Soviet Union had been able to reverse overall declines in their output performance and had moved on positive growth trajectories (EBRD Transition Report 2002).

This paper aims to examine plausible sources of economic growth in the region over the past thirty years. Growth analysis is a long-run phenomenon and considering a longer time span will enable us to have a precise picture of patterns and dynamics of economic performance in Central Asian countries. By applying the standard growth accounting framework we seek to understand the role of each input, e.g., capital, labor, and total factor productivity on output growth rates.

Another underlying objective of the study pertains to exploring productivity performance in the region. The decomposition of output per worker into inputs and productivity and the comparison of each Central Asian country to a reference point is a relevant indicator to investigate the proximate cause of economic success in the region (Christensen et al. 1981). After utilizing the development accounting technique all components of economic performance including variation in productivity for a particular Central Asian republic are compared to two major economies in Asia: Japan and South Korea.

¹ In the text Kyrgyzstan and Kyrgyz Republic are used interchangeably.



Our research is connected with some earlier contributions. However, it will bring other essential insights to existing literature.

First, our paper captures long-run economic performance and incorporates all countries of Central Asia into a single sample. Many studies related to the region were chiefly conducted either during the 1990s or early 2000s. Alternatively, a number of authors who explored similar research examined them along with a sample consisting of other post-communist states of the former Soviet Union, and Central and Eastern Europe (Campos et al. 2002; Rapacki et al. 2009; Yormirzoev et al. 2020).

Second, a few scholars have recently conducted qualitatively motivated studies limiting their work only to statistical analysis of economic performance in Central Asia (Batsaikhan et al., 2017). Some other pieces are focused on only a specific Central Asian economy. For example, a study by Turganbayev (2016, 2017) looks at growth patterns in Kazakhstan in terms of total factor productivity performance over individual regions of the country.

Third, we conduct several productivity level calculations for a number of time periods. By comparing each Central Asian republic with two major economies in Asia we attempt to identify the region's productivity gap prior to the dissolution of Soviet economy and its dynamics over the past two decades. Our empirical approach thus reflects possible changes in the level of productivity among countries under study and reference economies. To the best of our knowledge, no prior study has touched on this approach to explain productivity differences in cross-country economic performance in Central Asia.

The rest of the paper is organized as follows. Section two highlights economic performance in the region since 2000. Review of related studies is given in section three. Section four is devoted to methodology. Data information is presented in section five. Results are then discussed in section six. The final section presents some concluding remarks.

Economic Performance in Central Asia since 2000

Economic performance in Central Asia in early post-Soviet period has been extensively explored and well documented in literature (Spechler 2008). By the start of the twenty-first century, the transition to market-based economy was practically completed in the region (Pomfret 2019). This section covers some analysis of key indicators pertaining to economic performance in all five Central Asian countries since the year 2000.

As Table 1 shows in the year 2000 the level of real GDP per capita in Central Asia that indicates changes in the wellbeing of the population followed different patterns. It ranges from 86 percent in Kazakhstan to 36 percent in Tajikistan as regards to their pre-independence period in 1991. Kazakhstan, a frontier economy in the region, achieved its 1991 level after eleven years. For Uzbekistan and Turkmenistan, this occurred in 2005 and 2007 accordingly. Kyrgyzstan reached its pre-independence real output per capita performance by 2014. However, for Tajikistan, only ninety-two percent of its 1991 level was accomplished by 2018. With the dissolution



of the Soviet Economy, both Kyrgyzstan and Tajikistan were the poorest republics in the region with unfavorable initial conditions and lack of major natural resources. This might have predetermined their relatively modest real per capita output growth capacity since the year 2000.

Kazakhstan and Turkmenistan enjoyed better performance during 2014–2018 and 2016–2018 as output per head in constant prices in these republics was twice higher prior to the disintegration of the Soviet Union. Uzbekistan has recently attained a similar level like its northern and eastern neighbors.

As regards to monetary and fiscal policies aimed at price stabilization and balancing between public revenue and spending, all five countries in Central Asia sustained solid economic performance since the year 2000. As Table 2 indicates during the period under study consumer prices on average decreased from 19.6 percent in 2000 to 6.7 percent in 2019. Apparently, this could be ascribed to a successfully implemented macroeconomic policy compared to the initial period of transition, when either Central Asian republic faced with a poorly controlled hyperinflation (EBRD Transition Report 2002, pp. 56–62).

The general government balances stemming from a difference between public revenue and spending were adequately maintained as well, albeit with the Kyrgyz Republic having a large budget deficit in 2000 relative to other countries in the region (Table 3). Over the past twenty nine years on average, three Central Asian countries, excluding the Kyrgyz Republic and Tajikistan, enjoyed a budget surplus with about two percent as a ratio to GDP in Kazakhstan and Turkmenistan, and about one percent in Uzbekistan.

Hence, for the period under study, countries in Central Asia achieved a relatively stable tendency of their key macroeconomic indicators, as evidenced with statistical information.

Literature Review

A large number of studies have been conducted in all countries of Central Asia since their transition from planned to market-driven economy. Pomfret (2019) provides a comprehensive survey of literature pertaining to the region. The existing literature covers a broad range of issues, including (i) initial conditions of transition and economic performance from different perspectives; (ii) migration and remittances; (iii) foreign trade; (iv) agricultural reforms and development; (v) household behavior and (vi) costs of economic transition. However, we will mention a few articles that are related to the general purpose of the present research.

A recent study by Batsaikan and Dabrowski (2017) provides a detailed analysis of the Central Asian region for twenty-five years since the breakup of the Soviet Union. Their narrative began with the historical background of the region, including geography and geopolitics. A certain part of their study is dedicated to trade and economic integration, and reform implementation. Special emphasis is placed on economic and social performance in the region since independence. Authors conclude that in the future, Central Asian countries should prioritize market force for structural diversification, support macro-/micro-economic environment, and



persist closer intra-regional cooperation that would improve business and investment climate in the region.

Djalilov and Piesse (2012) empirically analyzed the relationship between financial development and economic growth in all post-Soviet republics of the region. Their findings show that financial systems of these countries are not mature to have sustained effect on economic growth. Unlike some transition economies in Eastern Europe, Central Asian countries were late in conducting relevant financial and banking reforms. The so-called well-functioning stock and securities markets could be important in accelerating long-term economic growth in the region.

Spechler (2008) conducted a detailed survey of Central Asian countries by analyzing each country's performance in terms of transition strategies and accomplished results. He argues initial conditions were important, structural and institutional problems remained different compared to developing countries.

Pomfret (2003) compared economic performance in Central Asia by referring to macro- and micro-level datasets. He argues that there is a big gap between aggregate indicators and survey-based information. With respect to poverty and income inequality that dominated in the region, micro-level evidence is more feasible and can be used for economic analysis.

By taking stock of the first ten years of the transition from central planning to market economy Pomfret and Anderson (2001) pointed out that all countries in Central Asia pursued different economic paths, ranging from rapid reform, creation of crony capitalism to gradualism and no reforms. They believe that there were three major shocks with their transition, namely initial conditions and resource endowment, the collapse of the Soviet economy and hyperinflation. Change to an alternative economic system brought both winners and losers in the region. Some resource rich countries, in particular, Kazakhstan became a frontier economy in the region, whereas highly mountainous Tajikistan and the Kyrgyz Republic faced tremendous transition challenges.

One needs to admit that the transition period has also been associated with the emergence of a sizable shadow economy in the region. Abdih and Medina (2013) investigated the informal sector in the Caucasus and Central Asia by using a multiple indicator cause model. Their findings show that tax burden, labor rigidity, institutional quality and regulatory burden in financial, and product markets seem to be the underlying determinants for the size of the unreported economy. In three countries of the region that were covered in this study, namely Kyrgyz Republic, Kazakhstan and Tajikistan the estimated size of the informal economy was about one third of their GDP. Authors believe that policymakers in the region should improve the business environment, relax labor market, reduce tax burden, and provide informal workers with access to skill upgrading which will eventually shrink the informality and foster long-term growth performance.

Thus, on the basis of official dataset coming from the Penn World Table our study brings a new contribution to literature and employs a relatively longer time period to examine economic growth in Central Asia. Understanding variation in output per worker across countries in the region is important as a higher level of productivity performance is positively correlated with an increased standard of living. This is one



of the key economic goals that every Central Asian country ought to maintain as an essential component of its long-term economic policy.

Methodology

In this section, we proceed further with our analysis for two models of economic growth. As an initial point, we are interested in identifying proximate determinants of growth on the basis of the Solow model, for its simple extensions can be used to explore both economic growth over time and grasp cross-country output differences in Central Asia. Growth accounting, which was pioneered by Solow (1957) and empirically tested in development studies, allows us to break down growth in output into growth in capital, labor, and technological progress. The last component can be indirectly derived from the model in the form of residual. Residual is also known as total factor productivity which reflects not only technological changes; it can be attributed to economic reforms, transition specific conditions, organizational and institutional changes in countries of transition, including Central Asian republics (Blanchard 1998).

For our following analysis, we consider a standard production function with its general form as:

$$Y(t) = F(K(t), L(t), A(t)) \quad (1)$$

where $Y(t)$ is a country's GDP, $K(t)$ and $L(t)$ represent its physical capital and labor in time t and they are directly measurable indicators. According to the Solow model, this function exhibits constant returns to scale for both capital and labor. Alternatively, there are positive and diminishing returns to capital and labor, e.g., ($F_K, F_L > 0, F_{KK}, F_{LL} < 0$). These inputs are paid their marginal products owing to complete input utilization and perfect competition. Other assumptions of the Solow model such as rates of savings, population growth, and technological progress are exogenous. Technological progress is said to be Hicks-neutral implying that any shift in expression (1) does not have an impact on marginal rates of substitution of factor inputs.

Differentiating the production function with respect to time and leaving time dependence, we get:

$$\frac{\dot{Y}}{Y} = \frac{F_A A \dot{A}}{Y A} + \frac{F_K K \dot{K}}{Y K} + \frac{F_L L \dot{L}}{Y L} \quad (2)$$

We denote the growth rates of output, capital, and labor as $g = \dot{Y}/Y$, $g_K = \dot{K}/K$ and $g_L = \dot{L}/L$ accordingly. As for an unobservable factor reflecting the contribution of technology to growth in output, we may specify it as:

$$z = \frac{F_A A \dot{A}}{Y A} \quad (3)$$

Defining elasticity of output with respect to capital and labor as $\varepsilon_K = \frac{F_K K}{Y}$ and $\varepsilon_L = \frac{F_L L}{Y}$, we may express our final equation as follows:



$$z = g - \varepsilon_k g_K - \varepsilon_L g_L. \quad (4)$$

Thus, Eq. (4) is a fundamental *growth accounting* technique that allows us to trace out the contribution from technological progress or total factor productivity to economic growth once data on factor shares as well growth rates of output, capital, and labor are available.

The next step in our analysis is related to identifying the proximate causes of economic performance in Central Asia. Understanding differences in the level of productivity via decomposing differences in output per worker and capital accumulation can be further examined via the *development accounting* technique.

Existing differences in the level of productivity in cross-country analysis may occur due to variations in income stemming from differences in efficient use of physical and human capital (Caselli 2004), various degrees of the use of capital-output ratios (Klenow and Rodroguez 1997; Hall and Jones 1999) and differences in accumulation of human capital (Hsieh and Klenow 2010).

With respect to the second point of economic performance analysis in Central Asia, we refer to the Hall and Jones (1999) methodology. Consider a Cobb-Douglas aggregate production function with output (Y_t), capital (K_t), labor (L_t), and Harrod-neutral technology (A_t)

at period t :

$$Y_t = K_t^\alpha (A_t L_t)^{1-\alpha} \quad (5)$$

with $0 < \alpha < 1$. We rewrite Eq. (5) in an intensive form that shows output per worker (labor productivity) as a function of capital intensity as follows:

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{A_t L_t} \right)^\alpha = A_t \left(\frac{K_t}{Y_t} \right)^{\alpha/1-\alpha} \quad (6)$$

This equation implies that output per worker across Central Asian republics represents the product of a term with the observable capital-output ratio $\left(\frac{K_t}{Y_t}\right)^{\alpha/1-\alpha}$ and productivity level associated with unobservable labor augmenting technical progress A_t . After the productivity level is obtained for a single country i in the region, it involves its comparison to some “frontier” benchmark (superscript F) as a reference point.

$$\frac{\left(\frac{Y}{L}\right)_t^i}{\left(\frac{Y}{L}\right)_t^F} = \frac{A_t^i}{A_t^F} \left(\frac{\left(\frac{K}{Y}\right)_t^i}{\left(\frac{K}{Y}\right)_t^F} \right)^{\alpha/1-\alpha} \quad (7)$$

where the benchmark is normalized to be one, i is a Central Asian republic and t refers to some period of time, e.g., 1990, 2000, 2010, and 2017. Japan and South Korea serve as the frontier for the analysis as the major Asian economies.



Data

Data for our study are from the Penn World Table which represents a set of national accounts data for key macroeconomic indicators. We collected relevant time-series indicators covering the period from 1990 to 2017 for all Central Asian republics. Our data refer to the rates of growth in each country's GDP, capital stock, and labor force. All macroeconomic indicators from this source, including output and capital stock are provided at constant prices over time for international comparisons purposes.

In conducting economic performance analysis based on either methodology—growth or development accounting approach capital stock and its accurate estimation are important. The existing literature suggests two methods for estimating capital stock. The first one introduced by King and Levine (1994) assumes that the economy is in a steady state with a constant ratio between capital and output. Whereas the second method called the perpetual-inventory approach has been widely used and is considered to be the most acceptable estimate for the measurement of capital stock consisting of the initial capital stock, gross investment, and depreciation of existing capital (Yormirzoev et al. 2020).

A proper estimate and measurement of this particular input have been a subject of continuous debate in transition literature.

For instance, Izyumov et al. (2008) argue that due to the transition from plan to market in CIS countries, a significant part of Soviet-made capital was destroyed and it was important to re-assess its transformation and reallocation. They focused on the market-quality part of capital as it appeared to demonstrate a more accurate picture of capital formation in the region. Their findings on Central Asian countries showed that a reduction in capital stock was augmented by relatively higher growth of labor force resulting in a rapid decrease in capital to labor ratio.

Rapacki et al. (2009) presented a quantitative estimate of capital stock for all transition economies, including countries in Central Asia, and admitted that their calculation did not account for the qualitative parts of changes in the capital due to transformation processes. Based on the perpetual inventory approach Yormirzoev et al (2020) provided their estimates on the stock of capital in post-Soviet countries. However, their choice on the initial value of capital as well as the depreciation rate of investment might have been a less adequate measurement of post-Soviet stock of capital.

In this paper, we follow Feenstra et al. (2015) whose calculation on aggregate indicators, in particular, capital stock appeared to be a harmonized procedure for all countries, in particular Central Asian countries. The initial year of capital stock for former Soviet republics begins in 1990 and all series of the stock of capital are provided in constant terms with appropriate use of depreciation rate.

In terms of using factor shares, we choose 1/3 for capital input as the most adequate value in growth literature (Hall and Jones 1999).



Results and Discussions

In this section, we will discuss findings from both growth and development accounting relationships. The first part of our analysis pertains to total factor productivity growth for all Central Asian countries over the period 1990–2017 based on the Solow growth model.

Our second part of the analysis shows how productivity remains different due to differences in output per worker and factor accumulation for certain time periods. To make our comparisons easier, all terms are taken as ratios to Japanese and South Korean values.

Table 4 presents estimates of total factor productivity growth in Kazakhstan. As we see over the 1990–1999 period, as one would expect, Kazakhstan experienced negative growth of output of about five percent per annum due to the transition to market economy. During this period the growth rate of the labor force was also negative. A possible explanation of this tendency was related to the massive emigration of Slav people (Russian, Ukrainians, Polish), Germans, and Jews from Kazakhstan who constituted a major share in the country's population (Pomfret 2005).

The first decade of the present century brought better economic performance for Kazakhstan as the country entered the period of oil boom leading to increased domestic investment and attraction of foreign labor force to the economy from the region (Kalyuzhnova et al. 2016).

However, the period characterized by 2010–2017 was associated with the world's financial crisis and the end of high prices for energy resources. As a result, the growth rate in GDP was slow and constituted about 50% of its pre-2010 level. The stock of capital increased by 17% compared with the previous period, whereas the rate of the growth of the labor force declined by 1.6 percent accordingly.

In general, in Kazakhstan for the period from 1990 to 2017 all components of total factor productivity reflected a positive but modest pattern. In particular, the growth rate of GDP was 2.7%; the weighted stock of capital and labor sustained positive estimates. The total factor productivity growth was not impressive with an average of 1.7% per annum.

Table 5 reflects estimates of total factor productivity growth in the Kyrgyz Republic. As expected, the transition cost in the country was high with a negative growth in output of five percent for the period of 1990 to 1999. This time span was also a period of negative productivity growth in the country with an average of – 5.3% per year.

Over the period 2010–2017 the average growth rate of output accounted for about 5 percent. Interestingly, with weighted capital input growing an average of 0.6 percent in 2000–2009 and 1.3 percent in 2010–2017 the weighted labor input shrank from 1.6 percent in 2000–2009 to 0.9 percent in the post-2010 period.

The growth rate of total factor productivity accelerated in the 2000s due to sustained growth in the country's output of 4.6 percent and increases in weighted capital stock and labor inputs from 0.1 to 0.3% in the 1990s to 0.6% and 1.6% in the first decade of the current century.



As shown in this table over 1990 to 2017 as a whole total factor productivity growth in the Kyrgyz economy averaged -0.4 percent per annum, with weighted capital stock and labor force averaging to 0.6% and 0.9% .

In Table 6 we see total factor productivity growth estimates for Tajikistan. Unlike other Central Asian republics, Tajikistan experienced a harder economic shock accompanied by a two-digit real output decline of 11% during the 1990s. A devastating civil war during this period appeared to have a negative impact on the Tajik economy as well. Both weighted capital stock and labor inputs decreased with an average of -0.7% and -0.8% , while the last component was chiefly attributed to mass migration of non-Tajik part of the population from the country. The total factor productivity growth of the 1990s was on average negative, amounting to -9.4% accordingly.

Two decades following the unfavorable economic performance of the 1990s were associated with a relatively higher level of real output growth rates, ranging from an average of 8.2% during the 2000s, to 6.2% in the post-2010 period. Despite an output recovery, the weighted capital stock shrank further, to -0.4% in the post-2010 period, compared with a -0.6% decline of this input during the 2000s. As for the weighted labor force input, it also demonstrated its decline from 1.9% in the 2000s, to 1.1% in the post-2010s, even though Tajikistan experienced positive population growth rates.

Total factor productivity growth seemed to have shrunk over time, with an average 6.9% during the 2000s to 5.5% in the post-2010 period.

In general, for the entire period of our analysis, growth rates of real output averaged 0.8% , with modest performance of total factor productivity growth. While the weighted labor input remained 0.7% on average per annum, the weighted stock of capital stayed constantly negative both during the last 27 years, and in each decade of the period under study.

Table 7 reflects total factor productivity growth in Turkmenistan. Like other neighboring countries in the region, Turkmenistan faced negative output performance in the 1990s with an average of -3.2% per annum. The growth rate of total factor productivity remained negative as well amounting to -6.5% on a yearly basis.

Despite the economic recovery in the first decade of the XXI century with real output growth of 7.5% annually, the weighted capital stock and labor inputs contracted from 1% and 2.2% in the 1990s to 0.9% and 1.6% in the 2000s. Yet, Turkmenistan demonstrated an average rate of productivity growth of 4.9% during this particular time period.

The post-2010s period was characterized with a substantially higher level of output performance of 9.3% , while capital inputs seemed to have played a major role in it. Thus, the weighted capital stock increased approximately four times, e.g., from 0.9% in the 2000s to 0.32% in the post-2010s making Turkmenistan to possess the extremely highest capital intensity economy compared with other neighboring countries in the region. The role of labor input in productivity performance appeared to be less important as its weighted value increased by one percent on average.

Thus, over the 1990–2017 period, total factor productivity rose by 0.8% per annum. While the average growth rate of real output accounted for 4.2% , growth in



weighted capital stock and labor inputs remained in fact negligible with an average of 1.6% and 1.7% per year.

Table 8 shows total factor productivity growth in Uzbekistan. Unlike other Central Asian republics, Uzbekistan did not experience a substantial decline in real output during the initial transition period. GDP in real terms fell only by -0.6% per annum. Both weighted capital stock and labor inputs exhibited positive trends in this particular time span. However, the growth in total factor productivity remained negative and amounted to -2.7% on an annual basis.

The first decade of the XXI century allowed Uzbekistan to enjoy one of the highest growth rates of its real output in the region. On average, GDP increased by 6.7%, whereas weighted capital stock and labor did not demonstrate notable increments. Total factor productivity grew on average by 3.7% per year.

Post-2010s seemed to be favorable to Uzbekistan in terms of economic performance. In particular, real output increased on average by 7.3% up to 2017. Weighted capital stock input increased from 0.1% in the 2000s to 1.9% percent in the post-2010s. Yet, the weighted labor force input stayed negligible given the positive population growth in the country. Growth in total factor productivity was not markedly different from the previous decade.

Hence, Uzbekistan demonstrated a relatively sound economic performance over the period of 1990–2017. Real output grew on average by 4.3%; both inputs of aggregation production showed remarkable upturn. Given this augment Uzbekistan sustained total factor productivity growth rates of 1.4% over this period as a whole.

Prior to calculating productivity differences among Central Asian countries and Japan, and South Korea as frontier economies, we incorporated a correction for natural resources. In other words, we subtracted total natural resources rents from the GDP of each country in the region. Based on data from the World Bank we found that the share of the mining industry which includes oil and gas, constitutes on average 1.67% for Tajikistan, 5.48% for the Kyrgyz Republic, 15.78% for Uzbekistan, 20.75% for Kazakhstan and, 45.25% for Turkmenistan. Without this correction Kazakhstan and to some extent Turkmenistan would rank as high productivity-level economies.

Table 9 displays productivity differences between Central Asian countries and Japan by decomposing differences in output per worker and capital intensity. A similar calculation is exhibited in the last table in comparison with South Korea.

As one may notice before the collapse of the USSR the productivity gap between Central Asian republics and Japan ranges between 12.5% in Turkmenistan, 13.9% in Tajikistan, 28.3% in Uzbekistan, 39% in the Kyrgyz Republic, and 47.2% in Kazakhstan. Compared to Japan, Tajikistan and Turkmenistan had a higher level of capital intensity. Uzbekistan and Turkmenistan enjoyed less than 20% of output per worker than in Japan.

However, in the year 2000, all Central Asian countries lagged significantly behind Japan. For instance, Tajikistan and Turkmenistan could produce about 4% of the Japanese level, while Kazakhstan was at only 26% of Japanese productivity performance. By 2017 productivity differences between countries of the region and Japan narrowed. Productivity in Kazakhstan and Uzbekistan was about 81% and 41% of



that in Japan, whereas Tajikistan appeared to produce 16 percent of that in the frontier economy. This may be due to a higher capital-output ratio in Tajikistan.

On average, Kazakhstani productivity accounts for 53.4% of the Japanese level. In Uzbekistan, the Kyrgyz Republic and Turkmenistan productivity is between 23% and 29%, while Tajikistan achieved an extremely low productivity level with 11% of a similar value in Japan.

The last table displays the decomposition of productivity level in the region compared to another leading Asian economy. According to the table in 1990 output per worker in Kazakhstan and Uzbekistan constituted about 85% and 39% of that value in South Korea. Tajikistan and Turkmenistan had the highest capital intensity. The Kazakhstani productivity accounted for 85% of the South Korean level. Turkmenistan had a rather lower productivity level in Central Asia in that particular period.

However, the situation with productivity performance in all Central Asian countries exacerbated in the first decade of the transition period. Most notably, in 2000 except for Kazakhstan output per worker in the region was less than 20% of the similar value in South Korea. With the highest capital-output ratio Tajikistan and Turkmenistan enjoyed the lowest productivity with only about 5 percent of that in South Korea.

For the year 2010 except for the Kyrgyz Republic the productivity performance slightly improved in Central Asia. In Kazakhstan, the frontier economy in the region, productivity increased from 32.9% in 2000 to 58.1% in 2010 compared to the South Korean value. Turkmenistan demonstrated a notable upturn in its productivity performance which rose from 4.5% in 2000 to 22.5% in 2010. Tajikistan enjoyed modest growth in its productivity performance, while in Uzbekistan this indicator changed marginally as to the analogous value in South Korea.

As for the last period under study one can notice some notable changes. For instance, in Kazakhstan the value of A accounted for 77.9% of that in South Korea. In Turkmenistan and Uzbekistan the productivity value was approximately 47% and 39% accordingly. The Kyrgyz Republic and Tajikistan maintained a lower productivity level of about 24% and 15% compared to the South Korean value.

Hence, over the period 1990–2017 on average differences in productivity gap among Central Asian republics and South Korea remained remarkable with 64% in Kazakhstan, 35% in Kyrgyz Republic and Uzbekistan, 14% in Tajikistan, and 25% in Turkmenistan accordingly.

Conclusions

In this paper, we analyzed the patterns of economic performance in Central Asia since their transition to market economy. In doing so, we utilized two fundamental approaches, i.e., *the growth and development accounting* framework.

Results from the first method revealed that over the entire period under study on average, the growth rates of total factor productivity were not remarkable ranging from 1.7% for Kazakhstan, 1.4% for Uzbekistan, and 0.8% for Tajikistan and Turkmenistan to—0.4% for the Kyrgyz Republic.



The second part of the study related to identifying productivity differences in the region, compared the dynamics of output per worker with that in major economies in Asia. Our findings show that in 1990 differences in productivity performance between Central Asian republics and Japan ranged from 47% in Kazakhstan, 39% in the Kyrgyz Republic, 14% in Tajikistan, 13% in Turkmenistan, and 28% in Uzbekistan. By 2017 all countries of the region seemed to have narrowed their productivity gap, in particular with Kazakhstan being able to enjoy about 80% of the same Japanese productivity. A possible explanation for this situation may be linked with overall productivity slowdown and rapid aging population in advanced economies worldwide, and modest output per worker performance in Japan.

However, compared with South Korea, the situation appeared to have been unlikely. For instance, in 1990 differences in productivity varied from 85% in Kazakhstan, 70% in the Kyrgyz Republic, 51% in Uzbekistan, 25% in Tajikistan, and to 21% in Turkmenistan accordingly. By 2017 differences in productivity gap between countries of the region and South Korea increased. With a similar endowment of capital per worker, Kazakhstan would produce about 60 percent of output per worker of the South Korean value, a reduction in one-third of its pre-independence period. South Korea significantly improved its economic potential and while being a member of five tiger economies in Asia it reached the status of an advanced economy in the world. In this regard, in recent years countries of the region were left far behind from South Korea.

Another important implication of the study shows that a relatively higher level of capital intensity in the region in certain periods of our analysis reflects lower productivity. For Tajikistan and Turkmenistan, extremely high capital intensity has not altered during the entire period under study.

We need to admit that there might be some doubt regarding the quality of data used in the study. Yet, it is contained in famous Penn World Tables. Authors of this dataset should be aware of this problem and have addressed this issue when they disseminate this information to all interested stakeholders in academia, research and government bodies.

We believe that regional economic growth and productivity performance can be further explored from different research angles. In particular, it is essential to investigate how differences in the quality of labor input expressed in the form of education and health might explain cross-country differences among Central Asian republics and other countries. In our study, we did not distinguish various forms of the labor force and treated it as homogenous across all countries of the region and frontier economies.

In recent years the world economy has been seriously hit by COVID-19 pandemic and Central Asia is not an exception. It seems to be feasible to analyze this problem and its possible impact on changes in growth and productivity among all Central Asian republics both during pandemic and later the post-pandemic period.

Another feasible area for potential research can be related to the role of information technology as an important source of growth and productivity in Central Asia. The leading role of IT investment in the acceleration of growth is well pronounced in the case of advanced economies (Jorgensen et al. 2010). A similar study related to



Central Asian economies could bring a new contribution to transition literature and provide certain practical and policy implications.²

Appendix

See Tables 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Table 1 Growth in real GDP per capita, 2000–2018

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Kazakhstan	0.86	0.98	1.08	1.17	1.28	1.39	1.52	1.64	1.67
Kyrgyzstan	0.66	0.69	0.68	0.72	0.76	0.75	0.77	0.83	0.89
Tajikistan	0.36	0.38	0.42	0.46	0.49	0.52	0.54	0.57	0.61
Turkmenistan	0.69	0.71	0.71	0.72	0.75	0.84	0.92	1.01	1.15
Uzbekistan	0.84	0.86	0.88	0.91	0.97	1.02	1.09	1.17	1.26
Country	2009	2010	2011	2012	2013	2014	2015	2016	2017
Kazakhstan	1.65	1.74	1.84	1.90	1.99	2.04	2.04	2.03	2.09
Kyrgyzstan	0.90	0.89	0.93	0.91	0.99	1.01	1.03	1.05	1.08
Tajikistan	0.62	0.64	0.67	0.71	0.74	0.78	0.80	0.84	0.88
Turkmenistan	1.20	1.29	1.45	1.59	1.72	1.86	1.94	2.03	2.12
Uzbekistan	1.34	1.40	1.47	1.55	1.64	1.73	1.83	1.91	1.96
Country				2018	1991=100				
Kazakhstan				2.14					
Kyrgyzstan				1.09					
Tajikistan				0.92					
Turkmenistan				2.22					
Uzbekistan				2.02					

² Sources: IMF and World Economic Outlook (Tables 1, 2, and 3).



Table 2 Inflation, annual changes in consumer price index, 2000–2019 (Percent)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Kazakhstan	13.3	8.4	5.9	6.5	6.9	7.5	8.6	10.8	17.1
Kyrgyzstan	18.7	6.9	2.1	3.1	4.1	4.3	5.6	10.2	24.5
Tajikistan	32.9	38.6	12.2	16.4	7.2	7.3	10.0	13.2	20.4
Turkmenistan	8.0	11.6	8.8	5.6	5.9	10.7	8.2	6.3	14.5
Uzbekistan	25.0	27.3	27.3	11.6	6.6	10.0	14.2	12.3	12.7
Average	19.6	18.5	11.2	8.6	6.1	7.9	9.3	10.5	17.8
Country	2009	2010	2011	2012	2013	2014	2015	2016	2017
Kazakhstan	7.3	7.1	8.3	5.1	5.8	6.7	6.7	14.6	7.3
Kyrgyzstan	6.8	8.0	16.6	2.8	6.6	7.5	6.5	0.4	3.8
Tajikistan	6.4	6.5	12.4	5.8	5.0	6.1	5.8	5.9	8.9
Turkmenistan	-2.7	4.5	5.3	5.3	6.8	6.0	7.4	3.6	6.0
Uzbekistan	14.1	12.3	12.4	11.9	11.7	9.1	8.5	8.0	13.0
Average	6.3	7.6	11.0	6.1	17.9	6.9	6.8	6.5	7.8
Country	2018								2019
Kazakhstan	6.2								5.2
Kyrgyzstan	1.5								1.1
Tajikistan	3.8								7.8
Turkmenistan	13.3								5.1
Uzbekistan	17.5								14.5
Average	8.4								6.7



Table 3 The general government balances, as percent of GDP, 2000–2019

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Kazakhstan	-1.345	2.654	1.92	3.996	3.287	6.08	7.652	5.134	1.227
Kyrgyzstan	-10.697	-6.747	-5.9	-5.169	-4.892	-3.789	-2.096	1.277	1.924
Tajikistan	-5.555	-3.188	-2.442	-1.762	-2.369	-2.899	1.705	-5.534	-5.061
Turkmenistan	-0.516	0.721	0.173	3.715	1.374	0.806	5.252	3.907	10.001
Uzbekistan	-3.741	-3.354	-6.46	-4.984	-3.827	-3.602	2.784	3.636	6.109
Country	2009	2010	2011	2012	2013	2014	2015	2016	2017
Kazakhstan	-1.328	1.47	5.811	4.431	4.945	2.482	-6.259	-4.513	-4.368
Kyrgyzstan	0.378	-5.947	-4.704	-5.862	-3.699	-3.411	-2.722	-6.424	-4.591
Tajikistan	-5.229	-2.979	-2.142	0.589	-0.901	-0.126	-1.972	-9.032	-5.965
Turkmenistan	1.861	2.684	6.09	6.605	2.955	2.654	1.146	1.591	1.788
Uzbekistan	1.861	2.684	6.09	6.605	2.955	2.654	1.146	1.591	1.788
Country	2018			2019			Average		
Kazakhstan	2.675			0.377			1.82		
Kyrgyzstan	-7.304			-15.959			-9.34		
Tajikistan	-2.781			-4.03			-3.08		
Turkmenistan	-0.216			-0.136			2.09		
Uzbekistan	2.24			0.594			0.84		

Table 4 Total factor productivity growth—Kazakhstan

Time period	Annual growth of					
	Real output	Real capital stock	Weighted capital stock (alpha=1/3)	Labor force	Weighted labor force (alpha=2/3)	TFP
1990–1999	-0.049	0.007	0.002	-0.025	-0.017	-0.034
2000–2009	0.083	0.021	0.006	0.027	0.018	0.058
2010–2017	0.042	0.038	0.012	0.011	0.007	0.022
1990–2017	0.027	0.020	0.006	0.004	0.110	0.017

Table 5 Total factor productivity growth—Kyrgyz Republic

Time period	Annual growth of					
	Real output	Real capital stock	Weighted capital stock (alpha=1/3)	Labor force	Weighted labor force (alpha=2/3)	TFP
1990–1999	-0.050	0.005	0.001	0.003	0.002	-0.053
2000–2009	0.046	0.020	0.006	0.025	0.016	0.022
2010–2017	0.047	0.041	0.013	0.014	0.009	0.024
1990–2017	0.011	0.021	0.006	0.014	0.009	-0.004



Table 6 Total factor productivity growth—Tajikistan

Time period	Annual growth of					
	Real output	Real capital stock	Weighted capital stock (alpha=1/3)	Labor force	Weighted labor force (alpha=2/3)	TFP
1990–1999	– 0.109	– 0.022	– 0.007	– 0.012	– 0.008	– 0.094
2000–2009	0.082	– 0.018	– 0.006	0.028	0.019	0.069
2010–2017	0.062	– 0.012	– 0.004	0.017	0.011	0.055
1990–2017	0.008	– 0.018	– 0.006	0.010	0.007	0.008

Table 7 Total factor productivity growth—Turkmenistan

Time period	Annual growth of					
	Real output	Real capital stock	Weighted capital stock (alpha=1/3)	Labor force	Weighted labor force (alpha=2/3)	TFP
1990–1999	– 0.032	0.031	0.010	0.034	0.022	– 0.065
2000–2009	0.075	0.027	0.009	0.024	0.016	0.049
2010–2017	0.093	0.098	0.032	0.025	0.017	0.043
1990–2017	0.042	0.050	0.016	0.026	0.017	0.008

Table 8 Total factor productivity growth—Uzbekistan

Time period	Annual growth of					
	Real output	Real capital stock	Weighted capital stock (alpha=1/3)	Labor force	Weighted labor force (alpha=2/3)	TFP
1990–1999	– 0.006	0.038	0.012	0.012	0.008	– 0.027
2000–2009	0.067	0.032	0.010	0.029	0.019	0.037
2010–2017	0.073	0.058	0.019	0.028	0.019	0.035
1990–2017	0.043	0.041	0.013	0.023	0.015	0.014



Table 9 Productivity calculations: ratios to Japanese values

Country	Period	Output per worker Y/L	Capital-output ratio $\left(\frac{K}{Y}\right)^{\alpha/1-\alpha}$	Productivity A
Kazakhstan	1990	0.404	0.854	0.472
	2000	0.272	1.034	0.262
	2010	0.445	0.754	0.590
	2017	0.587	0.724	0.810
	Average		0.427	0.842
Kyrgyzstan	1990	0.209	0.536	0.390
	2000	0.120	0.620	0.193
	2010	0.118	0.587	0.202
	2017	0.146	0.579	0.253
	Average		0.148	0.580
Tajikistan	1990	0.244	1.747	0.139
	2000	0.093	2.290	0.040
	2010	0.144	1.141	0.102
	2017	0.180	1.141	0.157
	Average		0.165	1.647
Turkmenistan	1990	0.191	1.527	0.125
	2000	0.076	2.105	0.036
	2010	0.286	1.103	0.259
	2017	0.510	1.053	0.484
	Average		0.266	1.447
Uzbekistan	1990	0.186	0.658	0.283
	2000	0.134	0.747	0.180
	2010	0.175	0.643	0.271
	2017	0.244	0.601	0.406
	Average		0.185	0.662



Table 10 Productivity calculations: ratios to South Korean Values

Country	Period	Output per worker Y/L	Capital-Output Ratio $\left(\frac{K}{Y}\right)^{\alpha/1-\alpha}$	Productivity A
Kazakhstan	1990	0.847	0.997	0.850
	2000	0.385	1.169	0.329
	2010	0.487	0.838	0.581
	2017	0601	0.772	0.779
Average		0.580	0.944	0.635
Kyrgyzstan	1990	0.439	0.626	0.702
	2000	0.170	0.701	0.242
	2010	0.129	0.652	0.199
	2017	0.150	0.617	0.243
Average		0.222	0.649	0.346
Tajikistan	1990	0.512	2.039	0.251
	2000	0.132	2.587	0.051
	2010	0.158	1.566	0.101
	2017	0.184	1.217	0.151
Average		0.247	1.852	0.138
Turkmenistan	1990	0.402	1.781	0.225
	2000	0.108	2.378	0.045
	2010	0.313	1.225	0.255
	2017	0.523	1.123	0.465
Average		0.336	1.627	0.248
Uzbekistan	1990	0.390	0.767	0.509
	2000	0.190	0.844	0.226
	2010	0.191	0.715	0.267
	2017	0.250	0.641	0.390
Average		0.255	0.742	0.348



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References

- Abdih, Y., L. Medina (2013). Measuring the Informal Economy in the Caucasus and Central Asia. *IMF Working Paper*. WP/13/137.
- Batsaikhan, U., and M. Dabrowski. 2017. Central Asia – twenty -five years after the breakup of the USSR. *Russian Journal of Economics* 3: 296–320.
- Blanchard, O. 1998. *The economics of post-communist transition*, 164. Oxford: Oxford University Press.
- Campos, N.F., and F. Coricelli. 2002. Growth in transition: what we know, what we don't, and what we should. *Journal of Economic Literature* 40(3): 793–836.
- Caselli, F. (2004). Accounting for Cross-Country Income Differences. *National Bureau of Economic Research*. Working Paper 10828.
- Christensen, L.R., D. Cummings, and D.W. Jorgenson. 1981. Relative productivity levels, 1947–1973: an international comparison. *European Economic Review* 16(1): 61–94.
- Djalilov, K., and J. Piesse. 2012. Financial Development and Growth in Transition Countries: A Study of Central Asia. *Emerging Markets Finance and Trade* 47(6): 4–23.
- European Bank for Reconstruction and Development. *Transition Report 2002*.
- Feenstra, R., R. Inklaar, and M. Timmer. 2015. The Next Generation of the Penn World Table. *American Economic Review* 105(10): 3150–3182.
- Green, D., and A. Bauer. 1998. The Costs of Transition in Central Asia. *Journal of Asian Economics* 9(2): 345–364.
- Hall, R.E., and C.I. Jones. 1999. Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics* 114(1): 83–116.
- Hsieh, C., and P. Klenow. 2010. Development Accounting. *American Economic Journal: Macroeconomics* 2(1): 207–223.
- Izyumov, A., and J. Vahaly. 2008. Old capital vs. new investment in post-Soviet economies: conceptual issues and estimates. *Comparative Economic Studies* 50(1): 79–110.
- Jorgenson, D.W., and M.V. Khuong. 2010. Potential growth of the world economy. *Journal of Policy Modelling* 32(5): 615–631.
- Kalyuzhnova, Y., and K. Patterson. 2016. Kazakhstan: Long-Term Economic Growth and the Role of the Oil Sector. *Comparative Economic Studies* 58: 93–118.
- King, R., and R. Levine. 1994. Capital Fundamentalism, Economic Development, and Economic Growth. *Carnegie–rochester Conference Series on Public Policy* 40: 259–292.
- Klenow, P., and R. Rodriguez-Clare. 1997. The Neoclassical Revival in Gross Domestic Product: Has It Gone Too Far. National Bureau of Economic Research. *Macroeconomics Annual* 12: 73–103.
- Pomfret, R. 2003. Economic Performance in Central Asia since 1991: Macro and Micro Evidence. *Comparative Economic Studies* 45(4): 442–465.
- Pomfret, R. 2019. *The Central Asian Economies in the Twenty-First Century*. Princeton University Press.
- Pomfret, R., and K. Anderson. 2001. Economic Development Strategies in Central Asia since 1991. *Asian Studies Review* 25(2): 185–200.
- Rapacki, R., and M. Prochniak. 2009. Economic growth accounting in twenty-seven transition countries, 1990–2003. *Eastern European Economics* 47(2): 69–112.
- Solow, R.M. 1957. Technical change and the aggregate production function. *The Review of Economics and Statistics* 39(3): 312–320.
- Spechler, M. 2008. The Economies of Central Asia: A Survey. *Comparative Economic Studies* 50: 30–52.
- Turganbayev, Y. 2016. Regional convergence in Kazakhstan. *Post-Communist Economies* 28(3): 314–334.
- Turganbayev, Y. 2017. Total factor productivity convergence across the Kazakh regions. *Post-Communist Economies* 29(2): 182–197.
- Yormirzoev, M., F. Yormirzoeva, and A. Gorodilov. 2020. Characteristics of economic performance in former soviet countries: lessons learned from last two decades. *Economy of Region* 16(3): 754–764.

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