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Characteristics of Economic Performance in former Soviet Countries: Lessons Learned from Last Two Decades [1]

This paper attempts to explore economic performance in countries of the former Soviet Union since their transition to a market system based on the World Bank data for the period from 1993 to 2016. The first part of the study is related to estimating proximate sources of economic growth within the standard growth accounting framework. Results indicate that under the period of study capital accumulation was the primary engine for growth in the post-Soviet region. Total factor productivity (TFP) growth rates were modest ranging from 1.15 % for Uzbekistan and 0.77 % for Belarus to −1.83 % for Turkmenistan and −1.20 % for Latvia accordingly. In the second part of the paper we analyse productivity level across all former Soviet republics by decomposing differences in output per worker into differences in capital intensity and productivity for the year 2016. Compared to Russia, a frontier for the analysis, nearly all former Soviet republics demonstrated a lower level of productivity. Some countries of the region such as Georgia, Kyrgyz Republic and Turkmenistan have extremely high capital intensity. Productivity in Russia was about 14 times higher than productivity in Kyrgyz Republic and Tajikistan. Despite the fact that more than two decades passed since the transition to a market system the Soviet legacy of aggregate production did not experience notable changes.

Keywords: determinants of growth, capital intensity, labour force, productivity comparison, economic performance, growth accounting, former Soviet Union, transition economies, point-in-time approach, market system

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Характеристики экономической деятельности стран бывшего Советского Союза: уроки, извлеченные из последних двух десятилетий

Статья посвящена изучению экономических показателей стран бывшего Советского Союза с момента их перехода к рыночной системе на основе данных Всемирного банка за период с 1993 по 2016 гг. Первая часть исследования связана с оценкой непосредственных источников экономического роста в рамках классического анализа экономического роста. Результаты показывают, что в период исследования накопление капитала было основным двигателем роста на постсоветском пространстве. Темпы роста совокупной производительности факторов производства (СПФП) скромные: от 1,15 % для Узбекистана и 0,77 % для Беларуси до -1,83 % для Туркменистана и -1,20 % для Латвии. Во второй части статьи авторами проанализирован уровень производительности во всех бывших советских республиках с декомпозицией различий в объеме производства на одного работника на различия в капиталоемкости и производительности за 2016 г. По сравнению с Россией почти все бывшие советские республики продемонстрировали более низкий уровень производительности. В России же производительность за анализируемый период примерно в 14 раз выше, чем в Кыргызской Республике и Таджикистане. Некоторые страны региона, такие как Грузия, Кыргызская Республика и Туркменистан, имеют чрезвычайно высокую капиталоемкость. Несмотря на то, что с момента перехода к рыночной системе прошло более двух десятилетий, советское наследие агрегатного производства не претерпело заметных изменений.

Ключевые слова: детерминанты роста, капиталоемкость, рабочая сила, сравнение производительности, экономические показатели, учет роста, бывший Советский Союз, страны с переходной экономикой, рыночная система

Introduction

The collapse of the centrally planned economy in the former Soviet Union was initially accompanied by severe economic downturn. In some countries of the region, this decline ranged between 10 % and 50 % of their Soviet era output level (World Bank). Yet, in the following years, former Soviet republics were able to reverse this shock and achieve and maintain positive economic growth path. Thus, understanding the proximate sources and patterns of growth is important both for academia and policy making decisions. Since the earlier period of transition processes, this topic has been the subject of a heated debate and exploration. Many researchers have conducted theoretical and empirical analysis of various aspects of economic performance across certain post — Soviet countries or region as a whole. Campos and Coricelli [1] were among a few authors who attempted to examine in detail growth performance in the former Soviet Union and other post-communist countries in Central and Eastern Europe. Their analysis summarises the first decade of transition in terms of stylised facts on output dynamics, capital and labour market changes, institutions, foreign trade and associated transition costs.

Rapacki and Prochniak [2] explored the determinants of growth for the entire group of former socialist countries over the period 1990 — 2003 using a simple growth-accounting framework. Their findings indicate that changes in total factor productivity were an essential element for the growth of transition economies.

Alternatively, investment data in the region have a short historical span and their estimation and construction has been another field of continuous debate among several scholars. For instance, Izyumov and Vahaly [3] argue that a large portion of Soviet-era capital was destroyed by the switch from enterprises to the market and official statistics did not reflect this phenomenon. On the basis of combining the old and new capital estimations, and perpetual inventory method they calculated the amount of "market-quality" capital that was accumulated in CIS economies during 1992 and 2005.

A notable empirical study of growth performance in post-socialist economies is associated with contributions made by Iradian [4]. Based on several panel regressions, he concluded that the rapid growth in transition economies for the period of 1991–2006 was attributed to improvements

in macroeconomic policies, sound market reforms and favourable external environment. Further improvement in the policy and institutions would be significant for long-term economic success in the region.

Numereous previously conducted studies are related to individual republics of the region. In particular, Kaitila [5] empirically analysed output growth in Russia based on different capital stocks and terms of trade development. Brock [6] argued that growth rates in Russia's federal districts can be well explained by the neoclassical model, implying that there can exist a convergence among poor and rich regions. Changes in total factor productivity, the output fluctuations and inflation level were explored in detail by Michaelides and Millios [7]. Their findings indicate that total factor productivity played an essential role in Russia's growth since 1998. However, output expansion in the country was highly correlated with increases in inflation.

Total factor productivity and regional convergence in Kazakhstan were investigated in works of Turganbayev [8, 9]. Generally, regions in the country demonstrated divergence for the period under study. TFP on average declined both in resource abundant and scare regions. There is sigma divergence of regional output per capita in Kazakhstan that basically stems from capital intensity.

We believe that our research will bring several contributions to the existing literature. First, our analysis covers the period of more than two decades, i.e., it reflects the time span from 1993 through 2016. Growth analysis is a long-run phenomenon and considering a longer time span will enable us to have a better picture of economic performance in the post-Soviet region.

There are two major research hypotheses pertaining to this research. First, we analyse the contribution of each factor of production, namely, capital and labour to long-term economic growth in countries of the former Soviet Union. In the second case, we intend to examine productivity performance in the region based on available data for the most recent post-transition period. Both approaches are essential for growth studies.

While conducting our analysis we followed the historical approach of dividing countries into regions of the former Soviet Union. Our differentiation of former Soviet republics is not related to their income and growth performance.

Second, along with standard growth-accounting framework that sheds light on the relative importance of capital accumulation and labour force to economic growth, we also pay attention at level analysis. Hall and Jones [10] found that differences in long-run economic performance are better reflected in levels as they are directly relevant to welfare analysis. Alternatively, Christensen and Cummings [11] stated that decomposition of output per worker into inputs and productivity and the comparison of each country to a reference point is an appropriate indicator to examine the proximate cause of economic success in the region. Variation in productivity across countries of the former Soviet Union originating from differences in output per worker and capital output ratio will be demonstrated for 2016. No prior study has touched this approach to explain productivity differences in cross-country economic performance in this region.

The rest of the paper is organised as follows. Section two highlights the aggregate growth performance in the post-Soviet region. Section three describes the growth-accounting methodology. Section four is devoted to the data. Results are then discussed in section five. The last section presents summary and conclusions.

Theory

A. The Solow Growth Model

We proceed with a neoclassical model of growth that takes its significant influence from seminal work by Solow [12]. Afterwards it was further developed and empirically explored in other works written by Solow [13], Jorgenson and Grilliches [14], Baily et al. [15], Mankiw et al. [16], Barro [17], Alwyn [18], Jorgenson and Khuong [19].

The Solow model is an essential neoclassical model of growth analysis and has been an important empirical tool to estimate long term economic performance for groups of countries and the world. However, it does not consider several changes attributable to a country under study, namely, the quality of labour and capital, external and internal shocks that former Soviet republics were faced with. Yet, under certain assumptions of the Solow model, we consider as reasonable to examine and analyse long-term economic growth performance in the region.

Consider the post-Soviet region with two inputs and a single good. Capital (K) and labour (L) are used to produce a homogenous output in the region that can be either consumed or used directly for production processes. We also assume that the technology can be described by an aggregate production function as follows:

$$Y = F(K, L) \qquad (1)$$

where Y is the aggregate output. $F(K, L)$ is a smooth and concave function reflecting constant returns

to scale as well as positive and decreasing marginal products (F_K, $F_L > 0$, F_{KK}, $F_L < 0$). Alternatively, both factor inputs are important for production, i.e. ($F(0, L) = F(K, 0) = 0$). These inputs are paid their marginal products due to complete input utilisation and perfect competition. Other assumptions of the Solow model imply that the rates of saving, population growth and technological progress are exogenous. Technological progress is said to be Hicks-neutral meaning that any shift in aggregate production function does not impact marginal rates of substitution of factor inputs.

For empirical purposes, the Cobb-Douglas specification of the aggregate production function is used as

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}, 0 < \alpha < 1, \qquad (2)$$

where A_t stands for total factor productivity (TFP) in time t that summarizes the current state of technological progress and it is directly unobservable. The coefficients for α and $1 - \alpha$ measure the elasticity of output with respect to the stock of capital and labour force.

The growth rate of output can be divided into associated factor accumulation and technological progress. Taking logarithms of equation (2) and derivatives with respect to time we get

$$g_Y = g_A + \alpha g_K + (1 - \alpha)g_L, \qquad (3)$$

where $g_Y = \dfrac{\dot{Y}}{Y}$, $g_A = \dfrac{\dot{A}}{A}$, $g_K = \dfrac{\dot{K}}{K}$, and $g_L = \dfrac{\dot{L}}{L}$.

Hence, the total factor productivity (TFP) growth rate is the difference between the growth rates of output, capital stock and labour, i.e.

$$g_A = g_Y - \alpha g_K - (1 - \alpha)g_L. \qquad (4)$$

This formulation was first presented by Solow [13] and sometimes it is called Solow residual. In empirical analysis α and $1 - \alpha$ refer to capital and labour share to GDP. Once values for output, capital stock and labour force are available, it is straightforward to calculate the TFP growth rate. In fact, TFP growth rates are attributed to "improvements in efficiency" due to unobservable factors. In the case of the former Soviet republics such factors can represent market reforms, privatisation of state enterprises, trade liberalisation, organisational and institutional change, etc. Blanchard [20].

It is important to specify the practical implementation of growth accounting requires that growth rates of inputs need to be properly calculated. Ideally, it would be relevant to use the flow of services from physical capital as a measure of capital stock as Barro and Sala-i-Martin [21] stated. However, in practise, it is unfeasible. Alternatively, the measurement of the stock of capital includes

initial capital stock, gross investment and deprecation of existing capital. The approach called perpetual-inventory method has been widely used and is considered the most acceptable estimate for capital stock. This method can be expressed mathematically in the following way:

$$K_{t+1} = I_t + (1 - \delta)K_t, \qquad (5)$$

where K_{t+1} is capital stock at time $t + 1$, I_t refers to gross investment at time t, δ is constant depreciation rate and K_t is capital stock from a previous year. Before getting a capital stock series the value for the initial capital stock must be calculated. In growth literature the initial capital stock represents the ratio of investment in the initial year and the sum of the growth rate of investment and constant depreciation rate, i.e.

$$K_0 = \frac{I_0}{g + \delta}, \qquad (6)$$

where K_0 is the initial capital stock, I_0 stands for gross investment in the initial year, g is its growth rate and δ is constant depreciation rate.

The labour input theoretically it is related to the number of hours worked in a given time period. Given the fact that information on hours worked is not readily available statistics on total employment is primarily used as in the paper of Acemoglu [22].

After capital stock is calculated and labour is obtained, the growth rates of factor inputs are found from the simple formula

$$\theta = \frac{X_{t+1} - X_t}{X_t}, \qquad (7)$$

where θ is the growth rate of factor inputs and X_{t+1} and X_t refer to their associated values in current and past period of time accordingly.

B. A Point-in-Time Growth Approach of Hall and Jones

The next step in our analysis is to examine the proximate causes of economic performance in the post-Soviet region based on Hall and Jones' [10] point-in-time approach. Consider a Cobb-Douglas aggregate production function again with output (Y_t), capital (K_t), labour (L_t) and Harrod-neutral technology (A_t) at period t:

$$Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}, \qquad (8)$$

with $0 < \alpha < 1$. We rewrite (8) in intensive form that shows the output per worker (labour productivity) as a function of capital intensity as follows:

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{A_t L_t}\right)^{\alpha} = A_t \left(\frac{K_t}{Y_t}\right)^{\alpha/1-\alpha}. \qquad (9)$$

Aggregate Growth Structure in the Region, 1992–2016[*]

Period	Regions[**]	Output	Labour	Capital	Output per worker
1992–1999	BRU	−5.4	−0.3	−15.8	−4.4
2000–2008		7.2	0.1	16.1	6.5
2008–2016		−0.1	−0.1	−1.6	0.1
1992–2016		0.8	−0.1	0.2	0.9
1996–1999	Baltics	5.0	−1.2	17.4	−1.1
2000–2008		6.9	−0.2	12.3	6.3
2008–2016		0.7	−0.6	0.1	1.3
1992–2016		4.3	−0.6	9.1	2.3
1992–1999	Caucasus	−4.8	0.1	16.1	−4.5
2000–2008		10.1	0.2	17.1	9.7
2008–2016		2.7	0.5	−0.4	2.1
1992–2016		3.2	0.2	11.8	2.7
1992–1999	Central Asia	−4.3	1.7	−4.4	−5.4
2000–2008		7.4	2.3	12.8	4.8
2008–2016		6.3	1.8	8.5	4.4
1992–2016		3.2	1.9	5.7	1.2

Source: Authors' calculations based on the World Bank data.

[*] Annual percentage rate of change.

[**] BRU consists of Belarus, Russia and Ukraine; Baltics includes Estonia, Latvia and Lithuania; Caucasus represents Armenia, Azerbaijan, Georgia and Moldova; Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan belong to Central Asia.

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

$$\frac{\left(\dfrac{Y}{L}\right)^i_t}{\left(\dfrac{Y}{L}\right)^F_t} = \frac{A^i_t}{A^F_t}\left(\frac{\left(\dfrac{K}{Y}\right)^i_t}{\left(\dfrac{K}{Y}\right)^F_t}\right)^{\alpha/1-\alpha}. \qquad (10)$$

where the benchmark is normalised to be one. *i* is a former Soviet republic, *t* refers to 2016. Russia serves as the frontier for the analysis as the major economy of the region.

Data

The data for our analysis are from the World Bank[1] and it is readily available online. The data set consists of the growth rate of GDP, gross fixed capital formation, the total number of labour force, the capital-output ratio and total GDP in PPP terms. The data are annual and cover the period of 1993–2016 for a majority of former Soviet republics.

We begin our analysis of the data by characterising overall growth patterns in the region. Table 1 reports key indicators of the growth for the economies of all former Soviet republics over the period of 1992 to 2016. The first and the second columns of the table represent the time span consisting of several periods and country sub-groups within the region.

The output refers to the annual percentage growth rate of GDP in real terms; capital is annual growth rate of gross capital formation in real terms; Output per worker is obtained by dividing GDP (in 2011 PPP international U.S. dollars) to the number of labour force. Then, its growth rate was calculated. The Baltic States have data on GDP growth rate since 1996.

It is worth mentioning that all republics of the former Soviet Union used to be highly integrated with each other with strong production and consumption chains via vertical mechanisms of centralised planning and single resource allocation framework. After this economic system collapsed output was negatively affected. As we can see from the table on average during the 1992–1999 period real output decline in the region ranged from −5.4 % in Belarus, Russia and Ukraine (BRU group of countries) to −4.3 % in Central Asia. The second period, namely 2000–2008 was favourable for

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[1] World Bank Open Data [Electronic Source] URL: https://data.worldbank.org/ (Date of access: 26.02.2019).

all former Soviet economies, for their real output level growth rate accounted for 6.9 % in the Baltic States and 10.2 % in the Caucasus. Afterwards, the growth path slowed down even it became negative for Belarus, Ukraine and Russia. The economy crisis that hit the world economy in 2007–2008 is likely associated with the economic slowdown in the region.

The fourth column shows labour force growth for each group of countries and several time periods. As we can see in the Baltic States and Belarus, Russia, and Ukraine labour force did not increase. All these former Soviet republics follow similar path of negative population growth and ageing being common to many developed societies. In addition to this, the migration also contributes to the labour reduction, in particular in the case of the Baltic region whose economically active part of the population seeks employment in Europe after their membership access to the European Union as Hazans and Philips [23] stated. On the contrary, we see the opposite picture in the Caucasus and Central Asia. Historically, these regions of the former Soviet Union enjoyed positive population growth and during the post-Soviet period, this tendency did not alter essentially. In particular, this is more evident in the case of Central Asian republics where labour growth increased from 1.75 % during 1992–1999 to 2.3 % over the period 2000–2008. For the entire period of 1992–2016 labour force grew to 2 %.

The next column of the table shows changes in capital in the region. On average, its growth rate remains mostly positive for nearly all former Soviet republics during the whole period of 1992–2016 ranging from 0.2 % in Belarus, Russia and Ukraine to approximatively 12 % in the Caucasus republics.

Productivity performance expressed as output per worker is presented in the last column of the table. As expected, the initial transition period was accompanied by a significant decline of output per worker in all countries. The regional economic growth has undergone a powerful revival since 2000. The GDP growth rate per worker reached the highest level in republics of the Caucasus by approximately 10 % during 2000–2008. Other countries of the region, in particular Belarus, Russia, Ukraine (BRU group), and the Baltic States experienced more than 6 % growth rate, while Central Asia enjoyed about 5 % of output per worker growth. The period of 2008–2016 provides the recent pattern of labour force productivity in the region. Republics of Central Asia have been the leading economies reaching 4.5 % growth rate of GDP per worker compared with the

Caucasus with 2.1 %, Baltics with 1.4 % and BRU group with approximatively 0.1 % of output per worker growth rate.

Throughout the period of 1992–2016 output per worker growth rate in the post-Soviet region was unambiguous; Belarus, Russia and Ukraine together achieved about 1 % increase. The Baltic States and republics in Central Asia experienced nearly identical rates of productivity performance growth. The Caucasus could maintain higher GDP per worker performance with approximatively 3 % increase in this period.

Methods

In the case of the post-Soviet region a major challenge in growth accounting is associated with calculating physical capital stock [2]. The ongoing debate in literature is not comprehensive as regard to selecting the depreciation rate of investment and initial value of capital stock. We follow [5] in selecting values for depreciation rate of investment, which is equal to 5 % and share of capital being equal to 0.4. The initial period for calculating the stock of capital is 1993. Although her research is primarily focused on the Russian economy, we believe that these parameters and the initial year of capital stock can be applied to other former Soviet republics, for all of them share common economic background.

For some countries of the region, i.e. Latvia, Lithuania and Moldova data for capital are available since 1995 and this year were chosen to be initial values for investment flows. Tajikistan and Turkmenistan report their data on capital up to 2014 and 2013. Hence, capital stock for these Central Asian economies includes periods of 1993–2014 and 1993–2013 accordingly.

In growth literature, gross fixed capital formation previously classified as domestic investments by the World Bank is used as a proxy for capital. The same approach is applied in our analysis. For each former Soviet republic we refer to the perpetual inventory method to calculate the stock of capital. Afterwards, the growth rates of factor inputs were obtained via equation seven.

Our second analysis attributed to a point-in-time approach includes output per worker and capital intensity. Y/L is real GDP in 2016 and it is divided by labour force in that year for each former Soviet republic. The total value for GDP is expressed in 2011 PPP international US dollars.

We should admit that both estimates for the stock of capital and labour do not reflect qualitative aspects of changes in these factor inputs. During the earlier period of transition, many capital items were negatively affected due to changes

Growth Accounting for Belarus, Russia and Ukraine

Country	(1) Growth Rate of GDP	(2) Contribution from Capital	(3) Contribution from Labour	(4) TFP Growth Rate
Belarus	0.0381	0.0283 (74 %)	0.0021 (6 %)	0.0077 (20 %)
Russia	0.0217	0.0322 (148 %)	0.0006 (3 %)	−0.0111 (−51 %)
Ukraine	0.0034	0.0027 (−28 %)	−0.0065 (68 %)	-0.0058 (60 %)

Source: Authors' calculations.

in ownership, imbalances in supply and demand sides of economy and changes related to international trade and price level [2]. A similar pattern happened regarding labour force. The quality of labour could be disaggregated into several different categories based on schooling, experience, gender and health-related characteristics [21]. Yet, the basic assumption of growth-accounting framework enables us to consider that both input factors are homogenous across countries of the region.

Results

In this section we will discuss findings from growth-accounting relationships for all former Soviet republics over the period 1993–2016. The second part of our analysis will be related to productivity comparison by decomposing output per worker and capital intensity in 2016. All terms will be expressed as ratios to Russian values. The post-Soviet region will be divided into numereous samples as Belarus, Russia and Ukraine (BRU), Baltics (Estonia, Latvia and Lithuania), the Caucasus (Armenia, Azerbaijan, Georgia and Moldova) and Central Asia (Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan).

A. Belarus, Russia and Ukraine

Table 2 presents estimates for total factor productivity for three former Soviet republics of Belarus, Russia and Ukraine. The growth rate of TFP within this sample of countries ranges from −1.11 % to 0.77 %. It accounts for approximatively 10 % of the overall growth rate of output in all the countries. As one can notice capital input contribution to TFP growth remains higher in Belarus and Russia compared to Ukraine. The role of labour is extremely low in the sample. On average, it accounts for −0.13 % for overall growth of output.

The third table displays the Hall and Jones decomposition of productivity level. The output per worker in Belarus and Ukraine constitutes 66 % and 34 % of that in Russia. Belarus has a higher capital intensity compared to Russia, while Ukraine has twice smaller capital-output ratio than Russian value. The Ukrainian productivity

Hall and Jones Decomposition of Productivity Level

Country	(1) Y/L	(2) $\left(\dfrac{K}{Y}\right)^{\alpha/1-\alpha}$	(3) A
Russia	1.000	1.000	1.000
Belarus	0.664	1.418	0.469
Ukraine	0.335	0.503	0.667

Source: Authors' calculations.

accounts for approximatively 67 % of the Russian level. Belarus has a rather low productivity level.

B. Baltics

Table four below reports total factor productivity growth estimates for Estonia, Latvia and Lithuania. The contribution of capital as a factor input to the growth rate of GDP remains influential in this sample and its average value is equal to approximatively 5 %. Labour did not have an important effect on output increase. Its contribution is negative ranging from −0.21 % in Estonia to −0.45 % and −0.47 % in Latvia and Lithuania. Productivity growth in Lithuania is 0.39 % compared to −0.6 % and −1.2 % in Estonia and Latvia. This trend can be associated with a lower level of capital contribution to the growth rate of output in Lithuania.

Table 5 that highlights the decomposition of productivity level for this sample of countries shows some interesting findings. The output per worker in Estonia and Lithuania is higher, while this indicator in Latvia is almost the same as Russian output per worker. Capital intensity in Estonia remains larger. Other Baltic republics have lower capital-output ratio. All Baltic republics achieved higher productivity compared with Russia in 2016, reflecting more effective use of factor inputs.

C. The Caucasus

Estimates for total factor productivity growth rates for the Caucasus are given in table 6. On average, the growth rate of GDP in this sample of countries is approximatively 6 % with 7.18 % in Azerbaijan and 3.05 % in Moldova. Despite higher output growth rates, the estimates of TFP growth

Growth Accounting for Estonia, Latvia and Lithuania

Country	(1) Growth Rate of GDP	(2) Contribution from Capital	(3) Contribution from Labour	(4) TFP Growth Rate
Estonia	0.0343	0.0423 (123 %)	−0.0021 (−6 %)	−0.0060 (−17 %)
Latvia*	0.0413	0.0578 (140 %)	−0.0045 (−11 %)	−0.0120 (−29 %)
Lithuania*	0.0432	0.0439 (102 %)	−0.0047 (−11 %)	0.0039 (9 %)

Source: Authors' calculations.

* Period: 1995–2016.

for the Caucasus are mainly negative ranging from −1.37 % in Moldova to 0.29 % in Georgia. The reason for this economic performance is primarily attributed to a larger fraction of capital in these countries.

Productivity level decomposition from table 7 shows that output per worker is much lower in the Caucasus with 29 % in Moldova to 67 % in Azerbaijan compared to Russia. Except for Armenia other former Soviet republics from the region have relatively high capital intensity but a lower productivity level. In Georgia and Moldova productivity is about 18 % and 27 % while in Armenia and Azerbaijan it approximately accounts for 50 % of that in Russia.

D. Central Asia

Table 8 below reports the decomposition of growth for countries in Central Asia. On average, this region enjoyed output growth rates of approximatively 5 % over the period under study. Turkmenistan and Uzbekistan, with 5.7 % of their GDP growth are frontiers than Kyrgyz Republic and

Hall and Jones Decomposition of Productivity Level

Country	(1) Y/L	(2) $\left(\dfrac{K}{Y}\right)^{\alpha/1-\alpha}$	(3) A
Russia	1.000	1.000	1.000
Estonia	1.134	1.093	1.037
Latvia	0.981	0.726	1.351
Lithuania	1.155	0.784	1.473

Source: Authors' calculations.

high capital-output ratio of about five times more than the Russian value. In Kazakhstan, the output per worker is nearly identical to that in Russia and productivity level is slighter lower than a frontier country of the post-Soviet region. For other Central Asian republics in the table, differences in productivity are the most important factor in explaining difference in GDP per worker. For example, the output per worker in Kyrgyz Republic and Tajikistan is approximatively 16 % of that in Russia, and such differences are mainly attributed to lower productivity.

Growth Accounting for Armenia, Azerbaijan, Georgia and Moldova

Country	(1) Growth Rate of GDP	(2) Contribution from Capital	(3) Contribution from Labour	(4) TFP Growth Rate
Armenia	0.0627	0.0695 (110 %)	0.0003 (1 %)	−0.0071 (−11 %)
Azerbaijan	0.0718	0.0660 (92 %)	0.0119 (17 %)	−0.0061 (−9 %)
Georgia	0.0567	0.0620 (109 %)	−0.0024 (−4 %)	0.0029 (5 %)
Moldova*	0.0305	0.0462 (152 %)	−0.0020 (−7 %)	−0.0137 (−45 %)

Source: Authors' calculations.

* Period: 1995–2016.

Hall and Jones Decomposition of Productivity Level

Country	(1) Y/L	(2) $\left(\dfrac{K}{Y}\right)^{\alpha/1-\alpha}$	(3) A
Russia	1.000	1.000	1.000
Armenia	0.363	0.660	0.550
Azerbaijan	0.669	1.349	0.496
Georgia	0.361	2.012	0.179
Moldova	0.293	1.077	0.272

Source: Authors' calculations.

Tajikistan with nearly 3.17 % and 3.79 % growth of their output level accordingly. The estimates of TFP growth for the region range between −2.31 % for Tajikistan to 1.15 % for Uzbekistan. Along with a substantial role of capital labour is also an essential factor input for the overall growth rate of output in Central Asia.

Table 9 displays the productivity level decomposition for five countries in the region. All of them demonstrate a higher level of capital intensity. In particular, Turkmenistan has extremely

Table 8

Growth Accounting for Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan

	(1)	(2)	(3)	(4)
Country	Growth Rate of GDP	Contribution from Capital	Contribution from Labour	TFP Growth Rate
Kazakhstan	0.0435	0.0418 (96 %)	0.0034 (8 %)	−0.0017 (−4 %)
Kyrgyz Republic	0.0317	0.0439 (139 %)	0.0095 (30 %)	−0.0217 (−69 %)
Tajikistan*	0.0379	0.0423 (51 %)	0.0169 (23 %)	−0.0231 (26 %)
Turkmenistan**	0.0569	0.0602 (79 %)	0.0150 (37 %)	−0.0183 (−16 %)
Uzbekistan	0.0570	0.0293 (51 %)	0.0163 (29 %)	0.0115 (20 %)

Source: Authors' calculations.

* Period: 1993–2014.

** Period: 1993–2013.

Table 9

Hall and Jones Decomposition of Productivity Level

	(1)	(2)	(3)
Country	Y/L	$\left(\dfrac{K}{Y}\right)^{\alpha/1-\alpha}$	A
Russia	1.000	1.000	1.000
Kazakhstan	0.968	1.131	0.856
Kyrgyz Republic	0.167	2.272	0.073
Tajikistan	0.153	2.070	0.074
Turkmenistan	0.735	4.882	0.151
Uzbekistan	0.272	1.359	0.200

Source: Authors' calculations.

Conclusions

In this study, we attempted to analyse patterns of economic performance in all countries of the former Soviet Union since their transition to a market system. The collapse of centralized planning and resource allocation framework was the primary cause for substantial output level decline in the region. Some former-Soviet republics have experienced negative population growth rate leading to further labour force reduction, particularly in Baltic States.

It is worth mentioning that dynamics of growth are better understood once they are fundamentally explored within a framework of long-term perspectives. The second emphasis of the paper was related to identifying differences in productivity level across countries of the region. For this purpose, we decomposed the output per worker in each former Soviet republic into such components as: the contribution from physical capital intensity and the contribution from productivity for 2016. All values obtained for each country of the region were compared with those in Russia that we selected as the frontier for the analysis. It is a commonly accepted statement in development studies that output per worker reflects a relatively concrete picture of the productivity of labour force. Its detailed analysis is essential to relate it to the context of post-Soviet region.

For the first part of our analysis we conducted a standard growth-accounting exercise. Results indicate that the growth rate of GDP in the region under the period of consideration was primarily driven by capital accumulation. The role of labour input in output growth was prevailing in Azerbaijan and Central Asian republics, for they experienced positive population growth.

On average, the growth rates of TFP for former Soviet republics were unremarkable: only a few countries as Belarus, Georgia, Lithuania and Uzbekistan achieved positive rates in their TFP. Other countries of the region had negative TFP growth rates. Over the period under study the TFP growth rates ranged from 1.15 % for Uzbekistan and 0.77 % for Belarus to −1.83 % for Turkmenistan and −1.20 % for Latvia.

The second part of our analysis showed that except for the Baltic region, all other former Soviet republics maintained lower productivity level performance compared with Russia. Generally, the capital intensity remained relatively large in the post-Soviet region ranging from 1.4 points for Belarus to 4.9 points for Turkmenistan higher than a similar value in the frontier country. Results also reflect that there is an inverse relationship between output per worker and productivity in the region. For example, in Kyrgyz Republic and Tajikistan output per worker was approximatively 16 % of that in Russia. Productivity in Russia was about 14 times higher than a similar indicator in these Central Asian republics.

Another remarkable point is between Russia as a frontier economy in post-Soviet region and United States as a leading economy in the world. In 2016, the output per worker in Russia was approximatively 43 % of that in the United States. Russia had the level of capital intensity of 1.2 points higher than the United States. However, productivity in Russia was about 40 % of that in the United States. If we compare these results with findings by Hall and Jones [10] we see that between

1988 and 2016 nearly all components of growth decomposition in Russia remained unchanged except for the Soviet productivity that accounted for about 50 % of that in the United States.

Despite the fact that more than two decades have passed since transition to a market system the Soviet legacy of aggregate production did not experience notable changes. A relatively higher level of capital intensity is a clear example of lower productivity level that is negatively attributed to the welfare of people as Jones and Vollrath stated [24].

Future research can be directed at exploring the differences in the quality of labour input and how such differences can affect economic performance in the post-Soviet region. We expect that human capital as a proxy for labour input quality will be one of the ultimate determinants of cross-country differences among former Soviet republics. Another potentially important area for further study can be related to look at contributions of external factors such as energy price fluctuations at the world market and their role in economic performance. Alternatively, their effect on the rental cost of capital and labour compensation is significantly leading to growth slowdown in Russia as a major economy of the region and its consequences for the rest of former Soviet republics.

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