

Analysis of Factors Affecting Economic Growth and Productivity in Azerbaijan, Belarus, Georgia, Moldova, and Ukraine

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ABSTRACT

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This study analyzed the national and agricultural economic growth in response to the composition of input factors such as capital, labor, and productivity. Here, we considered five post-Soviet countries, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine, located in Eastern Europe. The study analyzed panel data collected between 1992 and 2015 by the World Bank, FAO, UN Comtrade, using regression analysis with random and fixed effects. The analysis was primarily based on the Solow–Swan model with the Cobb–Douglas production function. First, the contribution of capital, labor, and total factor productivity (TFP) growth in the composition of gross domestic product (GDP) growth and the agricultural value added to the agricultural sector was examined using the Solow–Swan model. Exports, imports, foreign direct investment (FDI), research and development (R&D), and education were adopted as explanatory variables that may affect GDP and TFP. Second, regression analysis was used to examine the effect of FDI, exports, imports, and other factors on the national economy (GDP), agricultural value added, and TFP (national economy and agricultural sector).

Keywords: Exports, FDI, GDP, Growth, Imports, TFP

Introduction

Economic growth is a quantitative change in the country's measurable economic factors over a comparable period. The growth of the country's GDP is measure as economic performances. The relevance of this topic is explained by the fact that economic growth is one of the central tasks of the economy, namely, the achievement of continuous and sustained economic development. To understand how this goal is carried out, it is important to identify the internal mechanism for increasing the production of economic goods on a countrywide scale. Such a mechanism can be found in the deep structure of the national economy, which is capable of ensuring balanced extended reproduction. Economic growth, its pace, quality, and other indicators depend not only on the potential of



the national economy but largely on foreign economic and foreign policy factors. However, economic growth alone cannot be an end in itself of society. It should be accompanied by an increase in the standard of living of the population, a decrease in the differentiation of incomes in society, the modernization of the structure of the national economy, and the improvement of the quality of life. In this regard, the goal of the society is not economic growth in itself, but sustainable economic development. Initially, for a long period, economic development was identified with economic growth, which was interpreted as the growth of GDP or per capita income. Doubts about the legality of this approach were generated by the unsuccessful experience of the development of the former colonies. Many developing countries in the 1950 – 1960 years showed high growth rates of GDP and per capita income, however, most of them failed to improve the standard of living of the population. Thus, the experience of developing countries has led to an understanding of the illegitimacy of identifying economic development and economic growth. This type of growth is generally related to catching up growth which although fast than developed countries after some period faces stagnation. For sustainable development, underdeveloped countries should accept cutting-edge growth which is based on innovation and technology development.

The process of economic development also implies the implementation of structural changes in the national economy, urbanization, the change in the structure of consumption, which consists of reducing the share of food expenditures. Economic development is generally defined as a process in which the real per capita income of the country's population has been rising for a long time, while simultaneously meeting the following two conditions: reducing or maintaining an unchanged number of people living below the poverty line, maintaining or reducing the level of inequality in income distribution. Such an approach to the problem of development means concentrating attention in the process of economic growth on combating poverty, inequality, unemployment, and improving the quality of life of the population.

From the above, it can be concluded that the problems of economic growth are important both for the economy of the country as a whole and for every person living in this country.

The object of this paper is to analyze factors of economic growth, that is, to study the main characteristics of economic growth, and productivity not only in the national economy but also in the agricultural sector.

Organization of the Study

The study consists of six sections; the first is an introduction, following the literature review (according to the research objectives), a methodology of the study (empirical model, data sources and variables), and estimations and interpretations. Finally, conclusions will be given.

To analyze growth rate, we will use the Solow-Swan (1957) model which explained the economic growth by capital accumulation, labor/population growth, and total factor productivity (TFP) growth. In this model, the economic growth could be decomposed by development accounting and the growth accounting methods.

The purpose of growth accounting is to analyze how much real GDP growth resulted from the growth of labor and capital and how much is attributed to technological change. With growth accounting, we use time-series data,

development accounting for analyzing the ratio of the growth rate of two countries in the same period is based on cross-sectional data.

Using the Solow-Swan model we can predict the future of the economy. Generally, in this model, we also use saving, investment, and depreciation rates. We can predict the economy by the growth rate of population saving. According to this model, poor countries have a catching effect, they grow faster than developed countries. And if we look at factors of production we can say that unfortunately capital and labor factors have a feature to depreciate. Capital has the diminishing marginal return of scale, it means that after a time, part of the existing capital depreciates and the economy needs more and more investment to keep this capital, but in some period eventually depreciation becomes higher than investment, in this case, the economy reaches the steady-state.

The main idea is that the driver of economic growth should be productivity (technology and innovation) and factors of production. By productivity, we can find out how with fewer inputs (factors of production) more output could be produced.

$$\text{Output} = \sum \text{Productivity} * \text{Factors of Production} \quad (1)$$

One of the key measures of economic performance is the Total Factor Productivity (TFP). This indicator measures the rate of technology development and shows how effectively using factors of production (labor and capital) to turn inputs into outputs. Easterly and Levine(2001) estimated that the TFP accounts for 60 percent of the growth of output per worker for an average country

We will use three different methods for empirical analysis of economic growth as follows; Growth accounting, Development accounting, and Growth regression.

Along with these, the regression of growth has some serious shortcomings, such as an empirical analysis method. Menkyu (1992), Aghion and Durlauf (2007), Rodrik (2006), and other researchers note the following shortcomings:

Beta (β) in the regression model is regarded as a substitute for each other. This does not allow for prioritizing and determining the fundamental determinants of economic growth as a complementary one. On the other hand, the estimated parameters are derived from the intergovernmental regression model and may be negligible in specific countries. These problems are called econometric problems of endogenous and heteroscedasticity.

Many of the independent variables in the regression model have a high correlation with each other. This also creates serious errors in the evaluation of the model, leading to a misleading conclusion on which determinants are the real determinant of long-term economic growth. The problem can be considered as multicollinearity

The less number of observations also can reduce the effectiveness of the regression models. This problem can be the problem of degrees of freedom in the econometric language.

Growth diagnosis is understood as finding a binding constraint that slows down any economic growth in any country. This method, proposed by Hausman, Rodric, and Velasco (2005), is based on the idea that determinants of economic growth are not substitutes, but complementarities. A tree of growth factors is set up to determine the key limitations of economic growth and the analysis is conducted from top to bottom.

Literature Review

In the literature review, I would like to mention other researchers' analyzes in case of economic growth and productivity.

According to Kim and Lim (2004) “The Effect of Imports and Exports on Total Factor Productivity in Korea” imports have a significant positive effect instead of export. It is the main factor for technological transfers and economic growth.

In another paper, Vahid Shahabineja, Baft Shahid, Mohammad Reza Zare Mehrjerdi (2014) They use Stochastic Frontier Analysis (SFA) for 44 Asian countries from 2000 to 2010. According to their studies in most developed countries, the TFP has a big portion of growth rate, instead of developing countries accumulating factors of production has a significant role in economic growth.

In another study, Jungsuk Kim and Jungsoo Park (2017) showed that TFP has a significant role in transferring country from middle-income status to high – income status. They determine that the catch-up effect, human capital, smaller population, weak currency, research, and development (R&D) growth are significant sources of TFP growth. Also, they find out that during the transition of the economy they can overcome challenges by developing innovative activities and creating innovation institutions. By making reforms for stimulating innovation and the education system they can achieve sustainable development. Another Azeta Lungu and Johan F.M. Swinnen (2003) researchers analyses of TFP in the agricultural sector for Eastern Europe and Central Asia countries. According to their study in Post-Soviet countries, the TFP development was not stable

Model and Data

The methodology of this study is mainly based on the growth accounting approach. The growth accounting empirically accounts for growth in output by measuring factor inputs and an unexplained residual, which is generally attributed to technological change.

We assume a two-factor Cobb-Douglas production function for the national economy

For country i country at time t :

$$Y_i(t) = A_i(t) K_i^\alpha(t) L_i^{1-\alpha}(t) \quad (2)$$

Where

$$Y = AK^\alpha L^\beta$$

$Y_i(t)$: Output- GDP

$A_i(t)$: Residual Factor (Total Factor Productivity)

$K_i(t)$: Gross capital formation

$L_i(t)$: Labor forces

α : dividend of capital

For analyzing data, the Cobb-Douglass production function is used for the national economy and the agricultural sector. Panel data consisting of six Post-Soviet Eastern European countries: twenty-four years (1992 – 2015) is used in this study. Six countries were getting independence from USSR in the same year. To find different sources in economic growth, we use three methods;

- Growth Accounting
- Development accounting
- Regression Analysis with panel data

To find the relationship between output (GDP), factors of production (Capital, Labor), and TFP, we use Growth accounting. Growth accounting is a procedure that gives primary diagnostics of growth and visualizes the contribution by each factor input and productivity. Macroeconomic basics assume that sustainable economic growth depends critically on productivity growth. Other factor inputs have diminishing marginal returns. Hence, the accumulation of factor inputs only can generate growth until the optimal factor deepness has been achieved. Afterward, the only growth in productivity may generate sustainable growth. The meaning of growth accounting is to decompose the growth rate of GDP into contributions from the main production factors, i.e. capital, labor, and technology. The growth accounting could be expressed as follows;¹⁾

$$\begin{aligned} g_{Y_{it}} &= g_{A_{it}} + \alpha g_{K_{it}} + (1 - \alpha)g_{L_{it}} + \epsilon_{it} \\ g_{y_{it}} &= g_{A_{it}} + \alpha g_{k_{it}} + \epsilon_{it} \end{aligned} \quad (3)$$

Where

$g_{Y_{it}}$: Growth rate of GDP in i th country in the j year.

$g_{A_{it}}$: Growth rate of TFP in i th country in the j year.

$g_{K_{it}}$: Growth rate of capital in i th country in the j year.

$g_{L_{it}}$: Growth rate of labor in i th country in the j year.

$g_{y_{it}}$: Growth rate of per capita GDP in i th country in the j year

$g_{k_{it}}$: Growth rate of per capita capital in i th country in the j year

To compare countries' output and factors of production we use ratios (Development accounting) to find out how the difference in output results, the difference of factor accumulation. In another word this expression says that, in determining the productivity difference between the two countries, we look at their levels of output and levels of factor accumulation.

1) For details, see appendix 1

$$\frac{Y_i}{Y_{Az}} = \left(\frac{A_i}{A_{Az}} \right) \left(\frac{K_i^\alpha \cdot L_i^{1-\alpha}}{K_{Az}^\alpha \cdot L_{Az}^{1-\alpha}} \right) \quad (4)$$

Generally, capital-based growth is a widely accepted diagnosis for the countries that rely on catch-up strategy. For instance, Young (1995) demonstrated that accumulation of capital explains a huge part of the growth in the majority of Asian tigers through 1960–1990. The larger the ratio of GDP in the two countries, the larger a productivity gap we would infer. Conversely, the larger the gap in the accumulation of factors (Capital and labor), the smaller the productivity gap we would infer. In other words, the larger the difference in output between two countries that is explained by differences in factor accumulation, the less reason there is to conclude that a difference in productivity is the source of differences in income between the two countries. In development accounting, we can analyze the sources of differences in the level of income per capita among countries.

In the panel data, to choose between the fixed-effect model or the random effect model, Hausmann Test is used. Endogenous variables which detect endogenous repressors in a regression model have values that are determined by other variables in the system. Having an endogenous repressor in a model will cause ordinary least squares estimators to fail, as one of the assumptions of OLS is that there is no correlation between a predictor variable and the error term. Instrumental variables estimators can be used as an alternative in this case.

Growth regression is aimed at finding fundamental deterrents for long-term economic growth, by setting up different econometric models in inter-country or time order. Sala-Martin (1997), Barro (2003), and other economists have experimental researches on growth regression. The base methodology of growth regression is based on the regression equation in the following form:

$$y = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \dots + \beta_k * x_k + \epsilon \quad (5)$$

Economic growth vector in the y axis and x_1, \dots, x_k explanatory variables (growth determinants vector), the error ϵ . Note that the functional form of the model (1), as well as its independent variables, is differently given by different researchers.

Analyzing of National Economy in selected countries

Analyzing of National Economy in Selected Countries

To analyze differences in the TFP, GDP per capita, and capital per labor we use the development accounting method. In Table 1 we can see that Azerbaijan's total average growth rate of per capita GDP (8.4%) is higher than in other countries. But about 87.2% of this is derived from capital per labor (capital accumulation), 7.3% by the labor force, and only 5.5 % derived by TFP. The rapid economic development is mainly attributed to the exploitation of hydrocarbon resources (through production-sharing agreements with foreign oil companies and

foreign direct investment) Looking at other countries (Belarus, Ukraine, and Moldova we can see that although the total average growth rate of per capita GDP growth is much less than Azerbaijan (accordingly 4.6%, 2.8%, 0.6%) but generally TFP is contributed more than 50% of GDP.

Table 1. Growth Rates and Its Constituents: National Economy (Continued)

Unit: %

Year	The growth rate of GDP	Contribution from Capital	Contribution from Labor	The growth rate of TFP
Azerbaijan				
Total (1995 – 2015)	8.4	7.3	0.6	0.5
Share	100.0	87.2	7.3	5.5
1995 – 2000	3.6	4.6	0.3	-1.4
Share	100.0	128.9	8.8	-37.7
2001 – 2005	12.7	17.3	1.2	-5.8
Share	100.0	136.6	9.2	-45.9
2006 – 2010	15.2	-1.2	0.6	15.8
Share	100.0	-7.8	3.7	104.1
2011 – 2015	2.2	8.6	0.4	-6.8
Share	100.0	391.8	17.9	-309.7
Belarus				
Total (1995 – 2015)	4.7	2.1	0.2	2.4
Share	100.0	45.0	4.3	50.7
1995 – 2000	3.3	-0.6	0.2	3.7
Share in	100.0	-16.8	4.8	112.0
2001 – 2005	7.2	4.7	0.3	2.1
Share in	100.0	65.5	4.7	29.7
2006 – 2010	7.0	6.7	0.3	0.1
Share	100.0	94.7	3.9	1.4
2011 – 2015	1.2	-2.4	0.00 ¹⁾	3.6
Share	100.0	-205.4	3.8	301.5
Georgia				
Total (1995 – 2015)	5.5	8.4	-0.4	-2.5
Share	100.0	152.5	-6.5	-46.0
1995 – 2000	5.1	20.6	-1.1	-14.3
Share	100.0	399.8	-21.9	-277.9
2001 – 2005	7.1	8.1	-0.2	-0.8
Share	100.0	114.5	-3.1	-11.4
2006 – 2010	5.0	-2.1	-0.3	7.4
Share	100.0	-40.7	-5.3	146.1
2011 – 2015	4.8	7.0	0.2	-2.4
Share	100.0	146.3	4.0	-50.3

Table 1. Growth Rates and Its Constituents: National Economy

Unit: %

Year	The growth rate of GDP	Contribution from Capital	Contribution from Labor	The growth rate of TFP
Moldova				
Total (1995 – 2015)	2.8	1.2	-0.1	1.8
Share	100.0	40.7	-3.8	63.1
1995 – 2000	-2.5	-1.6	-0.1	-0.8
Share	100.0	65.7	2.5	31.9
2001 – 2005	6.8	5.3	0.2	1.4
Share	100.0	77.2	2.5	20.4
2006 – 2010	3.2	-0.5	-1.5	5.2
Share	100.0	-15.6	-48.8	164.4
2011 – 2015	3.8	1.5	1.0	1.3
Share	100.0	38.6	26.2	35.2
Ukraine				
Total (1995 – 2015)	0.6	-1.2	-0.5	2.3
Share	100.0	-216.7	-93.1	409.8
1995 – 2000	-3.8	-6.5	-1.2	3.9
Share	100.0	170.3	30.3	-100.6
2001 – 2005	7.4	4.8	0.1	2.5
Share	100.0	65.1	1.0	33.9
2006 – 2010	1.0	-0.1	-0.4	1.5
Share in	100.0	-9.5	-35.4	144.9
2011 – 2015	-2.3	-3.1	-0.7	1.4
Share	100.0	133.7	28.4	-62.1

¹⁾0.00=0.0005

Sources: World Bank, calculated by myself.

After the independence from the Soviet Union, Azerbaijan as other Post-Soviet countries faced an economic crisis. But after the signed contract in 1995 (named as “Contract of the century”) with developed countries (US, UK, France, Turkey, etc.) related to the oil industry, the economic stability period began and it attracts foreign direct investment which makes Azerbaijan as one of highest economic growth among the CISs. But although high economic growth we can observe some problems from tables. In period 1995 to 2000 average total economic growth rate was 3.6% and the major part was contributed by capital accumulation, TFP at that period didn’t have any effect because the most industry was abolished after independence. In 2001 – 2005 there was the same scenario. Although the average growth rate of GDP increases to 12.7%, the main contribution came from the capital and labor factor accumulation. Only in 2006 to 2010 the composition of economic growth was changed. The main factor became TFP and the labor force. This happened because of the global crisis which was in 2008. In the last analyzed period (2011 – 2015) a contribution of capital again became a major factor with labor forces. And major capital comes from FDI of the oil sector. We can conclude that even capital increase total economic growth, excess of capital, and increasing labor force harms the development of TFP. It means that a high level of a factor of

productions (capital and labor) made fewer incentives to enhance TFP. The second-highest total average growth rate of per capita GDP (5.5%) was observed in Georgia, but we can see that the growth is contributed by capital per labor and TFP even negative in this case. We can conclude that as more attention on capital deepening TFP less will increase. In Georgia case, a single sector or in which the country has a comparative advantage in the wine industry and tourism. The country has positive TFP only in the period 2006 – 2010, which can be explained by the 2008 global crisis that harms capital accumulation. With the drop in FDI, the Georgian economy has become vulnerable to external forces and shocks.

In the Belarus case, we can see that the annual average growth rate of GDP per capita is 4.7 % and nearly 51% is contributed by TFP. Belarus's main exports included heavy machinery (tractors), agricultural products. To develop their industry sectors they mostly increase their technology. But also we should consider the fact that in comparison with other countries at the beginning stage after independence from the USSR, GDP is almost fully contributed by TFP. Also, we should mention the fact that Belarus has no oil and gas resources, potassium salts are the main and modest source of natural resources.

In Ukraine's case, the general average growth of total GDP between 1995 – 2015 years is 0.6 %, which mostly contributed 2.3 (409.8 % of GDP) by TFP, -0.5 (93.1 % of GDP) by labor, and -1.2 (-216.7 % of GDP) by capital per labor. In Moldova case general average growth of total GDP between 1995 – 2015 years is 2.8 %, TFP brings the largest input (63.1 %), and the second-largest contribution comes from capital (40.7 %). A total average GDP per capita contribution of the labor force is negative (-3.8 %), which shows the problem of a lack of labor force.

Analyzing of Agricultural sector in selected countries

In analyzing the agricultural sector, we also use the growth accounting method. Through agricultural value-added, agricultural capital, and agricultural labor force we calculate TFP and by making decomposition we try to find main factors affecting total agricultural value-added. All data were taken from the FAO STAT from 1992 to 2016.

According to Table 2, the annual average growth rate of the agricultural sector in 1995 – 2000 in Azerbaijan was -2.3%, owing to the economic and political crisis after independence in 1991 although it was one of the main industries. The lack of capital was a major factor of negative impacts on economic growth during that period. From 2001 to 2005 there was a recovering period. After the land reform in 1995, the agricultural sector became recovering and it was mainly affected by TFP. In 2006 – 2010 there was a positive growth period for agriculture, its growth rate was 5.2% and the contribution of TFP was increased to 77.6%. In a period from 2011 to 2015, the contribution of capital increased from 17% to 23.1% instead of this TFP in comparison with the previous period decreased from 77.6% to 72.3%. Nowadays in Azerbaijan agricultural sector one of the priority sphere. Although the average agricultural value-added growth was -2.3 it increases to 4.4 in 2011 – 2015 years. This mainly contributed from government supporting policy (subsidy, soft long-term loans, leasing, free of tax policy (except land tax)) to the agricultural sector.

In the Belarus case although at the beginning period 1995 – 2000 the agricultural value-added growth rate was positive 0.8% in the last period it was decreased to -5.8%. According to the average indicator from 1995 to 2015, the main issue in Belarus agricultural sector is the labor force and the main contribution came from capital. In Georgia's case, although at the beginning stage 1995 – 2000 the average agricultural value-added was negative (-4.8%) it has developed and increased to an average of 6.4 % in 2011 – 2015. And the highest contribution to the

Table 2. Growth Rates and Its Constituents: Agricultural sector(Continued)

Unit: %

Year	The growth rate of Agr Val Added	Contribution from Capital	Contribution from Labor	The growth rate of TFP
Azerbaijan				
Average (1995 – 2015)	2.2	7.2	0.3	-5.3
Share in GDP	100.0	332.5	12.8	-245.3
1995 – 2000	-2.3	29.6	-0.3	-31.5
Share in GDP	100.0	-1305.9	15.4	1390.5
2001 – 2005	1.4	-2.8	1.0	3.2
Share in GDP	100.0	-206.0	72.8	233.2
2006 – 2010	5.2	0.9	0.3	4.0
Share in GDP	100.0	17.0	5.4	77.6
2011 – 2015	4.4	1.0	0.2	3.2
Share in GDP	100.0	23.1	4.1	72.9
Belarus				
Average (1995 – 2015)	0.8	1.8	-2.1	1.1
Share in GDP	100.0	222.3	-263.2	140.9
1995 – 2000	1.1	14.3	-2.1	-11.1
Share in GDP	100.0	1311.1	-196.8	-1014.3
2001 – 2005	0.000	-6.3	-2.8	9.0
Share in GDP	100.0	12983.7	5662.3	-18546.0
2006 – 2010	7.9	1.6	-2.3	8.7
Share in GDP	100.0	19.9	-29.3	109.4
2011 – 2015	-5.8	-2.4	-1.2	-2.1
Share in GDP	100.0	42.2	21.3	36.5
Georgia				
Average (1995 – 2015)	-4.8	-1.1	-1.0	-2.7
Share in GDP	100.0	23.2	20.3	56.5
1995 – 2000	-16.9	-6.0	-1.8	-9.1
Share in GDP	100.0	35.5	10.9	53.6
2001 – 2005	0.4	1.3	0.1	-1.0
Share in GDP	100.0	316.6	17.6	-234.2
2006 – 2010	-9.1	0.0	-1.1	-8.0
Share in GDP	100.0	0.2	11.4	88.4
2011 – 2015	6.4	0.2	-1.1	7.3
Share in GDP	100.0	3.8	-17.2	113.4

Table 2. Growth Rates and Its Constitutes: Agricultural sector

Unit: %

Year	The growth rate of Agr Val Added	Contribution from Capital	Contribution from Labor	The growth rate of TFP
Moldova				
Average (1995 – 2015)	-1.5	-4.7	-1.1	4.3
Share in GDP	100.0	307.9	72.8	-280.7
1995 – 2000	-5.3	-11.2	0.4	5.5
Share in GDP	100.0	209.8	-7.0	-102.7
2001 – 2005	-1.9	-8.8	-2.4	9.2
Share in GDP	100.0	456.4	123.1	-479.5
2006 – 2010	-3.0	-0.4	-5.8	3.2
Share in GDP	100.0	13.5	192.8	-106.3
2011 – 2015	4.2	1.5	3.3	-0.7
Share in GDP	100.0	37.0	80.3	-17.4
Ukraine				
Average (1995 – 2015)	0.4	-0.7	-1.2	2.2
Share in GDP	100.0	-175.0	-330.0	575.0
1995 – 2000	-1.0	-3.4	0.7	1.6
Share in GDP	100.0	330.1	-69.4	-160.6
2001 – 2005	-1.7	-1.0	-1.7	1.1
Share in GDP	100.0	62.2	105.1	-67.3
2006 – 2010	-3.2	2.1	0.3	-5.6
Share in GDP	100.0	-65.9	-9.2	175.1
2011 – 2015	7.3	-0.5	-4.1	11.9
Share in GDP	100.0	-6.2	-55.5	161.7

Sources: FAOSTAT

growth of the agricultural sector comes from TFP. The main problem as in the Belarus case, however, was lack of labor force. In the Moldova case, although at the beginning period 1995 – 2000 the average agricultural value-added was negative (-1.5%) in the 2011 – 2015 years, the growth rate was increased to average 4.2% which mainly was contributed by labor force (80.3%) and capital deepening (37.0%). TFP was negative (-17.4 %) at that time. In Ukraine's case, the development of the agricultural sector is generally contributed by TFP.

Estimation and Results

The analyzing is held by panel data which is consists of 6 countries for 24 years (1992 – 2015) as followings:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots + \beta_k x_k + \mu \quad (6)$$

6 regression models with different specification will be analyzed.

- $grgdp_{i,t} = \beta_0 + \beta_1 grcapital_{i,t} + \beta_2 grTrade_{i,t} + \beta_3 grgdpRus_{i,t} + \varepsilon_{i,t}$
- $gdp_{i,t} = \beta_0 + \beta_1 grcapital_{i,t} + \beta_2 grTrade_{i,t} + \beta_3 grgdpRus_{i,t} + \beta_3 grFDI_{i,t} + \varepsilon_{i,t}$
- $TFP_{i,t} = \beta_0 + \beta_1 grcapital_{i,t} + \beta_2 grTrade_{i,t} + \beta_3 grgdpRus_{i,t} + \varepsilon_{i,t}$
- $TFP_{i,t} = \beta_0 + \beta_1 grcapital_{i,t} + \beta_2 grTrade_{i,t} + \beta_3 grgdpRus_{i,t} + \beta_3 grFDI_{i,t} + \varepsilon_{i,t}$
- $grAGVAD = \beta_0 + \beta_1 grcapital_{i,t} + \beta_2 grtrade_{i,t} + \beta_3 grgdprus_{i,t} + \beta_3 grALabor_{i,t} + \beta_4 \ln AIM_{i,t} + \beta_5 \ln AXP_{i,t} + \varepsilon_{i,t}$
- $grATFP = \beta_0 + \beta_1 grAcapital_{i,t} + \beta_2 grALabor_{i,t} + \beta_3 grgdprus_{i,t} + \beta_3 grAXP_{i,t} + \beta_4 grAIM_{i,t} + \varepsilon_{i,t}$

Analyzing factors on the Growth rate

Model 1 is using Fixed-effects (within) regression, number of observation 134, number of groups 6. The main factor affecting the growth rate of GDP per capita is capital per labor (69.02%) and Russian GDP growth rate (52.3%), Trade has less effect (only 3.3%) because as we see from previous tables capital accumulation is the main factor in GDP, also like the Russia main trade partner of selected countries is Russian GDP growth rate also highly affected. With a 5% significant level, the null hypothesis all dummy variables of 5-panel groups are “0” is rejected. So the fixed effects model is adequate (Table 3).

Table 3. Estimation and Results

Depend. Var.	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	gy	gy	gYA	ga	ga	gaA
gk	0.690*** (0.014)	0.646*** (0.17)		-0.428*** (0.021)	-0.449*** (0.029)	
rgT	0.033*** (0.084)	0.233** (2.37)		0.458*** (0.013)	0.349** (0.015)	
gYRus	0.523*** (0.104)	0.529*** (0.101)	0.566** (0.254)	0.423*** (0.122)	0.472*** (0.124)	0.606** (0.258)
L1_FDI		0.002*** (0.001)			0.002*** (0.001)	
gKA			0.028 (0.034)			-0.510*** (0.035)
gLA			0.491*** (0.042)			0.399 (0.197)
gAXP			0.896** (0.043)			0.079 (0.044)
gAIM			-0.438 (0.048)			-0.036 (0.049)
constant	0.029*** (0.006)	0.014* (0.007)	-0.237 (0.014)	0.032*** (0.006)	0.148* (0.008)	-0.025*** (0.258)
R ²	0.586	0.532		0.761	0.672	0.7083

Notes: Figures in parentheses are standard errors. Asterisk indicates significance at the 1% (***), 5% (**) and 10% (*).

In Model 2, we added the growth rate of foreign direct investment. FDI in the previous year are affecting the growth rate of per capita GDP is statistically significant.

In Model 3, the main factor affecting agricultural value-added is agricultural labor, Russian GDP, and export, import negatively affected agricultural value-added. We cannot reject all dummy variables of 5-panel groups are “0”. So the Pooled GLS model is much adequate than the fixed effects model. The coefficient of the gYRus variable is 0.566 and it has a 5% significant level, it means that Russian GDP growth has strong effects on the growth rate. The growth rate of labor in the Agricultural sector (gLA) and Growth rate of Agricultural Export (gAXP) have positive effects on the growth rate.

In the last three models we will analyze TFP cases:

According to Model 4 growth rate of capital negatively affected TFP. As we see from the previous analysis (tables) in periods when the growth rate of capital decrease portion of TFP increase. Another dependent variable (real growth rate of trade and Russian real GDP growth) is positively affected. It should be noted that $R^2 = 0.7613$, it means that this dependent variable 76% can be explained by selected variables. We cannot reject all dummy variables of 5-panel groups are “0”. So the Pooled GLS model is much adequate than the fixed effects model.

Model 5 used the same variables by adding FDI and according to estimation FDI positively affects TFP. As we can see in Model 6, agricultural capital per labor growth and agricultural import negatively affected TFP in the agricultural sector. Another independent variable as the Growth rate of per capita GDP of Russia and the growth rate of agricultural products export, labor force in this sector positively affect TFP. $R^2 = 0.7083$, which means selected variables 70.83% can explain dependent variable.

Conclusion

In the situation of excess capital stocks and labor forces generally, accompany fewer incentives to develop TFP. Without the development of TFP, we will have unstable growth and the growth rate is also fragile on the external shock.

Countries with a lack of factors of production, however, their TFP is inclined to be more developed. To get more output with fewer inputs, they have focused on the development of TFP. Another cause of the underdeveloped TFP among Post Soviet countries was a lower initial level of TFP after independence.

From the regression analysis, we observed that generally Post-Soviet countries' agricultural market was mainly dependent on Russian GDP growth. For the long-term, economic growth government should concentrate on policies promoting TFP growth. There is room for growth through technology adoption. Policies aimed at promoting competitiveness and better state-owned enterprise management (in particular, through privatization) will create incentives and conditions for technology adoption.

Also, growth in the quality of labor should be supported by education. Growth in physical capital stock which determines by new capital investment should be less than existing capital stock more investment should be directed

in technology and efficiency of production.

There are some limitations to the methodological approach which should be highlighting. Because of lack of data some main factors as FDI for the Agricultural sector, R&D, Effects of climate change on the agricultural sector, and TFP not analyzed. In reality, TFP change is entirely attributable to technical change only when production technology is defined by constant returns to scale, and when there is no technical inefficiency. Denny, et al (1981). This suggests that it is possible for the decline of technical efficiency, considering that constant returns to scale to be the major cause of the downtrend in TFP growth although technical change is positive.

Appendix A

The growth rate of GDP

$$g_{Y_{it}} = g_{A_{it}} + \alpha g_{K_{it}} + (1 - \alpha)g_{L_{it}} + \epsilon_{it}$$

$$g_{y_{it}} = g_{A_{it}} + \alpha g_{k_{it}} + \epsilon_{it}$$

If we take the log function,

$$\ln Y = \ln A + \alpha \ln k + (1 - \alpha) \ln L$$

$$\frac{d \ln Y}{dt} = \frac{d \ln A}{dt} + \alpha \frac{d \ln K}{dt} + (1 - \alpha) \frac{d \ln L}{dt}$$

$$\ln \left(\frac{Y}{L} \right) = \ln A + \alpha \ln \left(\frac{K}{L} \right)$$

$$\text{Let } y = \frac{Y}{L}, k = \frac{K}{L}$$

$$\ln y = \ln A + \alpha \ln k$$

$$\frac{d \ln y}{dy} = \frac{d \ln A}{dt} + \alpha \frac{d \ln k}{dt}$$

Appendix B

Table A1. Definitions and Sources of Variables (Continued)

Variables	Definition	Source
gy	The growth rate of real GDP per capita GDP (current LCU)/ GDP deflator: linked series (base year varies by country)/total population	World Bank
gYA	The growth rate of agricultural value-added – Value Added (Agriculture, Forestry, and Fishing), Value Local Currency	FAOSTAT
ga	TFP for National Economy	Calculation
gaA	TFP for the Agricultural sector	Calculation
gk	The growth rate of real capital per labor (Gross capital formation (current LCU), GDP deflator: linked series (base year varies by country) Labor force, total	World Bank
rgT	The real growth rate of Trade (Export + Import) Export/Import UNSD Annual Totals trade (ATT) 2000 – 2015 (as of 17 Jan 2017)	http://data.un.org/Explorer.aspx?d=ComTrade
gYRus	The growth rate of real GDP per capita of Russia GDP (current LCU)/ GDP deflator: linked series (base year varies by country)	World Bank

Table A1. Definitions and Sources of Variables

Variables	Definition	Source
L1_FDI	Foreign direct investment, net inflows (% of GDP)	World Bank
gKA	The growth rate of real agricultural capital Net Capital Stocks (Agriculture, Forestry, and Fishing) GDP deflator: linked series (base year varies by country)	FAOSTAT World Bank
gLA	The growth rate of labor in the Agricultural sector	ILO.org
gAXP	The growth rate of Agricultural Export, Agricult.Products, Total Export Value, 1000 US\$	FAOSTAT
gAIM	The growth rate of Agricultural Import, Agricult.Products, Total Import Value, 1000 US\$	FAOSTAT

Table A2. Summary of Variables in the Growth Accounting Method

Obs	Mean	Std.	Dev.	Min	Max
gKA	100	0.01	0.35	-0.83	2.67
gkA	100	0.03	0.35	-0.90	2.67
gYA	104	-0.02	0.14	-0.68	0.42
gyA	104	0	0.15	-0.62	0.47
gLA	105	-0.02	0.07	-0.36	0.21
gY	104	0.04	0.07	-0.16	0.3
gy	104	0.04	0.06	-0.14	0.27
gL	105	0	0.02	-0.06	0.07
gK	104	0.06	0.27	-0.73	1.69
gk	104	0.06	0.27	-0.71	1.73
gaA	105	-0.01	0.22	-1.52	0.47
rgT	104	-0.13	0.48	-1.98	0.82
gAIM	95	0.12	0.29	-0.86	1.12
gAXP	95	0.11	0.3	-1.58	0.89
gYRus	105	0.03	0.05	-0.08	0.1
L1_FDI	100	7.3	9.35	0.075	5.08

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