DOI: https://doi.org/10.30525/2256-0742/2022-8-4-8-18

ECONOMIC GROWTH AND TOTAL FACTOR PRODUCTIVITY IN CENTRAL AND EASTERN EUROPEAN COUNTRIES BETWEEN TWO GLOBAL CRISES AND BEYOND

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Abstract. The *aim* of the article is to assess the factors of economic growth of the CEE countries over the 30-year history, the productivity of capital and human resources, the resilience of these countries to the negative impact of the global financial crisis. *Methodology*. The Solow growth model was used to estimate the growth rates of capital, labor and total factor productivity (TFP). The impact of macroeconomic indicators on GDP and TFP growth is assessed. The group of Central and Eastern European countries that joined the European Union was chosen for the analysis: Bulgaria, Romania, Poland, Hungary, Czech Republic, Slovakia, Slovenia, Estonia, Lithuania, Latvia, as well as post-Soviet European countries: Ukraine, Belarus, Russia and Moldova and Albania in the period from 1991 to 2019. *Results*. TFP makes a significant contribution to the economic growth of CEE countries. During the period of market reforms, TFP significantly decreased, and during the boom of 2000–2008 it fully ensured the growth of the CEE economies, after the crisis of 2008, the contribution of TFP decreased by 2 times. In the conditions of recovery, TFP growth is positively influenced by inflation, negative CA balance, and unemployment reduction. In the post-crisis period, a decrease in inflation, a positive CA balance, and an increase in unemployment had a positive impact on TFP growth. During a depression, the influence of capital becomes dominant. Restrictive monetary policy contributes to the efficiency of CEE economies. In the short run, unemployment increases, but in the long run it decreases significantly due to the growth of investment and exports. *Practical implications.* The analysis makes it possible to identify effective macroeconomic policies to stimulate the productivity of the economies of Central and Eastern Europe during the period of economic recovery and depression. *Value/originality.* A long-term study of the economic performance of CEE countries using the Solow methodology has revealed the behavior of total factor productivity in different periods of modern economic history and its contribution to economic growth.

Key words: economic growth, total factor productivity, crisis, internal and external balance, CEE.

JEL Classification: O47, O57, F43

1. Introduction

The thirty-year development path of post-socialist countries requires serious reflection and new understanding of further movement in the conditions of economic and geopolitical turbulence observed on the European continent.

The struggle of economic models of development of states, their successes and failures, their potential in ensuring stable economic development are becoming decisive in the modern world economy.

The Soviet model of economy with its authoritarian-totalitarian institutional environment left a deep imprint on the economic life of the countries of Central and Eastern Europe, especially on the attitude to the working person and the formation of value orientations. All this is very clearly projected on the social capabilities of the economy, its productivity. Resource-rich Russia, which has significant problems in economic efficiency and distribution of national wealth, wants to compensate for its backwardness in productivity with an aggressive war of aggression against Ukraine, terrifying the free peoples of Europe.

The global crisis of 2008, as well as the pandemic, had a significant impact on the economies of CEE countries, which is associated with significant capital outflows, volatility in world resource prices, and rising unemployment. In this analysis, an attempt will be made to assess the factors of economic growth

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in CEE countries over the 30-year history, how fully and efficiently capital and human resources are used, and how resilient these countries are to the negative impact of the global financial crisis. All this affects the future capacity of the countries to counter the pandemic, as well as geopolitical challenges.

The crisis of 2008 has certain common features with the crisis of the early 1930s, which ended with the Second World War, when European countries were economically weakened and the process of protectionism in international trade and the collapse of the Genoa Monetary Agreement began. Germany, which lost the First World War, wanted to take revenge and implement a new territorial division of Europe, which is very similar to the actions of Russia, which is trying to restore the collapsed Soviet Union, and even 6 years after the global financial crisis.

Productivity of the economy in the definition of such famous economists, Nobel laureates as R. Solow, P. Krugman, J. Stigler, who first introduced the concept of total productivity of production factors (Stigler, 1947), is a determining factor in the economic life of the country, which ensures long-term stability and prosperity.

So, P. Krugman in his book "The Age of Diminishing Expectations" wrote that "Productivity is not everything, but in the long run it is almost everything" (Krugman, 1997, p. 11).

The high productivity (efficiency) of the economy shows how much it has adapted, whether technological changes have taken place that have laid a stable foundation for sustainable economic growth, as well as the insulation of the economy from internal and external shocks.

In this study, the period of economic development of the CEE countries was divided into three stages: I stage – 1991–1999 – the stage of radical market reforms, liberalization of economic life; II stage – 2000–2008 – economic recovery, acceleration of economic growth rates, which were the highest in the world, huge inflow of foreign capital; III stage – 2009–2019 – the beginning of the crisis, recession, outflow of private foreign capital, high unemployment, the beginning of the Russian-Ukrainian war. In comparison of the last two periods the main economic trends of post-crisis development of the CEE countries are determined.

2. Analysis methodology

Growth accounting helps to explain economic growth by decomposing output growth into the contributions of capital, labour and residuals as a measure of improvements in the efficiency of capital and labour use. The residual is an estimate of changes in total factor productivity (TFP), which reflects a wide range of factors that affect the efficiency of resource use. Labour productivity is affected by the level of education and work experience. Capital productivity is affected by the age of the equipment, the level of technology embodied in it, and whether the capital good is publicly or privately owned (Iradian, 2007).

In the twentieth century, the model formalization of the mechanism of economic growth was carried out in the works of Robert Solow (2, 3), written in 1956 and 1957, respectively. Using the Cobb-Douglas production function, the trajectory of economic growth is calculated:

$$Y = AK^{\alpha}L^{1-\alpha} \quad (1),$$

where Y is the total income of the economy, K is the amount of capital, L is the amount of labor, A is the level of technical progress or total factor productivity, α is the parameter that determines the share of capital. The author decomposed this formula in a dynamic form, differentiating (2, 3):

$$\Delta Y = \Delta A + \alpha\Delta K + (1-\alpha)\Delta L \quad (2)$$

$$\Delta A = \Delta Y - (\alpha\Delta K + (1-\alpha)\Delta L) \quad (3)$$

Variable ΔA (rate of growth of total factor productivity) is set externally or exogenously, and it is impossible to influence its value. The economy grows steadily up to a certain steady state of capital per capita, after which only technological progress is the main source of growth. This model is called the neoclassical theory of exogenous economic growth.

The group of Central and Eastern European countries that joined the European Union was chosen for the analysis: Bulgaria, Romania, Poland, Hungary, Czech Republic, Slovakia, Slovenia, Estonia, Lithuania, Latvia, as well as post-Soviet European countries: Ukraine, Belarus, Russia, Moldova and Albania and conducted a study of economic growth in the period from 1991 to 2019, which covers 420 observations.

The capital was calculated on the basis of the PIM method (perpetual inventory method) with a capital depreciation rate of 5%, and for the period from 1990 to 2019 in USD at constant 2005 PPP prices. The amount of capital for 1990 was estimated according to the capital to GDP ratio of 3. According to the PIM method (4), the amount of capital in a given year is equal to the amount of capital in the previous year plus investments minus depreciation for the year of the initial capital for the year.

$$K_{t+1} = K_t + I_t - \delta K_t \quad (4),$$

where K_{t+1} – the amount of capital, I_t – investment rate, δ – rate of depreciation of capital. According to the PIM method, the amount of capital in a given year equals the amount of capital for the previous

year plus investments minus depreciation for the year of the initial capital for the year. The author collected share of capital α from UN data national accounts (UNSD, 2021), using data on compensation of employees.

A preliminary analysis of capital per worker shows a significant increase in the new EU member states: Poland, Slovakia and the Baltic States more than doubled, in contrast to the post-Soviet European countries, where the growth of capital per worker does not exceed a few percent, and in Ukraine has not reached the levels of 1991, and given the significant reduction in employment in these countries, the total amount of capital in the economy has changed very little.

In general, it can be concluded that over the past thirty years the differentiation in the provision of post-socialist countries with physical capital has increased significantly.

Some authors have interpreted economic growth through direct effects of human and physical capital (sweat factors) and through TFP growth (inspiration). Inspired growth can raise the technological frontier, thereby increasing the maximum possible output with a given amount of human and physical capital; alternatively, it can increase the efficiency of human and physical capital, bringing output closer to the maximum possible given the existing technological frontiers (Van Leeuwen et al., 2015). Total factor productivity can be interpreted as technological improvement or factor efficiency improvements, as the acquisition and introduction of new technologies, structural reallocation or simply a shift to the efficient frontier, sustainable TFP growth is the key to long-term economic development (Burda & Severgnini, 2009).

The first accounting of economic growth was carried out by R. Solow, who found that the accumulation of physical capital accounted for about 12% of the increase in output per hour worked in the United States from 1900 to 1949, and the remaining 88% was due to the growth of TFP (Solow, 1957).

In more recent study for 145 countries Baier, S., Dwyer, G., & Tamura, R. found that weigted-average TFP growth is only about 8% of growth of ouput per worker. They attribute this decline in TFP to institutional regression and armed conflict. Their study of TFP growth shares for different regions shows the following results: 25% growth in output per worker for Western countries, 20% for Southern Europe and 18% for newly industrialized countries (Baier et al., 2002).

A new study by these authors in 2016 over a longer period of time and a new methodology for measuring human capital found that in the unweighted case, output per worker in a typical country had an annual growth rate of 1.32%, 0.90% for inputs and 0.42% for TFP, with growth in inputs explaining almost 60% of the growth in output per worker, with a range from 55% for Asia to 94% for Central and Eastern Europe over the period 1970 to 2010, with negative growth rates in TFP (Tamura et al., 2016). With the new human capital measure, more than 90 percent of the variation in long-run growth can be explained by variation in the growth of expenditures per worker, and less than 10 percent by variation in TFP growth.

Furthermore, between 55% and 70% of the variation in the logarithm of output per worker can be explained by the variation in the logarithm of the level of inputs, and less than half of the variation in the logarithm of output per worker can be explained by the variation in the logarithm of TFP. These results are robust to different time periods and different values of human capital accumulation technology parameters. The longer the study period, the smaller the share of TFP growth in output per worker (Tamura et al., 2016).

For Central and Eastern European countries, special growth accounting studies have been conducted (Alam et al., 2000; Brada, Bah El-hadj, 2009; De Broek, Koen, 2000; Dobrinsky et al., 2006; Iradian, 2007; Schadler et al., 2006; Van Leeuwen et al., 2015; Levenko et al., 2017), in which TFP growth was measured for different periods.

3. Growth accounting for CEE and its explanation

In the Soviet economic model, economic growth was an imperative, but the introduction of an extensive rather than intensive growth strategy led to the collapse of the socialist system (Campos and Corricelli, 2002). Why did this happen? The answers are: low productivity and various rigidities in the economic structure, which are well reflected in the low elasticity of substitution between factors of production (Easterly and Fisher, 1995). During the last fifteen years of the Soviet Union (1978–1993), GDP growth was -1%, physical capital growth was 3%, and TFP growth was negative -4% (Van Leeuwen et al., 2015).

The beginning of market reforms, which was associated with price liberalization and small-scale privatization, as well as the creation of new independent states after the collapse of the Soviet Union, was accompanied by a significant decline in economic growth.

In fact, all countries showed a decline, except Poland and Slovenia, where it was short-lived. The dominant factor behind the fall in gross domestic product was a sharp decline in the efficiency or overall productivity of the factors of production. Capital degraded, labour was artificially delayed, and technology became obsolete, especially in large

industrial enterprises. According to the authors, the lack of structural adjustment led to low unemployment, which in turn increased inefficient employment.

In the first period, CEE countries showed a significant decline in economic growth, with the worst performance in the post-Soviet republics: Moldova, Russia, Ukraine, where the annual decline ranged from 5 to 7%. In the Baltic States, the decline was also significant – from 1.65 to 4.1%. The lowest rates of decline were observed in Albania, Czech Republic and Hungary. Economic growth was observed only in Poland, Slovenia and Estonia (Table 1).

Decomposition of economic growth indicators shows a significant drop in employment growth in all countries except Romania and Slovenia. The highest annual rate of employment decline was observed in Estonia -3.5%, on average this indicator was -0.83% (Table 1).

As for capital, its growth was observed during this period, as countries carried out technological reconstruction and formed the foundation for future economic growth (Table 1). Among the countries with high growth rates of physical capital are: Albania, Czech Republic, Poland, Slovakia, Slovenia.

A drop in capital accumulation was observed in Bulgaria, Latvia, Lithuania, Moldova and Ukraine. If to project this process to the aftermath of the 2008 crises, an interesting pattern emerges: the higher the rate of capital accumulation observed in 1991–1999, the lower the volatility of economic growth, measured by standard deviation, with a correlation coefficient of -0.75.

Thus, a high level of capital is the basis for the sustainability of economic growth and its low volatility.

The rate of decline in total factor productivity during this period was extremely high, especially in Moldova, Ukraine, Russia, Romania and Lithuania (Table 2). Only in Poland TFP grew by 3.24% during this period, indicating significant technical change. The analysis shows that the drop in economic growth was largely caused by a decline in economic efficiency. Although there is a rather interesting phenomenon, when in some countries (Czech Republic, Hungary, Slovakia, Slovenia) with a very significant loss of economic efficiency there was a parallel accumulation of capital. This is a wise economic policy aimed at future economic achievements and sustainable development of the state.

It was noted that the transformational recession has become a large-scale growth crisis in most countries of Eastern Europe and the CIS, in which two main factors of production and aggregate production efficiency have made a negative contribution to GDP growth (Dobrinsky et al., 2006). This period also accompanied by a sharp drop in TFP, largely reflecting the "disorganization effects" (Blanchard and Kremer, 1997).

The study (De Broeck and Koen, 2000) notes that the drop in output at the beginning of the transition period is explained by a decline in TFP growth, which indicates a rapid deterioration of the growth potential of the Soviet-style economy (Campos and Corricelli, 2002).

In general, during the transformation of the planned-administrative economy into a market economy, according to our estimates, the decline in GDP during this period is 96% explained by the fall in total factor productivity (Table 2).

Quite sporadic and chaotic moves to liberalize economic life in many CIS countries ended in the

Table 1

Contribution of capital and employment to economic growth in CEE countries

Country	Capital growth			Employment growth		
	1991–1999	2000–2008	2009–2019	1991–1999	2000–2008	2009–2019
Albania	3,01	14,60	4,46	-1,05	-0,38	0,77
Belarus	0,84	4,98	7,00	-1,09	1,44	0,28
Bulgaria	-0,34	5,66	2,61	-1,03	2,15	-0,66
Czech Republic	2,70	3,77	2,32	-0,30	0,73	0,71
Estonia	0,97	9,26	6,11	-3,50	1,51	0,12
Hungary	0,74	2,88	1,66	-0,37	0,12	1,61
Latvia	-1,86	4,87	1,84	-2,60	1,69	-1,28
Lithuania	-0,50	4,28	1,96	-0,86	0,09	-0,30
Moldova	-0,47	1,44	2,25	-1,19	-0,45	-0,48
Poland	2,07	4,13	3,88	-0,65	1,57	0,84
Romania	1,13	4,59	3,00	1,85	-2,44	-0,15
Russian Federation	0,40	1,48	1,95	-0,68	1,08	-0,15
Slovak Republic	3,37	3,04	2,26	-1,04	2,00	0,61
Slovenia	2,02	5,54	1,98	1,41	1,34	-0,06
Ukraine	-0,92	0,16	-1,27	-1,39	-0,06	-0,87
Average	0,88	4,71	2,80	-0,83	0,69	0,07

Source: author's assessment

1998 financial crisis (the so-called "Russian winter"), which was accompanied by a significant devaluation of national currencies and, in fact, the formation of an authoritarian regime in Russia, which is still in force today.

The recovery of growth in the 2000s, preparations for EU accession, and foreign capital inflows led to accelerated economic growth. Such a high dynamics of economic development was due to improved terms of trade, high quality of institutional reforms for the countries that integrated into the European Union, as well as export orientation and commodity boom in the world economy for the CIS countries.

The second stage of economic development covers the period 2000–2008. Since 2000, the economic growth of the CEE countries began to boom. GDP growth rates ranged from 5 to 11%. The highest rates of economic growth were in the Baltic countries, as well as in the European post-Soviet republics – Ukraine, Belarus and Russia.

Capital growth in all countries is positive, averaging 4.7% (Table 1), with the highest rates in Estonia and Albania, which have undergone a transition from agrarian to industrial economies. The lowest indicators were observed in the economies of Ukraine and Russia.

Common to this group of countries was rapid financial integration, increased inflow of foreign capital and dominance of foreign banks in the financial markets of post-socialist European countries. Analysis of investments and savings shows that Central and Eastern European countries have chosen the path of economic development at the expense of foreign capital and external savings. The gap between savings and investments in favor of the latter has increased significantly over the period 2002–2008.

Total foreign financing of Eastern European countries increased from 96 billion USD in December 2003 to a peak of 550 billion USD in September 2008. Foreign liabilities of the banking sector of the CIS countries increased nine times in five years and reached USD 280 billion. The Baltic countries are the most dependent on foreign banks (almost 50% of banks' liabilities belong to foreign creditors) (Flows to Eastern Europe, 2009).

The pace of economic reforms in general slowed down during this period, and high growth rates were based on a rapid increase in domestic demand, credit booms contributed to consumption growth and investments in construction and real estate. The flip side was the emergence of very large external imbalances as production capacity did not keep pace with demand.

Financial flows from the EU increased sharply after accession, from less than 1% of GDP on average before accession to almost 2.5% of GDP within three years in the form of structural funds, agricultural support and other subsidies (Roaf et al., 2014).

In general, it can be said that external debt has been growing in all Central and Eastern European countries during these years, especially after 2002. The average external debt of the Central and Eastern European countries in 2008 was USD 1165.3 billion.

EU membership spurred economic and financial integration, leading to rapid economic growth and large capital inflows. It also created a "halo effect", shielding some countries from paying more to borrow external funds in spite of growing vulnerabilities (Čihak, Mitra, 2009).

During this period, the growth rates in transition countries were significantly higher than in the euro

Table 2
Contribution of total factor productivity to economic growth in CEE countries

Country	1991–1999			2000–2008			2009–2019		
	GDP growth	TFP growth	TFP share	GDP growth	TFP growth	TFP share	GDP growth	TFP growth	TFP share
Albania	-0,01	-1,19	131,2	5,59	-2,27	-0,41	3,09	0,30	0,10
Belarus	-2,37	-2,12	0,89	11,03	7,68	0,70	1,83	-2,03	-1,11
Bulgaria	-2,42	-1,74	0,72	7,58	3,14	0,41	1,31	-0,02	-0,01
Czech Republic	-0,33	-1,46	4,45	4,95	2,49	0,50	2,19	0,54	0,25
Estonia	-1,65	0,33	-0,20	8,21	2,86	0,35	2,24	-1,01	-0,45
Hungary	-0,75	-0,79	1,06	3,73	2,20	0,59	1,58	-0,06	-0,04
Latvia	-4,10	-1,79	0,44	8,59	5,07	0,59	3,39	2,94	0,87
Lithuania	-3,68	-2,99	0,81	8,62	6,08	0,71	2,26	1,32	0,58
Moldova	-8,68	-7,80	0,90	7,98	7,29	0,91	3,79	2,69	0,71
Poland	3,96	3,24	0,82	4,94	1,77	0,36	3,99	1,26	0,31
Romania	-2,07	-3,50	1,70	7,22	5,38	0,75	1,84	-0,01	-0,01
Russian Federation	-5,26	-5,10	0,97	8,37	7,07	0,84	0,79	-0,16	-0,21
Slovak Republic	0,07	-0,70	-9,74	7,58	4,93	0,65	2,40	0,77	0,32
Slovenia	1,11	-0,48	-0,43	5,00	1,60	0,32	0,67	-0,27	-0,40
Ukraine	-7,38	-6,21	0,84	8,96	8,90	0,99	-1,28	-0,19	0,15
Average	-2,24	-2,15	0,96	7,22	4,28	0,59	2,01	0,40	0,20

Source: author's assessment

area and exceeded the world average. This is because they are middle-income countries that are catching up with more advanced economies in terms of both capital investment and knowledge acquisition. They grow faster because it is usually easier to imitate existing technologies that have been pioneered in other countries than to innovate (Aghion et al., 2010).

Employment in almost all countries, except Moldova and Romania, grew at an average annual rate of 0.69% (Table 1). During this period, extremely high growth rates of economic efficiency were observed. The growth due to technological progress was 59% (Table 2).

The same results were obtained in surveys (Dobrinsky et al., 2006; Iradian, 2007; Schadler et al., 2006). The most important factor contributing to the acceleration of the post-crisis recovery was the sharp increase in TFP in the later stages of transition. Moreover, in a number of countries the average annual TFP growth rates during 2000-2003 exceeded the corresponding average annual GDP growth rates. At the same time, capital accumulation during this period contributed to positive technological change as new investments were directed to modern and highly productive capital equipment. Thus, positive TFP growth likely reflected a combination of productivity gains and technological change (Dobrinsky et al., 2006).

TFP growth in the CEE region was almost twice as high as in other groups of emerging market countries. This is not surprising given the inefficiencies inherited from central planning, which left much room for improving management, freeing up labour and benefiting from intersectoral reallocation of resources (Schadler et al., 2006).

Burda, M. & Severgnini, B. using Solow-Törnqvist residuals estimated of total factor productivity (TFP) growth in a sample of 30 European economies for the period 1994–2004, they conclude that TFP growth was consistently higher in Central and Eastern relative to Western Europe.

Consider the economic consequences of the external shock caused by the global financial crisis of 2008. Between 2000 and 2008, CEE countries changed the structure of their capital account in favor of debt, the share of direct investment became smaller, but investment inflows are more stable than those that generate debt.

O. Blanchard emphasized that one of the channels through which the crisis moved from developed economies to emerging markets was the reduction of credit lines from financial institutions of developed countries to their foreign subsidiaries, which forced them, in turn, to sell assets or reduce lending to domestic borrowers.

Securitisation and globalisation have led to increased interconnectedness between financial institutions both within and between countries. Foreign claims of banks from the five largest developed countries increased from USD 6.3 trillion in 2000 to USD 22 trillion in June 2008. In mid-2008, these banks' claims on emerging market countries alone exceeded $4 trillion. Think about what this means if for some reason these banks decide to reduce their foreign investments, as is happening now (Blanchard, 2009).

Capital inflows can increase banks' risks, while capital outflows can have serious macroeconomic consequences if they lead to a domestic bank liquidity crisis. Research on country financial vulnerabilities in the context of financial integration shows that emerging market countries (Southeast Asia, Latin America, and Eastern Europe) are more susceptible to crises in the face of an unexpected reduction in capital inflows if their debt obligations (Lane, Milesi-Ferretti, 2006). Debts are denominated in foreign currency because the cost of debt servicing in national currency increases depending on the level of devaluation of the national currency. Thus, for the growth of the national economy it is more efficient to attract foreign capital in the form of foreign direct investment.

In contrast, most Central and Eastern European countries quickly accumulated large net external liabilities, but relied heavily on equity financing, which improves risk sharing by more closely linking the return on external liabilities to domestic economic performance. At the same time, increased international financial integration naturally increases vulnerability to external financial shocks (Lane, Milesi-Ferretti, 2006).

Debt flows are much more volatile, as they are cyclical and highly volatile and, in case of negative shocks, can have a negative impact on the economic growth of the borrowing country. Foreign capital in CEE countries has been used to finance non-tradable sectors of the economy and contributed to overheating of the economy, causing a boom in consumer demand and widening the current account deficit. The fixed currency regime contributed to the deepening of GDP decline with high external borrowing. The currency and financial crisis of 2008 is a clear example of such consequences for Ukraine, Hungary and Latvia.

The crisis of 2008 radically changed the economic situation, and in the following years the average economic growth rate in the EU member states decreased by about 3 times, in Russia – by 11 times, and in Belarus there was a six-fold drop. At the same time, the share of capital increased by 1.5-2 times, especially in rich EU countries.

After the crisis and until 2019, the average economic growth rate fell by more than 3.5 times, while the capital growth rate decreased by 1.6 times

and employment growth fell by 10 times (Table 1). Only Poland, Hungary, the Czech Republic and Slovakia have positive employment growth due to stable capital accumulation and moderate growth in total factor productivity (Table 2).

The conclusion is that the contribution of capital and labour has been gradually increasing, especially after the financial crisis of 2008 and the sharp decline in the impact of total factor productivity (efficiency loss) on economic growth in Central and Eastern Europe.

The growth rates of the total productivity of factors became negative in Belarus, Russia, Ukraine, Hungary, Estonia, Bulgaria, Slovenia, and Romania. The highest share of totalfactor productivity is observed in Latvia, Lithuania, Poland and Moldova, the efficiency of these economies has decreased, but not so radically, than in other Central European countries (Table 2).

Since 2009, CEE countries have been recovering from the crisis with varying degrees of success. Some have reached the pre-crisis level within 3-5 years, others are stagnating to this day, and economic and political conflicts have added to the economic turmoil and imbalance (CIS countries).

In times of crisis, the volatility of economic growth can increase significantly. In this paper, the volatility of economic growth and TFP growth is measured using standard deviation. Measurements were made for each country during the economic boom of 2000–2008 and after the crisis of 2009–2019.

The results show that, on average, the volatility of economic growth increased by 1.7 times and the volatility of TFP growth by 1.5 times.

There is a significant differentiation of these indicators between countries. The greatest volatility of economic growth indicators increased in the Baltic States, in particular, in Lithuania – 3 times, Latvia – 2 times. The most stable economies are Estonia, Poland and the Slovak Republic.

Where the highest TFP growth rates were during the economic upturn, after the crisis there is an extremely high volatility of economic growth rates. Thus, Latvia, Lithuania, Ukraine and Moldova demonstrated very high TFP growth rates (in the range of 5-8%). Instead, in countries where physical capital grew steadily and TFP grew moderately, the volatility of economic growth is stable and low.

It is interesting to determine the period that countries needed to restore the level of GDP per capita that was in the pre-crisis period. It should be noted that in Albania, Belarus and Poland there was no fall in GDP per capita. It took 3-4 years to restore the well-being of people in Bulgaria, Slovakia, Lithuania, Russia and Moldova; 6-7 years – in the Czech Republic, Estonia, Hungary and Latvia; 9 years – in Slovenia, while the Ukrainian economy has not yet recovered.

A significant jump in unemployment was observed in almost all CEE countries. Most countries overcame labour market imbalances in the first few years after the crisis. However, in the Baltic States, this process was delayed, so in Estonia and Latvia the pre-crisis level of employment was reached in 2018, in Albania – in 2019, in Latvia – in 2020.

4. Internal and external balance and economic growth in CEE countries

The economic boom of 2000–2008 was associated with significant internal and external imbalances (Table 3). Especially countries with high GDP and TFP growth rates experienced very high inflation (Belarus, Moldova, Romania, Russian Federation, Slovak Republic and Ukraine).

As economic growth was supported by a significant inflow of foreign capital in the form of debt, which caused a significant deterioration of the current account balance (in Albania -8.7%, Bulgaria -9.5%, Estonia -10.6%, Latvia -11.6%, Lithuania -8.5%, Romania -7.17%).

In countries with moderately growing economies, the budget deficit was quite high compared to countries with high GDP and TFP growth rates, but during the economic boom the consolidated fiscal deficit was about 2 times lower (Table 3).

After the financial crisis in these countries (Czech Republic, Hungary, Poland, Slovakia) the budget deficit decreased, while in the countries with fast-growing economies the budget deficit increased by 1.5 times.

Current account balances (CA) improved dramatically in all countries, especially in the Baltic States, but also in Hungary, Slovenia, the Czech Republic and Slovakia. Only in Albania, Belarus and Ukraine the CA balance deteriorated in the post-crisis period. On average, the CA deficit in all countries decreased by more than 3 times. The dominant feature of the economic development of CEE countries after the 2008 financial crisis was a significant increase in public debt. Public debt increased significantly in Belarus, Hungary, Ukraine, Slovenia and the Baltic States. On average, in the group of countries studied, public debt increased by more than 1.3 times. The influence of various macroeconomic factors on the growth of aggregate productivity of production factors is investigated.

The identification of macroeconomic factors, indicators of internal and external equilibrium that influenced economic growth after the 2008 crisis allows us to draw some conclusions. The impact of public debt on the CA balance and especially on the budget deficit is growing compared to the pre-crisis period. The correlation coefficient is -0.23 and -0.79 respectively, compared to -0.04 and -0.23 before the crisis. Growth of public debt reduces negative current account balance and budget deficit.

Table 3

Internal and external balance before and after the global financial crisis of 2008, % of GDP (average)

Country	Budget deficit, %		Current account, %		Government Debt, %		Inflation, %	
	2000–2008	2009–2019	2000–2008	2009–2019	2000–2008	2009–2019	2000–2008	2009–2019
Albania	-5,09	-3,67	-8,75	-10,0	58,86	66,90	2,73	2,18
Belarus	-7,69	-1,74	-3,87	-6,48	13,59	44,77	39,93	19,16
Bulgaria	1,23	-1,26	-9,56	0,49	40,32	20,02	7,22	1,26
Czech Republic	-3,61	-1,65	-3,87	-0,68	25,99	38,67	2,98	1,58
Estonia	0,97	-0,09	-10,6	1,38	4,82	8,59	4,83	2,44
Hungary	-6,12	-3,01	-7,26	1,96	59,79	76,55	6,35	2,64
Latvia	-1,51	-2,22	-11,6	-0,05	13,66	40,09	6,12	1,58
Lithuania	-1,93	-3,02	-8,59	-0,32	19,21	37,93	2,93	2,05
Moldova	-0,34	-2,02	-6,39	-6,20	36,97	25,40	13,31	5,29
Poland	-4,07	-3,78	-4,40	-2,34	43,37	52,09	3,52	1,72
Romania	-2,77	-3,37	-7,17	-3,25	20,49	35,66	17,57	3,00
Russian Federation	4,25	-1,52	8,89	3,63	25,26	13,52	14,23	7,34
Slovak Republic	-4,71	-3,57	-6,11	-1,70	38,52	48,53	5,73	1,48
Slovenia	-0,92	-4,34	-2,05	3,56	26,27	62,75	5,35	1,18
Ukraine	-2,46	-3,62	2,55	-3,69	25,94	55,78	12,87	12,88
Average	-2,32	-2,59	-5,26	-1,58	30,20	41,82	9,71	4,39

Source: author's calculations based on the IMF Economic Prospects database

Before the pandemic in 2020, the CEE economies achieved extremely high internal balance, low unemployment of 3-5% and low inflation, and, in turn, external balance: the current account balance became positive, and at most did not exceed -3%. In fact, the countries have achieved macroeconomic stabilization and very moderate economic growth: 2-3% per year, although the efficiency of the economy in the post-crisis period has decreased very significantly (11 times). Thus, the CEE economies approached the pandemic crisis in conditions of macroeconomic equilibrium.

The impact of various macroeconomic factors on the growth of aggregate factor productivity was investigated (Table 4).

As for the factors that influence TFP growth, the magnitude of their impact has changed significantly compared to the period of economic recovery. Thus, unemployment growth after the crisis has a positive impact on TFP growth, while in the previous period it was negative. The growth of TFP in 2000–2008 was associated with inflation. The post-crisis period demonstrates a significant reduction in the impact of the external debt and public debt. Rising inflation and budget deficit have a negative impact on TFP growth (Table 4).

The impact of TFP on GDP growth decreases from 0.76 to 0.57, capital growth from negative to positive from -0.17 to 0.46, the impact of employment increases by 2 times. It can be concluded that macroeconomic indicators in the post-crisis period begin to influence economic growth, as defined in classical economic theory.

To complete our study, we have developed a variance decomposition analysis of growth to assess the contribution of each factor of economic growth:

Table 4

Correlations between changes in GDP, TFP and macroeconomic variables

Types of interactions between variables	Coefficients of correlation	Coefficients of correlation
	2000–2008	2009–2019
TFP ↔ GDP	0,760	0,571
TFP ↔ Capital	-0,752	-0,420
TFP ↔ Labor	-0,095	-0,314
TFP ↔ Unemployment	-0,441	0,404
TFP ↔ Inflation	0,588	-0,495
TFP ↔ Budget Deficit	0,194	-0,175
TFP ↔ Current Account	0,406	-0,064
TFP ↔ Government Debt	-0,525	-0,024
GDP ↔ Capital	-0,179	0,465
GDP ↔ Labor	0,107	0,216

Source: author's assessment

factors of production and TFP growth. In essence, given a posteriori averages of growth parameters, this approach provides a systematic study of the distribution of configurations of fundamental determinants and their combined ability to explain differences in growth (Durlauf et al., 2008).

Express the decomposition of GDP growth variance-gy, in terms of the partial contribution of each growth component; respectively, TFP growth – g_A, growth in physical capital – g_k, and growth in labor – g_l.

$$Var\left(g_y\right)=\frac{Cov\left(g_{y,g_A}\right)}{Var\left(g_y\right)}+\frac{Cov\left(g_{y,}\alpha g_k\right)}{Var\left(g_y\right)}+\frac{Cov\left(g_{y,}\left(1-\alpha\right)g_l\right)}{Var\left(g_y\right)} \quad (5)$$

The contribution of total factor productivity to economic growth was calculated using this methodology (5) for the two periods 2000–2008 and the

post-crisis period 2009–2019 (based on annual changes in TFP and GDP growth) and the following results were obtained: for the first period, the share of TFP was 89%, and for the second period – 43%. This means that the shock received by the CEE countries from the financial crisis has resulted in a decrease in economic productivity by more than half. In general, the whole world has suffered from this crisis, especially the European continent, which has a lower level of productivity compared to the United States.

N. Crafts views social capabilities as a key determinant of success or failure in productivity growth. Social capabilities can be seen as the incentive structures, such as regulation and taxation, that influence investment and innovation decisions that allow enterprises to effectively absorb technologies developed by leaders (e.g., the US) and eliminate inefficiencies. In service-oriented economies, the forces of creative destruction have been even more critical, replacing less efficient firms and old technologies with new and more efficient ones (Crafts, 2017).

The problem of slowing economic growth in CEE countries raises the question of whether TFP growth can be sustainable, and if not, what can replace it as a basis for rapid catch-up development (Schadler et al., 2006).

Recently, new growth theory has linked productivity growth to innovation. Innovations, in turn, are motivated by the prospect of excess returns that successful innovators can realize (Aghion et al., 2010). The theory suggests that innovation, and hence productivity growth, should always be facilitated by: better protection of intellectual property rights, financial development and macroeconomic stability. Thus, faster growth tends to imply higher firm turnover rates, as the process of creative destruction generates the entry of new innovators and the exit of old ones due to high levels of competition (Aghion & Howitt, 2006).

According to the author, the monetary and financial crisis has shown the vulnerability of the CEE economies to external shocks due to a significant dependence on external savings, so it is necessary to develop the domestic economy on the basis of an innovative paradigm, stimulate domestic investment and savings, introduce new energy-efficient technologies to isolate the economy from external shocks.

5. Conclusions

The analysis of thirty years of economic development of Central and Eastern European countries allows to draw certain conclusions about the efficiency of their economies, economic growth rates, internal and external balance.

For the study the methodology of growth accounting based on the classical model of economic growth by R. Solow was used, which allowed to determine the contribution of capital, labor and total factor productivity to the economic growth of countries.

In the first phase – 1991–1999 – most CEE countries implemented radical market reforms and actively liberalized economic life, although with varying degrees of success. During this period, CEE countries demonstrated a significant decline in economic growth, with the worst performance in the post-Soviet republics: Moldova, Russia, Ukraine, where the annual decline ranged from 5 to 7%. In general, during the transformation of the planned-administrative economy into a market economy, 96% of the GDP decline was associated with a decrease in TFP.

The second stage, which covers the period from 2000 to 2008, can be defined as a period of rapid economic growth. The economic growth rates of CEE countries were the highest in the world compared to other regions.

Since 2000, the economic growth of CEE countries has been booming. GDP growth rates ranged from 5 to 11%. The highest rates of economic growth were in the Baltic countries, as well as in the European post-Soviet republics – Ukraine, Belarus and Russia. Capital growth in all countries is positive, averaging 4.7%. Employment in almost all countries, except Moldova and Romania, grew at an average annual rate of 0.69%. During this period, extremely high growth rates of economic efficiency were observed. The growth due to technological progress amounted to 59%.

The crisis of 2008 radically changed the situation, and in the following years the average economic growth rate fell by more than 3.5 times, while the capital growth rate decreased by 1.6 times and employment growth decreased by 10 times. Only in Poland, Hungary, Czech Republic and Slovak Republic there is a positive employment growth due to stable capital accumulation and moderate growth of total factor productivity.

The conclusion is that the contribution of capital and labour has been gradually increasing, especially after the financial crisis of 2008, i.e., a sharp decline in the impact of total factor productivity (efficiency loss) on economic growth in Central and Eastern Europe, with average TFP growth over this period of only 0.4% annually.

In times of crisis, the volatility of economic growth can increase significantly. Where the highest TFP growth rates were during the economic upturn, after the crisis there is an extremely high volatility of economic growth rates. Thus, Latvia, Lithuania, Ukraine and Moldova have demonstrated very high TFP growth rates (in the range of 5-8%). On the contrary, in countries where physical capital grew steadily and TFP grew moderately, the volatility of economic growth is stable and low. After the financial crisis in these countries (Czech Republic, Hungary, Poland, Slovakia, Czech Republic) the

budget deficit decreased, while in fast-growing economies the budget deficit increased by 1.5 times. Current account balances (CA) have improved dramatically in all countries, especially in the Baltic states, but also in Hungary, Slovenia, the Czech Republic and Slovakia. Only in Albania, Belarus and Ukraine did the CA balance deteriorate in the post-crisis period. On average, in all countries the negative CA balance decreased by more than 3 times. As for the factors that influence TFP growth, the magnitude of their impact has changed significantly compared to the period of economic recovery. Thus, unemployment growth after the crisis has a positive impact on TFP growth, while in the previous period it was negative. TFP growth in 2000–2008 was associated with inflation. The post-crisis period shows a significant reduction in the impact of CA and public debt. Rising inflation and budget deficit have a negative impact on TFP growth.

The impact of TFP on GDP growth decreases from 0.76 to 0.57, capital growth from negative to positive from -0.17 to 0.46, the impact of employment increases by 2 times. It can be concluded that macroeconomic indicators in the post-crisis period begin to influence economic growth, as defined in classical economic theory.

In this paper, the contribution of total factor productivity to economic growth was calculated based on variance decomposition for two periods 2000–2008 and the post-crisis period 2009–2019 (based on annual changes in TFP and GDP growth) and the following results were obtained: for the first period the share of TFP was 89%, and for the second period – 43%.

Although there is a rather interesting phenomenon, when in some countries (Czech Republic, Hungary, Slovakia, Slovenia) with a very significant loss of economic efficiency there was a parallel accumulation of capital. If to project this process to the aftermath of the 2008 crises, an interesting pattern is observed: the higher the rate of capital accumulation observed in 1991–1999, the lower the volatility of economic growth, measured by standard deviation, with a correlation coefficient of -0.75. This is a wise economic policy aimed at future economic achievements and sustainable development of the state. Thus, a high level of capital is the foundation of sustainability of economic growth and its low volatility.

According to the author, the monetary and financial crisis has shown the vulnerability of the CEE economies to external shocks due to a significant dependence on foreign savings, so it is necessary to change the debt model to an innovative model of economic growth, stimulate domestic investment and savings, introduce new energy-efficient technologies to isolate the economy from external shocks.

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Received on: 8th of September, 2022
Accepted on: 11th of October, 2022
Published on: 30th of November, 2022