South East European Journal of Economics and Business
Volume 18 (1) 2023, 145-160
DOI: 10.2478/jeb-2023-0010

DOES TOTAL FACTOR PRODUCTIVITY GROWTH AMELIORATE SOCIO-ECONOMIC STANCE? NEW FINDINGS FROM CENTRAL AND EASTERN EUROPE

Emin Efecan AKTAŞ

Abstract

National income calculations may not include knowledge that directly concerns the socioeconomic stance in an economy. Knowledge plays a significant role in promoting the economic growth of a country; however, its socio-economic role has received little attention in the literature. Total factor productivity, which is the main source of long-term economic prosperity, expresses the increase in productivity in all production factors. This paper attempts to quantify the effects of total factor productivity growth on economic prosperity. The analysis is conducted for the 2007-2020 period and 18 Central Eastern Europe countries. The "Legatum Prosperity Index" is utilized in the econometric analysis, in line with the purpose of the study. Results of the study with panel ordinary least squares, panel fixed-effects, panel random effects, panel-corrected standard errors (robustness check), and system-generalized method of moments (robustness check) confirm that total factor productivity growth positively correlated with economic prosperity.

Keywords: *total factor productivity, economic growth, economic prosperity, and panel data*

JEL classification: *C23, D24, I31, O47*

1. Introduction

Identifying the drivers and dynamics of economic growth has been a common trend among economists for many years. The social, technical, and institutional forces that increase productivity and increase economic growth have been discussed first philosophically and then mathematically and have recently been examined empirically. Initially, the dynamics of growth have been explained based on the accumulation of basic production factors such as labor and capital. Later, factors such as technology, human capital, governance, and social capital have been added to the growth literature. However, even if all these factors are tackled together, they are not considered sufficient to explain the expansion or prosperity of an economy anymore. That is, the amount of factors is insufficient to expound economic growth. It is impossible to explain how much output is produced per input with the indicator(s) of economic growth (Albeaik et al. 2017). This difference, which occurs when the increase in output is different from the contribution of labor and capital, is explained based on total factor productivity (TFP). Productivity is expressed as the ratio between

Emin Efecan AKTAŞ, Ph.D.
Assistant Professor
Vocational School of Social Sciences,
Kirsehir Ahi Evran University
Address: Sht. Necdet Yagiz Ave., No: 143,
Kirsehir Ahi Evran University, Bagbasi Campus,
40100, Kirsehir
Türkiye
E-mail: emin.aktas@ahievran.edu.tr
ORCID: 0000-0001-7751-3275

the input and output volume. It is considered a key source of economic growth and competitiveness and is, therefore, the basis for many international comparisons or country performance evaluations. (Krugman 1994). The relationship between productivity and growth has become a popular subject of economic research, especially in the long term from the 1950s to the present (Nordhaus 2005, p. 6-7). Productivity impacts macro variables such as countries' competitiveness and employment level. It is accepted that changes in productivity affect economic and social events such as economic development, the standard of living, the balance of payments, and control of inflation (Xu and Lybbert 2017, p. 2).

A wide variety of concepts has been used to evaluate the level of welfare from the past to the present. While the welfare level, which determines the development of a country, was evaluated as economic growth in the 19th century, it began to be measured by social welfare at the beginning of the 20th century and the quality of life at the end of the 20th century (Bate 2009, p. 1). It is argued that these indicators alone would not suffice to discern a country's development and that environmental, social, cultural, and political indicators, in addition to this indicator, have a significant impact (Markou et al. 2015, p. 1-2). It is possible to observe that the socio-economic stance of a country does not increase at the same pace and even decreases in some countries, while welfare is growing on a global basis. This situation has brought with it discussions about whether it is realistic to calculate economic prosperity level over macroeconomic variables such as gross domestic product (GDP) or gross national income (GNP). In the traditional sense, the concept of welfare, which expresses the quality of life of individuals and societies, emphasizes economic growth and material well-being (Fritz and Koch 2016, p. 41). The emergence of several needs with the changing world order has brought along discussions that welfare cannot be measured only by GDP and GNI, and that welfare should be measured in socio-economic terms (Bate 2009, p. 1). Many previous studies have stated that only the economic effects of socio-economic stance are measured and emphasized that many indicators such as social, geographical, human, institutional quality, education, and health should be added to these measurements. In this respect, several theoretical and empirical analyses have been realized. (Simon 1973; Easterlin 1974; Weitzman 1976; Elias 1992; Young 1995; Iwata et al. 2003; Fogel 2004; Oulton 2004; Danquah 2006; Idea 2008; Stevenson and Wolfers 2008; Stiglitz et al. 2009; Oulton 2012a; Oulton 2012b). It is anticipated that national income methods, which are used to calculate the socio-economic stance of countries, cannot fully represent economic prosperity. Therefore, the Legatum Prosperity Index is used to represent the socio-economic stance in line with the purpose of the study. The motivation of the study is to investigate whether total factor productivity growth can contribute to the socio-economic stance, which is defined as prosperity in 18 Central and Eastern Europe (CEE) countries or not. The following two hypotheses were tested in the study.

> H_1: Prosperity is a multidimensional indicator that includes many economic, social, and societal dynamics and components in a given period in a country/economy, and economic growth alone cannot explain the socio-economic stance regarding prosperity.
>
> H_2: Total factor productivity and economic prosperity are positively related.

Since the variables related to economic growth, such as GDP and GNP, are no longer sufficient to measure real economic performance, the Legatum Prosperity Index constitutes the research center of the analysis. Several explanatory variables are also included in the analysis. With this aspect, it is assumed that the study would contribute to the literature on two axes: i) Previous studies mostly focus on analyses such as TFP and economic growth or TFP and human/physical capital/governance quality, etc. This study uses an indicator of prosperity. ii) Basic policy proposals that can be evaluated in terms of countries with different economic, social, and political conditions have been remarked on. Estonia, Latvia, Lithuania, Czechia, Slovakia, Poland, Hungary, Slovenia, Romania, Bulgaria, Croatia, Russia, Belarus, Ukraine, Moldova, North Macedonia, Bosnia Herzegovina, and Serbia are subjected to the analysis. Most of these countries are newly industrialized and developing countries and are selected due to their future prosperity potential. The rest of the study consists of conceptual and theoretical framework, empirical literature review, data, methods, results, discussion, and recommendations.

2. Conceptual and Theoretical Framework

2.1. The concept of prosperity

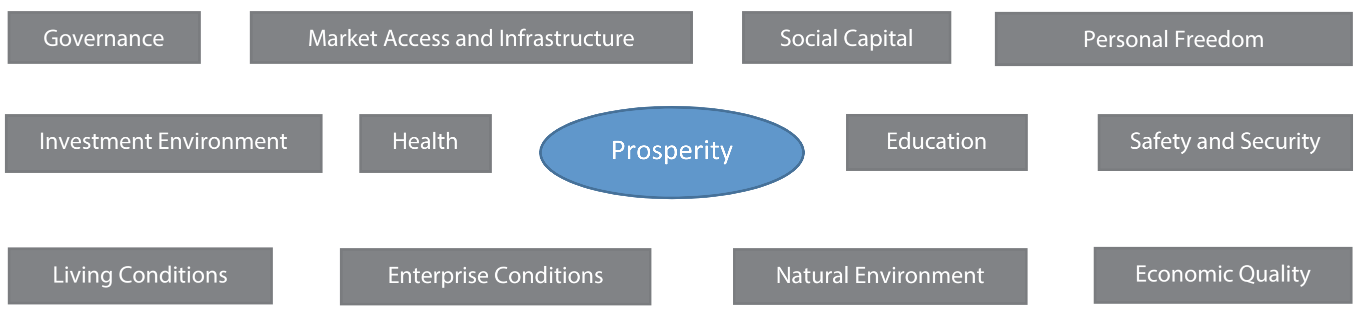
Welfare can be expressed in many ways, such as tranquillity, spaciousness, comfort, and life quality. Welfare economics, which is a branch of the economy that uses microeconomic techniques to determine macroeconomic resource distribution efficiency and income distribution together, has placed the concept of prosperity at the center of welfare debates for a while. The prosperity term which implies the overall welfare and access level of individuals or societies, not only includes wealth and employment but also contains concepts such as environment status, physical and mental health, education, entertainment, spare time, social belonging, freedom, human rights, and happiness. Prosperity is measured through an index. The Legatum Prosperity Index is a multidimensional index developed by the Legatum Institute in 2007. The Legatum Institute identifies prosperity as both well-being and wealth and records that the most prosperous nations in the world are not assuredly those with a high GDP, but those with healthy, delighted, and free citizens.

The Institute viewed prosperity as human development and argued that a nation's prosperity could only be achieved with effective institutions, an open economy, and empowered people who are healthy, educated, and secure. For this purpose, the institute created the prosperity index and succeeded in obtaining a very rich dataset representing more than 99% of the world's population (LPI 2020a, p. 5-8). With the regulations and improvements made in 2019, the Institute redefined prosperity and improved the existing dataset using 294 different sub-components by increasing 9 basic indicators to 12 (LPI 2019, p. 36-39). Currently, the prosperity index is calculated with 300 sub-components. The overall index score is calculated by weighting the 12 indicators equally (Figure 1), assuming that each criterion has equal importance for prosperity. The overall score for each country is determined by taking a simple average of 12 indicators (LPI 2020b, p. 84).

2.2. The theoretical background of total factor productivity

Although the differences in natural resources and capital per capita are shown as the main reasons for the differences in the growth rates of the countries, the effect of these factors is insufficient to explain the differences. The main factor explaining the growth rates and income differences between countries is the total factor productivity differences. TFP creates this difference by directly and indirectly affecting labor productivity (Ghosh and Kraay 2000, p. 13-14; Prescott 1998, p. 529). Total factor productivity is one of the basic elements of growth in national economies. In this context, it is among the major notions that explain the differences in the development levels of countries. TFP not only directly figures the effect of classical production factors such as labor force, capital, and technology on economic growth but also ensures an opportunity to evaluate the current situation and course of growth. TFP is obtained by dividing the total output by the inputs. Thus, it is possible to appoint the share and significance of the inputs in the production process. In this respect, it can be pronounced that high factor productivity means greater producing power (Murray 2016, p. 113; Khadimee 2016, p. 621). The ratio of output to input is the simplest way to calculate TFP. An illustration of such a scenario is shown. Assume that in an economy with two factors of production, labor, and capital, the output is depicted by Y and the input is symbolized by capital (K) and labor (L). TFP can be determined by calculating the proportion of total output to total labor and capital. If wages, the price of labor, are denoted as "w" and the price of capital, interest, as "r":

Figure 1. Sub-components of the Legatum Prosperity Index



Source: LPI 2020a.

$$TFP = Y \,/\, (w.L + r.K) \tag{1}$$

Suppose we would like to calculate TFP between the two firms. The average monthly wage at factory X, where there is only one employee, was $2000 per month. The monthly rent for the factory's two production machines is $10000. The average wage was $1250 per month at factory T with four employees. The rent for one production machine was $7500 per month. Both companies manufactured 15000 units. These two factories' total factor productivity can be aligned as follows:

$$TFP_X = 15000/(2000 * 1 + 10000 * 2) = 0.68$$
$$TFP_T = 15000/(1250 * 4 + 7500 * 1) = 1.2$$

These findings indicate that factory T has a more efficient production structure than factory X. TFP not only augments the amount of output but also enhances labor and capital productivity, the impact of elasticity, rivalry, and resource usage efficiency.

Studies on TFP are models for obtaining more output with the existing production factors in the economy. In this sense, it can be stated that the first studies in this field are based on the growth model developed by Solow (1956). Later, researchers such as Barro (1991), Elias (1992), Young (1995), Senhadji (1999), and Iwata (2003) reconsidered the concept. According to Solow (1956), technology is considered exogenous under perfectly competitive market conditions. Technology and output growth are posited as productivity growth. The Solow model, which is called the neoclassical growth model, has been developed by adding human capital to labor and capital. The theory of neoclassical growth is based on an economic development model that is derived from an external source such as physical capital, labor, and technological change. The model employs the production function, which either unveils the relationship between input and output, to quantify the economic growth rate, with the presumption that the growth rate is detected exogenously in the production function. As a consequence, according to Neo-Classical theory, the only factor that ensures economic growth is the Solow residual or technological change that exists by chance. Economic growth can also be expressed by adding the change in components (Solow residual) that cannot be explained by factor inputs (capital and labor). (Danquah 2006, p. 19; Idea 2008, p. 38-39). According to Solow (1956), the Solow residual can be formulated with the Cobb-Douglas (1928) production function (Solow 1956, p. 58):

$$Y = F(K, A.L) \tag{2}$$

K connotes capital. A refers to technology or knowledge. Multiplying A by labor force L means an effective labor force.

$$Y = K^{\propto}(A.L)^{1-\propto}, \qquad 0 < \propto < 1 \tag{3}$$

$$Y = BK^{\propto}L^{1-\propto} \qquad B = A^{1-\propto} \tag{4}$$

$$\frac{\dot{Y}}{Y} = \propto \frac{\dot{K}}{K} + (1-\propto)\frac{\dot{L}}{L} + \frac{\dot{B}}{B} \tag{5}$$

The above equation $\propto$ and $1\text{-}\propto$ parameters represent the capital and labor share in output under perfect competition conditions. The term B is expressed as total factor productivity. If equations (4) and (5) are to be shown as the growth rate:

$$g_y = g_{TFP} + \propto g_K + 1 - \propto g_L \tag{6}$$

Accordingly, the growth rate (g_y) in an economy consists of the sum of the total factor productivity (g_{TFP}), the capital growth rate (g_K) weighted by the share of capital in the output, and the labor growth rate (g_L) weighted by the share of labor in output. Equation, which is characterized as the growth equation, can also be formulated as in (7).

$$g_{TFP} = g_y - \propto g_K - (1-\propto) g_L \tag{7}$$

According to this equation, the TFP growth rate is equal to the difference between the output growth rate and the labor and capital growth rates. The growth analysis can also be redefined with the output growth rate per employee:

$$g_{TFP} = g_y - \propto g_K - g_L + \propto g_L \tag{8}$$

$$g_{TFP} = (g_y - g_L) - \propto g_K + \propto g_L \tag{9}$$

$$g_{TFP} = (g_y - g_L) - \propto (g_K - g_L) \tag{10}$$

The factor shares of the Cobb-Douglas production function are constant over time and correlate with the derivations of the production function. The elasticity of output relative to labor is equal to the labor share when the production function showcases constant returns to scale at K and L. Similarly, under perfectly competitive conditions and where the production function betrays constant returns to scale at K and L, the elasticity of output relative to capital is equal to the capital share. When we subtract the labor growth rate (g_L) from equation (10), we get equation (11).

$$g_{TFP} = g_y - \propto g_K \tag{11}$$

According to equation (11), the TFP growth rate is equal to the difference between the output growth rate per employee (g_y) and the capital growth rate per employee (g_K). In the Solow model, the growth rate of capital per worker and output per worker is equal to the rate of technological progress and can be formulated as follows:

$$g_y = g_K = \theta \qquad g_{TFP} = (1-\propto)\theta \tag{12}$$

According to equation (12), the rate of increase in TFP is equal to the product of labor share in output (1-∝) and the rate of increase in technology (θ) (Baier et al. 2006, p. 27-28). Here, the total factor productivity can be called a technological development that increases the efficiency of labor. In the Solow model, there is an essential assumption that technological development is exogenous. Additionally, it is argued that the source of sustainable growth per capita is technological development. Because technological development eliminates the decrease in the marginal productivity of capital, and eventually, the growth rate of countries becomes equal to the rate of technological development (Ghosh and Kraay 2000, p. 2-3).

3. Empirical Literature Review

Many studies deal with the relationship between total factor productivity and economic performance or economic effects of TFP for various countries or country groups. First, studies that analyze CEE and/or EU countries are discussed. Benkovskis et al. (2012) state that TFP plays a key role in long-term growth for the period 1995-2009 and 10 CEE countries. The contribution of technological change at the industry level to the overall growth performance of an economy has been analyzed. A model open to terms of trade shocks is constructed with the Solow residual and fixed income-to-scale approach, and the characteristics of open economies have been investigated. Beugelsdijk et al. (2018), using the development accounting technique, confirm that large and persistent differences in economic development in 257 European Union sub-national regions are due to growth in total factor productivity. The findings show that TFP differences vary even within countries and that the interregional spread of technology and efficient production implementations is limited. Levenko et al. (2019) have determined the relationship between total factor productivity and economic growth according to the crisis years for 18 CEE countries from 1996 to 2016. It has been detected that while total factor productivity increased economic growth before the crisis, there were significant differences between countries after the crisis. Borović et al. (2020) query the impact of economic freedom on total factor productivity for the period 2000-2018 and 10 CEE countries. The study proves that a high level of economic freedom, defined as an indicator of the quality of institutions, with a fixed effect panel, leads to a higher level of total factor productivity.

Other studies were listed as follows. Nehru and Dbareshwar (1994) have found a nonlinear and positive relationship between TFP growth and national income growth in 83 countries between the years 1960-1987, using regression analysis. It is concluded that rapid growth is related to factor accumulation rather than TFP growth. Senhadji (1999) investigated TFP differences in 88 countries for the period 1960-1994 using Phillips-Ouliaris and Shin's cointegration tests. The results reveal that TFP is effective in GDP growth. While TFP is low in African and Latin American countries, there is a better performance in Asian countries, especially in China. Easterly and Levine (2001) conducted a pioneering study on the economic effects of total factor productivity. It is stated that most of the income and growth differences between countries are due to total factor productivity rather than factor accumulation, and that income differs eventually. Economic activity is concentrated at high rates where the production factors flow to the richest areas, and long-term economic growth rates and economic policies are closely related. It is remarked that TFP growth does not yet make a clear distinction between different theoretical understandings.

Miller and Upadhyay (2002) inspected the convergence of real GDP per worker and TFP in 83 developed and developing countries from 1960 to 1989. The results of the beta and sigma convergence tests indicate that convergence is higher in underdeveloped and emerging economies than in developed economies. Bosworth and Collins (2003) have situated that the appropriate application and interpretation of growth regressions are valuable tools to better understand growth experiences across countries. The panel regression analysis has been performed based on 84 countries representing 84% of the world population from 1960 to 2000. It is claimed that capital accumulation is more effective in growth for all countries. It is exposed that 0.9% of the economic growth is due to TFP increases. Baier et al. (2006) conducted panel data analysis for 145 countries using variation tests from 1960 to 2000 period. A positive relationship has been found between TFP and economic growth. It is also determined that 14% of the national income is related to TFP growth in all countries. De La Escosura and Rosés (2009) have investigated the sources of long-term growth in Spain for the period 1850-2000 using a Jorgenson-type growth analysis. It has been detected that the increase in economic growth rates is closely related to the increase in TFP. De Vries et al. (2012) have enounced that the increase in labor productivity and total factor productivity contribute to growth in China, India, and Russia because of the panel data analysis from 1980 to 2010. Such a result for Brazil has not been detected. Yang and Zhao (2018) investigated the effects of total factor productivity, physical capital, human capital, energy consumption, and environmental pollution on economic growth in China between 1981 and 2012. The main driver of China's current economic growth is an investment in physical capital. It is emphasized that total factor productivity growth is the main driver of sustainable growth in China. It has also been remarked that for sustainable economic growth in China, TFP-oriented growth is needed instead of physical capital and energy consumption. By extension of these previous literature examples, the study gauges the economic prosperity effects of total factor productivity growth in CEE countries.

4. Data

The dependent variable of the model is the "Legatum Prosperity Index" (epi) The independent variable is the growth rate of total factor productivity $(rtfp_{j,t}^{na})$.

The relative total factor productivity, which is compiled from the Penn World Table (PWT) 9.0, is used for the analysis. The total factor productivity growth rates (relative) are attained mediately by Feenstra et al. (2015) as follows:

$$\frac{rtfp_{jt}^{na}}{rtfp_{jt-1}^{na}} = \frac{rgdp_{jt}^{na}}{rgdp_{jt-1}^{na}} / Q_{jt,t-1} \tag{13}$$

$$Q_{jt,t-1} = \frac{1}{2\left(labsh_{jt} + labsh_{jt-1}\right)\left(\frac{emp_{jt}}{emp_{jt-1}}\frac{hc_{jt}}{hc_{jt-1}}\right)} + \left[1 - \frac{1}{2}\left(labsh_{jt} + labsh_{jt-1}\right)\right]\left(\frac{rk_{jt}^{na}}{rk_{jt-1}^{na}}\right) \tag{14}$$

This function is used for comparing productivity between countries *j* and *t* at a given time.

$Q_{jt,t-1}$ = *Törnqvist quantity index of factor inputs* Q^T

$rtfp^{na}$ = *TFP at constant national prices* (2017=1)

$rgdp^{na}$ = *Real gdp at constant national prices*

rk^{na} = *Capital services at constant* 2017 *national prices* (2017=1)

emp = *Number of persons employed (in millions)*

Table 1. The salient features of the data

Variable	Source	Definition
epi	*"Legatum Prosperity Index"*	The highest prosperity: 10, and the lowest prosperity: 0
rtfp	*Penn World Table* (9.0)	The growth rate of total factor productivity
tfp	*The Conference Board Total Economy Database*	The growth rate of total factor productivity (robustness check)
gfcf	*World Bank Open Data*	Measurement of gross net investment (earnings minus disposals) in fixed capital assets by government, households, and enterprises within the domestic economy.
open	*World Bank Open Data*	The sum of exports and imports of goods and services measured (% of GDP)
hc	*Penn World Table (9.0)*	Human capital index, based on years of schooling and returns to education
labor	*The Conference Board Total Economy Database*	Share of total labor in GDP
capital	*The Conference Board Total Economy Database*	Share of total capital in GDP
ggfce	*World Bank Open Data*	government current spending for purchases of goods and services and national defense and security spending, excluding government military spending, which is a part of government capital formation

Notes: Please note that all variables are used in the natural logarithmic form. (ln) presents the natural logarithm form of the variables and is prefixed with each variable to represent the variables in the logarithmic form. All variables except (*rtfp*) are from 2007 to 2020, while (*rtfp*) is from 2007 to 2019.

Source: Own edited.

Table 2. Summary statistics of the data

	Observation	Mean	Sta. Dev.	Minimum	Maximum
epi	252	52.38678	8.90958	39.44097	73.43861
rtfp	238	0.634909	0.2315521	0.3011301	1.282417
tfp	252	0.1865961	2.624995	0.328403	7.232754
gfcf	252	23.84451	6.113728	12.4456	35.1069
open	252	62.58794	39.97126	20.72252	210.4002
hc	252	2.407043	0.49057	1.674091	3.765123
labor	252	43.5253	8.217675	25.24954	57.78493
capital	252	56.4747	8.217675	42.21507	74.75046
ggfce	252	10.26874	3.132434	4.403315	18.17166

Source: Own edited using Stata 14.2 calculations.

hc = Human capital index,based on years of schooling and returns to education

labsh = Share of labour compensation in GDP at current national prices

j = country, t = year, na = constant national prices

For the robustness check, the logarithm of the growth of total factor productivity data for each country and year compiled from "The Conference Board Total Economy Database" is used in the analysis. All variables used in the model are presented in Table 1. Control variables have been compiled following the empirical literature among the indicators that are excluded in the Legatum Institute's 300 sub-components. Table 2 represents the summary statistics of the data.

5. Methods

Before the analysis of the basic linear logarithmic model, the research method is organized as cross-sectional dependence and unit root test. The fact that the cross-section units that comprise the panel are independent of one another is critical in terms of analysis results. Cross-section independence assumes that any shock to any panel unit affects all countries and that any macroeconomic shock that appears in any country has no impact on the other countries in the panel. It would be more plausible that such economic shock inside one country may have a divergent impact on other countries. Because the results of the analysis would be biased and inconsistent if the cross-sectional dependence is not presumed, it is crucial to verify whether there is a dependency between the cross-sections before initiating the analysis. Breusch and Pagan Lagrange Multiplier (1980) LM and Pesaran Cross-section Dependence Lagrange Multiplier (2004) CD_{LM} tests are used for the analysis of cross-sectional dependence.

$$\Delta Y_{i,t} = \alpha_i + \delta_i Y_{i,t-1} + \sum_{j=1}^{p_i} Y_{ij} \Delta Y_{i,t-j}$$

$$+ \theta_i \bar{Y}_{t-1} + \sum_{j=0}^{p_i} \vartheta_{ij} \Delta \bar{Y}_{i,t-j} + u_{it} \quad (15)$$

$$t = 1, \ldots, T \; i, j = 1, \ldots N$$

Here, $\Delta Y_{i,t}$ represents the critical values. Y_{ij} and ϑ_{ij} demonstrate observable values in units of a cross-section. $Y_{i,t\text{-}1}$ and $\Delta Y_{i,t\text{-}1}$ show the coefficients with no constant. $\bar{Y}_{i,t\text{-}1}$ presents the coefficients with constant. $\Delta \bar{Y}_{i,t\text{-}1}$ displays the coefficients with constant and trend. The simple correlation coefficients gathered adopting the model's estimated residuals are tested to view if they are equal to zero. The model that incorporates the lagged values of $\Delta \bar{Y}_t$ and $\Delta \bar{Y}_{i,t}$ is used to obtain the autocorrelation in error terms for each cross-section unit. The following hypotheses were tested to detect whether there is a relationship between the cross-sections of units:

$$H_0: p_{ij} = cor(u_{it}, u_{jt}) = 0 \quad i \neq j$$

$$There\ is\ no\ dependency\ between\ units.$$

$$H_\alpha: cor(u_{it}, u_{jt}) \neq 0 \quad i \neq j$$

$$There\ is\ dependency\ between\ units.$$

When N and T progress to infinity, the test statistic is computed as shown below.

$$CD_{LM} = \left(\frac{1}{N(N-1)}\right)^{\frac{1}{2}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{p}_{ij}^2\text{-}1) \quad (16)$$

Unit root testing is used to assess whether or not the series is stationary after cross-sectional dependency. The Augmented Dickey-Fuller (CADF) process (Pesaran 2007) is one of the second-generation panel unit root tests. In this test, a strong upshot can be acquired both for N goes to infinity and for scenarios where T is higher than N and N is larger than T.

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + \delta_{i,t} + \sum_{j=1}^{p_j} \emptyset_{i,j} \Delta Y_{i,t-j} + u_{i,t} \quad (17)$$

The CADF test's equation is symbolized in equation (17). As N approaches infinity, the stationary sections or not are proved by forecasting the equation with the least squares.

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + \sum_{j=1}^{p_j} c_{i,j}\, \Delta Y_{i,t-j} + d_i t + h_i \bar{y}_{t-1} + \sum_{j=0}^{p_i} \eta_{i,j} \Delta \bar{y}_{i,t-j} + \varepsilon_{i,t} \quad (18)$$

The CADF test's null and alternative assumptions are as follows:

$H_0^i: \beta_i = 0;\ H_A^i: \beta_i < 0$

In equation (19), the $\overline{\text{CADF}}$ statistics adjusted for case $N > T$ can be seen. This statistic is renowned as the CIPS (cross-sectionally augmented panel unit root test) statistic, and it doesn't compute significant results if $T > N$.

$$\overline{CADF} = CIPS = \sum_{i=1}^{N} \frac{CADF_i}{N} \quad (19)$$

The linear panel static model in equation (20) has been set up for estimating the nexus between economic prosperity and total factor productivity growth by adding the other control variables.

$$lnepi_{j,t} = \alpha_0 + \alpha_1 lnrtfp_{j,t} + lngfcf_{j,t} + lnopen_{j,t} + lnhc_{j,t} + lnlabor_{j,t} + lncapital + lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (20)$$

The econometric analysis is based on data from 18 countries. Static and dynamic panel data models have been used in statistical analysis with the help of Stata 14.2. Panel data regressions have some advantages owing to the data quality, using cross-sectional analysis, and time series together. Panel regressions were created with the help of static and dynamic models. Equation (20) represents a static panel linear model. To eliminate the endogeneity problem in a static panel model, the variables have been re-estimated with the help of a dynamic model. In dynamic models, the lagged value of the dependent variable is included in the model as an independent variable. For this reason, known estimators cannot be used to estimate these models (Bond 2002, p. 1-2; Verbeek 2017, p. 146; Akay 2018, p. 115). For dynamic models, the System Generalized Method of Moments estimator is typically used. Contrary to the first difference method, the difference from the prior period is not accounted for if the System Generalized Method of Moments (GMM) is conducted. The analysis is based on the combination of the difference equation and level equations. Instead, the average of all potential future values of a variable is subdivided to identify the difference. As a result, the System GMM allows the creation of estimates that are significantly authentic when the variables are undergoing a random walk (Breitung 1997, p. 9; Bond 2002, p. 5-6; Sattarhoff 2010, p. 4; Akay 2018, p. 110-12). Additionally, the System GMM estimator has more accurate and effective forecasting in small samples (Hayakawa 2007, p. 35; Soto 2009, p. 13-14; Roodman 2009, p. 124-125). To obtain more consistent results, the dynamic relationship between the variables has been tested with the help of equations (21) and (22).

$$lnepi_{j,t} = \beta_0 + \beta_1 lnepi_{jt-1} + \beta_2 lnrtfp_{j,t} + \beta_3 lngfcf_{j,t} + \beta_4 lnopen_{j,t} + \beta_5 lnhc_{j,t} + \beta_6 lnlabor_{j,t} + \beta_7 lncapital_{j,t} + \beta_8 lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (21)$$

$$lnepi_{j,t} = \beta_0 + \beta_1 lnepi_{jt-1} + \beta_2 lntfp_{j,t} + \beta_3 lngfcf_{j,t} + \beta_4 lnopen_{j,t} + \beta_5 lnhc_{j,t} + \beta_6 lnlabor_{j,t} + \beta_7 lncapital_{j,t} + \beta_8 lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (22)$$

6. Results

The presence of cross-sectional dependence implies a significant connection between model errors. The null hypothesis of the tests denotes the absence of cross-sectional dependence. The alternative hypothesis for the tests indicates cross-sectional dependence. The probability values were less than 1%. There is a cross-sectional dependence between the series.

It also ascertained the extent to which the series is stationary to avoid complications caused by a cross-sectional dependency. Deceptive regression issues in non-stationary series models may arise (Gujarati and Porter 2012, p. 748). As a result, Pesaran (2006)'s Cross-sectionally Augmented Dickey-Fuller ($CADF$) unit root test is used for stationarity analysis. If the $CADF$ critical value exceeds the $CADF$ statistic, the null hypothesis is invalidated, and the series is defined to be stationary. The results demonstrate that the series becomes stationary when the first difference is taken, implying that the null hypothesis is dismissed.

In the analysis, panel ordinary least squares (OLS), panel fixed effects (FE), and panel random effects (RE) methods are realized. The panel-corrected standard error (PCSE) method is also conducted to obtain more consistent results. This method performs estimation by considering constraints such as cross-section dependence and heteroscedasticity. A high R^2 indicates that the regression model is well-fitting. A perfect model is formed when all points are on the regression line. Since the sum of squares of the residuals will be zero when all points are on the line, R^2 will also be equal to 1 and take the highest possible value. Each independent variable introduced into the regression models is projected to raise the explanation rate of alterations to the dependent variable, i.e., the coefficient of determination. For this reason, the coefficients of determination are adjusted for the comparison of models with the different numbers of independent variables and the selection of the appropriate model. In reality, however, more than one dependent variable influences the dependent variable. When we use R^2 as the fit indices, the better the fit, the lower the

Table 3. Results of cross-sectional dependence test

Variables	LM Test Results		CD_{LM} Test Results	
	Statistic	p-value	Statistic	p-value
lnepi	444.07	0.000	28.49	0.000
lnrtfp	310.74	0.000	6.78	0.000
lntfp	216.53	0.000	4.71	0.000
lngfcf	195.47	0.000	11.32	0.000
lnopen	108.09	0.000	5.47	0.000
lnhc	578.82	0.000	9.11	0.000
lnlabor	391.66	0.000	5.46	0.000
lncapital	273.37	0.000	6.42	0.000
lnggfce	101.28	0.000	1.49	0.000

Source: Own edited using Stata 14.2 calculations.

Table 4. Results of CADF unit root test

Variables	Level	First Difference	Result
lnepi	-3.280	-4.036**	I_1
lnrtfp	-1.294	-1.943**	I_1
lntfp	-0.434	-2.527**	I_1
lngfcf	-0.032	-1.637**	I_1
lnopen	-2.384	-4.307**	I_1
lnhc	-3.791	-3.911**	I_1
lnlabor	-5.208	-7.045**	I_1
lncapital	-1.935	-2.889**	I_1
lnggfce	-2.257	-4.629**	I_1

Notes: ** represents the null hypothesis rejection at 5%. The 5% critical value for the constant model is -2.163, while the value for the constant and trend model is -3.091.

Source: Own edited using Stata 14.2 calculations.

total square of the residuals. However, as the number of independent variables increased, the denominator would continue to decrease. Thus, R^2 would not decrease, and the more variables included in the model, the better the fit. To reduce model complexity and generate intelligible, interpretable models, variables that have little or no effect on the target variable are excluded from the model. For this reason, adjusted R^2 is used. Adjusted R^2 is distinct from R^2 that, it hinders superfluous arguments. Adjusted R^2 is a useful metric because it re-measures model fit because of duplicated variables. The adjusted R^2 findings of all models depict that the variables included in the model have high explanatory power.

Tables 5 and 6 present the estimation findings of the linear logarithmic model in Equation (20). As can result from the tables, the growth of total factor productivity affects ($lnrtfp$ and $lntfp$) economic prosperity positively. These findings are in line with the prior studies of Nehru and Dbareshwar (1994), Senhadji (1999), Easterly and Levine (2001), Bosworth and Collins (2003), Baier et al. (2006), De La Escosura and Rosés (2009), Benkovskis et al. (2012), De Vries et al. (2012), Beugelsdijk et al. (2018), Yang and Zhao (2018), and Levenko et al. (2019). The result of this study suggests that economic prosperity is highly correlated with the total factor productivity accompanied by economic growth and/or development. Besides, $lngfcf$, $lnopen$, $lnhci$, $lnlabor$, and $lncapital$ have positive coefficients. In contrast, $lnggfce$ has negative coefficients. In brief, openness, human capital, the share of labor and capital in GDP, and gross fixed capital formation enhance economic prosperity, while general government final consumption expenditure negatively affects economic prosperity. Since the panel least squares, fixed effects and random effects analysis results differ in the size of the coefficients, it is attempted to determine which method is more convenient by applying the Hausman test. The Hausman test shares that according to the probability values of test results, fixed-effects findings are more appropriately realized with two total factor productivity indicators $lnrtfp$ and

Table 5. Results of panel OLS, FE, RE, and CSE tests

Variables Dep. Var: ***lnepi***	OLS	FE	RE	PCSE	
				FE	RE
lnrtfp	0.152174*** (0.03295)	0.003293** (0.058392)	0.198439*** (0.087392)	0.038204*** (0.030837)	0.105034** (0.058392)
lngfcf	0.242950*** (0.018390)	0.001051*** (0.004824)	0.048251* (0.104821)	0.274020*** (0.028491)	0.004923** (0.048293)
lnopen	0.187391** (0.158293)	0.035920*** (0.238025)	0.000184*** (0.001517)	0.590231** (0.004821)	0.058293** (0.039045)
lnhc	0.002719*** (0.058293)	0.006349*** (0.038951)	0.138094*** (0.005281)	0.058341*** (0.046391)	0.289201*** (0.003782)
lnlabor	0.382941*** (0.032859)	0.022072*** (0.017403)	0.047210** (0.002048)	0.603481*** (0.047038)	0.039201*** (0.056382)
lncapital	0.232451*** (0.073619)	0.382056*** (0.004932)	0.186302*** (0.079302)	0.490281*** (0.393021)	0.047329*** (0.006035)
lnggfce	-0.057314*** (0.034392)	-0.039201*** (0.027391)	-0.011390*** (0.004839)	-0.083026*** (0.047291)	-0.054634 (0.186043)
Ad. R^2	0.68	0.74	0.69	0.72	0.67
F statistic	13.47291 (0.0000)	41.04528 (0.0000)	18.94621 (0.0000)		
Breusch-Pagan LM	97.28349 (0.0000)	62.68241 (0.0122)	78.59352 (0.0000)		
Hausman Test			(0.0000)		

Notes: Values in parentheses represent standard errors and values before parentheses represent coefficients. ***,**,* indicate 1%, 5%, and 10% significance levels, respectively. Hausman and Breusch-Pagan's values demonstrate the probability values of the tests.

Source: Own edited using Stata 14.2 calculations.

lntfp. Breusch-Pagan test results indicate the cross-section in fixed-effects, random-effects, and ordinary least squares. As the cross-sectional dependence between the units has been ascertained, first-order differences of the variables have been applied to the estimations, and the variables have become stationary when the first-order differences have been handled. Even so, because of the heteroscedasticity issue in OLS, FE, and RE, these outcomes may be biased and incoherent. Therefore, the panel-corrected standard error method is adopted as a robustness check. The findings of PCSE still partake in similar aspects of the nexus.

The derivative of one variable concerning another in a function that becomes linear by undergoing a logarithmic transformation denotes the elasticity. Therefore, the logarithmic form of the variables helps make the elasticity interpretation of the slope coefficients. According to the panel-corrected standard error fixed-effect results in Table 5, the elasticities of the economic prosperity *lnepi* concerning the growth of total factor productivity *lnrtfp* is 0.03. The elasticities are for the other variables as follows: gross fixed capital formation *lngfcf* is 0.27, the openness *lnopen* is 0.59, the human capital *lnhc* is 0.05, the share of labor and capital in GDP are 0.60, 0.49, and the general government final consumption expenditure *lnggfce* is -0.08. In other sayings, if the total factor productivity growth increases by 1%, economic prosperity increases by approximately 0.03%. Similarly, if the gross fixed capital formation, the openness, the human capital, the share of labor and capital in GDP scaled up 1%, the economic prosperity in CEE countries increased by about 0.27%, 0.59%, 0.05%, 0.60%, and 0.49%, respectively. On the other hand, if the general government's final consumption expenditure goes up 1%, economic prosperity declines 0.08%. According to Table 6, these ratios are for all variables as: 0.004% for

Table 6. Results of panel OLS, FE, RE, and CSE tests (robustness check)

Variables Dep. Var: ***lnepi***	OLS	FE	RE	PCSE	
				FE	RE
lntfp	0.004603*** (0.003027)	0.0018402*** (0.018401)	0.004820** (0.018057)	0.004072*** (0.104937)	0.059237** (0.003902)
lngfcf	0.048037*** (0.038021)	0.048301*** (0.048042)	0.049301*** (0.059042)	0.004829*** (0.012704)	0.005902*** (0.206738)
lnopen	0.340371** (0.083023)	0.026052*** (0.004037)	0.183021*** (0.009482)	0.073032*** (0.053082)	0.047328** (0.059043)
lnhc	0.069302*** (0.000837)	0.004839*** (0.04902)	0.004629** (0.007037)	0.320854*** (0.004037)	0.303728*** (0.007852)
lnlabor	0.004728* (0.003729)	0.017035*** (0.047291)	0.043092*** (0.004932)	0.058391*** (0.007047)	0.004502*** (0.076083)
lncapital	(0.028104)*** (0.003729)	0.003058*** (0.005041)	0.080472*** 0.004782	0.048301*** (0.004839)	0.004527** (0.004532)
lnggfce	-0.036281* (0.047390)	-0.058201*** (0.049253)	-0.053904*** (0.009831)	-0.005930*** (0.003092)	-0.048291* (0.007810)
Constant	3.04721*** (0.000)	3.00572*** (0.0000)	4.05832*** (0.0000)	9.40417*** (0.0000)	4.04829*** (0.0000)
Ad. R^2	0.69	0.71	0.72	0.66	0.70
F statistic	16.04627 (0.0000)	34.04619 (0.0000)	18.57390 (0.0000)		
Breusch-Pagan LM	83.46021 (0.0000)	35.06291 (0.0048)	47.04529 (0.0000)		
Hausman Test			(0.0000)		

Notes: Values in parentheses represent standard errors and values before parentheses represent coefficients. ***,**,* indicate 1%, 5%, and 10% significance levels, respectively. Hausman and Breusch-Pagan's values demonstrate the probability values of the tests.

Source: Own edited using Stata 14.2 calculations.

total factor productivity growth *lntfp*, 0.004% for gross fixed capital formation, 0.07% for openness, 0.32% for human capital 0.05%, and 0.04% for the share of labor and capital in GDP, respectively. Table 6 pictures that the general government's final consumption decreases economic prosperity 0.005%.

The results of the diagnostic tests performed for the confidence of the forecasts are given in Table 7. Under the null hypothesis of no autocorrelation, the Arellano Bond autocorrelation AR(2) analysis has confirmed that there is no second-order autocorrelation among the first-differenced residuals. The null hypothesis (the validity of over-identifying constraints) is not verified by the Sargan test. The coefficients of the variables are strongly significant according to both the test results. The System GMM results indicate that economic prosperity is positively correlated with the total factor productivity growth *lnrtfp* and *lntfp*. A one-unit increase in *lnrtfp* and *lntfp* results in a completely different relative growth in *lnepi* for each country. According to the results of the previous period, the economic prosperity index *lnepi(-1)* is also positively associated with the prosperity *lnepi* and increases well-being in these countries. *lngfcf*, *lnopen*, *lnhc*, *lnlabor*, *and lncapital* indicators are positively correlated with the *lnepi*. All the estimation results of these variables have significant values at the 1% level. The general government final consumption expenditure indicator *lnggfce* is negatively related to economic prosperity *lnepi*.

Tables 5, 6, and 7 briefly show that increases in total factor productivity growth ease the social and economic conditions in CEE countries, as proven by prior studies. In other words, the effect of total factor productivity growth on economic prosperity is more effective when the indicators are included in the calculations that evaluate real economic performance such as education, health, human capital, expenditures, labor, and physical capital. Prior studies of Nehru and Dbareshwar (1994), Senhadji (1999), Easterly and Levine (2001), Bosworth and Collins (2003), Baier et al. (2006), De La Escosura and Rosés (2009), Benkovskis

Table 7. Results of dynamic panel test (robustness check)

Variables	System GMM Model-1 Dependents Var: ***lnepi*** Coe. (sta. err.)	P- Values	Variables	System GMM Model-2 Dependents Var: ***lnepi*** Coe. (sta. err.)	P- Values
lnepi(-1)	0.017304 (0.0008)	(0.000)	***lnepi(-1)***	0.027493 (0.0105)	(0.000)
lnrtfp	0.003062 (0.0027)	(0.000)	***lntfp***	0.038047 (0.0012)	(0.000)
lngfcf	0.001058 (0.0023)	(0.000)	***lngfcf***	0.008395 (0.0048)	(0.000)
lnopen	0.003840 (0.00098)	(0.000)	***lnopen***	0.002850 (0.0063)	(0.000)
lnhc	0.017403 (0.0054)	(0.000)	***lnhc***	0.000149 (0.0027)	(0.000)
lnlabor	0.000839 (0.0003)	(0.000)	***lnlabor***	0.028045 (0.0093)	(0.000)
lncapital	0.003047 (0.0077)	(0.000)	***lncapital***	0.007037 (0.0186)	(0.000)
lnggfce	-0.004027 (0.0034)	(0.000)	***lnggfce***	-0.002854 (0.0044)	(0.000)
Observations	238			252	
			Diagnostic Tests		
Sargan	12.385 (0.1047)			24.056 (0.0284)	
AR(2)	-1.503 (0.0048)			-2.048 (0.1408)	

Note: System GMM Model 1 reflects the results of Equation (21). System GMM Model 2 reflects the results of Equation (22). Two-step GMM estimator results are shown. *lnepi(-1)* is considered a lag variable.

Source: Own edited using Stata 14.2 calculations.

et al. (2012), De Vries et al. (2012), Beugelsdijk et al. (2018), Yang and Zhao (2018), and Levenko et al. (2019) share similar results.

As such, the increase in TFP, the study's findings, and its relationship to the Legatum Prosperity Index are critical because; i) TFP is a measure of how efficiently companies, sectors, or countries allocate their resources on a macro scale. ii) Because TFP is a marker of how much resources are scattered, it also serves to highlight socioeconomic distinctions among nations, particularly income distribution, inequality, and poverty. iii) TFP is notable in terms of country, sector, and company competitiveness. In a sector with a high TFP, for example, the amount of final output produced with unit labor may be greater, or it may manufacture more with the same amount of capital. Therefore, a direct positive effect on the competitiveness of that company or sector would be provided. This strengthens not only output or economic growth but also labor and capital productivity and/or elasticity. Furthermore, there would be an ease in macroeconomic indicators such as (trade) openness, stable, equilibrating, and long-term capital flows, increasing investment, and human capital growth resulting from rising labor/capital quality and productivity. As a result, socioeconomic stance would invigorate. iv) In a market, resources are channeled toward sectors with high TFP. The higher the TFP, the more competitive countries, sectors, or companies are. Therefore, the higher the TFP, the greater the economy's resource usage efficiency.

7. Conclusions and Discussion

The impact of the increase in total factor productivity on economic prosperity in 18 CEE economies has been realized by panel data analysis. Previous studies associate TFP with indicators such as economic growth, labor, use of physical capital, deepening, and governance. This paper analyzes the increase in total factor productivity with the Legatum Prosperity Index, which includes many sub-components such as human well-being, quality of life, education, health, wealth, and growth. The total factor productivity growth indicator was been obtained from Penn World Table 9.0. The other total factor productivity growth rate compiled by The Conference Board Total Economy Database was also used for a robustness check. The findings show that TFP growth has positive and significant effects on economic prosperity in the 2007-2020 period. CEE countries are seen as potentially making significant economic progress in the current and future periods. Benkovskis et al. (2012), Beugelsdijk et al. (2018), and Levenko et al. (2019) argue that high investment in GDP in CEE countries is due to capital deepening and TFP growth. These three analyses that research CEE countries consider total factor productivity growth in terms of technological progress, regional progress, and industrial progress that takes into account different production technologies in detail. The studies performed analysis by developing the constant returns Cobb-Douglas production function to scale, which has been brought up in the theoretical part, to quantify the increment in TFP. This and its derivative functions presume the share of capital and labor force as constant. It is postulated in this case that the parameter values obtained for developed countries apply to all countries. As an offshoot of this assumption, it is accepted that the technological parameters are identical for whole countries, just like in the Solow exogenous growth model. The analysis in this study has been formed by following the total factor productivity growth in the study by Feenstra et al. (2015). Feenstra et al. (2015) used modeling that calculates capital and labor share separately for each country and each period. This is the first distinction and/or contribution of this study to previous research. If an international comparison is to be realized, it would be more factual to surmise that the TFP growth that is likely to change owing to the subjective capital and labor share circumstances, such as in CEE countries, is due to the various parameter preferences. The second contribution is as follows: It is specified that the capital stock increased rapidly in all Central and Eastern European countries during the crisis years, but the rate of use of capital stock decreased significantly. Instead of the standard growth analysis, the use of a more consistent and comprehensive socio-economic indicator and the analysis of whether the increase in total factor productivity creates economic prosperity expands the contribution to the literature.

Although the global financial crisis periods have harmed the CEE economies, considering that the analysis period coincided with the monetary expansion period in the world economy, economic prosperity may be positively affected by total factor productivity growth in this period. The panel-corrected standard error analysis findings confirm that the share of labor and capital in GDP makes the largest contribution to economic prosperity in CEE countries. Considering that the total factor productivity is an element that increases labor productivity and the labor productivity is determined by factors such as health, education, skills, and knowledge, the policies to improve these issues may have positive effects on economic prosperity in CEE countries. Moreover, considering that productivity increase is a factor that pushes the physical capital stock up, it is of great importance to allocate more resources to research and development activities that enable the increase in knowledge and the emergence of inventions, and the development of education policies that would increase the quality of labor. The productivity increase due to a more qualified labor force and increased inventions can enhance the human capital stock by increasing the amount of physical capital and its efficiency, and the prosperity/wealth gap between CEE and developed countries can be closed. The analysis findings display that the human capital variable also has a positive effect on economic prosperity. The effect of macroeconomic indicators on economic prosperity should not be ignored. Openness and capital formation have positive effects on economic prosperity according to the results. If openness allows technology transfer, capital will be positively affected and productivity will be achieved. The developed financial structure that accompanies openness and keeping up with the global financial system would contribute to capital formation by providing financial resources for technological improvements that may increase TFP. According to the results of the analysis, the expenditure variable is negatively correlated with economic prosperity. Creating a strong awareness that price stability is a prerequisite of economic prosperity, and similarly, the realization of public spending policies with this awareness may decline the oppression of fiscal and monetary policy tools in these countries. These matters may help policymakers eliminate the negative effects of expenditures on economic prosperity. Although TFP is an essential condition for the prosperity increase in countries, the nexus should be promoted by macroeconomic variables for TFP-based prosperity increase.

It is meditated that the beginning of the Legatum Prosperity Index from 2007 constitutes the major limitation of the study. This index is calculated using data compiled from many social, economic, and institutional databases. To eliminate this issue, dynamic panel analysis has also been operated as a robustness check. The research area should be improved with other indicators as well. Nonlinear models may also be operated. It is envisioned that the analyses to be carried out for different econometric methods and country groups would strengthen the contribution to the research field. Given that fixed capital investments, human capital investments, export, import, and foreign trade volume, foreign direct investments, and capital and labor productivity all donate to an upward trend in total factor productivity, sectoral comparison analyses can help advance the research area. Short and long-term policy implications may be undergone by pinpointing the sources of the increase in total factor productivity, both for the CEE economies as a whole and for the low-productivity sectors classified by sectoral comparison. To boost total factor productivity, it may be convenient to policies on intensifying foreign trade volume, imports, and labor productivity, and then implement strategies to uplift fixed capital investments, human capital investments, exports, and foreign direct investments. While applying these, it would be beneficial to control the money supply increase and eliminate the negative effect on TFP increases. To sustain the increase in total factor productivity over the long term, similar policies should be constructed that prioritize the rise in capital productivity. Because of the increase in total factor productivity achieved in both the CEE economies in general and in low-productivity sectors, economic development would be accelerated, and the substructure required for improved prosperity would be established.

References

Akay, E. Ç. 2018. Stata ve panel modellerinin tahmini. In Uygulamalı panel veri ekonometrisi, edited by S. Guriş, 106-30. İstanbul: Der Yayınları.

Albeaik, S., Kaltenberg, M., Alsaleh, M., Hidalgo, C. A. 2017. Improving the economic complexity index. https://arxiv.org/ftp/arxiv/papers/1707/1707.05826.pdf (accessed September 12, 2022).

Baier, S. L., Dwyer, G. P., Tamura, R. 2006. How important are capital and total factor productivity for economic growth? Economic Inquiry 44 (1): 23-49.

Barro, R. M. 1991. Economic growth in a cross section of countries. Quarterly Journal of Economics 106 (2): 407-444.

Bate, R. 2009. What is prosperity and how do we measure it? American Enterprise Institute for Public Policy Research No. 3. https://www.aei.org/wp-content/uploads/2011/10/03-DPO-2009g.pdf?x91208 (accessed October 3, 2022).

Benkovskis, K., Fadejeva, L., Stehrer, R., Wörz, J. 2012. How important is total factor productivity for growth in Central, Eastern and Southeastern European countries? Latvijas Banka Working Paper No. 5. https://www.macroeconomics.lv/sites/default/files/wp_5_2012_0 (accessed September 12, 2022).

Beugelsdijk, S., Klasing, M. J., Milionis, P. 2018. Regional economic development in Europe: The role of total factor productivity. Regional Studies 2018 52 (4): 461-476.

Bond, S. 2002. Dynamic panel models: A guide to micro data methods and practice. Centre for Microdata Methods and Practice Working Paper No. CWPO9/02. University College London the Institute for Fiscal Studies Department of Economics. https://www.econstor.eu/

bitstream/10419/79398/1/362533474.pdf. (accessed August 11, 2022).

Borović, Z., Gligorić, D., Trivić, J. 2020. Impact of economic freedom on total factor productivity in former socialist countries. Economic Analysis 53 (2): 95-108.

Bosworth, B. P., Collins, S. M. 2003. The empirics of growth: An update. Brookings Papers on Economic Activity 34 (2): 113-206.

Breitung, J. 1997. Testing for unit roots in panel data using a gmm approach. Statistical Papers, 38 (3): 253-269.

Breusch, T. S., Pagan, A. R. 1980. The lagrange multiplier test and its applications to model specification in econometrics. The Review of Economic Studies 47 (1): 239-253.

Cobb, C. W., Douglas, P. H. 1928. A theory of production. The American Economic Review 18 (1): 139-165.

Danquah, M. 2006. Sources of growth in Ghana. African Institute for Economic Development and Planning. http://unpan1.un.org/intradocgroups/public/document/IDEP/UNPAN023359pdf (accessed September 12, 2022).

De La Escosura, L. P., Rosés, J. R. 2009. The sources of long-run growth in Spain, 1850- 2000. The Journal of Economic History 69 (4): 1063-1091.

De Vries, G. J., Erumban, A. A., Timmer, M. P., Voskoboynikov, I., Wu, H. X. 2012. Deconstructing the BRICs: Structural transformation and aggregate productivity growth. Journal of Comparative Economics 40 (2): 211-227.

Easterlin, R. E. 1974. Does economic growth improve the human lot? Some empirical evidence. In Nations and households in economic growth: Essays in honor of Moses Abramovitz, edited by P. David and M. Reder, 89-125. New York: Academic Press. https://www.sciencedirect.com/science/article/pii/B9780122050503500087 (accessed September 13, 2022).

Easterly, W., Levine, R. 2001. What have we learned from a decade of empirical research on growth? It's not factor accumulation: Stylized facts and growth models. The World Bank Economic Review 15 (2): 177-219.

Elias, V. J. 1992. Sources of growth: A study of seven Latin American economies. ICS Press: San Francisco.

Feenstra, R. C., Robert, I., Timmer, M. P. 2015. The next generation of the penn world table. American Economic Review 105 (10): 3150-3182.

Fogel, R. 2004. The escape from premature hunger and death, 1700-2100: Europe, America and the third world. Cambridge: Cambridge University Press.

Fritz, M., Koch, M. 2016. Economic development and prosperity patterns around the world: Structural challenges for a global steady-state economy. Global Environmental Change 38: 41-48.

Ghosh, S. R., Kraay, A. C. 2000. Measuring growth in total factor productivity. World Bank Poverty Reduction and Economic Management Notes No. 42. https://openknowledge.worldbank.org/bitstream/handle/10986/11423/multi_page.pdf?sequence=1&isAllowed=y (accessed August 24, 2022).

Gujarati, D. N., Porter, D. C. 2012. Temel ekonometri. Translated by, Ü. Şenesen and G. Şenesen. Literatür Yayıncılık: İstanbul.

Hayakawa, K. 2007. Small sample bias properties of the system gmm estimator in dynamic panel data models. Economics Letters 95 (1): 32-38.

Idea, C. 2008. A time series analysis of the development in national R&D intensities and national public expenditures on R&D. Orindicate Final Study Report for Specific Assignment No. 4. https://ec.europa.eu/invest-in-research/pdf/download_en/spa4_final_report_final.pdf (accessed August 22, 2022).

Iwata, S., Khan, M. S., Murao, H. 2003. Sources of economic growth in East Asia: A nonparametric assessment. International Monetary Fund Staff Papers 50 (2): 157-177.

Khadimee, M. 2016. The sources of economic growth in Iran's economy. Journal of Economics Library 3 (4): 621-630.

Krugman, P. 1994. Defining and measuring productivity. https://www.oecd.org/sdd/productivity-stats/40526851.pdf (accessed August 25, 2022).

Levenko, N., Oja, K., Staehr, K. 2019. Total factor productivity growth in Central and Eastern Europe before, during and after the global financial crisis. Post-Communist Economies 31 (2): 137-160.

LPI. 2019. The legatum prosperity index methodology report. Legatum Institute. https://prosperitysite.s3accelerate.amazonaws.com/7515/8634/9002/Methodology_for_Legatum_Prosperity_Index_2019.pdf (accessed September 29, 2022).

LPI. 2020a. The Legatum prosperity index. Legatum Institute. https://www.prosperity.com/ (accessed September 29, 2022).

LPI. 2020b. The Legatum prosperity index. A tool for transformation: Pillar and element profiles. https://www.prosperity.com/about/resources (accessed September 29, 2022).

Markou, G., Palaiolouga, E., Kokkinakos, P., Markaki, O., Koussouris, S., Askounis, D. 2015. Prosperity indicators: A landscape analysis. http://ceur-ws.org/Vol-1553/paper6.pdf (accessed September 29, 2022).

Miller, S. M., Upadhyay, M. P. 2002. Total factor productivity and the convergence hypothesis. Journal of Macroeconomics 24 (2): 267-286.

Murray, A. 2016. Partial versus total factor productivity measures: An assessment of their strengths and weaknesses. International Productivitiy Monitor 31 (Fall 2016): 113-126.

Nehru, V., Dbareshwar, A. 1994. New estimates of total factor productivity growth for developing and ındustrial countries. World Bank Policy Research Working Paper No. 1313. https://documents1.worldbank.org/curated/

en/305141468765855425/pdf/multi0page.pdf (accessed August 25, 2022).

Nordhaus, W. 2005. The sources of the productivity rebound and the manufacturing employment puzzle. National Bureau of Economic Research Working Paper No. 11354. https://www.nber.org/system/files/working_papers/w11354/w11354.pdf (accessed August 25, 2022).

Oulton, N. 2004. Productivity versus welfare: Or, GDP versus Weitzman's NDP. Review of Income and Wealth 50 (3). 329-55.

Oulton, N. 2012a. Hooray for gdp! Centre for Economic Performance Discussion Papers No. 30. London School of Economics and Political Science. https://cep.lse.ac.uk/pubs/download/occasional/op030.pdf (accessed August 25, 2022).

Oulton, N. 2012b. The wealth and poverty of nations: True ppps for 141 countries. Centre for Economic Performance Discussion Papers No. 1080. London School of Economics and Political Science. http://eprints.lse.ac.uk/48941/2/dp1080.pdf (accessed August 25, 2022).

Pesaran, M. H. 2004. General diagnostic tests for cross section dependence in panels. Cambridge Working Papers in Economics No. CWPE/0435. https://www.econ.cam.ac.uk/research-files/repec/cam/pdf/cwpe0435.pdf (accessed August 25, 2022).

Pesaran, M. H. 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. Econometrica 74 (4): 967-1012.

Pesaran, M. H. 2007. A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics 22 (2): 265-312.

Prescott, E. C. 1998. Lawrence R. Klein Lecture 1997: Needed: A theory of total factor productivity. International Economic Review 39 (3): 525-551.

Roodman, D. 2009. How to do xtabond2: An introduction to difference and system gmm in Stata. The Stata Journal 9 (1): 86-136.

Sattarhoff, C. 2010. GMM estimation of multifractal random walks using an efficient algorithm for hac covariance matrix estimation. Leibniz Information Centre for Economics Ruhr Conference Papers No. A19-V3. https://www.econstor.eu/bitstream/10419/37308/1/VfS_2010_pid_525.pdf (accessed August 12, 2022).

Senhadji, A. S. 1999. Sources of economic growth: An extensive growth accounting exercise. International Monetary Fund Working Papers No. 077. https://www.imf.org/external/pubs/ft/wp/1999/wp9977.pdf (accessed August 27, 2022).

Simon, J. L. 1973. Does economic growth imply a growth in welfare? Journal of Economic Issues 7 (1): 130-136.

Solow, R. M. 1956. A contribution to the theory of economic growth. The Quarterly Journal of Economics 70 (1): 65-94.

Soto, M. 2009. System gmm estimation with a small sample. Barcelona Economic Working Paper Series No. 395. https://bse.eu/sites/default/files/working_paper_pdfs/395.pdf (accessed August 12, 2022).

Stevenson, B., Wolfers, J. 2008. Economic growth and subjective wellbeing: Reassessing the easterlin paradox. Brookings Papers on Economic Activity 39 (1): 1-87.

Stiglitz, J. E., Sen, A., Fitoussi, J-P. 2009. Report by the commission on the measurement of economic performance and social progress. https://www.economie.gouv.fr/files/finances/presse/dossiers_de_presse/090914mesure_perf_eco_progres_social/synthese_ang.pdf (accessed September 21, 2022).

Xu, M., Lybbert, T. J. 2017. Innovation-adjusted economic complexity and growth: Does product-specific patenting reveal enhanced economic capabilities? https://arefiles.ucdavis.edu/uploads/filer_public/b1/dc/b1dc-7b3f-9f37-416e 93efd79495b1e940/ieci_xu_and_lybbert_oct_2017.pdf (accessed September 22, 2022).

Verbeek, M. 2017. A guide to modern econometrics. Fifth edition. Hoboken, NJ: John Wiley & Sons.

Weitzman, M. L. 1976. On the welfare significance of national product in a dynamic economy, Quarterly Journal of Economics 90 (1): 156-162.

Yang, W., Zhao J. 2018. Sources of China's economic growth: A case for green accounting. Advances in Management & Applied Economics 8 (2): 33-59.

Young, A. 1995. The tyranny of numbers: Confronting the statistical realities of the East Asian growth experience. Quarterly Journal of Economics 110 (3): 641-680.