Institute of Economics • University of Łódź

Comparative Economic Research

Central and Eastern Europe

Volume 23 No. 4/2020

WYDAWNICTWO UNIWERSYTETU ŁÓDZKIEGO
Łódź 2020

WYDZIAŁ EKONOMICZNO-SOCJOLOGICZNY
Uniwersytet Łódzki

COPE
Member since 2018
JM13708

INITIATING EDITOR
Katarzyna Smyczek

TECHNICAL EDITOR
Aleksandra Przybył

COVER DESIGN
Katarzyna Turkowska, Agencja Reklamowa efectoro.pl

Printed directly from camera-ready materials provided to the Łódź University Press

Journal affiliated with the Faculty of Economics and Sociology of the University of Łódź

Published by Łódź University Press
First Edition. W.10139.20.0.C
Printing sheets 14.375

ISSN 1508-2008
e-ISSN 2082-6737

Łódź University Press
90-131 Łódź, Lindleya 8
www.wydawnictwo.uni.lodz.pl
e-mail: ksiegarnia@uni.lodz.pl
tel. (42) 665 58 63

Contents

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.25

The Relationship between Corruption and the Shadow Economy in Ukraine and Other Central and Eastern European Countries

Valentyna Cherviakova
Ph.D., Associate Professor, National Transport University, Kyiv, Ukraine
e-mail: chervyakovav@gmail.com

Tetiana Cherviakova
Ph.D., Associate Professor, National Transport University, Kyiv, Ukraine
e-mail: cherti2015@gmail.com

Abstract

The article investigates the causes, essence, and peculiarities of corruption and the shadow economy, as well as how they are related, in Ukraine in comparison with other Central and Eastern European countries. A correlation-regression analysis of statistical data revealed a direct correlation connection of different strengths and statistical significance between levels of corruption and the shadow economy in all Central and Eastern European countries. However, the degree to which corruption impacts the variation in the levels of the shadow economy differs significantly in countries across the region. The key conclusion is that in countries with relatively high levels of corruption and the shadow economy, corruption causes a smaller share of the shadow economy than in countries with relatively low levels of these phenomena. Causes of the weak correlation between levels of corruption and the shadow economy in Ukraine were identified. The main corruption and non-corruption factors of Ukraine's economy shadowing were determined. It was concluded that policy and measures to counteract corruption and the shadow economy in Ukraine should be aimed at eliminating their root causes rather than manifestations.

Keywords: corruption, shadow economy, correlation

JEL: E26, H26, K42, O17, O57

Introduction

Ukraine belongs to a group of countries in which political and bureaucratic corruption is deeply rooted in various spheres of life and has become an organic element of social relations. At the same time, the level of corruption is closely linked to the state of the economy. Corruption distorts the functioning of market mechanisms that regulate the economy and impedes the country's economic growth, making it vulnerable and dependent on foreign economic conditions and international lenders. Corruption leads to revenue losses of the state budget due to tax evasion, the inefficient use of budget funds, and a reduction in domestic and foreign investment, and it increases the uncertainty of the environment in which economic agents function. A major consequence of corruption is a reduction in the efficiency of the economy due to the rising cost of capital and reducing its productivity in the face of high risks of doing business in the country. In addition, corruption constrains the development of state institutions and undermines the well-being of citizens, because it hinders the proper implementation of state social functions (for example, in medical and educational spheres), increases income inequality, raises poverty, and reduces the level of public trust. These factors, in turn, also have a negative impact on economic development (Boitsun et al. 2016; Burakovskyi et al. 2018).

Ukraine is the most corrupt country in Europe and has the largest share of the shadow economy in GDP among European countries. Since gaining independence in 1991, the shadow economy in Ukraine has consistently exceeded 30% of GDP and reached 50% of GDP in some years. A significant level of the shadow economy is one of the most dangerous threats to Ukraine's economic security, which exacerbates the socio-economic crisis in the country and negatively affects its international image.

The main objectives of our research are:

- to investigate the basic reasons for the emergence of certain types of corruption and their impact on the economy of Ukraine, especially the shadow economy;
- to study the root causes and peculiarities of the shadow economy in Ukraine;
- to explore the degree and nature of the relationship between levels of corruption and the shadow economy in Central and Eastern European countries;
- to determine what share of the shadow economy is sensitive to changes in the level of corruption in Ukraine in comparison with other countries of Central and Eastern Europe;
- to identify the corruption and non-corruption factors of Ukraine's economy shadowing;
- to determine priority areas to combat corruption and the shadow economy in Ukraine.

This article aims to confirm the hypothesis that in countries with higher levels of corruption and the shadow economy, it is corruption factors that mostly determine the variation in shadow economy volumes.

The value of this article is a comparative study of the relationship between levels of corruption and the shadow economy in post-socialist countries of Central and Eastern Europe, that have undergone a profound economic transformation in past decades. In addition, unlike other studies, we are not going to limit ourselves to confirming the existence of the relationship between these phenomena; we intend to determine which part of the shadow economy is caused by corruption factors and which by non-corruption factors in each of the studied countries.

The methodological basis of the study is statistical methods: a comparison of averages, and graphical, correlation, and regression analysis.

Literature review

In recent years, many scientific papers have been devoted to the study of the relationship between corruption and the shadow economy in different countries and regions. However, this relationship remains ambiguous, and its significance varies greatly from country to country, depending on income level, political system, and historical background.

In particular, Duc Hong Vo, Dao Thi-Thieu Ha, and Thinh Hung Ly found empirical evidence to support the view that there is a causal relationship between the shadow economy and corruption for the ASEAN countries from 1995 to 2014. The shadow economy is positively correlated with corruption and vice versa. These two relationships are statistically significant. In addition, they noted that the effect of corruption on the shadow economy was more significant than the effect of the shadow economy on corruption. The findings from their study indicate that controlling the shadow economy (and/or corruption) may be a better way to reduce the level of corruption (and/or shadow economy). However, for developing ASEAN countries, it may be more appropriate to start with policies to reduce the level of corruption than the other way round (Vo et al. 2015).

Similar conclusions were made by Turkish scientists, who studied the effect of corruption and the rule of law on the shadow economy in 11 transition economies of Central and Eastern Europe over the 2003–2015 period with panel cointegration and causality tests that considered heterogeneity and cross-sectional dependence. The cointegration coefficients revealed a complementary interplay between the size of the shadow economy and corruption. Furthermore, the causality analysis indicated that there was a bilateral causality between control of corruption and the shadow economy in all the cross-section units (Bayar et al. 2018).

Dreher and Schneider also addressed the dual relationship between corruption and the size of the shadow economy. They believe that the relationship might differ between high and low-income countries. However, dividing countries into these two groups can be an issue considering that in some countries, a significant part of income is being earned and spent in the shadow economy, and is not represented in official

statistics. They hypothesized that the shadow economy and corruption are substitutes in high-income countries. Conversely, in low-income countries, they expected the shadow economy and corruption to be complements. However, their results showed that there is no robust relationship between corruption and the shadow economy when perception-based indices of corruption are used. When employing an index of measured corruption, the results showed that corruption and the size of the shadow economy are complements in countries with low income, while there is no robust relationship in high-income countries. They admit that one of the most important problems in empirical studies of corruption and the shadow economy is the unavailability of high-quality data over time. Such data do not exist and given the hidden nature of corruption and the size of the shadow economy expecting clear-cut results might arguably be too ambitious (Dreher and Schneider 2010).

The paper by Robert Gillanders and Sinikka Parviainen, for the most part, found that corruption and the shadow economy are complements at the country level. Their analysis at the level of subnational units using Enterprise Surveys data likewise found that the two illicit phenomena are strongly and significantly positively correlated. Regions with more of a problem with one tend to have more of a problem with the other. Expressing measures of the problems in terms of deviations from national averages showed a similar pattern. Relatively more corrupt regions tend to be relatively more burdened by the shadow economy. Motivated by interesting findings in the literature, they split the sample into groups defined by broad global regions. They found that while their results hold in the Europe and Central Asia, and Latin America and Caribbean groups, these relationships are not evident in sub-Saharan Africa (Gillanders and Parviainen 2015).

Romanian scholars investigated the relationships between corruption and the shadow economy among the European Union countries between 2005 and 2014. They found that about one-fifth of the European Union's GDP is lost due to the shadow economy. Bulgaria, Romania, Hungary, Estonia, Greece, and Italy were found to have the highest levels of corruption and the shadow economy. At the same time, Nordic countries such as Denmark, Finland, and Sweden, followed by the Netherlands, and then Austria and Luxembourg, were found to have the lowest level of corruption. This study's descriptive statistics revealed that the most corrupt countries with the biggest shadow economies are located in low-income, mostly post-communist countries. In addition, a high and positive relationship between corruption and the shadow economy was found among the EU countries, which means that a higher level of corruption results in a higher level of the shadow economy. Researchers also revealed strong and negative effects of corruption and the shadow economy on the economic growth of EU countries in the period 2005–2014 (Borlea et al. 2017).

Jay Pil Choi and Marcel Thum developed a simple framework to analyze the links between corruption and the shadow economy and their implications for the official economy. In a model of self-selection with heterogeneous entrepreneurs, they showed that the entrepreneurs' option to flee to the underground economy constrains cor-

rupt officials' abilities to introduce distortions to the economy for private gains. The unofficial economy thus mitigates government-induced distortions and, as a result, leads to enhanced economic activities in the official sector. In this sense, the presence of the unofficial sector acts as a complement to the official economy, but a substitute for corruption. This result is in sharp contrast to the existing models of the unofficial economy where the official and unofficial sectors compete for resources and the existence of the informal sector is viewed as harmful for economic growth. However, when corruption is defined as "the abuse of public power for private benefit," and its avoidance is the main reason for the shadow economy, any efforts to eradicate the shadow economy without tackling the principal problem of corruption would be counterproductive. Their model thus suggests the importance of considering the genesis of the shadow economy to evaluate its implications for resource allocations (Choi and Thum 2005).

Therefore, the relationship between corruption and the shadow economy is not entirely clear in the literature. Researchers suggest plausible cases for both complementarity and substitution that is for positive and negative corruption and the shadow economy relationship, respectively. Some empirical studies find support for both cases. However, in different countries, various storylines are possible within each case, which makes empirical results difficult to interpret. In our opinion, the correlation between corruption and the shadow economy, as well as its effects, goes far beyond the concepts of complementarity and substitution. We support Travis Wiseman, who steps away from the designations of "complement" and "substitute," instead arguing that the relationship might be better defined as either collusive (crony) or non-collusive, i.e., either corrupt public officials and shadow economy participants work together or they do not. Therefore, it is not enough to determine the strength and direction of the correlation between corruption and the shadow economy in order to characterize the relationship between these phenomena in a certain country. It is essential to take into account the socio-political system, the state of the economy and its structure, as well as the history and traditions of a particular country (Wiseman 2016).

The essence of corruption and shadow economy in Ukraine

Corruption and the shadow economy are multifaceted phenomena and can take different forms depending on the country's political system and level of economic development. Transparency International identifies corruption as "the abuse of entrusted power for private gain," and it identifies three types of corruption: political, grand and petty, depending on the amounts of money lost and the sector where it occurs.[1]

1 Official website of Transparency International, https://www.transparency.org/ (accessed: 5.01.2020).

In Ukraine, at the legislative level, the term "corruption" is defined as the use by a person (a subject of corruption offense) of rendered powers or related possibilities to obtain an illegal benefit or receiving such a benefit or accepting a promise/offer of such a benefit for himself or other persons or, respectively, making a promise/offer or giving an illegal benefit to a specified person or other persons or legal entities on request in order to induce this person to illegally use rendered powers or related possibilities (Verkhovna Rada 2014).

This definition is almost in line with the definition of "corruption" used by Transparency International. At the same time, scientists emphasize the need to differentiate political corruption and bureaucratic corruption of different levels. The main criterion for distinguishing political and bureaucratic forms of corruption is their place in the process of policy development and implementation. Thus, political corruption occurs at the stage of policy-making (political decision-making, the establishment of "rules of the game"), while bureaucratic corruption takes place at different stages of policy implementation (the implementation of relevant decisions). The introduction of this criterion is conditioned by differences in the nature of political (standard-setting activity) and bureaucratic (administrative and executive activity) functions. Thus, subjects of political corruption use power to establish legal rules that are in line with their private interests and set up "by pass" ways to ignore other rules. Bureaucratic corruption means violating of established rules and standards (Armash 2017).

Political corruption in Ukraine first arose in the 1990s as a result of the large-scale privatization of large industrial enterprises by a limited group of individuals who subsequently began to use their economic power to influence political decision-making. Thus, an oligarchic political regime was formed in Ukraine, as oligarchs use monopolized sectors of the economy to concentrate political power in their hands, and political power to multiply their own capital. Now, Ukrainian oligarchs own a wide range of assets which are economic (industrial enterprises and financial institutions), informational (print and electronic media), and political (parties, parliamentary groups and factions, important government positions, influence on first persons in the state) (Davydenko et al. 2016; Kushnarov 2018). Therefore, political corruption in Ukraine covers:

- party corruption (violations of the order of party financing, making party decisions bypassing the mechanisms of internal party democracy, the sale of seats in the potentially passable part of the party list, the use of "false donors" to bypass limits on donations to parties, etc.);
- electoral corruption (violations of the rules of election fund formation, various forms of bribing voters and members of election commissions, the use of administrative resources in the interests of certain subjects of elections, etc.);
- lobby corruption (non-transparent actions aimed at shadow promotion of stakeholders' interests at the legislative level for reward, etc.);
- representative corruption (bribery of deputies of parliament and local authorities in order that they adopt desired legislative and regulatory acts);
- judicial corruption (courts implementing political orders).

An example of political corruption is the introduction of a moratorium on agricultural land sales in 2001 and its annual extension. As a result, millions of Ukrainians are deprived of the right to legally buy and sell agricultural land, while agrarian oligarchs receive super-profits due to land lease at much lower prices than in neighboring countries. In March 2020, the Verkhovna Rada voted for land reform in Ukraine, which will introduce a land market from July 1, 2021. However, the adopted law is quite controversial, introduces a long transition period, contains significant corruption risks, and may be amended or repealed before entry into force.

The impact of political corruption on the economy means the introduction of prohibitions or restrictions on certain types of economic activity and financial transactions, which leads to the bankruptcy of the subjects of these activities or their transition to the shadow economy sector. In addition, political corruption inhibits the entry of new players (in particular, foreign players) into the domestic market, and it contributes to the monopolization of certain economic sectors, ensuring the dominance of oligarchic structures in them. The main consequences of political corruption are violations of economic rights and freedoms of population and business, low level of investments, technological backwardness and the inefficiency of production in a number of economic sectors.

High-level bureaucratic corruption is the result of controversial legislation that gives public officials considerable discretionary powers and opportunities for abuse. The main forms of high-level bureaucratic corruption in Ukraine are (Krut 2018):

- non-transparent appointments to civil service positions;
- the opaque disposal of state and communal property in the interests of related parties (opacity of privatization and leasing of property, as well as the distribution of land and natural resources);
- abuses in public procurement in favor of related commercial structures;
- financing private enterprises by granting exemptions, subsidies, and subventions;
- combining a position in public authority that regulates a certain type of economic activity with entrepreneurial activity in the same sphere;
- promoting the monopolization of a certain type of commercial activity in the region where they exercise authority;
- protecting shadow (including illegal) economic activity;
- making artificial barriers and timing violations when granting permits, licenses, etc. (so-called trade in discretionary power).

High-level bureaucratic corruption affects the economy, providing competitive advantages to certain entrepreneurs (in particular, those related to officials) who avoid requirements or receive privileges and, therefore, operate on more favorable conditions than other market participants. As a result, other entrepreneurs become uncompetitive and are compelled to either cease their activity or work under the protection of officials, paying them corrupt rent. Bribes and corrupt rent are considered to be expenses and are included in the cost of goods and services, leading to higher prices of Ukrainian products and making them uncompetitive.

Low-level bureaucratic corruption in Ukraine has emerged as one of the informal institutions of interaction between citizens and various institutions that provide public services or which are authorized to take actions on behalf of the state. Sociological surveys show that Ukrainians most often face corruption in medical institutions (46%), higher education institutions (22%), local authorities (13%), schools (10%), and patrol police (9%). It is noteworthy that 33.3% of citizens give bribes in order to accelerate the solution to an issue that had to be resolved anyway, 25.7% simply to make officials perform their official duties, and only 14.4% to resolve an issue in their favor unlawfully and 4.7% to cancel or reduce a punishment or fine (Sukharyna 2017). At the same time, in many cases, low-level bureaucratic corruption is caused by insufficient state funding of the institutions involved, which means low salaries and poor motivation of the employees, as well as poor material and technical condition. Thus, low-level bureaucratic corruption replaces or complements the formal order of functioning of these institutions that were established by regulatory acts.

Therefore, it can be concluded that each type of corruption affects the economy in different ways. Political corruption suppresses economic freedom, leads to the monopolization of certain economic sectors, and inhibits economic growth. High-level bureaucratic corruption distorts the functioning of competitive mechanisms in certain economic sectors or regions, which prompts business entities to cease their activity or transit to the shadow sector; it also provides protection for illegal business activities. Low-level bureaucratic corruption partially eliminates disproportions in the economy and ensures the survival of the population in difficult socio-economic conditions caused by ineffective reforms on the way from a planned to a market economy.

In scientific circles, there is no single view on the definition of the shadow economy. This study will use the definition proposed by Schneider, which is used by the International Monetary Fund, namely: "the shadow economy includes all economic activities which are hidden from official authorities for monetary, regulatory, and institutional reasons. Monetary reasons include the avoidance of paying taxes and all social security contributions, regulatory reasons include avoiding governmental bureaucracy or regulatory burden, institutional reasons include corrupt legislation, the quality of political institutions and the weakness of rule of law. Thus, the shadow economy reflects mostly legal economic and productive activities that, if recorded, would contribute to national GDP. The definition of the shadow economy, in this case, does not include illegal or criminal activities, do-it-yourself, or other household activities" (Medina and Schneider 2018). The "shadow economy" is also often used interchangeably with "informality" (Kelmanson et al. 2019).

In our opinion, the concept of "the shadow economy" comes from the physical phenomenon of shadow from light, and it reflects the official economy. The shadow economy is not a separate sector of the economy and it may exist in any sector of the official economy and be closely intertwined with it. Therefore, it is impossible to define its boundaries clearly. The main types of shadow economic activities in Ukraine are cash transactions without accounting, concealing incomes or overstating expendi-

tures, unofficial employment and the payment of illegal wages, bribes and kickbacks, clandestine production, and economic activities that are not regulated by the current legislation.

The shadow economy in Ukraine is the result of a systemic crisis in the economy that arose due to the discrepancy of methods of implementing market reforms to the needs of society. The transformation processes in the economy were accompanied by the destruction of established distribution relationships and the construction of new ones that substantially violate the balance of interests of economic entities, the parity of development of economic sectors, and motivation to manage effectively. Thus, shadow economic relations in Ukraine should be viewed as a means of restoring balance in the economy, which has been violated by both corrupt and non-corrupt factors. Accordingly, the shadow economy includes both corrupt and non-corrupt components.

The relationship between corruption and the shadow economy

To investigate the relationship between corruption and the shadow economy, it is necessary to determine what part of the shadow economy is due to corruption and what is caused by other factors. This problem in Ukraine and other Central and Eastern European countries has virtually not been researched. This paper deals with the relationship between corruption and the shadow economy in post-socialist countries that have undergone a deep economic transformation. Statistical analysis of the correlation between levels of corruption and the shadow economy in 13 countries in Central and Eastern Europe is based on data from the International Monetary Fund and Transparency International. The average values of the indicators are shown in Table 1.

Table 1. Average values of the shadow economy and corruption in the region

Country	Average values of indicators	
	The level of the shadow economy between 1991 and 2015, % of GDP	The relative level of corruption between 1998 and 2019*
Belarus	44.52	0.60
Bulgaria	29.17	0.44
Czech Republic	14.83	0.34
Estonia	23.80	0.18
Hungary	25.23	0.34
Latvia	22.23	0.37
Lithuania	25.15	0.29
Moldova	43.43	0.65
Poland	25.10	0.34
Romania	30.14	0.50
Russia	38.42	0.78

Table 1. (continued)

Country	Average values of indicators	
	The level of the shadow economy between 1991 and 2015, % of GDP	The relative level of corruption between 1998 and 2019*
Slovakia	15.33	0.37
Ukraine	44.80	0.77
The average value across the region	29.40	0.46

* Calculated as the ratio of the country's rank in the Corruption Perceptions Index to the total number of countries in the ranking.
Source: author's own calculations based on Medina and Schneider, 2018 and data from the official website of Transparency International at https://www.transparency.org/ (accessed: 10.11.2019).

Distributions of the countries by the average value of the shadow economy level, as well as the average values of corruption level, are presented in Figures 1 and 2, respectively.

The highest levels of the shadow economy are observed in Ukraine, Belarus, Moldova, and Russia; the lowest ones are in the Czech Republic and Slovakia; average levels are found in Bulgaria and Romania; below average levels are found in Hungary, Lithuania, Poland, Estonia, and Latvia (see Figure 1).

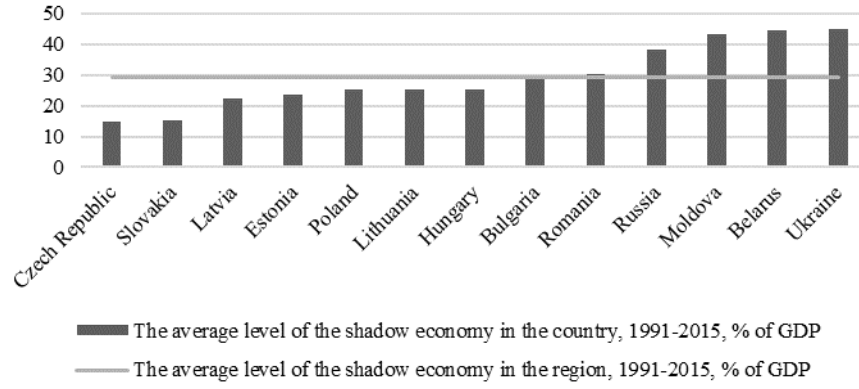

Figure 1. Distribution of the countries by the average level of the shadow economy
Source: author's own calculations based on Medina and Schneider 2018.

The highest levels of corruption are observed in Russia and Ukraine, the lowest in Estonia, and average levels in Bulgaria and Romania (see Figure 2). The level of corruption in Moldova and Belarus is almost 40% higher than the average throughout the region, while in other countries it is lower.

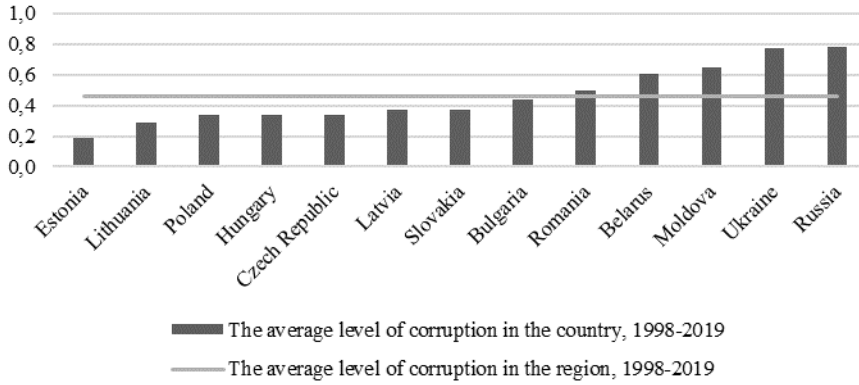

Figure 2. Distribution of countries by the average level of corruption
Source: author's own calculations based on data from the official website of Transparency International at https://www.transparency.org/ (accessed: 12.11.2019).

Further research was aimed at establishing a statistical link between levels of the shadow economy (Y) and levels of corruption (X) in Central and Eastern European countries.

The research was carried out on the basis of the correlation-regression analysis of data presented in the form of two samples of the same volume n:

$$X = \begin{pmatrix} x_1 \\ \dots \\ x_i \\ \dots \\ x_n \end{pmatrix}, \quad Y = \begin{pmatrix} y_1 \\ \dots \\ y_i \\ \dots \\ y_n \end{pmatrix}. \tag{1}$$

The correlation analysis of the relationship between levels of the shadow economy and levels of corruption in Central and Eastern European countries was preceded by a study of the correlation fields of the link between these indicators.

The resulting scatter diagrams confirmed the existence of a direct correlation between levels of the shadow economy and levels of corruption in all countries studied, i.e., rising levels of corruption are accompanied by an increase in levels of the shadow economy (see Figure 3).

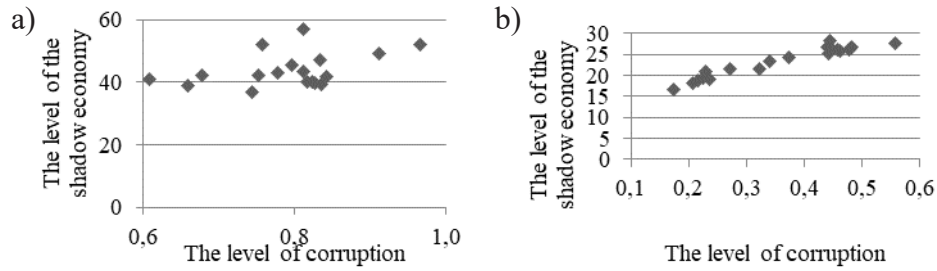

Figure 3. Correlation fields of the link between levels of the shadow economy and levels of corruption in Ukraine (a) and Poland (b)
Source: author's own calculations.

The measure of the correlation between X and Y is the Pearson correlation coefficient (linear correlation coefficient), which can be calculated from one of the dependencies (Rudenko 2012; Bilichenko and Kuzhel 2013):

$$r = \frac{\sum_{i=1}^{n}(x_i - \overline{x})\cdot(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2 \cdot \sum_{i=1}^{n}(y_i - \overline{y})^2}}. \quad (2)$$

$$r = \frac{\overline{xy} - \overline{x}\cdot\overline{y}}{\sigma_x \cdot \sigma_y}. \quad (3)$$

n – sample size;
x_i . , y_i . – the value of the i-th element of samples X and Y respectively;
$\overline{x}, \overline{y}$ – averages of samples X and Y respectively;
$\overline{xy}$ – the average value of product $x_i \cdot y_i$;
$\overline{x^2}$, $\overline{y^2}$ – the average value of squared X and Y respectively;
σ_x, σ_y – mean square deviations of corresponding values, which are defined as follows:

$$\sigma_x = \sqrt{\overline{x^2} - \overline{x}^2}\ ,\ \sigma_y = \sqrt{\overline{y^2} - \overline{y}^2}\ .$$

Applying of the Pearson correlation coefficient is correct only when the form of the correlation field indicates that there is a linear relationship. The Pearson correlation coefficient allows us to estimate the strength and direction of the linear relationship between X and Y. It is a number in the range from –1 to 1. T sign of the number determines the direction of the relationship, and its absolute value determines the strength of the relationship. Positive coefficient values indicate a direct relationship between the indicators, and negative ones show an inverse relationship (i.e., when the value of one indicator increases, the sd indicator decreases). A value of zero may indicate the ab-

sence of a linkage. However, zero general correlation may only indicate the absence of linear dependence, not the absence of any statistical connection.

For the linear regression, the correlation coefficient *r* is not only a criterion for the strength of the relationship, but for the accuracy of approximation (selecting the formula which expresses dependence). Estimating the accuracy of approximation by curvilinear dependence is made using the correlation index (Stavytskyi 2004; Bilichenko and Kuzhel 2013):

$$\eta = \sqrt{1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)}{\sum_{i=1}^{n}(y_i - \overline{y})}}. \quad (4)$$

$\hat{y}_i$. – the value of the i-th element of sample Y, calculated from the regression equation (theoretical value).

Unlike the linear correlation coefficient, the correlation index does not characterize the direction of the relationship. It varies in the range $0 \le \eta \le 1$. If $\eta > r$ the curve more accurately approximates the dependence than a straight line; $\eta = r$. for a straight line.

As an additional estimate of the accuracy of data approximation by nlinear dendence, the average relative error of approximation $\overline{\varepsilon}$ is often used, which is determined by the formula:

$$\overline{\varepsilon} = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_i - \hat{y}_i}{y_i}\right| \cdot 100\%. \quad (5)$$

To convert the quantitative characteristics of the strength of the correlation between two indicators into qualitative ones, the Chaddock scale can be used (see Table 2).

Table 2. Chaddock Scale for qualitative correlation analysis

The absolute value of the correlation coefficient (correlation index)	Qualitative characteristic of correlation between two indicators
up to 0.3	practically absent
0.31–0.5	weak
0.51–0.7	notable
0.71–0.9	strong
0.91–0.99	very strong
1	functional

Source: Sydorova et al. 2019.

The significance of the pair correlation coefficient *r* is tested by the Student's criterion (actually, the hypothesis about the equality of correlation coefficient to zero is checked), which is calculated by the formula (Stavytskyi 2004):

$$t_{\partial} = \frac{r^2 \cdot \sqrt{(n-2)}}{\sqrt{1-r^2}}. \quad (6)$$

r – the value of the correlation coefficient;
n – sample size.

The calculated value of the Student's criterion is compared with the critical value from the Student's t-distribution with given statistical significance α and a number of degrees of freedom.

If the calculated value of the Student's criterion t_{∂} is greater than its critical value $t_{\hat{e}\partial}$. ($t_{\partial} > t_{\alpha;k}$), the correlation coefficient is significant at the level of significance α (level of reliability $p = 1 - \alpha$.), indicating the non-random nature of the statistical relationship between the variables.

Establishing a mathematical model of the relationship between dependent variable Y and independent variable X (obtaining dependence of the type $Y = f(X)$.) can be done by conducting a regression analysis of the data. In the c pair correlation, the investigated data can be approximated by various functions, such as a straight line, second-order parabola, hyperbola, logarithmic function, power function, exponential function, arithmetic or geometric progressions, algebraic polynomial, or trigonometric series.

After identifying a sufficiently strong linear relationship between the X and Y indicators, the problem of determining the regression equation, that describes this relationship, arises (Holikov 2006):

$$y = b_1 \cdot x + b_0, \quad (7)$$

Linear regression makes it possible to detect how much the average value of one indicator changes with the change of another. The parameters of linear regression b_1. and b_0 are calculated using the least squares method. The essence of the method is to select a line with parameters b_1 and b_0, for which the sum of the squares of the residual deviations will rotate at a minimum:

$$\sum_{i=1}^{n} \left(y_i - \hat{y}_i \right)^2 \rightarrow min .$$

Parameters of linear regression are calculated by formulas (Lukianenko and Krasnikova 1998):

$$b_1 = \frac{\sum_{i=1}^{n} (x_i - \overline{x}) \cdot (y_i - \overline{y})}{\sum_{i=1}^{n} (x_i - \overline{x})^2} \text{ or } b_1 = \frac{\overline{xy} - \overline{x} \cdot \overline{y}}{\overline{x^2} - \overline{x}^2}. \quad (8)$$

$$b_0 = \overline{y} - b_1 \cdot \overline{x}. \tag{9}$$

In more complex cases of connection, polynomial dependences of the n-th order can be used:

$$y = a_0 + a_1 \cdot x + a_2 \cdot x^2 + \ldots + a_n \cdot x^n . \tag{10}$$

The values of parameters $a_0, a_1, a_2, \ldots, a_n$ are found by solving the system of normal equations.

To determine which part of the variation (%) of the dependent variable is due to the variation of the independent variable, the determination coefficient R^2 is used (Lukianenko and Krasnikova 1998):

$$R^2 = \frac{\sum_{i=1}^{n} \left(\hat{y}_i - \overline{y}\right)^2}{\sum_{i=1}^{n} \left(y_i - \overline{y}\right)^2} . \tag{11}$$

variance explaining regression;
$\sigma^2_{\text{çàã}}$ – total variance.

The determination coefficient is always positive and varies from zero to one $\left(0 \le R^2 \le 1\right)$. It is connected with the correlation coefficient by the dependence:

$$R^2 = r^2 . \tag{12}$$

The adequacy of the model of pair regression is checked by Fisher's criterion. The actual value of Fisher's criterion is determined by the formula (Stavytskyi 2004):

$$F_{\Phi} = \frac{R^2 \cdot \left(n-2\right)}{1-R^2} \tag{13}$$

and is compared with the critical values of Fisher's statistics with *1* and (*n* – 2) degrees of freedom and reliability level (1 – *α*): $F_{\kappa\rho} = F\left(1, n-2, 1-\propto\right)$. If $F_{\Phi} \ge F_{\kappa\rho}$, the model is statistically significant (adequate).

In order to avoid cumbersome calculations and to reduce computational volumes, statistical analysis of the relationship between levels of the shadow economy and levels of corruption in Central and Eastern European countries was conducted using modules Basic Statistics/Tables, Multiple Linear Regression and Advanced Linear/Nonlinear Models of the Statistica package (Lupan et al. 2015).

The critical values of the statistics were determined using the Probability Distribution Calculator (Toptunova et al. 2008).

At the first stage of the study, a linear correlation-regression analysis of the data was performed to establish the strength and direction of the correlation connection and to make a qualitative assessment (see Table 3).

The data show that a weak linear correlation between levels of corruption and levels of the shadow economy is observed in Russia, while it is notable in Moldova, Bulgaria, and Belarus; in other countries of the region, it is strong or very strong. The linear correlation between levels of the shadow economy and the levels of corruption in Ukraine is weak and statistically insignificant according to Student's criterion, with a probability of 95% (*1.8754 < 2.1199*).

Given that the strength of the pair correlation connection is significantly influenced by the form of connection (linear, nonlinear), nonlinear correlation-regression analysis of the relationship between levels of the shadow economy and levels of corruption was conducted.

Summary results of the linear and nonlinear correlation-regression analysis of the relationship between the indicators are presented in Table. 4.

Table 3. Characteristics of the linear correlation between levels of the shadow economy and levels of corruption in Central and Eastern European countries

Country	Number of observations *n*	Correlation coefficient *r*	Student's criterion		Qualitative characteristic of correlation
			t_p	t_{kp}	
Poland	20	0.9639	15.3587	2.1009	very strong
Latvia	18	0.9174	9.2209	2.1199	very strong
Romania	19	0.9022	8.6244	2.1098	strong
Slovakia	18	0.8935	7.9588	2.1199	strong
Hungary	21	0.8889	8.4580	2.0930	strong
Lithuania	17	0.8708	6.8599	2.1314	strong
Estonia	18	0.8430	6.2687	2.1199	strong
Czech Republic	20	0.8382	6.5208	2.1009	strong
Belarus	18	–0.5874	2.9033	2.1199	notable
Bulgaria	18	0.5388	2.5583	2.1199	notable
Moldova	17	0.5323	2.4353	2.1314	notable
Russia	20	0.4689	2.2523	2.1009	weak
Ukraine	18	0.4245	1.8754	2.1199	weak

Source: author's own calculations.

The data show that the correlation between levels of corruption and the shadow economy in all countries of the region is significant, according to the Student's criterion, and the Fisher test proves that regression equations fit the actual data well. At the same time, the degree of influence of corruption on the variation of the shadow economy levels in Central and Eastern European countries is very different (see Figure 4). Thus, the variation in the shadow economy levels depends on the impact of corruption by approximately 81–92% in Poland, Latvia, and Romania, by 71–80% in Slovakia, Hunga-

ry, Lithuania, and Estonia, by 60–70% in the Czech Republic, Moldova, Russia, and Belarus, by 48% in Bulgaria, and only by 26% in Ukraine.

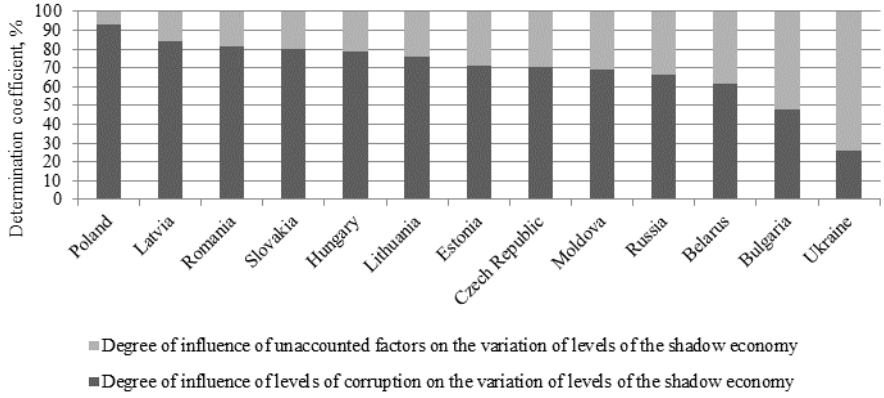

Figure 4. Variation of the shadow economy levels due to the influence of corruption and other factors
Source: author's own calculations.

Table 4. Results of nonlinear the correlation-regression analysis of the relationship between levels of the shadow economy and corruption in Central and Eastern European countries

№	Country	Model of correlation y = f(x)	Correlation ratio	Qualitative characteristic of correlation	Student's criterion		Fisher's criterion		Determination coefficient
					t_p	t_{kp}	F_ϕ	F_{kp}	
1	Poland	$y = 29.576x + 12.717$	0.96	very strong	15.36	2.10	236.19	4.41	0.93
2	Latvia	$y = 21.619x + 12.224$	0.92	very strong	9.22	2.20	85.02	4.49	0.84
3	Romania	$y = 22.589x + 16.845$	0.90	strong	8.62	2.11	74.42	4.45	0.81
4	Slovakia	$y = 20.789x + 6.049$	0.89	strong	7.96	2.20	63.36	4.49	0.80
5	Hungary	$y = 21.736x + 16.578$	0.89	strong	8.46	2.09	71.52	4.38	0.79
6	Lithuania	$y = 47.461x + 8.7732$	0.87	strong	6.86	2.13	47.05	4.54	0.76
7	Estonia	$y = 48.271x + 12.376$	0.84	strong	6.27	2.20	39.29	4.49	0.71
8	Czech Republic	$y = 21.185x + 6.4547$	0.84	strong	6.52	2.10	42.51	4.41	0.70
9	Moldova	$y = 4977.6x^4 - 14415x^3 + 15443x^2 - 7233.3x + 1289.9$	0.83	strong	5.81	2.13	9.29	4.54	0.69
10	Russia	$y = -22750x^4 + 71297x^3 - 82838x^2 + 42301x - 7975.7$	0.81	strong	5.93	2.10	35.18	4.41	0.66
11	Belarus	$y = 623.49x^3 - 1109.4x^2 + 598.79x - 51.873$	0.79	strong	5.10	2.12	26.03	4.49	0.62
12	Bulgaria	$y = 7161.5x^4 - 16828x^3 + 14387x^2 - 5265.6x + 722.4$	0.69	notable	3.81	2.12	15.01	4.49	0.48
13	Ukraine	$y = -106404x^5 + 425953x^4 - 676921x^3 + 533781x^2 - 208819x + 32458$	0.53	weak	2.38	2.12	5.24	4.49	0.26

Source: author's own calculations.

In our opinion, the weak correlation between the levels of the shadow economy and levels of corruption in Ukraine is due to the following factors:

- Insufficient official statistics that the assessment of the level of the shadow economy is based on. For instance, the last population census in Ukraine was in 2001, but its data is still used to calculate key macroeconomic indicators. Given that since then, the size and structure of the population have changed significantly due to mass emigration, the annexation of Crimea, and the occupation of territories in the east of Ukraine, there is currently no reliable data on the number of people actually living and working in Ukraine. Therefore, GDP per capita, as well as employment rates, cannot be considered reliable.
- Large-scale capital outflow from Ukraine. Corrupt officials prefer to store and spend unofficial revenues abroad rather than in Ukraine. That is, the funds acquired illegally, in particular, by corrupt means, mostly do not come into shadow turnover in Ukraine, but are transmitted abroad. Thus, according to Global Financial Integrity, Ukraine ranks 14th in the world in terms of hidden capital outflow, losing, on average, $11.6 billion annually (Global Financial Integrity 2015).
- The subjectivity of corruption perception indicators due to the predominance of one form of corruption or another in a particular country. Political and high-level bureaucratic types of corruption have the greatest impact on the shadow economy in the country; however, their manifestations can be extremely diverse and not always obvious to the general public. Consequently, most individuals and entrepreneurs are likely to estimate the extent of corruption in their country based on their own experience of low-level bureaucratic corruption cases.

Therefore, it is appropriate to highlight the corruption and non-corruption factors of the shadow economy in Ukraine. Corruption factors include:

- the complexity, inconsistency, and instability of legislation. Making amendments to legislation in the interests of certain oligarchic structures leads to legal uncertainty in entrepreneurial activity and social relations;
- the significant discretionary powers of officials in granting privileges to citizens and enterprises without personal responsibility for the decisions made;
- deficient procedures to register and re-register property rights due to the incompleteness of state registers of property rights, as well as the significant complexity, duration, and costs to protect these rights;
- abuses in the field of public procurement, i.e., artificially limiting the range of tenderers by imposing discriminatory requirements and purchases of overpriced goods and services;
- the unsatisfactory performance of state social functions, in particular, poor quality medicine and education, as well as low a level of social security of vulnerable sections of the population, which motivates individuals and enterprises to evade taxes;

- the ineffectiveness of the judiciary and the low level of public trust in it (only 12.3% of Ukrainians "trust" or "somewhat trust" courts) (Kyivskyi mizhnarodnyi instytut sotsiolohii 2018);
- complex and lengthy procedures to prepare tax reports and pay taxes; it requires 328 hours a year, far exceeding average regional and global indicators (PwC and World Bank Group 2020);
- high rates of tax and customs duties on imported products, overstatement of their customs value, as well as considerably complex and lengthy customs clearance, which results in significant amounts of smuggling (Dubrovskyi and Cherkashyn 2017).

Non-corruption factors of the shadow economy in Ukraine include:

- the transformation of socio-economic relations in the transition from a planned to a market economy, which was associated with the emergence of private property and entrepreneurship and slow changes in the public consciousness;
- Ukraine's economy is oriented to exporting raw materials, which determines its strong dependence on the conditions in the world commodity markets, i.e., levels of income and employment in Ukraine mostly depend on world prices for raw materials rather than decisions of Ukrainian authorities and actions of officials;
- the annexation of Crimea and the presence of areas which are not controlled by Ukrainian authorities due to armed conflict in eastern Ukraine and the related introduction of trade and transit restrictions;
- macroeconomic instability, in particular, the depreciation of the national currency by 250% between 2014 and 2018, and galloping inflation;
- the instability of Ukraine's banking system, in particular, the closure of 115 banks between 2014 and 2018, as well as a significant proportion of non-performing loans in portfolios of the remaining banks reaching 50%;
- the emergence and rapid development of virtual information services that enable the sale of goods and services without official registration or paying taxes (for example, Uber and Uklon in the taxi market; Booking.com and Airbnb in the rental housing market);
- the increasing popularity of employment forms that do not require presence in the workplace or the need to officially register employment relations;
- the increasing popularity of cryptocurrencies as a means of paying for goods and services on virtual trading platforms.

Conclusion

The article dealt with the causes, essence, and mechanisms of influence of high- and low-level political and bureaucratic corruption on Ukraine's economy, in particular the shadow economy.

The study of the nature of the shadow economy allowed us to conclude that in countries studied, it is caused mainly by transformation processes in the economy, and includes both corruption and non-corruption components.

The correlation-regression analysis of the relationship between levels of corruption and the shadow economy in Central and Eastern European countries over a 20-year period revealed the existence of strong links between these phenomena in all countries, except Ukraine. The resulting regression models enabled us to quantify the degree of influence of corruption on the change in the amount of the shadow economy in each country of the region.

We found out that the degree of influence of corruption on the variation in the shadow economy levels in these countries differs significantly. Thus, the variation depends on the impact of corruption by approximately 81–92% in Poland, Latvia, and Romania, by 71–80% in Slovakia, Hungary, Lithuania, and Estonia, by 60–70% in the Czech Republic, Moldova, Russia, and Belarus, by 48% in Bulgaria and only by 26% in Ukraine.

Hence, we did not confirm our hypothesis that in countries with relatively high levels of corruption and the shadow economy, it is corruption factors that are most responsible for the variation in the amount of the shadow economy. On the contrary, in countries with relatively high levels of corruption and the shadow economy, corruption accounts for a smaller share of the shadow economy than in countries with relatively low levels of these phenomena. Thus, in Ukraine, which has some of the highest levels of corruption and the shadow economy in the region, there is the lowest degree of impact of corruption factors on the variation in the amount of the shadow economy. In our opinion, this may be due to the shortcomings of Ukrainian official statistics, peculiarities of these phenomena in Ukraine, and the large-scale outflow of corrupt funds outside Ukraine.

We have highlighted the main corruption and non-corruption factors of Ukraine's economy shadowing. At the same time, the root causes of corruption and shadowing of Ukraine's economy require further research and consideration when developing policy to counteract them. The measures to combat these phenomena are inadequate for Ukraine. In particular, those borrowed from foreign experiences and aimed at combating their manifestations rather than causes are not only ineffective but sometimes lead to the opposite effect.

References

Armash, N. (2017), *Politychna koruptsiia – fenomen suchasnoho derzhavnoho upravlinnia*, "Naukovi zapysky Kirovohradskoho derzhavnoho universytetu imeni Volodymyra Vynnychenka. Seriia: Pravo", 2, pp. 12–17. http://nbuv.gov.ua/UJRN/snslnnp_2017_2_5 (accessed: 30.05.2019) [in Ukrainian].

Bayar, Y., Odabas, H., Sasmaz, M.U., Ozturk, O.F. (2018), *Corruption and shadow economy in transition economies of European Union countries: a panel cointegration and*

causality analysis, "Economic Research – Ekonomska Istraživanja", 31:1, pp. 1940–1952. https://doi.org/10.1080/1331677X.2018.1498010

Bilichenko, V., Kuzhel, V. (2013), *Modeliuvannia tekhnolohichnykh protsesiv pidpryiemstv avtomobilnoho transportu: Navchalnyi posibnyk*, VNTU, Vinnytsia [in Ukrainian].

Boitsun, A., Yablonovskyi, D., Zakharov, A., Kashko, O. (2016), *Skilky koshtuie suspilstvu koruptsiia. Analitychna zapyska*, Tsentr ekonomichnoi stratehii, Kyiv. https://ces.org.ua/wp-content/uploads/2016/07/How-much-does-Corruption-Cost-Ukraine_Research-Paper.pdf (accessed: 18.06.2019) [in Ukrainian].

Borlea, S., Achim, M., Miron, M. (2017), *Corruption, shadow economy and economic growth: An empirical survey across the European Union countries*, Studia Universitatis "VasileGoldis" Arad. Economics Series, 27 (2), pp. 19–32. http://publicatii.uvvg.ro/index.php/studiaeconomia/article/view/191/98 (accessed: 11.07.2019).

Burakovskyi, I., Anhel, Y., Betlii, O., Butin, A., Volokh, K., Koliushko, I., Kravchuk, V., Kuziakiv, O., Movchan, V., Khavroniuk, M. (2018), *Ukraina proty koruptsii: Ekonomichnyi front. Ekonomichna otsinka antykoruptsiinykh zakhodiv u 2014–2018 rr. Analitychna dopovid*, Instytut ekonomichnykh doslidzhen ta politychnykh konsultatsii, Kyiv. http://www.ier.com.ua/files/publications/Policy_papers/IER/2018/Anticorruption_%20Report_Ukr_.pdf (accessed: 21.12.2018) [in Ukrainian].

Choi, J., Thum, M. (2005), *Corruption and the Shadow* Economy, "International Economic Review", 46 (3), pp. 817–836. https://doi.org/10.1111/j.1468-2354.2005.00347.x

Davydenko, K., Taran, V., Taran, S., Hryshchenko, I., Liemienov, O., Voloshyna, A., Skyba, O. (2016), *Politychna koruptsiia: yak rozpiznaty ta podolaty*, Eidos, Kyiv. http://eidos.org.ua/wp-content/uploads/2017/03/KORUPCIA-all.pdf (accessed: 13.05.2019) [in Ukrainian].

Dreher, A., Schneider, F. (2010), *Corruption and the shadow economy: An empirical analysis*, "Public Choice", 144, pp. 215–238. https://doi.org/10.1007/s11127-009-9513-0

Dubrovskyi, V., Cherkashyn, V. (2017), *Porivnialnyi analiz fiskalnoho efektu vid zastosuvannia instrumentiv ukhylennia/unyknennia opodatkuvannia v Ukraini*, Instytut sotsialno-ekonomichnoi transformatsii, Kyiv. https://rpr.org.ua/wp-content/uploads/2018/02/Instrumenty-uhylyannya-vid-splaty-podatkiv-2017-1.pdf (accessed: 1.04.2019) [in Ukrainian].

Gillanders, R., Parviainen, S. (2015), *Corruption and the Shadow Economy at the Regional Level*, "Discussion Paper", 392, Helsinki Center of Economic Research, Helsinki. https://mpra.ub.uni-muenchen.de/64510/ (accessed: 15.11.2018).

Holikov, A. (2006), *Ekonomiko-matematychne modeliuvannia svitohospodarskykh protsesiv: navch. posib. dlia stud. vyshch. navch. zakladiv*, 2-he vyd, KhNU imeni V.N. Karazina, Kharkiv [in Ukrainian].

Kar, D., Spanjers, J. (2015), *Illicit Financial Flows from Developing Countries: 2004–2013*, Global Financial Integrity, Washington, DC. https://www.gfintegrity.org/wp-content/uploads/2015/12/IFF-Update_2015-Final-1.pdf (accessed: 23.10.2019).

Kelmanson, D., Kirabaeva, K., Medina, L., Mircheva, B., Weiss, J. (2019), *Explaining the Shadow Economy in Europe: Size, Causes and Policy Options*, IMF Working Paper WP/19/278. https://www.imf.org/~/media/Files/Publications/WP/2019/wpiea2019278-print-pdf.ashx (accessed: 20.01.2020).

Krut, V. (2018), *Vysokorivneva koruptsiia v systemi derzhavnoho upravlinnia Ukrainy*, "Naukovi zapysky Instytutu zakonodavstva Verkhovnoi Rady Ukrainy", 2, pp. 93–97. http://nbuv.gov.ua/UJRN/Nzizvru_2018_2_16 (accessed: 9.11.2019) [in Ukrainian].

Kushnarov, I. (2018), *Politychna koruptsiia yak systema protypravnykh dii: variatyvnist proiaviv*, "Politychne zhyttia", 0 (2), pp. 50–54. http://dx.doi.org/10.31558/2519-2949.2018.2.8

Kyivskyi mizhnarodnyi instytut sotsiolohii (2018), *Dumky i pohliady naselennia Ukrainy shchodo sudovoi reformy: veresen 2018 roku*, Kyiv. https://www.kiis.com.ua/?lang=ukr&cat=reports&id=792&page=1 (accessed: 4.10.2019) [in Ukrainian].

Lukianenko, I., Krasnikova, L. (1998), *Ekonometryka: Praktykum z vykorystanniam kompiutera*, Tovarystvo Znannia, Kyiv [in Ukrainian].

Lupan, I., Avramenko, O., Akbash K. (2015), *Kompiuterni statystychni pakety: navch-metod. posib.*, Polihrafichne pidpryiemstvo "KOD", Kirovohrad [in Ukrainian].

Medina, L., Schneider, F. (2018), *Shadow Economies Around the World: What Did We Learn Over the Last 20 Years?*, IMF Working Paper WP/18/17. https://www.imf.org/en/Publications/WP/Issues/2018/01/25/Shadow-Economies-Around-the-World-What-Did-We-Learn-Over-the-Last-20-Years-45583 (accessed: 20.09.2019).

PwC and World Bank Group (2020), *Paying Taxes 2020. The changing landscape of tax policy and administration across 190 economies*, https://www.pwc.com/gx/en/paying-taxes/pdf/pwc-paying-taxes-2020.pdf (accessed: 5.01.2020).

Rudenko, V. (2012), *Matematychna statystyka: navch. posib.*, Tsentr uchbovoi literatury, Kyiv [in Ukrainian].

Stavytskyi, A. (2004), *Navchalno-metodychnyi kompleks z kursu «Ekonometryka»*, Vydavnycho-polihrafichnyi tsentr «Kyivskyi universytet», Kyiv [in Ukrainian].

Sukharyna, A. (2017), *Pobutova koruptsiia: shcho pro nei dumaiut ukraintsi*, Fond Demokratychni initsiatyvy imeni Ilka Kucheriva: Informatsiino-analitychne vydannia «Hromadska dumka», № 31, Kyiv. https://dif.org.ua/uploads/pdf/10747785215b322e17c5f599.88913792.pdf (accessed: 17.06.2019) [in Ukrainian].

Sydorova, A., Bilenko, D., Burkina, N. (2019), *Biznes-analityka: navchalno-metodychnyi posibnyk*, DonNU imeni Vasylia Stusa, Vinnytsia [in Ukrainian].

Toptunova, L., Vasylieva, L., Klovanik, O. (2008), *Doslidzhennia odnofaktornoi i bahatofaktornoi rehresii, analiz chasovykh riadiv u systemi Statistica 6: Navch. posib. dlia sud. ekon. spets. vyshch. navch. zakl*, DDMA, Kramatorsk [in Ukrainian].

Verkhovna Rada (2014), *Law of Ukraine "On Prevention of Corruption"*, № 1700-VII. https://zakon.rada.gov.ua/laws/show/1700-18 (accessed: 12.09.2019) [in Ukrainian].

Vo, D.H., Ha, D.T., Ly, T.H. (2015), *Shadow Economy and Corruption in the ASEAN: Complement or Substitute?*, A New Paradigm for International Business. Springer Proceedings in Business and Economics, Singapore. https://doi.org/10.1007/978-981-287-499-3_8

Wiseman, T. (2016), *U.S. Shadow Economies, Corruption, and Entrepreneurship: State-level Spatial Relations*, "Journal of Regional Analysis and Policy", 46 (2), pp. 202–216. http://www.jrap-journal.org/pastvolumes/2010/v46/jrap_v46_n2_a8_wiseman.pdf (accessed: 7.04.2019).

Streszczenie

Związek między korupcją a szarą strefą na Ukrainie i w innych krajach Europy Środkowo-Wschodniej

W artykule dokonano analizy przyczyn, charakteru i cech korupcji oraz szarej strefy, a także związków między nimi, na Ukrainie, na tle innych krajów Europy Środkowo-Wschodniej. Analiza korelacyjno-regresyjna danych statystycznych ujawniła bezpośrednią liniową korelację o różnej sile i istotności statystycznej między poziomem korupcji a rozmiarami szarej strefy we wszystkich krajach Europy Środkowej i Wschodniej. Jednakże stopień wpływu korupcji na zróżnicowanie wielkości szarej strefy w poszczególnych krajach regionu istotnie się różni. Kluczowy wniosek jest taki, że w krajach o relatywnie wysokim poziomie korupcji i dużych rozmiarach szarej strefy korupcja ma mniejszy wpływ na rozmiary szarej strefy niż w krajach o relatywnie niskim poziomie tych zjawisk. Zidentyfikowano przyczyny słabej korelacji między poziomem korupcji a rozwojem szarej strefy na Ukrainie. Określono główne korupcyjne i niekorupcyjne czynniki rozwoju szarej strefy na Ukrainie. Stwierdzono, że polityka i środki zwalczania korupcji i szarej strefy na Ukrainie powinny mieć na celu wyeliminowanie ich pierwotnych przyczyn, a nie przejawów.

Słowa kluczowe: korupcja, szara strefa, korelacja

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.26

Comparative Analysis of R&D in the Visegrad Group Countries in the Years 2004–2018

Małgorzata Jabłońska
Ph.D., University of Lodz, Faculty of Economics and Sociology
Department of Finance and Accounting for SMEs, Lodz, Poland
e-mail: malgorzata.jablonska@uni.lodz.pl

Abstract

The purpose of this paper is to present a comparative analysis of basic measures that demonstrate the development of R&D in the Visegrad Group countries (Poland, the Czech Republic, Hungary, and Slovakia) in the years 2004–2018. The preliminary analysis of the problem allowed for the formulation of a research hypothesis, which reads: Since becoming a member of the EU, the innovation of the economies of the Visegrad Group countries has improved. The analysis shows that the structure and dynamics of R&D expenditure in these countries are diverse, although the innovation potential of the regions of the Visegrad Group countries is still low compared to the average EU level.

Keywords: innovativeness, R&D, Visegrad Group, economy

JEL: G30, G10, O16, K40

Introduction

An integral part of research and development is innovation, which is one of the most important instruments of competition. Innovations play a significant role in the processes of socio-economic development, and they are an indicator of the transformation processes and development of each country. They are also seen as a priority source of competitiveness, economic growth, and employment. Innovations allow companies to compete, which is why the literature on the subject qualifies innovations to a narrow group of factors that determine the sustainable economic and social development of regions.

The purpose of this paper is to present a comparative analysis of basic measures demonstrating the development of R&D in the Visegrad Group countries (Poland, the Czech Republic, Hungary, and Slovakia) in the years 2004–2018. The preliminary analysis of the problem allowed for the formulation of the research hypothesis, which reads: Since becoming a member of the EU, the innovation of the economies of the Visegrad Group countries has improved positively. The Visegrad Group countries are located in Central and Eastern Europe. All of them joined the European Union on 1 May 2004, thus becoming beneficiaries of assistance from the Structural Funds and the EU Cohesion Fund, which favored the development of innovativeness at many levels. The regional presentation of data used in the study is also justified by the fact that these countries have a similar history of the transformation of their economies, the same specifics, as well as similar economic and social conditions.

The study is based on an analysis of the available literature on the subject in the context of European integration and contemporary challenges in the development of the innovativeness of the economies. It is also based on an analysis of data collected by Eurostat across the Visegrad Group countries in the period 2004–2018.

Innovativeness and development. A theoretical approach

The integral elements of innovativeness are innovative solutions, which are of key importance for gaining a competitive advantage. Leadership in terms of competitiveness is not only about obtaining higher income, resulting from, e.g., the increased demand, but also gaining an advantage in the area of research, technology, and organization. Accumulating all these advantages results in the implementation of new or qualitatively improved products and processes (Jabłońska 2011, p. 124).

Activity in the area of research and development (R&D) is aimed at continuously improving the business activity of enterprises, as well as determining the opportunities and threats hidden in the environment of business units. R&D is understood as systematic creative work undertaken to increase the knowledge base, including knowledge about man, culture, and society, as well as to find new applications for this knowledge. Research and development includes three types of research:

- *basic research* understood as experimental or theoretical work, undertaken to acquire new knowledge about the foundations of phenomena and observable facts, without focusing on practical applications or use,
- *industrial research,* which is research aimed at acquiring new knowledge and skills to develop new products, processes, and services,
- *development work,* which includes the acquisition, combination, shaping, and use of currently available knowledge and expertise in the field of science for production planning and the creation and design of new, changed, or improved products, processes, or services (https://stat.gov.pl/cps/rde/xbcr/wroc/ASSETS_Dzialalnosc_badawcza_i_rozwojowa.pdf).

The innovativeness of the economy is, therefore, associated with an increase in the competitiveness of enterprises, and this directly translates into the development of the economy. Conducting a properly targeted innovation policy increases GDP and reduces the unemployment rate, thus creating favorable conditions for the development of entrepreneurship, which is the foundation of the country's economic growth (Dziuba 2014, p. 225). According to the literature on the subject, innovativeness is impacted by:

- entrepreneurship,
- ease of doing business,
- financial resources,
- the relationship between the user and the product or service provider (Mikołajczyk 2013, p. 265).

Modern enterprises treat innovations as a key to market success (Walas and Trębacz 2010, p. 289). They perceive innovations as ground-breaking ideas (Mikołajczyk 2013, p. 95). Therefore, the key factor of competitiveness is the ability to introduce innovations, which is a condition for achieving the sustainable competitiveness of the economy in the global market (Wysokińska 2011, p. 124).

Innovativeness is one of the phenomena that give rise to much doubt in the research and cognitive spheres. The most problematic issue here is the selection of measures that would be suitable to describe the state, level, and direction of changes in the area of innovativeness. The most commonly used measures of innovativeness include the following:

- expenditures of enterprises on innovative activities, the structure of financing innovative activities, and the structure of expenditures by type of innovative activity,
- the number of inventions filed in patent offices in a given country by its citizens, the number of foreign inventions filed in a given country by foreigners, the number of patent applications filed by domestic inventors per 10,000 inhabitants,
- the number and value of research projects, the share of private and public expenditures on R&D in GDP, internal and external expenditures on research and development activities, and employment in scientific and research and development units (Czupich 2013, p. 75).

The presented division of measures of the innovativeness of the economy covers the three most important areas: general innovation, inventiveness, and research and development. In the context of this study, the R&D area, which determines the level of innovativeness and competitiveness of each economy, deserves special attention.

The importance of innovativeness for the economic development of the Visegrad Group countries

The Visegrad Group (V4) is an alliance established in 1991 between the Czech Republic, Hungary, Poland, and Slovakia. The basis of the cooperation between these economies is the similar nature of the economic changes they underwent, as well as the established socio-cultural system (Dziuba 2013, pp. 64–65). Thanks to accession to the European Union, the V4 countries experienced rapid economic growth, accompanied by restructuring and modernization. Thus, the EU accession significantly improved the international competitive position of these economies (Molendowski and Folfas 2019, p. 65).

The V4 countries present a similar level of economic development, geographical location, history, and values. These economies have convergent interests in the area of policies and decisions taken in the European Union. The advantages of the V4 economies are low labor costs and a high level of professional qualifications of employees, which makes them an attractive place to locate foreign investments (Czupich 2018, p. 17). The table below summarizes the basic characteristics of the economies of the V4 countries.

Table 1. Basic data on the economies of the V4 countries. Comparative analysis of 2004 and 2018

Country / NUTS 2	Area (km^2)	Population density 2004	Population density 2018	GDP per capita 2004 in euro	GDP per capita 2018 in euro	Dynamics of GDP of per capita
Poland	312,685	122	123	6,109	12,200	200%
dolnośląskie	19,948	145	145	6,181	13,400	217%
kujawsko-pomorskie	17,970	115	116	5,379	9,800	182%
lubelskie	25,121	87	84	4,325	8,400	194%
lubuskie	13,989	72	73	5,416	10,100	186%
łódzkie	18,219	142	135	5,615	11,400	203%
małopolskie	15,190	215	224	5,412	11,100	205%
mazowieckie	35,559	145	152	9,237	10,400[a] 26,600[b]	
opolskie	9,412	112	105	5,217	9,700	186%
podkarpackie	17,844	118	119	4,439	8,500	191%
podlaskie	20,187	60	59	4,504	8,700	193%
pomorskie	18,293	120	127	5,998	11,800	197%
śląskie	12,331	381	368	6,812	12,600	185%
świętokrzyskie	11,708	110	106	4,861	8,700	179%
warmińsko-mazurskie	24,192	59	59	4,622	8,600	186%
wielkopolskie	29,826	113	117	6,538	13,300	203%
zachodniopomorskie	22,896	74	74	5,509	10,100	183%

Country / NUTS 2	Area (km²)	Population density 2004	Population density 2018	GDP per capita 2004 in euro	GDP per capita 2018 in euro	Dynamics of GDP of per capita
Slovakia	49,034.7	109.6	111.7	6,400	15,600	244%
Bratislavský kraj	2,052.6	289.2	319.8	14,600	36,700	251%
Stredné Slovensko	16,263.2	83.2	82.9	5,300	12,400	234%
Východné Slovensko	15,726.4	99.8	103.6	4,800	11,100	231%
Západné Slovensko	14,992.5	123.8	123.3	6,100	14,400	236%
Hungary	93,029	108.6	107.3	8,300	12,700	153%
Dél-Alföld	18,337.8	74.0	68.9	5,800	9,000	155%
Dél-Dunántúl	14,168.7	69.2	64.7	5,800	8,400	145%
Észak-Alföld	17,728.8	87.1	84.1	5,400	8,100	150%
Észak-Magyarország	13,431	95.0	85.7	5,400	8,500	157%
Közép-Magyarország	6,918.3	409.8	442.6	13,300	19,400	146%
Közép-Dunántúl	11,116.2	100.0	98.8	7,800	11,700	150%
Nyugat-Dunántúl	11,328.2	88.4	88.0	8,500	13,400	158%
Czech Republic	78,866.7	132.0	137.2	9,400	18,100	193%
Jihovýchod	13,991.3	119.6	123.3	8,200	16,400	200%
Jihozápad	17,618	68.8	71.1	8,700	15,700	180%
Moravskoslezsko	5,427	230.8	227.3	7,600	14,900	196%
Praha	496.1	2,391.3	2,654.7	19,800	37,900	191%
Severovýchod	12,440.1	120.6	123.2	7,900	15,200	192%
Severozápad	8,649	132.3	131.9	7,600	12,800	168%
Střední Cechy	11,014.8	105.5	125.6	9,100	16,900	186%
Střední Morava	9,230.4	136.4	133.4	7,400	14,800	200%

[a] Eurostat data for the region excluding capital city.
[b] Eurostat data for capital city.
Source: own elaboration based on Eurostat and Local Data Bank.

The Visegrad countries constitute a significant part of the European Union. The population concentrated in these four countries is 12% of the EU population. Slovakia and Poland recorded the highest dynamics of GDP per capita (244% and 200%, respectively). However, none of the economies exceeded the EU average in any of the analyzed periods. Above-average values were recorded only in individual NUTS 2 regions that are the economic centers of the countries. In Poland it is Mazovia (26,600 EUR/person), in Slovakia – Bratislavský Kraj (36,700 EUR/person), in the Czech Republic – Praha (37,900 EUR/person) and in Hungary – Közép-Magyarország (19,400 EUR/person).

From the point of view of the potential of the V4 regions, these countries are becoming particularly interesting in terms of the development of regional innovativeness, which can significantly affect the competitiveness of the entire European Union. Therefore, to support the development of R&D, innovation, and entrepreneurship in this part of Europe, the Warsaw Declaration was signed in 2017. The main premise of the Declaration was to strengthen cooperation in research, digitization, and innovation (Dworak and Grzelak 2018, p. 515). The subjects of interest for cooperation between the V4 countries were:

- strengthening and expanding the regional cooperation of clusters and start-ups;
- promoting the V4 region and sharing best practices in R&D&I and digitization;
- cooperation in the area of patents, activities for the European Digital Single Market;
- increasing the number of transnational research and development projects implemented by research institutions and enterprises from the Visegrad countries – including joint projects implemented under the Horizon 2020 program;
- ensuring free data flow and cybersecurity;
- cooperation in the field of next-generation mobile services (5G) (https://www.gov.pl/web/gospodarkamorska/premierzy-panstw-grupy-wyszehradzkiej-podpisali-deklaracje-warszawska).

The increase in innovativeness and competitiveness of the V4 economies is associated with the need to adapt to rapid changes in the global economy, as well as to eliminate the technological gap that exists between the V4 and the countries of the old Union (Adamczyk 2018, p. 156). Therefore, using the potential of this region is an opportunity to develop R&D in the European Union, while the region itself has the chance to become the center of European innovation (Dziuba, Jabłońska, Sulak and Ławińska 2018, p. 24).

Analysis of the changes and development directions of R&D potential in the Visegrad Group countries against the background of the European Union after 2004

The innovativeness of the economy occurs in the literature on the subject as the ability of enterprises to put into practice the results of scientific research and R&D, as well as the effective use of newly created concepts and ideas. Innovations play an important role in the socio-economic development of countries and regions. The innovation performance of regions can be assessed in a variety of ways using several indicators (Ivanova and Masarova 2018, p. 28). Selected indicators will be discussed in the next parts of the paper.

Employment structure indicators, which include the employment of people involved in research and development activities (both knowledge employees and supporting personnel), are used to determine the innovative position.

Table 2. Employment in the R&D sector in 2004 and 2018

EU countries	Total employment in R&D in 2004	Total employment in R&D in 2018	Average employment in R&D in enterprises	Average employment in R&D in the public sector	Average employment in R&D in universities
European Union	100%	100%	100%	100%	100%
Czech Republic	1%	2%	2%	3%	2%
Hungary	1%	1%	1%	2%	1%
Poland	4%	5%	2%	1%	6%
Slovakia	1%	1%	0%	1%	1%

Source: own elaboration based on Eurostat.

There were no evident changes in the dynamics and structure of employment in the R&D sector in the V4 countries in the analyzed period. The employment rate remains one of the lowest in the EU. The highest number of people employed in R&D was reported in Poland, which in recent years has recorded the fastest growth in this respect among the EU and OECD countries. The rapid increase in the number of employees in the R&D sector in Poland should be associated with the introduction of tax breaks, which also include the cost of remuneration for employees involved in R&D.

The indicators presenting R&D expenditures are the primary determinants of innovativeness on a micro and macroeconomic scale.

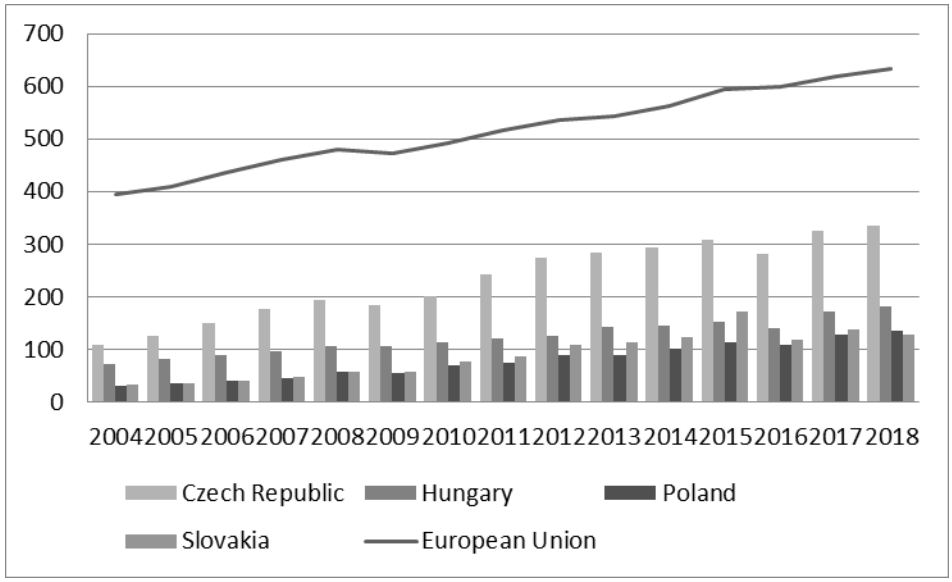

Figure 1. Total R&D expenditures [EUR/person]
Source: own elaboration based on Eurostat.

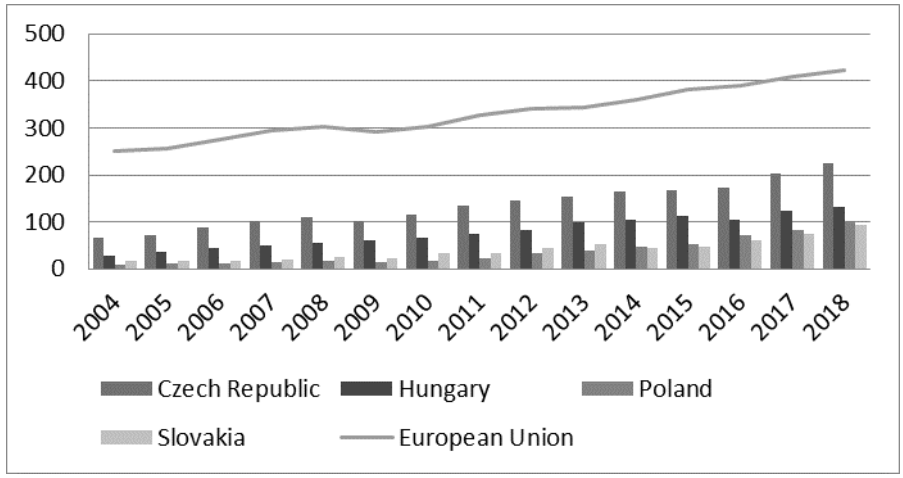

Figure 2. R&D expenditures in the enterprise sector [EUR/person]
Source: own elaboration based on Eurostat.

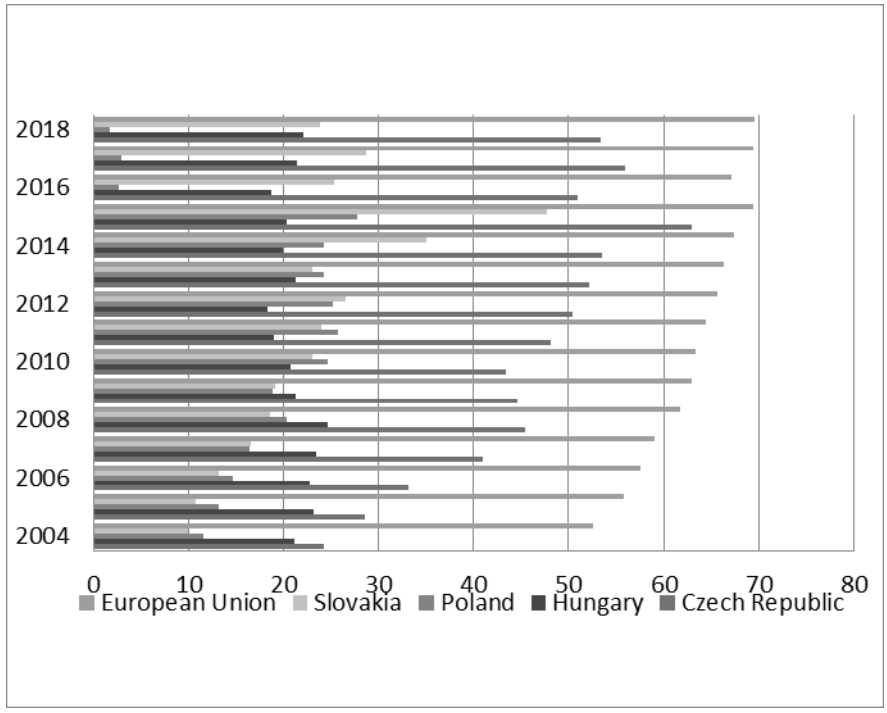

Figure 3. Government expenditures on R&D [EUR/person]
Source: own elaboration based on Eurostat.

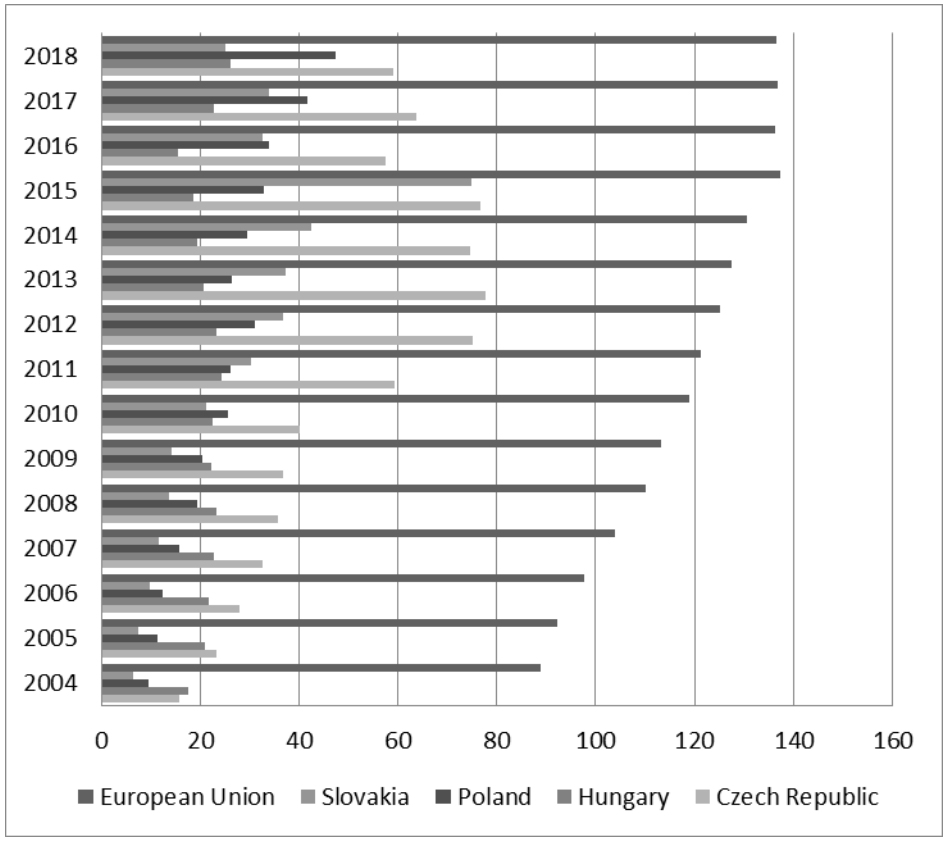

Figure 4. University expenditures on R&D [EUR/person]
Source: own elaboration based on Eurostat.

The above data show that none of the Visegrad Group countries recorded expenditures higher than the EU 28 average (the charts illustrate the expenditures in the period 2004–2018). Only the Czech Republic neared the average values for the EU in the period, standing out from the other V4 countries.

R&D expenditures in the enterprise sector were very low and far from the average in the analyzed years. Too little involvement of business in R&D is a serious barrier in the processes of commercializing created knowledge. The expenditures of enterprises on R&D may concern the investment activities of enterprises, for example, and they are important from the point of view of improving the availability or quality of R&D infrastructure in the enterprise sector. Therefore, their growth is essential and desirable from the point of view of increasing the competitiveness of enterprises.

Analyzing the data for the period 2004–2018 shows that government funds dominated the structure of R&D expenditures. This is especially visible in the Czech Republic, where the level was slightly lower than the average for all EU countries. The share of government expenditures on R&D in Poland was significant until 2015, af-

ter which, as the chart shows, their value significantly decreased. It can be concluded that Poland has become a leader of the changes in R&D financing in the V4 countries. The data present the phenomenon of increasing the expenditures of the enterprise sector on R&D with a simultaneous reduction in government expenditures. This change is taking place in the direction of the most innovative economies in which the share of R&D financing by the enterprise sector is the highest (e.g., 80% in Korea). In the case of the most innovative countries, a small share of public funds in financing the total R&D activity is noticeable. In the age of the knowledge-based economy, universities play a significant role in innovation. The recognition of the importance of universities in the development of R&D was reflected in financing, as there has been a significant increase in funds that universities spend on R&D since 2010.

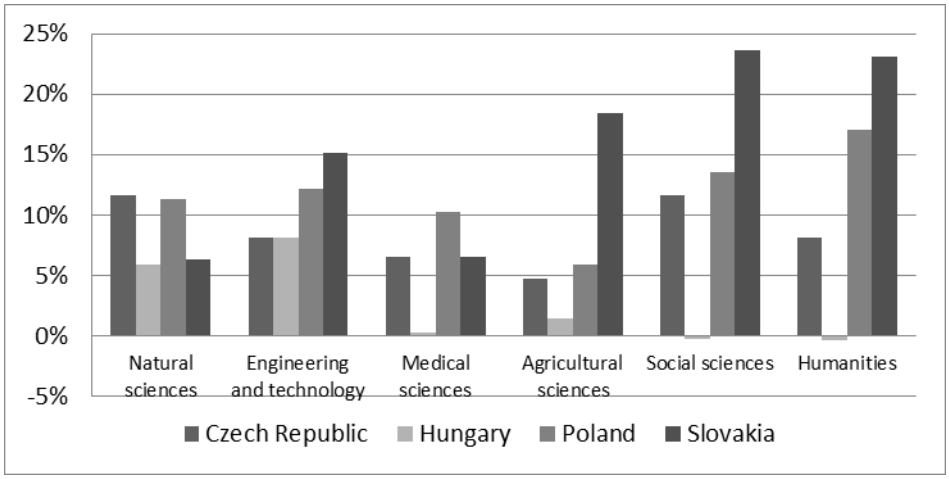

Figure 5. Average growth rate of total R&D expenditures in 2004–2018 by field of science
Source: own elaboration based on Eurostat.

The chart above shows how diverse the V4 economies are in terms of financing individual fields of science. During the analyzed period, most funds for innovation in the Czech Republic were allocated to natural and social sciences. Hungary allocated most resources to financing innovation in natural sciences as well as engineering and technology. This country stands out from the rest due to the low rate of change in expenditures in the field of medical sciences. In Poland, on the other hand, the pace of change in expenditures in individual fields of science is comparable because progress was observed in each of the fields in the analyzed period. Noteworthy, however, is the fact that Poland stands out from the other V4 economies in terms of increased expenditures on innovation in medicine. Slovakia recorded the highest rate of change in expenditures in the humanities, social, and agricultural sciences.

Table 3. R&D expenditures in the Visegrad Group countries by sector of the economy. Average values in 2004–2018 [EUR/person]

Sector	Czech Republic	Hungary	Poland	Slovakia
Agriculture, forestry and fishing	0.49	1.34	0.15	0.21
Manufacturing	77.80	43.51	12.26	20.50
Manufacture of food products; beverages and tobacco products	10.48	10.77	30.18	0.94
Manufacture of textiles, wearing apparel, leather and related products	1.07	0.05	0.17	0.09
Manufacture of wood, paper, printing and reproduction	2.35	5.33	13.09	0.00
Manufacture of chemicals and chemical products	3.49	1.09	0.71	0.56
Manufacture of basic pharmaceutical products and pharmaceutical preparations	3.84	19.13	1.31	1.34
Manufacture of rubber and plastic products	2.96	0.68	0.52	2.05
Manufacture of other non-metallic mineral products	1.84	0.25	0.24	0.26
Manufacture of basic metals	1.07	0.31	0.30	0.66
Manufacture of fabricated metal products, except machinery and equipment	3.17	0.77	1.07	0.91
Manufacture of fabricated metal products, computer, electronic and optical products, electrical equipment, machinery, motor vehicles and other transport equipment	55.95	20.36	9.24	17.70
Manufacture of computer, electronic and optical products	6.42	4.64	0.78	0.71
Manufacture of electronic components and boards	0.54	0.51	0.08	0.17
Manufacture of communication equipment	1.64	5.04	0.30	0.43
Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	3.04	0.70	0.27	0.29
Manufacture of electrical equipment	7.76	2.20	1.53	2.36
Manufacture of machinery and equipment n.e.c.	11.65	3.83	1.29	2.27
Manufacture of motor vehicles. trailers and semi-trailers	21.49	9.51	2.44	13.26
Manufacture of other transport equipment	5.56	0.25	1.19	1.35
Manufacture of medical and dental instruments and supplies	1.02	0.92	0.20	0.27
Repair and installation of machinery and equipment	4.90	0.57	0.37	1.39
Construction	1.68	0.42	0.25	0.15
Services of the business economy	59.16	27.96	22.60	13.91
Wholesale and retail trade; repair of motor vehicles and motorcycles	3.12	8.86	1.89	0.71
Wholesale of information and communication equipment	0.33	0.24	0.18	0.05
Information and communication	21.84	7.55	4.89	2.89
Computer programming, consultancy and related activities	15.42	6.03	5.97	5.28

Table 3. (continued)

Sector	Czech Republic	Hungary	Poland	Slovakia
Professional, scientific and technical activities; administrative and support service activities	30.86	13.60	8.49	7.60
Professional, scientific and technical activities	30.59	13.30	9.13	7.69
Scientific research and development	23.15	9.91	7.31	5.83
Administrative and support service activities	0.34	0.42	0.26	0.29
Human health and social work activities	0.79	0.82	0.14	0.14
Other service activities; activities of households as employers and extraterritorial organizations and bodies	0.23	0.21	0.07	0.00

Note: n.e.c. – not elsewhere classified
Source: own elaboration based on Eurostat.

The growing share of enterprises in financing innovation somehow forces a more detailed analysis of the role of this sector in financing R&D. The presented structure of enterprises makes it possible to determine which units play a crucial role in creating and developing innovations in the economies of the V4 countries. The most significant expenditures on R&D in the Czech Republic are incurred by enterprises manufacturing fabricated metal products, electronic products, other machinery and equipment, motor vehicles, those providing services of the business economy, information services, as well as information and communication services, computer services, and those conducting scientific activities and statutory research, and development activities. It can be concluded that some of these sectors are the key sectors for the development of the Czech economy, which is famous for the production of machinery, equipment, and means of transport (as evidenced by the highest export of these products). In all of these areas, Czech enterprises spend above the average for the V4 economies. In Hungary, the enterprises that invest most in R&D represent the pharmaceutical sector, wholesale and retail trade, the repair of motor vehicles and motorcycles, and R&D. In Poland, on the other hand, investments mainly concern the manufacture of food products and the manufacture of wood and paper products. The dominant sectors in Slovakia are the manufacture of motor vehicles and the manufacture of plastic products. The data presented in the table above regarding expenditures on R&D by sector illustrate significant differences between the V4 countries.

Conclusions

Innovations are closely related to science and research, and they express the practical implementation of an idea into economic reality. Investing in R&D directly affects the level of innovativeness and competitiveness of the country. The priority of research and development is the development and successive implementation of technological innovations in the area of products and processes. The level of innovativeness of the economy is, next to technical infrastructure, the fundamental factor that determines

the possibility of achieving and maintaining the high dynamics of socio-economic development of regions.

Strengthening research and innovation capacity at the level of the Visegrad Group countries, and increasing the facilitation of inclusion in the European Research Area, may contribute to the economic development of these countries. The level of investment should be increased, in particular by investing in the business environment, and by stimulating public and private investment in research. Thanks to such investments, the level of the innovative capacity of the Visegrad Group countries should expand.

The innovation potential of the regions of the Visegrad Group countries is still low compared to the average EU level, although an increase in the share of expenditures on R&D is evident. However, the scale of this increase is different, as confirmed by the analysis of the structure and dynamics of innovation measures in individual V4 countries. Indicators related to capital city regions differed significantly from those related to other regions. This is primarily due to the higher level of entrepreneurship, education, or financial resources that enable the implementation of an innovative idea into a business. It is also worth noting that the Czech Republic achieved the highest values of indicators of innovation potential among the V4 countries (this concerned the level of R&D expenditures, among others, which was close to the EU average). The Czech Republic is still an evident leader in the region in terms of both the share of R&D expenditures and its growth dynamics. A lower share than in the Czech Republic, but similar dynamics, can be observed in Hungary and Poland.

References

Adamczyk, P. (2018), *Efektywność wydatków na badania i rozwój w krajach Grupy Wyszehradzkiej na tle średniej unijnej*, "Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie", 39 (3), p. 156.

Czupich, M. (2013), *Elementy teorii innowacyjności regionu*, [in:] W. Kosiedowski (ed.) *Przedsiębiorczość i innowacyjność w procesie rozwoju regionów Europy Środkowo-Wschodniej*, UMK Publishing House, Toruń, p. 75.

Czupich, M. (2018), *The innovative potential of the Visegrad Group Regions*, "Економічний вісник університету | Випуск", № 38. p. 17, https://doi.org/10.31470/2306-546x-2018-38-14-22

Dworak, E., Grzelak, M.M. (2018), *Innovativeness of the Polish economy in relation to the Visegrad Group countries*, "Economic and Environmental Studies", 18 (2), pp. 515–529. https://doi.org/10.25167/ees.2018.46.3

Dziuba, R. (2013), *CEFTA as a Proven Path to Accession to the European Union*, "Comparative Economic Research. Central and Eastern Europe", 16 (2), pp. 63–78. https://doi.org/10.2478/cer-2013-0012

Dziuba, R. (2014), *Rola innowacyjności i konkurencyjności w rozwoju regionu Bałkanów Zachodnich na przykładzie Czarnogóry*, "Studia i Prace WNEIZ US", 37 (2), p. 225.

Dziuba, R., Jabłońska, M., Sulak, K., Ławińska, K. (2018), *Textile Sector of the Visegrad Group Countries in Trade with the European Union*, "Fibres & Textiles in Eastern Europe", 26, 6 (132), pp. 24–29. https://doi.org/10.5604/01.3001.0012.5160

Ivanova, E., Masarova, J. (2018), *Evaluation of innovation performance of Visegrad countries regions putting a stress on human capital*, "Sociálno-Ekonomická Revue", 02, p. 28.
Jabłońska, M. (2011), *Zagraniczne centra B+R a innowacyjność gospodarki*, "Studia Europejskie", 4, p. 124.
Mikołajczyk, B. (2013a), *Innowacje w sektorze publicznym w krajach Unii Europejskiej (wyniki badań)*, "Studia Ekonomiczne, Innowacje w Bankowości i Finansach", 1. p. 265.
Mikołajczyk, B. (2013b), *Pomiar i ocena innowacyjności MSP*, "Journal of Management and Finance", 2 (2), p. 95.
Molendowski, E., Folfas, P. (2019), *Effects of the Pillars of Competitiveness on the Competitive Positions of Poland and the Visegrad Group Countries in the Post-Accession Period*, "Comparative Economic Research. Central and Eastern Europe", 22 (2), pp. 55–67. https://doi.org/10.2478/cer-2019-0012
Walas-Trębacz, J. (2010), *Innovation as an enterprise's development factor*, [in:] R. Borowiecki, A. Jaki (eds.), *Enterprises Facing New Economic Challenges*, Management-Development-Restructuring, Foundation of the Cracow University of Economics, Kraków.
Wysokińska, Z. (2011), *Konkurencyjność w międzynarodowym i globalnym handlu technologiami*, Wydawnictwo Naukowe PWN, Warszawa–Łódź.
http://www.eurostat.com (accessed: 11.11.2019).
http://www.gov.pl/web/gospodarkamorska/premierzy-panstw-grupy-wyszehradzkiej-podpisali-deklaracje-warszawska (accessed: 17.11.2019).
http://www.stat.gov.pl/cps/rde/xbcr/wroc/ASSETS_Dzialalnosc_badawcza_i_rozwojowa.pdf (accessed: 11.11.2019).
https://bdl.stat.gov.pl/BDL/start? (accessed: 11.11.2019).

Streszczenie

Analiza porównawcza działalności B+R w krajach Grupy Wyszehradzkiej w latach 2004–2018

Celem niniejszej pracy jest analiza porównawcza podstawowych mierników świadczących o rozwoju B+R w krajach Grupy Wyszehradzkiej (Polska, Czechy, Węgry i Słowacja) w latach 2004–2018. Wstępna analiza problemu pozwoliła na postawienie hipotezy badawczej, która brzmi: członkostwo w UE gospodarek krajów Grupy Wyszehradzkiej wpłynęło pozytywnie na ich innowacyjność. Przeprowadzone analizy pokazały, że struktura i dynamika wydatków na B+R w badanych krajach jest zróżnicowana a potencjał innowacyjny regionów krajów Grupy Wyszehradzkiej jest nadal niski, w porównaniu ze średnim poziomem UE.

Słowa kluczowe: innowacyjność, badania i rozwój, Grupa Wyszehradzka, ekonomia

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.27

An Empirical Study of the Effects of Demographic Factors on Economic Growth in Advanced and Developing Countries

Serhii Kozlovskyi
Sc.D., Professor, Vasyl' Stus Donetsk National University, Vinnytsia, Ukraine
e-mail: s.kozlovskyy@donnu.edu.ua

Mykola Pasichnyi
Sc.D., Associate Professor, Kyiv National University of Trade and Economics, Kyiv, Ukraine, e-mail: m.pasichnyi@knute.edu.ua

Ruslan Lavrov
Sc.D., Professor, Chernihiv National University of Technology, Chernihiv, Ukraine, e-mail: lavrus2017@gmail.com

Natalya Ivanyuta
Sc.D., Associate Professor, Donetsk Law Institute of the Ministry of Internal Affairs of Ukraine, Mariupol, Ukraine, e-mail: natalaivanuta9@gmail.com

Anton Nepytaliuk
Ph.D. student, Vasyl' Stus Donetsk National University, Vinnytsia, Ukraine
e-mail: anton.nepytaliuk@gmail.com

Abstract

In this article, an updated approach to investigate the effects of demographic factors on economic growth is proposed. The initial hypothesis was that these factors significantly affected production proportions, determining development vectors. The predictable shifts in production dynamics are considered for the institutional framework. The article investigates the statistically significant relationships between the demographic variables and economic growth for the sample of the OECD countries (excluding Columbia) and Armenia, Belarus, Bulgaria, Croatia, Georgia, Kazakhstan, Romania, the Russian Federation, and Ukraine, from 1990 to 2017; unbalanced

panel data was used. The investigation aimed to highlight the intrinsic interconnection between the changes in demographic variables (e.g., the working-age population growth rate and the average life expectancy growth rate) and economic growth. Our investigation focused on the issue of whether demographic influence on economics was the same for advanced and developing countries in the sample. Over the period, a significant increase in life expectancy adversely affected the real GDP per capita growth rate. However, the empirical study pointed out that life expectancy was strongly linked to nominal GDP per capita. In advanced countries, the demographic indicator was considerably higher than in emerging markets. We found that the rise in the working-age stratum of the nation's population radically reduced the output dynamics as well, but that interconnection was not robust. The institutional framework should be taken into account in order to achieve a favorable performance of public governance in the long-run. The main demographic variables should be properly forecasted and calibrated for potential endogenous economic triggers. Both public and private investments are important when considering the economic growth rates that are achieved. We propose a balanced approach to macroeconomic policy regarding both demographic and institutional determinants.

Keywords: population, human capital, demographic sustainability, institutional framework, economic growth

JEL: E22, I30, J10, J18, J24, O10

Introduction

There are several indisputable reasons to investigate the population's impact on economic development – with inherent social and demographic characteristics – regarding growth theories. Firstly, the actual level of public welfare is sensed and described only through human consciousness. Secondly, a person with his own needs and desires creates the initial tasks for public production and directly participates in that process. So, the nation's population simultaneously plays the roles of the aggregated producer and consumer of goods and services. The individual's economic behavior causes and, at the same time, is caused by higher interests, which are represented by social groups (e.g., nations, economic classes, strata, etc.). General changes in the population's number, density, and age structure unquestionably affect public production. After centuries of relatively slow and uneven growth, the world population reached 1 billion nearly two hundred years ago. Before the start of the first so-called demographic transition, there were countless births and deaths, human life expectancy was short, and the population was generally young.

Due to the transition, mortality and then fertility seriously declined. The population growth rates accelerated and then – unequally for advanced and the third-world countries – they fell again, matching low fertility, extended life spans, and a rather old population. During the second half of the 20th century, the total population growth accelerated at an unprecedented rate. The aforementioned global demographic chang-

es brought decisive changes, reshaped both the economic and demographic life-cycles of the individuals, and restructured communities. As a result, the current world population exceeds 7.7 billion, and it is expected to increase at a constant rate for at least the next several decades.

This has raised lots of economic, social, and ecological questions (e.g., the societal costs of the elderly, the redistribution of responsibility between the generations, the lack of food provision, global pollution, etc.). The population's characteristics were considered to be the main economic growth determinants. So, their complex impact on the development processes is everlasting and should be evaluated properly. The issues related to the key factors of economic growth have been at the heart of economic science since its origin. Nearly five centuries of profound investigations have produced a plethora of sustainable development theories, but the uncertainty remains.

In the vast majority of those theories, the main demographic variables are regarded as endogenous determinants. On the one hand, everyone possesses a unique combination of productive capacities that should be viewed as a part of human capital. On the other hand, the population is jointly characterized by an essential economic potential, which eventually results in output. Thus, modern demography and economics merged to propose some theoretical and practical statements on production improvement. Even though demographic issues are traditionally associated with fertility and mortality rates, in this paper, we consider demographic variables in a broad sense, including aggregated knowledge, the purposeful skills of the workforce, the potential of education and public health, etc. Some of the above characteristics overlap, so it is crucial to identify and separate their influence on the growth processes.

The ongoing shifts in the demographic structure have enabled national economies to convert most of the benefits from factor accumulation and technological changes into income per capita growth. Both labor productivity and development processes were generally enhanced via three channels. Firstly, the downtrend in population growth has limited stock dilution and simultaneously increased the number of resources per capita. Secondly, the reduced fertility sanctioned the reallocation of resources from quantity toward the quality of children, intensifying the human capital formation and total labor productivity. Finally, the reduction in fertility rates changed the age distribution of the population. So, if the fraction of the labor force in the population temporarily increased, productivity per capita could be raised mechanically.

The overall influence of the population change on economic growth and performance is ambiguous. There are alternative possibilities that population growth is supportive, restrictive, or neutral to economic development. The changes in population number and density are commonly interconnected with some shifts in the community's age structure. The latter could be described as the population's distribution across different age groups. Human economic behavior varies depending on the different stages of the individual's life. Thus, nations with an enormously high proportion of children should devote most of their resources to childcare programs. That fact

depresses the pace of economic growth in the short-run but could be associated with intensified human capital acceleration in the long-run.

By contrast, if most of a nation's population belongs to the working-age stratum, the extended productivity of that group can produce the so-called "demographic dividend." If the nation's population consists of the elderly, the effects can be different. On the one hand, the result can be similar to the case of a very young population, when a large share of resources is consumed by a relatively less productive population segment, inhibiting economic growth. On the other hand, the elderly, for many reasons (primarily, effective public health care), can maintain working capacity and demonstrate significant labor productivity, especially in the tertiary and quaternary sectors of the economy.

A demographic dividend should be emphasized that considers both productivity and consumption. It should be specifically mentioned that a demographic dividend in the modern scientific discourse exists in two different forms. The "first" demographic dividend is caused by an increase in the share of countries' populations that are concentrated in the working ages. Economically active individuals form the main factor responsible for development.

The "second" dividend is much more difficult to explain. A rapid growth in the elderly stratum presumably strains the public pension and health care systems. Over recent decades, this has led to pessimistic forecasts concerning future economic performance. Nevertheless, an aging population can be a source of a second demographic dividend rather than an economic decline. While the economically productive population stratum is declining, a major challenge for aging and aged societies is to provide a favorable framework for specific old-age consumption and to achieve a desirable level of public welfare. The legislative framework is indirectly connected with the above problem, but the main task for smart public governance is to provide a favorable configuration of the financial system.

Demographic dividends do not occur automatically; their scale is largely dependent on the quality of public institutions. The weaknesses of possible pension programs (e.g., an unsustainable increase in public pension benefits or critical tax evasion) could offset many of the potential demographic dividends. For example, if most of the increases in labor supply are concentrated in the informal sector, which does not contribute to social security finances, it can cause imbalances and a decline in public welfare. The most significant factors for sustainable development demographic variables are represented by both the qualitative and the quantitative parameters of the working-age population. But the age dependency ratio is not the only demographic characteristic that matters. Fertility and mortality fluctuations affect the average life expectancy and determine the age distribution between the population strata. Even though increased life expectancy is interconnected with life quality, it usually reshapes public finances and potentially induces a tax burden. The quality of human capital depends on aggregate public and private productive expenses. Thus, the model of sustainable economic growth should combine the parameters related to human and physical capital creation.

Development trends in advanced, emerging-market, and third-world economies are incomparable. Moreover, in the above groups, a sub-group of commodity economies should be specified regarding a wide range of factors. Even though all economies are dependent on the same endogenous development triggers, the scale and the proportion of those growth determinants significantly vary. In this study, we primarily examine advanced (OECD member-states) as well as some emerging, post-Soviet (Armenia, Belarus, Bulgaria, Croatia, Georgia, Kazakhstan, Romania, the Russian Federation, and Ukraine) economies over the periods of institutional transformation and sustainable growth. We reveal the overall dual impact on economic development of an expansion in the working-age population stratum and the increased life expectancy.

Literature review

Rethinking Romer's (1990) conceptual model of endogenous technical change, Malmberg (1994) proposed combining it with human capital and the life-cycle of savings theories. He also argued that the population's age structure was crucial. Due to the profound analysis of the changes in financial behavior and human capital accumulation over the life-cycle, a theory of the age pattern of economic growth effects was highlighted. Bloom, Canning, and Sevilla (2001; 2003) examined the impact of population change on economic growth, regarding the alternative positions that population growth restricted, promoted, or appeared to be neutral to economic growth trends. They identified not only the impact of the size and growth rate of the population on economic performance but the effects of the age structure. The agents' behavior was described as being highly dependent on the structure. They concluded that, on the concept of a demographic dividend, the effect of an optimal working-age population combined with health care, and educational, financial, and human capital policies could initiate decent cycles of wealth creation.

Due to the enormous range of empirical cases, the evidence on the relevance of the shifts in the age structure for economic growth was highlighted. The concept of a demographic dividend was further developed by Bloom et al. (2007; 2009). The age structure was considered to be a crucial determinant of economic growth and the main forecast objective. Boucekkine, de la Croix, and Licandro (2002) identified and empirically proved that endogenous economic growth was caused by the accumulation of generation-specific human capital. While preferable shifts in the survival probabilities resulted in an extended schooling period and later retirement, their effect on economic growth was ambiguous. Demographic variables had significant medium-term economic effects, but the numerical interdependencies in the long-run did not appear to be robust. Kozlovskyi et al. (2019) pointed out the essence of economic security management for an emerging economy under conditions of globalization. The interrelation between security issues and life quality dynamics was generally revealed.

Lee (2001; 2003) summarized the main evidence of the demographic transition and the related issues over the last three centuries. Considering the retrospective data on the multiple interrelations between population shifts and fiscal policy performance, he sketched the possible demographic changes and their economic consequences for advanced and emerging markets. Taking human capital theory into account, numerous papers are dedicated to the essential social and demographic determinants of both economic and population growth. Gador (2012) revealed the empirical validity of the main demographic theories and their relevance for a sound understanding of the transition from the stagnation phase to sustainable growth. A significant increase in the demand for human capital in the development process was suggested as being the main trigger for fertility reduction as well as the transition to the present growth rates.

Acemoglu and Johnson (2007) and Hansen and Lønstrup (2015) proved that an increase in life expectancy over the second half of the 20th century simultaneously reduced the real GDP per capita growth rate and fostered population growth. That dual conclusion was based on the fact that, due to medical breakthroughs, many advanced countries have experienced high growth rates in life expectancy and population size, and low growth rates in per capita GDP. Based on empirical evidence from Western economies during the past century, Fernihough (2017) revealed the importance of the demographic transition as a support mechanism for the growth of human capital. The impact of education on fertility rates and human capital accumulation was also investigated.

Lucas Jr. (2015) examined the aggregate innovative potential of the nation as a result of knowledge creation based on consistent schooling and skills improvement. Meanwhile, the actual role of knowledge management was dependent on the initial level of the country's economic development and the quality of the institutional framework. Barro and Lee (2013) investigated how output was related to the stock of human capital, which was determined by the total years of schooling and by the composition of the workers' educational attainment. Education had a significantly positive effect on the output dynamics, optimizing the endogenous interrelations between the main components of economic growth.

Significant conclusions were made regarding human capital production. Using panel data, Pelinescu (2015) proved the value of a good education and a flexible training system for sustainable economic growth. Knowledge diffusion in manufacturing goods and services, creative industries, and concrete efforts to establish a research-intensive economy were identified as the main triggers responsible for long-term development. Hanushek (2015) examined the possibilities for a tertiary education-based improvement in public production. No statistically significant interdependencies between the indicators mentioned were revealed. Nevertheless, reasonable effects of education were observed. Ahsan and Haque (2017) refuted the hypothesis that the years of schooling were unrelated to economic growth. According to their empirical study, a decisive influence of education could be discerned after a particular economy exceeds a threshold development level.

Using a growth model with integrated variables from the supply and demand side, Teixeira and Queirós (2016) assessed the direct and indirect effects of human capital

on output growth, including the interaction of human capital with the country's industrial specialization. Both human capital dynamics and the country's productive specialization were identified as the main economic growth determinants.

Economic development was strongly influenced by the composite effect of human capital applications and structural change in high knowledge-intensive industries. Meanwhile, the sign of the observed effect depended on the type of economic model and the analyzed period. Over a long-time period (1960–2011), the cumulative impact of the interaction between human capital and structural change appeared to be positive for OECD countries. Nagarajan, Teixeira, and Silva (2016) reviewed the literature regarding the aging population and its integral impact on economic growth, and they discovered the main mechanisms by which aging affected development.

Applying different mathematical methods, Uddin, Alam, and Gow (2016) investigated population saving behavior regarding age structure, dependency ratio, savings rate, and real GDP. The negative effect of population aging on advanced economies was statistically proved. Meanwhile, McGrath (2016) concluded that the indicators of GDP, capital stock, and human capital were co-integrated. While the causalities from GDP to capital stock and from capital stock to human capital were bidirectional, the causality from GDP to human capital appeared to be unidirectional, but not vice versa. As a result, the initial hypothesis that economic growth was caused by human capital has been generally refuted.

Focusing on the differences in the mortality rate for comparative development, Cervellati and Sunde (2015) proposed a unified growth theory – covering both demographic and economic issues – and investigated the demographic transition's mechanics. The results explained an essential part of the differences in economic development (e.g., the timing of the takeoff) across countries under study and the worldwide density distribution of the main demographic variables.

Acemoglu and Restrepo (2017) disputed the negative effects of an aging population on economic development. The main theoretical statements on the possible negative effects of an aging population on economic growth were empirically investigated. Both the lower labor force participation and productivity decreasing of the older employees were considered. The hypothesis that aging had a negative impact on the savings-to-investment ratio and led to so-called secular stagnation was not supported. It should be mentioned that the authors applied a rather unusual methodology: all the population over 50 was identified as "aged," irrespective of the person's production activity and economic behavior. Cooley, Henriksen, and Nusbaum (2019) identified persistent deceleration in economic growth rates of the four largest advanced economies in Europe caused by a shift in the age-cohort distribution. Defining the impact of complex demographic factors on economic development, they revealed some interdependencies between the total factor productivity, capital accumulation, labor supply, and population growth. They proved that the effects of an aging population on economic growth distorted individual factor-supply choices regarding the pension systems.

Ahmad and Khan (2019) empirically investigated whether the demographic transition and the dynamics of human capital mattered for economic growth for a representative sample of the developing world. The positive lagged contribution of the economically active population and the labor force participation rate in economic growth were identified. Kozlovskyi et al. (2018) investigated the Ukrainian agrarian sector's regional peculiarities in the context of sustainable development. As an essential precondition for economic growth, they highlighted a strong interconnection between sound management in the above sphere and the human capital quality.

Regarding the shift in advanced countries from industrial to knowledge economies, Faggian, Partridge, and Malecki (2017) investigated the underlying causes of endogenous economic development. The main prerequisites for growth were defined as intensified creativity, an entrepreneurship environment, and expanded human capital; those factors were linked to the demographic parameters of the nation. While the interrelation between human capital (measured by educational attainment) and business environment (characterized by the intensity of small and medium-sized firms) appeared to be statistically interconnected with subsequent growth, other factors (e.g., the share of creative class workers, the share of advanced technology industries, etc.) were described as insignificant. Meanwhile, Cuaresma et al. (2018) assessed the potential contribution of future educational attainment to economic growth and income convergence. They suggested that income convergence dynamics and human capital acted as important drivers for real income growth.

The aims

This paper investigates the interrelation between selected demographic variables and the main economic variables regarding OECD and some developing countries. The possible and predicted demographic dividends and the general character of the impact of the demographic transition on economic development processes are examined. We try to find effective public management measures regarding the highlighted demographic trends.

Methods and data

Sustainable economic development is dependent on a dynamic interrelation between economic and demographic factors. Their overall effect is described by *a production function (1)*:

$$Y = f\left(x_1, x_2, \ldots, x_n\right), \tag{1}$$

where Y – the national production capacity or annual economic growth;
$x_1, x_2, \ldots, x_n$ – the most essential economic and demographic factors.
Those factors are deeply interconnected with the category of human capital. Meanwhile, all the significant elements of the aforementioned category are mostly inseparable and overlap. In our investigation, public production is defined by the Cobb-Douglas function *(2)*.

$$Y_{ij} = A_{ij} * L_{ij}^{\alpha} * K_{ij}^{\beta}, \tag{2}$$

where
Y_{ij} – real GDP of country j in the year i;
A_{ij} – the total factor productivity coefficient of country j in year i;
L_{ij} – the labor input of country j in year i;
K_{ij} – the capital input of country j in year i;
α, β – the output elasticities of labor and capital, respectively, while $\alpha + \beta = 1$.
In present conditions, all production factors should be regarded as imperfect complements. Public welfare could be described by the real annual GDP per capita growth rate. The latter is dependent on the main productive factors, namely, physical and human capital. If the real GDP per capita growth rate is decomposed into several conditionally independent variables, *multiplicative function (2)* can be transformed into an *additive one (3)*:

$$\mathrm{growt}_{ij} = \gamma_0 + \gamma_1 \mathrm{demogr}_{ij} + \gamma_2 \mathrm{hum\_cap}_{ij} + \gamma_3 \mathrm{contr}_{ij} + \varepsilon, \tag{3}$$

where
$growth_{ij}$ – the real GDP per capita growth rate of country j in year i;
$demogr_{ij}$ – the demographic variables of country j in year i;
hum_cap_{ij} – the other human capital variables (indirectly related to the demographic ones) of country j in year i;
$contr_{ij}$ – the economic controls (related to the physical capital) of country j in year i.
The OLS method was applied to evaluate the overall impact of demographic and other selected determinants on economic development.

Demographic variables are traditionally associated with fertility and mortality rates. Broadly, the population's dynamics depend not only on natural factors but on mechanical ones as well (e.g., migration). We strongly believe that the overall demographic impact on economic growth is represented by the permanent changes in the working-age population stratum and expected life span dynamics. So, the demographic variables of our study consist of the working-age population growth rate ($WAPop_{gr}$) and the average life expectancy growth rate ($LifeExp_{gr}$). The other human-capital-related essential economic growth determinant is represented by the composite public and private expenses on research and development activities ($RD_{\%GDP}$), regarded as a percentage of GDP.

In addition, we impose two economic controls: public expenditures ($PubExp_{\%GDP}$) and total investment ($TInv_{\%GDP}$) as percentages of GDP. Public spending characterizes the scale of GDP redistribution and the government's role in welfare creation processes. That variable aggregates both the productive expenses (related to human capital formation) and the other expenditures with an ambiguous impact on economic growth (regarded as unproductive). Aggregating public and private financial activity simultaneously, the total investment indicator is related primarily to the physical capital production of the Cobb–Douglas function.

We used a panel data analysis over the period 1990–2017. The sample included the economies of the OECD countries (excluding Columbia) and the economies of Armenia, Belarus, Bulgaria, Croatia, Georgia, Kazakhstan, Romania, the Russian Federation, and Ukraine. Due to a critical lack of information on several emerging markets in the early 1990s, the panel data was unbalanced. Because the vast majority of the studied emerging economies successfully conducted institutional and structural reforms before joining the EU (and its principal formation ended around 2004–2005), we examined two periods: 1990–2004 and 2005–2017.

The main sources of our empirical data were the databases of the World Bank and the IMF. Some essential data were drawn from the databases of the OECD and the European Commission. Summary statistics data for the sample regarding the three periods are presented in Table 1.

Table 1. Summary statistics

Variables	Period	Observations	Mean	Standard deviation	Max	Min
$GDPpc_{gr}$	1990–2017	1032	2.35	3.64	23.99	–14.56
	1990–2004	465	2.89	3.25	15.31	–12.16
	2005–2017	567	1.90	3.88	23.99	–14.56
$LifeExp_{gr}$	1990–2017	1032	0.31	0.38	2.34	–1.59
	1990–2004	465	0.31	0.37	2.34	–1.59
	2005–2017	567	0.30	0.38	2.10	–1.03
$WAPop_{gr}$	1990–2017	1032	0.34	0.94	4.93	–4.08
	1990–2004	465	0.48	0.85	4.93	–4.08
	2005–2017	567	0.23	1.00	3.03	–2.48
$R\&D_{\%GDP}$	1990–2017	1032	1.52	0.94	4.58	0.08
	1990–2004	465	1.41	0.81	4.19	0.19
	2005–2017	567	1.60	1.03	4.58	0.08
$PubExp_{\%GDP}$	1990–2017	1032	41.39	9.47	68.03	13.79
	1990–2004	465	42.22	9.89	68.03	13.79
	2005–2017	567	40.71	9.06	65.05	18.63
$TInv_{\%GDP}$	1990–2017	1032	23.70	4.59	43.81	10.22
	1990–2004	465	23.70	4.01	39.02	11.89
	2005–2017	567	23.71	5.02	43.81	10.22

Source: authors' own calculation based on The International Monetary Fund Database (2019), The World Bank Open Data (2019), The European Commission Database (2019), and The OECD Data (2019).

Over the period 1990–2017, all the analyzed indicators varied significantly. While the volatility – characterized by the standard deviation – of the public expenditures-to-GDP ratio reduced slightly, the volatility of the other examined indexes increased. Meanwhile, the aforementioned ratio was characterized by the highest standard deviation, which equaled 9.47%. This was due to the remarkable differences in the sampled countries' institutional framework, fiscal policies, and economic models.

Results

Sustainable growth is described as the ultimate and primary objective of an economic policy in the long-run. Different demographic variables are traditionally integrated into development programs and strategies as their most significant indices. Yet, the actual role of the population's characteristics as the growth triggers remains unknown. Set by the authorities due to electoral obligations and commitments regarding the mutual interconnection between political and business cycles, some declarative goals in the distinct fields (e.g., demographics, public finances, etc.) can contradict each other and deteriorate the analyzed system's overall effect. Given the above, a complex numerical investigation of the contribution of both demographic and non-demographic factors to economic growth was carried out.

Sanchez-Romero, Lee, and Prskawetz (2018) pointed out that differences in life expectancy are observed not only between different countries but between high and low socioeconomic groups as well. That hypothesis is extremely important when societies with significant inequalities are analyzed. However, in our investigation, both life expectancy and economic development indicators are regarded as the universal characteristics of a particular nation's population. Figure 1 represents the interrelation between the mean GDP per capita (expressed in current US $) and total life expectancy at birth (expressed in years) in the sample over the period 1990–2017. The observed interdependency appeared to be statistically significant and quite robust ($R^2 = 0.58$). Regarding the empirical data on the mean GDP per capita, the sample was divided into three sub-samples. The 1st sub-sample included countries with a mean GDP per capita lower than US $12,500.00; the 2nd sub-sample – countries with a mean GDP per capita from US $12,500.01 to US $37,500.00; the 3rd sub-sample – countries with a mean GDP per capita higher than US $37,500.01.

The vast majority of post-Soviet countries were included in the 1st sub-sample due to their rather unfavorable endogenous social and economic conditions in the early 1990s. The 1st sub-sample also included Chile, Mexico, and Turkey. Meanwhile, over the entire period, Slovenia appeared to be the only post-Soviet country with a sufficiently high average GDP per capita that was equal to US $16,221.94. Considering the entire sample, the countries of the 1st sub-sample were characterized by the lowest average life expectancy; the indicator varied from 67.47 years in Kazakhstan to 75.64 years in the Czech Republic. The average life expectancy in Slove-

nia (77.03 years) was slightly lower than in Chile (77.08 years). In the 2nd and the 3rd sub-samples, the interconnection was generally the same, but its statistical density appeared to be weaker. The highest average life expectancy at birth was observed in Japan (81.60 years). Australia, Italy, and Spain (from the 2nd sub-sample) as well as Iceland, Sweden, and Switzerland (from the 3rd sub-sample) formed a group of countries with an average life expectancy that exceeded 80.00 years. Kazakhstan, the Russian Federation, and Ukraine formed a group of countries with the lowest average life expectancy, which did not exceed 70.00 years. The group was also characterized by the lowest average GDP per capita.

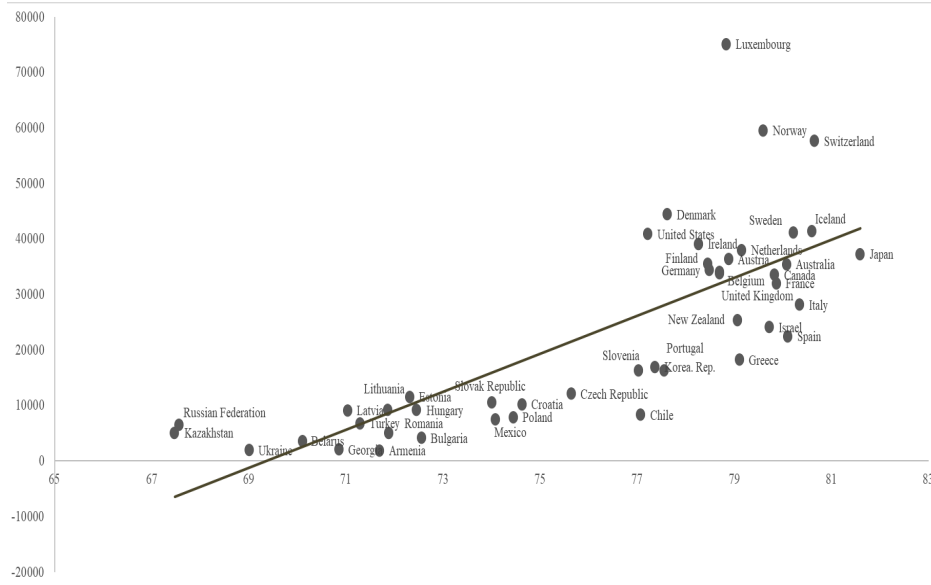

Figure 1. The average GDP per capita (US $) and total life expectancy at birth (years) in selected countries over the period 1990–2017
Source: authors' own calculation based on The World Bank Open Data (2019).

In the entire sample, Luxembourg was characterized by an enormously high mean GDP per capita that was equal to US $75,070.34. The indicator rose significantly from US $34,645.14 in 1990 to US $104,498.74 in 2017. The life expectancy indicator varied from 75.01 years to 82.69 years, respectively. We did not exclude the data on Luxembourg from the entire sample, but that fact was considered important for subsequent analysis. It should be specifically mentioned that the standard deviation of average life expectancy at birth was equal to 3.96 years, while the standard deviation of mean GDP per capita equaled US $17,630.46. Over the investigated period, the total life expectancy at birth in most advanced countries has reached the biological limits. The level of GDP per capita varied significantly. The results of the above analyses should be proved in a further investigation.

As it was numerically proved, demographic variables have fundamentally affected economic development. Bloom et al. (2007) demonstrated that an increase in population was primarily observed in the non-working-age stratum, affecting both consumption and investment behavior and reducing economic growth. According to Pasichnyi et al. (2017; 2019), in both advanced and emerging markets economies, an increase in the total population had a significantly negative impact on their development. That situation was generally caused by negative shifts in the population's age structure. The influence of the human development index on the resultative variable unexpectedly appeared to be negative as well. That requires further investigations.

Considering the sample and the time scale, the real GDP per capita growth rates were unsustainable and hugely dependent on the mutual interconnections between the economic development determinants. Over the period 1990–2017, all the analyzed variables appeared to be statistically significant (see Table 2, *OLS1*), while the investigated demographic variables were negative to economic growth. If the average life expectancy increased by 1.00%, the decline in real GDP per capita was equal to 1.23%. It should be specifically mentioned that the life expectancy growth rate was characterized by the lowest volatility. Its standard deviation equaled 0.31% and showed a slight growth over the period in almost all countries in the sample. The most rapid decline in the analyzed indicator was observed in Iceland in 1995. It was accomplished by a reduction in the real GDP per capita growth rate. The examined indexes were equal to –1.59% and –0.43%, respectively. Meanwhile, over the entire period, the highest life expectancy growth rate was identified in Croatia in 2001. It was associated with rather high economic growth. The investigated variables equaled 2.34% and 7.51%, respectively. The interconnection between the indicators was uneven and ambiguous due to the complex nature of the life expectancy growth rate, which was simultaneously related to the life quality and the public finances' architectonics.

Considering the periods of 1990–2004 (*OLS2*) and 2005–2017 (*OLS3*), the impact of the life expectancy growth rate on economic development was negative and statically significant in both cases. Thus, an increase in the life expectancy growth rate by 1.00% reduced the real GDP per capita growth rate by 0.36% and 1.85%, respectively. This difference could be caused by a lack of information on some emerging economies over the period 1990–1995.

Unexpectedly, over the entire period, the working-age population growth rate appeared to be negative to economic growth. Between 1990 and 2004, if the working-age population growth rate increased by 1.00%, the real GDP per capita growth rates fell by 0.94%. However, considering the same time-scale, this variable was statistically insignificant. Between 2005 and 2017, if the working-age population grew by 1.00%, the real GDP per capita growth rate fell by 0.63%. And the interconnection between the variables was statistically significant. As a result, between 1990 and 2017, the interconnection mattered and was negative. If the working-age population increased by 1.00%, the respective reduction in GDP per capita growth rate equaled 0.59%. Over the entire period, the average annual working-age population expansion equaled 0.34%, while

the standard deviation equaled 0.94%. Regarding the periods 1990–2004 and 2005–2017, the average annual working-age population growth rates equaled 0.48% and 0.23%, respectively. Summarizing the above, it should be mentioned that an insufficient increase in the working-age stratum accomplished by sustainable life expectancy growth causes population aging.

Table 2. Regressions of economic growth on demographic variables and controls, the sample of 45 countries, 1990–2017, unbalanced panel

Variables	Period		
	OLS1	*OLS2*	*OLS3*
$LifeExp_{gr}$	–1.233[1]	–0.355[1]	–1.847[1]
	(0.268)	(0.366)	(0.367)
$WAPop_{gr}$	–0.589[1]	–0.940	–0.631[1]
	(0.109)	(0.162)	(0.147)
$R\&D_{\%GDP}$	–0.452[1]	–0.551[1]	–0.226
	(0.113)	(0.177)	(0.147)
$PubExp_{\%GDP}$	–0.074[1]	–0.078[1]	–0.090[1]
	(0.012)	(0.015)	(0.018)
$TInv_{\%GDP}$	0.235[1]	0.119[1]	0.289[1]
	(0.023)	(0.035)	(0.030)
R^2	0.216	0.195	0.273
N	1032	465	567

Notes: The numbers in parentheses are the standard errors of the estimated parameters.
'1' denotes significance at the 1 percent level. R^2 represents the adjusted coefficient of determination.
Source: the authors' own calculation based on The International Monetary Fund Database (2019), The World Bank Open Data (2019), The European Commission Database (2019), and The OECD Data (2019).

Research and development (R&D) expenditures denote both public and private productive spending, closely associated with an increase in human capital. Thus, the examined interconnection between R&D expenditures and the actual economic development level depended on many determinants. In general, R&D expenditures are considered to be productive, but their overall effect on the national economy's development level should be examined properly. The composite structure of R&D expenditures can contradict the main aims of economic development. Theoretically, if the most significant economic advantages were received via direct government grants, the national economy could be deemed paternalistic.

Meanwhile, the empirical data proved that the achieved economic development level was indifferent and slightly negatively interconnected with economic growth. Surprisingly, over the entire period, an increase in the R&D expenditures-to-GDP ratio by 1.00% reduced the real GDP growth rates. And, in that case, the average annual decline in the resulting variable was equal to 0.45%. Considering the selected time periods, the dynamic interrelation between the R&D expenditures-to-GDP ratio and the real GDP per capita growth rate was significant over the period 1990–2004.

When the empirical base of our study was expanded to include some emerging Eastern and Central European economies, the statistical significance of the investigated interconnection rapidly declined and appeared to be insignificant. Regarding the period 1990–2004, an increase in the R&D expenditures-to-GDP ratio by 1.00% was interconnected with a reduction in the GDP per capita growth rate, which was equal to 0.55%. As previously written, over the period 2005–2017, the observed interrelation between the R&D expenditures-to-GDP ratio and the real economic growth rate appeared to be statistically insignificant. The standard deviation of the investigated human capital-related variable equaled 0.94%. Regarding the different time periods, that specific characteristic grew from 0.81% to 1.03%.

According to Barro and Sala-i-Martin (2003), the total public expenditures could and should be divided into two separate groups, productive and non-productive, considering their overall impact on production dynamics. Based on the empirical data, the dominance of non-productive public expenditures causes a decline in the real GDP per capita growth rate. The public spending-to-GDP ratio variable was generally negative to economic growth regarding the selected time-scales. Moreover, the negative impact of the investigated independent variable was observed for both advanced and emerging market economies. The variable was hugely dependent on the model of the national economy and the quality of the institutional framework. Due to the extended time period and the quality of the sample, one can see that the public spending-to-GDP ratio varied widely. Its standard deviation changed from 9.89% to 9.06%.

It should be specifically mentioned that R&D expenditures are hugely dependent on their inherent structure. If the structure was rigid, it could be characterized as an intrinsic aspect of the public spending policy. In emerging economies in the early 1990s, the latter was closely interconnected with the doctrine of paternalistic public finances. Thus, public spending was often determined by the political rather than the economic cycle. The electoral promises – both at the local and national levels – affected the economic performance and quite often deteriorated it.

In general, the total investment indicator – represented by the composite public and private financial efforts – positively affected the growth processes. Over the period 1990–2017, an increase of 1.00% in the total investment-to-GDP ratio was accomplished by the simultaneous increase in the real GDP per capita growth rate that was equal to 0.24%. The overall effect of investment over the period 1990–2004 (with a respective coefficient that equaled 0.12%) was less significant compared with the respective indicator over the period 2005–2017 (with a respective coefficient that equaled 0.29%). This proved that the composition of the investment recourses really mattered. Regarding all the analytical periods in the investigated model, the total investment-to-GDP ratio was the only variable that showed a sustainable positive influence on production.

The interrelation between the working-age population stratum and the output growth rate should be investigated properly. The interdependency is shown in Figure 2.

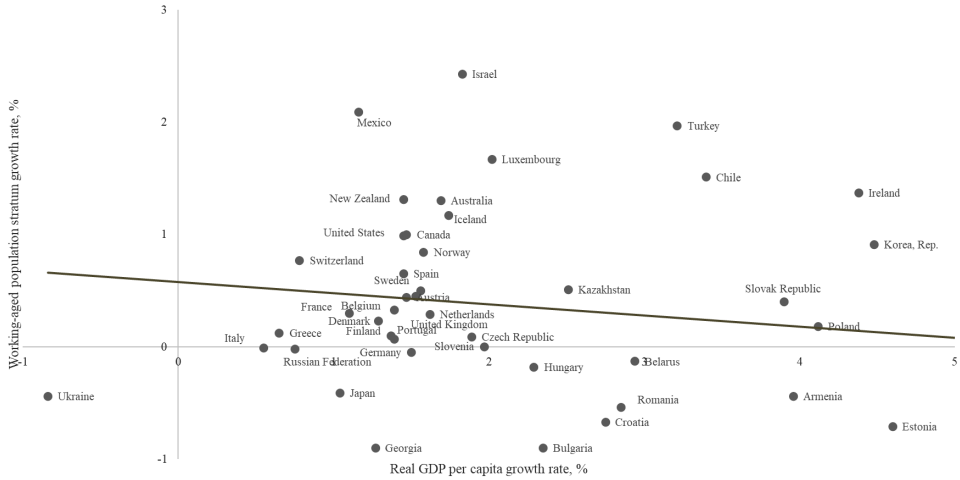

Figure 2. The average working-age population stratum growth rate and the average real GDP per capita growth rate in selected countries over the 1990–2017 period, %
Source: authors' own calculation based on The World Bank Open Data (2019).

In terms of the real GDP per capita growth rates, over the period 1990–2017, Ukraine maintained a unique position with simultaneous negative average output dynamics and a decline in the economic active population stratum. Some of the investigated advanced countries, namely Germany, Italy, and Japan, were characterized by positive GDP dynamics accomplished by a decrease in the working-age population stratum growth rate. Meanwhile, the influence of the average working-age population stratum growth rate on the output dynamics was ambiguous. There were many emerging market economies (Armenia, Bulgaria, Estonia, Georgia, Hungary, Latvia, Lithuania, Romania, Russian Federation) with a negative working-age population stratum growth rate, while the respective output dynamics was positive. A number of advanced economies were characterized by a positive working-age population stratum growth rate. Poland, Ireland, and South Korea should be mentioned as the countries with the best indicators of population and output dynamics. The working-age population stratum should be considered the most productive, regarding the structure. Future studies should focus on the population's productive capacity.

The legislative framework was essential, as it had an important impact on the agents' behavior and considering macroeconomic efficiency. If the terms of the national legislation were regarded as acceptable for the vast majority of the agents involved, public governance would achieve the best performance. Meanwhile, unfavorable national fiscal legislation fostered migration processes due to the *Tiebout hypothesis* and decreased the national economy's final results. So, a significant increase in the population's quality of life was closely interconnected with public governance and the respective formal institutional framework.

Discussion

Based on the empirical data, one can see that over the past three decades, economic development has been hugely dependent on different demographic variables. Meanwhile, the examined social and demographic indicators – the working-age population and the average life expectancy growth rates – had a rather negative impact on the output growth rates. In the case of the adverse interrelation between the working-age population and the real GDP growth rates, a possible explanation can be derived from the quality of the labor force. In our investigation, the working-age stratum of the population was defined according to the International Labour Organisation methodology; however, people aged from 15 to 64 objectively possess incomparable working abilities and competencies. The observed expansions in the above stratum could be caused by increases in the low-skilled and unskilled sub-strata. The latter was described by relatively poor productive capacities and a rather insignificant contribution to public production. Further investigation should cover the structural peculiarities of the working-age stratum.

The overall negative impact of an extended life expectancy can be explained due to the same changes in the population's distribution through the age strata. In advanced and emerging market economies, longevity is directly connected to the tax burden: increased life expectancy induces payments related to social contributions. A very aged population is characterized by significant medical and recreation spending – both public and private – in GDP. Moreover, the dynamics of investment and consumption behavior are hugely dependent on the population's age structure. At the same time, longevity was described as a natural and direct consequence of high economic development.

In this article, the indirect human-capital-related economic growth determinant was represented by the share of R&D expenditures in GDP. In modern economic discourse, R&D expenditures are traditionally defined as productive. Nevertheless, in our study, an increase in R&D spending was associated with a downtrend in public production. The possible explanation was interconnected with the structure of the aforementioned expenditures. In several countries, R&D expenditures were primarily financed through public funds. If the structure of government spending was infirm, the efficiency of public spending declined significantly. However, the possible solution was closely interconnected with the R&D activities and private business convergence. If scientific decision-makers were connected to the business programs, their overall effect could be generally high. If the R&D activities were unconnected to the public needs, real GDP would be crucially reduced.

Demographic sustainability should be integrated into the national economic doctrine and determined as society's ability to automatically support and – using implicit compensators – restore its own structure in the context of social stratification. This would refer to a set of significant parameters, including the level of economic activity as well as educational, professional, and competence training. Demographic sustainability optimizes productivity proportions of intellectual and physical capital, provides

intensification and continuity of production, and increases the welfare of the population. The complex demographic factors, in particular, the working-age population and the average life expectancy growth rates, heavily influence long-term economic growth. Demographic sustainability should be defined as a strategic task for national socio-economic policy. To achieve demographic sustainability, tight coordination of social, fiscal, migration, and cultural policies is required.

Conclusion

Public production can be described as a complicated multidimensional process that is highly dependent on a set of social, demographic, and economic factors. People influence economic dynamics enormously as they are simultaneously producers and consumers of goods and services. The demographic factors contribute to economic development, and the character of their influence should be investigated properly. We examined the OECD countries (excluding Columbia) and Armenia, Belarus, Bulgaria, Croatia, Georgia, Kazakhstan, Romania, the Russian Federation, and Ukraine over the period 1990–2017. Our initial hypothesis was that demographic factors significantly affected production proportions, determining development vectors. However, the observed demographic variables appeared to be slightly interconnected with the output dynamics, regarding both advanced and developing countries. The possible and predicted demographic dividends and the general character of the demographic transition's impact on the economic development processes in the OECD member-states and selected developing countries were examined. Potential public management measures regarding the highlighted demographic trends were proposed.

Providing comprehensive research, we pointed out some dependencies between the GDP per capita growth rates and the selected demographic variables (the working-age stratum and expected life-span growth rates). We examined states with relatively low, medium, and high development levels. Considering the fact that average life expectancy in the sample was generally dependent on the achieved economic development, some conclusions were reached. In the emerging market countries (e.g., some of the post-Soviet states, as well as Chile, Mexico, and Turkey), the adverse interdependencies between the extended life expectancy and the output dynamics were primarily caused by the quality of the institutional framework. In the advanced countries (the OECD member-states), this interrelation appeared negative, too. However, the possible explanation was that the life-span in those cases had reached biological limits; economic growth in the developed countries was considerably slower than in developing ones. In case of the adverse impact of the working-age stratum on the output dynamics, it was not only the quantity that mattered but the actual quality, as well. Even though the impact of both demographic variables that were studied appeared not to be robust for the entire sample, further research in the aforementioned area with respect to the national economy's peculiarities would be mattered.

In this investigation, we considered there to be three main groups of impact factors on economic growth. The 1st group was demographic factors that directly related to the quality of human capital. This group included the working-age population and the average life expectancy growth rates. The 2nd group was closely connected to human capital and knowledge management, but indirectly. The investigated variable referred to the R&D expenditures-to-GDP ratio. The 3rd group was economic controls that primarily related to physical capital: the public spending-to-GDP and total investment-to-GDP ratios. The entire period was divided into two separate periods, i.e., 1990–2004 and 2005–2017.

The total sample was divided into three sub-samples that took into consideration average GDP per capita and mean life expectancy. We found that the above economic and demographic characteristics were directly interconnected: higher life expectancy was observed in the most developed countries. Moreover, that connection appeared to bilateral: significantly high real GDP per capita increased life expectancy. We identified three sub-samples, regarding low, medium, and high average GDP per capita. It was proved that countries with the lowest average life expectancy were simultaneously characterized by relatively low real GDP per capita. High life expectancy was considered the logical and natural consequence of an effective public production structure.

Over the observed periods, the general interdependency – represented by *model 3* – appeared to be statistically significant and quite robust, while the impact of the main indicators varied. The vast majority of the investigated variables had a significantly negative impact on the scale of public production. An increase in the life expectancy growth rate by 1.00% reduced the real GDP per capita growth rate by 1.23%. If the working-age population grew by 1.00%, the output was reduced by 0.59%. Surprisingly, an increase in the R&D expenditures-to-GDP ratio by 1.00% slowed down the real GDP per capita growth rate by 0.45%. An increase in the public spending-to-GDP ratio by 1.00% reduced the output dynamics by 0.07%. The total investment-to-GDP ratio was the only independent variable that had a positive influence on public production: if the ratio increased by 1.00%, the output was increased by 0.24%.

In the numerous previously mentioned scientific investigations, the impact of demographic factors was traditionally included in the global influence of human capital on economic development. In this particular study, we argued that the effect of demographics on economic growth could not be identified with the category of human capital effect. Even though the active economic agents produced GDP, both the production and the consumption mattered. Human capital was commonly associated with production capacity, while demographics determined both the aggregated demand and supply. Thus, in this article, we considered the direct and indirect influence of demographics on developed and emerging market economies. The "overlapping" of the variables was not critical but should be considered in future studies. We augmented the above separation in this paper, taking the transformation experience of Central and Eastern European states into account.

Regarding the selected time scales, the independent variables had, in general, a similar impact on the output dynamics. Over the period 1990–2004, the impact of the working-age population growth rate on economic development appeared to be statistically insignificant. The same results were obtained when the entire sample was divided into two sub-samples, taking the actual development of the examined economies into account. The empirical investigation proved there is a robust negative interconnection between the observed variables. Meanwhile, the actual impact of demographic variables still needs to be investigated properly.

References

Acemoglu, D., Johnson, S. (2007), *Disease and development: the effect of life expectancy on economic growth*, "Journal of Political Economy", 115 (6), pp. 925–985. https://doi.org/10.1086/529000

Acemoglu, D., Restrepo, P. (2017), *Secular stagnation? The effect of aging on economic growth in the age of automation*, "American Economic Review", 107 (5), pp. 174–179. https://doi.org/10.1257/aer.p20171101

Ahmad, M., Khan, R.E.A. (2019), *Does demographic transition with human capital dynamics matter for economic growth? A Dynamic Panel Data Approach to GMM*, "Social Indicators Research", 142 (2), pp. 753–772. https://doi.org/10.1007/s11205-018-1928-x

Ahsan, H., Haque, M.E. (2017), *Threshold effects of human capital: Schooling and economic growth*, "Economics Letters", 156, pp. 48–52. https://doi.org/10.1016/j.econlet.2017.04.014

Barro, R.J., Lee, J.W. (2013), *A new data set of educational attainment in the world, 1950–2010*, "Journal of Development Economics", 104, pp. 184–198. https://doi.org/10.1016/j.jdeveco.2012.10.001

Barro, R.J., Sala-i-Martin, X. (2003), *Economic growth*, 2nd ed., MIT Press, Massachusetts, https://mitpress.mit.edu/books/economic-growth-second-edition (accessed: 21.11.2019).

Bloom, D.E., Canning, D., Sevilla, J. (2001), *Economic growth and the demographic transition*, NBER Working Paper Series 8685, National Bureau of Economic Research, Cambridge, USA. https://doi.org/10.3386/w8685

Bloom, D.E., Canning, D., Sevilla, J. (2003), *The demographic dividend: A new perspective on the economic consequences of population change*, Rand Corporation, Santa Monica, Canada. https://www.rand.org/pubs/monograph_reports/MR1274.html

Bloom, D.E., Canning, D., Fink, G., Finlay, J.E. (2007), *Does age structure forecast economic growth?*, "International Journal of Forecasting", 23 (4), pp. 569–585. https://doi.org/10.1016/j.ijforecast.2007.07.001

Bloom, D.E., Canning, D., Fink, G., Finlay, J.E. (2009), *Fertility, female labor force participation, and the demographic dividend*, "Journal of Economic Growth", 14 (2), pp. 79–101. https://doi.org/10.1007/s10887-009-9039-9

Boucekkine, R., De la Croix, D., Licandro, O. (2002), *Vintage human capital, demographic trends, and endogenous growth*, "Journal of Economic Theory", 104 (2), pp. 340–375. https://doi.org/10.1006/jeth.2001.2854

Cervellati, M., Sunde, U. (2015), *The economic and demographic transition, mortality, and comparative development*, "American Economic Journal: Macroeconomics", 7 (3), pp. 189–225. https://doi.org/10.1257/mac.20130170

Cooley, T.F., Henriksen, E., Nusbaum, C. (2019), *The Growth-Cost of Demographic Change in Europe*, "Review of Economic Dynamics", 1352, pp. 1–30. https://economicdynamics.org/meetpapers/2019/paper_1352.pdf (accessed: 1.12.2019).

Cuaresma, J.C., Doppelhofer, G., Huber, F., Piribauer, P. (2018), *Human capital accumulation and long-term income growth projections for European regions*, "Journal of Regional Science", 58 (1), pp. 81–99. https://doi.org/10.1111/jors.12339

Faggian, A., Partridge, M., Malecki, E.J. (2017), *Creating an environment for economic growth: creativity, entrepreneurship or human capital?*, "International Journal of Urban and Regional Research", 41 (6), pp. 997–1009. https://doi.org/10.1111/1468-2427.12555

Fernihough, A. (2017), *Human capital and the quantity–quality trade-off during the demographic transition*, "Journal of Economic Growth", 22 (1), pp. 35–65. https://doi.org/10.1007/s10887-016-9138-3

Galor, O. (2012), *The demographic transition: causes and consequences*, "Cliometrica", 6 (1), pp. 1–28. https://doi.org/10.1007/s11698-011-0062-7

Hansen, C.W., Lønstrup, L. (2015), *The rise in life expectancy and economic growth in the 20th century*, "The Economic Journal", 125 (584), pp. 838–852. https://academic.oup.com/ej/article-abstract/125/584/838/5077886?redirectedFrom=fulltext (accessed: 1.12.2019).

Hanushek, E.A. (2016), *Will more higher education improve economic growth?*, "Oxford Review of Economic Policy", 32 (4), pp. 538–552. https://doi.org/10.1093/oxrep/grw025

Koziuk, V., Dluhopolskyi, O. (2018), *Resource curse: The role of weak institutions and cronysectors*, "Ideology and Politics Journal", 1 (9), pp. 68–104.

Kozlovskyi, S., Baidala, V., Tkachuk, O., Kozyrska, T. (2018), *Management of the sustainable development of the agrarian sector of the regions of Ukraine*, "Montenegrin Journal of Economics", 14 (4), pp. 175–190. http://dx.doi.org/10.14254/1800-5845/2018.14-4.12

Kozlovskyi, S., Grynyuk, R., Baidala, V., Burdiak, V., Bakun, Y. (2019), *Economic Security Management of Ukraine in Conditions of European Integration*, "Montenegrin Journal of Economics", 15 (3), pp. 137–153. http://dx.doi.org/10.14254/1800-5845/2019.15-3.10

Kozlovskyi, S., Bilenko, D., Kuzheliev, M., Lavrov, R., Kozlovskyi, V., Mazur, H., Taranych, A. (2020), *The system dynamic model of the labor migrant policy in economic growth affected by COVID–19*, "Global Journal of Environmental Science and Management", 6, Special Issue (Covid–19), pp. 95–106. http://dx.doi.org/10.22034/GJESM.2019.06.SI.09

Lee, R.D. (2001), *Demographic change and fiscal policy*, Cambridge University Press, Cambridge.

Lee, R.D. (2003), *The demographic transition: three centuries of fundamental change*, "Journal of Economic Perspectives", 17 (4), pp. 167–190. https://doi.org/10.1257/089533003772034943

Lucas Jr., R.E. (2015), *Human capital and growth*, "American Economic Review", 105 (5), pp. 85–88. https://doi.org/10.1257/aer.p20151065

Malmberg, B. (1994), *Age structure effects on economic growth – Swedish evidence*, "Scandinavian Economic History Review", 42 (3), pp. 279–295. https://doi.org/10.1080/03585522.1994.10415889

McGrath, P. (2016), *The Relationship between Human Capital and Economic Growth in Ireland*. http://dx.doi.org/10.2139/ssrn.2872739

Nagarajan, N.R., Teixeira, A.A. Silva, S.T. (2016), *The impact of an ageing population on economic growth: an exploratory review of the main mechanisms*, "Análise Social", 218, pp. 4–35. https://www.jstor.org/stable/43755167

Pasichnyi, M. (2017), *Empirical study of the fiscal policy impact on economic growth*, "Problems and Perspectives in Management", 15 (3), pp. 316–322. http://dx.doi.org/10.21511/ppm.15(3-2).2017.01

Pasichnyi, M., Kaneva, T., Ruban, M., Nepytaliuk, A. (2019), *The impact of fiscal decentralization on economic development*, "Investment Management and Financial Innovations", 16 (3), pp. 29–39. http://dx.doi.org/10.21511/imfi.16(3).2019.04

Pelinescu, E. (2015), *The impact of human capital on economic growth*, "Procedia Economics and Finance", 22, pp. 184–190. https://doi.org/10.1016/S2212-5671(15)00258-0

Romer, P.M. (1990), *Endogenous technological change*, "Journal of Political Economy", 98 (5, Part 2), pp. S71–S102. https://doi.org/10.1086/261725

Sanchez-Romero, M., Lee, R.D., Prskawetz, A. (2018), *Redistributive effects of different pension structures when longevity varies by socioeconomic status in a general equilibrium setting*. Population Association of America, Manuscript, pp. 1–56. https://www.econstor.eu/handle/10419/203628 (accessed: 1.12.2019).

Teixeira, A.A., Queirós, A.S. (2016), *Economic growth, human capital and structural change: A dynamic panel data analysis*, "Research Policy", 45 (8), pp. 1636–1648. https://doi.org/10.1016/j.respol.2016.04.006

The European Commission Database (2019), https://ec.europa.eu/eurostat/data/database (accessed: 21.11.2019).

The International Monetary Fund Database (2019), https://www.imf.org/en/Data (accessed: 21.11.2019).

The OECD Data (2019), https://stats.oecd.org/ (accessed: 21.11.2019).

The World Bank Open Data (2019), https://data.worldbank.org/ (accessed: 21.11.2019).

Uddin, G.A., Alam, K., Gow, J. (2016), *Population age structure and savings rate impacts on economic growth: Evidence from Australia*, "Economic Analysis and Policy", 52, pp. 23–33. https://doi.org/10.1016/j.eap.2016.08.002

Streszczenie

Badanie empiryczne wpływu czynników demograficznych na wzrost gospodarczy w krajach rozwiniętych i rozwijających się

W artykule zaproponowano zaktualizowane podejście do badania wpływu czynników demograficznych na wzrost gospodarczy. Wstępna hipoteza zakładała, że czynniki te w istotny sposób wpływają na proporcje produkcji, determinując kierunki rozwoju. Ramy instytucjonalne uwzględniały przewidywalne zmiany dynamiki produkcji. W artykule zbadano, wykorzystując niezbilansowane dane panelowe, istotne statystycznie związki między zmiennymi demograficznymi a wzrostem gospodarczym dla krajów OECD (z wyłączeniem Kolumbii) oraz Armenii, Białorusi, Bułgarii, Chorwacji, Gruzji, Kazachstanu, Rumunii, Federacji Rosyjskiej i Ukrainy w latach 1990–2017. Badanie miało na celu podkreślenie związku między kształtowaniem się zmiennych demograficznych (np. tempa wzrostu populacji w wieku produkcyjnym i tempa wzrostu średniej długości życia) a wzrostem gospodarczym. Badanie było próbą odpowiedzi na pytanie czy wpływ czynników demograficznych na gospodarkę był taki sam dla badanych krajów rozwiniętych i rozwijających się. W omawianym okresie znaczny wzrost oczekiwanej długości życia niekorzystnie wpłynął na dynamikę realnego PKB per capita. Badanie empiryczne wykazało, że oczekiwana długość życia jest silnie powiązana z nominalnym PKB per capita. W krajach rozwiniętych ten wskaźnik demograficzny był znacznie wyższy niż na rynkach wschodzących. Okazało się, że wzrost liczby ludności w wieku produkcyjnym radykalnie zmniejszył również dynamikę produkcji, ale związek ten nie był silny. Aby uzyskać pozytywne efekty zarządzania publicznego w perspektywie długoterminowej, należy uwzględnić ramy instytucjonalne. Główne zmienne demograficzne powinny być odpowiednio prognozowane i skalibrowane pod kątem potencjalnych endogenicznych czynników ekonomicznych. Dla osiąganych wskaźników wzrostu gospodarczego ważne są zarówno inwestycje publiczne, jak i prywatne. Autorzy sugerują wyważone podejście do polityki makroekonomicznej w zakresie uwarunkowań zarówno demograficznych, jak i instytucjonalnych.

Słowa kluczowe: ludność, kapitał ludzki, równowaga demograficzna, ramy instytucjonalne, wzrost gospodarczy

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.28

Does Financial Development Enhance Foreign Trade in Selected Transitional Economies?

Kunofiwa Tsaurai
Ph.D., Associate Professor at the University of South Africa
Department of Finance, Risk Management and Banking, Pretoria, South Africa
e-mail: kunofiwa.tsaurai@gmail.com

Patience Hlupo
Lecturer at Bindura University of Technology, Bindura, Zimbabwe
e-mail: phlupo@gmail.com

Abstract

The study investigates the influence of financial development on foreign trade in transitional economies using panel data (1994–2014). Although empirical studies on the impact of financial development on foreign trade are available, none of them that the authors are aware of attempted to explore the subject matter in the context of transitional economies. None attempted to investigate if human capital development is a channel through which financial development influences foreign trade or international trade. Under fixed effects, financial development was found to have a non-significant positive influence on foreign trade, while the random effects approach shows a significant positive relationship running from financial development towards foreign trade. The findings resonate with the majority of the literature on the subject. However, pooled ordinary least squares (OLS) shows that financial development had a significant negative influence on foreign trade.

Under both fixed and random effects, human capital development was found to be a channel through which financial development had a significant positive effect on foreign trade. The results are in line with Patrick's (1966) argument that foreign trade is quickened by high levels of human capital and financial development. The implication of the study is that transitional authorities should develop and implement human capital development enhancement policies in order to enable financial development to have a significant positive effect on foreign trade. In contrast to the available literature, human capital development was found to have had a significant negative impact on foreign trade under the OLS approach. Future studies on the subject matter should address the endogeneity concerns and the dynamic characteristics of the foreign trade data.

Keywords: Financial Development, Foreign trade, Transitional Economies, Panel Data

JEL: G15, J24, P45, P2

Introduction

Globalization, economic integration, financial liberalization, and technological development all seem to dictate that interdependence among countries is unavoidable and, critically, the order of the day. Financial liberalization, among others, has been a widespread phenomenon in many economies. Equally, more effort and expenditure are being spent on human capital development as one of the 17 sustainable development goals. Hence, foreign trade is an inevitable outcome of such developments. Foreign trade is essential in that it contributes to economic growth directly (Akeem 2011; Edoumiekumo and Opukri 2013), or indirectly through either financial development (Gokmenoglu et al. 2015) or human capital development (Haq and Luqman 2014). Consequently, studies on the determinants of foreign trade are abundant (Ghanbari and Ahmadi 2017; Mete and Bozgeyik 2017). Research evidence on the individual effects of financial development and human capital on foreign trade abounds (Paravisini et al. 2011; Manova 2013; Shahbaz and Rahman 2014).

Likewise, human capital accumulation plays a vital role in a country's international competitiveness, as global economic progress centers on knowledge (Domenico et al. 2009). It generates an absolute advantage and a temporary monopoly until such a time when other countries can match the level of human capital development. This positive link between human capital and foreign trade is important in this study.

Some researchers dwell on the complementarity of financial development and human capital (Hakeem and Oluwatoyin 2012; Zaman et al. 2012; Sehrawat and Giri 2014; Eryigit and Dulgeroglu 2015; Tsaurai 2018). It is argued that financial development makes it easy to accumulate human capital (Abubakar et al. 2015; Kargbo et al. 2016). To be more elaborate, the link between human capital and financial development forms a vicious cycle where increased access to finance is a means for human capital accumulation. The latter also stimulates better usage of financial resources, with the ability to save or invest professed to rise with the level of human capital development (Evans et al. 2002).

This background is the basis for the current study. It not only investigates the influence on financial development on foreign trade, but it also explores how human capital and financial development complement each other to foster foreign trade.

The impact of financial development on foreign trade – the theoretical literature

The first theoretical underpinning that explains the channel through which finance impacts foreign trade is trade finance theory (Vaubourg 2016). Firms involved in foreign trade have a choice among a variety of trade finance options, which include open accounts, cash in advance, letters of credit, and export credit guarantees. Cash in advance works well with low finance costs in the importer's country and robust contract enforcement mechanisms in the exporter's country. An open account is suitable when finance costs are low in the exporter's country and when robust enforcement mechanisms exist in the importer's country. Letters of credit and export credit guarantees are safe modes of payment that make trade more attractive, especially to the exporter. Thus, the importer (exporter) imports (exports) more when payment terms are favorable.

The second theoretical perspective holds that variable and fixed costs associated with foreign trade are high, and internal finance may not be enough to cover them. When a firm expands its operations to serve foreign markets, it requires more capital to cover upfront costs like research and development, customizing the product, and establishing distribution channels (Baldwin and Krugman 1989). Inevitably, exporting firms resort to external finance to cover the gap (Vaubourg 2016). Imperfections in capital markets delay firms' decisions to go international. Firms find it difficult to buy equipment and more raw materials that allow them to scale up operations for export trade. Hence, while the production scale remains low, the export business remains less feasible. As firms wait to grow organically through ploughing back profits, the country's share of foreign trade is reduced in the meantime. So, it can be argued that less developed financial markets do not favor foreign trade and vice versa.

The above viewpoint resonates with factor endowment theory, which asserts that firms overcome illiquidity problems by exporting goods that are highly dependent on external finance, thereby improving the structure and balance of trade (Rajan and Zingales 1998). Rajan and Zingales argued that developing financial systems are a way to deal with moral hazard and adverse selection in so doing attracting external finance and growing exports.

Bardhan and Kletzer's (1987) model advocates a link between foreign trade and financial development. The primary focus of the model is on mobilizing and investing financial resources. The intermediate goods sector is said to require less foreign capital, while the final goods sector depends more on external capital to fund its working capital needs. As such, a developed financial system allows for the efficient mobilization of external capital by reducing information asymmetry and moral hazard, which benefits firms specializing in final goods. Therefore, a less developed financial system justifies the involvement of firms in the intermediate goods sector in foreign trade while well-developed financial systems provide a comparative advantage for firms to specialize in trading finished goods. This model is further extended by Beck (2002), who

shows that even when two different sectors rely on external finance, trade patterns for manufactured goods are largely dependent on the level of financial development.

A similar theoretical model by Baldwin and Krugman (1989) supports the above view. They assert that developed financial systems allow for risk reduction through diversification, making it possible for a country to specialize and trade in a risky good than is the case when risk premium is high. Underdeveloped financial markets find it difficult to diversify away risk, and hence they opt to trade in low-risk or risk-free goods, since they pay high-risk premiums. To this end, the nature of trade between any two countries is dependent upon dissimilarities in levels of financial development.

In the same vein, the liquidity easing theoretical angle contends that greater liquidity in the market comes with better financial development as the speed of trading and settling transactions increases (Ezeoha and Cattaneo 2012), thus making it possible for firms to trade internationally. Fundamentally, finance-trade theory comes in two clusters: the demand-following hypothesis and the supply-leading view, where the former relates to causal links from trade to finance while the latter relates to causal links from finance to trade.

The effect of financial development on foreign trade – the empirical literature

Empirical evidence on the relationship between financial development and trade is two-pronged. Initially, there was a group of researchers who found a positive link between financial development and foreign trade. One study by Hur et al. (2006) investigated the extent to which different industries in different countries depended on external finance given asset tangibility. Their results show that developed financial markets stimulate more export business for intangible assets. A recent study by Choi (2018) also confirms a positive relationship between financial development and trade. Considering asset tangibility, study findings show that more asset tangibility attracts external finance and enhances export activity for countries with developed financial markets.

Hanh (2010) used time-series data from 1994–2008 to test the existence of causal effects between financial development, foreign trade, and economic growth for 29 countries. The results support the feedback hypothesis on the link between trade and financial openness in Asia. Another study by Waqas et al. (2011) studied the long-run linkages between economic growth, foreign trade, and financial development in Pakistan. A bounds test showed a long-run relationship between financial development and foreign trade in Pakistan, which is confirmed by Granger causality tests, running from financial development to foreign trade. Analogously, empirical evidence from Bangladesh found bidirectional causality between domestic credit and trade openness (Hassan and Islam 2005).

Further evidence from Kiendrebeogo (2013) supports this positive effect. Using a gravity model to investigate the negative effect of financial crises on exports, they sampled 75 countries and studied how their exports responded to demand and supply shocks in the financial sector from 1988 to 2010. Their results show that as a financial crisis deepens, the level of bilateral trade falls. The effect is more marked for countries that export manufactured goods and those dependent on external finance. Their conclusions are robust, even after controlling for different estimation approaches, endogenous factors, and the existence of outliers.

Kumarasamy and Singh (2018) made a different analysis relating to the effect of financial development on a firm's capability to enter export markets. Their study utilized World Bank Enterprise Survey data for Asia-Pacific countries and concluded that developed financial markets make it easy and possible for firms to start exporting. Fauceglia (2015) conducted a study on 17 developing countries to examine the impact of credit constraints on exporting. The findings show that credit constraints inhibit firms from exporting, with a greater effect on less developed countries. Their results also suggest that credit constraints have a larger negative impact on firms in the technology sector, which rely more on external finance. More support on the effect of credit constraints on trade is found in the works of Brooks and Dovis (2019).

Another analogous study by Manova (2013) linked external credit constraints to productivity. He found that beyond a certain productivity threshold, firms start obtaining external finance to cover their fixed costs. Higher productivity enables firms to meet high finance costs related to external finance, which is necessary to cover export fixed costs. The study determined that low productivity firms are constrained to export as they cannot afford credit that would allow them to partly cover their variable costs. In line with this, Becker et al. (2013) demonstrated that modern financial systems are a source of comparative advantage to firms reliant on external finance to further their export business. Examining more than 170 countries, they collected bilateral trade data between 1970 and 1988. From OLS regression analysis, they determined that developed financial systems nurture export growth.

Cross country evidence on the link between financial development and foreign trade from a study by Leibovici (2018) provides a different lens through which to view the nexus. He suggests that developed financial systems reallocate a country's share of foreign trade from labor-intensive to capital-intensive industries, which are highly dependent on external finance. The probability of venturing into the export business positively and significantly correlates with the leverage ratio, the liquidity ratio, and collateralizable assets in Berman and Héricourt's (2010) study.

Using a different approach, the study by Engel et al. (2013) focused on how financial constraints impacted a firm's decision to terminate its export business. Like Bellone et al. (2010), they used yearly data from French companies but over a shorter period, from 2000–2002. They found that the higher a firm's leverage ratio, the higher its probability of exiting exports, and the lower the firm's cashflow ratio, the higher the possibility of terminating export operations. Italian evidence from a study by Forlani

(2010) found from 1999–2005 data that higher liquidity levels allow a firm to expand its export market. In line with this finding, Muûls' (2012) investigation on Belgian firms proved, from OLS regression analysis, that low default risk firms are more likely to expand their exporting destinations. The same determination is made by Askenazy et al. (2011), who found a negative effect of financial vulnerability on the number of export destinations from a French study covering 1996–2006.

Research evidence from Italian firms shows that the low supply of credit can negatively affect export trade (Minetti and Zhu 2011). Cross-sectional data for 2001 was used. A firm faced credit constraints when its demand for credit exceeded its actual borrowing. Firms faced with a financing gap exported a minimum of 38% less than those who obtained enough credit and with a chance of exporting 39% below that of unconstrained firms. Likewise, the credit statistics of Peruvian firms for the period July 2007 to June 2009 corroborate this finding (Paravisini et al. 2011).

The second strand of research found no link between financial development and foreign trade. Babatunde and Fowowe (2012) refute the finance-led trade hypothesis in Sub Saharan Africa. Consistent with this stance, the results from Berman and Héricourt's (2010) study on the effects of financial characteristics on export levels proves the insignificant impact of the leverage ratio, the liquidity ratio, and collateralizable assets on the quantity of exports. Overall, the empirical evidence supports the theoretical literature that a financial crisis intensifies the negative effects of financial constraints on foreign trade (Vaubourg 2016).

Is human capital development a channel through which financial development influences foreign trade?

The extant literature provides substantial evidence on the positive interaction effects between financial development and human capital on GDP (Ukenna et al. 2010; Abubakar et al. 2015; Kargbo et al. 2016). Kendall (2007) established that human capital development can mediate the undesirable results of financial constrictions, enabling growth even where bank loans are deficient in some Indian regions. This means that the combined effects of these two variables exceed their individual influence on economic growth. Despite significant progress in explaining how the interaction effects of financial development and human capital may be growth-enhancing, the interaction effects of these two variables on foreign trade remains a matter for empirical investigation. In support of this reasoning, exogenous theories of trade suggest that when foreign capital interacts with foreign labor, it consequently magnifies foreign trade (Rao and Mahale 2011).

Other factors that affect foreign trade – control variables

A summary of the determinants of foreign trade is provided in Table 1 below.

Table 1. A summary of the determinants of foreign trade

Variable	Proxy	Reference
Relative size of economies	GDP (real or per capita)	Rahman (2007)
Market flexibility	Flexibility or rigidity of factor of production variables and related rewards	Uzagalieva and Cukrowski (2006)
Political factors	Dummy (1 when preferential trade agreements exist and zero otherwise), trade barriers	Bordo and Rousseau (2012)
History	Existence of colonial ties, common military alliance, or dummy	Ghanbari and Ahmadi (2017)
Linguistic differences	Dummy (1 if languages are similar and zero otherwise)	Rahman (2007)
Foreign direct investment	Change in foreign direct investment	Mete and Bozgeyik (2017)
Interest rate	Change in the real interest rate	Mete and Bozgeyik (2017)
Technological innovation	Related expenditure, internet hosts, technological distance	Spulber (2008)
Research and development	Research expenditure	Ghanbari and Ahmadi (2017)
Domestic consumption rate	Increase or decrease in domestic consumption rate	Mete and Bozgeyik (2017)
Imported capital	Imports of plant, machinery, and transport	Haq and Luqman (2014)
Preferences and tastes	distance	Rahman (2007)
Wealth	Income levels, domestic earnings, foreign earnings	Gebrehiwot and Gebru (2015)
Border sharing	Dummy (1 if the border is shared or zero otherwise)	Jafari et al. (2011)

Source: author's own compilation.

This section of the literature review has shown that there are numerous factors that explain foreign trade apart from the ones at the core of this study. Most of the links formed can be expressed in the form of gravity equations, demonstrating the superiority of gravity models over other trade theories.

Research methodology

Data and sources: The paper used panel data from 1994 to 2014 to investigate the impact of the interaction between financial development and human capital development on foreign trade in transitional economies. The data for the variables used (foreign

trade, financial development, human capital development, economic growth, foreign direct investment, infrastructural development) was extracted from World Bank Indicators, the International Monetary Fund (IMF), Africa Development Bank websites, and various United Nations Development Programme reports. Transitional countries involved in the study include Argentina, Colombia, Indonesia, Mexico, South Africa, Turkey, India, and Brazil, following the IMF (2015) report.

Table 2. Shows the correlation results of the study

	FT	FIN	HCD	GROWTH	FDI	INFR
FT	1.00					
FIN	0.2694***	1.00				
HCD	−0.1884**	−0.3172***	1.00			
GROWTH	−0.0747	0.0303	0.5306***	1.00		
FDI	−0.1557**	−0.0711	0.2713***	0.2613***	1.00	
INFR	0.1643**	0.7415***	0.1833***	0.4823***	−0.0314	1.00

Note: ***/**/* denotes statistical significance at the 1%/5%/10% level, respectively.
Source: author's own compilation from E-Views.

Table 2 shows that both financial development and infrastructural development separately had a significant positive relationship with foreign trade, which is consistent with theoretical predictions. On the other hand, human capital development, economic growth, and FDI were found to have had a separate significant negative relationship with foreign trade, contradicting available theoretical predictions. The maximum size of the relationship between variables (financial development and infrastructural development) is 74.15%, indicating that there is no multicollinearity problem between the variables studied.

Table 3. Descriptive statistics

	FT	FIN	HCD	GROWTH	FDI	INFR
Mean	42.7086	65.0119	0.7195	5077.491	2.0963	1833.511
Median	45.0900	50.4550	0.7300	4302.440	2.0350	1718.390
Maximum	96.1900	192.6600	0.8800	14443.07	8.4600	5061.200
Minimum	15.6400	19.6600	0.4500	353.2900	0.0700	240.0200
Standard. deviation	14.5706	42.2738	0.0852	3471.919	1.3344	1285.066
Skewness	0.1633	1.6908	−0.5301	0.5787	1.2173	1.004134
Kurtosis	2.7945	4.9810	3.0010	2.5097	5.9956	3.252352
Jarque-Bera	1.0421	107.52	7.8677	11.0603	104.3084	28.6777
Probability	0.5939	0.0000	0.0196	0.0040	0.0000	0.0000
Observations	168	168	168	168	168	168

Source: author's own compilation from E-Views.

According to Table 3, the standard deviation of economic growth from the mean economic growth value and that of infrastructural development from the mean infrastructural development value exceed 1000, indicating the existence of extreme values in these two variables. Financial development, economic growth, FDI, and infrastructural development data are abnormally distributed as they are characterized by zero probability values of the Jarque-Bera criterion. To deal away with problems of abnormally distributed data and extreme values, the current study first transformed all the data sets into natural logarithms before using them for final data analysis, consistent with Tsaurai (2017).

General Model and Econometric Specification: Using the available literature discussed in the earlier sections, the relationship between foreign trade and its determinants can be summarized in the following general model specification.

$$FT=f\ (FIN, HCD, FDI, GROWTH, INFR). \quad (1)$$

Where FT, FIN, HCD, FDI, GROWTH, and INFR are abbreviations for foreign trade, financial development, human capital development, foreign direct investment, economic growth, and infrastructural development, respectively.

In econometric terms, equation 1 can be shown in the form of equation 2 below.

$$FT_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 HCD_{it} + \beta_3 FDI_{it} + \beta_4 GROWTH_{it} + \beta_5 INFR_{it} + \varepsilon it \quad (2)$$

Table 4. Signs of equation 2 and their interpretations

FT_{it}	Foreign trade (total trade as a ratio of GDP) in country i at time t
FIN_{it}	Financial development (domestic credit by financial sector as a ratio of GDP) in country i at time t
HCD_{it}	Human capital development (human capital development index) in country i at time t
FDI_{it}	Foreign direct investment (net foreign direct investment inflow as a ratio of GDP) in country i at time t
$GROWTH_{it}$	Economic growth (gross domestic product per capita) in country i at time t
$INFR_{it}$	Infrastructural development [electric power consumption (kWh per capita)] in country i at time t
εit	Error term
i	Country
t	Time
β_0	Intercept term
β_1 to β_5	Co-efficient of the independent variables

Source: author's own compilation.

To determine the influence of the complementarity between financial and human capital development on foreign trade, and interaction term β_3 was introduced in equation 3.

$$FT_{it} = \beta_0 + \beta_1 FIN_{it} + \beta_2 HCD_{it} + \beta_3 (FIN_{it} . HCD_{it}) + \beta_4 FDI_{it} + \beta_5 GROWTH_{it} + \beta_6 INFR_{it} + \varepsilon it \quad (3)$$

The following proxies of the variables used were selected in a manner that helps to avoid mixing data problems, which overall has a negative effect on not only the quality but the integrity of the results.

Table 5. Variables, proxy used, and data sources

Variable	Proxy used	Sources(s) of data
Foreign trade (FT)	Total trade (% of GDP)	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.
Financial development (FIN)	Domestic credit by financial sector (% of GDP)	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.
Human capital development (HCD)	Human capital development index	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.
Foreign direct investment (FDI)	Net FDI inflow (% of GDP)	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.
Economic growth (GROWTH)	GDP per capita	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.
Infrastructural development (INFR)	Electric power consumption (kWh per capita)	International Monetary Fund databases, World Development Indicators, African Development Bank databases, and United Nations Development Programme various reports.

Source: author compilation.

Panel root tests and co-integration: The results are presented in Tables 6 and 7, respectively.

Table 6. Panel root tests – Individual intercept

Level				
	LLC	IPS	ADF	PP
LFT	–0.8022	–0.3867	15.3166	32.1230***
LFIN	–3.4184***	–2.1749**	29.9143**	101.744***
LHCD	–6.1001***	–5.2949***	57.4886***	84.5501***
LFDI	–3.5403***	–3.3369***	39.7762***	55.4211***
LGROWTH	0.1719	2.1605	6.0965	3.4072

Level				
	LLC	IPS	ADF	PP
LINFR	−0.8898	1.5288	14.2593	25.1836*
First difference				
LFT	−4.2743***	−6.5918***	72.4081***	199.787***
LFIN	−4.0320***	−2.9937***	36.8941***	47.6092***
LHCD	−11.0672***	−10.4702***	114.800***	1106.98***
LFDI	−6.5957***	−7.96657***	87.0560***	613.728***
LGROWTH	−3.8221***	−4.1543***	46.0404***	86.2116***
LINFR	−7.1645***	−5.4011***	59.5967***	83.3332***

Note: LLC, IPS, ADF, and PP stands for Levin, Lin, and Chu (2002); Im, Pesaran, and Shin (2003); ADF Fisher Chi-Square and PP Fisher Chi-Square tests, respectively. *, ** and *** denote 10%, 5% and 1% levels of significance, respectively.
Source: author's own compilation from E-Views.

Table 7. Johansen Fisher Panel Co-integration test

Hypothesized no. of CE(s)	Fisher Statistic (from trace test)	Probability	Fisher Statistic (from max-eigen test)	Probability
None	461.9	0.0000	211.8	0.0000
At most 1	258.7	0.0000	162.3	0.0000
At most 2	134.1	0.0000	78.11	0.0000
At most 3	70.86	0.0000	45.42	0.0001
At most 4	40.79	0.0006	33.92	0.0056
At most 5	29.19	0.0227	29.19	0.0227

Source: author's compilation from E-Views.

According to Table 6, all the variables were found to be stationary at first difference while using the Johansen Fisher Panel Co-integration test. Table 7 shows that there are at most five co-integrating equations among the variables studied (statistical evidence that there exists a long-run relationship between and among the variables studied). The finding paved the way for the main data analysis (see results in Table 8).

Under fixed effects, financial development had a non-significant positive effect on foreign trade, while random effects showed a significant positive relationship running from financial development towards foreign trade in transitional economies. The findings support the argument by Kumarasamy and Singh (2018) and Brooks and Dovis (2019). By contrast, pooled OLS showed that foreign trade was negatively but significantly affected by financial development, a finding which resonates with Yakubu et al. (2018). A non-significant positive relationship running from human capital development towards foreign trade was detected under the pooled OLS approach, a finding which was supported by Chatterjee (2017). However, both fixed and random effects produced results that show that human capital development had a non-significant negative influence on foreign trade in contrast to the available theoretical literature. The literature (Samuelson 2001; Waugh 2008) argues that human capital stimulates inter-

national trade. Abundant human capital allows countries to increase production and quality, thereby resulting in an upper hand on moving trade balances. This is not the case for countries low on human capital stock.

Table 8. Panel regression results – The foreign trade function

	Fixed effects		Random effects		Pooled OLS	
	Co-efficient	t-statistic	Co-efficient	t-statistic	Co-efficient	t-statistic
FIN	0.0531	0.8818	0.0968*	1.6799	–0.2084**	–2.0719
HCD	–0.4326	–1.0509	–0.6244	–1.5879	0.4221	0.6600
FTERAC-TION TERM	0.1645	1.2734	0.2081	1.6414	–0.4576*	–1.9529
FDI	0.0433*	1.8043	0.0510**	2.1555	–0.0298	–0.6878
GROWTH	–0.1757***	–3.1860	–0.0856*	–1.8109	0.0358	0.5164
INFR	0.7057***	5.0991	0.3356***	3.4644	0.0556	0.7824
Adjusted R-squared 0.7716 F-statistic 44.40 Prob (F-statistic) 0.0000			Adjusted R-squared 0.6491 F-statistic 32.17 Prob (F-statistic) 0.0000		Adjusted R-squared 0.5928 F-statistic 28.18 Prob (F-statistic) 0.0000	

***/**/* indicate 1%, 5% and 10% significance levels respectively
Source: author's own compilation from E-Views (8).

Human capital development had a significant positive effect on the ability of financial development to enhance foreign trade under both the fixed and random effects approaches. These results do replicate the predictions of the available literature on the subject matter, which, according to Patrick (1966), states that high human capital and financial development quicken the rate of foreign trade. On the other hand, human capital development had a negative influence on financial development's impact on foreign trade under the OLS approach, which contradicts the available theoretical predictions (Lucas 1988; Stokey 1991; Benhabib and Spiegel 1994).

A significant positive impact of FDI on foreign trade was detected under both fixed and random effects, in line with Mete and Bozgeyik (2017). On the other hand, the pooled OLS methodology produced results that show that FDI had an insignificant negative effect on foreign trade. This finding disagrees with most available theoretical predictions on the subject matter.

Pooled OLS noted, however, that the effect of economic growth on foreign trade was positive though non-significant, which is consistent with the study by Rahman (2007). In contrast to the majority of the literature on the subject matter, the influence of economic growth on foreign trade was found to have had a significant negative impact on foreign trade under both the fixed and random effects. Infrastructural development had a significant positive influence on foreign trade under the fixed and random effects, yet the pooled OLS methodology shows a non-significant positive causality running from infrastructural development towards foreign trade.

Conclusion

The study investigated the influence of financial development on foreign trade in transitional economies using panel data (1994–2014). Although empirical studies on the impact of financial development on foreign trade are available, none of them that the authors are aware of attempted to explore the subject matter in the context of transitional economies. None of them attempted to investigate if human capital development is a channel through which financial development influence foreign trade or foreign trade. Under fixed effects, financial development was found to have a non-significant positive influence on foreign trade, while the random effects approach shows a significant positive relationship running from financial development towards foreign trade. The finding resonates with the majority of the literature on the subject matter. However, pooled ordinary least squares (OLS) shows that financial development had a significant negative influence on foreign trade.

Under both fixed and random effects, human capital development was found to be a channel through which financial development had a significant positive effect on foreign trade. The results are in line with Patrick's (1966) argument that foreign trade is quickened by high levels of human capital and financial development. The implication of the study is that transitional authorities should develop and implement human capital development enhancement policies in order to enable financial development to have a significant positive effect on foreign trade. In contrast to the available literature, human capital development was found to have had a significant negative impact on foreign trade under the pooled ordinary least squares (OLS) approach. Future studies on the subject matter should address the endogeneity concerns and the dynamic characteristics of foreign trade data.

References

Abubakar, A., Kassim, S.H., Yusoff, M.B. (2015), *Financial development, human capital accumulation and economic growth: Empirical evidence from the economic community of West African States (ECOWAS)*, "Procedia-Social and Behavioral Sciences", 172 (January), pp. 96–103. https://doi.org/10.1016/j.sbspro.2015.01.341

Akeem, U.O. (2011), *Performance evaluation of foreign trade and economic growth in Nigeria*, "Research Journal of Finance and Accounting", 2 (2), pp. 1–15.

Askenazy, P., Caldera, A., Gaulier, G., Irac, D. (2011), *Financial Constraints and Foreign Market Entries or Exits: Firm-Level Evidence from France*, Working Papers 328, Banque de France. https://doi.org/10.2139/ssrn.1832647

Babatunde, M., Fowowe, B. (2010), *Foreign trade and Financial Development Link: Evidence from Sub-Saharan Africa*, "Journal of Economic Management", 7 (1), pp. 1–15.

Baldwin, R., Krugman, P. (1989), *Persistent trade effects of large exchange rate shocks*, "The Quarterly Journal of Economics", 104 (4), pp. 635–654. https://doi.org/10.2307/2937860

Beck, T. (2002), *Financial development and foreign trade: Is there a link?*, "Journal of International Economics", 57 (1), pp. 107–131. https://doi.org/10.1016/S0022-1996(01)00131-3

Becker, B., Chen, D., Greenberg, J. (2013), *Financial development, fixed costs and foreign trade*, "Review of Corporate Finance Studies", 2 (1), pp. 1–28. https://doi.org/10.1093/rcfs/cfs005

Bellone, F., Musso, P., Nesta, L., Schiavo, S. (2010), *Financial constraints and firm export behaviour*, "The World Economy", 33 (3), pp. 347–373. https://doi.org/10.1111/j.1467-9701.2010.01259.x

Benhabib, J., Spiegel, M.M. (1994), *The role of human capital in economic development evidence from aggregate cross-country data*, "Journal of Monetary Economics", 34 (2), pp. 143–173. https://doi.org/10.1016/0304-3932(94)90047-7

Berman, N., Héricourt, J. (2010), *Financial factors and the margins of trade: Evidence from cross-country firm-level data*, "Journal of Development Economics", 93 (2), pp. 206–217. https://doi.org/10.1016/j.jdeveco.2009.11.006

Bordo, M., Rousseau, P. (2012*), Historical Evidence on the Finance-Trade-Growth Nexus*, "Journal of Banking and Finance", 36 (4), pp. 1236–1243. https://doi.org/10.1016/j.jbankfin.2011.11.012

Brooks, W., Dovis, A. (2019), *Credit market frictions and trade liberalizations*, "Journal of Monetary Economics", 27 (3), pp. 1–16.

Cartiglia, F. (1997), *Credit constraints and human capital accumulation in the open economy*, "Journal of International Economics", 43 (1–2), pp. 221–236. https://doi.org/10.1016/S0022-1996(96)01469-9

Chatterjee, A. (2017), *Endogenous comparative advantage, gains from trade and symmetry-breaking*, "Journal of International Economics", 109 (November), pp. 102–115. https://doi.org/10.1016/j.jinteco.2017.08.009

Choi, B. (2018), *Financial development, endogenous dependence on external financing, and trade*, "Economica", March, pp. 1–58.

Domenico, S., Emiliano, C., Alina, C. (2009), *Human Capital and Openness to Foreign Trade: Evidence from the Enlarged Europe*, "Analele Universităţii Din Oradea", 7 (3), pp. 36–55.

Edoumiekumo, S.G., Opukri, C.O. (2013), *Economic growth factor in Nigeria: the role of global trade*, "American Journal of Humanities and Social Sciences", 1 (2), pp. 51–55. https://doi.org/10.11634/232907811301303

Engel, D., Procher, V., Schmidt, C. (2013), *Does firm heterogeneity affect foreign market entry and exit symmetrically? Empirical evidence from French firms*, "The Word Economy", 85 (1), pp. 37–47. https://doi.org/10.1016/j.jebo.2012.10.016

Eryigit, S.B., Dulgeroglu, E. (2015), *How to Measure the Level of Financial Development*, [in:] *Handbook of Research on Strategic Developments and Regulatory Practice in Global Finance*, IGI Global, United States, pp. 260–286. https://doi.org/10.4018/978-1-4666-7288-8.ch017

Evans, D., Green, C., Murinde, V. (2002), *Human capital and financial development in economic growth: New evidence using the Translog Production Function*, "International Journal of Finance and Economics", 7 (2), pp. 123–140. https://doi.org/10.1002/ijfe.182

Ezeoha, A.E., Cattaneo, N. (2012), *FDI flows to Sub-Saharan Africa: the impact of finance, institutions and natural resource endowment*, "Comparative Economic Studies", 54 (3), pp. 597–632. https://doi.org/10.1057/ces.2012.18

Fauceglia, D. (2015), *Credit constraints, firm exports and financial development: Evidence from developing countries*, "The Quarterly Review of Economics and Finance", 55 (February), pp. 53–66. https://doi.org/10.1016/j.qref.2014.08.003

Forlani, E. (2010), *Liquidity constraints and firm's export activity*, Centro Studi Luca d'Agliano Working Papers 291. https://doi.org/10.2139/ssrn.1646950

Gebrehiwot, G., Gebru, B. (2015), *Ethiopia's foreign trade potential: Inferences from a dynamic gravity approach*, "International Journal of Economics and Business Research", 9 (4), pp. 355–375. https://doi.org/10.1504/IJEBR.2015.069667

Ghanbari, A., Ahmadi, M. (2017), *The Effect of Innovation on Foreign trade: Selected Medium-High-Technology Industries, Evidence on Iran*, "Iranian Economic Review", 21 (1), pp. 21–44.

Gokmenoglu, K.K., Amin, M.Y., Taspinar, N. (2015), *The relationship among foreign trade, financial development and economic growth: the case of Pakistan*, "Procedia Economics and Finance", 25, pp. 489–496. https://doi.org/10.1016/S2212-5671(15)00761-3

Grossman, G.M., Helpman, E. (1991), *Trade, knowledge spill overs, and growth*, "European Economic Review", 35 (2–3), pp. 517–526. https://doi.org/10.1016/0014-2921(91)90153-A

Hakeem, M., Oluwatoyin, O. (2012), *Financial development and human capital in South Africa: a time-series approach*, "Research in Applied Economics", 4 (3), pp. 18–38. https://doi.org/10.5296/rae.v4i3.1498

Hanh, P.T.H. (2010), *Financial development, financial openness and trade openness: New evidence*, FIW working paper Number 60.

Haq, M., Luqman, M. (2014), *The contribution of foreign trade to economic growth through human capital accumulation: Evidence from nine Asian countries*, "Cogent Economics and Finance", 2 (1), 947000. https://doi.org/10.1080/23322039.2014.947000

Hassan, A.K., Islam, M.R. (2005), *Temporal causality and dynamics of financial development, trade openness, and economic growth in Vector Auto Regression (VAR) for Bangladesh, 1974–2003: Implication for poverty reduction*, "Journal of Nepalese Business Studies", 2 (1), pp. 1–12. https://doi.org/10.3126/jnbs.v2i1.50

Hur, J., Raj, M., Riyanto, Y.E. (2006), *Finance and trade: A cross-country empirical analysis on the impact of financial development and asset tangibility on foreign trade*, "World Development", 34 (10), pp. 1728–1741. https://doi.org/10.1016/j.worlddev.2006.02.003

Im, K.S., Pesaran, M.H., Shin, Y. (2003), *Testing unit roots in heterogeneous panels*, "Journal of Econometrics", 115 (1), pp. 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7

International Monetary Fund (2015), *World Economic Outlook: Adjusting to Lower Commodity Prices*, Washington (October).

Jafari, Y., Ismail, M.A., Kouhestani, M.S. (2011), *Determinants of trade flows and D8 countries: Evidence from the Gravity Model*, "Journal of Economic Cooperation and Development", 32 (3), pp. 21–38.

Kargbo, A.A., Ding, Y., Kargbo, M. (2016), *Financial development, human capital and economic growth: New evidence from Sierra Leone*, "Journal of Finance and Bank Management", 4 (1), pp. 49–67.

Kendall, J. (2007), *The importance of local finance and human capital in regional growth: The case of India*, University of California Santa Cruz, Job Market Paper.

Kiendrebeogo, Y. (2013), *How do banking crises affect bilateral exports?*, "Empirical Economics", 150, pp. 1–29. https://doi.org/10.5089/9781475576276.001

Kumarasamy, D., Singh, P. (2018), *Access to finance, financial development and firm ability to export: experience from Asia-Pacific countries*, "Asian Economic Journal", 32 (1), pp. 15–38. https://doi.org/10.1111/asej.12140

Leibovici, F. (2018), *Financial development and foreign trade*, Federal Reserve Bank of St. Louis, Working Paper 2018–015A. https://doi.org/10.20955/es.2018.13

Levin, A., Lin, C.F., Chu, C.S.J. (2002), *Unit root tests in panel data: Asymptotic and finite-sample properties*, "Journal of Econometrics", 108 (1), pp. 1–24. https://doi.org/10.1016/S0304-4076(01)00098-7

Lucas, R.E. (1988), *On the Mechanics of Economic Development*, "Journal of Monetary Economics", 22 (1), pp. 3–42. https://doi.org/10.1016/0304-3932(88)90168-7

Manova, K. (2013), *Credit constraints, heterogeneous firms, and foreign trade*, "Review of Economic Studies", 80 (1), pp. 711–744. https://doi.org/10.1093/restud/rds036

Mete, M., Bozgeyik, Y. (2017), *An Empirical Investigation on Determinants of Foreign Trade in Turkey*, "Expert Journal of Economics", 5 (1), pp. 27–37.

Minetti, R., Zhu, S. (2011), *Credit constraints and firm export: microeconomic evidence from Italy*, "Journal of International Economics", 83 (1), pp. 109–125. https://doi.org/10.1016/j.jinteco.2010.12.004

Muûls, M. (2012), *Exporters, importers and credit constraints. Centre for Economic Performance*, National Bank of Belgium Working Paper Number 139, October 2012.

Owen, A.L. (1999), *Foreign trade and the accumulation of human capital*, "Southern Economic Journal", 66 (1), pp. 61–81. https://doi.org/10.2307/1060835

Paravisini, D., Rappoport, V., Schnabel, P., Wolfenson, D. (2011), *Dissecting the effect of credit supply on trade: Evidence from matched credit-export data*, NBER Working Paper 16975. https://doi.org/10.3386/w16975

Patrick, H.T. (1966), *Financial development and economic growth in underdeveloped countries*, "Economic Development and Cultural Change", 14 (2), pp. 174–189. https://doi.org/10.1086/450153

Rajan, R., Zingales, L. (1998), *Financial dependence and growth*, "American Economic Review", 88 (3), pp. 559–586.

Rao, D.T., Mahale, K. (2011), *Growth in Exports of Services of India Exogenous Human Capital, Labor Market Infirmities and Complementing Foreign Capital*, "Transnational Corporations Review", 3 (3), pp. 106–123. https://doi.org/10.1080/19186444.2011.11658301

Samuelson, P.A. (2001), *A Ricardo-Sraffa paradigm comparing gains from trade in inputs and finished good*s, "Journal of Economic Literature", 39 (4), pp. 1204–1214. https://doi.org/10.1257/jel.39.4.1204

Schumpeter, J.A. (1934), *The Theory of Economic Development: An Inquiry FTo Profits, Capital, Credit, interest, and the Business Cycle*, Transaction Books, New Brunswick.

Sehrawat, M., Giri, A.K. (2014), *The relationship between financial development indicators and human development in India*, "International Journal of Social Economics", 41 (12), pp. 1194–1208. https://doi.org/10.1108/IJSE-11-2013-0268

Shahbaz, M., Rahman, M.M. (2014), *Exports, financial development and economic growth in Pakistan*, "International Journal of Development Issues", 13 (2), pp. 155–170. https://doi.org/10.1108/IJDI-09-2013-0065

Spulber, D.F. (2008), *Innovation and foreign trade in technology*, "Journal of Economic Theory", 138 (1), pp. 1–20. https://doi.org/10.1016/j.jet.2007.06.002

Stokey, N.L. (1991), *Human capital, product quality, and growth*, "The Quarterly Journal of Economics", 106 (1), pp. 587–616. https://doi.org/10.2307/2937948

Tsaurai, K. (2017), *Is foreign portfolio equity investment inspired growth hypothesis relevant in emerging markets?*, "Euro Economica", 36 (2), pp. 78–90.

Tsaurai, K. (2018), *Is the interaction between human capital and financial development one of the determinants of FDI in emerging markets?*, "International Journal of Education Economics and Development", 9 (1), pp. 24–37. https://doi.org/10.1504/IJEED.2018.10012161

Ukenna, S., Ijeoma, N., Anionwu, C., Olise, M. (2010), *Effect of Investment in Human Capital Development on Organisational Performance: Empirical Examination of the Perception of Small Business Owners in Nigeria*, "European Journal of Economics, Finance and Administrative Sciences", 1 (26), pp. 93–107.

Uzagalieva, A., Cukrowski, J. (2006), *Labor Market Flexibility, International Competitiveness and Patterns of Trade*, "International Economics", 59 (2), pp. 225–246.

Vaubourg, A.G. (2016), *Finance and foreign trade: A review of the literature*, "Revue d'économie politique", 126 (1), pp. 57–87. https://doi.org/10.3917/redp.261.0057

Waqas, M., Shaheen, S., Awan, M.S., Aslam, M.A. (2011), *Financial Development, Foreign trade and Economic Growth: Empirical Evidence from Pakistan*, MPRA Paper No. 32876. https://doi.org/10.2139/ssrn.1950013

Waugh, M.E. (2008), *Human capital, product quality, and bilateral trade*, Federal Reserve Bank of Minneapolis, Minnesota.
Yakubu, A.S., Aboagye, A.Q., Mensah, L., Bokpin, G.A. (2018), *Effect of financial development on foreign trade in Africa: Does measure of finance matter?*, "The Journal of Foreign Trade and Economic Development", 27 (8), pp. 917–936. https://doi.org/10.1080/09638199.2018.1474246
Zaman, K., Izhar, Z., Mushtag Khan, M., Ahmad, M. (2012), *The relationship between financial indicators and human development in Pakistan*, "Economic Modeling", 29 (5), pp. 1515–1523. https://doi.org/10.1016/j.econmod.2012.05.013

Streszczenie

Czy rozwój finansowy wpływa na rozwój handlu zagranicznego w wybranych gospodarkach przejściowych?

W opracowaniu zbadano wpływ rozwoju finansowego na handel zagraniczny w gospodarkach przejściowych z wykorzystaniem danych panelowych (dla lat 1994–2014). Chociaż dostępne są badania empiryczne dotyczące wpływu rozwoju finansowego na handel zagraniczny, żadne ze znanych autorom badań nie stanowiło próby zgłębienia tematu w odniesieniu do gospodarek przejściowych. Nie podjęto próby zbadania, czy rozwój kapitału ludzkiego jest kanałem, poprzez który rozwój finansowy wpływa na handel zagraniczny lub handel międzynarodowy. W przypadku podejścia opartego o efekty stałe stwierdzono, że rozwój finansowy nie ma istotnego pozytywnego wpływu na handel zagraniczny, podczas gdy podejście oparte o efekty losowe wskazuje na istotną pozytywną zależność między rozwojem finansowym a handlem zagranicznym. Ustalenia te są zbieżne z większością literatury przedmiotu. Jednakże, metoda pooled OLS wskazuje, że rozwój finansowy miał znaczący negatywny wpływ na handel zagraniczny.

Zarówno w przypadku podejścia opartego o efekty stałe, jak i losowe, rozwój kapitału ludzkiego okazał się kanałem, przez który rozwój finansowy miał istotny pozytywny wpływ na handel zagraniczny. Wyniki ten są zgodne z argumentacją Patricka (1966), że handel zagraniczny jest napędzany przez wysoki poziom kapitału ludzkiego i rozwoju finansowego. Z badania wynika, że władze państw przejściowych powinny opracować i wdrożyć politykę rozwoju kapitału ludzkiego, tak aby rozwój finansowy miał znaczący pozytywny wpływ na handel zagraniczny. W przeciwieństwie do dostępnej literatury, niniejsze badanie wykazało, że rozwój kapitału ludzkiego miał znaczący negatywny wpływ na handel zagraniczny przy zastosowaniu podejścia OLS. Przyszłe badania na ten temat powinny uwzględniać kwestie związane z endogennością i dynamicznym charakterem danych dotyczących handlu zagranicznego.

Słowa kluczowe: rozwój finansowy, handel zagraniczny, gospodarki przejściowe, dane panelowe

JEL: G15, J24, P45, P2

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.29

Tracing the Spatial Patterns of Innovation Determinants in Regional Economic Performance

Alicja Olejnik
Department of Spatial Econometrics, Institute of Spatial Economy
Faculty of Economics and Sociology, University of Lodz, Poland
e-mail: alicja.olejnik@uni.lodz.pl

Agata Żółtaszek
Department of Spatial Econometrics, Institute of Spatial Economy
Faculty of Economics and Sociology, University of Lodz, Poland
e-mail: agata.zoltaszek@uni.lodz.pl

Abstract

In this paper, we investigate innovation factors and their role in regional economic performance for a sample of 261 EU NUTS 2 regions over the period 2009–2012. In our study, we identify regions with spillover as well as drain effects of innovation factors on economic performance. The spatial analysis indicates that both regional innovativeness and regional development are strongly determined by the region's location and "neighbourhood", with severe consequences for Central and Eastern Europe. We assessed the impact of innovation factors and their spatial counterparts on economic performance using a spatial Durbin panel model. The model is designed to test the existence and strength of the country-effect of innovativeness on the level of regional economic status. This allows for controlling the country-specific socio-economic factors, without reducing the number of degrees of freedom. Our model shows that regions benefit economically from their locational spillovers in terms of social capital. However, the decomposition of R&D expenditures revealed competition effect between internal R&D and external technology acquisition, favouring in-house over outsourced research.

Keywords: regional innovation, patterns of innovation, spatial spillover, common factors, spatial panel econometric model

JEL: O30, O33, C21, C23, R12

Introduction

Recognising patterns of innovation is essential for designing and implementing policies that can help stimulate long-term output growth, improve productivity, as well as create jobs. Recognising innovation indicators is especially important at a regional level as it makes it possible to compare local innovation performance and its influence on the local economic development. Such evidence is undoubtedly vital for proper policymaking. However, the evolution of new technologies and ideas is not merely confined to regional administrative borders. A company in a given location can benefit from research conducted at a nearby university, as well as projects developed by companies located in nearby regions. By contrast, it would be more difficult for an individual firm to benefit from the innovative results of even the most dynamic region should it be geographically distant. Nevertheless, each year, the number of innovations carried out through collaborative networks is rising (c.f. *Global Innovation Index 2016,* as well as the *2017, 2018* and *2019 reports*).

The Regional Innovation Scoreboard (RIS 2016; 2017; 2019) is an insightful analysis of innovation performance in European regions. RIS 2016[1] is a study that considers the strengths and weaknesses of the regional innovation performance based on a number of indicators. These indicators include variables on Research and Development (R&D) expenditure, patents, entrepreneurship, innovation collaboration, and the spread of innovative products.

Figure 1 presents RIS 2016 with four performance groups ranging from Innovation Leaders to Modest Innovators. We have 36 regions of Regional Innovation Leaders, 65 regional Strong Innovators, 83 regional Moderate Innovators, and 30 regional Modest Innovators. The Regional Innovation Leaders are located mainly in Sweden, Denmark, Finland, Germany, the Netherlands, the UK, and Île de France in France. Strong Innovators are regions located in Germany, Austria, Belgium, the Netherlands, the UK, France, Norway, Italy, País Vasco in Spain, and Bratislavský kraj in Slovakia. Countries with moderate innovating regions are situated mainly in the South (Portugal, Spain, Italy, Greece) as well as in the Central and Eastern EU states (Czech Republic, Slovakia, Hungary, Lithuania, Latvia, Estonia, Croatia, Poland, and Vzhodna Slovenijain in Slovenia), with additional locations, outliers in their own countries: Weser-Emsin Germany, Bassin Parisien, Nord-Pas-de-Calais, and Départements d'outre-mer in France. Finally, regional Modest Innovators are found in Romania, Bulgaria, Poland, some Greek, Italian, and Spanish islands, and Extremadura in Spain.

Overall, regions in Central and Eastern EU states and Sothern Europe have predominantly performed poorly in the assessment of innovativeness. Moreover, there are no Innovation Leaders and almost no Strong Innovators within the borders of these countries. This hinders any learning-from-the-best policies or spillover effects, and

1 Though the RIS 2017 and 2019 reports were published more recently, we refer to the 2016 study, as it is more appropriate for our data base.

it slows the pace of the innovativeness and regional development in notable parts of Europe.

According to the RIS 2016 report, regional performance corresponds to the European Innovation Scoreboard (EIS 2016) country performance groups. As stated in the RIS report: "Almost all of the regional Innovation Leaders and Strong Innovators are located in the EIS Innovation Leader and Strong Innovator countries. Most of the regional Moderate and Modest Innovators are found in the EIS Moderate and Modest Innovator countries." Therefore, this might suggest the existence of a strong country-specific factor.

Tracing the patterns of innovation is a valid topic, which has been widely studied in the literature for years. However, it is noteworthy that the regional aspect had not been studied much until the seminal work of Jaffe (1989). In his work, a version of Griliches' (1979, pp. 92–116) Knowledge Production Function was applied at a regional level. Since publication, this paper has served as an example for various studies, such as Anselin et al. (1997, pp. 422–448), Crescenzi et al. (2007, pp. 673–709) Cabrer Borrás & Serrano-Domingo (2007, pp. 1357–1371), and Gonçalves & Almeida (2009, pp. 513–528). They all conclude that the proximity to highly innovative regions has a positive impact on their neighbours' development.

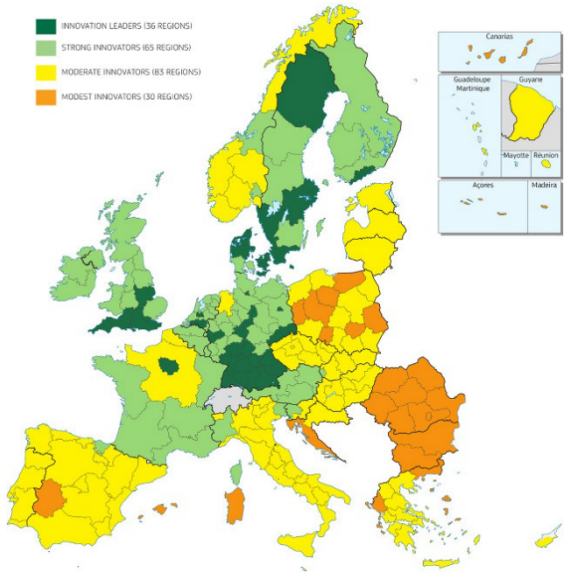

Figure 1. Regional Innovation Scoreboard 2016
Source: *European Innovation Scoreboard 2016*.

Intangible or knowledge-based capital has been widely recognised as an essential driver of innovation, growth, and competitiveness in advanced economies (c.f. Corrado et al. 2009, pp. 661–685; Corrado et al. 2017). There are several works which stress a significant correlation between social capital and economic growth. All social

structures, and in particular, social networks, are essential factors for the economic outcome, on account of the decrease in information costs and the reduction of information asymmetries (Granovetter 2005, pp. 33–50). Caragliu and Nijkamp (2012, pp. 1363–1374) argue that insufficient levels of cognitive capital (that is social capital, which accounts for cognitive skills like norms, customs, and psychological dispositions towards socio-economic interactions) can hinder European regions from fully benefitting from newly produced knowledge.

In this paper, we aim to identify knowledge-based innovation factors that determine regional economic performance, and we will determine for which factors the complementary or competitive effect can be found. Moreover, as innovation is expected to occur in (regional) spatial patterns, we aim to test whether there are any common, national-specific factors. Implementing the country-specific effect (alternative to the standard regional fixed effects) constitutes an important value added to the regional studies. We developed and applied our own novel procedure to specify and estimate these country-specific effects in a spatial panel model.

In order to achieve this goal, first, we aim to identify regions and their clusters that share a similar level of innovativeness and their relation to regional development using spatial statistics. Then, as the central part of our analysis, we introduce a modified econometric spatial panel model to verify the innovation-based determinants of regional growth. Throughout the study, we focus on the regions of Central and Eastern Europe (CEE).

The rest of the paper is structured as follows. Section 2 describes the variables and data used in the empirical part of the analysis. Section 3 provides a brief theoretical background of uni- and bivariate Moran's *I* statistics as well as a presentation of the Durbin's Spatial Autoregressive Panel Model with spatial fixed effects used in the empirical part of the paper. The results of the analysis and the discussion are presented in Section 4. Section 5 offers a summary and some closing remarks.

Determinants and data

In our study, in line with the RIS report, we have selected innovative determinants of regional economic performance, namely high-tech employment and patent applications, which represent social capital and R&D investments. The data used in the study are taken from the Eurostat Regional Database. Some missing data were interpolated from past trends and data derived from NUTS 1 and NUTS 0 levels. We considered 261 EU regions from 27 countries from 2009 to 2012. For the description of the spatial structure for the EU regions, we used the three nearest neighbours (3nn) spatial weights matrix W (c.f. Anselien 1998).

To account for both the spatial and temporal aspects of our study, the dataset we employed requires not only contiguity of regions – to apply a spatial matrix – but also continuity in the time dimension. In turn, to obtain a balanced panel dataset for the

maximal range of periods, due to the number of unavailable values at the time of the databank creation, we have decided to apply the earlier NUTS 2006 classification system (used between 2006 and 2011), with the converted values available for 2012. Further changes in the NUTS classification made it impossible to extend the panel. Consistent with RIS (2019), it is expected that the general spatial pattern found in the study would not change for an extended dataset.

While the data on tertiary education give valuable information on the prospective highly-qualified labour force in Europe, the indicator of employment in technology and knowledge-intensive sectors provides exact knowledge on the proportion of people actually working in technological and knowledge-intensive fields. Therefore, we used specifically this indicator as one of the critical factors of innovation. In our study, employment in technology and knowledge-intensive sectors (H) refers to the share of employees in technology and knowledge-intensive sectors of the total number of the economically active population. Human capital in nearby locations is described by its spatial lag (WH).

In our study, we use patent applications to the European Patent Office (EPO) as the other important element of social capital. However, we are aware that the intensity of patenting may vary depending on the sector or the characteristics of companies. Moreover, not all inventions are patented, patent values are different, and finally, not all patents lead to significant technological improvements. However, since all EU countries have national patent systems, and the data covers most technological fields, patents are often used as indicators of innovation. In this work, patents are represented by patent applications to the EPO by priority year per million of active population (EPO). Patent applications in neighbouring regions are defined by its spatial lag (WEPO).

Research and experimental development comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications (Frascati, 2002). The intensity of research and experimental development (research and experimental development expenditures as a percentage of GDP) is an indicator of the high political importance at the EU, national and regional levels. Therefore, we use R&D expenditures as one of the critical indicators of innovation. In our study, the variable R&Dexp represents the total intramural R&D expenditures, approximated by the gross domestic expenditure on R&D (GRED) in purchasing power standard (PPS) (constant prices 2000) per economically active population. R&D expenditures in neighbouring regions are represented by its spatial lag (WR&Dexp).

As a measure of regional performance, we take local gross domestic product per economically active population (expressed in thousands of people at the age of 15 and over), which has been converted into a common scale using purchasing power standard PPS (in millions), and expressed in constant prices from the year 2000. GDP in bordering regions is described by its spatial lag (WGDP).

The distributions of variables used in the study in the last year of analysis – 2012 – are presented in Figure 2. All the variables are expressed in logarithms. Table 1 offers the descriptive statistics of the variables.

Table 1. Descriptive statistics of variables used in the analysis

Variable	Description	Mean	σ	Min	Max
GDP	Regional GDP in Millions (PPS, cs 2000) per thousand of economically active population	43.9	22.2	3.8	178.6
R&Dexp	Total intramural R&D expenditure (GERD) (PPS, cs 2000) per economically active population	764.3	782.7	11.3	6697.8
H	Employment in technology and knowledge-intensive sectors per economically active population	0.9	0.1	0.6	1.2
EPO	Patent applications to the EPO by priority year per million of economically active population	199.0	231.2	0.0	1399.2

Source: own study based on Eurostat data (https://ec.europa.eu/eurostat/web/regions/data/database) done in Matlab (accessed: 18.06.2019).

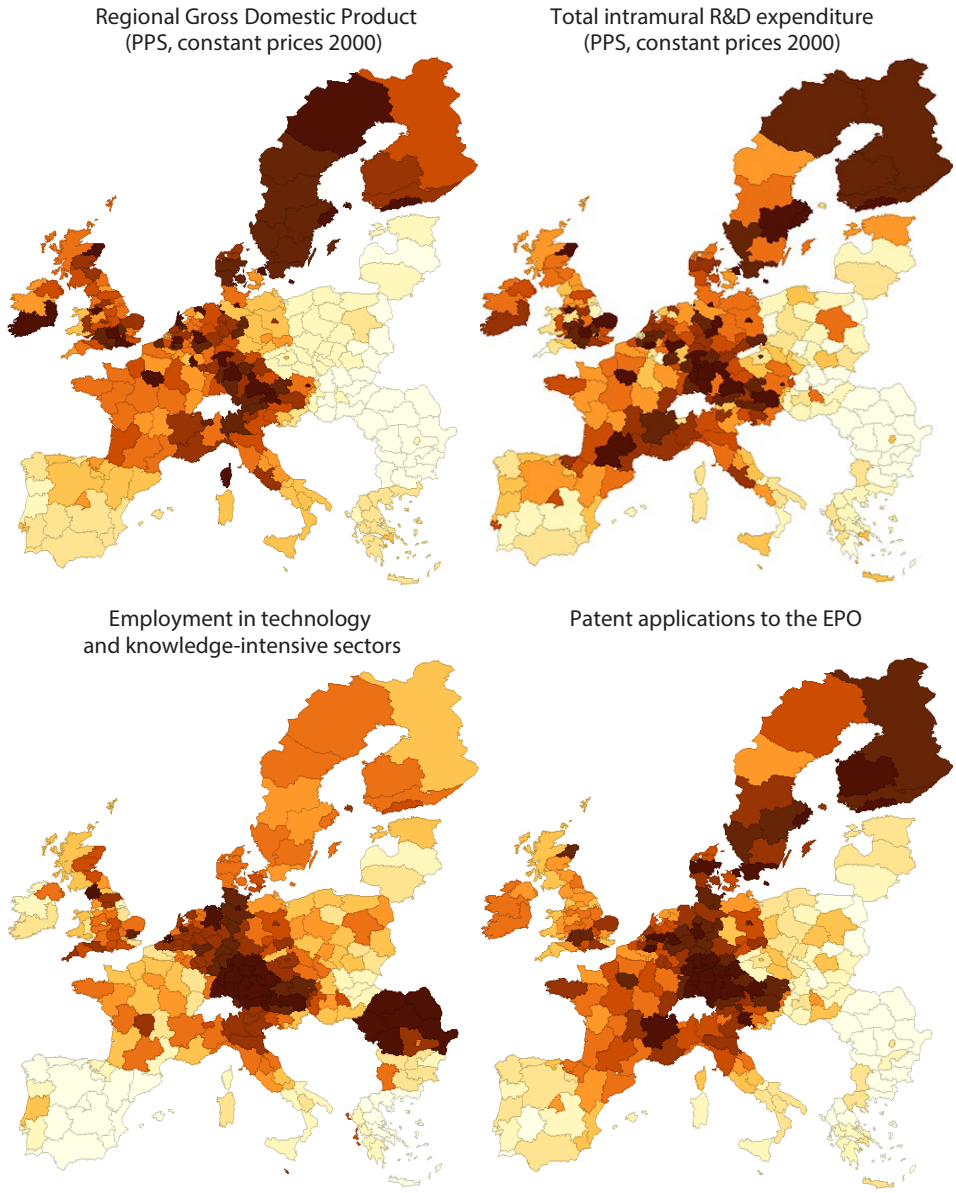

Figure 2. Variables used in the analysis, 2012
Source: own study based on Eurostat data (https://ec.europa.eu/eurostat/web/regions/data/database) done in GeoDa. (Shading of each variable is a quantile (10); the higher the value, the darker the colour) (accessed: 18.06.2019).

Theoretical background

One of the most basic tools of spatial analysis is Moran's I statistic (Moran 1948, pp. 243–251; Cliff and Ord 1981). We distinguish two basic types of Moran's I statistics: local and global. As a measure of local spatial association, the local Moran's I_i indicates if the i-th spatial object is surrounded by other spatial objects with similar (positive spatial autocorrelation) or significantly different (negative spatial autocorrelation) values of the variable in question

$$I_i = \frac{\left(x_i - \overline{x}\right)}{\frac{1}{N}\sum_{i=1}^{N}\left(x_i - \overline{x}\right)^2}\sum_{j=1}^{N} w_{ij}\left(x_j - \overline{x}\right), \tag{1}$$

where x_i represents the variable in question, $\overline{x}$ its mean and w_{ij} represents elements of spatial weight matrix W. On the other hand, the global Moran's I statistic is a more general measure of regional association as it expresses the likeness of all spatial objects as a mean of the local Moran's I_i statistics

$$I = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}\left(x_i - \overline{x}\right)\left(x_j - \overline{x}\right)}{\frac{1}{N}\sum_{i=1}^{N}\left(x_i - \overline{x}\right)^2}. \tag{2}$$

While both local and global Moran's *I* aim to measure the similarities and dissimilarities between one spatial variable, the bivariate local Moran's I explains the spatial pattern formed by two different variables. That is, it measures spatial autocorrelation between variable x and another variable (y) in nearby areas

$$I_i = \frac{\left(x_i - \overline{x}\right)}{\frac{1}{N}\sum_{j=1}^{N}\left(x_j - \overline{x}\right)^2}\sum_{j=1}^{N} w_{ij}\left(y_j - \overline{y}\right), \tag{3}$$

with analogous notation.

The generalisation of the cross-sectional spatial autoregressive (SAR) model (Ord 1975, pp. 120–127; Kelejian and Prucha 1998, pp. 99–121, and 2010, pp. 53–67) to the panel setting has been very popular in the literature. In addition to the spatial lag of the dependent variable, a spatial lag of independent variables can be included in the regression, which leads to the so-called spatial Durbin model (see, e.g., LeSage and Pace 2009). The identification of the spatial Durbin panel model concerns the effect of the spatial lags of the dependent variable in the presence of spatial time lags and exogenous spatial variables (Anselin et al. 2008, pp. 627–662; Elhorst 2014). This approach is a beneficial and flexible instrument in the process of specifying the econometric model, as it can incorporate the spatial lags of the exogenous variables on the right-hand side of the equation. In order to introduce some notation used in the study, we present a theoretical formula for the spatial Durbin panel model with spatial fixed effects

$$\mathbf{y} = \rho\mathbf{W}\mathbf{y} + \mathbf{X}\beta + \mathbf{W}\mathbf{X}\gamma + \vartheta,\ \vartheta = \left[\mu_i + \varepsilon_{it}\right]_{it}, \varepsilon_{it} \sim N\left(0, \sigma^2\right), \tag{4}$$

where y (NT×1) is a vector of observations on the dependent variable and X (NT×K) represents a matrix of observations on K independent variables, W is a pre-defined spatial weight matrix representing the spatial structure of observations, WX is a matrix of spatial lags of the independent variables, $\mathbf{Wy}$ spatially lagged vector dependent variable, ρ is a spatial coefficient. Parameter ε_{it} is a vector of random errors, and μ_i represent spatial fixed effects, where $1 \le i \le \mathrm{N}$ and $1 \le t \le \mathrm{T}$.

In order to account for the role of country-specific effect, among others, we tested the spatial Durbin panel model with spatial group effects. In this newly developed spatial group effects model, instead of spatial fixed effects term μ_i, we introduce the term $\varphi_{group(i)}, 1 \le group(i) \le \mathrm{K}, 1 \le i \le \mathrm{N}$, where K represents the number of groups (Olejnik and Olejnik 2020).

$$\mathbf{y} = \rho\mathbf{W}\mathbf{y} + \mathbf{X}\beta + \mathbf{W}\mathbf{X}\gamma + \vartheta,\ \vartheta = \left[\varphi_{group(i)} + \varepsilon_{it}\right]_{it}, \varepsilon_{it} \sim N\left(0, \sigma^2\right), \tag{5}$$

Notice that the spatial group fixed effects can be tested using a two-step procedure based on the augmented CD-test (c.f. Elhorst et al. 2018; Olejnik and Olejnik 2020).

Results and discussion

We start our analysis by focusing on individual regions and identifying clusters that share a similar level of innovativeness using univariate spatial statistics. This enables the identification of spillover effects for individual regions via hot and cold spots, as well as drain effects pinpointed by mixed clusters (hot-cold or cold-hot). In the second step, we confront the chosen innovation factors with the level of regional development by employing the bivariate Moran's measure to highlight individual regions for which high/low levels of innovation factors in nearby locations coincide with high/low GDP.

Finally, we expand the spectrum of the analysis to search for more general mechanisms and regularities in the determinants of innovation factors. We aim to assess the statistical significance of each factor by incorporating a multivariable causality spatial Durbin panel model of economic performance determined by selected indicators of regional innovativeness and their spatial counterparts. Moreover, the model is designed to test the existence and strength of the country-effect of innovativeness on the level of regional economic status.

Below, local univariate and bivariate have been performed for 250 regions (as 11 regions have been defined as neighbour-less). Figures 3 and 4 report results from a univariate LISA analysis for the first (2009) and the final year of the study (2012). Figures 5 and 6 provide the results from bivariate LISA (2009 and 2012, respectively).

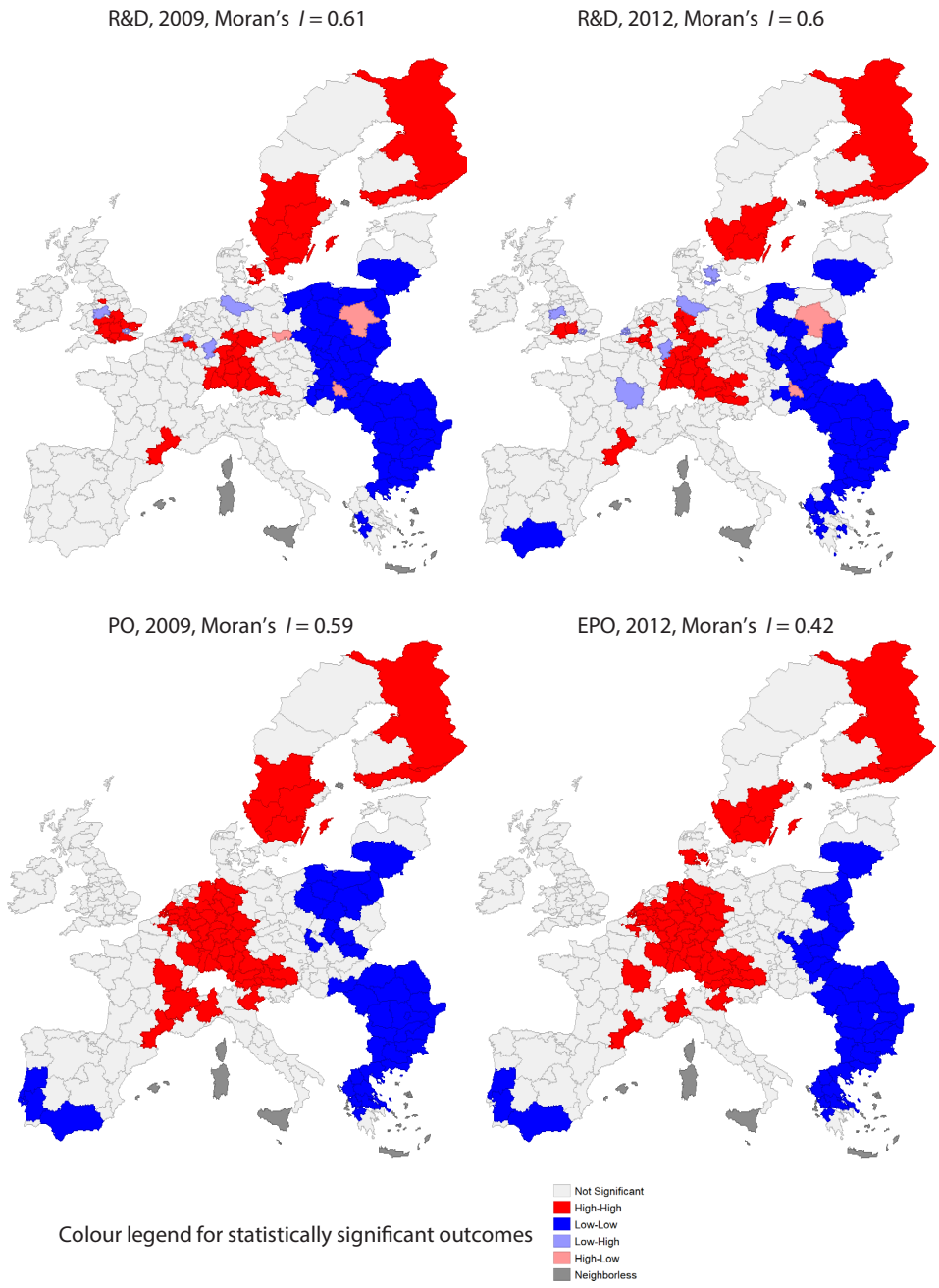

Figure 3. Univariate Local Moran's *I* for R&D and EPO, 2009 and 2012
Source: own study based on *Eurostat Regional Database* done in GeoDa.

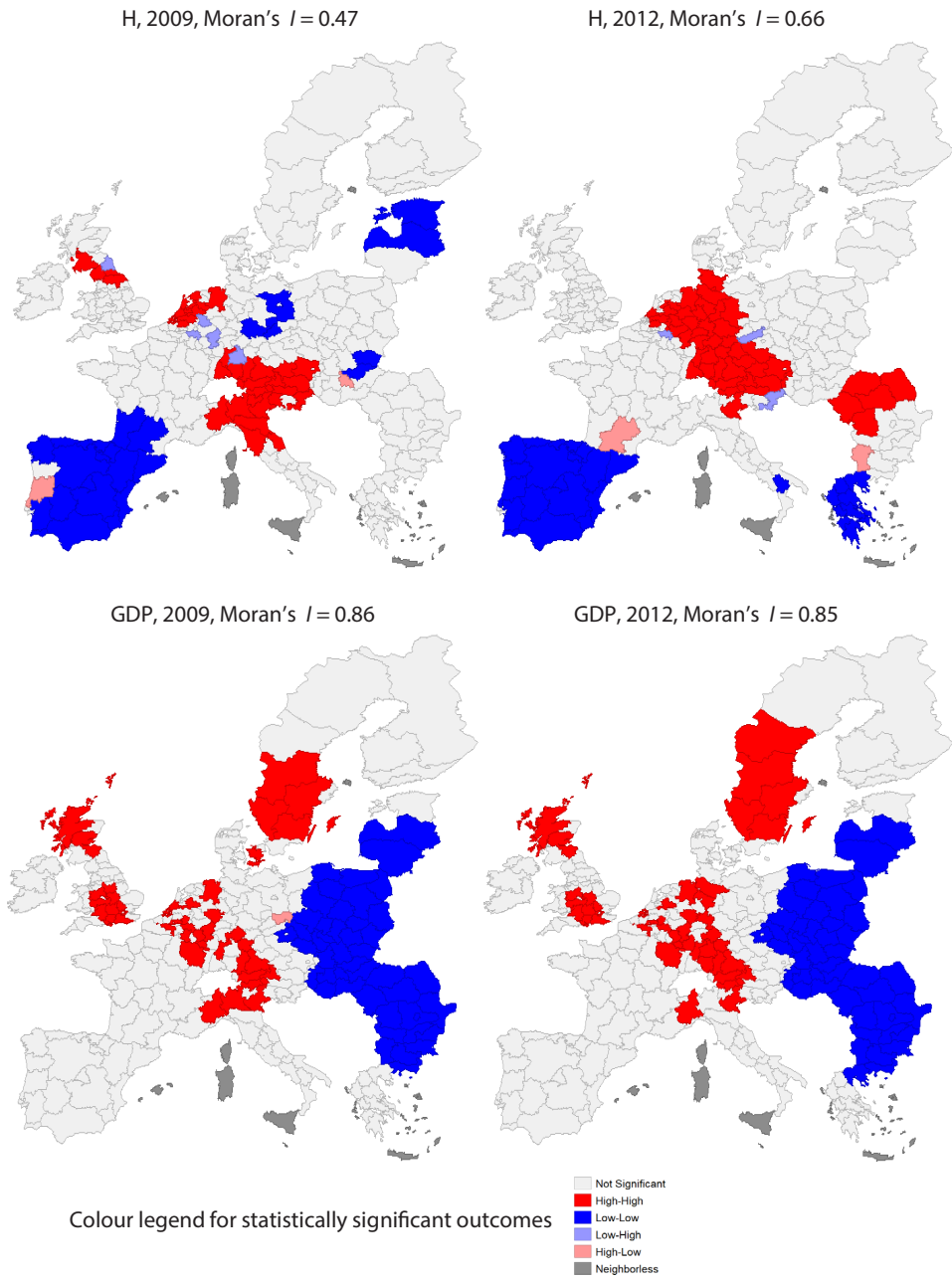

Figure 4. Univariate Local Moran's *I* for H and GDP, 2009 and 2012
Source: own study based on *Eurostat Regional Database* done in GeoDa.

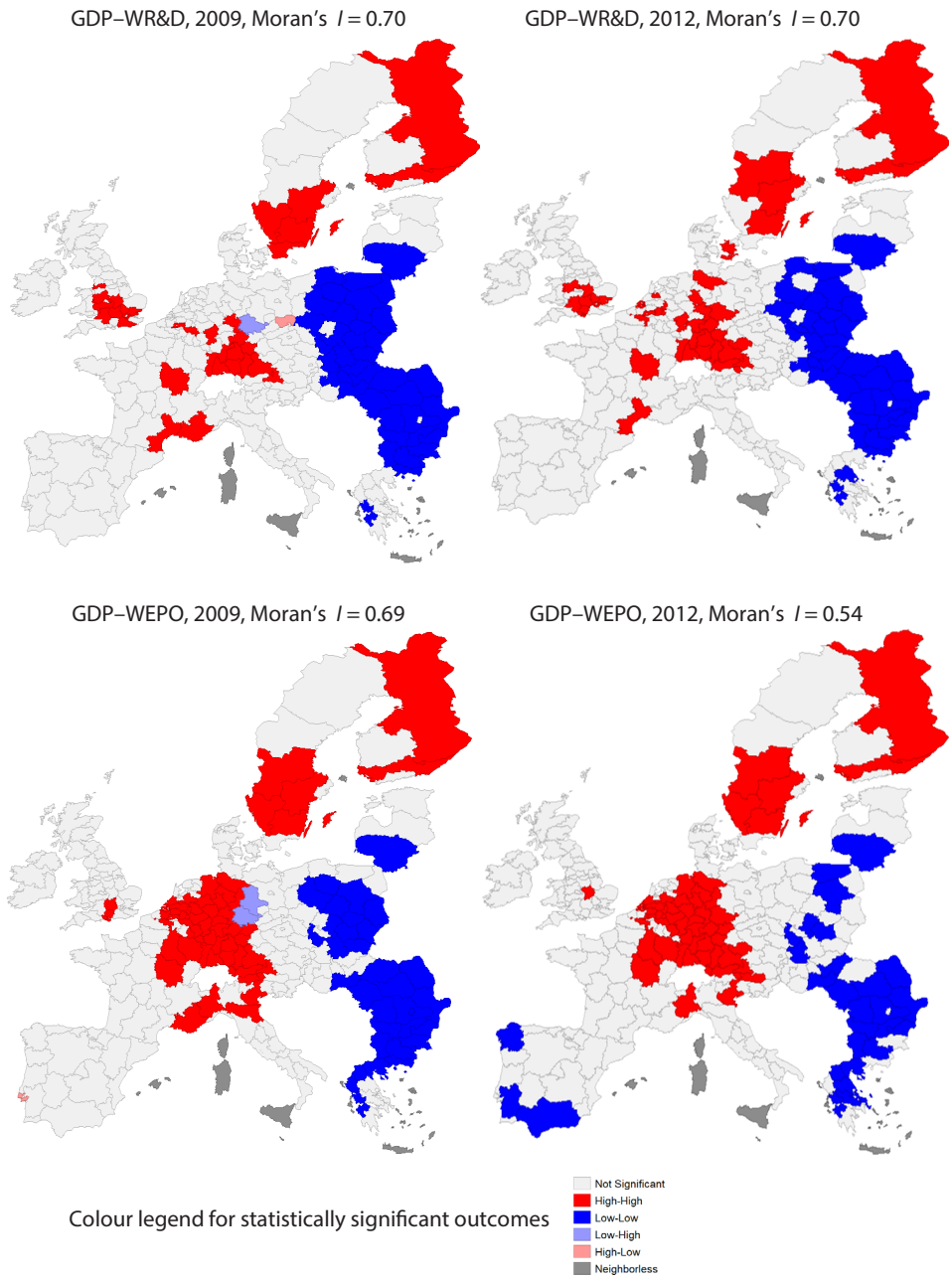

Figure 5. Bivariate Local Moran's *I*, for GDP with W*R&D* and W*EPO*
Source: own study based on *Eurostat Regional Database* done in GeoDa.

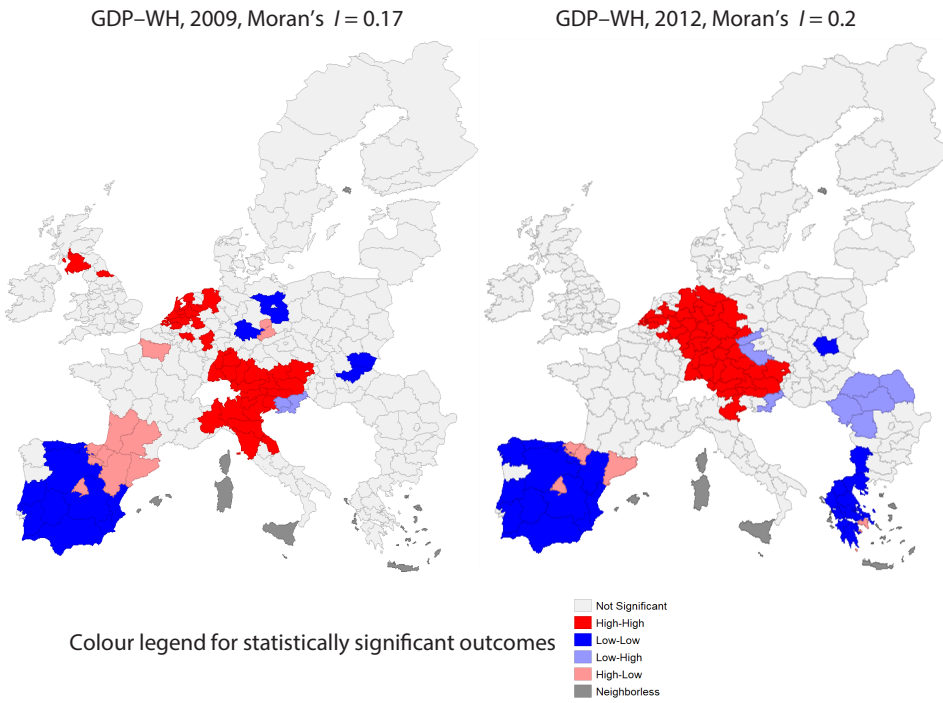

Figure 6. Bivariate Local Moran's *I*, for GDP with W*H*
Source: own study based on *Eurostat Regional Database* done in GeoDa.

The spatial autocorrelation for the total intramural R&D expenditures is high, with Moran's $I = 0.6$. From the maps, we can observe 33 clusters of regions with high R&D expenses surrounded by regions also with high expenditures (high-high, hot-spots) in Finland, Southern Sweden, Germany, a few regions in the UK, Alsace and Tarn in France, Liège in Belgium, Luxembourg, Sjælland in Denmark, and Salzburg in Austria. Due to low values of R&D expenditures in the whole CEE region (see Figure 2), we have 41 low-low clusters (cold-spots or regions with low R&D expenses bordering areas with similarly low expenditures) located mainly in the Eastern part of the EU. The spatial pattern seems to be similar for 2009 and 2012, except for Andalusia in Spain and Greece, where new cold-spots emerged, the UK, where a few hot-spots disappeared, some regions of Poland, where a few cold-spots disappeared, and Germany, where some new hot-spots appeared.

The spatial autocorrelation for patent applications to the EPO by priority year per million of active population is high, with Moran's $I = 0.6$, in 2009 and $I = 0.4$ in 2012. From the maps in Figure 3, one can observe clusters of regions with a high number of patent applications surrounded by regions also with a high number of patent applications (high-high cluster, hot-spots) in Finland, Southern Sweden, Germany, France (Lorraine, Alsace, and Burgundy), Belgium (Namur, Hainaut, Flemish Brabant, Antwerp, Limburg, Liège), the Netherlands (Gelderland, South Holland, North

Brabant, and Limburg), Southern Denmark, Piemonte and Veneto in Italy, and Austria. Cold-spots are located mainly in Portugal and southern Spain, as well as in the Eastern part of the EU, which corresponds with the low numbers of patent applications submitted to the EPO from the CEE regions (Figure 2).

The spatial autocorrelation of employment in technology and knowledge-intensive sectors per economically active population is high, with Moran's $I = 0.5$, in 2009 and $I = 0.7$ in 2012. In contrast to the earlier indicators, the difference between 2009 and 2012 is noticeable. From the maps in Figure 4, we can observe clusters of regions with high employment surrounded by regions with similarly high employment (high-high) in Namur, Hainaut, Flemish Brabant, Antwerp, Limburg, Liège in Belgium, Eastern Netherlands and North Brabant in the Netherlands. The Northern part of Italy, South West Scotland, North Yorkshire, Tees Valley, and Durham in the UK were in high-high clusters only in 2009. On the other hand, one can observe an additional hot-spot in Romania, and some new hot-spots in Germany, Austria and Benelux. At the same time, we have disappearing cold-spots in Latvia, Estonia and Germany, and even a change from cold- to hot-spot in Thüringen (Germany) over time. Overall, by 2012, the number of hot-spots had increased from 36 to 52, and the number of cold-spots had remained stable; however, it had concentrated mainly in the Iberian Peninsula and Greece.

The spatial autocorrelation of GDP per active population is very high (Moran's $I = 0.86$, in 2009 and $I = 0.85$ in 2012) with a very similar spatial pattern for both years. From the maps in Figure 4, we can observe hot-spots mainly in Southern Sweden, Scotland, Midlands and the South East of the UK, Northern Italy, Austria, some regions in Germany, Belgium, and the Netherlands. Regions with a low GDP surrounded by regions with a similar level of GDP (low-low) clusters in the Eastern part of the EU. The low-GDP cluster dominates almost the whole CEE region for the whole analysed period 2009–2012, with the notable exception of Estonia.

Overall, the values of GDP, R&D expenditures, and patent applications to the EPO at the regional level for CEE states are significantly lower than in the rest of the EU. This results in the widespread and significant cold-spots. Hot-spots are more typical for Western and Northern Europe; however, they appear in much smaller clusters. Only in the case of human capital do the Central and Eastern regions not exhibit any clear spatial patterns (except for a hot-spot in Romania in 2012).

The spatial clustering of individual indicators of innovativeness aligns with most RIS conclusions. Moreover, we do observe the spillover effect from Innovation Leaders to Followers.

For R&D expenditures and patents, we see that South and East Middle Sweden, as well as Stockholm, are indeed Innovation Leaders and the spillover effect can be seen for Småland and the islands. Similarly, in Finland, spillover occurs from Innovation Leaders (Lapland and Helsinki-Uusimaa) to eastern regions, which are Innovation Followers. In the United Kingdom, Innovation Followers like Gloucestershire, Wilt-

shire, and the Bristol/Bath area mainly benefit from Innovation Leaders: Berkshire, Buckinghamshire, Oxfordshire, Surrey, and East and West Sussex.

In the case of employment in technology and knowledge-intensive sectors, the spatial clustering analysis only partially coincides with RIS innovators classification. The only spilling-over from Innovation Leaders can be seen in Germany, the Netherlands, and Austria. Additionally, human capital is spilling-over from Moderate Innovators in northern Italy.

In our analysis, it is noteworthy that we do not observe any significant impact of Moderate Innovators on neighbouring regions. This is especially visible in the eastern part of the EU.

Figures 5 and 6 present results from the bivariate LISA analysis for the years 2009 and 2012 for all three innovation factors with a regional GDP.

The spatial association between the regional GDP and the total intramural R&D expenditures in neighbouring regions is high, with Moran's $I = 0.7$. From the map, we can observe clusters of regions with a high GDP surrounded by regions with high R&D expenditures in Finland, Sweden, Germany, the UK, France, the Netherlands, Belgium, Denmark, and Austria. On the other hand, we also have clusters of regions with a low GDP border as well as low R&D expenditures in the Eastern part of the EU.

Additionally, the spatial association between regional GDP and patent applications to the EPO in bordering regions is high, with Moran's $I = 0.69$ in 2009, and $I = 0.54$ in 2012. Moreover, local clusters of regions with a high GDP surrounded by regions with a high number of patent applications are visible in regions of Finland, Sweden, Germany, France, the Netherlands, Belgium, Italy, Austria, and the UK. We also have clusters of regions with low GDP adjacent to regions with a low number of patent applications in Greece, Bulgaria, Romania, Poland, Lithuania, Hungary, and additionally Portugal and Spain in 2012.

From Figure 6, it is clear that the global spatial autocorrelation between regional GDP and employment in professional sectors in neighbouring regions is low, with Moran's $I = 0.2$. However, one can observe local clusters of regions with a high GDP surrounded by regions with high employment in R&D in Germany, the Netherlands, Belgium, and Austria. Additionally, there are also clusters of regions with a low GDP bordering low R&D employment in Portugal and Spain, and in 2012, in Greece and Malopolskie in Poland.

The bivariate analysis confirmed that for CEE regions, low GDP corresponds with low R&D expenditures and a low number of EPO applications. On the other hand, hot-spots are observed in Western and Northern Europe. Combining the results from the bi- and univariate analysis, it becomes apparent that the EU is divided in terms of innovation. Higher values and high-high clusters appear in the West and the North, while cold-spots and lower values are observed in the Central and Eastern parts, as well the Iberian Peninsula (Figures 2–6)

Recognising the spatial heterogeneity of both the innovation potential and the regional development, we turn to econometric tools to identify any general patterns con-

necting the GDP level with the indicators of innovation. In the central part of our analysis, to investigate whether the influence of innovation factors in neighbouring regions stimulate economic performance within the region, we performed a spatial Durbin panel model with random and fixed effects ($\varphi_{group(i)} + \varepsilon_{it}$). To this end, we consider the following specification

$$\begin{aligned} GDP_{it} = \rho \mathbf{W} GDP_{it} + \gamma_1 \mathbf{W} H_{it} + \gamma_2 \mathbf{W} EPO_{it} + \gamma_3 \mathbf{W} R\,\&\,Dexp_{it} + \\ + \beta_1 H_{it} + \beta_2 EPO_{it} + \beta_3 R\,\&\,Dexp_{it} + \varphi_{group(i)} + \varepsilon_{it}, \end{aligned} \tag{6}$$

where GDP_{it} represents GDP in the *i*-th region and year *t* (PPS; constant prices of 2000), H_{it} – employment in technology and knowledge-intensive sectors per economically active population in the *i*-th region and year *t*, EPO_{it} – patent applications to the EPO by priority year per million of active population in the *i*-th region and year *t*, $R\,\&\,Dexp_{it}$ – total intramural R&D expenditure (GERD) (PPS; constant prices of 2000) per economically active population, $\mathbf{W}GDP_{it}$ indicates the mean of GDP in neighbouring (in the sense of 3nn weight matrix) regions in year *t*. The variables $\mathbf{W}H_{it}$, $\mathbf{W}EPO_{it}$, $\mathbf{W}R\,\&\,Dexp_{it}$ are defined analogously.

The preliminary results from ML procedures indicated that the level of human capital, as well as patent applications within the given region, does not have a significant or direct impact on economic performance. Their spatial counterparts, however, do.

The final model takes the following form

$$\begin{aligned} GDP_{it} = \rho \mathbf{W} GDP_{it} + \gamma_1 \mathbf{W} H_{it} + \gamma_2 \mathbf{W} EPO_{it} + \gamma_3 \mathbf{W} R\,\&\,Dexp_{it} + \\ + \beta_3 R\,\&\,Dexp_{it} + \varphi_{country(i)} + \varepsilon_{it}. \end{aligned} \tag{7}$$

Parameter $\varphi_{country(i)}$ represents spatial effects common for each country (country-specific fixed effect), where $1 \le country(i) \le 27, 1 \le i \le 261$, as the sample consists of 261 regions for 27 countries, and therefore we introduce 27 spatial-fixed effects into the model. In our study, we considered both country-specific and regional fixed effect specifications. However, we found that incorporating the country-specific fixed effects considerably improved the goodness of fit of the model. At the same time, further extending the usual regional fixed effect specification provided virtually no improvement. This implies that employing the country-specific effects made it possible to control the country-specific socio-economic factors, without reducing the number of degrees of freedom too much.

Table 2 presents the estimation results. All coefficients associated with the explanatory variables of the model appear significant at the 5% confidence level, which suggests that the chosen set of innovation factors significantly explain economic performance in the EU regions. Most importantly, the significance of the spatial coefficient and the spatial lags of the explanatory variables confirms the assumed complex structure

of the interregional interactions of innovation factors. Furthermore, the value of goodness of fit (0.94) suggests a good adjustment of the model to the empirical data.

Table 2. Spatial Durbin panel model with country-fixed effects

Variable	Estimates	Var	t-value	p-value
Rho	0.146	0.036	4.071	<0.00001
W *H*	0.817	0.166	4.918	<0.00001
W *EPO*	0.021	0.009	2.263	0.023657
W *R&D exp.*	–0.039	0.015	2.604	0.009203
R&D exp.	0.193	0.007	26.258	<0.00001
R^2_pseudo with FE	0.94			
N	261			
T	4			

Source: own study based on research results done in Matlab.

From the outcomes, we conclude that the inclusion of spatially-weighted human capital in the set of innovation determinants of economic performance proved to be valid. Essentially, employment in technology and knowledge-intensive sectors in nearby regions have a positive impact on regional income. Also, the empirical outcomes show that patent applications to the EPO in neighbouring locations statistically have a significant effect on the economic performance within the region. Therefore, we conclude that regions benefit economically from their locational spillovers in terms of social capital, as suggested by the spatial patterns described by the uni- and bivariate analysis, and confirming the complementary effect of the above innovation factors.

In general, a high level of innovation factors in surrounding locations stimulate economic performance within the region. Interestingly, this does not apply to the expenditures on research and development, however, where we do not see substitution or complementarity between internal R&D and external technology acquisition.

It should be noted that in the results of the bivariate LISA analysis, strong and positive correlations between GDP and WR&D have been found. However, the econometric model, in which the decomposition of R&D expenditures has been applied, revealed that the actual impact on economic performance from nearby regions is negative, though highly significant. This means that the more substantial the expenditures in neighbouring regions, the more impoverished the region, *ceteris paribus*. So, our results suggest no regional complementarities for R&D investments. At the same time, a positive and significant coefficient associated with expenditures on in-house research indicates that the more substantial the R&D expenditures within the region, the more prosperous the region. From that, one can conclude that our model reveals a regional competition effect of the R&D expenditures, favouring in-house over outsourced research. This could be caused by the issue of limited resources, where possible, higher funding in one region comes at the expense of other regions, as a result, inhibiting their economic development.

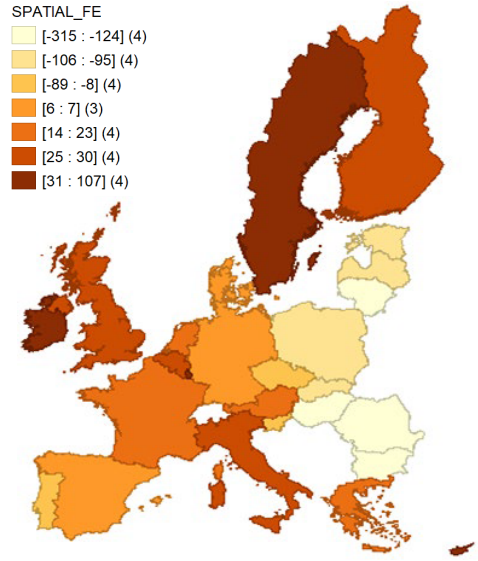

Figure 7. Country fixed effects for regional economic performance for innovation determinants in the EU
Source: own study based on research results done in GeoDa.

The final specification of the econometric model confirmed that country-specific effects surpass the individual regional effect and the common constant value for all locations. This means that while in each region the GDP is influenced by its innovativeness as well as the innovativeness of bordering regions, all regions within a single country have a mutual (common) time-constant baseline or starting-point level of regional development. This common factor reveals the contribution of innovation factors in wealth creation. It can be observed that these effects are the lowest in the Balkans, the Baltic States, and Central Europe. Hence, the CEE regions are hindered by their country-specific factors.

Conclusions

For the analysis of individual regions, we conclude that in the EU, innovation factors appear in a polarised structure with agglomerations in Western and Northern EU versus Eastern and Central EU and the Iberian Peninsula. A similar spatial pattern is also reflected in the RIS report for Innovation Leaders and Strong Innovators versus Moderate and Modest Innovators.

In the case of the Iberian Peninsula, one can observe extremely low employment in science and technology, which has been decreasing over time. This is probably caused by the largest share of the population with the lowest level of education in the EU (Educational attainment statistics). This, together with a very low level of expenditures on research and development, corresponds with the declining development in Spain and Portugal.

For the Central and Eastern EU, this study recognised a few notable disadvantageous patterns. Firstly, almost all NUTS 2 CEE regions have a low level of regional development. Secondly, they also have low levels of innovativeness, which (as proven by the Durbin model) stimulates global production. Thirdly, country-specific effects identified by the Durbin model hinder the development of NUTS 2 regions due to the relatively low values for the CEE states. Finally, as indicated by the theory and the results of the Durbin model, the regional development of each region is influenced by the situation of its neighbours. Unfortunately, for most analysed variables (studied separately and jointly with GDP), low-low clusters constitute a major share of CEE regions. Therefore, for these regions, spatial interactions can be seen as an obstacle rather than an aid.

This disturbing trend may have severe consequences for the economy in this part of the EU. It should also be noted that while Poland, together with some neighbouring states, like Lithuania, the Czech Republic, and Slovakia, are considered less developed countries in the EU, and rather moderate to modest innovators, their expenditures for research and development and patent applications have been increasing over time. This is also reflected in the high incline of GDP in this part of the EU. This may suggest that the awareness of innovativeness and its influence on regional development has risen in the region. Lastly, the performance of regional innovation appears to be relatively stable throughout the period of analysis.

In this paper, we have aimed to trace knowledge-based innovation factors that determine regional economic performance. Our results validate the assumed complex structure of the interregional interactions of innovation factors. We established that the complementary effect occurs for social capital, namely human capital and patent applications, with strong spillover effects. In the case of research and development expenditures, however, our analysis revealed both regional clustering of similarly high or low R&D expenses in large parts of Europe, as well as a regional competition effect, which indicates the preference for internal research programs over acquiring external technology. This result of the spatial panel model challenges the cooperation paradigm in the innovation process. Moreover, the spatial analysis indicates that regional innovativeness and regional development are strongly determined by the region's location and "neighbourhood". This constitutes an unfair but unalterable disadvantage to Eastern and Central Europe.

In the analysis, we specified and estimated country fixed effects which represent spatial effects common for each country. They appear to be significant and highly diverse, therefore, essential from the viewpoint of the analysed innovation-determined economic performance process. This factor might be associated with some socio-economic, legal, administrative, or cultural aspects, like the education system or a willingness to take risk, and it reveals the contribution of innovation factors to wealth creation.

Our research reveals that there are spatial patterns in innovation factors, and therefore, innovation is not merely confined to its administrative borders, despite the pres-

ence of country-specific factors. What is more, there is considerable diversity in the performances of regional innovation indicators. Treating the RIS 2019 as a benchmark for the future analysis, it can be expected that the gap between the Central and Eastern Europe and the Western and Northern parts will not disappear, but may strengthen the polarisation of the EU. Future analysis on an extended timeframe panel would make it possible to trace long-term patterns and their stability over time.

References

Anselin, L. (1998), *Spatial Econometrics: Methods and Models*, Kluwer, Dordrecht.

Anselin, L., Le Gallo, J., Jayet, H. (2008), *Spatial panel econometrics*, [in:] L. Mátyás, P. Sevestre (eds.) *The econometrics of panel data, fundamentals and recent developments in theory and practice*, 3rd ed., Kluwer, Dordrecht. https://doi.org/10.1007/978-3-540-75892-1_19

Anselin, L., Varga, A., Acs, Z. (1997), *Local Geographic Spillovers between University Research and High Technology Innovations*, "Journal of Urban Economics", 42 (3), pp. 422–448. https://doi.org/10.1006/juec.1997.2032

Bilbao-Osorio, B., Rodríguez-Pose, A. (2004), *From R&D to Innovation and Economic Growth in the EU*, "Growth and Change", 35 (4), pp. 434–455. https://doi.org/10.1111/j.1468-2257.2004.00256.x

Boschma, R. (2005), *Proximity and innovation – a critical assessment*, "Regional Studies", 39 (1), pp. 61–74. https://doi.org/10.1080/0034340052000320887

Brouwer, E., Kleinknecht, A. (1999), *Innovative output, and a firm's propensity to patent. An exploration of CIS micro data*, "Research Policy", 28 (6), pp. 615–624. https://doi.org/10.1016/S0048-7333(99)00003-7

Cabrer-Borrás, B., Serran-Domingo, G. (2007), *Innovation and R&D spillover effects in Spanish regions: A spatial approach*, "Research Policy", 36, pp. 1357–1371. https://doi.org/10.1016/j.respol.2007.04.012

Caragliu, A., Nijkamp, P. (2012), *The impact of regional absorptive capacity on spatial knowledge spillovers: the Cohen and Levinthal model revisited*, "Applied Economics", 44, pp. 1363–1374. https://doi.org/10.1080/00036846.2010.539549

Cliff, A.D., Ord, J.K. (1981), *Spatial processes: models and applications*, Taylor & Francis, London.

Corrado, C., Haskel J., Jona-Lasinio, C. (2017), *Knowledge Spillovers, ICT and Productivity Growth*, "Oxford Bulletin of Economics and Statistics", 79 (4), pp. 592–618. https://doi.org/10.1111/obes.12171

Corrado, C., Hulten, Ch., Sichel, D. (2009), *Intangible capital and U.S. economic growth*, "The Review of Income and Wealth", 55 (3), pp. 661–685. https://doi.org/10.1111/j.1475-4991.2009.00343.x

Crescenzi, R., Rodrígue-Pose, A., Storper, M. (2007), *The territorial dynamics of innovation: a Europe – United States comparative analysis*, "Journal of Economic Geography", 7 (6), pp. 673–709. https://doi.org/10.1093/jeg/lbm030

Dominicis, L. de, Florax, R.J.G.M., Groot, H.L.F. de (2013), *Regional clusters of innovative activity in Europe: are social capital and geographical proximity key determi-*

nants?, "Applied Economics", 45 (17), pp. 2325–2335. https://doi.org/10.1080/00036846.2012.663474

Educational attainment statistics. http://ec.europa.eu/eurostat/statistics-explained/index.php/Educational_attainment_statistics (accessed: 23.02.2020).

Elhorst, J.P. (2014), *Spatial Panel Models*, [in:] M. Fischer, P. Nijkamp (eds.) *Handbook of Regional Science*, Berlin, Springer. https://doi.org/10.1007/978-3-642-23430-9_86

Elhorst, J.P., Gross M., Tereanu E. (2018), *Spillovers in space and time: where spatial econometrics and Global VAR models meet*, European, Central Bank, Frankfurt, Working Paper Series, No. 2134.

European Innovation Scoreboard 2016. https://op.europa.eu/en/publication-detail/-/publication/693eaaba-de16-11e6-ad7c-01aa75ed71a1/language-en/format-PDF/source-31233711 (accessed: 23.02.2020).

Eurostat Regional Database. https://ec.europa.eu/eurostat/web/regions/data/database (accessed: 23.02.2020).

Frascati Manual (2002). https://www.oecd-ilibrary.org/science-and-technology/frascati-manual-2002_9789264199040-en (accessed: 23.02.2020).

Global Innovation Index 2016 report. http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016.pdf (accessed: 23.02.2020).

Global Innovation Index 2017 report. https://www.globalinnovationindex.org/userfiles/file/reportpdf/gii-full-report-2017.pdf (accessed: 23.02.2020).

Global Innovation Index 2018 report. https://www.globalinnovationindex.org/userfiles/file/reportpdf/gii_2018-report-new.pdf (accessed: 23.02.2020).

Global Innovation Index 2019 report. https://www.globalinnovationindex.org/userfiles/file/reportpdf/GII2019-keyfinding-E-Web3.pdf (accessed: 23.02.2020).

Gonçalves, E., Almaida, E.S. (2009), *Innovation and Spatial Knowledge Spillovers: Evidence from Brazilian Patent Data*, "Regional Studies", 43 (4), pp. 513–528. https://doi.org/10.1080/00343400701874131

Granovetter, M. (2005), *The impact of social structure on economic outcomes*, "Journal of Economic Perspectives", 19 (1), pp. 33–50. https://doi.org/10.1257/0895330053147958

Griliches, Z. (1979), *Issues in assessing the contribution of research and development to productivity growth*, "Bell Journal of Economics", 10 (1), pp. 92–116. https://doi.org/10.2307/3003321

Halleck, V.S., Elhorst J.P. (2016), *A regional unemployment model simultaneously accounting for serial dynamics, spatial dependence and common factors*, "Regional Science and Urban Economics", 60, pp. 85–95. https://doi.org/10.1016/j.regsciurbeco.2016.07.002

Jaffe, A.B. (1989), *Real effects of academic research*, "American Economic Review", 79 (5), pp. 957–970.

Kelejian, H.H., Prucha, I.R. (1998), *A Generalised Spatial Two-Stage Least Squares Procedure for Estimating a Spatial Autoregressive Model with Autoregressive Disturbances*, "The Journal of Real Estate Finance and Economics", 17 (1), pp. 99–121.

Kelejian, H.H., Prucha, I.R. (2010), *Specification and estimation of spatial autoregressive models with autoregressive and heteroskedastic disturbances*, "Journal of Econometrics", 157 (1), pp. 53–67. https://doi.org/10.1016/j.jeconom.2009.10.025

LeSage, J., Pace, R.K. (2009), *Introduction to Spatial Econometrics*, Taylor & Francis Group, New York. https://doi.org/10.1201/9781420064254

Moran, P.A.P. (1948), *The Interpretation of Statistical Maps*, "Journal of the Royal Statistical Society", Series B (Methodological), 10 (2), pp. 243–251. https://doi.org/10.1111/j.2517-6161.1948.tb00012.x

Olejnik, J., Olejnik, A. (2020), *QML estimation with non-summable weight matrices*, "Journal of Geographical Systems", 22, pp. 469–495. https://doi.org/10.1007/s10109-020-00326-2

Ord, K. (1975), *Estimation Methods for Models of Spatial Interaction*, "Journal of the American Statistical Association", 70, pp. 120–126. https://doi.org/10.1080/01621459.1975.10480272

Regional Innovation Scoreboard 2016 report. https://op.europa.eu/en/publication-detail/-/publication/693eaaba-de16-11e6-ad7c-01aa75ed71a1/language-en/format-PDF/source-31233711 (accessed: 23.02.2020).

Regional Innovation Scoreboard 2017 report. https://op.europa.eu/en/publication-detail/-/publication/ce38bc9d-5562-11e7-a5ca-01aa75ed71a1/language-en/format-PDF/source-99532255 (accessed: 23.02.2020).

Regional Innovation Scoreboard 2019 report. https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf (accessed: 23.02.2020)

Shi, W., Lee, L.F. (2017), *Spatial dynamic panel data model with interactive fixed effects*, "Journal of Econometrics", 197, pp. 323–347. https://doi.org/10.1016/j.jeconom.2016.12.001

Streszczenie

Określenie przestrzennych wzorców determinant innowacji w regionalnych wynikach gospodarczych

Niniejszy artykuł analizuje rolę czynników innowacyjności w rozwoju regionalnym 261 regionów UE w latach 2009–2012. Analiza przestrzenna wskazała, że regionalna innowacyjność, a dalej rozwój regionalny, zależą nie tylko od położenia geograficznego regionu, ale i jego sąsiadów. Pociąga to za sobą szczególnie poważne konsekwencje dla Europy Środkowo-Wschodniej. Za pomocą przestrzennego modelu panelowego Durbina ze stałymi efektami grupowymi (dla krajów), oceniliśmy wpływ czynników innowacji i ich przestrzennych odpowiedników na regionalne wyniki ekonomiczne. Pokazał on, że regiony czerpią korzyści ekonomiczne ze swoich efektów lokalizacyjnych pod względem kapitału społecznego, jednak w przypadku wydatków na badania i rozwój ujawniono efekt konkurencji między regionami.

Słowa kluczowe: innowacjność regionów, wzorce innowacji, przestrzenne rozprzestrzenianie, czynniki wspólne, przestrzenny ekonometryczny model panelowy

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.30

Progress in Achieving Sustainable Industrial Development – the Case of the Czech Republic and Poland[1]

Marta Ulbrych
Ph.D., Department of International Economics, College of Economics Finance and Law, Cracow University of Economics, Cracow, Poland
e-mail: e-mail: ulbrychm@uek.krakow.pl

Abstract

The aim of this paper is to clarify the concept of sustainable industrial development and present the results of a study on the progress in achieving goals in this field adopted by the United Nations (UN) in 2015. The research covered the Czech and Polish economies in the period 2000–2018. Under the United Nations 2030 Agenda for Sustainable Development, the need to promote inclusive and sustainable industrialisation was identified. In the context of sustainable industrial development, it is emphasised that it should encourage a competitive economy, create employment, and protect the environment by efficiently utilising non-renewable resources. To assess this phenomenon in the analysed economies, indicators identified by the UN under SDG9 were used.

Keywords: green industrial policy, sustainable development goals, SDG 9, sustainable industrial development

JEL: L50, 014, Q50

Introduction

The idea of sustainable development refers to shaping the quality of life and the environment, with a focus on conditions for purposeful human activity. Effective links between the idea of economic development and the environment have been discussed

1 This research has been financed by the subsidy for maintaining research potential granted to the College of Economics, Finance and Law, Cracow University of Economics.

internationally since the 1970s. Sustainable development tends to be considered with regard to environmental protection, but equally important areas of analysis include the economic dimension (economic policy instruments stimulating entities to use natural resources reasonably) and the technical aspect (new technologies saving the consumption of raw materials).

A tool for implementing sustainable development postulates is the green economy, based on the assumption of continuing socio-economic growth harmonised with the environment. The green economy aims to facilitate a decoupling of the economy from the environment so that production and consumption can occur within the planet's carrying capacity (UNEP 2019, p. 2). Emphasis is placed on transforming the economic model into a low-carbon, resource-efficient and socially-inclusive economy. The sector responsible for the largest share of energy consumption is industry, which includes refining, mining, manufacturing and construction (US Energy Information Administration 2019, p. 27).

From this perspective, sustainable industrial development is one of the pillars of the green economy. The concept starts from the assumption that a well-designed policy of structural changes can account for both productivity and environmental challenges (Altenburg and Assmann 2017, p. XII). The variation which is characteristic of the present-day world – also in terms of the organisation and structure of industrial production – drives the search for new solutions orientated towards the symbiosis of technological and economic progress with social and environmental advancement.

An additional challenge to a modern economy is to achieve the organisation of production that includes an economical approach to energy consumption and reduces health-related costs that stem from air pollution. The need for government action in order to maintain the transition to an inclusive green economy has gained in popularity, especially since the 2008 economic crisis. In this context, the greening of production methods and the more efficient use of natural resources are becoming increasingly noticeable.

The prospect of economic and social transformation towards a sustainable development model was defined at the global level by the UN in a document adopted by the member states in 2015 entitled *Transforming our world: the 2030 Agenda for Sustainable Development*. One of the 17 Sustainable Development Goals (SDG) defined at the time was Goal 9, which emphasizes the essence of sustainable industrial development, which will promote economic growth, greater social inclusion, and the rational use of natural resources (United Nations General Assembly 2015). The research topic of sustainable industrial development is receiving increasing attention (among others: European Commission 1999; Gilli et al. 2017; Seetoh and Ong 2008; Zodape et al. 2015). A literature review allows us to systematise the benefits, challenges and instruments for implementing sustainable industrial development. However, the empirical evidence concerning the transformation of economic structures towards sustainable industrial development is not widespread, especially in relation to Central and Eastern European countries.

This paper tries to fill the gap by investigating the progress in achieving sustainable industrial development in the Czech Republic and Poland based on indicators adopted for SDG 9 and an assessment of the decoupling of manufacturing growth from energy consumption. The choice of countries surveyed was determined by their common history, economic structure, the stage of development and energy profile. The shared historical heritage of these countries with centrally planned economies had a great impact on the direction of the development of their industry. These countries invested in energy-intensive, high-carbon heavy industry, creating a unique energy culture based on the availability of cheap energy resources – coal, oil and natural gas (Pach-Gurgul and Ulbrych 2019, p. 181). Although a typical feature of those countries was the decrease in the case of manufacturing value added (MVA) in the 1990s, in the twenty-first century, an increase has been observed (Rachwał 2015, p. 580). The MVA share in total GDP is still relatively high in the Czech Republic and Poland, respectively 25% and 18% (UNIDO 2020). At the same time, the sector is one of the major energy users – consuming 28.4% of the total energy consumption in the Czech Republic and 22.6% in Poland (Enerdata-Odyssee 2020).

The structure of the paper is organised as follows: the first section introduces a literature review as well as the concept of sustainable industrial development and green industrial policy. Section two presents the results of the analysis regarding the implementation of SDG 9 in the field of industrial development in the Czech Republic and Poland. In the third section, the focus is on presenting the results of the study on the decoupling of manufacturing growth from energy consumption in the analysed economies. Subsequently, conclusions and implications are developed. The research methodology is based on two techniques: a literature review and a presentation of the results of the analysis of available statistical data for the period 2000–2018. The data used are aggregated at the level of 'manufacturing', which refers to industries belonging to section C defined by the International Standard Industrial Classification of All Economic Activities, Revision 4 (ISIC Rev.4).

The concept of sustainable industrial development and green industrial policy

Concerns about the future of our overexploited planet have been consistently emphasised since the 1970s. By publishing the 1972 report entitled *The Limits to Growth,* commissioned by the Club of Rome, a group of scientists questioned the then promoted forms of growth (Meadows et al. 2005). The report triggered a global discussion on major threats to future development in the form of physical and social constraints on growth in the world economy. In this context, an equally important study was the report of the World Commission on Environment and Development entitled *Our Common Future*, published in 1987. The document provided a framework for the integration of environmental policy into development strategies, stressing the need

to create a strategy orientated to the dissemination and implementation of the concept of sustainable economic development on a global scale. In addition, it defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (United Nations World Commission on Environment and Development 1987).

However, it can be assumed that sustainable development became a priority goal for the international community in 1992 when the UN Conference on Environment and Development called on governments to prepare national economic development strategies that incorporate environmental aspects (Allen and Clouth 2012, p. 4). The adopted *Rio Declaration on Environment and Development* contained principles that indicate a key role to be played by states in reducing and eliminating unsustainable patterns of production and consumption (United Nations 1992). Subsequently, the global financial crisis and its aftermath constituted another turning point in the debate on the need for green economic development. In response to increasing social and economic problems, the idea of Green Keynesianism was developed as an alternative development path, which referred to the traditional fiscal policy proposed by Keynes as an instrument for implementing environmental objectives (Harris 2013, pp. 2–3). The launch of the Green Economy Initiative by the UN Environment Programme (UNEP) in 2008 and the report entitled *A Global Green Deal* (Barbier 2009) marked the beginning of the current stage of defining a *green economy*, presented as an alternative to the *brown economy*. The most important characteristics that distinguish the new approach are as follows (Burchard-Dziubińska 2014, pp. 137–138):

- efforts to decouple economic growth from the use of raw materials;
- resource-saving production instead of resource-intensive production;
- the dominance of renewable energy sources over fossil fuels;
- high energy efficiency;
- sustainable consumption, in contrast to the common phenomenon of overconsumption.

The term *green economy* was first used in a study for the British government entitled *Blueprint for a Green Economy* (Pearce et al. 1989). A green economy is frequently defined as 'one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities' (UNEP 2011). In other words, the concept represents a radical transition to more efficient, environmentally friendly and resource-saving technologies to reduce emissions and mitigate the effects of climate change (Jänicke 2012, p. 15). During Rio+20, also known as the United Nations Conference on Sustainable Development in 2012, it was agreed that the green economy was an important tool of sustainable development, aimed at stimulating economic growth, eradicating employment and poverty, while maintaining the Earth's healthy ecosystem.

In addition, it was highlighted that capacity building, experience sharing, and the institutionalisation of global cooperation were of critical importance to implementing green economy policies (United Nations 2012). The *green economy* concept, pri-

marily the discourse on green growth, has become a permanent item on the agenda of international institutions (European Commission 2010; OECD 2011; UNEP 2011; World Bank 2012). The paradigm refers to the Green New Deal postulates, which serve as catalysts for economic growth and which are, in turn, a contribution to the green economy. *Green growth* defines growth as being efficient in the use of natural resources, clean, thanks to reduced pollution and environmental impact, and resilient, due to the inclusion of natural hazards and the role of environmental management (World Bank 2012, p. 2).

However, the green economy is criticised on the basis of the doubtful assumption that green growth is determined by the decoupling of economic growth from the use of resources. In fact, there is evidence indicating relative decoupling of GDP growth trends from energy consumption and reduced energy intensity in a number of economies (Jackson 2009, p. 109). Nevertheless, the main problem remains: total energy consumption is on the increase, although at a rate lower than that of GDP growth. Some authors point to the need for absolute decoupling, and they emphasise the transitionary potential of the green economy agenda. Moving to greener forms of growth, even if they simply constitute relative decoupling, appears to be the only feasible first step towards a post-growth economy (Ferguson 2014, p. 6). In this context, it is worth stressing the need for an environmentally sustainable production method and a more efficient use of resources, in accordance with the 'producing more with less' principle. As a result, it is possible to adopt the following definition of sustainable industrial development, taking into account three parameters (Zodape et al. 2015, p. 112):

- the growth of endogenous productive capacities, especially the capacity for innovation;
- an improvement in the environmental performance of industry;
- improvements in living standards and a reduction of inequality, especially via growth in the quantity and remuneration of jobs in the manufacturing sector.

According to the Lima Declaration, the United Nations Industrial Development Organisation (UNIDO) indicates that inclusive and sustainable industrial development (ISID) is a key driver of successful integration of the economic, social and environmental dimensions, crucial for full implementation of sustainable development for the benefit of future generations (UNIDO 2013).

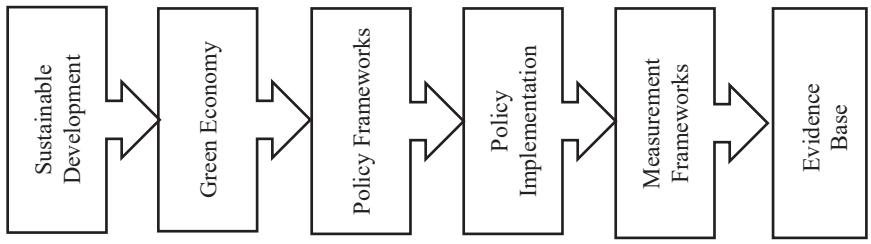

Figure 1. Green growth monitoring framework
Source: Georgeson et al. 2017, p. 4.

Therefore, the greening of industry is a method for achieving sustainable economic growth through policymaking, improved processes of industrial production and resource-efficient productivity. But it involves the preparation of an appropriate legal framework and coordinated efforts at various levels of administration as well as across policies. Figure 1 presents a green growth monitoring framework, with a focus not only on establishing certain norms and standards, but also on designing measurement methods. With regard to the implementation of the idea of sustainable industrial development, industrial policy is of relevance. As in the case of traditional industrial policy, there is no widely accepted definition of green industrial policy. However, it can be assumed that it comprises all economic policy tools orientated towards structural adjustments in the economy for the needs of sustainable development (Lütkenhorst et al. 2014, p. 1). Any attempt to justify the application of green industrial policy must take account of the main conditions thereof (Partnership for Action on Green Economy 2017, pp. 10–13; Rodrik 2014, pp. 470–471; World Bank 2012, pp. 66–67):

- market imperfections;
- externalities.

The need for economic intervention tends to be justified by the existence of market imperfections: the market concerned ceases to ensure – in terms of Pareto optimality – utility maximisation and optimal allocation of resources. It results from the lack of asymmetry of information, capital market imperfections and non-coordinated investment decisions. Incomplete information may cause social inefficiency of resource management. Collecting information is time-consuming and costly; hence, it is desirable for public institutions to intervene for the reinforcement and coordination of the information flow system. As regards the capacity of businesses (especially small and medium-sized enterprises (SMEs)) to incur environmental investment costs, it is frequently curbed by capital market imperfections. It gives rise to a need to define necessary framework conditions for easier access to funding. Furthermore, the benefits of technological improvements in the production process are not fully taken over by pioneering undertakings that invest heavily in research and development. It seems vital to monitor technology diffusion and to subsidise research and development activities in areas characterised by high innovation potential.

Externalities are caused by private undertakings that infringe on the environment (air and water pollution, noise, congestion). As a burden on other entities, they result in differences in the balance of marginal costs and marginal utilities for individuals and society. An example of economic policy measures in that regard might be taking steps to reduce negative externalities by adopting environmental protection legislation.

The above arguments for public intervention and remedy actions are mostly justified in situations that eliminate behaviour patterns of undertakings that counteract public utility maximisation. Furthermore, properly designed green industrial policy that makes use of market incentives can intensify the process of implementing new

technologies. By stimulating innovation, strict environmental regulations can actually enhance competitiveness and improve the competitive advantage of domestic companies (Porter and van der Linde 1995, p. 98).

Monitoring Sustainable Development Goal 9 in the Czech Republic and Poland

As emphasised before, the social and economic consequences of the financial crisis revealed the need to re-think economic theory and practice, which resulted in the renaissance of industrial policy. In addition, the present-day environmental challenges draw greater attention to industrial capacity to change current production and consumption models. The literature provides evidence that structural economic transition, through productivity improvements, which fosters economic diversification and builds green industries, is of key significance to boosting economic growth, job creation and forming structures necessary to achieve common welfare (Li 2015, p. 447).

Naturally, the debate should address not only the need to increase the share of industry in the economy, but also how industry actually contributes to sustainable development in all its dimensions – at the economic, social and environmental levels. The foundations for such a vision of industrial development were adopted by the UNIDO Member States in the Lima Declaration (the ISID concept) and subsequently included in the UN agenda, i.e. the 2015 development programme entitled *Transforming Our World: The 2030 Agenda for Sustainable Development*. The resolution introduced 17 goals (Sustainable Development Goals – SDG) as the main points of reference for sustainable development policy until 2030. ISID was included in the global development programme as SDG 9, calling to 'Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation'. Table 1 presents an overview of the targets and indicators adopted for SDG 9 in the field of sustainable industrialisation.

SDG 9.2 emphasises the importance of industrial production in generating value added and employment in an economy, according to Kaldor's studies that indicate a positive correlation between increased industrial production and GDP variations (Kaldor 1967). There is empirical evidence corroborating the relationship between economic growth and the size and expansion of the production sector. Industrial production makes it possible to attain faster productivity growth and drives technological changes (UNIDO 2019, p. 15).

The first dimension of Goal 9.2 is composed of two indicators: MVA as a proportion of GDP and MVA *per capita*, with their values for the Czech Republic and Poland presented in Figures 2 and 3, respectively. A widespread global phenomenon in developed countries is deindustrialisation, i.e. a relative decrease in industry's share of the economy (Ulbrych 2018, p. 459).

Table 1. Targets and indicators for SDG 9 in the field of sustainable industrialization

Goal	Proposed indicator	Concept and rationale
9.2 Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in the least developed countries.	Manufacturing value added (MVA) as a proportion of GDP	It reflects the role of industrial production in the economy.
	MVA per capita	It is the main indicator of a country's industrialisation level, adjusted to the size of its economy measured by population.
	Manufacturing employment as a proportion of total employment	It measures the capacity of manufacturing to absorb excess labour from other sectors. In developed countries, the workforce is expected to decrease in industrial production as a result of the automation of various processes.
9.3 Increase the access of small-scale industrial and other enterprises, in particular, in developing countries, to financial services, including affordable credit, and their integration into value chains and markets.	Proportion of small-scale industries in total industry value added	Despite the minor contribution of small-scale industries to total value added generated by industry, they play a significant role in job creation, especially in developing countries.
	Proportion of small-scale industries with a loan or line of credit	The indicator shows the extent of services supplied by financial institutions to small-scale industries, with limited access to financial services, particularly in developing countries.
9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.	Carbon dioxide emissions from manufacturing	Assuming that CO_2 emissions account for ca. 80% of total greenhouse gas emissions from production processes, the indicator adopted is the level of CO_2 emissions from manufacturing.
	Carbon dioxide emissions per unit of MVA	The indicator applied is the level of CO_2 emissions per unit of value added, measuring the carbon dioxide emission intensity of manufacturing.
9.b Support domestic technology development, research and innovation in developing countries, including ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities.	Medium and high-tech (MHT) industry value added in total value added	Industrial development involves a structural transition from resource-based low-technology activities to those characterised by higher technology intensity and increased labour productivity.

Source: own elaboration based on UNIDO, https://stat.unido.org/SDG (accessed: 15.02.2020).

Nevertheless, the process is not observed in countries concerned where MVA as a proportion of GDP has been on the increase since 2000. In the period covered, the share of manufacturing in GDP, measured by value added, rose from 15.4% to 25.5% and from 11.1% to 18.8% in the Czech and Polish economies, respectively. In comparison, in Germany – where the industrial sector plays a major role – the indicator went up from 19.5% to 21.4%.

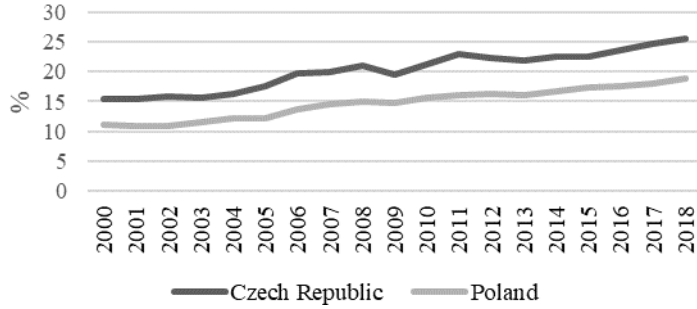

Figure 2. MVA as a proportion of GDP (%)
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

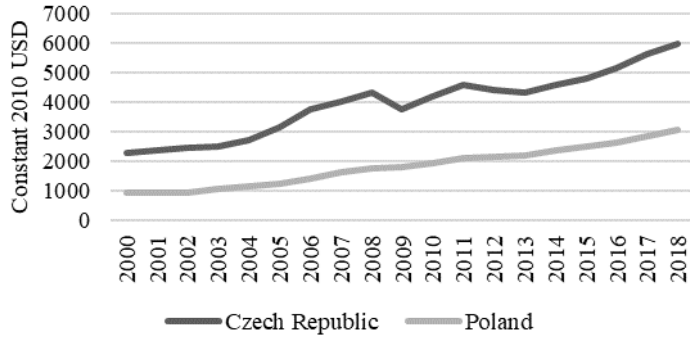

Figure 3. MVA per capita (constant 2010 USD)
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

A similar upward trend can be seen in the case of MVA per capita: in 2018, it was 263% of the 2000 level in the Czech Republic and 327% in Poland. However, despite the rise, in 2018, MVA per capita in the Czech Republic – at USD 5,976 – represented slightly more than half of the respective indicator for Germany (USD 10,268). As regards the Polish economy, the proportion was approximately one-third. The third and last indicator for Goal 9.2 is manufacturing employment as a proportion of total employment, with relevant changes illustrated in Figure 4. In 2000–2017, manufacturing employment remained relatively stable, generating more than one-fourth of jobs in the Czech Republic and around one-fifth in Poland. Therefore, the sector is vital for the labour market in both countries. In addition, throughout the period covered sim-

ilar relative levels of employment were accompanied by rising MVA per capita, which suggests an increase in productivity.

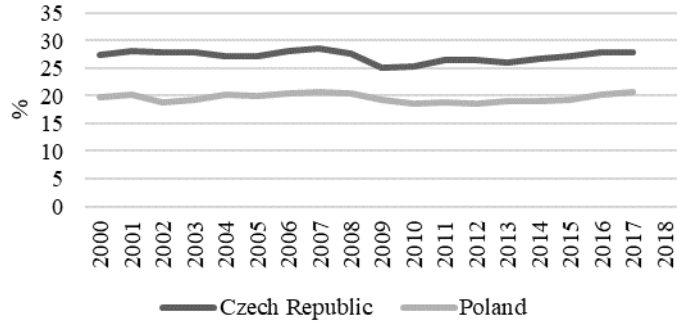

Figure 4. Manufacturing employment as a proportion of total employment
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

In the long term, however, technological development, automation and digitisation can be expected to change employment opportunities towards rising demand for a high-skilled workforce. At the same time, the existing advantage of Central and Eastern European countries, which is based on relatively low labour costs, is not sufficient. Manufacturing is characterised by major pay gaps (in terms of net monthly earnings) in the countries of the region in relation to Northern and Western Europe (Drahokoupil and Piasna 2018, pp. 12–13). Modern and internationally competitive industrial activities involve continuous upgrading of products and increased production capability.

A major challenge faced by countries such as the Czech Republic and Poland becomes skills mismatch, defined as the gap between a worker's skills and the labour market's demands (The Adecco Group 2018, p. 18). Empirical analysis identifies an inverted U-shaped relationship with the share of manufacturing employment first rising and then falling with income per capita. Thus, deindustrialisation measured by a decrease in the share of production in total employment becomes a key policy issue. The phenomenon may have a favourable effect on the economy if resources are shifted to highly productive activities such as modern services. However, it may also exert a negative influence as a result of human capital moving to low-productivity and low-wage activities or informal services (UNIDO 2017, p. 12).

Two indicators were adopted for the measurement of Goal 9.3 (Table 1). One of those, i.e. the proportion of small-scale industries in total value added, emphasises the role of small and medium-sized enterprises in the economy, particularly in the context of job creation and self-employment. The other – the proportion of small-scale industries with a loan or line of credit – was selected on account of frequent difficulties faced by small businesses that stem from limited access to financial services.

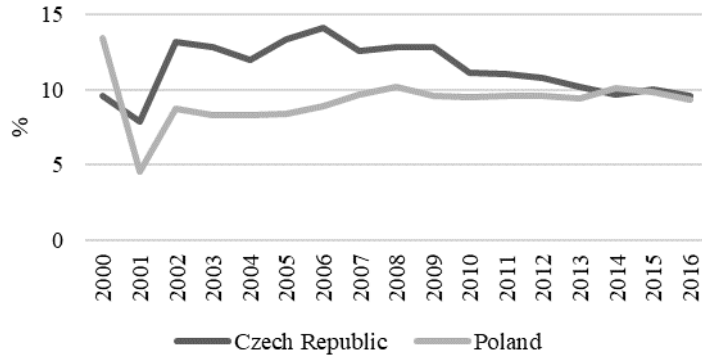

Figure 5. Proportion of small-scale industries in total industry value added
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

Although financing is a key element in the development of the SME sector, the indicator in question entails a major problem with obtaining information, due to the lack of publicly available, comparable data (UNCTAD 2020).

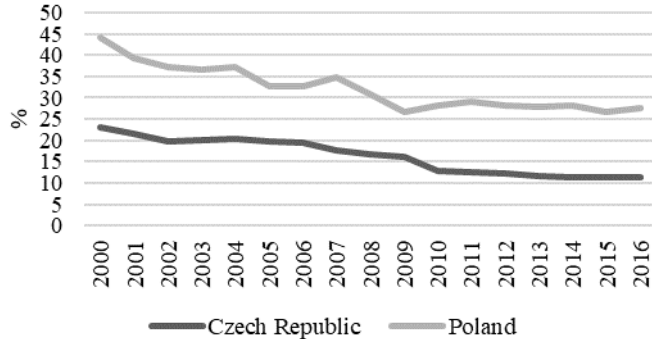

Figure 6. CO_2 emissions from manufacturing (% of total fuel combustion)
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

But the analysis of aggregated data in Figure 5, concerning the first indicator of Goal 9.3, demonstrates that in the last years of the period covered, the proportion was very similar in both countries, at approximately 10%. Throughout the period under examination, however, both economies showed different trends: in the Czech Republic, there was a minor fall (by 3.6 percentage points) after 2002, whereas the opposite was the case in Poland.

In the context of Goal 9.4, UNIDO publishes data on greenhouse gas emissions. Based on the assumption that CO_2 emissions account for 80% of total emissions from production processes, the focus is on CO_2 emissions in total fuel combustion (Figure 6) and CO_2 emissions per unit of value added (Figure 7).

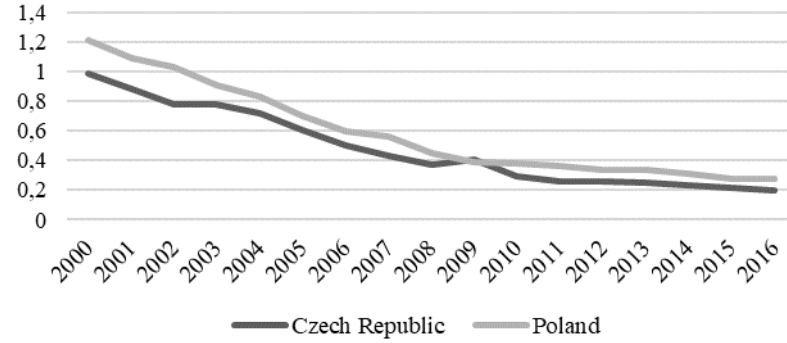

Figure 7. CO_2 emission per unit of value added (kilogrammes of CO_2 per constant 2010 USD)
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

The analysis of movements in the value of the former indicator shows a gradual decrease to 11.2% in the Czech Republic and 27.5% in Poland. The latter indicator measures CO_2 emission intensity, resulting from the energy mix used, the technology employed and its energy efficiency. The indicator is on the decrease in both economies. While in the period 2000–2009, the annual average rate of change was 12% in Poland and 10% in the Czech Republic, the following years witnessed a deceleration in those positive developments.

The measure of Goal 9b shows the relative importance of medium- and high-tech industry (MHT) in manufacturing. An increased share of MHT in total MVA indicates not only improved technological intensity of the production sector, but it also reflects its capability to introduce new technologies to other sectors (UNIDO 2019, p. 46). Figure 8 illustrates changes in the structure of manufacturing value added, including MHT, in the Czech Republic and in Poland. Throughout the period covered, the Czech economy performed better in terms of the indicator under examination.

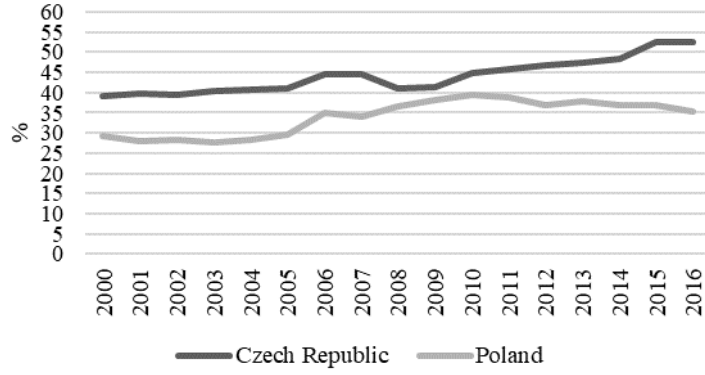

Figure 8. Medium and high-tech industry value added in total value added
Source: own dataset based on UNIDO, https://stat.unido.org/SDG (accessed: 10.02.2020).

Between 2000 and 2016, the proportion of MHT in the total value added of Czech manufacturing rose by 13 percentage points, with an acceleration of the upward trend noted after 2010. During the whole period in question, the respective share for Poland went up by 6 percentage points; however, the proportion of MHT in total MVA started to drop after 2010. It is worth noting that the share of MHT in MVA in industrialised economies such as Germany exceeds 60%.

Decoupling manufacturing growth from energy consumption in the Czech Republic and Poland

Technological progress is the foundation for efforts to achieve environmental objectives, e.g. increasing resource productivity and energy efficiency. Cleaner and more resource-saving methods of production may gradually lead to the decoupling of economic growth from environmental degradation. The term decoupling refers to breaking the link between 'environmental bads and economic goods'. It occurs when the growth rate of an environmental pressure is less than that of its economic driving force over a given period. Decoupling can be either absolute or relative. The first case – absolute decoupling – is recorded when the environmentally relevant variable is stable or decreasing while the economic driving force is growing. Decoupling is said to be relative when the growth rate of the environmentally relevant variable is positive but less than the growth rate of the economic variable (OECD 2002, p. 4).

Investigating this process and enriching the above list of indicators with trends in energy consumption by manufacturing in the studied economies seems reasonable and interesting. Figure 9 presents the relationship between MVA, final energy consumption and the energy intensity of manufacturing in the Czech Republic and Poland. Comparisons across time series present the indicator as an index compared with 2000.

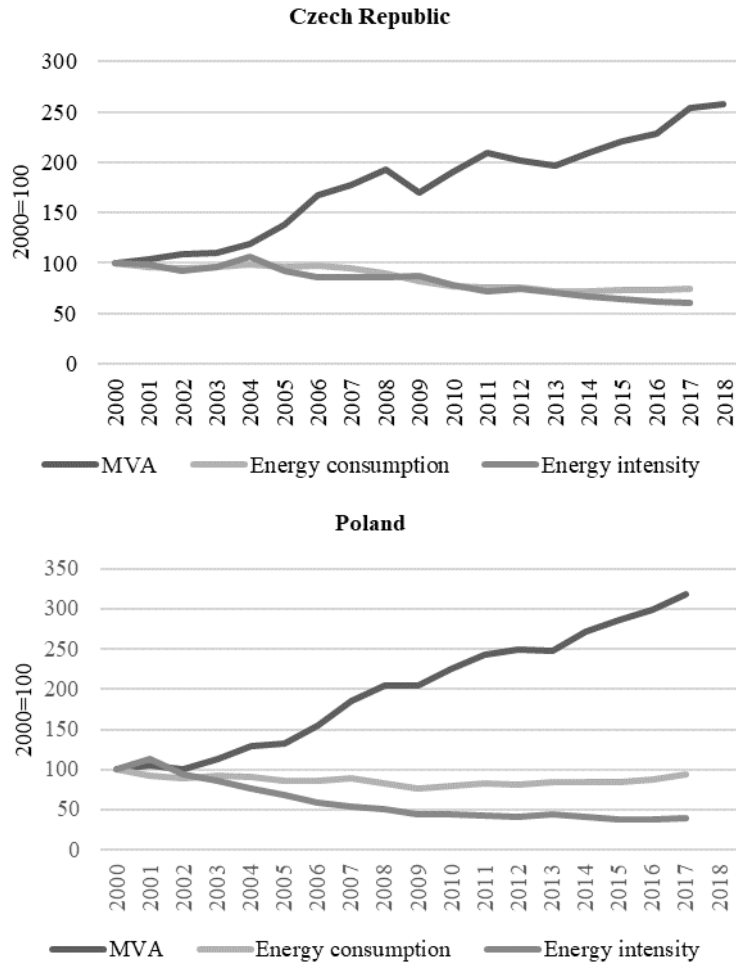

Figure 9. Trends in MVA, final energy consumption and energy intensity of manufacturing in the Czech Republic and Poland
Source: own dataset based on Enerdata-Odyssee, https://odyssee.enerdata.net/database/ (accessed: 15.02.2020).

Between 2000 and 2017, energy intensity in the manufacturing sector, i.e. the ratio between its final energy consumption and the value added at a constant price, decreased in both economies – in the Czech Republic by 39%, and in Poland by 61%. This decrease was continuous during the entire period, with an average annual decrease of 2.9% in the Czech Republic and 5.41% in Poland. The 2000–2017 period is characterised by high MVA growth and a steady decline in energy consumption in the Czech Republic. The value of MVA increased 2.5 times, while energy consumption fell by 25% from 9.7 to 7.3 Millions of tonnes of oil equivalent (Mtoe). Similarly, in Poland, final energy consumption decoupled from MVA growth: while MVA value grew by more than three times, energy consumption decreased by 6.4%. As a consequence, energy

intensity fell during this period. Thus, absolute decoupling was observed in both countries. However, it is worth noting that while the decrease in intensity in the Czech Republic is quite even, in Poland the largest decrease occurred in the period 2000–2009 (by 56%) and in the following years, the improvement in energy intensity was fairly constant.

Conclusion

The idea of sustainable development has become widely accepted, also in the aspect of industrial development. The review of the literature allowed us to define and organize concepts such as the Green New Deal, the green economy, sustainable development, sustainable industrial development and green industrial policy. The hierarchy between these terms indicates the following relationships: the Green New Deal is a catalyst and contributor (by stimulating green growth) to the green economy, which is a means of achieving sustainable development. Pursuing responsible and sustainable development, the UN has urged the decoupling of economic growth from environmental impacts. One of the key elements of this process is the improvement of manufacturing organisations towards sustainable industrial development. Green industrial policy is conscious state interference in market processes aimed at implementing the assumptions of sustainable industrial development. The UN emphasises that industry must be made both green and inclusive, and therefore the indicators adopted under SDG 9 refer to both dimensions.

According to the literature review, it should be stated that sustainable industrial development should be considered one that causes:

- the growth of manufacturing capacity and the competitiveness of this sector,
- employment creation,
- improvement in environmental performance.

The first dimension, i.e. manufacturing capabilities, was measured as the share of MVA in GDP and MVA per capita. SDG Target 9.2 aims to significantly increase the level (it applies primarily to developing countries). In the case of the Czech and Polish economies, the absolute manufacturing value added increases, which is reflected in the higher MVA per capita. In both countries, the value of this indicator increased about three times. At the time, however, MVA per capita in the Czech Republic is almost twice as high as in Poland. The relative importance of manufacturing is also growing, from 10.9% to 18.8% of GDP in Poland, and from 15.4% to 25.5% of GDP in the Czech Republic. The important drivers of manufacturing competitiveness are micro, small and medium enterprises, which are a significant source of value added and jobs. The proportion of small-scale industries in total industry value added is very similar in both countries, at approximately 10%. This share is similar to that in the developed, large EU economies (e.g. France and Germany, it is also worth paying attention to the decreasing proportion of SMEs in the manufacturing sector in these countries recent-

ly). Another indicator that directly determines the level of competitiveness of industrial production is medium and high-tech industry value added in total value added. In this respect, the Czech Republic is improving, while Poland has experienced a slow decline since 2010.

The second dimension, i.e. the share of manufacturing employment in total employment, reflects the share of the population that directly benefits from the manufacturing sector. In the Czech Republic and Poland, in contrast to the changes recorded in most developed economies, the share of the workforce employed in manufacturing is stable over the period (27% in the Czech Republic and 20% in Poland). This phenomenon can be explained by the growing production activity and participation of both economies in global value chains.

The third dimension underlines the need to reduce manufacturing pressure on the environment. Despite the increased activity in manufacturing, final energy consumption in this sector has decreased in both the Czech Republic and Poland (respectively by 1.1 and 2.4 Mtoe). As a result, energy intensity in manufacturing fell in both countries during the period.

Similarly, CO_2 emission intensity is on the decrease in both economies. Despite the progress, the economies are still among the most carbon-intensive in the EU. The Czech Republic and Poland have one of the highest greenhouse gas emission per capita in the EU – 12.2 and 11.0 tonnes, respectively, compared to an EU average of 8.5 in 2018 (Eurostat 2020). These trends resulted in absolute decoupling; however, the pace of these positive changes was faster until 2010 and then slowed down, especially in Poland.

In summary, both economies are transit countries with a high share of manufacturing in GDP, and therefore a developing competitive and sustainable industrial base is of crucial importance. An important issue is the modernization of production processes and an increase in the share of medium and high-tech industry value added in total value added. A key challenge for these economies is to curb greenhouse gas emissions through decarbonising power generation to move closer to climate neutrality. Such tendencies should be associated with energy savings and structural changes (towards less energy-intensive technology), which would decrease consumption in the long run. In this regard, an appropriate policy framework is needed that will reduce the scale of externalities of industrial activity. Additionally, industrial policy is central in fostering the transmission of new technologies in order for workers to be able to enter more productive manufacturing sectors, to improve competitiveness and to upgrade the position of economies in global value chains. Policy documents developed by national governments have defined goals for the development that follow the idea (Office of the Government of the Czech Republic, Department of Sustainable Development 2017; Ministry of Economic Development of Poland 2017); however, more emphasis on actions aimed at implementing the SDG 9 can be seen in the Polish strategy.

References

Allen, C., Clouth, S. (2012), *A guidebook to Green Economy*, UNDESA, New York.

Altenburg, T., Assmann, C. (eds.) (2017), *Green Industrial Policy. Concept, Policies, Country Experiences. Geneva*, UN Environment, German Development Institute, Bonn.

Barbier, E. (2009), *Rethinking the Economic Recovery*: *A Global Green New Deal, Report prepared for the Green Economy Initiative of UNEP*, United Nations Environment, University of Wyoming, Laramie.

Burchard-Dziubińska, M. (2014), *Wdrażanie zielonej gospodarki jako odpowiedź Unii Europejskiej na trudności rozwojowe*, "Acta Universitatis Lodziensis. Folia Oeconomica", 3 (303), pp. 135–150.

Drahokoupil, J., Piasna, A. (2018), *What is behind low wages in central and eastern Europe?*, "Post-Communist Economies", 30(4), pp. 421–439. https://doi.org/10.1080/14631377.2018.1442037

Enerdata-Odyssee (2019), *Energy Efficiency Indicators in Europe Database*. http://www.odyssee-indicators.org (accessed: 10.01.2019).

European Commission (1999), *Commission Staff Working Paper on Sustainable Industrial Development*, SEC (1999)1729.

European Commission (2010), *Europe 2020: A European strategy for smart, sustainable and inclusive growth*, COM (2010)2020.

Eurostat (2020), *Greenhouse gas emissions per capita*. https://ec.europa.eu/eurostat/web/products-datasets/-/T2020_RD300 (accessed: 9.02.2019).

Ferguson, P. (2015), *The green economy agenda: business as usual or transformational discourse?*, "Environmental Politics", 24:1, pp. 17–37. https://doi.org/10.1080/09644016.2014.919748

Georgeson, L., Maslin, M., Poessinouw, M. (2017), *The global green economy: a review of concepts, definitions, measurement methodologies and their interactions*, "Geo: Geography and Environment", 4 (1), pp. 1–23. https://doi.org/10.1002/geo2.36

Gilli, M., Giovanni, M., Mazzanti, M., Francesco, N. (2017), *Sustainable development and industrial development: manufacturing environmental performance, technology and consumption/production perspectives*, "Journal of Environmental Economics and Policy", 6:2, pp. 183–203. https://doi.org/10.1080/21606544.2016.1249413

Harris, J.M. (2013), *Green Keynesianism: Beyond Standard Growth Paradigms*, Global Development and Environment Institute Working Paper, No. 13–02, GDAE, Tufts University.

Jackson, T. (2009), *Prosperity without growth: economics for a finite planet*, Earthscan, London. https://doi.org/10.1260/0958-305X.22.7.1013

Jänicke, M. (2012), *Green growth: from a growing eco-industry to economic sustainability*, "Energy Policy", 48, pp. 13–21. https://doi.org/10.1016/j.enpol.2012.04.045

Kaldor, N. (1967), *Strategic Factors in Economic Development*, Cornell University Press, Ithaca.

Li, Y. (2015), *Towards Inclusive and Sustainable Industrial Development*, "Development", 58, pp. 446–451. https://doi.org/10.1057/s41301-016-0055-8

Lütkenhorst, W., Altenburg, T., Pegels, A., Vidican, G. (2014), *Green Industrial Policy. Managing Transformation under Uncertainty*, Deutsches Institut fűr Entwicklungspolitik. Discussion Paper, 28. https://doi.org/10.13140/2.1.1706.7529

Meadows, D.H., Randers J., Meadows D.L. (2005), *Limits to Growth. The 30-Year Update*, Earthscan, London.

Ministry of Economic Development of Poland (2017), *The Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030)*, Warsaw.

OECD (2002), *Indicators to measure decoupling of environmental pressure from economic growth*, SG/SD (2002)1/Final. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&cote=sg/sd(2002)1/final (accessed: 9.02.2019).

OECD (2011), *Towards Green Growth: Monitoring Progress. OECD Indicators*. https://www.oecd.org/greengrowth/48224574.pdf (accessed: 9.02.2019).

Office of the Government of the Czech Republic, Department of Sustainable Development (2017), *Strategic Framework Czech Republic 2030*. https://www.cr2030.cz/strategie/wp-content/uploads/sites/2/2018/05/Strategic_Framework_CZ2030_graphic2.compressed.pdf (accessed: 13.07.2020).

Pach-Gurgul, A., Ulbrych, M. (2019), *Progress of V4 Countries towards the EU's Climate and Energy Targets in the Context of Energy Security Improvement*, "Entrepreneurial Business and Economics Review", 7 (2), pp. 175–197. https://doi.org/10.15678/EBER.2019.070210

Partnership for Action on Green Economy (PAGE) (2017), *Green Industrial Policy and Trade: A Tool-Box*. https://www.un-page.org/files/public/gita_manual_150ppi_full_3.pdf (accessed: 9.02.2019)

Pearce, D., Markandya, A., Barbier, E. (1989), *Blueprint for a Green Economy*, Earthscan Publications Ltd., London.

Porter, M.E., Linde, C. van der (1995), *Toward a New Conception of the Environment-Competitiveness Relationship*, "Journal of Economic Perspectives", 9 (4), pp. 97–118. http://dx.doi.org/10.1257/jep.9.4.97

Rachwał, T. (2015), *Structural Changes in Polish industry after 1989*, "Geographia Polonica", 88 (4), pp. 577–605. http://dx.doi.org/10.7163/GPol.0035

Rodrik, D. (2014), *Green Industrial Policy*, "Oxford Review of Economic Policy", 30 (3), pp. 469–491. https://doi.org/10.1093/oxrep/gru025

Seetoh, K.C., Ong, A.H.F. (2008), *Achieving Sustainable Industrial Development Through a System of Strategic Planning and Implementation: The Singapore Model*, [in:] T.C. Wong, B. Yuen, C. Goldblum (eds.) *Spatial Planning for a Sustainable Singapore*, Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-6542-2_7

The Adecco Group (2018), *4th Industrial Revolution in Central and eastern Europe*. http://www.adecco.si/wp-content/uploads/2018/07/Inovantage-June-18th-Adecco.pdf (accessed: 9.02.2019).

Ulbrych, M. (2018), *The Role and Importance of Manufacturing Trade Cooperation of the Visegrad Group Countries*, Proceedings of 18th International Joint Conference: Central and Eastern Europe in the Changing Business Environment, Oeconomica Publishing House, Bratislava, pp. 455–466.

UNCTAD (2020), *Development and Globalization. Facts and Figures*. https://stats.unctad.org/Dgff2016/prosperity/goal9/target_9_3.html (accessed: 10.01.2019).

UNEP (2011), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policy Makers*. http://www.unep.org/greeneconomy (accessed: 9.02.2019).

UNEP (2019), *Shades of green: an introduction to the green economy for parliamentarians*, Issue Brief, February. https://www.unenvironment.org/resources/publication/shades-green-introduction-green-economy-parliamentarians-issues-brief (accessed: 9.02.2019).

UNIDO (2013), *Lima Declaration: Towards inclusive and sustainable industrial development*, 15 UNIDO General Conference Lima-Peru, 2–6.12.13, Resolution GC.15/RES1.

UNIDO (2017), *Structural Change for Inclusive and Sustainable Industrial Development*, UNIDO, Vienna.

UNIDO (2019), *Statistical Indicators of Inclusive and Sustainable Industrialisation. Biennial Progress Report 2019*, UNIDO, Vienna.

UNIDO (2020), *Statistical Databases*. https://www.unido.org/researchers/statistical-databases (accessed: 10.01.2019).

United Nations (1992), *Rio Declaration on Environment and Development, The United Nations Conference on Environment and Development*, Rio de Janeiro, Brazil, 3–14 June 1992, A/CONE.151/26 (vol. I). https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf (accessed: 9.02.2019).

United Nations (2012), *The Future we want. Outcome document of the United Nations Conference on Sustainable Development*, Rio de Janeiro, Brazil, 20–22 June 2012. https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf (accessed: 9.02.2019).

United Nations General Assembly (2015), *Transforming Our World: The 2030 Agenda for Sustainable Development*, A/RES/70/1.

United Nations World Commission on Environment and Development (1987), *Report of the World Commission on Environment and Development: Our Common Future*, Oxford University Press, Oxford.

US Energy Information Administration (2019), *International Energy Outlook 2019 with projections to 2050*, Office of Energy Analysis, U.S. Department of Energy, Washington.

World Bank (2012), *Inclusive Green Growth. The Pathway to Sustainable Development*, The World Bank, Washington. https://openknowledge.worldbank.org/handle/10986/6058 (accessed: 9.02.2019).

Zodape, H., U Patil P., Ranveer, A. (2015), *Sustainable Industrial Development*, "International Journal for Research in Applied Science & Engineering Technology (IJRASET)", 3 (XII), pp. 111–116.

Streszczenie

Postępy w osiągnięciu zrównoważonego rozwoju przemysłowego – przypadek Czech i Polski

Celem artykułu jest wyjaśnienie koncepcji zrównoważonego rozwoju przemysłowego i przedstawienie wyników badania w zakresie postępów w osiąganiu celów w tej dziedzinie przyjętych przez Organizację Narodów Zjednoczonych (ONZ) w 2015 r. Analiza dotyczy czeskiej i polskiej gospodarki w okresie 2000–2018. Zgodnie z Agendą ONZ na rzecz Zrównoważonego Rozwoju 2030 zidentyfikowano także potrzebę promowania inkluzywnej i zrównoważonej industrializacji. W kontekście zrównoważonego rozwoju przemysłowego podkreśla się, że powinien on wspierać konkurencyjną gospodarkę, tworzyć miejsca pracy i chronić środowisko poprzez efektywne wykorzystanie zasobów nieodnawialnych. W celu oceny tego zjawiska w analizowanych gospodarkach wykorzystano wskaźniki zidentyfikowane przez ONZ w ramach SDG 9.

Słowa kluczowe: cele zrównoważonego rozwoju, SDG 9, zielona polityka przemysłowa, zrównoważony rozwój przemysłowy

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.31

Investment in Human Capital Within the Creative Economy Formation: Case of the Eastern and Central Europe Countries

Sergiy Londar
Doctor of Economic Sciences, Professor, State Scientific Institution "Institute of Educational Analytics", Kyiv, Ukraine, e-mail: s.londar@iea.gov.ua

Andrii Lytvynchuk
Candidate of Economic Sciences (Ph.D.), State Scientific Institution "Institute of Educational Analytics", Kyiv, Ukraine, e-mail: litvinchuk.andrew@gmail.com

Nataliia Versal
Candidate of Economic Sciences (Ph.D.), Docent, Taras Shevchenko National University of Kyiv, Department of Insurance, Banking and Risk-Management, Kyiv Ukraine, e-mail: natalia_versal@knu.ua

Tatiana Posnova
Candidate of Economic Sciences (Ph.D.), Docent, University of the State Fiscal Service of Ukraine, Department of Economic Theory, Irpin, Ukraine
e-mail: tatosnova@gmail.com

Hanna Tereshchenko
Candidate of Economic Sciences (Ph.D.), Senior Research Officer
State Scientific Institution "Institute of Educational Analytics", Kyiv, Ukraine
e- mail: tganna@ukr.net

Abstract

The purpose of the article is to determine the link between investing in human capital and the formation of the creative economy. Given that human capital is considered both a factor in the socio-economic development of countries and a prerequisite for the formation of the creative economy and consequently, for the modernization

changes in today's economy, there is a need to study the areas of investment in human capital.
The study is based on an analysis of a number of indicators in Eastern Europe (Ukraine and Moldova) and Central Europe (Poland, the Czech Republic, Romania, Hungary, and Lithuania): total expenditure on education, the analysis of which made it possible to determine the level of education funding in each country; the average cost per pupil/student, which allowed us to identify trends in spending by funding organizations; the share of total expenditure on education in GDP, depending on the level of education, which made it possible to determine the priority and sufficiency of education system funding; the cost allocation indicator by funding organizations; and the human development index, which measures living standards, literacy, education, and longevity. The study also focuses on analyzing data that determine the global innovation index, since its calculation is based on the assessment indicators of human capital and research (education, tertiary education, research, and development) and creative outputs (intangible assets, creative goods, and services, online creativity).
Based on the results of the research, it was concluded that human capital is the main factor that boosts the creative economy, and enhancing human capital depends on the level of education and scientific progress in a country. Empirical evidence shows that directing investment in human capital contributes to the formation of the creative economy, improving the competitiveness of countries, and at the same time, ensuring the appropriate rates of their socio-economic development.

Keywords: human capital, investment in human capital, education, education funding, creative economy, innovation economy

JEL: H52, I22, I23, I25

Introduction

The term "creative economy" has a lot of meanings and is not straightforward, given that it emerges at the intersection of fields such as art, culture, business, and technology. The term itself was proposed by Howkins in 2001, and it meant that "the transactions of creative products that have an economic good or service that results from creativity and has economic value" (Howkins 2001, p. 8). However, this definition lacks the specificity that emerges if we clearly distinguish three parameters: types of creativity (scientific, cultural, technological, economic) (*The Creative Economy Report* 2008); creative industries, whose number varies depending on the model that underlies their division (according to the UK DCMS model: advertising, architecture, art and antiques market, design, fashion, film and video, music, performing arts, publishing, software, television and radio, and video and computer games); the creative class, according to Florida (2002). So, we get a triad that will have its specifics in each country.

Why is there such a focus on the creative economy today? The reason is obvious because, according to Howkins, "The creative economy deals in ideas and money." Both ideas and money matter, especially within the multiplication of wealth that is made possible through the realization of ideas. Before the global financial crisis, the "inter-

national trade in creative goods and services experienced an unprecedented average annual growth rate of 8.7 percent" in 2000–2005 (*The Creative Economy Report* 2008) and an average growth rate exceeding 7 percent between 2002 and 2015 (Creative Economy Outlook 2018). The traditional goods and services trade, in particular, the commodities trade, has not been able to demonstrate such significant growth.

Another important factor that determines the specifics of the creative economy is developing countries' ability to strengthen their position in international trade. In 2002, emerging economies together recorded 84.3 bln USD in trade in creative goods. By 2015, this number had climbed to 265 bln USD (Creative Economy Outlook 2018). It is irrelevant how rich in natural resources a country is; what is of great importance is how strong the nation's creative skill is and in what way the creative class is supported by the economic agents, in particular by the government. This is especially true for Ukraine and Moldova. Their regions have been annexed, and in particular, they were areas where a large proportion of industry was concentrated. The formation of a new paradigm of economic development of society, in which creative human capital becomes the determining factor of production and economic growth, could be an important milestone in the economic growth of Ukraine and Moldova.

The purpose of this paper is to prove that the development of a creative economy depends on the quality of higher education and science in the analyzed countries. The next section shows the main approaches in the research on the role of human capital for the development of the creative economy. Section 3 characterizes the data set and main indicators, based on which, further analysis is performed. Section 4 summarizes the empirical evidence on the investments in education, depending on the level of education (pre-school education, primary education, the first stage of secondary education, the second stage of secondary education, post-secondary education, tertiary education, doctoral studies or equivalent) and provides some policy implications. Conclusions are given in Section 5.

Literature review

First, attention is concentrated on the hypothesis that there is a link between investing in human capital and the development of the creative class and the creative economy, which results in economic growth. Therefore, research into the issues of the development and efficiency of investment in human capital has been the subject of interest since the 1960. Human capital, according to Becker – one of the creators of the theory of human capital – is a stock of knowledge, skills, and motivation that is available to each person (Becker 1964).

Fischer, Dornbusch, and Schmallensee believe that human capital reflects a person's ability to generate income. Human capital includes innate ability and talent, as well as education and qualifications (Fischer et al. 1988). This definition stresses a very important complement – the ability to generate income. Also, human resources have

become a crucial point for achieving a competitive advantage in today's economies. The necessary amount of effective human capital is a key reference for scientific and technological progress and the transition to a new technological development model in a country (Kuznets 2001; Diebolt and Hippe 2019). By contrast, the poor quality and value of national human capital, the poor quality of life, the underdevelopment of state institutions, and so on, are factors that constrain the development of a creative economy (Bilan et al. 2019).

Creative human capital is a set of specific values that create new values in the form of original, unique ideas, and new knowledge (Salikhov 2017, p. 47). Thus, the formation and development of this creativity require not only an understanding of the growing role and importance of human capital in today's economy but also massive investments for its comprehensive and progressive development.

It is no accident that at the Davos Forum, the experts emphasized that creativity will be among the three most sought after trends in the labor market by 2020 (The World Economic Forum 2019).

According to Florida, the founder of "creative class" theory, creativity depends on the environment that supports it – a wide range of social, cultural, and economic factors. Creativity is associated with the emergence of new working conditions, lifestyles, forms of communication, and the environment, which, in turn, stimulate creativity. Florida defines the creative class in areas of employment that are associated with structuring new models and producing ideas. It includes actors, designers, architects, but also "thought leaders," scientists, engineers, and even the entertainment industry; in other words, people who, in their work, must constantly solve non-standard tasks, analyze circumstances and risks, and offer new ways of development (Florida 2002).

The creative class facilitates new principles being brought into both work and everyday life. Members of this class profess new values, i.e., self-expression, individuality, freedom of choice, and mobility. The young generations especially possess such values. According to Florida, members of the creative class are distinguished by mobility, flexibility, self-education, a "new" workplace, leisure as a job, social involvement and active leisure, and interest in street culture (Florida 2002).

Along with evaluating the contribution of the creative class to the development of the creative economy, there was also the issue of determining the contribution of the creative industries to GDP, which Throsby draws attention to since creative goods often have no monetary value, although they certainly represent an intangible value to society (Throsby 2014).

According to Harrison and Huntington, the reasons for the backwardness and prosperity of countries are the cultural differences of society. Some cultural features contribute to modernization, while others, by contrast, impede a country's economic development. Thus, to construct a creative economy, investments in culture and the arts should be channeled as a means of enhancing the country's human capital (Harrison and Huntington 2000).

One of the central aspects of human capital formation is the idea that human capital (including innate talent) develops through conscious investment. Schultz stresses that people's abilities evolve through activities that have attributes of investment (Schultz 1971, p. 32). These include activities such as school education, workplace training, and health promotion. He also notes that investing in human capital is a way of overcoming a country's poverty. According to Shkurupiy, the creative capabilities of the individual, and in particular, the features of a producer of scientific knowledge and his cognitive resources, are formed by investing in education, health care, mobility, and access to information. At first glance, the link between investments and human capital is obvious. However, another question arises: to what extent will an increase in funding of these areas result in the rise of the human capital capacity? (Shkurupiy 2007)

Recent studies show the main areas of investment in human capital in the creative economy: 1) health care (including disease prevention); 2) living (improving living conditions; ensuring affordable housing; maintaining environmental requirements for habitat; safety and economic freedom; information services; ecology and environmental protection; forming creative infrastructure); 3) culture and art; 4) streamlining labor migration (information on the economic conditions in different fields and localities; moving workers to jobs with better labor productivity and wages); 5) employee motivation (addressing human needs); 6) education (general and specialist (i.e., master's, bachelor's degrees); formal and non-formal (self-education) education; training and retraining (i.e., advanced training)); 7) science (fundamental and applied scientific development) (Posnova 2018).

Methodology

In this research, investment in human capital is considered to be any actions that lead to an increase in a person's professional qualification and productive abilities, and the productivity of his work (Grachev et al. 2016). This definition is different from the above-mentioned definitions as it is difficult to determine someone's specialties (acquired through higher education institutions) belonging to the creative class since graduates can choose from a wide variety of professions nowadays. This means, for example, that graduates with a degree in finance can be employed as a marketing specialist and vice versa. At the same time, it becomes clear that quality and multifunctional higher education should be the basis for the formation of a creative class, regardless of the graduate specialties. That is why our research will focus on analyzing education expenditures by education level using indicators such as total expenditures, the average cost per student, the share of total spending on education in GDP, a breakdown of expenditures by funding organization, and the human development index.

The total expenditure on education is defined as the aggregate sum of expenditures of funding organizations, such as budget administrators (central and regional/local government agencies) and the private (non-government) sector, represented by house-

holds and firms. The analysis of this indicator in the dynamics allows us to determine the level of financing of education in the country.

The average cost per student is defined as the ratio of the total cost to the number of students. Such analysis is also important for identifying trends in spending by funders.

The total expenditure on education per GDP by education level (pre-school education are given as: ISCED 0, elementary education; ISCED 1, first stage of secondary education; ISCED 2, second stage of secondary education; ISCED 3, post-secondary, non-tertiary education; ISCED 4, higher education (short cycle, bachelor or equivalent, master's degree or equivalent) (ISCED 5–7), doctoral or equivalent (ISCED 8). These indicators are relevant for determining the priority and adequacy of funding of the education system.

The breakdown of expenditures by funding organization shows a balance in education funding between the state and the private sector.

The human development index is an integral indicator that is determined to measure living standards, literacy, education, and life expectancy.

The article is also based on data used to determine the global innovation index since the indicators to calculate are indicators of human capital and research (education, tertiary education, research, and development) and creative output (intangible assets, creative goods and services, online creativity).

The analyzed period (2009–2018) covers crisis and post-crisis periods in Poland, the Czech Republic, Romania, Hungary, Lithuania, Ukraine, and Moldova. This period includes post-crisis development after the global financial crisis of 2007–2009, as well as a critical political, economic, and social crises in Ukraine due to the Russian Federation's aggression in the form of a hybrid war, which has begun in 2014.

Results

First, it is necessary to analyze the average cost per student of GDP per capita. This indicator reflects the situation with education funding since it takes into account not only the volume of GDP but also the size of the population that produces it, and that actually uses it. Figure 1 presents a comparison of the indicator and its parts by country. By focusing on the indicator only, the analysis will give reasonable results for Ukraine: the average ratio for 2012–2017 is 52.1% versus 27.4% for Romania, 28.8% for Hungary, 30.6% for Poland, 27.3% for Lithuania, and 22.0% for the Czech Republic.

However, focusing on the parts of this indicator shows that education funding in Ukraine has become much worse, especially during political, economic and social crises 2014–2017, compared to countries from Central Europe. So, in 2012, the costs per student in Ukraine were on a par with the costs in Romania, in euro equivalent; then, in subsequent years, they substantially decreased due to the devaluation of the national currency. On the one hand, this can be seen as a positive aspect, as it

led to an enhancement of competitiveness in Ukrainian education, at least regarding price. On the other hand, the payment of teachers is an important component of the cost of education, which means that there will be an outflow of highly professional teachers to countries where salaries are higher. And, as a result, there will not be a significant increase in the competitiveness of Ukrainian education unless effective action is taken to reform the country's educational system.

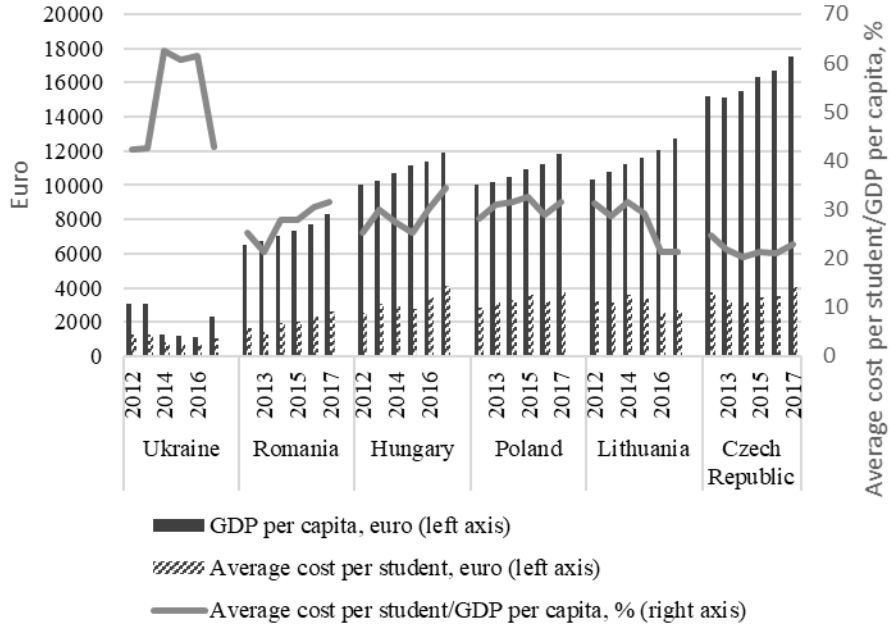

Figure 1. GDP per capita and average cost per student in Poland, the Czech Republic, Romania, Hungary, Lithuania, Ukraine between 2012 and 2017
Source: authors' own calculations based on data from Eurostat and the State Statistics Service of Ukraine – https://ec.europa.eu/eurostat/web/products-datasets/-/sdg_08_10 (accessed: 23.08.2020), https://appsso.eurostat.ec.europa.eu/nui/submitViewTable Action.do (accessed: 23.08.2020), http://www.ukrstat.gov.ua/?fbclid=IwAR2jnDdnfXFtUi718jc-oMd1z3NYQNlQAKJvMNmnGiwLDzJA9drsY7bXZhY (accessed: 23.08.2020)

Table 1 presents data in the local currency of Ukraine for a better understanding of the real situation with education funding because, during the analyzed period, the local currency was devalued by more than 70%. In addition, it would be desirable to evaluate the structure of spending, given that a large proportion of the costs of schools are for utilities, not for logistics and human resources.

Total spending on education had an upward trend in Ukraine between 2009 and 2018. Thus, if total expenditures for education amounted to 77.41 bln UAH in 2009, then in 2018, it reached 214.0 bln UAH. One can observe an almost three-fold increase, despite the fact that this period covers two crisis periods in Ukraine (2008–2010 – the influence of the global financial crisis, and 2014-present – the annexation of Crimea

by the Russian Federation and war in the eastern part of Ukraine). The average total expenditures on education amounted to 84.25 bln UAH in 2009–2010, 108.23 bln UAH in 2011–2013, 125.53 bln UAH during the most difficult period in Ukraine – 2014–2016, and 198.45 bln UAH in 2017–2018. The indicator of the average cost per student has the same trend: 9,850 UAH in 2009–2010, 13,170 UAH in 2011–2013, and 17,900 UAH in 2014–2016, and 28,050 UAH in 2017–2018. In general, the average cost per student increased 3.4 times. Analyzing these indicators in comparison with GDP shows a negative trend, since the share of total education expenditure in GDP constantly declined, from 8.48% in 2009 to only 6.01% in 2018 (Table 1).

Table 1. National Accounts in Education in Ukraine, 2009–2018

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total population (million people)	46.0	45.8	45.6	45.6	45.4	42.9	42.8	42.6	42.5	42.3
Gross Domestic Product at Actual Prices (GDP), UAH billion	913.4	1120.6	1349.2	1459.1	1522.7	1586.9	1988.5	2383.2	2983.9	3560.6
Total expenditure on education, UAH billion	77.4	91.1	97.6	111.2	115.9	109.5	127.1	140.0	182.9	214.0
The average cost per student, UAH thousand	8.9	10.8	11.7	13.5	14.3	15.5	18.2	20.0	26.0	30.1
Total expenditure on education as a % of GDP	8.48	8.13	7.23	7.26	7.62	6.9	6.39	5.87	6.12	6.01
Preschool education (ISCED 0), %*	11.2	11.7	12.6	13.6	14.0	14.4	14.9	15.0	15.9	15.4
Primary education (ISCED 1), %	13.0	13.6	13.8	15.1	15.6	16.2	16.8	17.6	19.8	20.9

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
The first stage of Secondary Education (ISCED 2), %	19.2	18.3	17.3	17.8	17.7	18.1	18.0	18.7	21.2	22.3
The second stage of secondary education (ISCED 3), %	7.1	7.2	7.9	8.0	7.5	6.9	6.5	6.3	6.8	5.7
Post-secondary non-tertiary education (ISCED 4), %	6.0	6.2	6.1	6.0	6.3	6.0	5.5	5.0	4.9	5.2
Higher Education (short cycle, bachelor or equivalent, master's degree or equivalent) (ISCED 5–7), %	42.0	41.4	40.7	38.0	37.2	36.8	36.8	35.8	29.6	28.6
Doctoral studies or equivalent (ISCED 8), %	1.5	1.6	1.6	1.5	1.7	1.6	1.5	1.6	1.8	1.9

Note. *the share of funding for each of the segments of the education system (ISCED 0–8) in total funding.
Source: State Statistics Service of Ukraine, http://www.ukrstat.gov.ua/?fbclid=IwAR2jnDdnfXFtUi718jcoMd1z3NYQNlQAKJvMNmnGiwLDzJA9drsY7bXZhY (accessed: 23.08.2020).

The share of public spending on education was 5.94% of GDP in 2017, 5.9% in 2018, and 6% in 2019, which is equivalent to the same share in EU countries. However, it is not possible to compare the GDP of the European countries with that of Ukraine since they differ in values. In the context of the Eastern Partnership (EaP) countries, as of 2014, the share of public spending on education in Moldova was 8.6%, in Georgia – 3.8%,

in Armenia – 2.8%, in Azerbaijan – 3%, in Belarus – 5%, and in Ukraine – 5.9%. Therefore, it is obvious that there is a lack of funding for education in Ukraine compared to the EU countries, but in the context of the EaP countries, Ukraine is one of the leaders in education funding.

It is also worth paying attention to the ratio of costs of pre-school, school, and vocational and higher education, where different trends can be noted, and such trends are controversial: there is a redistribution of costs from vocational and higher education in favor of pre-school and school education. Such trends are difficult to assess positively, as today there is a lack in the segment of working professions in Ukraine. At the same time, the costs of specialist training for working professionals are high due to the increase in the technological component under the training process.

The distribution of costs as a percentage by the source of funding is shown in Figure 2 for Poland, the Czech Republic, and Lithuania, and in Figure 3 for Ukraine. It is evident that government funding plays a crucial role both in Central and Eastern European countries, and the share of this type of funding has not changed significantly in recent years, and the trend is for a slight increase.

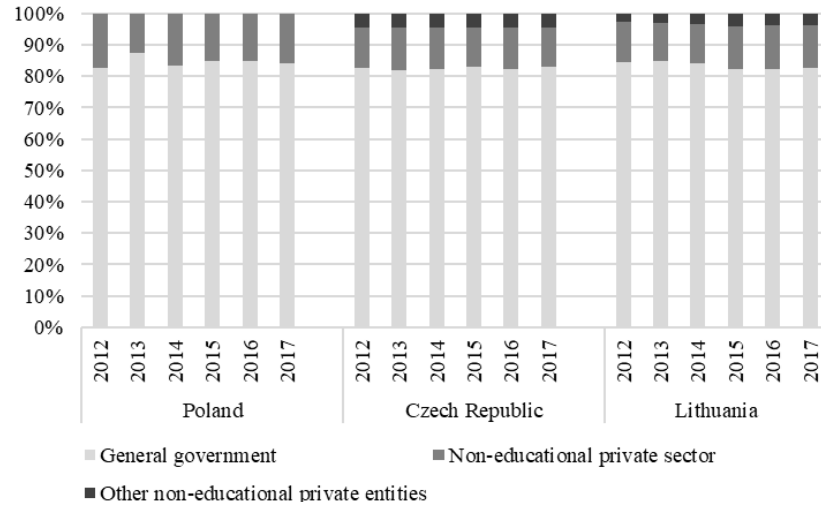

Figure 2. Distribution of total costs by funding source in Poland, the Czech Republic, and Lithuania, 2012–2017, %
Source: authors' own calculations based on data from Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_fine01&lang=en (accessed: 23.08.2020).

The Ukraine government's share in education funding increased from 80% to 88.5% between 2009 and 2018. This trend can be assessed either positively or negatively.

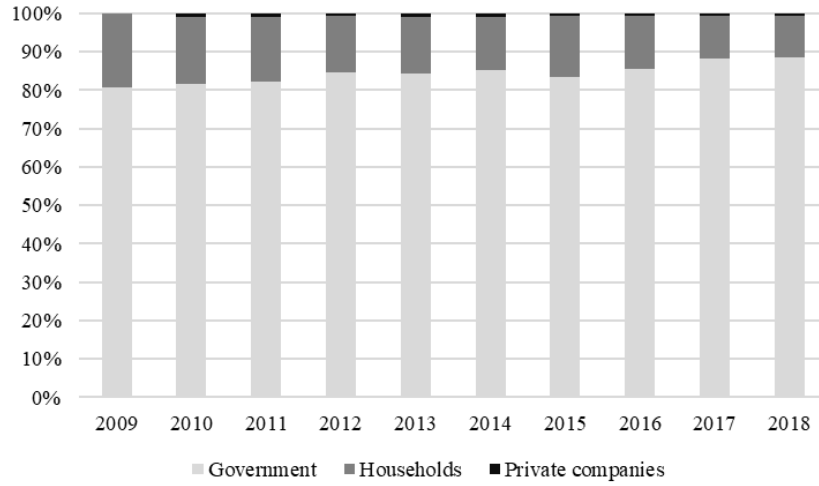

Figure 3. Distribution of total costs by funding source in Ukraine, 2009–2018, %
Source: authors' own calculations based on data from the State Statistics Service of Ukraine, http://www.ukrstat.gov.ua/?fbclid=IwAR2jnDdnfXFtUi718jc-oMd1z3NYQNlQAKJvMNmnGiwLDzJA9drsY7bXZhY (accessed: 23.08.2020).

It can be viewed positively, as government support is the main resource in providing quality education to disadvantaged segments of the population. This is especially true when entrance admission barriers to elementary school and higher education are being lifted. Nevertheless, it might be regarded as negative because the increase in the share of government spending is being implemented amid a reduction in the share of private companies financing education. Thus, in Ukraine, the share of private companies in education funding has fallen from 1% in 2010 to 0.7% in 2018, and this is against the backdrop of growing business needs for highly qualified specialists, in particular, for graduates of vocational schools. These private funds should be the basis for reforming vocational education to meet the requirements of the business, in particular, through the modernization of training facilities and dual education development.

There has also been a decline in the share of household funds in education, which is a negative trend as well. This reduction is caused not so much by the decline in household incomes but by the reorientation of households to finance an education abroad.

A detailed structure of total expenditures on education by funding organization is presented in Figure 4. In this case, it is worth paying attention to the structuring of government expenditures. Thus, in 2016, 61.6% of total spending on education was financed through regional budgets, and in 2018 it increased to 70.6%. Meanwhile, the share of the Ministry of Education and Science of Ukraine decreased from 19% in 2016 to 13.1% in 2018. The changes in shares of other government authorities were not so significant.

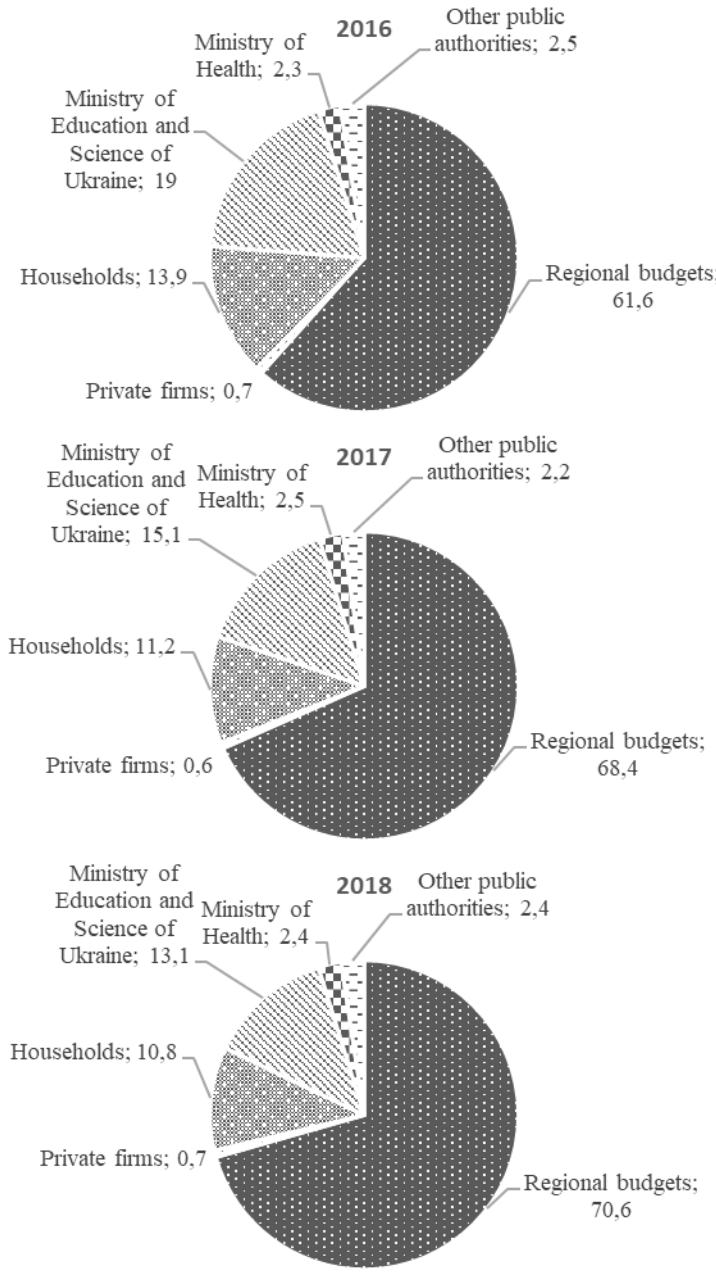

Figure 4. Structure of total expenditures on education by funding organization in Ukraine in 2016–2018, %
Source: authors' own calculations based on data from the state Statistics Service of Ukraine, http://www.ukrstat.gov.ua/?fbclid=IwAR2jnDdnfXFtUi718jc-oMd1z3NYQNlQAKJvMNmnGiwLDzJA9drsY7bXZhY (accessed: 29.07.2020).

The share of education funding from private firms is very low (0.7% in 2018). At the same time, private firms should be interested in financing the training of highly professional staff. One of the targets for the development of the education system is the introduction of a continuous integrated professional education system based on the integration of educational, scientific, and industrial activities. In turn, the preparation of a scientific, technical, or professional specialist is carried out at the basic stages of a person's life cycle: student (school) – student (higher education institution/vocational school) – specialist (enterprise). Integrated programs begin to be implemented in the upper classes of general education institutions. In this system, three stages of investments in human capital should be distinguished. The first stage should be funded by local government institutions and partly by households; the second stage – by central government, households, and enterprises; and the third stage – by employees and enterprises. However, the best way is for the retraining and training of employees to be funded by enterprises (Dubik and Mityakov 2013).

Financial support for education affects the quality of specialist training and, as a result, the development of human capital. Figure 5 shows the trends in the human development index (HDI) in the analyzed countries.

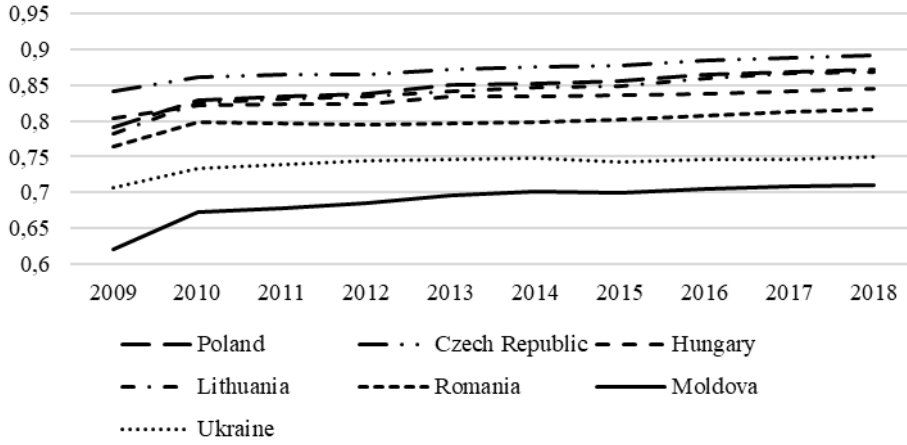

Figure 5. Trends in human development index, 2009–2018
Source: Human Development Data (1990–2018), http://hdr.undp.org/en/data (accessed: 29.07.2020).

In general, the countries of Central Europe show a high level of HDI. The development trends are also almost the same, with steady growth. It is also worth noting the leap that occurred after the global financial crisis in all countries, both in Central Europe and especially in Eastern Europe. Comparing the indices of Ukraine and Moldova shows that the situation in Ukraine, despite the higher values of HDI, is worse for growth trends. This is especially evident in the recent crisis years in Ukraine.

Considering the correlation between the cost per student and HDI in Ukraine shows its high level during the analyzed period (Figure 6), except for the period 2014–2016 when the country faced the most severe stage of the hybrid war with the Russian

Federation, which caused the financial, economic and socio-political crisis. However, generally, it did not significantly affect the development of human capital of Ukraine. There is great potential for development, including creative economy capabilities.

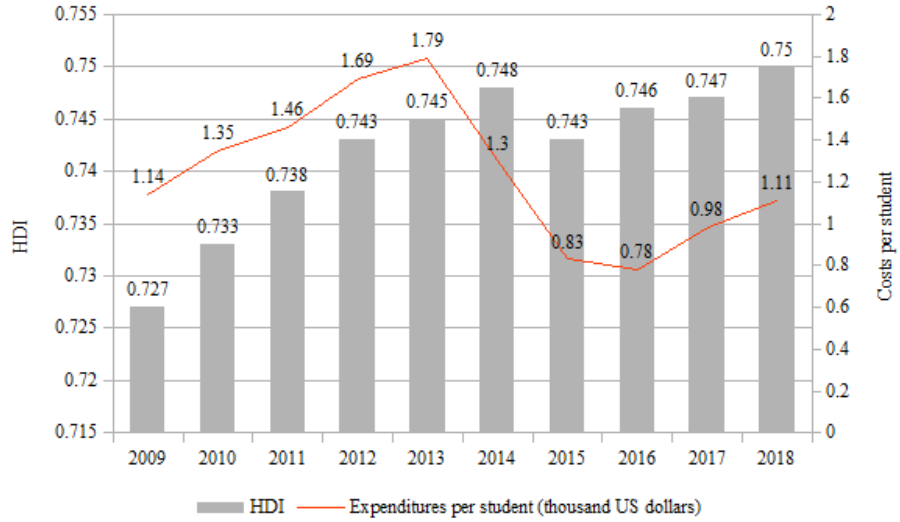

Figure 6. Human development index (left axis) and costs per student (right axis) in Ukraine, 2009–2018
Source: State Statistics Service of Ukraine; Human Development Data (1990–2018), http://hdr.undp.org/en/data (accessed: 22.08.2020).

Considering the components of the global innovation index, the three most important blocks should be distinguished: human capital & research, knowledge & technology outputs, and creative outputs. Figure 7 shows the average annual growth of these blocks between 2011 and 2019 in the analyzed countries and the volatility of growth. There is a direct correlation between creative outputs and human capital & research, and between creative outputs and knowledge & technology outputs: the better the situation with the human capital & research and the development of knowledge & technology, the more the creative outputs.

The leaders in creative output average growth during 2012–2019 are Ukraine and Lithuania. Evaluating creative output volatility shows that the most variable countries are Hungary, Ukraine, and Romania. This could be explained by the more active development of these countries and the search for new opportunities. Looking at the human capital & research volatility shows that the Czech Republic, Poland, Hungary, and Ukraine are more stable, than other countries; however, the least stable in their development are Lithuania and Moldova. The volatility of knowledge & technology outputs is much higher than human capital & research volatility, and this is quite logical. The least volatile countries are Romania and Moldova, followed by Poland, Ukraine, the Czech Republic, and Hungary, while the most volatile country is Lithuania.

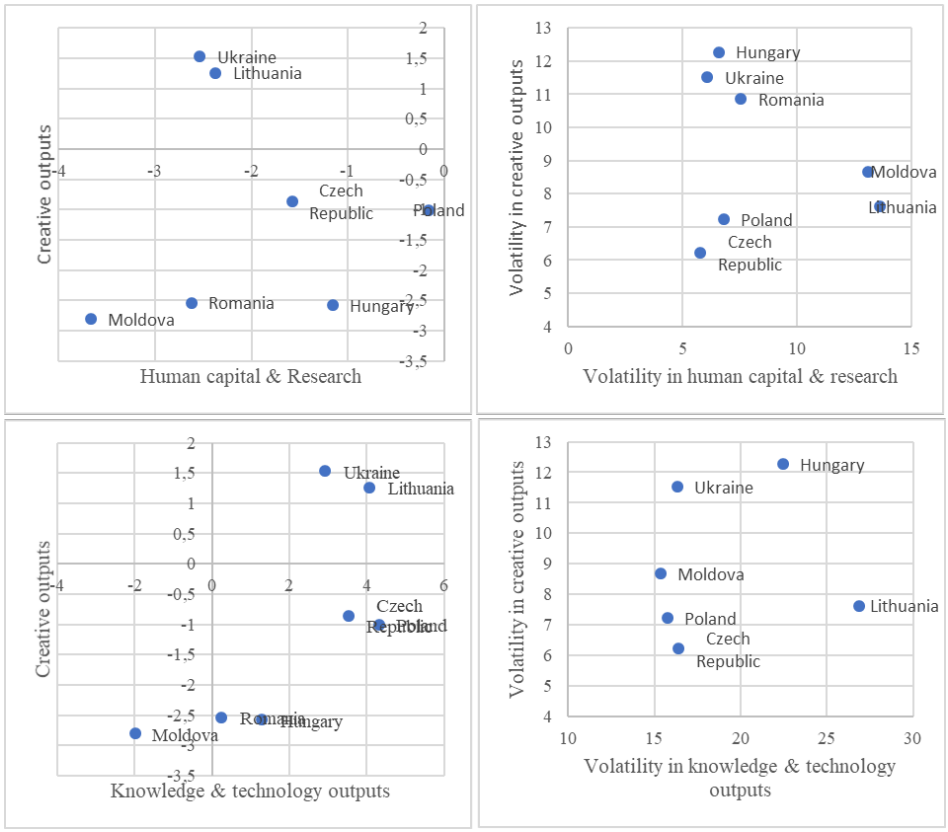

Figure 7. The average growth of human capital & research, knowledge & technology outputs, creative outputs, and growth volatility in Poland, Czech Republic, Romania, Hungary, Lithuania, Ukraine, and Moldova in 2011–2019
Source: authors' own calculation based on data from The Global Innovation Index Reports 2011–2019, https://www.wipo.int (accessed: 23.08.2020).

Given the fact that the article paid special attention to education and its impact on the formation of a creative economy, we consider the components of this block: education, tertiary education, and research & development (R&D). First, it is obvious that the greatest importance in the formation of a general assessment of human capital is that education and tertiary education play a key role, as shown in Fig. 8. The volatility of education and tertiary education in most countries is at approximately the same level, except for two countries – Lithuania and Moldova.

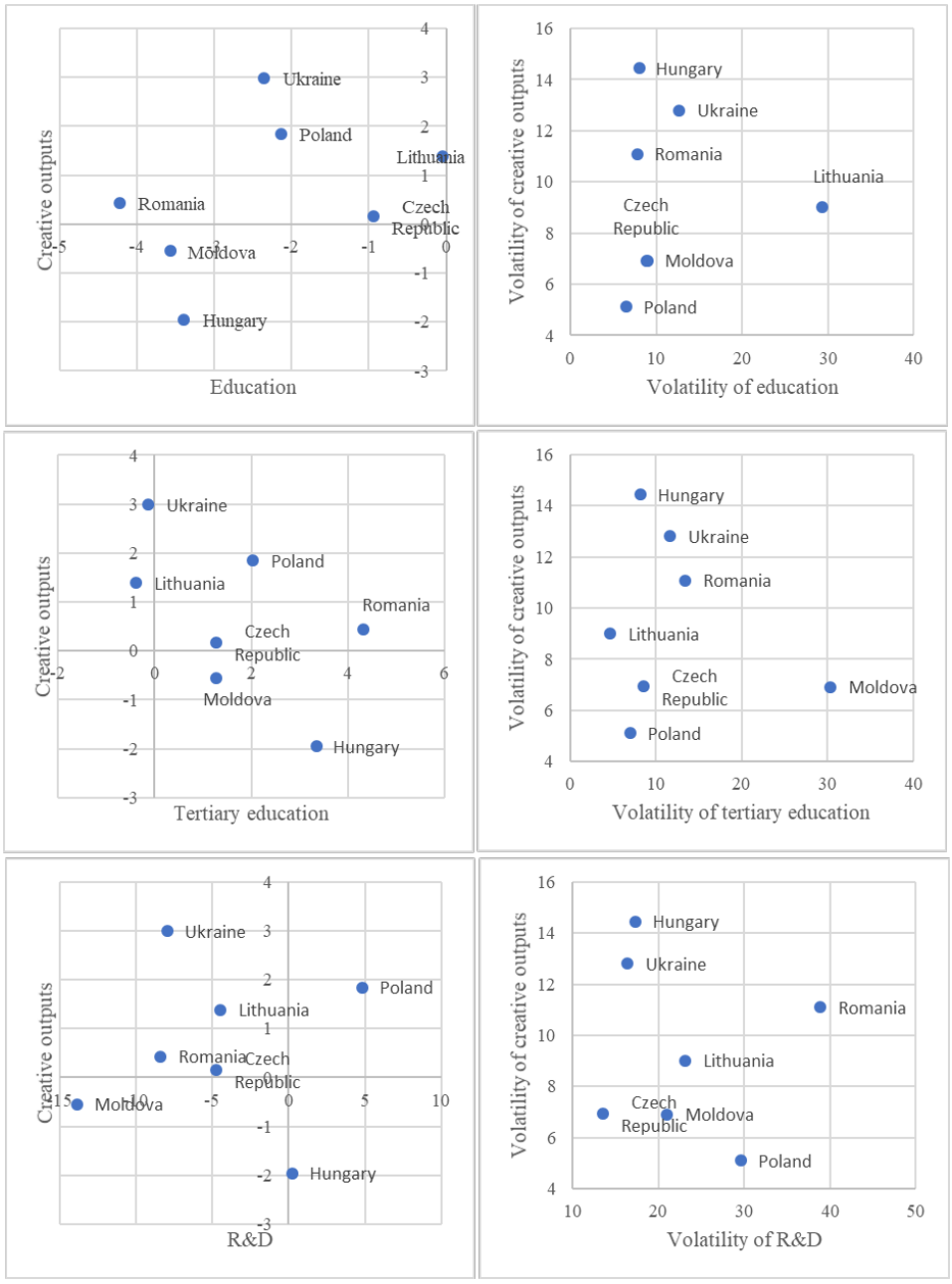

Figure 8. The average growth of education, tertiary education, R&D creative outputs, and growth volatility in Poland, the Czech Republic, Romania, Hungary, Lithuania, Ukraine, and Moldova between 2011 and 2019
Source: authors' own calculation based on data from The Global Innovation Index Reports 2011–2019, https://www.wipo.int (accessed: 23.08.2020).

So, the progress of the creative economy depends to a large extent on the development of education and science. Investments in science, technology, and innovation are an integral part of the effective creative economy. The study shows that the countries of Central and Eastern Europe have significant potential in the development of a creative economy, especially due to the existing strong basis – education. Of course, there are issues that affect the quality of education, in particular, funding, which is not sufficient in Eastern European countries.

Conclusions

In the creative economy, the main determinants of production and economic development are innovation and creative human capital. Human capital has its own peculiarities of functioning. In turn, the basis of any innovation is unique, extraordinary ideas, and knowledge, which are a function of the relevant competencies of creative people, whose ability to think and produce new, original ideas is called creativity.

Education is the basis for long-term effective realization of knowledge, and human abilities play one of the key roles in managing the development of creative capital. The leading function of education in the creative economy is determined by the fact that progress is not achieved through two-step education (i.e., school and further education) but is based on lifelong learning.

Thus, it was determined that today, as society is developing, the main factor in the creative economy is human capital, and the development of human capital depends on the level of development of education and science in the country. Empirical data show that directing investment in human capital contributes to the strengthening of a creative economy, improving the competitiveness of the country, and at the same time, guaranteeing the appropriate rates of socio-economic development.

The analysis conducted in the study, on the example of Poland, Lithuania, Romania, Hungary, the Czech Republic, Ukraine, and Moldova, revealed several points. First, the differences in funding sources are insignificant, and the main role is played by public funding – more than 80% of education spending comes from the government. Secondly, there are differences between the human development index in Central Europe and Eastern Europe. In Eastern Europe, it is not higher than 0.75, while the maximum values in Central Europe are more than 0.85. It should be emphasized that the example of Ukraine shows that the human development index does not always correlate with the average cost per student, which decreased significantly in Ukraine due to the sharp devaluation of the national currency. Third, the analysis of the components of the global innovation index (human capital & research, knowledge & technology outputs, creative outputs) showed that it is difficult to differentiate between the countries of Central and Eastern Europe, as in all countries there is significant volatility in all indicators, and it is impossible to distinguish patterns. At the same time,

there are two countries – Poland and the Czech Republic – where the volatility of the analyzed indicators is not too high.

In order to develop human capital – one of the main factors in strengthening a creative economy – especially professional competencies and talents, it is necessary to ensure appropriate investments, increasing the level of education funding at three levels: central government funding, local government funding, and funding from households.

References

Becker, G. (1964), *Human Capital*, Columbia University Press, New York.

Bilan, Y., Vasilyeva, T., Kryklii, O., Shilimbetova, G. (2019), *The creative industry as a factor in the development of the economy: dissemination of European experience in the countries with economies in transition*, "Creativity Studies", 12 (1), pp. 75–101. https://doi.org/10.3846/cs.2019.7453

Creative Economy Outlook (2018), *Trends in international trade in creative industries*. https://unctad.org/en/PublicationsLibrary/ditcted2018d3_en.pdf (accessed: 19.07.2020).

Diebolt, C., Hippe, R. (2019), *The long-run impact of human capital on innovation and economic development in the regions of Europe*, "Applied Economics", 51 (5), pp. 542–563. https://doi.org/10.1080/00036846.2018.1495820

Dubik, E., Mityakov, S. (2013), *Ynvestycyy v chelovecheskyj kapytal na raznih stadyyah zhyznennogo cykla*, "Kreatyvnaya ekonomyka – Creative Economy", 9 (81), pp. 3–13. https://cyberleninka.ru/article/n/investitsii-v-chelovecheskiy-kapital-na-raznyh-stadiyah-zhiznennogo-tsikla/viewer [in Russian].

Fischer, S., Dornbusch, R., Schmalensee, R. (1988), *Introduction to Macroeconomics*, McGraw-Hill Book Company, New York.

Florida, R. (2002), *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*, Basic Books, New York.

Grachev, S.A., Gundorova, M.A., Moshnov V.A. (2016), *Ynvestycyy v chelovecheskyj kapytal. Ucheb. Posobye*, Yzd-vo VlGU, Vladymyr [in Russian].

Harrison, L., Huntington, S. (2000), *Culture Matters: How Values Shape Human Progress*, Basic Books, New York.

Herman, E., Suciu, M.C. (2019), *Towards a smart, inclusive and sustainable development. Investment in human capital and innovation. An empirical analysis*, Proceedings of the International Conference on Business Excellence, Volume 13, Issue 1. https://doi.org/10.2478/picbe-2019-0070

Howkins, J. (2001), *The Creative Economy: How People Make Money From Ideas*, The Penguin Press, New York.

Informaciya shhodo finansuvannya osvity i nauky v Ukrayini (2017). http://zet.in.ua/statistika-2/byudzhet/informaciya-shhodo-finansuvannya-osviti-i-nauki-v-ukra%D1%97ni (accesssed: 18.12.2019) [in Ukrainian].

Kuznets, S. (2001), *Biographical Memoirs: Volume 79*, The National Academy of Sciences of the United States of America, Washington D.C. https://www.nap.edu/read/10169/chapter/13 (accesssed: 18.12.2019).
Posnova, T.V. (2018), *Kreatyvnyj lyudskyj kapital yak faktor rozvytku innovacijnoyi ekonomiky*, "Modern Economics", 7, pp. 148–157. https://modecon.mnau.edu.ua/issue/7-2018/UKR/posnova.pdf (accesssed: 15.11.2019) [in Ukrainian].
Salikhov, B. (2017), *Kreatyvnij kapytal v ekonomyke znanyj. Monografya*, ITK "Dashkov y K", Moscow [in Russian].
Schultz, T. (1971), *Investment in Human Capital. The Role of Education and of Research*, The Free Press, New York.
Shkurupiy, O.V. (2007), *Investyciyi v intelektualno-kreatyvnyj kapital: analogy ta vidminnosti*. http://dspace.nbuv.gov.ua/bitstream/handle/123456789/35136/33-Shkurupiy.pdf?sequence=1 (accesssed: 10.11.2019) [in Ukrainian].
Szara, K. (2019), *Technology as a stimulus for the development of creative capital at the local level on the example of municipalities of the Podkarpackie Voivodeship*, "Ekonomia i Prawo – Economics and Law", 18 (4), pp. 499–514. https://doi.org/10.12775/EiP.2019.033
The Creative Economy Report. The Challenge of Assessing the Creative Economy: towards Informed Policy-making (2008). https://unctad.org/system/files/official-document/ditc20082cer_en.pdf (accesssed: 25.11.2019).
The Global Innovation Index (2017). https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2017.pdf (accesssed: 25.11.2019).
The World Economic Forum (2019). https://www.weforum.org (accesssed: 1.12.2019).
Throsby, D. (2014), *Economics and culture*, Cambridge University Press, United Kingdom.
Vakhovich, I., Chul, O. (2014), *Rozvytok kreatyvnyh industrij: regionalnyj vymir. Monografiya*, Vezha-Druk, Luczk [in Ukrainian].
What a performance! Stellar employment boom continues for the UK's Creative Industries (2017). https://www.gov.uk/government/news/what-a-performance-stellar-employment-boom-continues-for-the-uks-creative-industries (accesssed: 11.11.2019).

Streszczenie

Inwestycje w kapitał ludzki jako element kształtowania gospodarki kreatywnej: przypadek Europy Środkowo-Wschodniej

Celem niniejszego artykułu jest określenie wpływu inwestycji w kapitał ludzki na kształtowanie gospodarki kreatywnej. Biorąc pod uwagę fakt, że kapitał ludzki jest dziś uważany zarówno za czynnik rozwoju potencjału społeczno-gospodarczego krajów, jak i za warunek tworzenia gospodarki kreatywnej, a w konsekwencji zmian modernizacyjnych we współczesnej gospodarce, konieczne jest dokonanie analizy obszaru inwestycji w kapitał ludzki.

Niniejsze badanie opierało się na analizie szeregu wskaźników dla krajów Europy wschodniej (Ukraina i Mołdawia) i środkowej (Polska, Czechy, Rumunia, Węgry i Litwa): *całkowite wydatki na edukację*, którego analiza umożliwiła określenie poziomu finansowania edukacji w kraju; *średni koszt na ucznia/studenta*, który pozwolił autorom zidentyfikować trendy w wydatkach według organizacji finansujących; *udział całkowitych wydatków na edukację w PKB w zależności od poziomu wykształcenia*, co umożliwiło określenie priorytetów i wystarczalności finansowania systemu edukacji; *wskaźnik alokacji kosztów według organizacji finansujących*; *wskaźnik rozwoju społecznego*, który mierzy poziom życia, umiejętności czytania, wykształcenie i długość życia. Analizie poddano również dane determinujące poziom globalnego wskaźnika innowacyjności, ponieważ podstawą jego obliczeń są w szczególności wskaźniki oceny kapitału ludzkiego i działalności badawczo-rozwojowej (edukacja, szkolnictwo wyższe, badania i rozwój) oraz dóbr kreatywnych (wartości niematerialne i prawne, produkty i usługi kreatywne, kreatywność online).

Wyniki badań pozwoliły na stwierdzenie, że we współczesnych warunkach rozwoju społeczeństwa głównym czynnikiem rozwoju gospodarki kreatywnej jest kapitał ludzki, a rozwój kapitału ludzkiego zależy od poziomu wykształcenia i rozwoju nauki w kraju. Zidentyfikowano główne obszary inwestycji w kapitał ludzki, w tym koszty edukacji i nauki. Dane empiryczne pokazują, że ukierunkowanie inwestycji na rozwój kapitału ludzkiego przyczynia się do tworzenia gospodarki kreatywnej, poprawia konkurencyjność kraju, a jednocześnie zapewnia odpowiednie tempo rozwoju społeczno-gospodarczego.

Dla rozwoju kapitału ludzkiego jako czynnika tworzenia kreatywnej gospodarki konieczne jest zapewnienie odpowiednich inwestycji – podniesienie poziomu wydatków na edukację, rozwój kompetencji zawodowych i talentów ludzkich. Tworzenie gospodarki kreatywnej wymaga dalszej reformy ukraińskiego systemu edukacji, która będzie w stanie zapewnić odpowiedni poziom specjalistycznego szkolenia.

Słowa kluczowe: kapitał ludzki, inwestycje w kapitał ludzki, edukacja, finansowanie edukacji, gospodarka kreatywna, innowacyjna gospodarka

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.32

A Review of Transnational Regulations in Environmental Protection and the Circular Economy

Zofia Wysokińska
Ph.D., Full Professor at the University of Lodz, Faculty of Economics and Sociology
Department of World Economy and European Integration, Lodz, Poland
e-mail: zofia.wysokinska@uni.lodz.pl

Abstract

The aim of the paper is to present a review of transnational regulations (global and European) in the field of environmental protection and the circular economy. The paper discusses the regulations proposed in publications and reports of such global organizations and UN Agencies as the United Nations Environmental Program (UNEP), the United Nations Conference for Trade and Development (UNCTAD), the Food and Agriculture Organization (FAO), as well as the World Trade Organization (WTO), and the European Commission as the Executive Body of the European Union. With regard to the WTO, these regulations concern the effects of liberalizing trade in environmental goods and services and environmentally sound technologies. Sustainable development means, above all, protecting the natural environment and reducing excessive dependence on depleting natural resources, including primary raw materials, in the economic sector. This implies the need to implement a new resource-efficient development model, based on the principles of the circular economy (CE), which has been proposed for several years by transnational organizations. In the CE model, the use of natural resources is minimized, and when a product reaches the end of its useful life, it is reused to create additional new value. This can bring significant economic benefits, contributing to new production methods and new innovative products, growth, and job creation.
The topics mentioned above are the main subject of consideration in the presented paper.

Keywords: transnational and European regulations, environmental protection, circular economy, global organizations, European Union

JEL: O13

Introduction

Sustainable development, as well as the protection and preservation of the environment, are the objectives of all global, international and regional organizations, with particular reference to the WTO (World Trade Organization), United Nations (UN) bodies such as UNEP (United Nations Environmental Program), UNCTAD (United Nations Conference for Trade and Development), or UNIDO (United Nations Industrial Development Organizations), and the FAO (Food and Agriculture Organization). Among the international regional groupings, the European Union plays an extremely active role, especially in promoting rules and regulations regarding the implementation of the circular economy.

The role of the WTO and United Nations Bodies

The WTO plays a special role in promoting the liberalization of foreign trade in environmentally friendly products and services and environmentally sound technologies. These aspects are enshrined in the Marrakesh Agreement, which established the WTO in 1994. And alongside the main WTO goal of reducing trade barriers and eliminating discriminatory treatment in international trade relations, they constitute a complementary goal which, in recent years, together with the pursuit of ambitious *Sustainable Development Goals* (*SDGs*), has become particularly important (*Trade and environment*).

Both the *WTO* and the *United Nations Environmental Program* (*UNEP*) strengthen international dialogue on trade and environmental issues. Environmental management is now a key driver for achieving sustainable development. In a globalized world, environmental threats require effective responses that promote the highest values, such as peace, justice, development, and compliance with environmental principles and human rights.

The UN promotes environmental management – including principles, policies, and institutions that shape people's interactions with the environment. Building stable management systems makes it possible to protect the environment and human rights and achieve all 17 UN sustainable development goals by 2030 (*Sustainable Development Goals; Environmental rights and governance overview*; see also: Wysokińska 2017).

UNEP's activities include helping governments obtain environmental information to make decisions and provide citizens with greater access to information on their environmental rights; strengthening environmental cooperation at global and regional levels, and promoting the relationship between civil society and governments in the development and implementation of environmental policies.

Identifying common goals in international environmental agreements and actions for dialogue on environmental issues at a regional level is also helpful. UNEP, through the environmental sub-program, deals with the most important factors that enable the achievement of progress in achieving these goals, i.e., in particular, those related

to the integration of environmental sustainability in development at regional, subregional, and national levels (*Environmental rights and governance*).

The updated program of partnership cooperation between UNEP and UN bodies, international organizations, and UNEP member states was agreed in August 2019. This Program contributes to the advancement of sound environmental governance in one of the following ways (*Environmental Governance Update…* 2019):

- UN bodies and international organizations integrate environmental policy issues from UNEP policy advice;
- The uptake of approaches for the coherent implementation of multiple multilateral environmental agreements;
- Policy action is taken by countries on environmental issues of international concern;
- Countries with enhanced institutional capacity and legal frameworks fully implement international environmental objectives;
- Increased integration of the environment in sustainable development planning;
- Increased partnerships between UNEP and stakeholders to promote the achievement of internationally agreed environmental goals.

UNEP cooperates with governments and relevant institutions in the UN system, such as UNCTAD, FAO, and UNIDO, through the environmental management sub-program, as well as with the WTO within the framework of *Multilateral Environmental Agreements* (MEAs), to promote more consistent, effective, and efficient decision-making and action for environmental protection and to mitigate adverse climate changes.

InforMEA is the United Nations Information Portal on Multilateral Environmental Agreements, an online portal that provides information about the MEAs to the public. The InforMEA Initiative consists of 20 MEAs hosted with four United Nations bodies. The MEAs include Basel, Rotterdam, Stockholm, and Minamata (Chemicals and Wastes); CBD (Biodiversity); CITES (Trade in Wildlife); ITPR-FA (Plants); Vienna (Ozone); Ramsar (Wetlands); UNESCO-WHC (World Heritage); UNCCD (Deserts); UNFCCC (United Nations Framework Convention on Climate Change); as well as 5 UNECE (United Nations Economic Commission for Europe) Conventions and a number of regional conventions (UNESCO 2011).

Multilateral Environmental Agreements. The Agreement signed in 1997 resulted from the need for common regulations in the field of environmental protection. MEAs are based on MEA-s are based on the general principles of cooperation with ISO (*International Organization for Standardization*).

The four main MEAs Systems include:

- **CITES – the Convention on International Trade in Endangered Species of Wild Fauna and Flora.** The main goal of this convention is to ensure the inviolability of wild fauna and flora, i.e., the member states' commitment that fauna and flora cannot be exploited as a result of the development of international trade.
- **The Montreal Protocol on Substances that Deplete the Ozone Layer** is an international agreement made in 1987. It was designed to stop the production and

import of ozone depleting substances and reduce their concentration in the atmosphere to help protect the earth's ozone layer. The Montreal Protocol sits under the Vienna Convention for the Protection of the Ozone Layer. The Vienna Convention was adopted in 1985 following international discussion of scientific discoveries in the 1970s and 1980s highlighting the adverse effect of human activity on ozone levels in the stratosphere and the discovery of the 'ozone hole'. Its objectives are to promote cooperation on the adverse effects of human activities on the ozone layer. The Montreal Protocol was agreed on 16 September 1987 and entered into force on 16 September 1989, following a first meeting in Helsinki, May 1989. Since then, it has undergone eight revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), 1998 (Australia), 1999 (Beijing), and 2016 (Kigali – which was adopted but has not come into force).

- As a result of the international agreement, the ozone hole in Antarctica is slowly recovering. Climate projections indicate that the ozone layer will return to 1980 levels between 2050 and 2070.
- **The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal** was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel (Switzerland) in response to a public outcry following the discovery in the 1980s of deposits of toxic wastes imported from abroad in Africa and other parts of the developing world.
- **The Stockholm Convention on Persistent Organic Pollutants** is an international environmental treaty, signed in 2001 and effective from May 2004, that aims to eliminate or restrict the production and use of persistent organic pollutants (POPs).

UNIDO supports countries in their environmental management efforts, including the implementation of multilateral environmental agreements and the provision of sustainable energy. It helps create new green industries, establishing national road maps for greening the supply chain, determining benchmarks and indicators, disseminating and sharing best practices, running clean technology programs, undertaking various capacity-building exercises, and contributing to international forums with the necessary research and expertise.

UNIDO's services include capacity building, direct technical support to enterprises, and assistance to government institutions on Cleaner Production (CP) policy matters, as well as the promotion, adaptation, and transfer of environmentally sound technologies and the implementation of advanced CP business models, such as chemical leasing.

In the field of water management, UNIDO focuses on the sustainable use of water resources. This includes capacity-building for the industrial sector to improve water productivity, reuse, and recycling, as well as the introduction at all levels of government policies and training in the adoption of the ecosystem approach and the sustainable use of its living resources.

UNIDO stresses the need to improve industrial energy efficiency by contributing to the transformation of markets for energy-efficient products and services. It promotes sustainable energy solutions for making industries more productive and climate-resilient, which in turn promotes green jobs and green growth, including the deployment of industrial energy efficiency standards, smart grids based on renewable energy, and renewable energy for industrial applications, as well as the promotion of climate-resilient industries. An urgent need also remains to phase out the production and consumption of ozone-depleting substances (ODSs), which lead to the continuing degradation of human health and the natural environment. The Vienna Convention and the Montreal Protocol respond to that need.

UNIDO assists the governments of developing countries that are signatories to the Montreal Protocol to comply with its requirements through transferring non-ODS-based technologies to Article 5 countries and supports them to meet the set targets in terms of tonnages of ODS to be eliminated. There is a commitment on the part of governments that are parties to the Stockholm Convention on Persistent Organic Pollutants (POPs) to implement legal, organizational, and environmental management measures, including substantive technological changes, in order to comply with the requirements of the Convention. The production and use of POPs, as well as their presence in the biosphere, are causing severe damage to human health and the environment. UNIDO also assist countries in reaching compliance with the Stockholm Convention and develops capacity in developing countries to protect their populations and their environmental resources from POP-related pollution. UNIDO also supports countries in addressing the commitments under the Minamata Convention on Mercury. UNIDO also supports countries in building capacity to plan, develop, and implement related industrial development aspects in the United Nations Framework Convention on Climate Change (UNFCCC) (*Implementation of multilateral environmental agreements*).

Most international financial institutions (IFIs) require collateral to approve various types of development projects. Environmental security (as well as social security) are the cornerstones of IFIs' support for sustainable development. The purpose of these policies is to avoid or, where avoidance is not possible, to minimize and mitigate the negative impact of the project on the environment and people affected by this problem, as well as to help borrowers (and grant beneficiaries) strengthen their security systems and develop their capacity to manage the environmental risks. The key environmental issues include biodiversity protection, sustainable management of natural resources, pollution prevention and reduction, use of pesticides, and greenhouse gas emissions. Security principles provide guidelines for international financial institutions and borrower/country personnel in identifying, preparing, and implementing programs and projects. They also provide a mechanism for incorporating environmental issues into the development decision-making process (The Food and Agriculture Organization).

Zofia Wysokińska

Regulations concerning trade in environmental goods under the WTO, and Bio-Trade under the UNCTAD BioTrade Initiative

The negotiations within the WTO on the agreement on trade in environmental goods (***Environmental Goods Agreement – EGA***) began on 8 July 2014.

The parties negotiating the agreement were 18 WTO members, including the USA, EU, China, Canada, and Japan. The purpose of this initiative was ***to facilitate international trade in environmentally friendly goods and technologies.*** During the negotiations, the parties sought to eliminate or reduce tariffs on goods that would be identified as key to environmental protection and, for example, to clean water and air, or that would measure pollution, produce energy from renewable sources, etc. As a result of the negative attitude of the US administration, the talks were suspended. They were later continued in 2016–2017 (*Environmental Goods Agreement…*).

The second phase of the negotiations mainly concerned products that can help achieve environmental and climate protection goals, such as generating clean and renewable energy, improving energy and resource efficiency, controlling air pollution, managing waste, treating wastewater, monitoring the quality of the environment, and combatting noise pollution.

The participants to these negotiations account for the majority of global trade in environmental goods. The benefits of this new agreement will be extended to the entire WTO membership, meaning all WTO members will enjoy improved conditions in the markets of the participants to the EGA. The participants in these negotiations were 18 Partners representing 46 WTO members, i.e., Australia, Canada, China, Costa Rica, the European Union, Hong Kong China, Iceland, Israel, Japan, Korea, New Zealand, Norway, Singapore, Switzerland, Liechtenstein, Chinese Taipei, Turkey, and the United States (*Environmental Goods Agreement news archive*).

Environmentally sound technologies (*EST*)[1], often also referred to as "clean" technologies, are technologies that reduce the risk to the environment and minimize pollu-

1 ESTs are technologies that "protect the environment, are less polluting, use all resources in a more sustainable way, process more of their waste and products and process residual waste in a more acceptable way than the technologies they replaced" (Agenda 21). They are not just individual technologies, but complete systems that include know-how, procedures, goods and services, and equipment, as well as organizational and management procedures to promote environmental sustainability. Closely related to ESTs is the concept of goods and services related to environmental protection, which is more widely used in trade negotiations and discussions. To date, there is no precise definition of goods and services related to environmental protection, and some WTO members have tried to solve this problem by listing products that interest them. They are generally divided into six categories, namely air pollution control, renewable energy, waste management and water treatment, environmental technologies (i.e., emissions reduction, heat and energy management, environmental monitoring equipment), carbon capture and storage, and other areas that may be related to the removal of waste, and the protection of natural resources, etc., based on United Nations Environment Program 2018, pp. 3–4.

tion as well as the consumption of energy and resources, and they are necessary in the fight against climate change. They also contribute to the achievement of many sustainable development goals, such as goal 7 concerning energy, goal 8 related to growth, goal 12 regarding sustainable consumption and production, and goal 13 – actions dedicated to the climate.

Trade liberalization can further facilitate market creation and the expansion of ESTs and create opportunities for enterprises, particularly in developing countries, to participate in regional and global value chains. Increasing EST trade can give a triple victory by promoting economic development, industrialization, job creation, and innovation while giving countries more efficient access to the technologies needed to improve their environmental performance.

It should be noted that trade in environmentally sound technologies is steadily increasing with the growing participation of developing countries. Despite a slight decrease in trade flows since reaching the maximum in 2011, global trade in EST-related goods has shown a steady upward trend since 2006. However, a significant proportion of the EST industry is still concentrated in a relatively small number of countries. As for the larger EST group, trade in selected ESTs is still dominated by developed countries and emerging economies. The main exporters of selected ESTs between 2006 and 2016 were China, Germany, the United States, Japan, and Korea. The leading traders among developing countries were Mexico, Malaysia, and South Africa. New Caledonia, Senegal, Uganda, and Ethiopia are among the least developed countries, *although* they export the most. Solar photovoltaic modules, wafers, and cells are the most frequently sold ESTs with a clear environmental end-use. The overall growth rates of EST trade have been unstable since the global financial crisis in 2009, especially for the least-developed countries, and they peaked in 2010. Between 2006 and 2016, the share of developing countries and BRIC countries in global trade in EST goods neared the overall trade surplus.

Analysis of trade in EST-related services shows that the value of trade in this sector increased more than five times over the past decade. Data from the 61 largest companies that have the largest share in terms of trade value in environmental consulting and engineering services show that revenues are mainly concentrated in North America and Europe (United Nations Environment Program 2018, pp. 2–3).

The global trade in EST increased by over 60% from USD 0.9 trillion in 2006 to USD 1.4 trillion in 2016[2], with renewable energy technologies accounting for over a third

2 Comparative research on the development of the global and European market in the first decade of the new century showed that the environmental goods and services market was among those world markets that has demonstrated one of the highest growth rates in demand over the past ten years in the period 2000–2010. Its volume was assessed at approximately USD 518 billion in the year 2000 and projections for the year 2010 assume its growth to approximately 600 billion (*Environment Business International, Inc*., in *Environmental Benefits of Removing Trade Restrictions and Distortions*, Note by the Secretariat, Addendum, Committee on Trade and Environment. WT/CTE/W/67/ADD.1, March 13, 1998; "Implications of WTO Agreements for International Trade in Environmental Industries," ITC, 1999, in *Trade and Environment Review 2003*, United Nations,

of total trade, followed by wastewater and water treatment and solid and hazardous waste management technologies (United Nations Environment Programme 2018, p. 2). While emerging economies such as China have dramatically increased their share of global EST trade, many low-income countries, especially the least developed countries (LDCs), have not yet fully benefited from EST trade.

Negotiations in EST trade have made progress at the international and regional levels. Following early discussions in the context of Asia-Pacific (APEC) and WTO economic cooperation, smaller groups of countries have made recent efforts to negotiate an environmental goods agreement (EGA) to lift tariffs on selected environmental goods (United Nations Environment Programme 2018, pp. 7–8).

The negotiations on the *Trade in Services Agreement* (TiSA) were launched in 2013. Several negotiating parties submitted proposals for further opening of environmental services markets and insisted on ambitious commitments. However, progress in reaching an agreement has stalled.

A notable initiative at the regional level is the APEC Agreement on Environmental Goods, which aims to voluntarily reduce the tariffs applied for 54 categories of organic products to no more than 5%. The agreement represents by far the most specific commitments to trade liberalization associated with organic goods among a large group of trading partners (United Nations Environment Programme 2018, p. 4).

Geneva, New York, 2004; The research carried out at the Department of World Economy and European Integration at the University of Lodz, showed that the low and irregular share of foreign trade in environmental services and world export in environmental services over various years is at a level of barely 0.3–0.4% of what is produced. For comparison, world exports in environmental products is approximately 20% of their production. This shows a high disproportion in the trading of environmental products between its products and services sections. The environmental industry (i.e., industry "working" for environmental protection) was characterized by an average growth rate of more than 10% over the past ten to fifteen years. However, the dynamics of its growth in highly developed countries had a significantly lower rate, which barely amounted to approximately 1.6–2%. At the same time, the growth rate in developing countries was at a level of approximately 7–8%. Projections show that such growth will be particularly characteristic of those countries and will amount to approximately 8–12%. Compared with other markets, it may be stated that the environmental products and services market is not as large as the steel or agricultural markets. However, its size is comparable with the pharmaceutical or information technology markets. The environmental products market encompasses three main segments-equipment (technical equipment), environmental services, and natural resources. Technical equipment obviously encompasses the most advanced technologies, while environmental services include simpler, albeit more common ones. The predicted growth of more than 15% in the sales of environmental services over the past decade is an additional approximately USD 42 billion increase in demand on the world market providing employment for approximately 1–2 million workers. It is the highly developed countries that are the largest producers of environmental services (United States – approximately 38% of the world market, Japan – approximately 18%, and Germany, Great Britain, France, and Italy). A mere 2%, approximately, make up the share of Eastern Europe (inclusive of the European part of the CIS), where Poland's share is between 0.3% and 0.4%, based on Wysokińska 2009; see also: Wysokińska 2005, p. 25, see also: Wysokińska 2011, pp. 155–164.

Trade, Environment, Climate Change, and Sustainable Development – the role of UNCTAD

UNCTAD's work on harnessing international trade in promoting sustained growth and inclusive development includes as a key aspect the support to developing countries in taking advantage of emerging opportunities for trade associated with the protection, promotion, and preservation of the environment and sustainable development objectives generally while minimizing potential adverse impacts. This work is carried out by the Trade, Environment, Climate Change, and Sustainable Development Branch of Division on International Trade and Commodities (*DICT*) of UNCTAD.

Through research and analysis, intergovernmental deliberations and consensus building, and technical assistance, as well as partnerships and networks with an array of stakeholders, the branch works to strengthen the capacity of developing countries to formulate and implement mutually supportive trade, environment, and sustainable development objectives; integrate sustainable development and poverty reduction objectives in development strategies at all levels, including the need to address climate change implications inter alia by promoting climate-friendly trade and production strategies, including in green sectors, and support the effective participation of developing countries in international deliberations on trade and environment[3].

Developing countries have great potential to benefit from EST trade and global value chains

EST trade offers developing countries great opportunities in terms of economic growth, diversification of exports, technological development, and environmental protection. In particular, environmental services, due to their local nature, provide enterprises in developing countries with the opportunity to join global value chains. EST trade and absorption of such technologies can additionally create sustainable jobs, especially in services related to the installation and maintenance of products, systems, and infrastructure related to environmental protection.

BioTrade Initiative

BioTrade (UNCTAD, *BioTrade*) refers to those activities of collection, production, transformation, and commercialization of goods and services derived from native biodiversity under the criteria of environmental, social, and economic sustainability.

3 Local Content Requirements and the Green Economy, Division of International Trade and Commodities-DITC; United Nations, 2014, https://unctad.org/system/files/official document/ditcted2013d7_en.pdf – data dostępu: 28.10.2018.

Since its launch by UNCTAD in 1996, the BioTrade Initiative has been promoting sustainable BioTrade in support of the objectives of *the Convention on Biological Diversity.* The Initiative has developed a unique portfolio of regional and country programs.

UNCTAD is currently implementing the Global BioTrade Program: Linking trade, biodiversity, and sustainable development with the support of the Swiss State Secretariat for Economic Affairs (SECO). The objective of this four-year program is to provide key stakeholders with the ability to seize and capitalize on trade opportunities from linking biodiversity and sustainable development, thereby advancing the implementation of the SDGs, as well as the Aichi Targets and the Post Aichi framework (*The next 20 years: Upscaling BioTrade and the 2030 Agenda*).

In the past 20 years, BioTrade has expanded in terms of the number of partners and practitioners involved, sectors, and geographical coverage. BioTrade has been mainstreamed at both national and international levels, for instance, in the Decisions of the Parties to the CBD (*Convention on Biological Diversity*) and CITES (*Convention on International Trade in Endangered Species of Wild Fauna and Flora*), discussions at the United Nations General Assembly, as well as within development banks, the private sector, civil society, and markets. A strong network of partners and practitioners has been established and is being expanded continuously to cover the evolving needs of beneficiaries, document lessons learned, and address relevant emerging issues. Further efforts from BioTrade partners should continue documenting, disseminating, and measuring its impact and contribution to sustainable development, SDGs, and the Aichi Targets at all levels.

The BioTrade Initiative of UNCTAD facilitates and supports national, regional, and international BioTrade programs, partnerships, and businesses that have contributed to fighting biodiversity loss while ensuring the sustainable use of biological resources and ecosystems. Activities are implemented in close cooperation with the secretariats of the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Fauna and Flora on the development of regulatory and institutional frameworks to prevent illicit trade in natural species and to safeguard them.

The main objective of the Bio-Trade Initiative is to build sustainable livelihoods, particularly for rural communities and marginalized groups, in biodiversity-rich developing countries. This is central to the conservation and sustainable use of nature's resources. Thus, UNCTAD collaborates with Governments, the private sector and international organizations in all countries to promote BioTrade-programs and businesses that adhere to sustainable development principles, ethical sourcing of biological resources, access and sharing of benefits, proper traceability of products derived from biodiversity, and awareness-raising of the value of nature. It is also important to improve income-earning opportunities for rural communities. It can also bring added dividends such as consolidating peacebuilding in post-conflict areas.

BioTrade covers the collection, production, transformation, and commercialization of goods and services originating from native biodiversity (species and ecosys-

tems) in accordance with the criteria of sustainable environmental, social, and economic development.

The following sectors are involved in BioTrade activities: personal hygiene, pharmaceuticals/phyto-farm, food, fashion, protection of flora and fauna, handicrafts, textiles and natural fibers, sustainable tourism, forestry (UNCTAD 2016).

The main current BioTrade effects are noticed as follows (UNCTAD 2016, chapter 1):

- Sales in companies and associations of BioTrade beneficiaries achieved the level of EUR 4.3 billion, which was a significant increase from USD 40 million in 2003.
- Around 5 million beneficiaries worldwide.
- 83% of consumers expect companies to have a supply policy that respects biodiversity.
- 12,000 companies in over 70 countries have applied for the UN Global Compact, committing themselves to greater responsibility for the environment (and biodiversity).
- More and more companies reporting biodiversity in their annual reports; 36 of the 100 largest cosmetics companies and 60 of the top 100 food companies are involved in a business based on biodiversity.
- BioTrade has a share in almost all of the 17 Sustainable Development Goals[4].

The Circular Economy – the next step in the implementation of sustainable development strategies

One of the weaknesses of modern industry is its high dependence on access to primary raw materials. Although many enterprises are introducing improvements and innovations that reduce the consumption of materials and energy per unit of production (e.g., per ton of product), this does not change the fact that the production of new products is still aiming for limited deposits of natural resources. The way out of the economy's dependence on primary raw materials may be a change in the source of raw materials for manufacturing processes. That is because the value and durability of products and materials in a circular economy are maintained for as long as possible. Resource utilization is minimized, and when the product reaches the end of its useful life, it is reused to create additional new value. It may generate substantial economic benefits, contributing to the creation of new production methods and new innovative products, growth, and job creation. Therefore, the circular economy model has been promoted for several years based on the 3Rs: *reduce, reuse, and recycle*, which means: 1. Produce new products – (product innovations) without generating waste – "Zero-Waste"

4 *20 years of Bio-Trade, Connecting People, Planet and Markets, UNCTAD, Palais des Nations, 1211, Geneva 10, Switzerland.,2016/4, chapter, 1.* http://unctad.org/en/PublicationsLibrary/ditcted2016d4_en.pdf (accessed: 25.04.2018).

2. However, if there is already waste, use it to create a new product, 3. If 1 or 2 is not possible, direct the waste to recycling.

According to UNCTAD experts, traditional models of growth are becoming increasingly constrained. The Circular Economy offers lasting benefits in the form of material savings, new forms of employment, and reduced price volatility. At the same time, the international community has committed to change, as measured by the SDGs, especially in the industrial and innovation aspects of SDG 9, as well as sustainable consumption and production, embodied in SDG 12. Significant social gains can be realized from improving resource circularity in multiple sectors, such as in recycling and the reutilization of materials, energy efficiency, value-chain optimization, and in collaborative economy models such as in fast-growing space and vehicle sharing (UNCTAD, *The Circular Economy*). Circularity is already part of many lines of work within UNCTAD, such as activities on tackling fossil fuel and fisheries subsidies. Resource circularity cannot be promoted in international value chains just by promoting and enacting national rules. While companies have made strides in improving their social and environmental footprints, privatizing public policy through voluntary sustainability standards and Corporate Social Responsibility (CSR) falls short in this task. In a world where most trade happens in parts and components in highly globalized value chains, promoting global resource circularity goes through international rules and cooperation, as well as individuals and consumers empowered with education (UNCTAD, *The Circular Economy*).

Implementing the principles of the circular economy in the European Union

On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the ***Circular Economy Action Plan***. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources, as well as ecosystems, is minimized. The analysis served to assess to what extent EU policy tools addressing products are supporting circular, sustainable products. There are many policy tools covering all the different products on the EU market, and these tools together provide a great contribution to sustainability. They protect the environment and human health, make products more energy- and resource-efficient, and they empower consumers to choose better products. The analysis found that there is potential to further strengthen the policies, especially as concerns the circular design of products such as textiles and furniture. Also, more could be done to support consumers and circular sectors such as reuse and repair (*EU Circular Economy Action Plan*).

The above-mentioned report shows that the recycling rate of plastic packaging has almost doubled since 2005. Overall, the EU recycled around 55% of all waste, exclud-

ing major mineral waste, in 2016, compared with 53% in 2010. The recovery rate for construction and demolition waste reached 89%, and the packaging waste recycling rate exceeded 67% compared with 64% in 2010, while the municipal waste recycling rate was 46% in 2017 compared to 35% in 2007. The recycling rate of electrical and electronic equipment waste (computers, televisions, refrigerators and mobile phones containing valuable materials that can be recovered) reached 41% (2016), compared with 28% in 2010. Despite these high recycling rates, on average, only 12% of the material resources used in the EU in 2016 came from recycled and recovered materials, thus saving on the extraction of primary raw materials. This indicator, called the circular material use rate, measures the contribution of recycled materials to overall demand. The indicator is lower than recycling rates, which measure the share of waste that is recycled because some types of materials cannot be recycled, e.g., fossil fuels burned to produce energy, or biomass consumed as food or fodder (*Record recycling rates and use of recycled materials in the EU* 2019).

The diagnosis of the state of the implementation of the principles of the green and then circular economy shows that, in Europe, resources are being consumed, on average, twice as fast as our planet can reproduce them. Statistically, for every European in 2012, 14.2 tons of resources were used to manufacture both imported and manufactured products in the EU. The increasing demand for resources around the world means that European enterprises are starting to feel the increase in the costs of basic raw materials and materials, and they are struggling with shortages and price volatility, which weakens the competitiveness of the European economy. It was, therefore, necessary to take measures to reduce the overall consumption of resources and to introduce solutions that would improve the efficiency of their use. As part of the work on the EC proposal of 2015 regarding the Circular Economy, the European Parliament proposed setting a European resource efficiency increase target of at least 30% by 2030 compared to 2014. The scale of this challenge is easier to assess knowing that, according to EU forecasts, the implementation of existing action scenarios could increase resource efficiency by 15% between 2014 and 2030. The planned EU goal is not overly ambitious if you take into account the guidelines of the World Business Council for Sustainable Development to strive for a level of a 4- to 10-fold increase in resource efficiency by 2050 (*Report From the Commission to the European Parliament…* 2017; *Commission Staff Working Document…* 2019).

Key challenges at the stage of incorporating the project/company into the circular economy are (*Eco-innovation Action Plan;* see also Eco-Innovation Index):

– **Eco-Design – The support and commitment of designers**. The need to prioritize at the design stage issues such as minimizing the use of materials and energy, refraining from the use of hazardous substances, the possibility of repairing and reusing or recycling the item, and also using materials of biological origin. It is estimated that the introduction of the eco-design directive and, i.e., the Energy Label Directive, enabled the creation of 800,000 jobs and generated an additional EUR 55 billion in income for European enterprises. It also avoided the

emission of a significant amount of greenhouse gases. European households have also benefited because they save an average of 432 euros a year in electricity bills (Komunikat Komisji 2016; see also: Bachorz 2017, pp. 25–31).

– **The manufacturer's responsibility for the product after use.** In 28 EU countries, there are EPR (extended producer responsibility) schemes that extend the producer's responsibility for the product for the period after its use. In practice, this means that a business that has introduced a certain type of product to the market (e.g., a washing machine) is required to bear some or all of the costs associated with its development in the post-use phase. Charging the enterprise with this additional cost is intended to encourage it to introduce solutions that will make using the product cheaper in the post-use phase. The manufacturer can, for example, design more durable and repairable products with a lower weight. Thinking about the optimization of expenses related to waste management, it may also – at the design stage – choose materials that are more suitable for recycling and use substitutes for hazardous and problem substances.

It also became necessary to reduce enterprises' dependence on primary raw materials and to create a system for reuse and repair (cultural change). According to the assumptions of the circular economy, enterprises should base their production, firstly, on end-of-life products and components that have already been circulated, and secondly, on the use of secondary raw materials. The waste generated in plants should be treated as material that can be used on-site or easily transferred to another company for production purposes. An example of an industry in Europe that works largely on recyclable materials is the European paper industry. The signatories of the European declaration on paper recycling proved in 2017 that it is possible to use 59 million tons of waste paper as a secondary raw material, thereby bringing 71.5% of paper used in Europe to be recycled. The European glass industry, which, according to the European Glass Packaging Federation, achieved an average glass recycling rate of 74% in 2016, can also boast good results. In the steel industry, a significant part of metal production also comes from recycling, e.g., in the case of copper, 50% of this metal used in Europe comes from scrap recycling (*Eco-innovation Action Plan;* see also Eco-Innovation Index).

In December 2019, the European Commission presented a new strategy for the European Union under the name ***European New Deal*** for the coming years in order to strengthen the implementation of the main principles of the circular economy and achieve significant progress in reducing greenhouse gas emissions in Europe.

The European Green Deal is the new growth strategy of the EU. It will help us cut emissions while creating jobs (*What is the European Green Deal?* 2019). The EU proposes a green and inclusive transition to help improve people's well-being and secure a healthy planet for generations to come. The new strategy is about improving the well-being of people. Making Europe climate-neutral and protecting our natural habitat will be good for people, planet, and economy. No one will be left behind (*What is the European Green Deal?* 2019).

Main objectives of the new growth strategy of the EU are proposed as follows:

- Become climate neutral by 2050;
- Protect human life, animals, and plants by cutting pollution;
- Help companies become world leaders in clean products and technologies;
- Help ensure a just and inclusive transition.

The program was also based on the following opinions of most Europeans:

- 93% of Europeans see climate change as a serious problem,
- 93% of Europeans have taken at least one action to tackle climate change,
- 79% agree that taking action on climate change will lead to innovation (*What is the European Green Deal?* 2019).

The European Green Deal provides a road map with actions (*Annex to the Communication from the Commission to the European Parliament…*) to boost the efficient use of resources by moving to a clean, circular economy and stopping climate change, reversing biodiversity loss, and cutting pollution. It outlines the investments needed and financing tools available and explains how to ensure a just and inclusive transition. The European Green Deal covers all sectors of the economy, notably transport, energy, agriculture, buildings, and industries such as steel, cement, ICT, textiles, and chemicals (*The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050…* 2019). Meeting the objectives of the European Green Deal will require significant investment. Achieving the current 2030 climate and energy targets is estimated to require €260 billion of additional annual investment, representing about 1.5% of 2018 GDP. This investment will need the mobilization of the public and private sectors. In early 2020, the Commission presented an investment plan for a sustainable Europe to help meet investment needs. At least 25% of the EU's long-term budget should be dedicated to climate action, and the European Investment Bank, Europe's Climate Bank, will provide further support. For the private sector to contribute to financing the green transition, the Commission will present a Green Financing Strategy in 2020. The European Union already has a strong track record in reducing its emissions of greenhouse gases while maintaining economic growth. Emissions in 2018 were 23% lower than in 1990, while the Union's GDP grew by 61% in the same period. But more needs to be done. The EU, given its extensive experience, is leading the way in creating a green and inclusive economy (*The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050…* 2019).

The EU's share in global emissions is declining, and we need to make sure now that our partners also take action. The Commission will enhance the enforcement of sustainability commitments in trade agreements. The EU is committed to (*EU as a global leader* 2019):

- Leading by example, through the European Green Deal.
- Using diplomacy, trade, and development cooperation to advance climate action.
- Setting standards for sustainable growth across global value chains.

Under the new strategy, the EU is planning to enhance international cooperation:

- Work with Africa to bring climate and environment issues to the center of our relations.
- Engage with G20 countries who are responsible for 80% of global greenhouse gas emissions.
- Following the Poznan Summit, set up a Green Agenda for the Western Balkans, mirroring the Green Deal.
- Establish environment, energy, and climate partnerships with the Eastern Partnership and Southern Neighborhood.
- Build Green Alliances with partner countries and regions in Latin America, the Caribbean, Asia, and the Pacific.[5]

Conclusions

- Sustainable development focused on environmental protection and counteracting negative climate change have become the leading areas of interest for both the European Union and global organizations.
- This is due to the growing threats associated with soil, air, and water pollution on our planet as a result of the huge scale of waste collection and excessive dependence on depleting natural resources, including primarily primary raw materials.
- Research results point to the fact that Europeans alone, who make up only about 8% of the world population, consume mineral resources and use ecosystem services on average twice as fast as our planet can reproduce them.
- The contemporary model of economic development, based on continuous growth, may lead to the exhaustion of resources available at acceptable prices and destroy the biological foundations of life to such an extent that mankind will fight over drinking water and food, and will suffer from unpredictable, rapid climate changes.
- Many communities, enterprises, and local governments have taken steps to limit the consequences of such events that contribute to the emergence of many threats to life and health on Earth. The time has come to seek products and services that are, beginning at the design stage, intended for the longest possible life-cycle; to engage in transformations and the recycling of natural resources; and to exclude toxic materials and processes which generate harmful emissions.
- The idea of a circular economy, which can also be called a "closed-loop economy," i.e., one that produces minimum waste, and in which waste, if it is generated, becomes a raw material. The amount of real waste is constantly shrink-

5 Currently 40% of the world's public climate finance comes from the EU (*EU as a global leader* 2019).

ing. The waste on our planet can be minimized by implementing responsible research to further the innovation principle, i.e., "reduce, reuse, and recycle." This means that each individual must reduce waste and, if he or she has generated any, reuse it or recycle it. This model can also bring significant economic benefits, contributing to new production methods and new innovative products, growth, and job creation.

- A helpful process in the pursuit of sustainable development and the circular economy is the progressing (although relatively slow) liberalization of trade in goods and services that are conducive to environmental protection and environmentally sound technologies at both European and global levels. It has contributed to increasing the share of developing countries and *transition economies* in access to technology and the market of goods and services conducive to environmental protection.
- UNCTAD initiatives related to the development of BioTrade (which created an opportunity especially for developing countries) should also be rated very positively because they build sustainable livelihoods, especially for rural communities and marginalized groups, and increase their activity for the development of biodiversity and sustainable use of natural resources. In addition, it should be emphasized that BioTrade has a share in almost all 17 sustainable development goals.
- The European Union is the world leader in environmentally friendly products and services within the sustainable development strategy, and the Circular Economy has become the next step in the implementation of sustainable development strategies. On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the *Circular Economy Action Plan*. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources as well as ecosystems is minimized.
- Key challenges at the stage of incorporating the project/company into the circular economy are based inter alia on Eco-Design – the support and commitment of designers – and on the manufacturer's responsibility for the product after use in order to promote the reduction of the dependence of enterprises on primary raw materials and the creation of a system for reuse and repair.
- In December 2019, the European Commission presented a new growth strategy for the European Union under the name *European New Deal* for the coming years in order to strengthen the implementation of the main principles of the circular economy and achieve significant progress in reducing greenhouse gas emissions in Europe.

References

20 years of Bio-Trade, Connecting People, Planet and Markets, UNCTAD, Palais des Nations, 1211, Geneva 10, Switzerland.,2016/4, chapter, 1. http://unctad.org/en/PublicationsLibrary/ditcted2016d4_en.pdf (accessed: 25.04.2018).

Annex to the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions – The European Green Deal, Brussels, 11.12.2019 COM(2019) 640 final.

Bachorz, M. (2017), *Polska droga do gospodarki o obiegu zamkniętym. Opis sytuacji i rekomendacje*, *ISBN 978-83-947616-0-8* (Publikacja elektroniczna do ściągnięcia w formacie PDF, dostępna na stronie internetowej www.igoz.org w dziale Baza Wiedzy).

Commission Staff Working Document Sustainable Products in a Circular Economy – Towards an EU Product Policy Framework contributing to the Circular Economy (2019). https://ec.europa.eu/environment/circular-economy/pdf/sustainable_products_circular_economy.pdf (accessed: 8.10.2019).

Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, The European Green Deal, Brussels, 11.12.2019 COM(2019) 640 final. https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf (accessed: 20.12.2019).

Eco-innovation Action Plan. https://ec.europa.eu/environment/ecoap/frontpage_en (accessed: 19.01.2020).

Eco-Innovation Index. https://ec.europa.eu/environment/ecoap/indicators/index_en (accessed: 18.01.2020).

Environmental Goods Agreement (EGA). https://www.wto.org/english/tratop_e/envir_e/ega_e.htm (accessed: 10.11.2019).

Environmental Goods Agreement news archive. https://www.wto.org/english/news_e/archive_e/ega_arc_e.htm (accessed: 10.11.2019).

Environmental Governance Update – August 2019 (2019) https://www.unenvironment.org/resources/report/environmental-governance-update-august-2019 (accessed: 16.10.2019).

Environmental rights and governance. https://www.unenvironment.org/explore-topics/environmental-rights-and-governance (accessed: 15.12.2019).

Environmental rights and governance overview. https://www.unenvironment.org/explore-topics/environmental-governance/about-environmental-governance/environmental-governance (accessed: 5.12.2019).

EU as a global leader (2019). https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6721 (accessed: 13.11.2019).

EU Circular Economy Action Plan. https://ec.europa.eu/environment/circular-economy/ (accessed: 5.10.2019).

Implementation of multilateral environmental agreements. https://www.unido.org/our-focus/safeguarding-environment/implementation-multilateral-environmental-agreements (accessed: 5.11.2019).

Komunikat Komisji (2016), *Plan prac dotyczący ekoprojektu na lata 2016–2019*, Brussels, 30.11.2016; COM, 773 final. https://eur-lex.europa.eu/legal-content/PL/TXT/HTML/?uri=CELEX:52016DC0773&from=PL (accessed: 20.10.2019).

Record recycling rates and use of recycled materials in the EU (2019). https://ec.europa.eu/eurostat/documents/2995521/9629294/8-04032019-BP-EN.pdf/295c2302-4ed1-45b9-af86-96d1bbb7acb1 (accessed: 22.10.2019).

Report From the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Implementation of the Circular Economy Action Plan (2017). https://ec.europa.eu/environment/circular-economy/implementation_report.pdf (accessed: 10.01.2020).

Sustainable Development Goals. https://www.unenvironment.org/explore-topics/sustainable-development-goals (accessed: 23.01.2020).

The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind (2019). https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691 (accessed: 15.12.2019).

The Food and Agriculture Organization, *Environmental Safeguards*. http://www.fao.org/investment-learning-platform/themes-and-tasks/environmental-social-safeguards/environmental-safeguards/en/ (accessed: 24.01.2020).

Trade and environment. https://www.wto.org/english/tratop_e/envir_e/envir_e.htm (accessed: 12.11.2019).

UNCTAD (2016), *20 years of Bio-Trade, Connecting People, Planet and Markets*, Geneva. http://unctad.org/en/PublicationsLibrary/ditcted2016d4_en.pdf (accessed: 12.11.2019).

UNCTAD, *BioTrade*. https://unctad.org/en/Pages/DITC/Trade-and-Environment/BioTrade.aspx (accessed: 4.01.2020).

UNCTAD, *The Circular Economy*. https://unctad.org/en/Pages/DITC/Trade-and-Environment/Circular-Economy.aspx (accessed: 2.12.2019).

UNESCO (2011), *Launch of InforMEA – the United Nations Information Portal on Multilateral Environmental Agreements (MEAs)*. https://www.informea.org/en/launch-informea-%E2%80%93-united-nations-information-portal-multilateral-environmental-agreements-meas (accessed: 20.11.2019).

United Nations Environment Programme (2018), *Trade in environmentally sound technologies: Implications for Developing Countries*. http://wedocs.unep.org/bitstream/handle/20.500.11822/27595/TradeEnvTech.pdf?sequence=1&isAllowed=y (accessed: 28.10.2019).

What is the European Green Deal? (2019). https://ec.europa.eu/commission/presscorner/detail/en/fs_19_6714 (accessed: 23.12.2019).

Wysokińska, Z. (2005), *Foreign Trade in Environmental Products*; *The WTO Regulation and Environmental Programs*, "Global Economy Journal", 5 (3). https://doi.org/10.2202/1524-5861.1076

Wysokińska, Z. (2009), *The International Environmental Goods and Services Market: an Opportunity for Poland*, "Polish Journal of Environmental Studies", 18 (5), pp. 941–948.

Wysokińska, Z. (2011), *Competitiveness of Selected New Members of the EU in the Environmental Products and Services Market*, [in:] J. Blanco, H. Kheradmand, *Climate Change. Socio-Economic Effects*, In Tech. https://doi.org/10.5772/23597
Wysokińska, Z. (2017), *Millennium Development Goals/UN and Sustainable Development Goals/UN as Instruments for Realising Sustainable Development Concept in the Global Economy*, "Comparative Economic Research. Central and Eastern Europe", 20 (1), pp. 101–118. https://doi.org/10.1515/cer-2017-0006

Streszczenie

Przegląd regulacji transnarodowych w dziedzinie ochrony środowiska i gospodarki cyrkularnej

Celem artykułu jest zaprezentowanie przeglądu regulacji transnarodowych (globalnych i europejskich w dziedzinie ochrony środowiska i gospodarki cyrkularnej. W artykule omówione zostały regulacje zaproponowane w publikacjach i raportach przygotowanych przez takie organizacje globalne i Agendy ONZ jak: Program Ochrony Środowiska Narodów Zjednoczonych (UNEP); Konferencja ONZ do spraw Handlu i Rozwoju (UNCTAD), Organizacja Narodów Zjednoczonych do spraw Wyżywienia i Rolnictwa (FAO), jak również przez Światową Organizacja Handlu (WTO), oraz przez Komisję Europejską jako ciało wykonawcze Unii Europejskiej.

W odniesieniu do WTO regulacje te dotyczą efektów liberalizacji handlu towarami i usługami środowiskowymi oraz technologiami przyjaznymi środowisku.

Zrównoważony rozwój polega głównie na ochronie środowiska naturalnego oraz ograniczaniu w sektorze gospodarki nadmiernego uzależnienia od wyczerpujących się zasobów naturalnych w tym przede wszystkim od surowców pierwotnych. W tym znaczeniu proponowany jest od kilku lat nowy bardziej zasobooszczędny model rozwoju, bazujący na zasadach gospodarki cyrkularnej. W ramach tego modelu wykorzystanie zasobów jest zminimalizowane, a gdy produkt osiąga koniec okresu użytkowania, jest ponownie wykorzystywany do tworzenia dodatkowej nowej wartości. Może to generować znaczne korzyści ekonomiczne, przyczyniając się do tworzenia nowych metod produkcji i nowych innowacyjnych produktów, wzrostu oraz tworzenia miejsc pracy.

Słowa kluczowe: regulacje transnarodowe i europejskie, ochrona środowiska, gospodarka cyrkularna, organizacje globalne, Unia Europejska

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.33

The Multiple Effects of Capital Controls

Chokri Zehri
Assistant professor of economics, Prince Sattam Bin Abdulaziz University, College of Sciences and Humanities in Al-Sulail, Department of Business Administration, Al-Sulail, Saudi Arabia, e-mail: c.alzhari@psau.edu.sa

Abstract

Capital controls are seen as a means to promote financial stability or improve macroeconomic adjustment in economies with nominal rigidities and suboptimal monetary policy. Such controls may take various forms, including explicit or implicit taxation of cross-border financial flows and dual or multiple exchange rate systems. Using a quarter dataset on capital controls actions in 27 emerging economies from 2010 to 2018, the study analyzes the effectiveness of capital controls (CCs) along different angles. Since the 2008 financial crisis, strengthening capital controls has allowed more monetary policy autonomy and exchange rate stability, verifying the Mundell-Fleming trilemma model. Following CCs, the results show that accumulating international reserves may compensate for the loss of inflows and lead to more effective policies. Tighter CCs on inflows cause significant spillovers, specifically in the conditions of liquidity abundance. These spillovers originate from the problem of policy coordination of emerging economies and are mainly caused by capital controls being used as an instrument to manage capital flows. For governments that have to manage the risks associated with inflow surges or disruptive outflows, capital controls need to play a key role.

Keywords: capital, controls, flows, impacts

JEL: F21, F32, F41, F42

Introduction

It is important to understand international capital flows to enhance macroeconomic stability and design effective economic policies. Effective capital controls (CCs) reduce the volume of capital flows, alter the composition from short-term to long-term capital flows, make exchange rates more stable, and allow monetary policy autonomy

(Magud et al. 2018, p. 114). Previous studies highlighted various problems concerning CCs, but it is unclear whether these controls achieve their objective or not (Korinek 2011, p. 76; Bianchi and Mendoza 2011, p. 45; Benigno et al. 2013, p. 73). The identified problems include the absence of a theoretical framework to define the macroeconomic consequences of these controls, the heterogeneity between countries that apply CCs, and the success of these restrictions. Several studies have also identified the difficulties that occur due to isolating the direct effect of CCs, which limits the success of capital flows and their objectives (Fernandez et al. 2015, p. 82; Forbes et al. 2015, p. 32; Alfaro et al. 2017, p. 112).

CCs are used in countries all around the globe, but their effectiveness is still not clear. It complicates the development of a standard of best practices to accomplish the influential regulation of international capital flows due to the specific characteristics of economies and different market responses (Forbes et al. 2015, p. 41). There are two aspects of studying the effectiveness of CCs: (a) actions on capital control and (b) achieving macroeconomic objectives (autonomy of monetary policy, reduction of exchange rate pressures, etc.).

The present study discusses the impact of controls on emerging markets. After the Great Recession of 2008, several economies used restrictions, especially on short term capital inflows, while others increased restrictions (Fernandez et al. 2015, p. 61). This study is associated with the studies of monetary policy and exchange policy in influencing the nature of the financial crisis. Recently, monetary policy has been restricted by the global financial cycle under a flexible exchange rate regime when capital flow management is preferable to maintain monetary autonomy, and there is free capital mobility (Rey 2015, p. 83; Passari and Rey 2015, p. 22). Optimal CCs and monetary policy were explored with small, open countries, considering risk premium shocks (Farhi and Werning 2014, p. 15). Those studies reported that CCs retain monetary autonomy in a fixed exchange rate and work as trade manipulation in a flexible exchange rate regime. Exchange rate policies are beneficial to lower the severity of a financial crisis beyond CCs (Benigno et al. 2016, p. 31; Chamon and Garcia 2016, p. 152). Likewise, Devereux, Young, and Yu (2017) showed that CCs can be considered state-improving tools when optimally merged with monetary policy in the presence of policy commitment. Many older studies on CCs focused on the incompatibility triangle, so CCs were usually related to the hope of keeping a degree of autonomy of the monetary policy while applying fixed exchange regimes. In the last several years, some emerging economies (EEs) have tended to use a more flexible exchange rate. The fear of floating will cause these countries to intervene massively on the exchange markets or to vary their director rate to prevent huge fluctuations in the exchange rate.

We contribute to previous empirical studies in two ways. First, we use a recent, large dataset on capital control acts, which allow us to more exactly detect the policy whose efficiency is evaluated. Most of the previous studies on the effectiveness of CCs used infrequent data, usually annual. Capital control measures thus used are less precise, and they suffer from two essential shortcomings: they do not reflect the fair intensi-

ty of their application among countries, and they are often confused with other policies simultaneously applied with CCs. The use of quarterly data in this study allows for a larger time interval and allows for a more correct analysis of the actions taken by policymakers.

Second, the effectiveness of CCs is examined using a model that regroups the components of the monetary policy trilemma, which indicates that it is difficult to use a fixed exchange rate, together with an independent monetary policy and an open capital account. These components are usually studied independently. A major contribution of the paper is to regroup the three elements of the incompatibility triangle into one model. The incompatibility triangle framework also shows that the de jure and de facto changes in the opening of a capital account are related (Rebucci and Ma 2019, p. 35). This is how we can examine whether the applied controls are effective from this incompatibility triangle. Thus, using a panel VAR model, we test whether capital markets affect both monetary policy autonomy and changes in the exchange rate. As presented in several studies, CCs are endogenous, which highlights the recurrent changes in these controls among countries, and, therefore, we will know their repercussions on other macroeconomic policies. To the best of our knowledge, there is no previous study that used a panel VAR approach to study the repercussions of CC changes on monetary and exchange policies.

As regards CC effects, we analyze domestic and multilateral impacts. Domestically, our main finding is that by reducing capital inflows, CCs make it possible to better stabilize the economy. It allows more independence to monetary policy and allows less pressure on the exchange policy at which the exchange rate manifests slight fluctuations.

Empirical evidence shows that EEs accumulated excessive international reserves after the 2008 crisis. Our study has shown that despite the strict capital controls applied by several emerging countries after the crisis, it did not prevent the accumulation of reserves. The latter supported the decisions of monetary policy and exchange rate policy. To the best of our knowledge, few previous studies have highlighted the association between capital control actions with the accumulation of international reserves (Jeanne 2016, p. 52; Korinek 2018, p. 86).

For the multilateral effects, the study presents an understanding of the spillovers that may happen following restrictions applied by a country. Other countries will be affected after the migration of capital flows to their frontiers. Little empirical evidence exists on this spillover effect (Forbes et al. 2017, p. 112; Lambert et al. 2011, p. 165). We are among the first to demonstrate empirically these policy changes towards capital controls as a reaction to the early policy of another country which has already applied similar controls.

Our paper is organized as follows. After presenting the literature review of the effectiveness of CCs in Section 2, we present the data and methodology in Section 3. The results of the model regressions are presented in Section 4. The last section gives conclusions.

Literature review

Multiple effects on monetary and exchange policies

The theoretical and empirical literature on the effectiveness of CC on monetary and exchange policies has several methodological shortcomings. There are several criticisms of the indexes used to reflect the intensity of CC. It is often difficult to separate the effects caused by the controls from the effects caused by other macroeconomic policies, such as the effectiveness of prudential supervision. CCs have been successful in different countries; however, the degree of success is not equal for all countries.

The empirical literature shows multiple impacts of CCs on proxy variables of monetary and exchange policies. Some recent studies have shown evidence that these controls can effectively affect the monetary and exchange policies under some macroeconomic conditions, and they also can protect economies from external shocks (Pasricha et al. 2018, p. 176; Magud et al. 2018, p. 51). Some studies focused on the macroeconomic framework in which CCs are instituted. Among these studies, Bayoumi et al. (2015) studied 37 countries that introduced outflow restrictions from 1995–2010. They found evidence that capital outflow restrictions reduce the pressure on both policies under certain conditions. These conditions include strong macroeconomic fundamentals (growth rate, inflation, and fiscal and current account balances), good institutions (World Bank Governance Effectiveness Index), and existing restrictions (intensity of CCs or comprehensiveness). When none of the three conditions are met, controls will fail to support these policies. Furthermore, some studies suggest that controls are more effective in advanced countries than in others, perhaps because of the better quality of institutions and regulations (Binici et al. 2010).

Some recent studies (Pasricha et al. 2018; Magud et al. 2018) analyzed the conditions of success of capital controls and especially their impacts on the country that applies these controls compared to countries that did not apply these restrictions. Pasricha et al. (2018) used a recent frequency dataset on capital control instruments in 16 emerging market economies from 2001 to 2012. They give novel evidence on the domestic and multilateral impacts of these instruments. Increases in financial liberalization constrain monetary policy autonomy and decrease exchange rate instability, confirming the incompatibility trilemma. Magud et al. (2018) presented a meta-analysis of the literature on CCs, seeking to standardize the results of nearly 40 empirical studies. They build two indices of capital controls: the Capital Controls Effectiveness Index and the Weighted Capital Controls Effectiveness Index. Their results show that CCs on inflows seem to make monetary policy more independent, and they alter the composition of capital flows (Zehri 2020, a); there is less evidence that they reduce real exchange rate pressures. Kim and Yang (2012) determined that a fixed exchange rate allows CCs to support the independence of the monetary policy. This impact is clearer with wide and long term CCs.

Klein and Shambaugh (2015) found that economies with large CCs are more covered concerning external monetary shocks. Meanwhile, Liu and Spiegel (2015) showed that the wide use of CCs allows countries to maintain a desired interest rate differential between domestic and foreign markets. However, these strict controls did not have any link with the currency appreciation detected in some countries in their sample. Ito, McCauley, and Chan (2015) studied a small open economy and focused on simple policy rules, while Devereux et al. (2019) investigated the optimal monetary policy and optimal CC. A model with fixed exchange rates, downward nominal wage rigidities, and free capital mobility was presented by Bayoumi et al. (2015), where an optimal devaluation eliminates the effects of the wage rigidity.

Table 1 summarizes the results of most studies on this issue and shows that the "Unclear" effect dominates the findings.

Table 1. Summary of studies' results

Study	Reducing Real Exchange Rate Pressure	Autonomy of Monetary Policy
Control on Inflows		
Brazil	Unclear	Unclear
Chile	Unclear	Unclear
Colombia	Unclear	Unclear
Malaysia (1989)	Yes	Yes
Malaysia (1994)	Unclear	Yes
Thailand	Unclear	Unclear
Malaysia (1998)	Yes	Yes
Control on Outflows		
Brazil	Yes	Unclear
Chile	Unclear	Yes
Colombia	Yes	Unclear
Thailand	Unclear	Unclear
Multi-country studies	Unclear	Unclear

Source: author's own elaboration.

Indexes of capital controls

It is difficult to give an exact measure of CC. The pre–2008 crisis literature utilizes indexes that measure the degree of capital restrictions. These indexes usually serve to set the extent of restrictions (the kind of transactions controlled) and then define what is the most appropriate when evaluating the effectiveness of controls. Many improvements in measuring CCs have been made in the recent literature. The relevant novelties of these studies gather data on variations in institutional arrangements (Edison and Warnock 2003, p. 63; Ocampo, Spiegel and Stiglitz 2008, p. 23; Qureshi, Ostry, Ghosh, and Chamon 2011, p. 91). The advantage of this method is that it precisely determines

the type of policy action that is consistent with the time of the action. As discussed in the introduction, the puzzle of the similarities of policy effects over time and across EEs continues to appear with this approach.

Older studies utilized diverse approaches to improve the distinction of capital control impacts. These approaches can be arranged into two classes: the first, called "splitting-the-announcements" method, aims to define similar and homogeneous macroeconomic policies. Quantitatively, these policies must have relatively identical impacts, especially on capital inflows. This needs to rearrange the controls established in more homogeneous subgroups of controls. The second aims to compute the opportunity cost of certain variations in regulation. This can be achieved by computing a tax rate of the control actions (Benigno et al. 2016, p. 31; Forbes et al. 2016, p. 162; Baba and Kokenyne 2011, p. 151). Unfortunately, this effective tax is only applied for a certain type of policy tool (e.g., unremunerated reserve requirements), which form a minority of the actions made by EEs.

In this study, we combine the advantages of both approaches by employing indexes constructed recently in some empirical studies (Fernández et al. 2016; Chinn and Ito 2008). Fernández et al. (2016) presented a new data set of CCs divided into ten asset categories along with the structure of inflows and outflows. These indexes were applied to 100 economies over the period 1995–2013. Our study uses the first three indexes among the ten asset categories of CC: ka, kai, and kao (controls applied respectively to gross flows, inflows, and outflows). Chinn and Ito (2008) create a new index that measures the extent of openness in capital account transactions, this index is termed kaopen, and it was regularly updated (the last update is there of 2017). Table 2 summarizes these indexes.

Table 2. Capital Control Indexes

Index	Definition	Source
ka	Overall restrictions index (all asset categories)	Fernández, Klein, Rebucci, Schindler, and Uribe (2016) "Capital Control Measures: A New Dataset"
kai	Overall inflow restrictions index (all asset categories)	
kao	Overall outflow restrictions index (all asset categories)	
kaopen	The extent of openness in capital account transactions	Chinn, M. D., and H. Ito, The Chinn-Ito Index, http://web.pdx.edu/~ito/Chinn-Ito_website.htm, last updated July 2017

Source: author's own elaboration.

The principal distinction between both indexes is that the kaopen index is a larger measure of capital account liberalization, including regulations to the current account of the balance of payments and the foreign exchange market, while the dataset of Fernández et al. (2016) is smaller, focusing especially on capital flows. However, it has further details on the intensity of controls, with distribution data on ten asset

categories. The indexes of Fernández et al. (2016) make it possible to detect more time change when countries set regulations than the Chinn-Ito index.

These indexes of Chinn and Ito (2008) and Fernández et al. (2016) capture the cross-country changes in the level of capital account liberalization; unfortunately, however, they are smaller in the time scope due to the way they are built and their annual frequency. To overcome these shortcomings, we propose duplicating the annual value of each of these indexes in 4 equal sub-values, as if they were quarterly data. This does nothing to diminish the robustness of this analysis since CCs are often long-term political instruments. This change will allow consistency with the frequency of the other variables in the model, which are quarterly.

Data and methodology

Capital control instruments may affect a set of variables, but at the same time, they can be affected by these variables. Thus, we use a panel VAR model. This model includes a system of equations in which the dependent variables will be representative of CCs, capital flows, monetary policy, and exchange rate policy. Our sample includes 27 EEs that used CCs over the period 2010Q1 to 2018Q4.

We use the interest rate differential as a proxy for monetary policy independence (*rate* variable). A country that maintains a differential of the domestic and external interest rate makes it possible to act on the volume of capital inflows and, consequently, to freely define a domestic interest rate without having a constraint with the external rate. The standard deviation of the bilateral exchange rate (to the US $) is a proxy used for the volatility of the exchange rate (the *xchge* variable). To separate the effect of the capital flows variables, we distribute them between inflows (the *infl* variable) and outflows (the *outf* variable), and for the global flows, we use the "*gross*" variable. Also, we include a set of exogenous variables to control for drivers that can influence the endogenous variables (the short-term interest rate in the United States (*us_rate*), the price of oil (*oil*), real gross domestic product growth in the United States (*gdp*) and international reserves (*ir*). The impact of CCs used by the country can affect the inflows to other countries, and these spillover effects are presented by the variable (*spill*).

A panel VAR is the baseline model. The independent variables of this model are all considered endogenous and are explained by the set of exogenous variables previously cited. The model is written as follow:

$$Y_{i,t} = \alpha_0 + Z_1 y_{i,t-1} + \ldots + Z_n y_{i,t-n} + W_1 x_{i,t-1} + \ldots + W_m x_{i,t-m} + FE_i + £_{i,t} \qquad (1)$$

Our model is described by a system of equations, where Y_t is the vector of endogenous variables for country *i*, x_t is the vector of exogenous variables common to all countries, $£_{i,t}$ is the vector of residuals, and "Z" and "W" represent the coefficients for the endogenous and exogenous variables, respectively. Factors that have omitted

and that can affect the dynamics of the model (e.g., administration efficiency) are regrouped in the term FE_i, which represents the country fixed effects (*FE* variable).

To examine if the cross-sectional changes in CC can be well used, we regress the model with the use of the Chinn-Ito (Chinn and Ito 2008) and Fernández et al., (2016) indexes. All of the explicative variables are introduced with one lag difference. Additionally, we propose a regression with the levels of these indexes and analyze the effect of a shock to them.

Results

In this section, we present the evidence from the estimation of the PVAR model for the period 2010:1–2018:4. We analyze if variations in CCs affect monetary and exchange rate policies and are under the forecasts of the incompatibility triangle. We also investigate the impact on international reserves and the multilateral effects. We examine the effect of a shock on CC, considered it as an inside policy instrument, and on different national policy variables, including differential interest rate, exchange rate volatility, capital movements, international reserves accumulation, and spillover effect.

The results of the PVAR analysis are displayed in Table 3. They show a positive and significant coefficient of the changes in "ka" and "kaopen" in the equation in which the differential interest rate is the independent variable. These findings show that changes in capital controls raise the differential of the interest rate and subsequently allow more autonomy of the monetary policy. The two other indexes of capital controls (kai and kao) do not affect the monetary policy. The results present negative and significant coefficients of the changes in "ka" and "kaopen" in the equation of exchange rate volatility (compared to the US dollar) suggesting that capital controls support the stability of the exchange rate policy, i.e., more liberalization is conducive to higher exchange rate instability.

Table 3. PVAR Analysis

		Coefficient	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
rate	ka	0.019	0.055	2.17	0.006	−0.998	0.118
	kai	0.049	0.767	0.58	0.365	0.915	3.157
	kao	0.035	0.858	0.15	0.247	0.758	2.549
	kaopen	0.541	0.467	3.58	0.000	1.625	4.457
	xchge	−0.227	−0.569	−4.00	0.000	−0.339	−0.116
	gross	0.041	0.467	0.58	0.365	1.625	4.457
	spill	0.045	0.658	1.15	0.247	0.958	3.549
	ir	0.7195	0.085	2.44	0.000	−0.738	0.218

		Coefficient	Std. Err.	Z	P>|z|	[95% Conf.	Interval]
xchge	ka	–0.319	–0.085	–2.44	0.000	–0.738	0.218
	kai	0.228	0.407	0.15	0.297	0.559	0.659
	kao	0.139	0.415	1.05	0.009	0.098	0.982
	kaopen	–0.742	0.283	–3.62	0.000	–0.128	–0.018
	rate	–0.396	–0.437	–2.24	0.032	0.223	0.970
	gross	0.180	0.150	1.06	0.063	0.147	0.575
	spill	0.596	0.437	1.45	0.068	0.123	0.770
	ir	0.096	0.537	1.68	0.148	0.253	0.958
ir	ka	0.096	0.427	3.24	0.001	0.213	0.854
	kai	0.141	0.592	2.38	0.005	1.925	3.257
	kao	0.345	0.456	0.85	0.517	0.468	1.549
	kaopen	0.080	0.350	2.06	0.013	0.147	0.575
	rate	0.358	0.157	1.35	0.587	0.257	1.970
	xchge	0.326	0.254	0.14	0.000	0.683	0.870
	gross	0.754	0.076	2.14	0.000	0.013	0.940
	spill	0.546	0.157	3.08	0.000	0.983	1.835
spill	ka	0.236	0.057	0.35	0.568	0.157	1.970
	kai	0.258	0.322	3.15	0.000	0.059	0.659
	kao	0.009	0.015	0.85	0.009	0.098	0.982
	kaopen	0.046	0.257	2.29	0.000	0.145	0.970
	rate	0.127	0.154	1.35	0.437	0.178	0.754
	xchge	0.458	0.022	0.15	0.197	0.059	0.659
	gross	0.359	0.415	2.05	0.009	0.098	0.982
	ir	0.101	0.037	1.32	0.302	0.021	0.587

Source: author's own calculations.

The trilemma is confirmed using the index related to gross flows (ka). However, for the two other indexes, for inflow and outflow controls (kai and kao), the results are insignificant. By using the Chinn-Ito index, the results support the compromises of the incompatibility triangle. Decomposing the annual data from these indexes into quarterly data is very useful. It made it possible to have a greater frequency of data, and it also made it possible to highlight the variations made to these restrictive policies in the short term.

The Granger causality test, presented in Table 4, confirms the previous results. It demonstrates the presence of causality between the indexes of capital controls with the "rate" and "xchge," i.e., CC actions cause monetary and exchange policies.

Table 4. Granger Causality Test

Equation	Excluded	Chi2	Prob > chi2
rate	ka	15.983	0.000
	kai	35.367	0.002
	kao	23.687	0.004
	kaopen	27.692	0.000
	xchge	57.427	0.000
	gross	13.548	0.041
	spill	55.327	0.021
	ir	17.692	0.000
xchge	ka	6.833	0.009
	kai	35.367	0.002
	kao	26.324	0.013
	kaopen	23.687	0.004
	rate	27.692	0.000
	gross	36.324	0.000
	spill	12.568	0.312
	ir	9.254	0.048
ir	ka	12.505	0.009
	kai	35.312	0.002
	Kao	23.639	0.004
	kaopen	47.615	0.000
	rate	23.622	0.004
	xchge	67.692	0.000
	gross	18.257	0.024
	spill	54.576	0.000

Source: author's own calculations.

As displayed in Table 5, this causality is bidirectional for the indexes "ka" and "ka-open," and is unidirectional for the "kai" and "kao" indexes.

Table 5. Direction of Causality

Null Hypothesis	F-Statistic	Prob.	Remarks
Ka index			
Ka does not Granger cause rate	7.888	0.001	Bidirectional
rate does not Granger cause ka	4.296	0.015	
ka does not Granger cause debt xchge	9.970	0.000	Bidirectional
xchge does not Granger cause ka	2.662	0.073	
Kai index			
kai does not Granger cause rate	15.348	0.007	Unidirectional
rate does not Granger cause kai	36.872	0.359	
kai does not Granger cause xchge	25.687	0.025	Unidirectional
xchge does not Granger cause kai	8.657	0.252	

Null Hypothesis	F-Statistic	Prob.	Remarks
Kao index			
kao does not Granger cause rate	25.315	0.017	Unidirectional
rate does not Granger cause kao	43.482	0.359	
kao does not Granger cause xchge	15.587	0.005	Unidirectional
xchge does not Granger cause kao	29.157	0.252	
Kaopen index			
kaopen does not Granger cause rate	45.302	0.017	Bidirectional
rate does not Granger cause kaopen	15.459	0.009	
kaopen does not Granger cause xchge	41.526	0.002	Bidirectional
xchge does not Granger cause kaopen	27.037	0.000	

Source: author's own calculations.

We suppose that the vector of endogenous variables listed in the system represented as Y_t = [rate, xchge, ir, and spill]. To investigate the fraction of the fluctuations in the endogenous variables that are due to the capital controls shock, Table 6 summarizes the forecast-error variance decomposition. The findings show that unpredicted changes in the "ka" and "kaopen" indexes explain a large percentage of the dynamics in the differential interest rate (78.1% and 78.8%, respectively) and the exchange rate fluctuation (78.4% and 81.5%, respectively) at the 4-quarters horizon.

Concerning the impact on international reserves for four quarters ahead, the "ka" and "kaopen" shocks explain 75.4% and 52.1%, respectively, the variation in international reserves, and 59.5% and 52.1%, respectively, the variation in spillovers. The impact of the CC indexes shocks on "spill" is also great, demonstrating that CCs are extremely conducive to spillover on other countries.

Table 6. Forecast-error variance decomposition due to a CC shocks

Variable	1 quarter ahead	2 quarters ahead	3 quarters ahead	4 quarters ahead
Ka				
rate	0.002	0.141	0.258	0.380
xchge	0.456	0.242	0.151	0.025
ir	0.154	0.178	0.197	0. 225
spill	0.054	0.148	0.165	0.228
Kaopen				
rate	0.015	0.141	0.258	0.374
xchge	0.501	0.232	0.057	0.025
ir	0.201	0.185	0.074	0. 061
spill	0.021	0.101	0.131	0.489

Source: author calculations.

Chart 1 displays the impulse-response functions to a positive shock in CC indexes (kaopen and ka) after a one unit shock on a capital account (i.e., a rise by one weighted unit in capital account restriction). These effects are significant and happen rapidly following the shock; however, they remain for a short time. For the exchange rate re-

sponse, the major portion happens in the first quarter ahead. The differential interest rate response is longer, lasting more than one year. This temporal difference in impact suggests that the loss of the autonomy of monetary policy is longer than the instability of the exchange rate. In the short run, applying CCs may allow the monetary policy to adapt the local interest rate,and reducing the vulnerability to higher instability of the exchange rate related to the occurrence of intensive short-term flows generated by the United States' monetary policy variations.

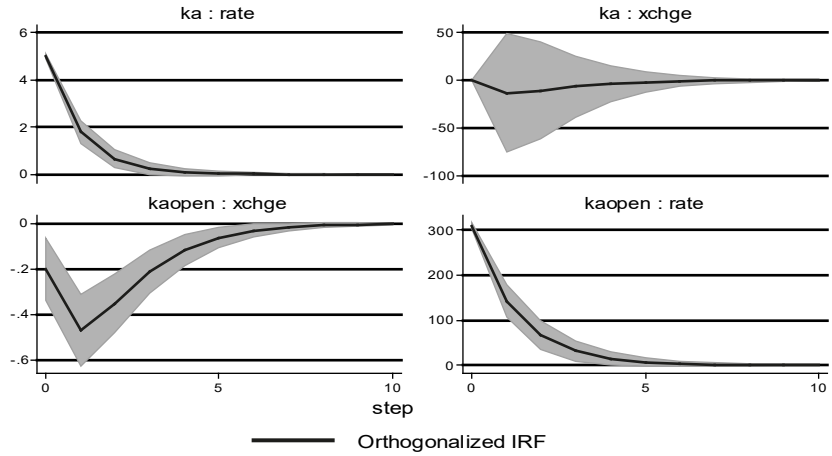

Chart 1. Impulse-response functions to positive capital control (ka and kaopen) shocks
Source: IRF STATA Software.

The constraints of choosing economic policies in the context of the free movement of capital can be circumvented following an accumulation of international reserves. In the 2000s, several EEs sought an optimal combination aimed at safeguarding their autonomous monetary policy, stabilizing the exchange rate, and liberalizing the capital account via an accumulation of reserves (Bianchi et al. 2018). The results show positive and significant coefficients of "ka," "kaopen," and "kai" to explain the changes in international reserves; only the coefficient of controls on outflows (the "kao" index) is insignificant (Table 3).

These reserves made it possible to correct the impossibility of recourse to certain macroeconomic policies (Zehri 2020, b). Our results confirm this positive effect of reserves on monetary policy and on exchange rate policy; the coefficient of the variable "ir" is positive and significant in the equations that explain the differential interest rate and the exchange rate fluctuation.

The multilateral impacts of CC policies are important for many causes. First, CCs applied by the country receiving international flows may motivate flows to reach other recipient economies that do not apply such controls, aggravating their local financial instability. Second, CCs may obstruct foreign adjustment, for example, when controls on capital inflow are utilized to maintain a certain value of a currency. The cross-sec-

tional equivalence of restrictions on capital flows is detected by the fixed-effects of each EE and, to a limited extent, by the international investment position changes.

We find proof that a net strict of inflow controls in the EEs (the kai index) produces effective spillovers to other economies, starting by driving these inflows into those economies and by causing tensions on their exchange rate. In response, the short-term interest rates of these countries will fall, to discourage these inflows. These reactions are short term and are difficult to detect statistically; the shock and the response to this shock happen in the same trimester. Our results (Table 3) show a positive and significant coefficient of "kai" in the equation of "spill." Additionally, the Chinn and Ito index "kaopen" is also positive and significant. These findings are in line with the literature evidence. The other indexes of capital controls on outflows and gross flows, "kao" and "ka," are insignificant.

In response to these high inflows and to counteract their negative effects on the domestic currency, the local policymakers react by strengthening inflow controls. This policy response is efficient and leads to a turnaround of the capital inflow in the next quarter, which causes a fall that covers the massive inflows of the previous period.

Our results, which show that CCs cause spillovers on the strategies of other economies, are backed up by theory. However, this study is among the first to discover empirical proof of these spillovers. Lu et al. (2017) examined the political response of one country following the intensive application of CCs by another. These capital controls provoked a negative externality and induced a similar reaction in the country that consequently received massive inflows of capital, also leading them to practice capital controls. Nevertheless, Lu et al. (2017) did not empirically verify this spillover effect.

The evidence for this spillover became clearer after the 2008 crisis. It was found that capital controls instituted by one country caused an appreciation of the currencies of other countries and a massive inflow of capital to these countries. During the following periods, these effects will gradually decrease and will end with the introduction of capital controls by other countries. There will then be a fall in inflows and an increase in the short-term interest rate differential.

Conclusion

The study examined the internal and external effects of capital controls in emerging economies after the 2008 crisis. We analyzed the impacts of variation in CCs through a new, elaborated dataset and by using a panel VAR approach. Concerning the impacts of CC, our major result is that the restrictions provided by the incompatibility triangle were formed by the policy decisions in emerging economies after the 2008 crisis. The governments of EEs have become more focused on quickly stabilizing their exchange rates while at the same time accepting the loss of their monetary policy independence. This combination of monetary policy, exchange rate policy, and CCs are similar to the

suggestions of the trilemma. The EEs would like to shift away from the corners of this triangle, wanting to have more monetary autonomy, more exchange rate stability, and more financial openness. The analysis of the impact of capital controls has made it possible to highlight a return to greater monetary autonomy and also to have more stable exchange rates. These results are consistent with the findings of the literature, according to which, the liberalization of the movements of capital may lead to a lose of control over monetary policy and causes a high fluctuation of the exchange rate.

This analysis has several limitations, in particular, the CC indexes used and the choice of differential interest rate as an indicator of monetary policy autonomy. Although the differential in domestic and foreign interest rates is often seen as a proxy for the independence of the monetary policy (Borio and Gambacorta 2017), it is subject to debate. A decrease in this differential will not effectively convert into a loss of monetary autonomy, especially in countries with high inflation, which will consequently affect the exchange rate. In these circumstances, a fall in the differential interest rate, maybe originating from a tightening of United States monetary rules, can explain the inside inflation order and, consequently, the differential interest rate (Rudebusch and Williams 2016; Laséen, Pescatori, and Turunen 2017).

This study highlights the role of accumulating international reserves as an instrument to support Ees' macroeconomic policies. The results confirm that CCs did not prevent emerging countries from accumulating international reserves. After the crisis, these reserves made it possible to support the monetary and exchange rate policies of these countries. These reserves constitute a substitute for capital outflows following capital controls. The spillover effect is very noticeable after some countries introduced capital controls. It was noticeable that EEs were affected by massive capital inflows following the application of such controls. These restriction policies may affect other countries through reversal capital flows. This spillover may be explained by abundant international liquidity and the important role of investment funds (Miyajima and Shim 2014). The study shows evidence of spillover policy, which originates from the problem of coordination between EEs concerning the use of capital controls as an instrument to manage capital flows.

References

Alfaro, L., Chari, A., Kanczuk, F. (2017), *The real effects of capital controls: Firm-level evidence from a policy experiment*, "Journal of International Economics", 108, pp. 191–210. http://dx.doi.org/10.1016/j.jinteco.2017.06.004

Bayoumi, T., Gagnon, J., Saborowski, C. (2015), *Official financial flows, capital mobility, and global imbalances*, "Journal of International Money and Finance", 52, pp. 146–174. http://dx.doi.org/10.1016/j.jimonfin.2014.11.017

Benigno, G., Chen, H., Otrok, C., Rebucci, A., Young, E.R. (2013), *Financial crises and macro-prudential policies*, "Journal of International Economics", 89 (2), pp. 453–470. http://dx.doi.org/10.1016/j.jinteco.2012.06.002

Benigno, G., Chen, H., Otrok, C., Rebucci, A., Young, E.R. (2016), *Optimal capital controls and real exchange rate policies: A pecuniary externality perspective*, "Journal of Monetary Economics", 84, pp. 147–165. http://dx.doi.org/10.1016/j.jmoneco.2016.10.004

Bianchi, J., Mendoza, M.E.G. (2011), *Overborrowing, Financial Crises and "Macro-Prudential'Policy?*, No. 11–24, International Monetary Fund. https://doi.org/10.5089/9781455216710.001

Bianchi, J., Hatchondo, J.C., Martinez, L. (2018), *International reserves and rollover risk*, "American Economic Review", 108 (9), pp. 2629–2670. http://dx.doi.org/10.1257/aer.20140443

Borio, C., Gambacorta, L. (2017), *Monetary policy and bank lending in a low interest rate environment: diminishing effectiveness?*, "Journal of Macroeconomics", 54, pp. 217–231. http://dx.doi.org/10.1016/j.jmacro.2017.02.005

Chamon, M., Garcia, M. (2016), *Capital controls in Brazil: effective?*, "Journal of International Money and Finance", 61, pp. 163–187. http://dx.doi.org/10.1016/j.jimonfin.2015.08.008

Chinn, M.D., Ito, H. (2008), *A new measure of financial openness*, "Journal of Comparative Policy Analysis", 10 (3), pp. 309–322. http://dx.doi.org/10.1080/13876980802231123

Devereux, M.B., Young, E.R., Yu, C. (2017), *Capital Controls, Monetary Policy, and Sudden Stops*. http://dx.doi.org/10.1016/j.jmoneco.2018.07.016

Edison, H.J., Warnock, F.E. (2003), *A simple measure of the intensity of capital controls*, "Journal of Empirical Finance", 10 (1–2), pp. 81–103. http://dx.doi.org/10.1016/S0927-5398(02)00055-5

Farhi, E., Werning, I. (2014), *Dilemma not trilemma? Capital controls and exchange rates with volatile capital flows*, "IMF Economic Review", 62 (4), pp. 569–605. http://dx.doi.org/10.1057/imfer.2014.25

Fernández, A., Rebucci, A., Uribe, M. (2015), *Are capital controls countercyclical?*, "Journal of Monetary Economics"", 76, pp. 1–14. http://dx.doi.org/10.1016/j.jmoneco.2015.07.001

Fernández, A., Klein, M.W., Rebucci, A., Schindler, M., Uribe, M. (2016), *Capital control measures: A new dataset*, "IMF Economic Review", 64 (3), pp. 548–574. http://dx.doi.org/10.1057/imfer.2016.11

Forbes, K., Fratzscher, M., Straub, R. (2015), *Capital-flow management measures: What are they good for?*, "Journal of International Economics", 96, pp. S76–S97. http://dx.doi.org/10.1016/j.jinteco.2014.11.004

Forbes, K., Reinhardt, D., Wieladek, T. (2017), *The spillovers, interactions, and (un) intended consequences of monetary and regulatory policies*, "Journal of Monetary Economics", 85, pp. 1–22. http://dx.doi.org/10.1016/j.jmoneco.2016.10.008

Glick, R., Hutchison, M. (2005), *Capital controls and exchange rate instability in developing economies*, "Journal of International Money and Finance", 24 (3), pp. 387–412, http://dx.doi.org/10.1016/j.jimonfin.2004.11.004

Ito, H., McCauley, R.N., Chan, T. (2015), *Currency composition of reserves, trade invoicing and currency movements*, "Emerging Markets Review", 25, pp. 16–29. http://dx.doi.org/10.1016/j.ememar.2015.11.001

Jeanne, O. (2016), *The macroprudential role of international reserves*, "American Economic Review", 106 (5), pp. 570–573. http://dx.doi.org/10.1257/aer.p20161013
Kim, S., Yang, D.Y. (2012), *International monetary transmission in East Asia: Floaters, non-floaters, and capital controls*, "Japan and the World Economy", 24 (4), pp. 305–316. http://dx.doi.org/10.1016/j.japwor.2012.05.003
Klein, M.W., Shambaugh, J.C. (2015), *Rounding the corners of the policy trilemma: sources of monetary policy autonomy*, "American Economic Journal: Macroeconomics", 7 (4), pp. 33–66. http://dx.doi.org/10.1257/mac.20130237
Korinek, A. (2011), *The new economics of prudential capital controls: A research agenda*, "IMF Economic Review", 59 (3), pp. 523–561. http://dx.doi.org/10.1057/imfer.2011.19
Korinek, A. (2018), *Regulating capital flows to emerging markets: An externality view*, "Journal of International Economics", 111, pp. 61–80. http://dx.doi.org/10.1016/j.jinteco.2017.12.005
Lambert, F.J., Ramos-Tallada, J., Rebillard, C. (2011), *Capital controls and spillover effects: evidence from Latin-American countries*, Banque de France Working Paper No. 357. http://dx.doi.org/10.2139/ssrn.1980091
Laséen, S., Pescatori, A., Turunen, J. (2017), *Systemic risk: A new trade-off for monetary policy?*, "Journal of Financial Stability", 32, pp. 70–85. http://dx.doi.org/10.1016/j.jfs.2017.08.002
Liu, Z., Spiegel, M.M. (2015), *Optimal monetary policy and capital account restrictions in a small open economy*, "IMF Economic Review", 63 (2), pp. 298–324. http://dx.doi.org/10.1057/imfer.2015.8
Lu, Y., Tao, Z., Zhu, L. (2017), *Identifying FDI spillovers*, "Journal of International Economics", 107, pp. 75–90. http://dx.doi.org/10.1016/j.jinteco.2017.01.006
Magud, N.E., Reinhart, C.M., Rogoff, K.S. (2011), *Capital controls: myth and reality-a portfolio balance approach*, No. w16805, Peterson Institute for International Economics Working Paper No. 2011-07. http://dx.doi.org/10.2139/ssrn.1773692
Magud, N.E., Reinhart, C.M., Rogoff, K.S. (2018), *Capital controls: myth and reality – a portfolio balance approach*, "Annals of Economics and Finance", 19 (1), pp. 1–47.
Ocampo, J.A., Spiegel, S., Stiglitz, J.E. (2008), *Capital market liberalization and development*, "Capital Market Liberalization and Development", pp. 1–47. http://dx.doi.org/10.1093/acprof:oso/9780199230587.001.0001
Pasricha, G.K., Falagiarda, M., Bijsterbosch, M., Aizenman, J. (2018), *Domestic and multilateral effects of capital controls in emerging markets*, "Journal of International Economics", 115, pp. 48–58. http://dx.doi.org/10.1016/j.jinteco.2018.08.005
Passari, E., Rey, H. (2015), *Financial flows and the international monetary system*, "The Economic Journal", 125 (584), pp. 675–698. http://dx.doi.org/10.1111/ecoj.12268
Qureshi, M.S., Ostry, J.D., Ghosh, A.R., Chamon, M. (2011), *Managing capital inflows: The role of capital controls and prudential policies*, No. w17363, NBER Working Paper Series. https://doi.org/10.3386/w17363
Rebucci, A., Ma, C. (2019), *Capital controls: A survey of the new literature*, No. w26558, National Bureau of Economic Research. http://dx.doi.org/10.2139/ssrn.3495987
Rey, H. (2015), *Dilemma not trilemma: the global financial cycle and monetary policy independence*, No. w21162, National Bureau of Economic Research.

Rudebusch, G.D., Williams, J.C. (2016), *A wedge in the dual mandate: Monetary policy and long-term unemployment*, "Journal of Macroeconomics", 47, 5–18. http://dx.doi.org/10.1016/j.jmacro.2015.05.001

Zehri, C. (2020a), *Capital Restrictions Policies, Currency Appreciation and Foreign Debts*. "Montenegrin Journal of Economics", 16 (3), 149–159. https://doi.org/10.14254/1800-5845/2020.16-3.12

Zehri, C. (2020b), *Conditions for the success of capital controls: The elasticity approach*. "International Journal of Finance & Economics". Articles in press. https://doi.org/10.1002/ijfe.2182

Streszczenie

Wielorakie skutki kontroli przepływu kapitału

Kontrola kapitału jest postrzegana jako metoda zapewnienia stabilności finansowej lub poprawy programu dostosowań makroekonomicznych w gospodarkach, w których występują sztywności nominalne i nieoptymalna polityka pieniężna. Taka kontrola może przybierać różne formy, w tym jawnego lub ukrytego opodatkowania transgranicznych przepływów finansowych oraz wprowadzenia systemu podwójnych lub wielokrotnych kursów walutowych. Wykorzystując kwartalne dane dotyczące kontroli kapitału w 27 gospodarkach wschodzących w latach 2010–2018, przeanalizowano skuteczność kontroli kapitału pod różnymi kątami. Od kryzysu finansowego w 2008 r. wzmocnienie kontroli kapitału umożliwiło zwiększenie autonomii polityki pieniężnej i stabilności kursu walutowego, zgodnie z założeniami modelu Mundella-Fleminga. Wyniki analizy pokazują, że gromadzenie rezerw międzynarodowych może rekompensować utratę wpływów i prowadzić do realizacji bardziej skutecznej polityki. Silniejsza kontrola napływu kapitału powoduje znaczne skutki uboczne, szczególnie w warunkach nadmiernej płynności. Te zewnętrzne efekty wynikają z problemu koordynacji polityki gospodarek wschodzących i są głównie spowodowane przez kontrolę kapitału stosowaną jako instrument zarządzania przepływami kapitału. W działaniach rządów, które muszą zarządzać ryzykiem związanym z gwałtownym napływem lub odpływem kapitału, kontrola kapitału powinna odgrywać kluczową rolę.

Słowa kluczowe: kapitał, kontrola, przepływy, skutki

JEL: F21, F32, F41, F42

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.34

A Panel Analysis of Trade Gravity between Pakistan and South Asian Countries

Waheed Ullah Jan
Ph.D., Research Scholar, Department of Economics, Gomal University
Dera Ismail Khan, Pakistan, e-mail: janwaheed77@gmail.com

Mahmood Shah
Associate Professor, Department of Economics, Gomal University
Dera Ismail Khan, Pakistan, e-mail: moodishahji@yahoo.com

Abstract

This paper attempts to examinePakistan's trade patterns with South Asian countries by using a gravity model of trade. The main objective of the study is to quantify the long-run impacts of gravity variables. To achieve this objective, a panel data set for the period 2003 to 2017 has been used. Based on the mixed evidence of the results of panel unit root tests, Pooled Mean Group (PMG) and Panel Dynamic Ordinary Least Square (DOLS) techniques are applied. The outcome of the PMG and Panel DOLS models justifies the theoretical background of the gravity model and suggests that all the basic gravity variables haveusual signs. The RGDPs and population ofboth Pakistan and the partner country have a positive impact on their bilateral trade. On the other hand,the distance between the two trading countries and the exchange rate have a negative impact on bilateral trade.The uniqueness of this study is that it measures the impacts of qualitative variables along with basic gravity variables. Language similarities and common borders have a positive impact on bilateral trade. Pakistan has borders with India and Afghanistan, but their trade relations are not worth mentioning. The military conflicts between Pakistan and India, andthe political suspicions between Pakistan and Afghanistan hinder their trade relations.

Keywords: South Asia, Pakistan, gravity model, exchange rate, population

JEL: F12, F15, F42, F53

Introduction

South Asia consists of eight self-governing states (India, Pakistan, Bangladesh, Nepal, Bhutan, the Maldives, Sri Lanka, and Afghanistan). A huge portion of the world's population lives in South Asia. These countries are economically very backward, however, and agriculture is the main occupation. Trade among these countries is not worth mentioning. They are heavily dependent on foreign markets, they get very little from international trade, and they always face trade deficits. The area is characterized by poverty, and the majority of people live below the poverty line. Each country has its own characteristics, with differences in consumption behavior, product manufacturing, tax structure, and investment structure. These differences provide a base for trade in the region.

South Asia has great importance in global politics due to its geographical location. The region has the world's attention due to the permanent stress on the line of control and military conflicts between India and Pakistan. However, this is only one side of the coin. On the other side, the region offers an authentic scenario of economic interests, joint development, and democracy. Since 1990, the economic policies of the South Asian countries have changed enormously; in particular, Bangladesh, India, Pakistan, and Sri Lanka have revised their trade policies. They liberalized their trade and started to open their economies to international trade.

South Asian countries have signed various trade agreements to liberalize their trade. The first step towards trade liberalization was the Regional Trade Agreement (RTA). The RTA provided the basis for SAARC Preferential Trading Arrangement (SAPTA), which was signed in 1993 and implemented in 1995. The main objective of this agreement was to encourage mutual trade among South Asian countries. SAPTA was later changed into the South Asian Free Trade Agreement (SAFTA).

The South Asian Free Trade Area: SAFTA was signed in January 2004 and implemented in January 2006. All the member countries agreed to follow the agreement. In the first phase, the member countries were legally bound to reduce their customs duty. In this regard, Pakistan, India, and Sri Lanka were asked to reduce their customs duties. In the next phase, Bhutan, Bangladesh, Nepal, Afghanistan, and the Maldives will decrease their customs duties.

The main objective of this agreement was to bring transparency and create competition in mutual trade. They emphasized the mobility of labor, a reduction in transportation cost, and capital accumulation. They also decided to reform the services sector and improve the energy sector.

The Afghan-Pak Transit Trade Agreement (APTTA): This agreement was signed by the two countries in 2010 and implemented in 2011. The main objectives were to stop smuggling, to ensure the smooth flow of commodities, and to protect Pakistan's strategic interests. Moreover, Pakistan will allow Afghanistan to trade with India through the Wagha Border, with Pakistan providing infrastructure and security. Goods will be transported through open trucks and containers. However, India will not be allowed to export goods through Wagha Border.

The Pakistan and Sri Lanka Free Trade Agreement (FTA): This agreement has been operational since 2005. In the light of this agreement, both countries will give permission to reach each other's markets by granting tariff concessions. After the implementation of this agreement, Pakistan is able to get concessions on 102 foodstuffs in the Sri Lankan markets. These products consist of fruits, fish, and spices. Meanwhile, Sri Lanka is able to export 206 duty-free goods to Pakistan, including coffee, black pepper, and dry fruits.

The India-Sri Lanka Free Trade Agreement (ISLFTA): This agreement was signed in 1998 and came into practice in 2000. According to this agreement, tariff concession will be given from each side on specific commodities. Both countries prepared two types of lists. One is a positive list, which means full concession. The second is a negative list, which means no concession. The criteria for the recommendation of tariff-free and not tariff-free goods are prepared under the FTA rules.

South Asian countries have gained a lot through the creation and diversification of trade. After the implementation of SAFTA, about US$ 8 billion was achieved from the total manufactured goods under the full tariff liberalization (Kumar 2005). Regional trade potential and economic integration of South Asia is amazing. According to Kumar (2005), mutual trade in the region would be three times bigger than the existing level if the unofficial flow of trade was considered. Official trade can be increased up to the level of US$ 36 billion by 2020. He further says that through SAFTA, trade diversion effects can make it easy for the small countries to reach the big markets of developed economies. Ultimately, smaller economies like Nepal, Bhutan, Bangladesh, and the Maldives will get more benefits from trade than comparatively larger economies like Pakistan and India (Rispens 2009).

To compare the reality with other regions, the trade performance of South Asian countries has been very poor in world trade during the last 20 years. Over the past 20 years, exports from the region grew only twofold, to reach approximately US$ 100 billion, while within the same period, East Asian exports were ten times greater (Newfarmer and Pierola 2006). This is the sign of the limited trade integration between South Asia and its trading partners in the world. Their mutual trade collaboration is very limited. The intra-regional trade ratio to GDP is about 33% of South Asia's GDP, whereas it is 71% in the East Asian nations (Wilson and Otsuki 2007).

The main objective of this research paper is to highlight the trade pattern of Pakistan with other South Asian countries. The other objectives of the study are: (1) To analyze the degree of trade integration between Pakistan and its South Asian trading partners. (2) To quantify the long-run impacts of basic gravity variables. (3) To discover the short-run and long-run impacts of a common border and common language on trade relations between Pakistan and the South Asian countries.

The rest of the paper is arranged as follows: the second section contains relevant literature to the study. The third section consists of the research methodology. The fourth section is furnished with empirical results, and in the last section, conclusions are drawn.

Literature review

The gravity model of trade is considered the workhorse for empirical analysis in bilateral trade. In this section, past research studies in which the gravity model of trade was used with new variables are discussed.

Panda and Kumaran (2016) researched India-China trade relations using the gravity model of trade. The results were obtained by a random-effects model and a panel regression model. Their findings suggest that the trade flows of both countries are greater with countries that are closer to them. India's trade flows are influenced by its GDP growth rate and low per capita income. Similarly, China's trade is highly influenced by a common language and the per capita income of its trading partners. GDP growth rate and common language have a positive impact on their bilateral trade.

Wang (2016) researched 80 countries for the period 2000 to 2013 using a balanced panel data set. He fitted the data in a gravity model of trade and used the Poisson pseudo maximum likelihood (PPML) technique for estimation. The results suggest that the GDPs of importer countries have a statistically positive impact, while distance has a negative impact on bilateral trade. So, both variables follow the theoretical background of the gravity variables.

Waheed and Shujaat (2015) studied the trade relations of Bahrain and its 31 trading partners. They used a panel data set for the period 1994 to 2013. The results were obtained by an augmented gravity model using panel generalized least squares (GLS) estimation technique. Based on their empirical results, they concluded that the relative price ratio and foreign reserves of the trading partners are important in determining the export flow of Bahrain. The dummy variables for FTA and GCC (Gulf Cooperation Council) are also crucial factors in determining the trade flow. The basic variables of the gravity model have the usual effects.

Mohmand and Wang (2013) conducted a study to explore the factors affecting exports of Pakistan through a gravity model. The authors collected data on 142 countries for the period 1995 to 2011. They furnished the gravity model with dummy variables like a common language, common religion, and free trade agreements along with basic variables (GDPs and distance). From the empirical findings, it was concluded that common language and common religion have no relation with Pakistan's bilateral trade. Furthermore, they explained that importer and exporter GDPs are very important for two-sided trade. It was recommended that Pakistan divert its trade towards countries that are nearest to it.

Malik and Chaudhry (2012) investigated the main reasons for Pakistan's imports from Asian economies in the light of the 1990s import policy. The researchers fitted a gravity model and applied the OLS technique to panel data for the period 1996–2006. The empirical work concentrated on macroeconomic variables and their behavior in trade gravity. The estimated findings indicate that the GDP of Pakistan and its trading partner has a positive impact on imports, while the exchange rate has a nega-

tive impact. From the results, it was concluded that GDP, exchange rate, and free trade agreements are the main factors of Pakistan's imports from Asian countries.

Akhter and Ghani (2010) examined the gains from regional trade and the trade potential of SAARC countries in the light of SAFTA. They estimated a gravity model to measure the trade flows among South Asian countries. The estimation techniques were applied on panel data, and the time period selected was from 2003 to 2008. The empirical results suggested that SAFTA can play a significant role in promoting bilateral trade in the SAARC region. The researchers also explained that all the member countries of SAARC will reap the trade benefits if SAFTA is implemented. They emphasized that in this respect, the role of three major partners (Sri Lanka, Pakistan, and India) is very important.

Wang et al. (2010) conducted a study on the trade structure of nineteen OECD countries between 1981 and 1999 and applied an augmented gravity model for estimation. Based on the empirical results, they concluded that the distance between the economic centers of these countries negatively affects bilateral trade among them. Moreover, it was declared that FDI and FDI stock, GDP, and local technology are no less important. They argued that these variables have a positive impact on the bilateral trade of OECD countries.

The previous research studies indicate that the gravity model of trade is commonly used to estimate international trade. However, very little work has been done on the trade patterns of south Asian countries. Most researchers analyzed only large countries in the region. In this paper, an attempt is made to analyse Pakistan's bilateral trade with all South Asian countries by using the gravity model of trade.

Research methodology

Study area

The study concentrates on Pakistan's bilateral trade with South Asian countries. They were selected because they are consistent trading partners of Pakistan. Pakistan and India share a long border, although there is always unrest on the line of control (LOC) and political conflicts; yet they have an opportunity to enhance their trade activities. Similarly, Afghanistan lies on the border with Pakistan. Other countries of the region also have close relations with Pakistan. Nepal and Bhutan are small countries of the region whose markets Pakistan can access, while Sri Lanka and Bangladesh are no less important for trade.

Data description and sources of data

For the empirical analysis, panel data was used for fifteen years, from 2003 to 2017. All the data are taken on a yearly basis. Countries' individual and bilateral import and export data is taken from the International Trade Center (ITC), based on UN Comtrade statistics (2017). Data about macroeconomics variables (population, RGDP, and exchange rate) were obtained from the World Development Indicators (WDI 2017). The distance between trade centers, normally the capital cities of the trading countries, is taken and calculated from the Great Circle Distance online. All the data were converted into USD millions. Data on the population for all countries is also presented in millions. The exchange rate between counter partners is changed into USD, and the Pakistani currency is linked to the USD because payments between Pakistan and its trading partners are made in USD.

The data was fitted and analyzed by the statistical package "Eviews9" with help from STATA9. The total bilateral trade variable TT_{ij} was generated by the summation of Pakistan's exports and imports to and from each counter partner. Common language and common border were incorporated as dummy variables. All the variables are log-transformed except the dummy variables. Throughout the study, seven variables-one independent and six dependents-are discussed for eight countries, including Pakistan.

Model specification

The gravity model has gained in importance in recent years in international trade. It was used for the first time by Tinbergen (1962) and Pöyhönen (1963) for their empirical studies. Its first implication in international trade was to find the causes of bilateral trade. In accordance with Newton's law of universal gravitation, i.e., two items attract each other in proportion to their masses and inversely proportional to the square of the distance between them, two countries will trade each other according to their GDP sizes and proximity. Put simply, two- sided trade will increase in direct proportion to their economic magnitude and will decrease with every increase in distance.

Krugman et al. (2012) formulated the gravity model of trade as:

$$T_{ij} = A\frac{Y_i^a \times Y_j^b}{D_{ij}^c} \tag{1}$$

Taking natural log to both sides

$$lnT_{ij} = A + alnY_i + blnY_j - clnD_{ij} + \varepsilon_{ijt} \tag{2}$$

where T_{ij} = Total trade volume between country *i* and country *j* (summation of imports and exports). *A* = Constant (gravitational proportionality). Y_{ij} = GDPs of country *i* and country *j* (economic mass). D_{ij} = Distance between two countries' capital cities or trade centers. a, b, and c = parameters to be estimated. ε_{ijt} = Error term. Equation (3) indicates that trade between two countries takes place due to three factors, their respective GDPs (GDP_i and GDPj) and the distance between them.

Krugman et al. (2012) believe that the gravity model is applicable in bilateral trade because high-income countries spend a huge share of their income on imports. They attract other countries to purchase goods from them because they have a large variety of goods and a vast home market. So, the larger the economy, the greater the trade.

The model is modified and augmented with some new variables:

$$lnTT_{ijt} = \alpha + \beta_1 lnRGDP_{ijt} + \beta_2 lnPOP_{ijt} + \beta_3 lnEXR_{ijt} + \beta_4 lnDIST_{ij} + \\ + \beta_5 CBOR + \beta_6 CLANG + U_{ijt} \quad (3)$$

where
α= intercept,
U_{ijt} = omitted variables or unobserved factors that influence bilateral trade,
β_i = coefficients (β_1, β_2,…, β_6 represent elasticities of variables),
TT_{ijt} = Total trade volume between country *i* and country *j* in period *t*,
$RGDP_{ijt}$ = Product of Real Gross Domestic Product of country *i* and country *j* in period *t*,
POP_{ijt} =Product of population of country *i* and country *j* in time period *t*,
EXR_{ijt} = Bilateral exchange rate between country *i* and country *j* in time period *t*,
$DIST_{ij}$ = Distance between country *i* and country *j*.
Note: Country *i* is always Pakistan and country *j* is the partner country.
Dummy variables of the study
CBOR: Common Border (1if the border is common, 0 otherwise).
CLANG: Common Language (1if the language is common, 0 otherwise).

Analytical techniques

Panel Unit Root Test

Panel data usually have the problem of stationarity. So, it is necessary to remove this problem from the data; otherwise, it will give spurious results. To detect the problem of stationarity, various panel unit root tests are used. For the current study, the LLC Test (Levin, Lin, and Chu 2002) and IPS Test (Im, Pesaran, and Shin 2003) are used

to check the stationarity and order of integration of the variables. The LLC test generated by Levin et al. (2002) is a simplified form of the ADF (augmented Dickey-Fuller) test and is frequently used for panel data. Both of these tests are discussed below.

LLC Panel Unit Root Test

The LLC panel unit root test constitutes the null hypothesis: every individual time series in the panel data has a unit root (not stationary), and the alternative hypothesis is: every individual time series in the panel data has no unit root (stationary). The customized shape of the ADF test (LLC Test) is presented below:

$$\Delta y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{pi} \theta_{ij} \Delta y_{it-j} + \varnothing_i z_{it} + \varepsilon_{it} \tag{4}$$

where ρ_i = the coefficient of autoregressive (AR), z_{it} = vector of deterministic variables (including fixed effects, linear time trends and time dummies) that capture cross-sectional heterogeneity, and $\varnothing_i$ = vector of the coefficients.

The limitation of the LLC test is that it requires long time periods; otherwise, its application will be tricky, and it will give weak results.

IPS Panel Unit Root Test

The LLC test is discouraging because it needs a large number of observations and homogeneity in all cross-sections. Im et al. (2003) considered homogeneity and designed a separate panel unit root test for heterogeneity. Their test is also based on individual cross-section ADF tests. They repeated the problem of heterogeneity in the panel data and tried to tackle this problem by taking the average of all cross-sections and then applying the ADF test individually. They suggested the null hypothesis as: there is no unit root in every time series of the panel ($H_0 : \rho_i = 0$ for all *i*), and set the alternative hypothesis as: there is a unit root in some time series of the panel ($H_a : \rho_i < 0$ for at least one *i*).

The IPS test can be calculated as the average of the ADF statistic for individual cross-sections:

$$\overline{t} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho i} \tag{5}$$

where $t_{\rho i}$ = the average of the ADF statistic for testing the null hypothesis. The IPS test indicates that $\overline{t}$ is normally distributed N (0, 1). The IPS test statistic equation is given below:

$$t_{IPS} = \frac{\sqrt{N}(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E(t_{iT}|\rho_i = 0))}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} var(t_{iT}|\rho_i = 0)}} \Rightarrow N(0,1) \quad (6)$$

When $T \to \infty$ and also $N \to \infty$ consecutively. The IPS test demonstrates that if a large number of observations are chosen for the basic ADF test, then applying thet-bar statistic (IPS test) for small sample observation is a logically more suitable option for detecting unit root than the LLC test (Baltagi 2008).

Panel Cointegration Tests

Baltagi (2008) investigated whether a cointegration test is able to answer the question of whether long-run relationships actually exist in the macroeconomic variables included in the model or not. For the current study, Pedroni's (1999; 2004) panel cointegration test was selected to capture the long-run properties of cointegrating variables.

Pedroni's (1999) cointegration equation is given as below:

$$y_{it} = \alpha_i + \beta_i t + \lambda_{1i} x_{1i} + \lambda_{2i} x_{2i} + \lambda_{3i} x_{3i} + \ldots + \lambda_{mi} x_{mi} + e_{it} \quad (7)$$

where *i* is the number of cross-sections ($i = 1, 2, 3, \ldots, N$), *t* is the time period ($t = 1, 2, 3, \ldots, T$), *m* indicates (xs) the explanatory variables ($m = 1, 2, 3, \ldots, M$) and $e_{it} = \rho_i e_{it-1} + \varepsilon_{it}$.

In the same equation, = the intercept, showing individual-based effects (fixed-effects) that change for every cross-section, β_i = time effect variations in each cross-section and $\lambda_{1i}, \lambda_{2i}, \lambda_{3i}, \ldots\ldots, \lambda_{mi}$ are the coefficients of the explanatory variables.

Pedroni classified the test statistics into two groups; one is within-group, which measures homogeneity, and the other is between-group which measures the heterogeneity of the AR component. Pedroni applied this to the seven panels and set the null hypothesis of no cointegration. Among them, four were within-group (pooled statistics), also known as panel test statistics, and the remaining three were between-group, encouraging the heterogeneity of the AR term. Kao's (1999) test is based on the equation below:

$$y_{it} = \alpha_i + x_{it}^{'}\beta + e_{it} \quad (8)$$

where α_i = the intercept (fixed effects), y_{it} = the dependent variable and is stationary at the first difference and, $x_{it}^{'}$ = the independent variable, which is also stationary at first difference. To test the null hypotheses of no cointegration, Kao (1999) suggested the DF and ADF unit root tests for the residual term (e_{it}). These tests are calculated on the basis of fixed-effects residuals ($e_{it} = \rho e_{it-1} + v_{it}$). Hence, the null hypothesis will be written as: $H_0 : \rho = 1$ (no cointegration).

Estimating the Pooled Mean Group (PMG) Estimator

Persaran et al. (1999) introduced a new technique, called 'the PMG estimator,' for estimating non-stationary dynamic heterogeneous panels. It depends upon the amalgamation of pooling and the averaging of coefficients across groups (Frank 2007). The procedure adopted by Persaran et al. (1999) follows an autoregressive distributed lag (ARDL) model. The dynamic panel specification is as follows:

$$y_{it} = \sum_{j=1}^{p} \varphi_{ij} y_{i,t-1} + \sum_{j=1}^{q} \delta_{ij} x_{i,t-j} + \mu_i + \varepsilon_{i,t} \tag{9}$$

where i = 1, 2, 3,…, N (number of groups); t = 1, 2, 3,…, T (number of periods); X_{it} = $k \times 1$ vector of explanatory variables; $\delta_{ij} = k \times 1$ coefficient vectors; φ_{ij} = scalars and u_i is the group-specific effect. Fixed explanatory variables and time trends are also included. The essential characteristic of the cointegrated variables is their reaction towards any deviation from the long-run equilibrium. The PMG estimator explains the short-run dynamics of the variables in the model by estimating an error correction equation of the ARDL model. The equation is outlined below:

$$y_{it} = \varphi_i \left(y_{i,t-1} - \theta_i' x_{it-t} \right) + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \ddot{A} y_{i,t-1} + \sum_{j=1}^{q-1} \delta_{ij}^{t*} \ddot{A} x_{i,t-j} + \mu_i + \varepsilon_{it} \tag{10}$$

where φ_i = error-correcting speed of the adjustment term. If $\varphi_i = 0$, then there would be no confirmation of a long-run relationship. It is assumed that if the variables affect the long-run equilibrium, then this parameter is likely to be negatively significant. The most important terms of the above equation are θ_i' and δ_{ij}^{t*}. The former (θ_i') represents long-run relationships between the variables (i.e., long-run coefficients), while the later (δ_{ij}^{t*}) illustrates the short-run relationships (Frank 2007).

The Panel Dynamic Ordinary Least Squares (DOLS) Estimator

Kao and Chiang (1999) used the panel dynamic OLS technique to measure the long-run relationships between the variables. They found that the DOLS surpasses the fixed effects (OLS) estimator and tends to be more capable in cointegrated panel regressions (Fidrmuc 2009; Baltagi 2008). The DOLS estimator is actually a panel extension of the method initially presented by Saikkonen (1991) and Stock and Watson (1993) for time series analysis. The basic DOLS specification is given as below:

$$y_{it} = \alpha_i + \beta' x_{it} + \sum_{j=-q}^{q} \delta_{ij} \ddot{A} x_{i,t+j} \varepsilon_{it} \tag{11}$$

where X_{it} = explanatory variables, β = coefficient (estimated long-run impact), q = lags of the first differenced data and δ_{ij} = related parameters. In this study, we employ the following DOLS gravity equation:

$$lnTT_{ijt} = \alpha_i + \beta M_{ijt} + \sum_{k=-m}^{m} \psi_{ij} \ddot{A} M_{ij,t+k} + \chi_1 CBOR_{ijt} + \chi_2 CLANG_{ijt} + \varepsilon_{ijt} \quad (12)$$

where M_{ijt} is the vector of integrated regressors, which consists of the logs of GDPs, population, real exchange rate, and distance, and $\sum_{k=-m}^{m} \psi_{ij} \ddot{A} M_{ij,t+k}$ is the summation of leads and lags of the differenced explanatory variables. By including the leads and lags of the differenced independent variables as additional explanatory variables in the gravity equation, the panel DOLS creates a probable endogeneity bias as well as the problem of autocorrelation. Standard errors are used to regulate interpretable test statistics with the usual restrictive distributions.

Results and discussion

Results of Panel Unit Root Tests

It is essential to check the integrational properties or stationarity of the time-variant variables included in the model. The results are obtained through the LLC and IPS panel unit root tests. To decide the country-specific lag length for the ADF regressions, the Schwarz-Bayesian Information Criterion (BIC) is used with a maximum lag of 2. The results of the LLC and IPS tests are presented in Table 1.

The results of the LLC panel unit root test indicate that all the variables, i.e., the product of the RGDP (RGDPijt), the product of the population (POPijt), and the exchange rate (EXRijt) are non-stationary at level with constant (individual intercept), demonstrating the existence of a unit root in these variables. Meanwhile, total bilateral trade (TTijt) can be seen as stationary in the same column. Now, the deterministic trend is included in the model, but again a problem arises. This time, three variables (TTijt, RGDPijt and EXRijt) are stationary, but one variable (POPijt) is non-stationary. With the same conditions (with and without time trend), the IPS test is applied to detect the unit root in the variables. This time, the problem is with total bilateral trade (TTijt). The results demonstrate that three variables (RGDPijt, POPijt, and EXRijt) are non-stationary, and one variable (TTijt) is stationary at level with individual intercept. When the time trend is included, all variables become non-stationary, indicating the unit root.

Table 1. Panel Unit Root Tests Results

	LLC Test				IPS Test			
	Level		First Difference		Level		First Difference	
Variables	Constant	Constant with Trend	Constant	Constant with Trend	Constant	Constant with trend	Constant	Constant with trend
$lnTT_{ijt}$	−4.189 (0.000)	−1.791 (0.036)	−5.540 (0.000)	−6.173 (0.000)	−1.926 (0.027)	0.612 (0.730)	−4.547 (0.000)	−4.185 (0.000)
$lnRGDP_{ijt}$	−1.540 (0.061)	−3.193 (0.007)	−2.827 (0.002)	−1.686 (0.045)	1.461 (0.928)	−1.049 (0.146)	−1.892 (0.029)	−0.400 (0.344)
$lnPOP_{ijt}$	2.386 (0.991)	0.888 (0.813)	0.061 (0.524)	−35.282 (0.000)	4.334 (1.000)	−0.337 (0.368)	−0.696 (0.242)	−22.484 (0.000)
$lnEXR_{ijt}$	−0.293 (0.384)	−4.431 (0.000)	−7.286 (0.000)	−7.693 (0.000)	2.897 (0.998)	−1.225 (0.110)	−4.482 (0.000)	−3.193 (0.007)

Note: values in parenthesis are ***p***-values. The results are obtained with the help of Eviews9.
Source: author's own calculations.

Now, the data are at first difference, and LLC and IPS tests are applied with the same conditions (constant and constant+trend). When analyzing without the deterministic trend (only individual effects), both the LLC and IPS tests accepted the alternative hypothesis (no unit root) and rejected the null hypothesis of the usual and individual unit root in all variables except POPijt. The results based on the LLC and IPS tests strongly confirm the integration of these variables of order one (i.e., I(1)). On the other hand, when the time trend is included, all the variables become stationary, rejecting the null hypothesis of the unit root.

The overall conclusion drawn from the outcome of the LLC and IPS panel unit root tests is that there is mixed evidence of non-stationarity in all time-variant variables because some variables are stationary at level with only constant, and some are with constant + time trend. All variables become stationary when the first difference is taken for the whole panel data set and the time trend is added to the individual intercept. The interpretation of these mixed results is such that when we estimate the augmented gravity model through the OLS technique, the results will be biased and incompatible. Consequently, we cannot rely on predictions based on such biased estimates. Therefore, it is essential to ascertain a stable cointegrating (long-run) association among the variables. To determine long-run associations among the variables, Pedroni's (1999; 2004) cointegration test is applied. The findings of the cointegration tests are summarized and explained in the next section.

Findings of the Panel Cointegration Tests

Pedroni (1999; 2004) developed seven tests to find the long-run relationships among the variables in a panel data set. These tests are divided into two groups. The first four tests constitute the panel statistics, and the last three represent group panel statistics. The results of Pedroni's cointegration tests and Kao's t-test are reported in Table 2.

Table 2. Panel Cointegration Tests Results

Dependent Variable	Log of Total Trade (lnTT)	
Pedroni's Panel Statistics	Statistic	p-value
Panel v-Statistic	–2.8585	0.9979
Panel rho-Statistic	1.5887	0.9439
Panel PP-Statistic	–8.4299***	0.0000
Panel ADF-Statistic	–3.1096***	0.0009
Group rho-Statistic	2.5104	0.9940
Group PP-Statistic	–6.9851***	0.0000
Group ADF-Statistic	–4.3739***	0.0000
Kao's t-Test	ADF t-Statistic	p-value
	–1.247349***	0.0061

Note: Results are obtained with the help of Eviews9.
Source: author's own calculation.

In the first group, among the four panel statistics, two tests, the Philips-Perron (PP) and augmented Dickey-Fuller (ADF) statistics robustly rejected the null hypothesis of no cointegration among the variables at 1%, 5%, and 10% significance level, respectively, taking into account total bilateral trade (TT) as a dependent variable. Meanwhile, in the second group, among the three group panel statistics, two tests (group PP statistics and group ADF statistics) strongly reject the null hypothesis of no cointegration. Hence, overall, in the seven tests statistics, four tests strongly recommend that there are long-run relationships (cointegration) among the variables. These findings are also supported by Kao's t-test statistics results. Kao's t-test results demonstrate the cointegration among the variables.

In sum, long-run relationships have been found among the variables. The implication of these findings is that Pakistan's total bilateral trade significantly depends on the respective independent variables. The results of long-run relationships among the variables are generated in the next section.

Estimation and Interpretation of the Long-Run Relationships

While establishing long-run relationships among the gravity variables, panel dynamic OLS (DOLS) (Kao and Chiang 1999) and the pooled mean group (PMG) (Pesaran, Shin, and Smith 1999) are applied to the data based on bilateral trade between Pakistan and the South Asian countries. The empirical findings of thepanel DOLS and PMG models are reported in Table 3.

Model 1 represents the panel DOLS estimates, and Model2 represents the pooled mean group estimates. The results indicate that the coefficients of all basic variables of the gravity equation follow the gravity theory of trade. The outcome of both models (panel DOLS and PMG) verify that the product of RGDPs (Pakistan's RGDP × partner RGDP) have a positive and significant impact on Pakistan's total bilateral trade. The coefficients of the RGDPs in both models are larger, but comparatively, it is very high in Model2 (the PMG model). This implies that development and growth is a long-term

process, so as the RGDPs of both countries increase with time, their bilateral trades will also increase. The distance between two countries imposes negative effects on bilateral trade. According to our study, the distance between Pakistan and South Asian countries (normally capital cities) reduces their trade. The reason is that, as time passes, transportation costs increase, and it negatively affects Pakistan's total trade volume. Thus, trade activities, both internally (within Pakistan) and externally (outside Pakistan), exert negative changes on the country's bilateral trade volume.

Table 3. Results of Panel DOLS and Pooled Mean Group (PMG) Estimators

Dependent Variables	Panel DOLS		Pooled Mean Group (PMG)	
	Model 1		Model 2	
$lnRGDP_{ijt}$	1.244***	(0.000)	2.264**	(0.015)
$lnPOP_{ijt}$	1.612***	(0.002)	6.557**	(0.041)
$lnEXR_{ijt}$	0.587***	(0.004)	–2.134***	(0.000)
$lnDIST_{ij}$	–0.856***	(0.000)	–0.227**	(0.030)
CBOR	0.070***	(0.006)	0.223***	(0.010)
CLANG	0.278**	(0.015)	2.099**	(0.035)

Note: *, **, and *** represent significance level at 1%, 5% and 10% respectively. The values in parenthesis are the p-values. Results are obtained with the help of Eviews9.
Source: author's own calculation.

The second macroeconomic variable of the gravity equation is population. The empirical results indicate that population (POP) is highly significant in both the panel DOLS and PMG techniques. The value of the coefficient suggests that a one-unit increase in population will increase the bilateral trade of Pakistan by 1.61%. In the same way, the population coefficient in the PMG model is also found to be highly significant with a positive sign (6.56). This implies that one a percent increase in population will accelerate bilateral trade by approximately 6.56%. The population coefficient in the PMG model is very high, indicating that population (market size) has a leading role in determining Pakistan's bilateral trade. The explanation is such that, overtime, both countries (Pakistan and the counter partner) will become self-sufficient in the production of goods and services, and hence their export capacity will increase. Its novelty is that it follows the theoretical background of the current study.

In the panel DOLS model, the coefficient of the exchange rate is found to be significant with a positive sign (0.59), indicating that in the long-run, the exchange rate has a positive impact on Pakistan's bilateral trade. These findings are against the theoretical background of this variable (exchange rate). However, these results favor expenditure switching effects; when the local currency depreciates, in turn, exports increase, ceteris paribus. In contrast to the panel DOLS results, in the PMG model, the coefficient of the exchange rate is found to be significant but with a negative sign (–2.13). The exchange rate coefficient value is very large, indicating that in the long-run, the

depreciation or appreciation of the currency brings major changes in Pakistan's bilateral trade volume.

The coefficient of distance has probable negative signs in both the panel DOLS and PMG models. The magnitudes of the coefficients in both models are different. The results of the panel DOLS model suggest that a 1% increase in distance will reduce bilateral trade by approximately 0.86%. Similarly, the PMG model suggests that a 1% increase in distance will reduce bilateral trade by approximately 0.23%. The coefficient sizes of distance in the panel DOLS and PMG models are very small, showing that distance has a very small impact on bilateral trade in the long-run. Both models support the theoretical background of this variable.

Besides the macroeconomic variables, two dummy variables are also incorporated in the gravity model. The common border (CBOR) is a time-invariant variable, but very sophisticated results are drawn from the estimation. The coefficient of the common border is found to be positive in both models, showing a positive impact on trade in the long-run. The coefficient size of a common border is very small (0.07) in the panel DOLS model, while in the PMG model, it is relatively high (0.22). Pakistan has common borders with India and Afghanistan. The explanation is that in the long-run, the disputes between Pakistan and India can be solved and, in turn, trade will increase between both countries. Similarly, if steps are taken to overcome terrorism, then trade between Pakistan and Afghanistan can be accelerated. However, the magnitude of coefficients in the panel DOLS and PMG models demonstrate that bilateral trade between Pakistan and border adjacent countries (India and Afghanistan) is not encouraging.

Finally, the results indicate that language similarity has a positive impact on bilateral trade. The coefficients of language are different in size in both models. The panel DOLS model suggests that Pakistan's bilateral trade is 27% greater with those countries that have language similarities. In the same way, the PMG model also demonstrates a positive relationship between language similarities and bilateral trade. The coefficient of language in the PMG model is very high, i.e., approximately 2.1%, implying that, in the future, Pakistan's trade prospects are very bright with countries that share a common language.

Short-Run Results of PMG Model

Under this heading, the short-run impacts of variables on Pakistan's bilateral trade are discussed. An error correction term (EC_{t-1}) is also incorporated in the model. The inclusion of the error correction term is intended to cover the short-run shocks (speed of adjustment) in the long-run. The short-run results of the PMG model are presented in Table 4.

The short-run findings of the PMG estimator indicate that the RGDPs of both countries (Pakistan and country *j*) have a very close relationship with bilateral trade in the short-run. The coefficient of RGDPij is very high (5.51) and significant at the 5% level of significance. It means that a 1% increase in economic masses (RGDPs) of South

Asian countries will increase Pakistan's trade volume by approximately 5.51%. A high value of the RGDP coefficient demonstrates a high level of trade flows between Pakistan and the South Asian countries.

Table 4. Short-Run Results of the PMG Model

Dependent Variables	Coefficients	p-value
Δ*lnRGDP*	5.506	0.016
Δ*lnPOP*	12.638	0.025
Δ*lnEXR*	–0.702	0.575
lnDIST	–24.040	0.0429
CBOR	–0.091	0.031
CLANG	0.057	0.062
ECT_{t-1}	–0.65	0.031

Note: Results are obtained using Eviews9.
Source: author's own calculation.

Similarly, the role of market size (POP) is also crucial in determining Pakistan's bilateral trade in the short-run. Its coefficient is very large and is approximately 12.64. The results can be justified because when the home country (Pakistan) population increases, it requires more goods to immediately fulfill the needs of the rising population. Hence, imports accelerate, and the total trade volume increases.

Distance is considered a key variable in the gravity model. The coefficient of distance was found to be very high with a negative sign (–24.04). It implies that a 1% increase in distance between the trade center (capital city) of Pakistan and the other South Asian countries will reduce bilateral trade flow by 24.04%. The reason is that people of both trading countries like to sell their goods in the local markets to eliminate transportation costs. Moreover, South Asian countries, including Pakistan, are basically agricultural countries, and they produce perishable goods that cannot withstand long transportation. So, to avoid losses, producers try to sell their commodities in the home markets as quickly as possible.

The coefficient of the exchange rate (EXR) is found to be insignificant with a negative sign (–0.70). The overall results signify that the exchange rate has no significant impact on Pakistan's bilateral trade flow. The empirical findings indicate that the role of a common border is not encouraging in the short-run. The findings suggest that Pakistan's trade is 9.1% less with India and Afghanistan than other South Asian countries. Though Pakistan shares a long border with Afghanistan and India, their trade is nominal. The reasons are military conflicts on the line of control with India and political suspicions between Pakistan and Afghanistan.

The coefficient of a common language is positive and significant at the 10% level of significance. The estimated coefficient is very small, indicating that language similarities have small impact on bilateral trade between Pakistan and its trading part-

ners. The results suggest that Pakistan's trade is 5.7% greater with countries that have language similarities. The reason is that people of both Pakistan and its trading partner countries quickly and easily understand their business language, facilitating trade activities. These findings are similar to the studies of Roy and Rayhan (2011) and Gul and Yasin (2011).

The main objective of the short-run analysis was to find out the coefficient of error correction term (ECTt–1). The error correction term measures short-run shocks or disequilibrium in the bilateral trade flow. The empirical findings of the current study indicate that the coefficient of ECTt–1 has the expected sign (–0.65) and significance at the 5% level of significance. The ECT also denotes the speed of adjustment. The result implies that if there is disequilibrium in the short-run or any divergence from the long-run in the preceding year, then it will be corrected by 65% in the current year. In other words, if Pakistan faces short-run losses or trade deficits with its trading partners, then 65% of its losses can be covered in the present year.

Conclusion

This research study was conducted to analyze the bilateral trade between Pakistan and South Asian countries by using a gravity model of trade. Thereis a long history of applied research where the gravity model is used to examine the bilateral trade patterns and trade relationships (see Poyhonen 1963; Bergstrand 1985; Koo and Karemera 1991; Oguledo and Macphee 1994; Zhang and Kristensen 1995; Mathur 1999; Paas 2000; Hassan 2001; Kalbasi 2001; Christie 2002; Akhter and Ghani 2010; Nguyen 2010; Wang et al. 2010; Gul and Yasin 2011; Malik and Chaudhary 2012; Panda and Kumaran 2016). In the above studies, the researchers analyzed only large countries in the region. Moreover, very little work has been done on the trade patterns of south Asian countries. In this paper, we analyzed Pakistan's bilateral trade with all South Asian countries, regardless of whether they are large or small. The degree of trade integration among the regional countries is quantified in a very sophisticated way. The role of all basic gravity variables in the long-run and short-run are justified both theoretically and empirically. The novelty of this study is that it measures the impacts of qualitative variables (common border and common language) along with the use of quantitative variables (GDP, POP & EXR).

Various econometric techniques were used for the empirical analysis. Panel unit root tests (LLC & IPS) were applied to remove the problem of the unit root. The findings of the LLC and IPS tests indicate that some variables are stationary at level while others are at first difference. Based on the mixed evidence of the panel unit root tests, Pedroni's cointegration test was applied. The outcome suggested that all variables are cointegrated and that long-run relationships exist among the variables. To capture the extent of these long-run relationships, pooled mean group (PMG) and panel dynamic ordinary least square (DOLS) models were estimated. The results of the PMG

and Panel DOLS models indicate that the economic mass (RGDP) and market size (population) of Pakistan and the other south Asian countries have a positive impact on their bilateral trade. The reason is that when population growth increases, they import more goods according to their needs. The distance between Pakistan and the other trading partners has a negative impact on bilateral trade because more distance means more transportation costs. The findings indicate that exchange rate has a negative sign in the PMG model and a positive sign in the Panel DOLS model. Pakistan has common borders with India and Afghanistan, but their trade is insignificant. The reasons are historical disputes and military conflicts. Similarly, terrorism and political suspicions between Pakistan and Afghanistan hinder their trade.

The novelty of the PMG model is that it gives short-run results. The findings suggested that RGDP and population have usual (positive) effects. The coefficient of distance is very large and negative in the short-run. The reason is that, in the short-run, people prefer to put their goods in the local market due to high transportation costs. The coefficient of the exchange rate is negative and insignificant. It means that the exchange rate has no impact on Pakistan's trade in the short-run. A common border has a negative coefficient, but its impact is very small. The coefficient of the error correction term, which measures short-run shocks, has the expected sign. This is justified as: if Pakistan faces short-run losses or trade deficits with its trading partners, then 65% of its losses can be covered in the present year.

References

Akhter, N., Ghani, E. (2010), *Regional Integration in South Asia: An Analysis of Trade Flows Using the Gravity Model*, "The Pakistan Development Review", 49 (2), pp. 105–118. https://doi.org/10.30541/v49i2pp.105-118

Baltagi, B.H. (2008), *Econometric Analysis of Panel Data (Fourth Edition)*, John Wiley& Sons, Chichester. https://www.worldcat.org/title/econometric-analysis-of-panel-data/oclc/191753150 (accessed: 23.04.2018).

Bergstrand, J.H. (1985), *The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence*, "The Review of Economics and Statistics", 67, pp. 474–81. https://doi.org/10.2307/1925976

Christie, E. (2002), *Potential Trade in Southeast Europe: A Gravity Model Approach*, Working Paper, The Vienna Institute for International Economic Studies. http://hdl.handle.net/10419/203886 (accessed: 12.12.2018).

Fidrmuc, J. (2009), *Gravity Models in Integrated Panels*, "Empirical Economics", 37, pp. 435–446. https://doi.org/10.1007/s00181-008-0239-5

Frank, M.W. (2007), *Estimation of Non-Stationary Heterogeneous*, "The Stata Journal", 7 (2), pp. 197–208. https://doi.org/10.1177/1536867X0700700204

Gul, N., Yasin, H.M. (2011), *The Trade Potential of Pakistan: An Application of the Gravity Model*, "Lahore Journal of Economics", 16 (1), pp. 23–62. https://doi.org/10.35536/lje.2011.v16.i1.a2

Hassan, M.K. (2001), *Is SAARC a Viable Economic Block? Evidence from Gravity Model*, "Journal of Asian Economics", 12, pp. 263–290. https://doi.org/10.1016/S1049-0078(01)00086-0

Im, K.S., Pesaran, M.H., Shin, Y. (2003), *Testing for Unit Roots in Heterogeneous Panels*, "Journal of Econometrics", 115, pp. 53–74. https://doi.org/10.1016/S0304-4076(03)00092-7

Kao, C. (1999), *Spurious regression and Residual-Based Tests for Cointegration in Panel Data*, "Journal of Econometrics", 90, pp. 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2

Koo, W.W., Karemera, D. (1991), *Determinants of World Wheat Trade Flows and Policy Analysis*, "Canadian Journal of Agricultural Economics", 39, pp. 439–455. https://doi.org/10.1111/j.1744-7976.1991.tb03585.x

Krugman, P.R., Obstfeld, M., Melitz, J.M. (2012), *International Economics: Theory and Policy, 9th Edition*, Addison-Wesley, Boston. https://www.amazon.com/International-Economics-Theory-Policy-9th/dp/0132146657 (accessed: 26.12.2017).

Kumar, N. (2005), *Globalization and the quality of foreign direct investment*, Oxford University Press, New Delhi–New York.

Levin, A., Lin, C.F., Chu, C. (2002), *Unit Root Test in Panel Data: Asymptotic and Finite Sample Properties*, "Journal of Econometrics", 108, pp. 1–25. https://www.scirp.org/reference/ReferencesPapers.aspx?ReferenceID=2340559 (accessed: 18.06.2017).

Malik, S., Chaudhary, A.R. (2012), *The Structure and Behavior of Pakistan's Imports from Selected Asian Countries: An Application of Gravity Model*, "Pakistan Journal of Commerce Social Science", 6 (1), pp. 53–66. http://www.jespk.net/publication_paper.php?publicationid=11 (accessed: 3.04.2018).

Mathur, S.K. (1999), *Pattern of International Trade, New Trade Theories and Evidence from Gravity Equation Analysis*, "The Indian Economic Journal", 47 (4), pp. 68–88.

Mohmand, Y.T., Wang, A. (2013), *The Gravity Of Pakistan's Export Performance In Stratified Sampling*, "Pakistan Journal of Statistics", 29 (2), pp. 203–216. https://www.researchgate.net/publication/286481873_The_gravity_of_Pakistan's_export_performance_in_stratified_sampling (accessed: 20.07.2018).

Newfarmer, R., Pierola, M.D. (2006), *SAFTA: Promise and Pitfalls of Preferential Trade Arrangements*, The World Bank, Washington.

Nguyen, B.X. (2010), *The Determinants of Vietnamese Export Flows: Static and Dynamic Panel Gravity Approaches*, "International Journal of Economics & Finance", 2 (4), pp. 122–129. https://doi.org/10.5539/ijef.v2n4p122

Oguledo, V.I., Macphee, C.R. (1994), *Gravity Models: A Reformulation and an Application to Discriminatory Trade Arrangements*, "Applied Economics", 26, pp. 107–120. https://doi.org/10.1080/00036849400000066

Paas, T. (2000), *Gravity Approach for Modeling Trade Flows between Estonia and the Main Trading Partners*, Working Paper, No. 721, Tartu University Press, Tartu.

Panda, R., Kumaran, M. (2016), *A Study of Bilateral Trade Flows of China and India*, "Indian Journal of Science and Technology", 9 (15), pp. 01–07. https://doi.org/10.17485/ijst/2016/v9i15/92098

Pedroni, P. (1999), *Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors*, "Oxford Bulletin of Economics and Statistics", 61, pp. 653–678.

https://web.williams.edu/Economics/wp/pedronicriticalvalues.pdf (accessed: 17.08.2018).

Pedroni, P. (2004), *Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis*, "Econometric Theory", 20, pp. 597–625. https://doi.org/10.1017/S0266466604203073

Pesaran, M.H., Shin, Y., Smith, R.P. (1999), *Pooled Mean Group Estimation of Dynamic Heterogeneous Panels*, "Journal of the American Statistical Association", 94, pp. 621–634. http://dx.doi.org/10.1080/01621459.1999.10474156

Poyhonen, P. (1963), *A Tentative Model for the Volume of Trade between Countries*, "Welt wirtschaftliches Archiv", 90, pp. 93–100. http://www.jstor.org/stable/40436776 (accessed: 7.04.2017).

Rispens, R.K.E. (2009), *Modern Economic Growth Theories and the "Miracle" of the East Asian Tigers*, Erasmus University Rotterdam, School of Economics, Rotterdam. https://thesis.eur.nl/pub/6437/Rispens%2C%20R.302857%20-%20id%20thesis6437.pdf (accessed: 13.11.2018).

Roy, M., Rayhan, M.I. (2011), *Trade Flows of Bangladesh: A Gravity Model Approach*, "Economics Bulletin", 31 (1), pp. 950–959. https://ideas.repec.org/a/ebl/ecbull/eb-11-00050.html (accessed: 19.03.2018).

Saikkonen, P. (1991), *Asymptotically Efficient Estimation of Cointegrating Regressions*, "Econometric Theory", 7, pp. 1–21. https://doi.org/10.1017/S0266466600004217

Stock, J.H., Watson, M.W. (1993), *A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems*, "Econometrica", 61 (4), pp. 783–820. https://doi.org/10.2307/2951763

Tinbergen, J. (1962), *Shaping the World Economy: Suggestions for an International Economic Policy*, Twentieth Century Fund, New York.

Waheed, A., Abbas, S. (2015), *Potential Export Markets for Bahrain: A Panel Data Analysis*, "International Journal of Trade, Economics and Finance", 6 (3), pp. 165–169. https://doi.org/10.7763/IJTEF.2015.V6.463

Wang, C., Wei, Y., Liu, X. (2010), *Determinants of bilateral trade flows in OECD countries: evidence from gravity panel data models*, "The World Economy", 33 (7), pp. 894–915. https://doi.org/10.1111/j.1467-9701.2009.01245.x

Wang, J. (2016), *Analysis and Comparison of the Factors Influencing Worldwide Four Kinds of Vegetable Oil Trade: Based on Gravity Model*, "Modern Economy", 7 (2), pp. 173–182. https://doi.org/10.4236/me.2016.72019

Wilson, J.S., Otsuki, T. (2007), *Regional Integration in South Asia: What Role for Trade Facilitation? World Bank Policy Research*, Working Paper, No. 4423. https://doi.org/10.1596/1813-9450-4423

World Bank (2017), *World Development Indicators*. http://data.worldbank.org/data-catalog/world-development-indicators (accessed: 19.12.2018).

Zhang, J., Kristensen, G. (1995), *A Gravity Model with Variable Coefficients: The EEC Trade with Third Countries*, "Geographical Analysis", 27, pp. 307–320. https://doi.org/10.1111/j.1538-4632.1995.tb00913.x

Streszczenie

Analiza panelowa grawitacji handlu między Pakistanem a krajami Azji Południowej

W artykule podjęto próbę zbadania wzorców handlowych widocznych w relacjach Pakistanu z krajami Azji Południowej przy użyciu grawitacyjnego modelu handlu. Głównym celem badania było ilościowe określenie długoterminowego wpływu zmiennych grawitacyjnych. Aby osiągnąć ten cel, wykorzystano zestaw danych panelowych dla lat 2003–2017. Ponieważ wyniki testów panelowych pierwiastka jednostkowego były niewiarygodne, zastosowano techniki Pooled Mean Group (PMG) i Panel Dynamic Ordinary Least Square (DOLS). Wyniki modeli PMG i Panel DOLS uzasadniają teoretyczne podstawy modelu grawitacyjnego i sugerują, że wszystkie podstawowe zmienne grawitacyjne mają typowe znaki. Realny PKB i liczba ludności zarówno Pakistanu, jak i kraju partnerskiego mają pozytywny wpływ na ich handel dwustronny. Z drugiej strony odległość między dwoma krajami dokonującymi wymiany handlowej oraz kurs walutowy mają negatywny wpływ na handel dwustronny. Wyjątkowość tego badania polega na tym, że mierzy ono jednocześnie wpływ zmiennych jakościowych oraz podstawowych zmiennych grawitacyjnych. Podobieństwa językowe i wspólne granice mają pozytywny wpływ na handel dwustronny. Jednakże, choć Pakistan graniczy z Indiami i Afganistanem, ich relacje handlowenie są istotne. Konflikty zbrojne między Pakistanem a Indiami oraz polityczna podejrzliwość w relacjach Pakistanuz Afganistanem komplikują ich stosunki handlowe.

Słowa kluczowe: Azja Południowa, Pakistan, model grawitacyjny, kurs walutowy, liczba ludności

Comparative Economic Research. Central and Eastern Europe
Volume 23, Number 4, 2020
http://dx.doi.org/10.18778/1508-2008.23.35

Organic Agriculture in Least Developed Countries in Relation to the Development of the Organic Farming Sector in Poland The Example of African Countries versus the Organic Sector in Poland

Anna Rydz-Żbikowska
Ph.D.,University of Lodz, Faculty of Economics and Sociology
Department of Global Economy and European Integration, Lodz, Poland
e-mail: anna.rydzzbikowska@uni.lodz.pl

Abstract

Over the past few years, organic farming has seen a dynamic development globally. In 2015, the global market for organic products was €81.6 billion, rising to more than €90 billion in 2018 (*Światowy rynek produktów ekologicznych osiągnął wartość 90 mld euro* 2019). There has also been a significant rise in the production of organic products by the group of Least Developed countries (LDCs) (such as African countries), which are being supported by all the World Trade Organisation negotiations within the Doha Round. The aim of this article is to present different definitions of organic farming according to the most important international organizations. Furthermore, it will examine the status of the organic farming sector in selected examples of Africa's LDCs and investigate the results of Doha's negotiations within the agricultural market (particularly towards LDCs). Finally, it will investigate the status and the latest developments of organic farming in the LDCs compared to Poland. The research methods used in the article include an analysis of available documentary and literary sources on the topics in question, the development of relevant statistical surveys, and the deductive approach to draw conclusions from the development of organic agriculture in LDCs and Poland (as an example of a Central European Country).

Keywords: organic agriculture, organic products, sustainable development, least developed countries, World Trade Organisation, Doha Round

JEL: O13, O18, O53, O55, P45, P48, Q01, Q13, Q17, Q18, Q56

Introduction

Today, organic farming is seen as one of the best alternatives to conventional agricultural production. This form of cultivation gives huge opportunities for native organic food producers to acquire new sources of income, and it also provides access to new markets. Interest in organic production is growing all over the world. Over the past few years, especially since the mid–1990s, there has been an annual increase of several percent in arable land. It has been reported that the world's area of organic arable land grew by over 530% between 1999 and 2017, when organic crops accounted for 69.8 million hectares of total organic arable land (FiBL 2019, p. 18). The pace of development of this type of agriculture accelerated at the beginning of the previous decade. However, it should be emphasized that it is diversified in terms of geographical location worldwide and in terms of the area in individual countries (Borowska 2006, pp. 1–2). Undoubtedly, the provisions resulting from negotiations conducted as part of the Doha Round, which have contributed to the lifting of trade barriers in the field of trade in agricultural products and entering the international market, have had a great impact on the development of organic farming, especially in developing and least developed countries (LDCs) (Dugiel 2008, pp. 9–37).

The article's goal is to answer the question of how to understand and define the concept of organic farming. Secondly, it will present how the negotiations within the World Trade Organisation's Doha Round influence the development of the agricultural sector in LDCs and what the key provisions of the actions taken by the organization are. The article also covers organic farming in developing and LDCs, on the example of African countries. Finally, the article explains the current changes (economic, social, institutional, etc.) within the organic agriculture sector of African emerging markets, resulting from the actions taken by the governmental policies. Finally, the article indicates the differences between the development of the organic agriculture sector in LDCs on the example of African countries and the organic sector of Poland (as an example of a Central Eastern European country).

Organic agriculture – defining and understanding the concept

Organic farming has its roots in traditional agricultural practices, developed over the centuries by small rural communities around the world. Farmers have passed on their knowledge of effective practices from generation to generation. Organic farming became more widely recognized in the 1940s, when both farmers and consumers began to recognize the problem of excessive use of chemicals for plant production and animal husbandry. They also realized that this could have negative consequences for human health and the environment (European Commission 2012, pp. 1–2). Organic farming has since grown into a more coherent and organized movement, and it is now one of the

fastest-growing food sectors in the world (FAO 2012, pp. 5–6). It is worth underlining that the first organic agriculture organizations and farmers' associations date back to the 1940s, including the first organic labels, Bioland and Bio Suisse in Switzerland, and Demeter in Germany. One of the milestones for the development of organic agriculture was the establishment of the Federation of Organic Agriculture Movements (IFOAM) in 1972, as a forum for different parties engaged in this sector (European Commission 2012, pp. 1–2).

Referring to the definition of the Food and Agriculture Organization of the United Nations (FAO), organic farming involves cultivation techniques that do not use artificial fertilizers and pesticides. However, it should be emphasized that this statement does not set the basic framework for such agriculture; it only identifies agriculture with a method of land management in which the major concern is to prevent all problems related to soil fertility, its erosion, and harmful pests. The FAO identifies organic farming as a system of plant cultivation, animal husbandry, and fisheries that emphasizes the importance of environmental protection and the use of natural agricultural techniques (FAO 1999). This system focuses not only on the control of the final product but also on the entire process of producing and delivering the organic product to the final consumer. The entire production, processing, handling, and transport cycle of organic farming excludes the use of artificial products, such as genetically modified organisms (GMOs) and specific external agricultural agents (pesticides, veterinary agents, medicines, artificial additives, and fertilizers) (European Network for Rural Development 2014, pp. 1–2). Organic farmers rely on natural farming methods, and they also benefit from modern knowledge of ecology to maximize the productivity of ecosystems, improve the quality of organic products, and protect the environment (Kristensen, Reganold and Taji 2006, pp. 3–5).

The definition of the International Federation of Organic Agriculture Movements (IFOAM) for organic agriculture is based on four main principles: health, ecology, fairness, and care (Luttikholt 2007, pp. 347–360). In 1996, IFOAM defined the term "organic" as an expression that refers to a specific plant-growing system set out by basic standards. The main goals of organic agriculture and processing (Principle Aims of Organic Agriculture and Processing) are based on the following equally important objectives and ideas (FAO 1998, p. 4):

- to produce food of high nutritional quality in sufficient quantity;
- to interact in a constructive and life enhancing way with all natural systems and cycles;
- to encourage and enhance biological cycles within the farming system, involving micro organisms, soil flora, and fauna, plants, and animals;
- to maintain and increase long-term fertility of soils;
- to promote the healthy use and proper care of water, water resources, and all life therein;
- to help in the conservation of soil and water;

- to use, as far as is possible, renewable resources in locally organized agricultural systems;
- to work, as far as possible, within a closed system with regard to organic matter and nutrient elements;
- to work, as far as possible, with materials and substances which can be reused or recycled, either on the farm or elsewhere;
- to give all livestock conditions of life which allow them to perform the basic aspects of their innate behavior;
- to minimize all forms of pollution that may result from agricultural practices;
- to maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats;
- to allow everyone involved in organic production and processing a quality of life conforming to the UN Human Rights Charter, to cover their basic needs and obtain an adequate return and satisfaction from their work, including a safe working environment;
- to consider the wider social and ecological impact of the farming system;
- to produce non-food products from renewable resources, which are fully biodegradable;
- to encourage organic agriculture associations to function along democratic lines and the principle of division of powers;
- to progress towards an entire organic production chain, which is both socially just and ecologically responsible.

The Organization for Economic Cooperation and Development (OECD), in turn, defines organic farming as "a cultivation system that avoids the use of artificial fertilizers and pesticides or herbicides by using organic fertilizers and various methods of crop rotation" (FAO 2012).

Summarizing all the above definitions of organic agriculture, it can be concluded that the cultivation of organic products is based on the principle of reducing the number of fertilizers, taking care of the environmental protection, using renewable sources of energy, implementing sustainable methods of production, and improving the development of rural areas.

The provisions of the Doha Round and the Issue of Developing and Least Developed Countries

The Doha Round is the latest round of negotiations on world trade among WTO members, with negotiations in its forum still underway. Its main task is to carry out many reforms in the global trade system by providing smaller trade barriers and correcting global trade rules. Negotiations under the Doha Round cover twenty-one trade areas. This round is also unofficially called the Doha Development Agenda because its fundamental goal is to improve the trade prospects of developing countries.

The round officially began its negotiations at the Fourth Ministerial Conference in Doha, Qatar, in November 2001 (Zajączkowski 2018, pp. 205–28). The Doha Ministerial Conference commissioned negotiations, including negotiations on agriculture, services, and intellectual property, which had already begun during the WTO's Uruguay Round (Martin and Mattoo 2011, pp. 1–55). During the Doha Round, ministers also approved the decision to include provisions related to solving problems faced by developing countries in the current WTO agreements (Wojtas 2008, pp. 219–222). The WTO's task is to facilitate trade flows, making them more fluid and predictable. Negotiation works are carried out in two ways: firstly, by abolishing and reducing trade barriers (where possible), and secondly, creating rules to maintain trade barriers and trade policies. All these activities are the result of negotiation rounds that have been conducted between the governments of individual countries since 1940 (Buckley 2003). The Doha Round continues this tradition and is the ninth round since the end of the Second World War and the first since the adoption of the multilateral trading system in 1995. Its mission is to make the first and most revolutionary change in the world trading system in the 21st century (Ancharaz 2012, pp. 102–110).

The problem of developing countries entering the global market and conducting free trade policy was reflected in the provisions and a series of procedures that are the result of negotiations within the Doha Round. As mentioned before, one of the priority goals of the Doha Development Agenda is to increase development prospects in trade for developing countries. Currently, a large number of developed countries have significantly reduced or even abolished customs duties on imports from LDCs. In the Doha Round Declaration, WTO member countries aim to remove tariffs, quantitative restrictions, and any barriers to access the international market for products from LDCs. Additionally, WTO member governments are considering the possibility of introducing additional measures to improve market access for such export products. WTO members also agree that it is essential to ensure that LDCs negotiate with WTO members in a simplified and faster manner. The WTO has also introduced special technical support, which is targeted especially at LDCs. The Doha Declaration also recommends WTO donor members significantly increase their financial contributions. In this regard, the Sub-Committee for LDC's, which is an auxiliary unit for the WTO Trade and Development Committee, developed a special work program in February 2002, consistent with the requirements of the Doha Declaration and provisions regarding trade approved at the United Nations Conference on Least Developed Countries (UN LDC Conference) (WTO 2019). The task of the Sub-Committee for the benefit of the Least-Developed Countries is foremost to consider such matters and solve problems, which from the view of these countries, are of the greatest importance. It is worth noting that, as in the Trade and Development Committee, all WTO members are also members of the Sub-Committee for Least Developed Countries.

Since the Doha Ministerial Conference in 2001, the LDCs Sub-Committee has focused on implementing the work program for the Least Developed Countries. The work program is focused on the following topics (WTO 2019):

- market access for LDCs;
- technical assistance in commercial matters and initiatives for capacity building in LDCs;
- assistance to agencies that support production and develop the export base in LDCs;
- creating mainstream activities (where needed) in the work of the WTO concerning trade-related elements under the implementation of the 3rd LDC program of activities;
- the participation of LDCs in the multilateral trading system;
- the accession of LDCs to the WTO;
- the compatibility of LDCs to ministerial decisions/declarations established by the World Trade Organization.

The Sub-Committee for the Least Developed Countries also monitors the work carried out under the integrated technical assistance framework related to trade for the LDCs. The WTO recognizes LDCs as those countries that are described as such by the United Nations.[1] Presently there are 47 LDCs on the UN list, 36 of which are members of the WTO. Eight LDCs are in the process of joining the WTO: Bhutan, Comoros, Ethiopia, Sao Tome and Principe, Somalia, South Sudan, Sudan, and Timor-Leste (WTO 2019).

One of the major spheres of negotiations within the Doha Round for the LCDs is the agricultural sector. Negotiations on agricultural trade began in early 2000 and became a part of the Doha Round at the 2001 Doha Ministerial Conference under the original mandate of the Agriculture Agreement. In 2013, during the Bali Ministerial Conference, vital agricultural decisions were adopted by the ministers. The outcomes of the Bali Conference included (WTO 2020a):

- "an agreement to negotiate a permanent solution to public stockholding for food security purposes, and to refrain from challenging breaches of domestic support commitments resulting from developing countries' public stockholding programmes for food security provided certain conditions are met;
- a call for more transparency in tariff (or tariff-rate) quota administration – whereby quantities inside a quota are charged lower import duty rates – and for governments not to create trade barriers by how they distribute quotas among importers;
- an expansion of the list of "General Services" – to include spending on land use, land reform, water management, and other poverty-reduction programmes -that qualify for Green Box support (i.e., domestic support that is allowed without limits because it does not distort trade, or at most causes minimal distortion);
- a declaration to reduce all forms of export subsidies and to enhance transparency and monitoring".

1 The Least Developed Countries (LDCs) is a list of developing countries that, according to the United Nations, are described by the lowest indicators of socioeconomic development and with the Lowest Human Index ratings of all countries in the world. The concept of LDC's originated in the late 1960s and the first group of LDCs was lited by the UN in November 1971.

The historic decision to eliminate agricultural export subsidies should be considered the greatest milestone for the WTO Nairobi Ministerial Conference in 2015 towards the negotiations on agricultural trade. The idea was to establish new mechanisms for export measures that would have an equivalent effect. As a result of the decision, developed countries will immediately eliminate export subsidies, with the exception of a few agricultural products, while developing countries would have an extended time to put all the changes into force (WTO 2020b). The elimination of export subsidies has led to the key objective of Sustainable Development Goals, which is Zero Hunger. WTO members also agreed to participate in finding a sustainable solution for developing countries to take advantage of public stockpiling programs for food security purposes.

Ministers also decided to continue negotiations on a special safeguard mechanism that would allow developing countries to temporarily raise customs duties on agricultural products in the event of a sharp increase in imports or falling prices (WTO 2020b). Understanding the importance of the level of commodity dependence of developing countries is crucial in that case. According to the latest statistics of an UNCTAD survey on the state of commodity dependence in 2019, commodity dependence is mostly concentrated in the least developed and most vulnerable country groups: 85% of LDC's, 81% of landlocked developing countries, and 57% of small island states. Only 13% of developed countries can be described as commodity-dependent, in comparison to 64% of developing and 66% of transition economies, makes a huge difference (OECD 2019, pp. 4–5). More importantly, 20% of commodity-dependent countries are dependent on agriculture, 17% on minerals, and the same amount on energy (32 countries) (OECD 2019, p. 4). The vast majority of commodity-dependent (agriculture-dependent) least developed and developing countries are African and South American countries. Furthermore, according to the World Bank country classification by income group, 91% of low-income countries are reliant on the export of goods, compared with less than one-third of high-income countries (OECD 2019, p. 5). Thus, it is necessary to support the least developed and developing countries in their struggle to expand their agriculture markets.

The latest changes in organic agriculture of Least Developed Countries on the example of Africa – statistics and developments

Most developing and least developed countries take advantage of the agriculture sector to boost their economies. According to a Working Paper of the UN Economic and Social Commission for Asia and the Pacific (ESCAP 2014, p. 5), the development of that sector should be seen as a crucial priority for the inclusive and sustainable development of LDCs. While in developed countries, organic agriculture is an ecologically,

economically, and socially justified solution to reduce the amount of surpluses and to gain crops from unused land, in least developed and developing countries, organic agriculture is grounded in generating profits from agriculture by promoting organic foodstuffs (Scialabba and Hattam 2002, p. 1). More importantly, the non-profit objectives of organic production are not supported by the governments of the majority of developing countries, though there are some exceptions, like India, Uganda, or Zambia. For most developing countries, well-managed organic production systems may increase the productivity of agriculture and have a positive effect on restoring natural resources (Schoonbeek et al. 2013, pp. 917–928). Another issue is the need to restructure agricultural policies in developing countries and to reorientate them into more food security objectives (Scialabba and Hattam 2000, pp. 1–10).

Slightly more than 70% of countries listed as LDCs by the United Nations Conference on Trade and Development are African. This would be the main reason to base further considerations on organic agriculture and its development on that continent. Another reason would be because African countries base their economies on exports of agricultural products (almost 19% of food and agriculture primary commodities exports in 2015–2017 by African LDCs and Haiti) (UNCTAD 2018, p. 16).

Main statistics on organic agriculture in Africa

According to the latest report on organic agriculture worldwide (IFOAM 2019), there were nearly 2.1 million hectares of agricultural land in 2017 in Africa, which represents 0.2% of the continent's agricultural area, and around 3% of the total organic agricultural area worldwide.

Organic agricultural land in Africa is constantly growing (an increase of 14% in 2017 compared to 2016), which can be observed by an increase of more than 2 million hectares compared with 52,000 hectares in 2000. There were 44 countries in Africa that published reports on organic activities in 2017. The leading countries were Tunisia (the largest organic area, with almost 306,500 hectares), Uganda (with the highest number of organic producers, with over 210,000), and Sao Tome and Principe (with the highest organic share of the total agricultural land, with 18% of its agricultural area being organic, followed by Tunisia with 3% and Egypt with 2.8%).

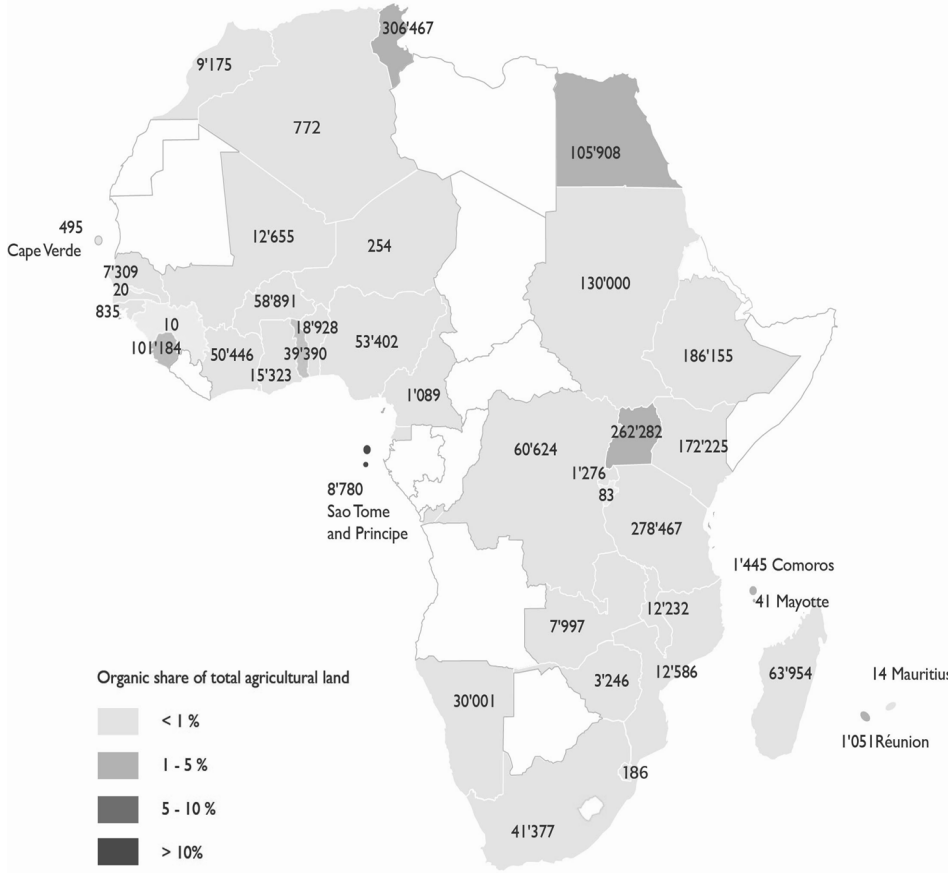

Figure 1. Organic agricultural land in countries of Africa 2017 (in hectares)
Source: FiBL survey 2019, based on information from the private sector, certifiers, goverments and for North Arica, the Mediterranean Organic Agricultural Network (MOAN), Julia Lernoud, Helga Willer and Bernhard Schlatter, *Africa: Current Statistics* in Willer and Lernoud 2019, p. 173.

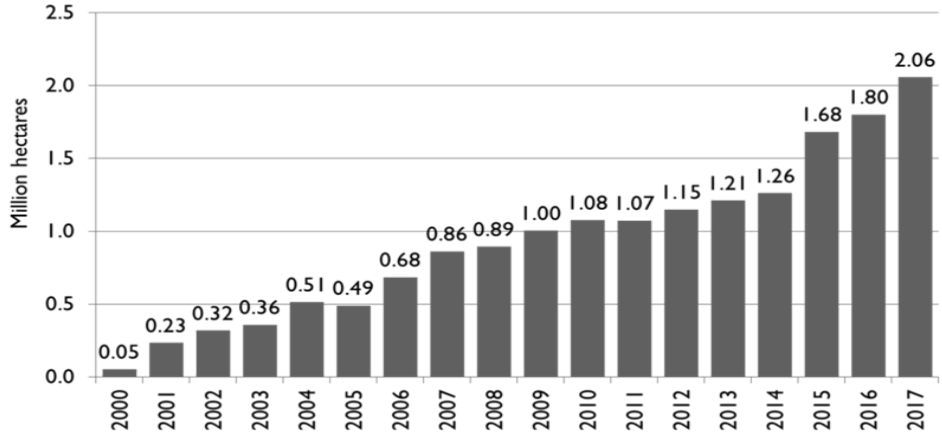

Figure 2. Development of organic agricultural land in Africa (2000–2017)
Source: FiBL-IFOAM-SOEL-surveys 2000–2019, Julia Lernoud, Helga Willer and Bernhard Schlatter, *Africa: Current Statistics* in Willer and Lernoud 2019, p. 182.

Land use

In 2017, over half of the organic agricultural land was used for permanent crops (around 1.3 million hectares), almost 30% was dedicated to arable crops (over 599,000 hectares), and nearly 2% (82 700 hectares) was grassland and grazing area (there was no data for 8% of organic agricultural land in Africa).

The largest permanent crop areas were reported in the following countries:

- Tunisia (274,000 hectares, mainly olives),
- Uganda (almost 170,700 hectares, mainly cocoa),
- Ethiopia (161,000 hectares, mainly coffee),
- Kenya (over 127,000 hectares, mainly nuts, and coconuts),
- Tanzania (almost 107,000 hectares, mainly coffee.

One of the major permanent crops is coffee, covering more than 373,000 hectares. It also constitutes 12.4% of the total coffee area of the region. Tanzania (almost 82,000 hectares) and Ethiopia (over 160,000 hectares) are the leaders in organic coffee areas. According to the FIBL statistics, the organic coffee area has increased 20-fold since 2004, but it should be noted that some of the increase might be the result of data availability. But what is even more interesting is the increase in cocoa yields, which has grown 64-fold since 2004. Cocoa was grown on almost 111,000 hectares, and the largest areas of organic cocoa were found in the following countries:

- Democratic Republic of Congo (51,900 hectares),
- Sierra Leone (43,300 hectares),
- Uganda (over 19,000 hectares).

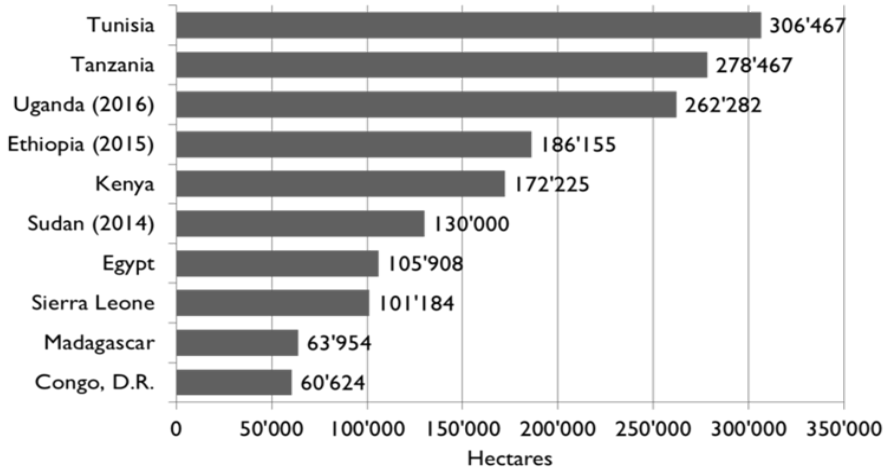

Figure 3. Leading African countries with the largest organic area in 2017 (in hectares)
Source: FiBL survey 2019, based on information from the private sector, certifiers and goverments, Julia Lernoud, Helga Willer and Bernhard Schlatter, *Africa: Current Statistics* in Willer and Lernoud 2019, p. 183.

Arable crops represented almost 30% of the total organic farmland in Africa (FIBL 2019). The most commonly grown plants were:

- oilseeds (almost 236,500 hectares, 0.9% of the total oilseed area; mainly sesame),
- textile crops (119,000 hectares, 2.3% of the region's total cotton area),
- cereals.

Cotton plays a significant role in the organic production of Africa. Almost 60% of the region's cotton originates from Tanzania (almost 68,500 hectares), followed by Sudan (15,000 hectares). The total organic cotton area has grown 12-fold since 2004.

Cereals, as the third type of most commonly grown plants within organic agriculture in Africa, were grown on over 66,000 hectares in 2017. The leading countries in that type of production were:

- Tanzania (almost 51,000 hectares),
- Egypt (over 8000 hectares),
- Senegal (almost 3700 hectares).

Organic producers

Organic producers in Africa play a significant role in shaping the whole system of organic production and implementing new standards of agricultural practices. The number of organic producers in Africa has steadily grown since 2010, when there were 540,000 organic producers. By 2017, the number had reached 815,000.

Among countries with the most organic producers might be listed:
- Uganda (over 210,000),
- Ethiopia (over 203,000),
- United Republic of Tanzania (148,000).

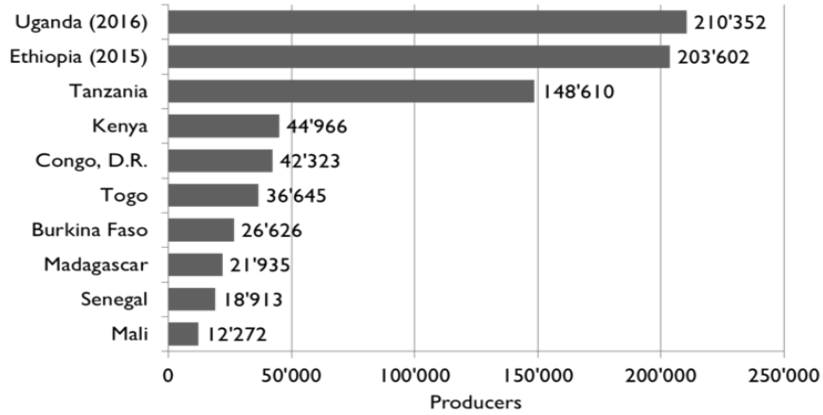

Figure 4. The ten African countries with the largest number of organic producers in 2017
Source: FiBL survey 2019, based on information from the private sector, certifiers and goverments, Julia Lernoud, Helga Willer and Bernhard Schlatter, *Africa: Current Statistics* in Willer and Lernoud 2019, p. 183.

Wild collection

Within organic agricultural production in Africa, wild collection plays a significant role and should be seen as a crucial part of that system. There were over 14.3 million hectares of wild collection that were certified as organic in 2017. Plants widely used in medicine, such as devil's claw, are the type of crops that represent the largest area (over 2.5 million hectares), followed by oil plants (almost 737,000 hectares), such as argan. Leaders of organic wild collection include African LDCs such as Zambia (the largest area – more than 5.9 million hectares, beekeeping in particular), followed by Tanzania (2.4 million hectares, mainly beekeeping), Mozambique (over 844,000 hectares, coconuts as a major crop), and Somalia (more than 807,000 hectares, mainly natural gums). Namibia (1.3 million hectares) and South Africa (1.3 million hectares) are the countries with the highest share of devil's claw crops.

The most important activity in organic wild collection in Africa is beekeeping, with almost 7.8 million hectares. The unquestionable leader in that activity is Zambia, with the largest wild collection area used for organic beekeeping (5.9 million hectares, representing 67% of the total beekeeping area).

Ecological organic agriculture in Africa – perspectives and challenges

Nowadays, organic agriculture and production in Africa are seen as outstanding successes by organic producers (farmers, processors), policymakers, stakeholders, and practitioners. They also play a vital role in reducing the problems of soil degradation and climate change, overcoming food insecurity, and inhibiting poverty. There are different initiatives to support the organic agriculture system in Africa and to foster sectoral policies into more organic-oriented ones. Another issue is the efforts to develop marketing and to enhance the value chain of organic production, or to implement different kinds of curricula in some academic institutions (Gama 2018).

The development of organic farming in Africa is entering a new phase. The awareness that this kind of production is the most suitable path to the development of African countries contributes to changes in sectoral policies. The most important breakthrough in African agriculture was undoubtedly the African Union's decision to support organic farming, as well as its ongoing leadership in promoting future strategies and framework conditions for organic farming policies, such as the African Ecological Organic Agriculture Initiative (EOA-I) or the IFOAM-Africa Union Conference. Undoubtedly, the Ecological Organic Agriculture Initiative had many positive effects, such as establishing a database on research findings and knowledge on ecological organic agriculture, available and accessible for various users (Ecological Organic Agriculture Initiative 2015). Summing up, two-third of recipients reached by the EOA Initiative in participating countries (Kenya, Tanzania, Uganda, Ethiopia in East Africa, Nigeria in West Africa, and Zambia in Southern Africa) are already aware of EOA practices and technologies (FiBL & IFOAM 2020, p. 186). It is also reported that 58% of organic producers have noted more than a 10% increase in their incomes, while 73% observed an increase in their life status. Still, there is much to be done, as many obstacles in the transition to being organic have been declared by the farmers. Another concern is farmers' fears about social exclusion, the scarcity of well-organized value chains, low economies of scale, and a clearly visible lack of knowledge at all levels.

There are more initiatives that support the development of organic agriculture in Africa, such as:

- the African Organic Network "AfroNet" (umbrella body to unite and to motivate non-state African ecological/organic stakeholders);
- the Network of Organic Agriculture Researchers in Africa "NOARA" (network established by African organic agriculture researchers).

The roles of NOARA include supporting capacity building for key players in organic and ecological agriculture across the continent, developing organic agriculture research, additional training, value chains and market development, mobilizing resources for promoting organic agriculture, and providing management and administrative consultancy to partners on mind-based programs (FiBL & IFOAM 2020, pp. 188–191).

The sector of organic agriculture in Poland – latest statistics and trends

The roots of organic farming in Poland can be traced back to 1924, when Stanislaw Steiner organized a course aimed at disseminating the principles and scope of organic agriculture, called biodynamic agriculture at the time (Runowski 2003, pp. 245–262). However, the process and methods of that kind of agriculture have changed a lot since then, and today, the organic agriculture system in Poland is based on European standards, and it is in line with all the regulations defined by the Common Agriculture Policy of European Union. After the accession to the European Union, the number of organic farms and the area of farmland managed organically increased significantly in Poland, as it had done before in other Member States (Kowalska 2015, pp. 467–476).

Between 1999 and 2013, the number of organic agricultural producers increased from 27 to 27,093, i.e., over 1003 times, while the cultivated area increased from 300,000 to 669,969 ha, i.e., as much as 2.2 times. The largest increase in the number of producers and the cultivation area took place in 2010, when the number of producers increased by 3533 compared to the previous year, while the area increased by 1.02 million hectares. Between 2004 and 2013, the area of ecological agricultural land in Poland increased 8-fold (from 82,730 ha in 2004 to 669,969 ha in 2013) (Makowska, Gotkiewicz and Pawlewicz 2015, pp. 161–163).

Organic agriculture plays a significant role in the development of rural areas and the improvement of standards of living for farmers in Poland. There has been huge interest and additional efforts to support organic production in Poland since 2001, when legal regulations regarding the production of organic food were introduced, as well as subsidies from the state (Kuś and Jończyk 2009, pp. 178–182).

Nowadays, the control system of organic production in Poland, as in most EU countries, is delegated to certification bodies that are authorized and supervised by a designated authority. The Minister of Agriculture and Rural Development, as a major authority, is responsible for authorizing certification bodies to conduct inspections as well as issuing and withdrawing certificates in organic farming. The second authority is the Agricultural and Food Quality Inspection (2019), which is responsible for supervising certification bodies and organic production (IJHARS 2019, pp. 10–12).

Current statistics on the organic agriculture sector in Poland

In 2019, there were 20,146 entities active in organic farming, including 18,656 organic farmers managing an area of 5.05 million hectares. The largest area of ecological agricultural land was occupied by cereal crops, followed by permanent grasslands.

According to the latest report on organic agriculture in Poland prepared by the Agricultural and Food Quality Inspection, the number of organic producers decreased

by 8.4% in 2017 compared to 2016, and it fell again in 2018 by 4%, from 21,400 in 2017 to 20,549. By analyzing the data on the number of organic producers, the period between 2017 and 2018 was the second time since 2014–2015, when a decrease was recorded. In 2018, compared to 2016 and 2017, the number of organic agricultural producers decreased (by 14.4% and 5.2%, respectively). However, in 2017–2018, a significant increase in the number of ecological entities dealing with the preparation of organic farming products was noted (by 12.8% in 2017, and by 14.5% in 2018).

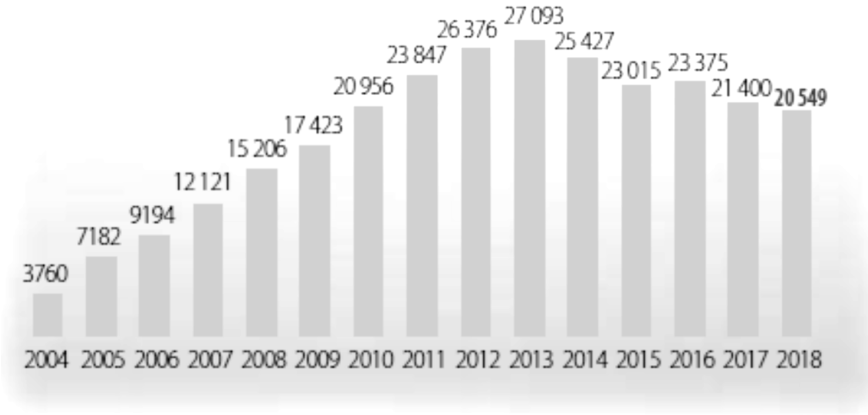

Figure 5. Number of organic producers in Poland in 2004–2018
Source: Agricultural and Food Quality Inspection 2019, p. 22.

In 2018, most of the organic producers (out of the total number of 20,549) operated in the following voivodeships: Warmińsko-Mazurskie (3420 producers, who accounted for 16.6% of the total number of organic producers in Poland), Podlaskie (3022 producers; 14.7%) and Mazowieckie (2648 producers; 12.9%). These voivodeships were also the leaders in terms of the number of farms: Warmińsko-Mazurskie (3393), Podlaskie (2989), and Mazowieckie (2284). The number of organic farms in these three voivodships (8666) accounted for almost half (45.1%) of all organic farms in Poland in 2018.

The total area of ecological agricultural land in 2018 reached 484,676.2 ha, of which 75.0% was agricultural land where the conversion had been completed, and 25.0% was during the conversion period. The largest area of ecological agricultural land was found in the following voivodeships: Warmińsko-Mazurskie (104,573.3 ha) and Zachodniopomorskie (92,891.8 ha), accounting for 40.7% of the ecological land in Poland. The voivodships with the smallest area of ecological agricultural land were Śląskie (2951.3 ha) and Opolskie (3553.9 ha). If we look at the statistics and data on the ecological area in Poland, the total area of organic agricultural land in Poland has steadily decreased since 2013, which shows a negative trend in that sphere.

It is important to compare Poland's statistics on organic land with those of the European Union and draw conclusions. In 2017, the total area of ecological agricultural

land in the European Union was over 12.5 million hectares, which accounted for 7% of the agricultural area in the community; in Poland, it was only 3.4%. Since 2012, the area of ecological land in the EU has increased by 25%, while at the same time in Poland, it has decreased by almost 25%. Nevertheless, since 2014, organic plant production in Poland has increased, and this has been done in almost all groups of crops except for fodder plants. Between 2014 and 2018, the number of animals (except broilers) kept on organic farms decreased, and there was also a decrease in certified animal production, e.g., meat and milk.

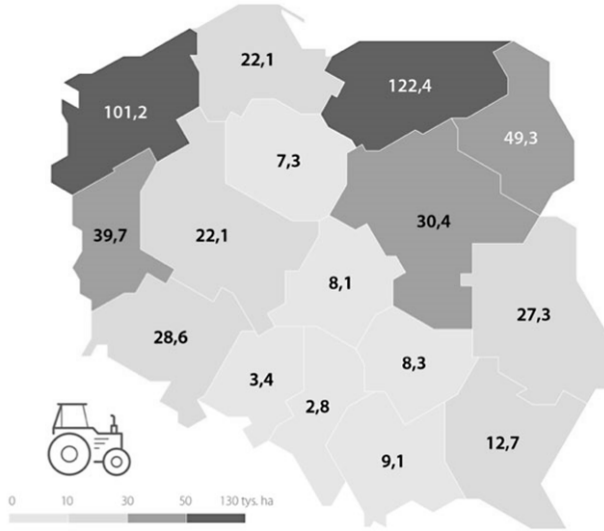

Figure 6. The area of ecological agricultural land in Poland in 2018 according to voivodships (in thousand hectares)
Source: own study of the Supreme Audit Office based on statistical data prepared by Agricultural and Food Quality Inspection – *Jak państwo wspiera ekorolników* 2019.

Since 2014, the number of processing plants has almost doubled, and in 2018 there were already 910, with the largest number in the Mazowieckie, Wielkopolskie, and Lubelskie voivodships. However, this is still not much compared to the countries of Western Europe. According to Eurostat, in 2017, there were 18,500 people in Italy dealing with processing plants, and approx. 15,000 in Germany and France. Spain was fourth in this ranking, with over 4 000 organic processors (Eurostat 2019 – *Agricultural production – crops* 2019).

In August 2018, the Ministry of Agriculture and Rural Development estimated the value of the Polish organic food market at approximately PLN 1 billion. However, its share in the food market is only 0.3%, while in 2017, the average in the European Union was 4%; in record-breaking Denmark, it was almost 8.5%, in Switzerland almost 8%, and in Austria 6.5% (Supreme Audit Office 2019 – Ministry of Agriculture and Rural Development 2020).

In 2019, there were 20,146 entities active in organic farming, including 18,656 organic farmers managing an area of 505,700 hectares. The largest area of ecological agricultural land was devoted to cereal crops, with permanent grasslands in second place. In 2019, the production of eggs and fish significantly increased in livestock production, and the number of animals, especially poultry, increased. The number of entities preparing organic products has increased significantly, numbering 967 in 2019. Each organic certification body makes information available on the Internet about the organic producers it controls. Currently, the control of organic producers is carried out by 13 authorized certification bodies (Ministry of Agriculture and Rural Development 2020).

According to the data cited by the Warsaw University of Life Sciences, currently, about 50–60% of organic products that are transferred to retail sale in Poland come from import, in particular, exotic fruit and their preserves, coffee and tea, highly processed products, and spices. Our producers mainly export fresh and frozen fruit and vegetables, apple juice concentrate, as well as grains and grain products (Supreme Audit Office 2019 – *Jak państwo wspiera ekorolników* 2019).

The Supreme Audit Office in Poland believes that organic farming has a chance to become a significant element in the development of the entire Polish agriculture sector, provided that the strengths of this type of production are used. The greatest strengths of Polish organic production include low environmental pollution, the predominance of small and medium-sized family farms, large natural resources, as well as relatively low labor costs, relatively low consumption of chemicals, the price competitiveness of Polish ecological products on the EU market, and introduction of European subsidies for organic production and from the national budget (Supreme Audit Office 2019 – *Jak państwo wspiera ekorolników* 2019).

Nevertheless, it should be noted that the profitability of production and the profits that can be achieved by ecological entities are the most important issues for the development of the organic agriculture sector in Poland. The desire to increase the supply or the range of organic products on the market is of secondary importance (Kowalska 2015, pp. 467–476). The same conclusion was drawn on the organic sector in LDCs in African countries.

Conclusion

Organic agriculture can be seen as one of the methods of sustainable farming. This method aims to obtain optimal, high-quality crops without the use of synthetic fertilizers or chemical pesticides. The principles of organic farming are based on the holistic treatment of basic biological processes. It draws attention to the fact that the optimal course of life processes is achieved only in the closed circulation of biological substances (soil – plant – animal – human). Organic agriculture plays a significant role in the development of rural areas and improving farmers' quality of life. It has a positive effect

not only environmentally but also economically and socially. Agriculture, as a sector, is undoubtedly one of the most important spheres in the economic sense for LDCs. The WTO's Doha Round aims to improve global trade rules and provide smaller trade barriers, in particular, for LDCs. It is also one of the most important negotiation rounds to remove all the export subsidies for agricultural products, which favors developing economies. Furthermore, the elimination of export subsidies is a step towards fulfilling the key objective of the Sustainable Development Goal, which is Zero Hunger.

Africa represents over 70% of the world's least developed countries. Most of them take advantage of the development of their agricultural sector, as it is the source of income for a large group of citizens. As a continent, Africa still suffers from poverty and insufficient financial resources. Organic agriculture in Africa is now perceived as both a great solution to improve the economy of African countries and a development path. In the case of organic production growth forecasts, Africa presents a great potential for millions of smallholder farmers and their families to exit the problem of poverty and hunger (FiBL & IFOAM 2020, p. 192). Traditionally, African agriculture is based on low external inputs, which facilitates the system of organic agriculture to grow the productivity and resilience, and to sustain the good quality of the environment (soil, air, water, etc.). It seems that with an adequate base of research, investments, and the development of ecologically sustainable technologies/production systems, becoming more organic presages a perfect option for the development of African countries, their economies, and their citizens.

More importantly, organic agriculture, as a system that integrates traditional methods of farming and takes advantage of local, accessible, and affordable resources, is highly important for the majority of farmers in Africa. There is a strong need to support the development of organic agriculture in Africa as it encourages farmers to fight for a better future for their families. Therefore, governments and their institutions, farmers' organizations, the private sector, and development partners should invest in research programs and establish special platforms to share good practices and experience among farmers and institutions. This is the only path to build a strong basis for a vibrant economy, food and nutrition security, and to reduce poverty (FiBL & IFOAM 2020, p. 192).

In conclusion, due to the enormous differences resulting from the weather, climate and soil conditions, the institutional and governmental environment, the financial support, and the development of technologies and modern cultivation methods, it might be extremely difficult to make a comparison between Poland and the LDCs in Africa. However, finding common challenges for the future development of the Polish organic sector and the LDCs in Africa might be important for creating future provisions on improving and supporting their organic sectors. The greatest challenges include:

- increasing trust in organic food producers,
- reduction of production costs,
- developing a network and distribution channels,

- clearer regulations on the organization of organic production,
- increasing marketing activities to popularize ecological products,
- defining a clear and transparent strategy for the development of agricultural policy in this area,
- creating institutional support for organic farmers,
- sharing information on good practices and ecological methods of cultivation,
- increasing public awareness of the benefits resulting from the consumption of organic products and the welfare of the planet.

References

Agricultural and Food Quality Inspection (2019), *The report on organic farming in Poland in 2017–2018*, Warszawa.

Agricultural production – crops (2019). https://ec.europa.eu/eurostat/statistics-explained/pdfscache/26212.pdf (accessed: 14.05.2020).

Ancharaz, V. (2012), *Can the Doha Round Be Saved?*, [in:] R. Meléndez-Ortiz, Ch. Bellmann, M. Rodriguez Mendoza (eds), *The Future and the WTO: Confronting the Challenges. A Collection of Short Essays*, International Centre for Trade and Sustainable Development, Geneva.

Borowska, A. (2006), *Rozwój rolnictwa ekologicznego na świecie na początku XXI wieku*, "Zeszyty Naukowe Akademii Rolniczej we Wrocławiu", no 540, pp. 79–92.

Buckley, R. (2003), *The WTO and The Doha Round: The changing face of World Trade*, Global Trade abd Finance Series, Kluwer Law International, Zuidpoolsingel, Netherlands, 1st Edition.

Dugiel, W. (2008), *Światowa Organizacja Handlu a kraje rozwijające się*, "International Journal of Management and Economics", 24, pp. 9–37. http://bazhum.muzhp.pl/media/files/International_Journal_of_Management_and_Economics/International_Journal_of_Management_and_Economics-r2008-t24/International_Journal_of_Management_and_Economics-r2008-t24-s9-37/International_Journal_of_Management_and_Economics-r2008-t24-s9-37.pdf (accessed: 25.05.2020).

Ecological Organic Agriculture (EOA) – Initiative, Continental Steering Committee (2015), *The Ecological Organic Agriculture (EAOA) Initiative*, *2015–2025 Strategic Plan*, EOA Continental Steering Committee, African Union Commission, Benin.

ESCAP (2014), *The role of agriculture in closing development gaps of LDCs*, Policy Papers on Countries with Special Needs, CSN/14/01, United Nations Economic and Social Commission for Asia and the Pacific, Bangkok. https://www.unescap.org/sites/default/files/CSN-14-01%20(June)_0.pdf (accessed: 12.05.2020).

FAO (1998), *Evaluating the Potential Contribution of Organic Agriculture to Sustainability Goals, Environment and Natural Resources Service Research, Extension and Training Division Sustainable Development Department Food and Agriculture Organization of the United Nations*. http://www.fao.org/3/a-ac116e.pdf (accessed: 14.05.2020).

FAO, Morgera, E., Bullón, C., Durán, C.G.M. (2012), *Organic agriculture and the law*, "FAO Legislative Study 107", Rome. http://www.fao.org/3/a-i2718e.pdf (accessed: 10.05.2020).

FiBL (2019), *World of Organic Agriculture Statistics and emerging trends 2019* (2019), IFOAM, FiBL, Frick–Bonn.

FiBL (2020), *FiBL survey 2020*, *The World of Organic Agriculture Statistics and emerging trends 2020*, IFOAM, FiBL, Frick–Bonn.

Gama, J. (2018), *Latest Developments in Organic Agriculture in Africa*, [in:] *FiBL & IFOAM – Organics International (2018): The World of Organic Agriculture: Statistics and Emerging Trends 2018, Research Institute of Organic Agriculture FiBL, Frick, and IFOAM – Organics International*, Bonn. https://www.organic-world.net/yearbook.html (accessed: 10.06.2020).

Golijan, J., Dimitrijevic, B. (2018), *Global organic food market*, "Acta Agriculturae Serbica", XXIII (46), Belgrade–Zemum. https://www.afc.kg.ac.rs/files/data/acta/46/1__AAS_252-18_Golijan_and_Dimitrijevic.pdf (accessed: 3.04.2020).

https://www.wto.org/english/res_e/booksp_e/anrep19_e.pdf (accessed: 20.05.2020).

Jak państwo wspiera ekorolników (2019). https://www.nik.gov.pl/aktualnosci/rolnictwo-ekologiczne.html (accessed: 30.06.2020).

Kowalska, A. (2015), *Rolnictwo ekologiczne jako czynnik rozwoju zrównoważonej konsumpcji*, "Journal of Agribusiness and Rural Development", 3 (37), pp. 467–476.

Kristiansen, P., Taji, A., Reganold, J. (eds.) (2006), *Organic Agriculture. A global perspective*, CSIRO Publishing, Australia. https://orgprints.org/14043/1/14043.pdf (accessed: 11.05.2020).

Kuś, J., Jończyk, K. (2009), *Development of Organic Farming in Poland*, "Journal of Research and Applications in Agricultural Engineering", 54 (3), pp. 178–182.

Luttikholt, L.W.M. (2007), *Principles of organic agriculture as formulated by the International Federation of Organic Agriculture Movements*, "NJAS – Wageningen Journal of Life Sciences", 54 (4). https://doi.org/10.1016/S1573-5214 (07)80008-X

Makowska, M., Gotkiewicz, W., Pawlewicz, A. (2015), *Rolnictwo ekologiczne w ujęciu przestrzennym i środowiskowym*, "Roczniki Naukowe SERiA", 4 (XVII), pp. 160–165.

Martin, W., Mattoo, A. (eds). (2011), *Unfinished Business? The WTO's Doha Agenda*, The World Bank, Washington.

Ministry of Agriculture and Rural Development (2020), *Rolnictwo ekologiczne*. https://www.gov.pl/web/rolnictwo/rolnictwo-ekologiczne1 (accessed: 30.06.2020).

Runowski, H. (2003), *Rolnictwo ekologiczne w Polsce na tle tendencji światowych*, "Zeszyty Naukowe SGGW. Ekonomika i Organizacja Gospodarki Żywnościowej", 49, pp. 182–193.

Schoonbeek, S., Azadi, H., Mahmoudi, H., Derudder, B., De Maeyer, P., Witlox, F. (2013), *Organic Agriculture and Undernourishment in Developing Countries: Main Potentials and Challenges*, "Critical Reviews in Food Science and Nutrition", 53 (9), pp. 917–28. https://doi.org/10.1080/10408398.2011.573886

Scialabba, N. (2000), *Factors Influencing Organic Agriculture Policies with a Focus on Developing Countries*, IFOAM 2000 Scientific Conference, Basel. http://www.fao.org/3/a-at734e.pdf (accessed: 19.05.2020).

Scialabba, N., Hattam, C. (2002), *Organic agriculture, environment and food security*. "Environment and Natural Resources Series", Food and Agriculture Organization of the United Nations (FAO), Rome.

Światowy rynek produktów ekologicznych osiągnął wartość 90 mld euro (2019). http://www.portalspozywczy.pl/owoce-warzywa/wiadomosci/swiatowy-rynek-produktow-ekologicznych-osiagnal-wartosc-90-mld-euro,169160.html (accessed: 3.12.2019).

UNCTAD (2018), *Statistical Tables on The Least Developed Countries 2018*, United Nations Conference on Trade and Development, Geneva.

UNCTAD (2019), *State of Commodity Dependence 2019, United Nations Conference on Trade and Development*, DITC/COM/2019/1/Corr.1, Geneva, https://unctad.org/en/PublicationsLibrary/ditccom2019d1_en.pdf (accessed: 29.05.2020).

Willer, H., Lernoud, J. (2019), *The World of Organic Agriculture. Statistics and Emerging Trends 2019*, 20 edition, Research Institute of Organic Agriculture FiBL and IFOAM Organics International, Frick–Bonn.

Wojtas, M. (2016), *Negocjacje rundy Doha – postępy w czasie Konferencji Ministerialnych w Bali i Nairobi*, "Finanse, Rynki Finansowe, Ubezpieczenia", 3 (81), pp. 275–284.

World Trade Organisation (2019), *Annual Report 2019*, Switzerland.

WTO, *Agriculture negotiations*. https://www.wto.org/english/tratop_e/agric_e/negoti_e.htm (accessed: 20.05.2020).

WTO, *Doha Round: what are they negotiating?* https://www.wto.org/english/tratop_e/dda_e/update_e.htm (accessed: 20.05.2020).

WTO (2020a), *Bali Package and November 2014 decisions*, World Trade Organisation. https://www.wto.org/english/thewto_e/minist_e/mc9_e/balipackage_e.htm (accessed: 2.06.2020).

WTO (2020b), *The Doha Round Texts and related documents*, World Trade Organisation, Switzerland. https://www.wto.org/english/res_e/booksp_e/doha_round_texts_e.pdf (accessed: 20.05.2020).

Zajączkowski, M. (2018), *Runda z Dohy WTO – próba przyjęcia reguł sprzyjającym interesom krajów rozwijających się*, "Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach", 372, pp. 205–219. http://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.cejsh-9db0f9cf-0a7d-4298-a16c-9da31e1a5188 (accessed: 26.06.2020).

Streszczenie

Rolnictwo ekologiczne w najmniej rozwiniętych państwach na przykładzie Afryki

W ciągu ostatnich kilku lat obserwuje się dynamiczny rozwój rolnictwa ekologicznego. Globalny obszar rolnictwa ekologicznego stale rośnie. Co więcej, rynek organiczny rozwija się nie tylko w Europie, ale także w Ameryce Północnej, a także w innych częściach świata. Rynek produktów ekologicznych stale rośnie i należy podkreślić, że w 2015 r. światowy rynek produktów ekologicznych wzrósł do 81,6 mld euro, przekraczając wartość 90 mld euro w 2018 r. Znacząco wzrosła również produkcja produktów ekologicznych , wytwarzanych przez grupę krajów najsłabiej rozwiniętych (takich jak wybrane kraje afrykańskie), które są wspierane przez postanowienia wynikające z negocjacji Światowej Organizacji Handlu w ramach Rundy z Doha. Celem tego artykułu jest przedstawienie różnych definicji rolnictwa ekologicznego według najważniejszych organizacji międzynarodowych. Ponadto kluczowe będzie zbadanie obecnego statusu sektora rolnictwa ekologicznego w wybranych przykładach krajów najsłabiej rozwiniętych w Afryce oraz określenie wyników negocjacji z Doha na rynku rolnym (szczególnie w odniesieniu do krajów najsłabiej rozwiniętych). Wreszcie należy przyjrzeć się problemowi, jaki jest stan i jakie są najnowsze osiągnięcia rolnictwa ekologicznego w odniesieniu do krajów najsłabiej rozwiniętych w porównaniu z Polską. Metody badawcze zastosowane w artykule obejmują analizę dostępnych źródeł dokumentalnych i literackich dotyczących omawianych zagadnień, opracowanie odpowiednich badań statystycznych oraz zastosowanie podejścia dedukcyjnego w celu wyciągnięcia wniosków ze statusu rozwoju rolnictwa ekologicznego w krajach najmniej rozwiniętych i Polski (jako przykładu kraju Europy Środkowej).

Słowa kluczowe: rolnictwo ekologiczne, produkty ekologiczne, zrównoważony rozwój, kraje najsłabiej rozwinięte, Światowa Organizacja Handlu, runda z Doha