Influence of Globalisation on Eco-innovations in Visegrad Group Countries

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Abstract: An effort to increase competitiveness, globalisation processes go hand in hand. At the same time, developed countries are focusing on keeping these trends in line with sustainable development by introducing eco-innovation. That is why we consider innovations as a principal driver of the economic growth from the global point of view. In terms of competitiveness advantage and economic position, an analysed country is compared to its nearest neighbours whit similar economic conditions. The study describes the evaluation of impact of globalisation on eco-innovation performance of the Slovak Republic and Visegrad Group Countries (V4). Base to literature review, the aim of the research is to determine the development of the economic and political globalisation and their influence on the development of eco-innovation. The results represents the most important combination of relationship between these two different globalisation and innovation from a mathematical point of view and describe the current position of the Slovak Republic, as a case study. The data indicate statistically significant positive influence of economic globalisation on eco-innovation in Slovakia and in Poland, however there are notable differences among observed countries. Moreover, Slovakia has been identified as the most sensitive country to development of globalisation.

Keywords: Eco-innovation, sustainability, globalisation, Central Europe.

INTRODUCTION

In the context of the constant growth of the global economy, globalisation and the integration of world economies, it is important to point out the consequences of these trends on the environment. Traditionally, the world community and the world economy have focused on achieving long-term economic growth while actively using available natural resources. In recent years, the effects of globalisation on the economy, politics and the environment have been discussed by many researchers. Globalisation supports economic growth by facilitating opportunities for international trade, leading to specialization in production processes and increasing the diversity of goods and services on offer [1]. Thus, there is some consensus that globalisation leads to economic prosperity [2-4]. On the other hand, these global developments results in an increase in industrial emissions and waste. Consumption of raw materials is growing at the cost of environmental externalities, which affect all stages of goods production, from raw material extraction, processing to waste management [5]. As globalisation connects economies through trade, investment and financial activities, the expansion of global economies and the growth of global financial activities lead to higher energy consumption and thus higher carbon emissions [6]. In other words, there is an increase in prosperity and at the same time a deterioration in the quality of the environment. Achieving sustainable development while preventing further environmental degradation is a key challenge facing today's society. These consequences of globalisation are urgent issues for the international community. However, another view points to the improving the quality of the environment through clean technology transferred by foreign direct investment (FDI) [7].

However, the traditional attitude and view of the global economy have changed significantly in recent years. The concept of sustainable development based on knowledge economy and rational use of resources with respect to the environment has come to the fore. Globalisation and the associated growing global competition provide incentives for the adoption of new technologies and innovations. Innovation is generally considered to be a major driver of economic growth and competitiveness. In this context, macroeconomic factors such as green growth and globalisation can play an integral role in achieving ecological sustainability in the presence of eco-innovations [8]. The importance of the ecological concept is growing due to the fact that this type of innovation is perceived as one of the main tools for the transition to a green economy.

The term eco-innovation is often used in the literature as an environmental innovation, green innovation or sustainable innovation. The inconsistency in the understanding of the concept also reflects a wide range of definitions. The first definition of environmental

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innovation appeared in 1996 by Fussler and James: "new products and processes creating value for enterprises and clients and reducing (negative) environmental effects" [9]. Oslo Manual (OECD, 2005) defines innovation as the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organizational method in business practice [10]. Kemp and Pearson (2007) define the term as "the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives" [11]. According to Sobczak *et al*. (2022) eco-innovation is "any innovation that results in the achievement of sustainable development through the reduction of negative impacts of manufacturing activities on the environment, increasing natural resilience to burdens or ensuring greater efficiency and responsibility in taking advantage of natural resources" [12].

In order for industry to grow in line with the concept of sustainability, individual companies must focus their economic priorities on maximizing profits with regard to environmental issues. The current protection of the biosphere can thus affect the current and future competitiveness of businesses [13]. This development is also influenced by other market and technological factors, such as customer requirements, stronger market competition, technological development and globalisation in business. As a result, companies should meet environmental protection requirements in order to reduce the carbon footprint and other negative impacts in the global environment [14, 15]. In this context, eco-innovation is a means to achieve a harmonious balance between economic development and environmental quality, as well as dynamic sustainability in various aspects [16].

Global environmental policy goals proposed in the Paris Climate Agreement and the United Nations Sustainable Development Goals (SDGs) play an important role in developing eco-innovation among countries [17]. Borghesi and Vecelli (2003) claim that the current process of globalisation is unsustainable in the long run unless we introduce new institutions and policies able to govern it [18]. Tisdell (2001) studied effects of economic globalisation on sustainability and came to similar conclusions. Sustainable development requires new paradigms and innovative methods [19]. This complexity of globalisation processes therefore requires an integrated approach that includes political, social, economic and environmental aspects [20].

According to literature review, the aim of the study is to determine the extent to individual independent variables, namely Economic globalisation (hereinafter EGI) and Political globalisation (hereinafter PGI) contribute to the explanation of various aspects of eco-innovation. The model represents the most important combination of relationship between globalisation and innovation aspects from a simple mathematical point of view.

METHODOLOGY

The article focuses on identifying the impact of economic and political globalisation on the development of eco-innovation in the region of Central Europe – the Visegrad Group (V4) countries. For this purpose, indicators were selected that comprehensively address the issue. The KOF Globalisation Index [21] is used to monitor trends in the degree of globalisation of countries in the world. The latest globalisation index KOF is available for 195 countries. The index distinguishes between de facto and de jure globalisation in the overall index and in its economic, social and political components. The index rates globalisation on a scale of 1 to 100. EGI includes business and financial globalisation and is measured by the actual flows of trade, FDI and portfolio investment, as well as the restrictions applying to these flows. PGI is characterized by the degree of political cooperation. It is measured by the number of embassies, membership of international organizations, participation in UN Security Council missions, and number of international treaties signed [3, 21]. The advantage of the KOF index is that it is available for a large panel dataset and encompasses the multifaceted aspects of globalisation. The level of eco-innovativeness of selected countries is assessed by the Eco-Innovation Scoreboard (Eco-IS). The Eco-Innovation Index (hereinafter ECOI) [22] is a tool for evaluating the performance of eco-innovation in all Member States of the European Union (EU). Various aspects of eco-innovation are represented by 16 indicators grouped into five areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes and socio-economic outcomes [22, 23].

Hypothesis H_1 assumes that the trend of globalisation is a significant driving force of eco-

innovation activities in V4 countries. On the other hand, hypothesis H_0 assumes no association between the indicators of globalisation and the eco-innovation performance of the V4 countries. To analyse the relationship between selected globalisation dimensions and eco-innovation performance the linear regression analysis has been applied. The first of all a set of assumptions has been realised. According to description statistical analyses we identified normal distribution of data, homoscedasticity and a linear relationship between eco-innovations and independent variables. Therefore, for the model, the ordinary least squares estimation method was applied to estimate parameters. The autocorrelation of residues the Durbin-Watson test was used to test multicollinearity in a Statistical Package for the Social Sciences (SPSS Inc., version 26, Chicago, USA). Regression analysis for modelling and analysis of the relationship between independent variables (EGI and PGI) and dependent variables (ECOI) was performed. In simple terms, we applied the method used to test the nature of relationships between a dependent variable and one or more independent variables.

The basic form of regression models includes unknown parameters (β), independent variables (X), and the dependent variable (Y). Regression model, basically, specifies the relation of dependent variable (Y) to a function combination of independent variables (X) and unknown parameters (β).

$$Y \approx f(X,\beta) \quad (1)$$

According to the literature review, eco-innovations are strongly influenced by the global economy and political development. In this context, products and services are being developed to promote sustainable development. Worldwide distribution of these products increase rate in the technology-driven global economy. This applies to every production activity and to every kind of product.

$$ECOI = f(EGI, PGI) \quad (2)$$

Regression equation can be used to predict the values of ECOI, if the value of EGI or PGI is given, and both parameters are the wo sets of measures of a sample size of during the years 2010-2021. The formulae for regression equation would be:

$$ECOI_c = \beta_0 + \beta X + \varepsilon_t \quad (3)$$

where $ß_0$ is a constant, X is a vector of explanatory variables (EGI, PGI) and ε_t is the error term.

The aim of the above mentioned approach is to determine the extent to which individual independent variables contribute to the explanation of the dependent variable. In this way, we evaluated the two most important variables (EGI and PGI), which formed the input data set for the creation of econometric models. The resulting model represents the most important combination of explanatory variables, both from a mathematical and statistical point of view, as well as from the point of view of fulfilling the expected assumptions, which were defined by economic theory.

RESULTS

The V4 is a cooperation platform of the countries of the Central European region - the Czech Republic, Hungary, Poland and Slovakia. It is a collaboration of countries that share a common history, cultural and intellectual values [24]. These are neighbouring countries that are often perceived as important trading partners from a global perspective. In addition, typical is their interconnection of the geopolitical situation, as well as similar strategic goals of foreign and security policy [25]. Similar economic development is currently supported by innovation activities.

To ensure sustainable growth worldwide, as well as at EU level, resources need to be used effectively. The EU's initiatives aim to improve environmental processes, such as energy efficiency and environmental efficiency, including the promotion of eco-innovation. Given the growing importance of environmental issues in EU policies, the Eco-Innovation Observatory publishes the Eco-Innovation Index for all EU Member States. The Eco-Innovation Index shows the levels of the Member States of the EU in terms of eco-innovation compared to the EU average (EU average = 100). Countries that reach levels above 115 are usually considered leaders [26]. Table **1** shows the average values of the monitored indicators of the V4 countries for the observed period. It is clear that the selected countries are not among the EU's eco-innovation leaders. On the contrary, it is characterized by weak development and weak preconditions for the development of eco-innovation. The three countries of the group achieve an average index value of less than 100 in the observed period. They are also referred to as countries catching up with the EU. On the contrary, the Czech Republic, which is at the level of the EU average, achieved the highest average value in the observed period. However, it is important to note that the level of the Eco-Innovation Index has increased in all countries in observed period.

Table 1: Average Values (Years 2010-2021) of Selected Indicators (Eco-Innovation Index, KOF Globalisation Index – Economic and Political Dimension)

	PL	HU	CZ	SK
ECOI	58.400	62.400	100.200	80.400
EGI	72.049	82.614	82.055	81.377
PGI	91.155	91.429	89.431	84.961

The average value of economic globalisation (EGI) for Slovakia is 81 points. The level of economic globalisation in Slovakia increased from 77.69 points in 2012 to 82.52 in 2021. Regarding the level of economic globalisation, the Czech Republic and Hungary recorded similar averages. Nevertheless, in the observed period there was a slight increase in the value of EGI in the Czech Republic and, conversely, a slight decrease in Hungary. Poland has recorded the lowest level of economic globalisation. However, over the observed period, the level of economic globalisation has also increased slightly in Poland from 68.69 to 72.84 points. The political dimension of the globalisation index (PGI) is at a relatively high level in all countries monitored. Slovakia, Poland and Hungary recorded a slight decrease in this indicator since 2012. On the contrary, in the Czech Republic there was an increase in all monitored indicators in the observed period. The Table **2** represents the model summary with the most important combination of relationship between globalisation and innovation aspects.

It is important to note the values of R-Square, which is a statistical measure of how close the data are to the fitted regression line. It indicates the percentage of the variance in the dependent variable that the independent variables explain collectively. As shown in Table **2**, in the case of Poland the largest value of 88.6% of the total variation in the dependent variable can be explained by the independent variable. In Slovakia, the predictors economic and political dimensions of globalisation account for 76.5% of the variance of eco-innovation index. For the Czech Republic and Hungary, these values are lower, around 40%. The results of linear regression analysis of globalisation indicators are shown in Table **2**. According to the level of significance, the variables for Slovakia and Poland are statistically significant. For all other variables, the significance level is higher than 0.05. Hence, we could claim that the used indicators of globalisation do not influence the level of eco-innovation index in Hungary and Czechia. In the case of Slovakia positive statistical dependence was demonstrated. One additional point of economic

Table 2: Model Summary

Model	R	R-Square	Unstandardized Coefficients		t	Sig.
			B	Std. Error		
SK con.	.875	.765	-781.094	323.478	-2.415	.046*
SKEGI			3.509	.824	4.257	.004**
SKPGI			6.778	3.142	2.157	.068
CZ con.	.641	.410	-219.250	401.118	-.547	.602
CZEGI			1.874	1.774	1.056	.326
CZPGI			1.852	5.675	.326	.754
H con.	.653	.426	412.805	271.801	1.519	.173
HEGI			2.141	1.303	1.643	.144
HPGI			-5.767	3.013	-1.914	.097
P con.	.941	.886	224.601	131.577	1.707	.132
PEGI			2.412	.345	6.984	.000**
PPGI			-3.730	1.425	-2.617	.035*

*p < 0.05; **p < 0.01.

globalisation is associated with 3,509 points increase in a dependant variable. In other words, the higher the level of economic globalisation measured by the KOF globalisation index the higher the development of eco-innovations in Slovakia.

Economic globalisation has proved to be statistically significant in the case of Poland as well, but to a lesser extent. Positive statistical dependence was confirmed. One additional point is associated with 2,412 points increase in eco-innovation index of the country. Political dimension of globalisation in Poland shows negative value for the unstandardized coefficient. As the value of political dimension of KOF globalisation index increases by one point, the value of eco-innovation index decreases by 3,730. In this case, economic and political globalisation show the opposite effect on the development of eco-innovation in the country.

DISCUSSION

The trend towards sustainable development and the transition to a low-carbon and resource-efficient circular economy are considered essential. At present, innovation in support of sustainable development is one of the main themes at the global level [27]. Political globalisation plays an important role in respecting international commitments to address the negative impacts of climate change and other environmental issues. Bernauer *et al*. (2010) provide evidence that countries that are already part of a larger network of international organizations are also behaving more cooperatively when ratifying environmental treaties. However, we can state that the concept of eco-innovation in the V4 countries is at an early stage of development. In addition, it is important to note that there is potential for further development and overall improvement in the V4 countries [28]. Lacko *et al*. (2021) confirm that the V4 countries are not among the most advanced in terms of recycling and transition to a circular economy. However, developments suggest significant improvements. However, when it comes to improving the circular economy processes in these countries, two main areas need to be focused on, and that is improving industrial and household recycling processes. However, the study points to a lack of environmental awareness in both industry and households [24].

The Czech Republic has the highest R&D intensity among the V4 countries, followed by Hungary, while the innovation performance is led by the regions of the capital city of Prague and Budapest [29]. Ivanová and Čepel (2018) examined the impact of the innovation performance of the V4 countries on their competitiveness. The V4 countries are transition economies and are quite similar in terms of their economic development, but their position in the global competitiveness rankings varies depending on innovation performance [30]. The Czech economy shows the best values from the group, the weakest performance of the indicator is attributed to the economies of Slovakia and Hungary. Poland's economy is relatively balanced. The reasons for Slovakia's unfavourable position are related to the country's complex innovation policy, which is influenced by the processes set up as a solution to the crisis in the country. In the near future, V4 should focus on expanding the use of its innovation potential. It is therefore necessary to develop strategic solutions at political level to improve the conditions for the development of eco-innovation.

CONCLUSION

The development of eco-innovation can be monitored from several perspectives. Globalisation has been a key factor in recent decades, affecting regions as well as national economies. At the same time, we should be able to compare their condition with the surrounding environment and thus determine the economic development and well-being of the region. According to analyses, the following conclusions can be drawn:

- There is a statistically significant positive influence of economic globalisation on eco-innovation in Slovakia and in Poland. For other countries, no statistically significant impact of globalization on eco-innovation has been identified.
- The analysis of absolute values shows that the Czech Republic has the highest R&D intensity among the V4 countries, followed by Hungary. The Czech Republic has significant impact on the innovation performance of the V4 countries as well as on the growth of competitiveness.
- The results identified significant differences among observed countries. However, Slovakia has been identified as the most sensitive country to globalisation.
- Development of analysed data shows that eco-innovation market in V4 countries is at its initial

stage, however, there is potential for further development and overall improvement in this area.

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