Evidence of the Environmental Kuznets Curve in Emerging Eastern European Economies

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Abstract

This study aims to investigate the relationship of economic development, measured as economic growth, energy use, trade and foreign direct investment one the one hand and environmental degradation (carbon dioxide (hereafter CO2) emissions) on the other hand, in eleven emerging Eastern European countries during the period of 1990 to 2014.

The empirical results support a carbon emission's Kuznets curve hypothesis for Eastern Europe. The current income level indicates that not every country has reached the turning point for CO2 emissions reduction goal.

In addition, the study proves a positive effect of foreign direct investment (FDI) on CO2 emissions in Eastern European countries. Also the results show that there is a negative effect of total energy consumption on environment as it increases CO2 emissions. Hence, there is a significant need of reforming the electricity markets that requires necessary improvement and attraction of investment, strong central political support, thorough preparation and continuous development.

Income elasticities for CO2 are positive for all 11 countries. The paper concludes that within the group Ukraine and Kazakhstan has the most sensitive change in economic growth in respect to its CO2.

It is expected that the innovative transition to a low-carbon economy offers great opportunities for economic growth and job creation. Technological leadership should be accompanied by the development and introduction of new technologies throughout Eastern European countries, hence, the paradigm of "sustainable development" should be considered. This requires the unification of the research, industry and financial sectors, as well as the support of state bodies.

Keywords: Environmental Kuznets curve (EKC), carbon emissions, energy intensive industry, income elasticity of CO2, U-shaped relationship.

JEL Classification: O13, Q53, Q56.

1. Introduction

In time of global climate change and risks it poses, a question arises: "Why is it vital for global security and stability to tackle climate change and invest in sustainability?" WWF (World Wide Fund for Nature), which is one of the world's largest and most experienced independent conservation organizations, states a 3S doctrine and it can be summed up in the following formula: a system that is not environmentally sustainable creates instability that inevitably devolves into insecurity. In other words: an environmentally unsustainable system produces instability, which inevitably leads to insecurity. When the balance between man and the ecosystem that provides him with key resources is upset, instability takes over; and in areas unprepared for these situations, the threats to security and economic growth arise as well (WWF, 2017).

Figure 1 presents own vision and the framework of components of sustainable development and place of the energy security in it.

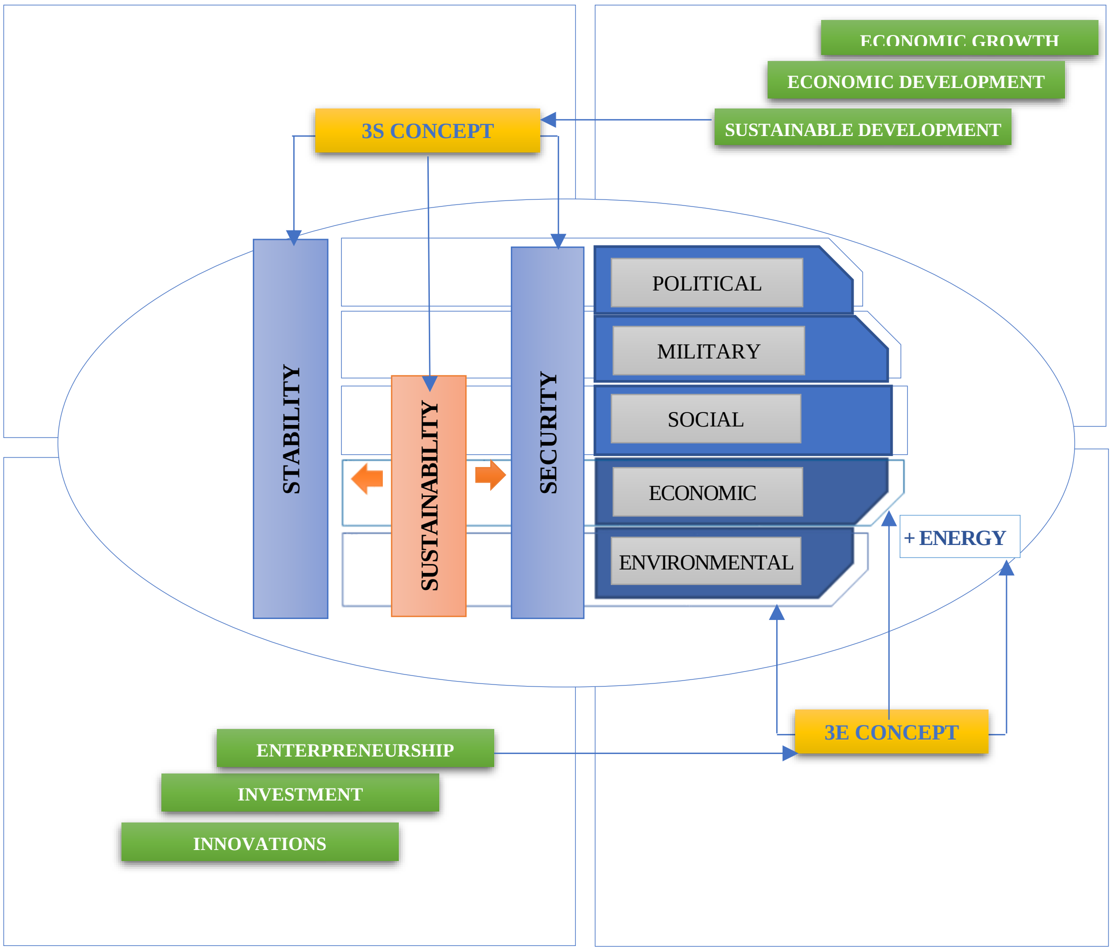


Figure 1. Framework of Energy Security and Components of Sustainable Development

Source: Compiled by authors

It shows that *sustainable development* comprises of three components, i.e. economic development, social inclusiveness and environmental sustainability. In driving towards a green growth, environmental sustainability will be a key consideration in enhancing economic growth and development within a society that promotes equity. Likewise, for green growth to be achievable, it will employ a number of policy instruments. These policies will invariably help to ensure the security of energy supply.

Climate changes are already taking place, upsetting the economic, political, social and environmental balance, and posing a threat to *stability* and security worldwide. If the system is not stable it can't be resistant to changes, and as result – not able to sustain something in future. In other words, there should be an economy, which is able to meet the needs of society and express the greatest potentials at present, while preserving biodiversity and natural ecosystems for future generations.

In a world where *security* is of ever-greater importance, all parameters must be taken into account to analyze problems and come up with the most effective responses. The first requirement is to recognize that climate changes and the risks they pose are a threat to stability and security.

It should be noted that according to the Copenhagen School there are five sectors of national security: military, political, societal, economic and environmental (Buzan, B., Woever, O., and de Wilde, J., 1998). In some national classifications energy is used as a part of economic security. But in fact, energy security is more about the association between national security and the availability of natural resources for energy consumption. In the modern world it's very important for every country to find the cheapest ways of energy resources' supply. This issue disturbs lots of countries and creates many threats to the national security and economic growth, economic development and sustainable development as well.

It should be noted that *economic growth* is demonstrated by the growth as the increase in a country's total output, here measured as GDP. It is the increase in a country's production, while the *economic development* is usually indicated by an increase in citizens' quality of life (often measured using HDI), which considers intrinsic personal factors not considered in economic growth, such as literacy rates, life expectancy and poverty rates.

If we talk about *sustainable development*, it was earlier mentioned that the term means the organizing principle for meeting human development goals, while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. Sustainable development can be classified as development that meets the needs of the present without compromising the ability of future generations. Thus, sustainable development is essentially a strong ethical, or moral, pronouncement as to what should be done. In recent studies researches call such a pronouncement a moral imperative and it incorporates three main elements: satisfying human needs, ensuring social equity and respecting environmental limits (Holden, E., Linnerud, K., and Banister, D., 2017).

2. Relation between environmental performance and human development

Sustainable development has entered a new era of data-driven environmental policymaking. To meet the ambitious targets outlined in the United Nations 2015 Sustainable Development Goals (SDGs) and the Paris Climate Agreement, countries must integrate environmental performance metrics across a range of pollution control and natural resources targets. A more empirical approach to environmental protection promised to make it easier to spot problems, track trends, highlight policy successes and failures, identify best practices, and optimize the gains from investments in environmental management (the Environmental Performance Index, 2018).

EPI scores 180 countries on 24 performance indicators across ten issue categories covering environmental health and ecosystem vitality. HDI reflects the level of economic development of the countries. The paper presents a correlation matrix between EPI and HDI in Eastern European and developed countries as well.

As can be seen from the Figure 2 for emerging economies the EPI varies from 0,26 to 0,70 and for developed economies from 0.48 to 0.90 respectively. The HDI is quite different for these groups, as emerging economies are classified as countries with high human development and developed with very high human development. Nevertheless, the environmental pollution level can't be characterized with a significant difference.

It should be noted that energy use and economic development could be an important source of variation in CO_2 emissions as for developed countries and especially for emerging countries (like many countries in Eastern Europe), characterized by a rapid increase of their economic activity and at the same time characterized by obsolete machinery and equipment, which means an energy-intensive production and as result – high level of CO_2 emission.

Therefore, studying the relationship between environmental degradation, economic growth and energy use is an important issue, it should be investigated whether or not the economic growth course the higher pollution and deterioration of resources, so these problems require further investigations.

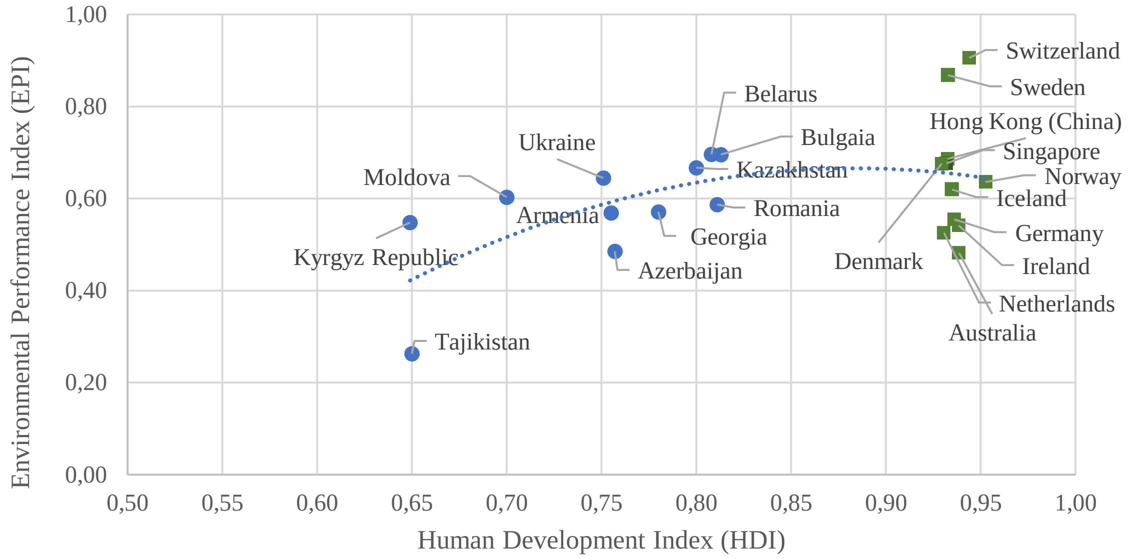


Figure 2. The correlation matrix between the Environmental Performance Index (EPI-2018) and the Human Development Index (HDI-2017)

Source: The Environmental Performance Index (2018) and the Human Development Index (2017)

3. Theoretical background

The consequences of economic growth and income on environment have been widely discussed. One of the most common arguments in this concept is the environmental Kuznets curve (EKC) hypothesis that refers to the inverted U-shaped relationship between environmental indicators and income.

The original EKC hypothesis suggests that when countries are experiencing economic development, they tend to disregard environmental integrity and strictly focus on gain within economic development. In addition, when the economy has developed to a certain point, there will be a popular demand for more environmental protection, which starts a change in environmental protection status from a luxury good to a normal good (Stern, 2004b).

In the work of Frankel and Rose (2005) the EKC analysis was extended by adding openness variables in order to investigate the effect of trade liberalization. The results showed a positive impact of trade on environmental pollution and also confirmed the EKC hypothesis.

Similarly, the long run and short run effects of economic growth, FDI inflows and trade on CO2 emissions was observed for Turkey using annual data for the period of 1974-2010 (Kaya, et al., 2018). The authors found that EKC is valid for Turkey. In addition, there are positive long run effects of FDI and trade openness on CO2 emissions.

Another approach presented Kacar and Kayalica (2014) used panel data for 42 countries over the period 1950-2000. The authors found an inverted U-shaped relationship between economic growth and sulfur emission in the presence of trade and population parameters.

A recent literature review on EKC investigated the long-run relationship between carbon dioxide (CO2) emissions, energy use and real GDP per capita in the Middle East and North Africa (Zaied, et al., 2017). In their study it was concluded that the estimated turning point of the EKC confirms that only oil producer countries achieved CO2 emissions reduction goal.

As for China, one used a spatial panel approach to analyze the relationship between economic growth and carbon emission (Xu, et al. 2018). The explanatory variables were industrial structure development, urbanization rate, and the level of economic growth and its squared value. It was investigated that due to the highly efficient industrial development and the trend of going green, the industrial development in this country is eliminating high polluted and inefficient production lines and is moving toward realizing internal organization optimization.

Several empirical papers have tested the inverted U-shaped relation between income and many indictors of environment degradation including SO2 and CO2. Tjoek and Wu (2018) showed that that CO2 displays an inverted U-shape pattern, whereas SO2 has decreased at an increasing rate since 2003. They also argued that the current Southeast Asia income level has not reached the turning point.

A study of Shahbaz and Avik Sinha (2018) stated that developed nations have been able to achieve the turnaround point of EKC, when the developing and emerging economies are yet to reach that point. In order to achieve the turning point in a sustainable manner, the last economies should consider a popular public-private partnership approach, which can ensure an inclusive growth, a recipe for sustainable development.

4. Data

In order to test the relationships between air pollution and economic development this paper applies annual data of GDP, net inflows of FDI, energy intensity and trade openness. The data are gathered from the open World Bank database. Due to the lack of data for some variables it is decided to use data covering the years from 1990 to 2014. The following study is based on the analysis of indicators of eleven Eastern European economies, i.e. Armenia, Azerbaijan, Belarus, Bulgaria, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Romania, Tajikistan and Ukraine. These countries had until the 1990s approximately the same economic systems and mechanisms, and, thereafter, began to transform their political and economic systems towards market oriented economies.

5. Methodology.

The paper uses a logarithmic form of the variables to make differences relative and reduce the effect of heteroscedasticity problems.

In this study, a log-linear quadratic equation is specified to validate the EKC hypothesis on the relationships between the dependent variable (i.e., carbon emission) and the explanatory variables. The formula used is given as:

$$log CO2_t = \alpha + \beta_1 \log GDPt + \beta_2 log^2 GDP_t + \beta_3 \log FDI_t + \beta_4 l\log \mathrm{Energy}_t + \beta_5 \log Trade_t + \varepsilon_t \quad (1)$$

where $log CO2_t$ – is the logarithm of CO2 emissions;
$log GDP_t$ and $log^2 GDP_t$ – is the logarithm of GDP and its square;
$log FDI_t$ – is the logarithm of FDI net inflows;
$log Trade_t$ – is the logarithm of trade in services (the sum of service exports and imports divided by the value of GDP);
$l\log \mathrm{Energy}_t$ – is the logarithm of energy intensity level of primary energy;
t – is the sampling year;
ε – is the vector of the residuals;

The foundation of the environmental Kuznets curve hypothesis is that the environmental degradation level is expected to increase at the same time as real GDP per capita increases, until a certain point, at which environmental degradation is expected to decrease as income per capita enters a different level (Xu, et al., 2018). The relationship between emission and economic growth is explained as follows:

- if $\beta_2 = \beta_1 = 0$, economic growth has no relationship with carbon emission;
- if $\beta_2 = 0$ and $\beta_1 > 0$, carbon emission has a linear relationship with economic growth;
- if $\beta_1 > 0$ and $\beta_2 < 0$, carbon emission has an inverted U-shaped relationship with economic growth, which indicates the existence of the EKC;
- if $\beta_1 < 0$ and $\beta_2 > 0$, carbon emission has a positive U-shaped relationship with economic growth.

The turning point is measured as $(-\beta_1/2\,\beta_2)$.

6. Results

Based on the adjusted R^2 value, there can be concluded that the model can explain 95% of the variation in CO2 emissions. In addition, the error correction term is 0.05. Also the results are reliable (statistically significant): Prob (F-statistic) (0.00), this value is less than 0.05. Another step is finding the likelihood of the sample result if the null hypothesis is true:

H_0: $\mu_1 = \mu_2 = \mu_3$
H_1: at least one of the means is different.

If F > F criteria, we reject the null hypothesis. In this case, 92.94 > 0.00 (Table 1). Therefore, the null hypothesis can be rejected.

According to the regression analysis the estimated regression line can be presented as the following:

$$\log CO2 = -9.16 + 2.27GDP - 0.12GDP^2 - 0.03FDI + 0.71Energy - 0.15Trade \qquad (2)$$

Table 1. Regression test results

Dependent variable: Log(CO2)			
Sample: 1990-2014			
Included observations: 11			
Variable	Coefficient	t-statistic	Std. Error
Constant	-9.16*	-3.62	2.53
log(GDP)	2.27*	3.99	0.57
$\log^2$(GDP)	-0.12*	-3.49	0.04
log(FDI)	-0.03	-1.56	0.02
log(Energy)	0.71*	4.19	0.17
log(Trade)	-0.16**	-1.91	0.08
R-squared	0.96		
Adjusted R-squared	0.95		
Sum of squared residuals (SSR)	1.13		
Residual sum of squares (RSS)	0.05		
F-statistic	92.94		
Prob(F-statistic)	0.00		

Source: Authors' calculations

Note: * 1% significance level; ** 10% significance level

This implies, that for each unit increase in Energy, CO2 emission increases with 0.7 percent, and for each percentage increase in FDI and Trade, CO2 emission decreases with 0.03 and 0.15 units respectively.

If we look to the energy consumption impact on CO2 emissions, we see that it increases CO2 emissions significantly (if we compare with other variables).

Based on the estimated results, the coefficient of log(GDP) is positive (2.27), and the coefficient of $\log^2$(GDP) is negative (−0.12). These results indicate that the relationship between carbon emission and economic growth tends to follow the inverted U-shaped Kuznets curve.

Therefore, this study preliminarily validates the EKC hypothesis in Eastern European countries: after the inflection point appears at 9 775.56 US dollars GDP per capita, carbon emission begins to decrease with the increasing level of economy, as shown in Figure 3, with the turning point being 9.18. It should be mentioned that not every country reached that point (only Romania in 2008 and Kazakhstan in 2011).

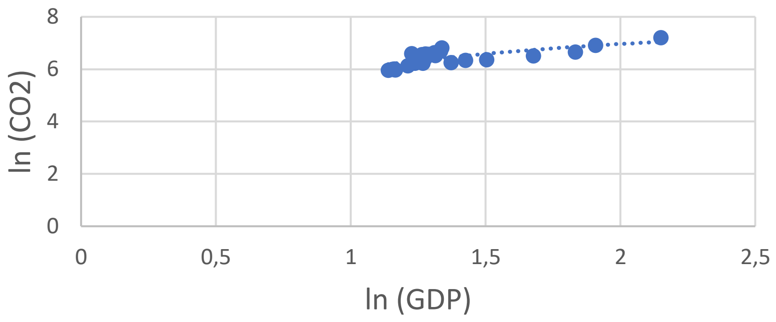


Figure 3. EKC for carbon emission and economic growth in Eastern European countries

Source: Authors' calculations

Kuznets curves are also estimated for eleven developed countries, with very high human development according to the HDI, the results showed that after the inflection point appears at 32 865.27 US dollars GDP per capita, carbon emission begins to decrease with the increasing level of economy, as shown in Figure 4 with the turning point being 10.4. Moreover, this point was reached in 2003. Therefore, it supports the EKC hypothesis.

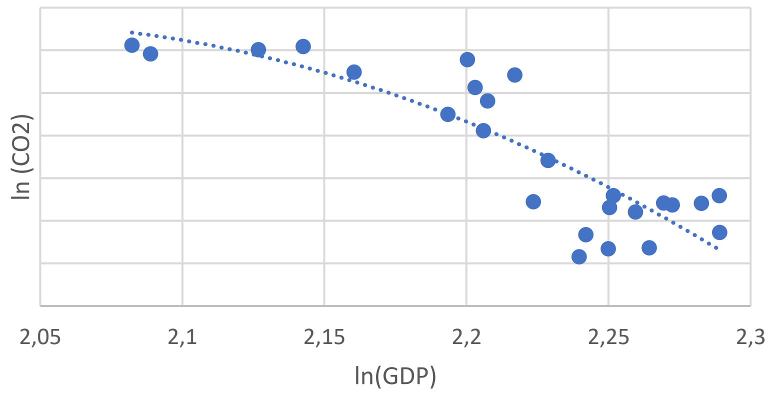


Figure 4. EKC for carbon emission and economic growth in developed countries

Source: Authors' calculations

According to the regression analysis the regression line for developed countries can be presented as the following:

$$logCO2 = -33.43 + 6.64GDP - 0.32GDP^2 - 0.01FDI + 0.45Energy + 0.01Trade \quad (3)$$

To conclude, the influence of FDI as for emerging, as for developed economies on CO2 emission is negative, hence it decreases the environmental degradation level; energy consumption has a positive impact on environmental pollution for both groups, but in Eastern Europeans countries this level is stronger. In contrast, the trade openness decreases the environmental degradation level in emerging economies, while the developed countries show another tendency (for each unit increase in Trade, CO2 emission increases with 0,01 units). In other words, developed countries produces more goods, so they extremely need more permissions to do that. That proves, according to the Kyoto agreement, states that produce less CO2 sell surplus quotas to another country acquiring the right to increase emissions.

7. Income elasticity of environmental degradation in Eastern European countries

The last quantitative estimate is to compute income per capita elasticity to the average emissions of CO2. The sole purpose of this estimation is to calculate the percentage change in CO2 emissions for every one percent change in income**.** The equation for CO2 elasticity, *e*, are represented as:

$$e_{GDP_t}^{CO2_t} = \frac{\partial CO2_t}{\partial GDP_t} * \left[\left(\sum_{t=1}^{N} \frac{GDP_t}{CO2_t} \right) \Big/ N \right] \quad (4)$$

where CO2 is the average emissions for all the countries in a certain period. The significance of income elasticity in respect to CO2 emissions is that it will clarify the relationship each country between its real GDP per capita and environmental degradation. In addition, the income elasticity of emissions can show the magnitude of change brought by economic development towards the environmental degradation rate of each country (Tjoek and Wu, 2018).

Table 2 describes the income elasticity of CO2 emissions for every single country of Eastern Europe. The computed CO2 emissions varies between 0.48 to 11.95 metric tons per capita, and the real GDP per capita ranges between 438.16 to 4851.06 US$ annual for every country in the 25-year period 1990–2014.

Table 2. Income elasticity of CO2 emissions for individual countries in SEA

Country	Average CO2 (metric tons per capita)	Average real GDP per capita (current US$)	Income elasticity of CO2
Armenia	1.37	1659.24	0.091
Azerbaijan	4.18	2455.27	0.441
Bulgaria	6.33	3692.71	0.517
Belarus	6.28	3324.98	0.527
Georgia	1.48	1754.22	0.102
Kazakhstan	11.95	4589.37	0.690
Kyrgyz Republic	1.31	612.18	0.085
Moldova	1.89	1055.71	0.170
Romania	4.75	4403.65	0.422
Tajikistan	0.48	438.16	-0.323
Ukraine	7.21	1875.36	0.604

Source: Authors' calculations

Table 2 shows that among the eleven countries, Armenia is the least elastic country within this analysis, with a coefficient of 0.091 at this level. The results showed that Kazakhstan and Ukraine have the most sensitive change in economic development in respect to its CO2 changes − 0.690 and 0.604 respectively. The income elasticity of CO2 emissions also indicates that CO2 for every individual country with emerging economies has different impact on economic development. Also should be noticed that only Tajikistan has negative elasticity, thus in this country the relationship between its real GDP per capita and environmental degradation is inelastic (should be added, in Tajikistan is the lowest level of income per capita and the lowest level of CO2 emissions).

To sum up, empirical investigation of EKC shows us a strong influence of the energy consumption on CO2 emissions.

Energy has always been essential for building an economy, without energy the economy could not function since there is no power to support all kinds of activities (Tjoek and Wu, 2018).

8. Discussion

The total amount of electricity generated worldwide increased almost three times during last 30-year period), from 9 882.22 TWh in 1985, 14 916.79 TWh in 1999, and finally 25 551.28 TWh in 2017. In the last year while total world energy came from 80% fossil fuels, 10% biofuels, 5% nuclear and 5% renewable (hydro, wind, solar, geothermal), only 18% of that total world energy was in the form of electricity. Most of the other 82% was used for heat and transportation.

At the beginning North America was the leader and generated 33% of world electricity. According to BP Statistical Review of World Energy (2018) some Eastern European countries belong to CIS group and they took the 4th position at the beginning of the investigated period. The situation rapidly changed during the last 30 years and Asia Pacific became the main active producer of energy with a share of 45% (almost a half of world amount). If we talk about CIS countries, the electricity generation decreased by 11%.

Figure 5 depicts the share of electricity generation by fuels by region in 2017.

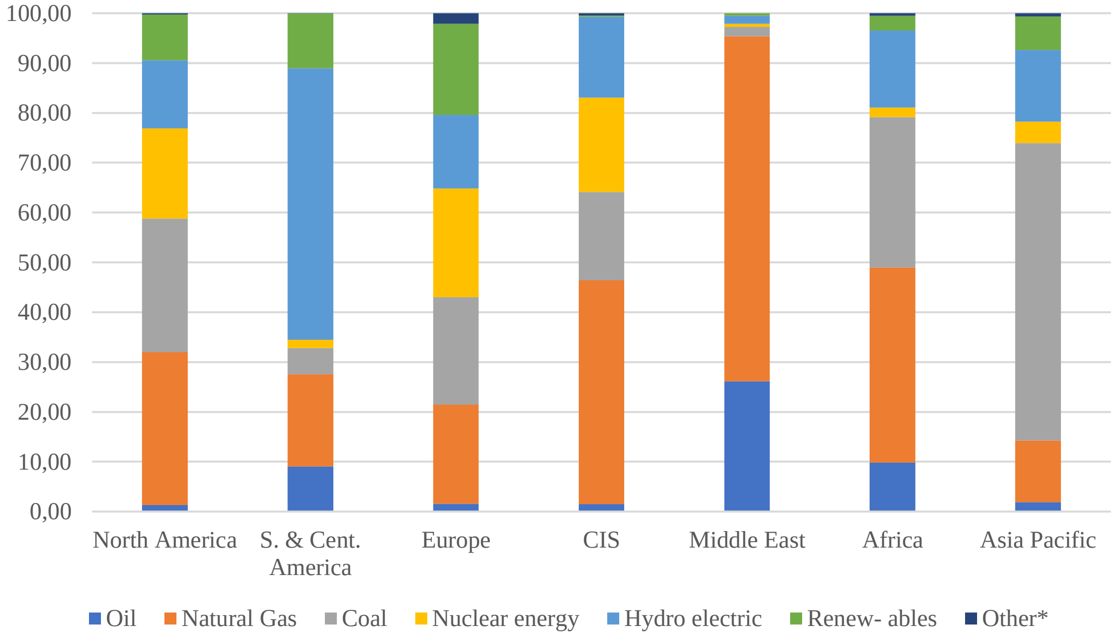


Figure 5. Regional electricity generation by fuels, 2017

Source: BP Statistical Review of World Energy (2018)

It should be noticed, that the share of renewables is extremely law in the CIS countries, meanwhile the share of natural gas and coal is very high. If we compare with data of Europe in general, there is a better tendency (percentages of electricity generation by fuels have almost equal shares of total generation, except other sources). This implies a good diversification in electricity generation in these countries.

Most energy is used in the country of origin, since it is cheaper to transport final products than raw materials. Energy consumption growth remained vigorous in several developing countries, specific in Asia (+4%). China became the world's largest energy consumer (23% of the total). In North America, Europe and the CIS, consumptions shrank by 4.5%, 5% and 8.5% respectively due to the slowdown in economic activity.

It should be noted that throughout the period of independence of the Eastern European countries, the energy sector remains the most vulnerable segment of the economy, the main problems are: energy intensity of the GDP, carbon intensity of GDP, and high level of CO2 emission.

In this context, in the Energy Strategy of Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine, the key targets were fixed. Presently the document was changed and a new Action Plan for the implementation of the Energy Strategy of Ukraine until 2035 "Safety, Energy Efficiency and Competitiveness" (2018) was approved. Nevertheless, none of the strategic goals were achieved (e.g., reducing the energy intensity of GDP, intensifying the development of own energy resources, diversifying sources and routes of energy supplies, creating a strategic oil reserve, creating elements of the nuclear fuel cycle, comprehensive development of alternative energy).

Energy intensity of GDP. The analysis reveals that the energy intensity level in Ukraine is the highest among the group. Furthermore, it is two times higher than the average world level and almost three times higher than in the EU (Table 3). This is mainly due to the high degree of wear of domestic infrastructure, in particular energy infrastructure, low efficiency of use of fuel and energy resources in technological processes. In Eastern European countries electric power can be divided into industries by types of power plants, which produce electricity, i.e.: hydro, atomic, thermal power and other renewable. For example, the biggest share of energy in Ukraine, which is one of the largest country within the estimated group, is produced precisely at thermal power plants (TPP). The problems of this plants is that they remain the largest pollutants of the atmosphere. Therefore, it is important for the TPP to upgrade them.

Also it should be noted that the level of energy intensity in these countries decreased since an independence year, but despite of this fact it is still remains extremely insufficient.

Table 3. Energy intensity level of primary energy, MJ/$2011 PPP GDP

Country	1990	2010	2011	2012	2013	2014	2015
Armenia	24.37	5.39	5.63	5.75	5.43	5.35	5.38
Azerbaijan	15.57	3.36	3.64	3.88	3.72	3.76	3.73
Bulgaria	14.60	6.63	7.02	6.69	6.09	6.36	6.38
Belarus	23.13	7.73	7.81	7.98	7.06	6.83	6.47
Kazakhstan	13.83	8.47	8.84	8.07	8.42	7.87	7.92
Kyrgyz Republic	20.54	7.58	8.61	10.76	9.26	9.21	8.64
Moldova	17.40	10.50	9.71	9.68	7.95	8.16	8.39
Romania	10.05	4.17	4.22	4.09	3.61	3.48	3.52
Russian Federation	12.03	8.73	8.78	8.70	8.46	8.35	8.41
Tajikistan	11.54	5.66	5.29	5.29	5.46	5.06	5.01
Ukraine	19.38	15.41	14.00	13.52	12.82	12.49	11.79

European Union	5.63	4.21	3.98	3.96	3.91	3.70	3.66

Source: World Bank (2019)

Carbon intensity of GDP. The CO2 intensity shows a similar tendency: the intensity of carbon emissions from fossil fuel combustion in Eastern European countries has decreased almost 50% during the period from 1990 to 2016. At the same time, the carbon intensity still remains the highest (e.g., in Ukraine this level exceeds CO2 intensity of Poland by 1.8 times, Germany − by 2.8 times and 2.1 times − by the world level). (Table 4).

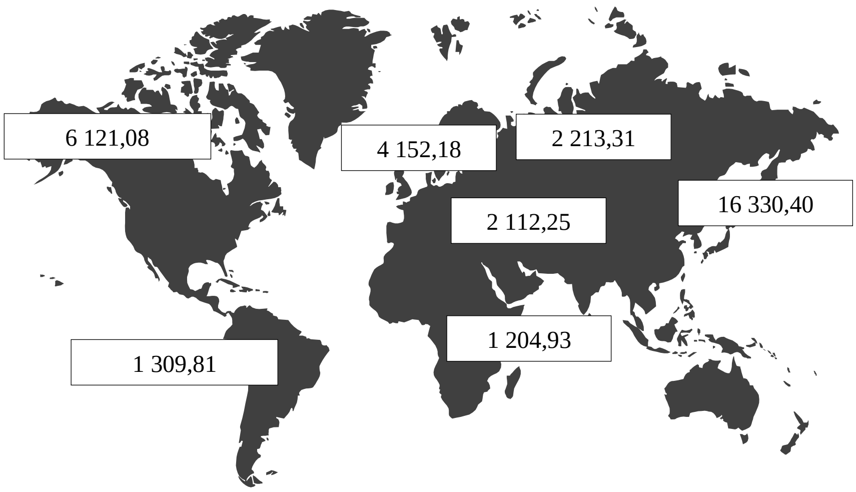
Table 4. CO2 emission intensity at constant parity of purchasing power, kg CO2 / $ 2005

Country	1990	2000	2010	2011	2012	2013	2014	2015	2016
Ukraine	1.34	1.37	0.86	0.85	0.83	0.80	0.73	0.65	0.67
Poland	1.17	0.65	0.48	0.45	0.43	0.43	0.39	0.37	0.36
Germany	0.44	0.32	0.27	0.25	0.25	0.26	0.24	0.24	0.24
World	0.50	0.42	0.38	0.37	0.36	0.36	0.35	0.34	0.32

Source: World Energy Statistics. Yearbook (2017)

Note: CO2 intensity is the ratio of CO2 emissions from fuel combustion and gross domestic product (GDP) and measures the amount of CO2 emissions to create one unit of GDP. CO2 emissions cover only emissions from the combustion of fossil fuels (coal, oil and gas).

Level of CO2 emissions. When aggregated by region we see that North America, Oceania, Europe, and Latin America have disproportionately high emissions relative to their population. North America is home to only 5% of the world population but emits nearly 18% of CO2 (Figure 6). Asia is home to 60% of the population but emits just 49%; Africa has 16% of the population but emits just 4% of CO2. This is reflected in per capita emissions; the average North American is more than 17 times higher than the average African.



Emissions by world region:

North America – 18%
South. & Central America – 4%
Europe – 12%
CIS – 7%
Middle East – 6%
Africa – 4%
Asia Pacific – 49%

Figure 6. Carbon dioxide emission, million tons of carbon dioxide

Source: BP Statistical Review of World Energy (2018)

This inequality in global emissions rests at the heart of why international agreement on climate change has (and continues to be) so contentious. The richest countries of the world are home to half of the world population, and emit 86% of CO2 emissions.

Hence, finding the compatible pathway for levelling this inequality is one of the greatest challenges of this century.

In the case of emerging economies, the economical use of energy resources of own extraction in combination with the necessary imports should be ensured through a well-balanced energy security system. It must function flexibly in both normal and emergency situations. In order to achieve these goals in sustainable manner a technological leadership should be accompanied by the development and introduction of new technologies throughout Eastern European countries.

This approach is widespread nowadays, some researchers have already offered some actionable recommendations on how to mitigate and curb the explosive industry sector global greenhouse gas emissions footprint, through a combination of renewable energy use, tax policies, managerial actions and alternative business models (Belkhir, L. and Elmeligi, A., 2018).

Moreover, the results show that some Eastern European countries, which are members of EU, have already implemented different tools toward the protection of environment, thus the situation is much better. Also the institutional development of these countries shows huge differences between the EE11 countries, e.g., Bulgaria and Romania at the top and Tajikistan at the bottom of the list (Grytten, O.H. and Koilo V., 2019).

Hence, in order to create a well-balanced system and improve an energy security situation of each emerging country there the following pillars can be of interest:

- energy saving and energy efficiency (attraction of FDI to upgrade the technology in energy industry);
- strategic reserves (own energy resources, e.g. coal, natural gas, oil, biomass and other renewable energy sources);
- import diversification (diversification of energy suppliers);
- integration into the EU energy area (connected and synchronized energy networks).

Such a system will become one of the guarantees of the country's survival under adverse external circumstances, preserving its sovereignty, territorial integrity and further economic development.

9. Conclusion

The present study empirically investigates the long-run relationship between carbon dioxide emissions, FDI net inflows, energy intensity and trade openness.

According to the data analysis, the following conclusions were obtained: the results confirm the carbon emission’s Kuznets curve hypothesis in Eastern Europe: relationship between carbon emission and economic growth tends to follow an inverted U-shaped Kuznets curve).

Lastly, the income elasticities of CO2 emissions for every country in Eastern Europe perform differently. The paper concludes that within a group Ukraine and Kazakhstan has the most sensitive change in economic growth in respect to its CO2. At the same time, Tajikistan has a negative elasticity, thus in this country the relationship between its real GDP per capita and environmental degradation is inelastic.

Based on above mentioned results derived from this study the following conclusions can be obtained: politics, which is based on the innovative transition to a low-carbon economy can offer great opportunities as for economic growth, as for job creation. Further studies are required to enable formulation of technological leadership, which should be accompanied by the development and introduction of new technologies throughout Eastern European countries. Hence, that can guarantee a more “sustainable development” and promote energy conservation in order to reduce carbon emissions.

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