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GREEN PATENTS AS A DETERMINANT OF SUSTAINABLE ECONOMIC GROWTH

Abstract

In order to establish sustainable economic growth, governments around the world are increasingly introducing programs to support the environmental aspects of companies' business as part of their policies. In order to meet the demands of the market, and at the same time contribute to the realization of the principle of sustainability, companies increasingly invest in research and development and eco-innovation. The number of green patents is often used as a parameter of the intensity of eco-innovation. The question is how the possession of green patents affects the performance of companies and the economic growth of the national economies in which they operate. The subject of this paper is to consider the impact of green patents on the economic growth of national economies that are leading in the number of applied green patents. The aim of this paper is to determine the relationship between the selected indicators of green patents and the gross domestic product of these national economies.

Keywords: *green patents, environmental-related patents, sustainability, economic growth, green growth*

JEL classification: O34, O44, Q01

ЗЕЛЕНИ ПАТЕНТИ КАО ДЕТЕРМИНАНТА ОДРЖИВОГ ЕКОНОМСКОГ РАСТА

Апстракт

У циљу успостављања одрживог економског раста, владе широм света све више у оквиру својих политика уводе програме подршке еколошком аспекту пословања компанија. Како би одговориле захтевима тржишта, а истовремено допринеле остварењу принципа одрживости, компаније улажу у активности истраживања и развоја и еко-иновације. Као параметар интензивности еко-иновација често се користи број зелених патената. Поставља се питање

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како се поседовање зелених патената одражава на перформансе компанија и на економски раст националних економија у којима оне послују. Предмет истраживања овог рада јесте сагледавање утицаја зелених патената на економски раст националних економија које су водеће по броју пријављених зелених патената. Циљ рада је да се утврди јачина и карактер везе између изабраних показатеља зелених патената и бруто домаћег производа ових националних економија.

Кључне речи: *зелени патенти, патенти везани за животну средину, одрживост, економски раст, зелени раст*

Introduction

In order to establish sustainable economic growth, governments around the world are increasingly introducing programs to support the environmental aspects of companies' business as part of their policies. The environmental aspect of the company's business has been particularly emphasized since 1992 when the United Nations meeting was held in Rio de Janeiro, on which the issue of climate change was highlighted. Since then, companies have been considered an important factor in reducing the impact of human activity on the environment. Incentives from governments to base their business on environmental principles are increasingly having an impact on companies' operations, the setting of their strategies, and the way they are operationalized. In order to meet the demands of the market, and at the same time contribute to the realization of the principle of sustainability, companies increasingly invest in research and development and eco-innovation. It is necessary for companies to achieve their financial and economic performance at the desired level while being environmentally responsible.

Companies' investments in eco-innovations related to so-called green technologies have numerous positive implications for the environment (mitigation of climate change, reduction of air and water pollution, increase of resource efficiency). The number of green patents is often used as a parameter of eco-innovation intensity. Green patents have a positive impact on the development of clean technologies (OECD, 2009). The largest increase is in the number of green patents related to innovations in technologies related to climate change mitigation and solar energy. In the period from 2007 to 2009, the number of PCT (Patent Cooperation Treaty) applications for patents related to solar energy was three times higher than their share in the period from 1997 to 1999 (OECD, 2011). On the other hand, when it comes to patent applications related to energy storage technology or material recycling, their growth is slower than the growth of the total number of patents (OECD, 2011). When it comes to innovations in the production of energy from renewable and non-fossil sources, the largest number of patent applications related to this type of innovation comes from European countries (in the late 2000s, the EU27 received 37% of all PCT applications in this area, followed by the United States and Japan, while China's share is in eighth place) (OECD, 2011).

The question is how the possession of green patents affects the performance of companies and the economic growth of the national economies in which they operate. The subject of this paper is to consider the impact of green patents on the economic growth

of national economies that are among the leaders in the number of applications for green patents. The aim of this paper is to determine the strength and character of the relationship between the selected indicators of green patents and the gross domestic product (GDP) of these national economies.

1. Literature review

Numerous authors have addressed the issue of sustainable economic development. The concept of sustainable development implies economic, environmental, and social dimensions. In the conditions of accelerated economic development, it is important not to neglect the other two dimensions of the concept of sustainable development in order to realize it in practice. Therefore, in the pursuit of economic development to be monitored and viewed from the other two perspectives, innovations in the field of ecology are gaining in importance, regardless of the branch in which the companies operate. Green patents as a form of intellectual property that protects eco-innovation, have become a valuable element of the portfolio of intellectual resources of companies and a significant factor in the financial performance of companies and economic growth and development of national economies. The following are the conclusions based on the results of research by various authors who have examined the link between green growth (based on eco-innovation protected by green patents) and economic growth.

In their work, Ferreira et al. (2020) examined the role of technology transfer on the European continent, including countries inside and outside the euro area. In examining this role, emphasis is placed on environmental patents and their impact on countries' real GDP as an indicator of economic growth. The authors came to the conclusion that there is a positive impact of environmental patents on the real GDP of European countries (this impact has not been established specifically within the euro area). They also highlight technological innovation as a solution to achieve environmentally friendly conditions in the production of goods and services in the context of combining economic development and sustainable growth.

In their study, Abedi & Moeenian (2021) studied the effects of patented technological innovations compatible with climate change mitigation and the impact of environmental patents on economic growth and development in the Middle East between 2010 and 2016. The results of their research indicate that patents related to the environment, patents related to environmental management, and patented technologies related to climate change mitigation have a significant positive impact on sustainable economic development and growth rate in the studied countries. However, the positive effect of patents for water adaptation on the economic growth of the countries in this region has not been confirmed. Based on this study, the role of patents as an important factor in sustainable economic growth in three important environmental areas is highlighted, namely: environmental management, water adaptation, and climate change mitigation. It is an important guideline for innovators and policymakers in making policy decisions related to sustainable development programs from the perspective of environmentally friendly technologies.

Tolliver et al. (2021) emphasize the importance of green innovation and green finance as elements of sustainable economic growth and development. Asian countries, Japan, South Korea, and China, as the fastest growing and developing economies, face the problem of

climate change and environmental impact. In order to achieve sustainable economic growth, these countries have implemented policies to promote green innovation and financing as a solution to these problems. According to research by these authors, Japan has been a global leader in green patents since the mid-1980s, while South Korea and China have seen a growing trend in green patents to reduce pollution. When it comes to green bonds, China is considered the global leader in their issuance, and there is also a growing trend in their issuance by banks and financial corporations in South Korea and Japan. Many companies in these countries, which are considered to be the highest-income companies, had revenue growth that coincided with the publication of ESG (Environmental, social, and governance) information. In this way, through the promotion of environmentally friendly growth of multifactor productivity, issuance of green bonds, registration of green patents, green foreign direct investment, and disclosure of information on the environment, society, and governance, they are moving towards achieving a paradigm of sustainable growth.

Fernandez et al. (2021) provide an answer to the dilemma that is reflected in two different points of view when it comes to the relationship between green growth on the one hand and economic growth on the other. The first view implies that it is possible to achieve sustainable growth without negatively affecting economic growth. Another view is that sustainability cannot be achieved if intensive consumption is present, which continuously stimulates economic growth. The authors analyzed the role that sustainable technology transfer and sustainable innovation play in green growth, as well as the impact of green growth on economic growth. The analysis was conducted using data from 32 countries for the period from 1990 to 2013. Environmental patents were included in the analysis as one of the indicators of green growth. The authors concluded that sustainable technology transfer and sustainable innovation encourage green growth, and that green growth has a positive impact on economic growth.

Hasna et al. (2021) conducted a study entitled "Greenovate for a better environment and economy" under the auspices of KPMG. For their analysis, the authors used data on patent applications for the period from 1990 to 2018 for 43 countries (OECD and BRICS). In the last three decades, these countries accounted for 89% of the world's real GDP and 97% of total and green patent applications. The 24 million patent applications were analyzed, which are divided into green and non-green (having in mind the designation Cooperative Patent Classification, which refers to technologies for climate change mitigation). In their report, they state that the doubling of green patent applications will lead to an increase in real GDP growth of 4.8%. They compare that to real GDP growth of 3.4%, provided that non-green patent applications are doubled. They point out that green innovations have a wider contribution than the impact on the environment, they also have a positive effect on economic growth.

In their research, Lee et al. (2021) addressed the impact of green innovation and institutional constraints on China's high-quality economic development at the national and regional levels from 2014 to 2018. The analysis includes companies that have green patents. Based on the results of their research, the growth of a comprehensive index and levels of high-quality economic development in all regions of China is noticeable. There is a significant positive impact of green innovations and institutional constraints, i.e. their mitigation by the green revolution, on high-quality economic development at the national level. On the other hand, when looking at the regional level, the impact on the economic quality of eastern China is more positive than that of central China. The positive impact of green innovations and

institutional constraints on the high-quality economic development of the central and western regions was absent because their presence in these regions is weaker. Also, the authors suggest that it is necessary to increase the "green" production line and capacity for research and development of green innovations, then that the government should improve the market system, and that all regions should increase financial investment in green innovation.

In their study, Hoang et al. (2020) determined the impact between environmental performance and financial performance of American companies (they used a sample of 361 companies; observed period: from 2007 to 2016). The companies that were in the sample were selected according to the criterion of owning green patents. Based on the results of the research, they found that transparent presentation of the environmental aspect of business has a positive impact on financial and market performance. However, there is a negative impact on the return on invested capital. They also observed different effects of lower pollution emissions on companies' financial performance depending on the time frame observed. Specifically, lower pollution emissions tend to improve current return on assets but have a negative impact on the efficiency of long-term capital employment. They then examined the impact of the global economic crisis (2007-2010) on the environmental performance of companies. They found that the global economic crisis has increased the environmental transparency of companies with green patents, and adversely affected their P/E ratio. Having in mind all the findings, the authors conclude that the environmental transparency of companies and greenhouse gas emissions are environmental variables that have the greatest significance and impact on the financial performance of companies with green patents. Finally, they note that this impact is particularly pronounced after the period of global crisis, due to the greater evaluation of their importance in the market.

Exploring the link between green patents and company performance, Zhang et al. (2019) point to their positive relationship. They found that on a sample of manufacturing companies in China for the period from 2000 to 2010. What is specific is that this conclusion applies only to public companies, not to private ones. Public companies have a close relationship with the government, whose influence in this area is significant. This is further confirmed by the fact that the positive relationship between green patents and company performance has been noticeable since 2006 when the government began to directly formally support the green industry. The authors' recommendation is that the government should focus on stimulating private companies in this area because they are an important factor that can contribute to green growth, and thus sustainable economic growth.

In their work, Scarpellini et al. (2019) aimed to point out the impact of eco-innovation on the financial performance of companies operating in Spain. To establish this, they used the number of green patents and the intensity of research and development activities as a measure of eco-innovation. For their analysis, they used a sample of 2,218 companies characterized by a proactive approach to eco-innovation, of which 249 are companies with green patents. A positive link has been established between eco-innovation activities on the one hand and the intensity of research and development and overall innovation activities on the other. Also, the impact of eco-innovation activities on the financial performance of foreign companies is positive.

Corrocher and Ozman (2020) investigated how communication and information technology companies innovate in the field of green technologies and whether this has an impact on their performance. They analyzed data related to European companies operating in the field of information and communication technology. They noted that the dispersion

of technologies is desirable in the context of encouraging the development of green technologies, but not to a great extent. Also, the authors conclude that companies in the field of communication and information technology that have green patents have better performance compared to companies in the same field that do not have green patents.

Based on the literature review, it is noted that most authors point to a positive link between green patents and green growth, i.e. that green growth based on eco-innovations protected by green patents has a positive impact on economic growth and ensures sustainability. With this in mind, the authors decided to examine the impact of green patents on the economic growth of national economies, which are among those with the most number of green patents, namely (Urbaniec et al., 2021): Germany, Japan, South Korea, United States, China.

2. Methodology

In order to see the impact of green patents on the economic growth of national economies (Germany, Japan, South Korea, the United States, and China), the following parameters related to green patents were selected: the proportion of environment-related patents (ERP) over overall patent applications, the number of environment-related patents (ERP) per million residents, the number of environment-related patents (ERP) per USD 100 billion (Urbaniec et al., 2021). Economic growth is represented by the value of GDP in billions of US dollars.

Data were collected from the following sources: Urbaniec et al., 2021; World Bank (a) (2022); World Bank (b) (2022); World Bank (c) (2022); World Bank (d) (2022); World Bank (e) (2022). For the selected parameters, data were collected for the period from 2000 to 2017. Data were processed via SPSS software using Pearson's coefficient r or Spearman's ρ correlation coefficient. Preliminary analyzes determined that the assumptions of linearity and homoskedasticity were met. Depending on the normality of the data distribution, Pearson's coefficient r was used when the data distribution is normal, and Spearman's coefficient ρ was used when it is absent. With the help of these coefficients, the strength and direction of the linear relation between two variables is determined. The coefficients can take values from -1 to +1. The sign indicates whether the correlation is positive or negative, while the absolute value of the coefficient indicates the strength of the correlation (correlation does not exist: $r/\rho = 0$; small: r/ρ = from 0.10 to 0.29; medium: r/ρ = from 0.30 to 0.49; large: r/ρ = 0.50 to 1.0) (Pallant, 2011, p. 137). Then, the standard multiple regression analysis was applied, which evaluates the power of variables to predict a certain outcome (Pallant, 2011, p. 151). Preliminary analyzes have shown that the assumptions of normality, linearity, multicollinearity, and homogeneity of variance were not violated.

The research is based on the following hypothesis:

Hypothesis: There is a positive relationship between the parameters of green patents and the GDP of the selected countries (Germany, Japan, South Korea, United States, and China) in the period from 2000 to 2017.

3. Research results

The following results were obtained by processing data via SPSS software using appropriate coefficients.

Table 1: Spearman's ρ correlation coefficient, Germany

Correlations		GDP
ERP patent applications over overall patent applications	Correlation Coefficient	.608**
	Sig. (2-tailed)	.007
	N	18
ERP per million residents	Correlation Coefficient	.668**
	Sig. (2-tailed)	.002
	N	18
ERP per USD 100 billion	Correlation Coefficient	.620**
	Sig. (2-tailed)	.006
	N	18

Source: Authors

A review of Table 1 shows a strong positive correlation (Correlation Coefficient> 0.5) between the indicators of the proportion of environment-related patents over overall patent applications, the number of environment-related patents per million residents, the number of environment-related patents per USD 100 billion, and GDP when it comes to Germany for the period from 2000 to 2017.

Table 2: Pearson's r correlation coefficient, Japan

Correlations		GDP
ERP patent applications over overall patent applications	Pearson Correlation	.741**
	Sig. (2-tailed)	.000
	N	18
ERP per million residents	Pearson Correlation	.802**
	Sig. (2-tailed)	.000
	N	18
ERP per USD 100 billion	Pearson Correlation	.816**
	Sig. (2-tailed)	.000
	N	18

Source: Authors

Based on Table 2, a strong positive correlation (Correlation Coefficient> 0.5) can be observed between the indicators of the proportion of environment-related patents over overall patent applications, the number of environment-related patents per million residents, the number of environment-related patents per USD 100 billion and the GDP in the case of Japan, for the period from 2000 to 2017.

Table 3: Spearman's ρ correlation coefficient, South Korea

Correlations		GDP
ERP patent applications over overall patent applications	Correlation Coefficient	.443
	Sig. (2-tailed)	.065
	N	18
ERP per million residents	Correlation Coefficient	.847**
	Sig. (2-tailed)	.000
	N	18
ERP per USD 100 billion	Correlation Coefficient	.769**
	Sig. (2-tailed)	.000
	N	18

Source: Authors

Based on Table 3, a strong positive correlation (Correlation Coefficient> 0.5) can be observed between the indicators of the number of environment-related patents per million residents, the number of environment-related patents per USD 100 billion, and the GDP in the case of South Korea for the period from 2000 to 2017. Also, there is a positive relationship of medium strength (0.3 <Correlation Coefficient <0.5) between the indicators of participation of the proportion of environment-related patents over overall patent applications and the GDP.

Table 4: Pearson r correlation coefficient, USA

Correlations		GDP
	N	18
ERP patent applications over overall patent applications	Pearson Correlation	.310
	Sig. (2-tailed)	.210
	N	18
ERP per million residents	Pearson Correlation	.451
	Sig. (2-tailed)	.060
	N	18
ERP per USD 100 billion	Pearson Correlation	.334
	Sig. (2-tailed)	.176
	N	18

Source: Authors

A review of Table 4 shows a positive relationship of medium strength (0.3 <Correlation Coefficient <0.5) between the indicators of the proportion of environment-related patents over overall patent applications, the number of environment-related patents (ERP) per million residents, the number of environment-related patents per USD 100 billion and the GDP in the case of the United States for the period from 2000 to 2017.

Table 5: Spearman's ρ correlation coefficient, People's Republic of China

Correlations		GDP
ERP per million residents	Correlation Coefficient	.992**
	Sig. (2-tailed)	.000
	N	18

ERP per USD 100 billion	Correlation Coefficient	.938**
	Sig. (2-tailed)	.000
	N	18
ERP patent applications over overall patent applications	Correlation Coefficient	-.153
	Sig. (2-tailed)	.545
	N	18

Source: Authors

A review of Table 5 shows a strong positive relationship (Correlation Coefficient> 0.5) between the parameters of the number of environment-related patents per million residents, the number of environment-related patents per USD 100 billion and the GDP, as well as a weak negative correlation (0> Correlation Coefficient> -0.29) between the indicators of the proportion of environment-related patents over overall patent applications and the GDP when it comes to China, for the period from 2000 to 2017.

This means that the hypothesis on which the research is based has been confirmed. A positive relation was established between the parameters of green patents and the GDP of the observed national economies (Germany, Japan, South Korea, USA, China), except for the parameters of the proportion of environment-related patents over overall patent applications and the GDP in the case of China.

Based on the correlation analysis for each country, the parameter of green patents was singled out, which has the strongest connection with the GDP and as such was used in the regression analysis as an independent variable, while the GDP was used as a dependent variable. Standard regression analysis was used to assess the ability of the selected parameter of green patents to predict the value of GDP. The following is a summary of the results of the standard regression analysis for each country.

The Adjusted R Square presented in Table 6 indicates that the model explains 48.7% of Germany's GDP. In Table 7 the value of Sig. = 0.001, i.e., p <0.05 which means that the model reaches statistical significance. The value of the non-standardized Beta coefficient in Table 8 of the independent variable ERP per million residents is 63.649 and shows its contribution to explaining the dependent variable in the model. Sig. value = 0.001, or p <0.05, means that the variable makes a significant unique contribution to the prediction of the dependent variable.

Table 6: Regression analysis - Model Summary, Germany

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.719[a]	.517	.487	461.70489
a. Predictors: (Constant), ERP per million residents				
b. Dependent Variable: GDP				

Source: Authors

Table 7: Regression analysis - ANOVA, Germany

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3658057.835	1	3658057.835	17.160	.001[b]
	Residual	3410742.442	16	213171.403		
	Total	7068800.278	17			
a. Dependent Variable: GDP						
b. Predictors: (Constant), ERP per million residents						

Source: Authors

Table 8: Regression analysis - Coefficients, Germany

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	1676.407	368.629	.000
	ERP per million residents	63.649	15.365	.001

Source: Authors

The value of Adjusted R Square presented in Table 9 indicates that the model explains 64.5% of Japan's GDP, while the results presented in Table 10 (the value of Sig. = 0.000, i.e., $p < 0.05$) indicate that the model is statistically significant. The value of the non-standardized Beta coefficient in Table 11 of the independent variable ERP per USD 100 billion is 14.239 and shows its contribution to the explanation of the dependent variable in the model. Sig. value = 0.000, i.e., $p < 0.05$, means that the variable makes a significant unique contribution to the prediction of the dependent variable.

Table 9: Regression analysis - Model Summary, Japan

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.816[a]	.666	.645	349.03068
a. Predictors: (Constant), ERP per USD 100 billion				
b. Dependent Variable: GDP				

Source: Authors

Table 10: Regression analysis - ANOVA, Japan

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3892305.621	1	3892305.621	31.951	.000[b]
	Residual	1949158.657	16	121822.416		
	Total	5841464.278	17			
a. Dependent Variable: GDP						
b. Predictors: (Constant), ERP per USD 100 billion						

Source: Authors

Table 11: Regression analysis - Coefficients, Japan

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	4141.482	173.606	.000
	ERP_per_USD_100_billion	14.239	2.519	.000

Source: Authors

The value of Adjusted R Square presented in Table 12 indicates that the model explains 64% of South Korea's GDP, while the results presented in Table 13 (the value of Sig. = 0.000, i.e., p <0.05) indicate that the model reaches statistical significance. The value of the non-standardized Beta coefficient in Table 14 of the independent variable ERP per million residents is 30827.059 and shows its contribution to the explanation of the dependent variable in the model. Sig. value = 0.000, i.e., p <0.05, means that the variable makes a significant unique contribution to the prediction of the dependent variable.

Table 12: Regression Analysis - Model Summary, South Korea

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.813[a]	.661	.640	203625.00645
a. Predictors: (Constant), ERP per million residents				
b. Dependent Variable: GDP				

Source: Authors

Table 13: Regression analysis - ANOVA, South Korea

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1295556929253.002	1	1295556929253.002	31.246	.000[b]
	Residual	663410292040.610	16	41463143252.538		
	Total	1958967221293.611	17			
a. Dependent Variable: GDP						
b. Predictors: (Constant), ERP per million residents						

Source: Authors

Table 14: Regression Analysis - Coefficients, South Korea

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	657081.435	90260.252	0.000
	ERP per million residents	30827.059	5514.866	0.000

Source: Authors

The Adjusted R Square presented in Table 15 indicates that the model explains 15.4% of Germany's GDP, while the results in Table 13 (the value of Sig. = 0.060, i.e., p <0.1) indicate that the model reaches statistical significance. The value of the non-

standardized Beta coefficient in Table 17 of the independent variable ERP per million residents is 397.089 and shows its contribution to the explanation of the dependent variable in the model. Sig. value = 0.06, i.e., p <0.01, means that the variable gives a significant unique contribution to the prediction of the dependent variable.

Table 15: Regression analysis - Model Summary, USA

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.451[a]	.203	.154	2629.78432
a. Predictors: (Constant), ERP per million residents				
b. Dependent Variable: GDP				

Source: Authors

Table 16: Regression analysis - ANOVA, USA

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28262558.472	1	28262558.472	4.087	.060[b]
	Residual	110652249.528	16	6915765.596		
	Total	138914808.000	17			
a. Dependent Variable: GDP						
b. Predictors: (Constant), ERP per million residents						

Source: Authors

Table 17: Regression analysis - Coefficients, USA

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	10388.810	2191.272	0.000
	ERP per million residents	397.089	196.428	0.06

Source: Authors

Table 18 presents the value of Adjusted R Square indicating that the model explains 95.3% of China's GDP, while the results in Table 19 (the value of Sig. = 0.000, i.e., p <0.05) indicate that the model reaches statistical significance. The value of the non-standardized Beta coefficient in Table 20 of the independent variable ERP per million residents is 8531006.989 and shows its contribution to the explanation of the dependent variable in the model. Sig. value = 0.000, i.e., p <0.05, means that the variable makes a significant unique contribution to the prediction of the dependent variable.

Table 18: Regression analysis - Model Summary, China

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.978[a]	.956	.953	858568.38440
a. Predictors: (Constant), ERP per million residents				
b. Dependent Variable: GDP				

Source: Authors

Table 19: Regression analysis - ANOVA, China

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	254561551769059.750	1	254561551769059.750	345.337	.000[b]
	Residual	11794234730940.242	16	737139670683.765		
	Total	266355786500000.000	17			
a. Dependent Variable: GDP						
b. Predictors: (Constant), ERP per million residents						

Source: Authors

Table 20: Regression analysis - Coefficients, China

Model		Unstandardized Coefficients		Sig.
		B	Std. Error	
1	(Constant)	1347874.206	309848.543	0.000
	ERP per million residents	8531006.989	459069.865	0.000

Source: Authors

Conclusion

In the conditions of accelerated economic growth of the most developed economies in the world, the question of sustainability of economic development and its impact on the environment arises. The problems that the world is facing today in the field of ecology are becoming more complex, more visible, more serious, and are becoming a priority to be solved, due to more and more intensive economic activity. That is why hard work is being done to find the optimal solution, having in mind both the environmental and economic responsibility of companies. Companies invest in eco-innovation and protect their inventions with green patents. Green patents are viewed as a parameter of the eco-innovation intensity of companies. Numerous studies indicate their positive impact on the financial performance of the companies that own them. Can we then assume and confirm the positive impact of green patents on the economic growth of national economies?

Based on the results of the research, it can be concluded that the hypothesis on which the research is based has been confirmed. A positive relation was established between the parameters of environmental patents and the GDP of the observed national economies (Germany, Japan, South Korea, USA, China), except for the parameters of the proportion of environment-related patents over overall patent applications and the GDP in the case of China. This means that as the value of selected parameters of green patents increases, the value of GDP increases, too. Given this fact, it is necessary for state governments to stimulate companies to focus their research and development activities on eco-innovation and thus provide environmental benefits, as well as economic benefits, which are reflected in their financial performance and their contribution to the economic growth of the national economies in which they operate. In this way, green growth and economic growth become complementary and fulfill the postulate of sustainability.

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