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Energy, Pollution, and Transport Taxes as Instruments of Sustainable Development of Manufacturing Enterprises in Emerging Economies in the European Union

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Abstract:

Purpose: *The paper's primary purpose is to assess environmental taxes' impact on sustainable development of manufacturing enterprises in emerging and developing economies in the European Union in 2008-2019.*
Design/Methodology/Approach: *This paper is both theoretical and empirical. The survey covers the European Union countries classified as emerging and developing economies by the International Monetary Fund including Bulgaria, Croatia, Poland, Romania and Hungary. The first part discusses the fundamental issues related to sustainable development and environmental taxes. The empirical part includes the methodology and results of the study. To determine the relationship between environmental taxes and sustainable development, we use the Pearson correlation coefficient and the Least Square Method.*
Findings: *The results indicate that there is a statistically significant relationship between the variables. Environmental taxes are one of the critical determinants of sustainable development of manufacturing enterprises. The models show that the impact of individual taxes is different in the analyzed countries.*
Practical Implications: *The results show that environmental taxes are essential to sustainable development. Hence, it is necessary to increase their importance and reform the tax system in the EU.*
Originality/Value: *The statistical assessment of the impact of environmental taxes on enterprises' sustainable development is relatively poorly understood. The issue is new and contemporary and requires further analysis. Environmental taxes are a significant issue in the era of counteracting climate change. It is necessary to increase the importance of environmental taxes and their effects on economic processes.*

Keywords: *Energy taxes, pollution taxes, transport taxes, sustainable development.*
Paper Type: *Research Paper.*
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1. Introduction

Climate change and the gradual use of natural resources are among the reasons behind the concept of sustainable development. The critical issue here is the preservation of natural resources for the present and future generations. The implementation of the idea requires the involvement of states, organizations, institutions, enterprises and society. Because enterprises are the biggest polluters of the planet, they should take critical actions to protect natural resources and improve citizens' quality of life. In business practice, sustainable development maintains the status quo between profit maximization and environmental and social investments.

The sustainable development of enterprises depends on internal and external factors. Internal factors include the financial situation, type of activity, environmental awareness of managers and employees. External (macroeconomic) factors include economic development, environmental policy, environmental awareness of the society, financial and tax systems, and external financing availability.

One of the environmental policy tools is ecological taxes, and the primary task is to activate enterprises to undertake ecologically practical activities. Environmental taxes are a non-returnable payment to a state superimposed on object taxation that hurts the environment. Environmental taxes include energy taxes, pollution taxes, resource taxes, and transport taxes.

The paper's primary purpose is to assess the impact of environmental taxes on sustainable development of manufacturing enterprises in emerging and developing economies in the European Union in 2008-2019. The research sample includes manufacturing enterprises from Bulgaria, Croatia, Poland, Romania, and Hungary. We focus on three of the kinds taxes: energy, pollution, and transport taxes. The central hypothesis is as follows *"There is a variation in the impact of types of environmental taxes on manufacturing enterprises' sustainable development in emerging and developing economies in 2008-2019".*

To verify the research hypothesis, we used the Pearson Correlation Coefficient and the Ordinary Least Square Method. The research sample covered manufacturing enterprises due to their large share role in the national economy and climate change, and the gradual use of natural resources are among the reasons behind the concept of sustainable development. The critical issue here is the preservation of natural resources for the present and future generations.

The implementation of the idea requires the involvement of states, organizations, institutions, enterprises and society. Because enterprises are the biggest polluters of the planet, they should take critical actions to protect natural resources and improve citizens' quality of life.

2. The Impact of Environmental Taxes on the Sustainable Development of Enterprises - Theoretical Considerations

The term "sustainable development" has an ambiguous character; it is difficult to define, it concerns many aspects of socio-economic life in a specific environment natural (Majewski, 2008; Brzozowski, 2010; Barbosa *et al.*, 2014; Simionescu *et al.*, 2021). It is a concept of global growth, the primary determinant of improving the quality of life and well-being of humanity in conditions of limited natural resources, taking into account the long-term effects of manufacturing development (Adamczyk, 2009; Gonzalez-Cabezas *et al.*, 2018). Sustainable development aims to strive for environmental, socio-economic egalitarianism and create favourable living conditions for the present and future generations (Pezzey and Toman, 2002; Dickens *et al.*, 2020). The tasks of sustainable development oscillate around economic goals (related to the results of conducted activities, cost reduction, creation of additional value), social (ensuring a minimum subsistence level, improving the conditions and quality of life of the inhabitants, improving working conditions, increasing access to education, culture and health care, including people at risk of social exclusion), ecological (taking actions aimed at the protection of natural resources, reducing the amount of waste and the emission of harmful substances to the environment) (Ciegis, 2009; Strezov, Evans, and Evans, 2017; Ranganathan and Swain, 2018; Zając-Lamparska *et al.*, 2019).

Sustainable development requires global and local actions. The key issues here are increasing knowledge about climate change and increasing social awareness. Its success largely depends on considering its goals by households and enterprises (van Zanten and van Tulder, 2018; Misztal, 2019; Schwartz *et al.*, 2021). Sustainable development of enterprises means taking actions to achieve their fundamental economic goal and supplementing it with issues related to its operation's social and environmental aspects (Trojanowski, 2015; Pieloch *et al.*, 2020). The enterprise's sustainable development meets its direct and indirect stakeholders' needs, both present and future (Dyllick and Hockerts, 2002; Wyrwa *et al.*, 2020). It is a philosophy and management style in which the current success should also consider future development prospects (Boudreau and Ramstad, 2005).

Sustainable business requires the skilful use of natural resources, the introduction of environmentally friendly technologies, and taking actions to develop and improve work quality (Grudzewski *et al.*, 2010; Bienkowska *et al.*, 2020). It is necessary to meet the following postulates, determining the influence of the enterprise on its environment, building an image based on the positive environmental and social impact, achieving the best possible financial results, multidimensional management, testing various business models and scenarios, implementation of continuous learning processes the organization, searching for and eliminating threats in the area of achieving sustainable goals development (Burchell, 2008; Tengku Ezni Balqiah, 2018).

Sustainable development of enterprises depends on many factors, both external and internal. The external factors include macroeconomic conditions, directions of development of the environmental protection policy, support from funds for activities to protect natural resources, social awareness, enterprises' competitiveness, research development, and innovative activities. The internal determinants include the management staff's awareness, the company's financial capabilities and the adopted development strategy (Reynolds *et al*., 2009; Pieloch *et al.*, 2020; Nguyen *et al*., 2020).

Environmental taxes are an instrument of environmental protection that is gaining importance, and this is due to their effectiveness in stimulating environmentally friendly economic processes. Environmental taxes are imposed on the subject of taxation and contribute to the state budget, with the tax base being a physical unit of an object or service that has a proven negative impact on the natural environment (Eurostat, 2013). Environmental taxes should encourage conservation efforts and discourage people from carrying out activities harmful to the natural environment (Żylicz, 2004).

Environmental taxes are the way to reduce pollution from diffuse emission sources and provide incentives for businesses and consumers to make more rational and conscious use of natural resources. The related fiscal burden with environmental protection should prevent the overexploitation of natural resources and increase public awareness and support economic and rational management. They can also stimulate technological and organizational innovation and support structural changes (Ziółko, 2016; Tong Niu *et al*., 2018; Wen and Zhong, 2020).

The implemented environmental tax reforms in the European Union are related to the increased fiscal burden concerning products and services harmful to the environment while reducing the tax burden about traditional factors (income, capital gains) (Bosquet, 2000; Costantini and Sforna, 2020). Environmental taxes fall into four categories energy taxes (which include taxes on energy used in stationary processes and transport, gasoline, diesel, they include carbon taxes and carbon taxes), transport taxes (related to use motor vehicles, aeroplanes and charges from related services), emission taxes (taxes on pollutant emissions and taxes on noise emissions), and taxes on natural resources (related to mining, forestry and water management) (Bartniczak and Ptak, 2011; Franco and Marin, 2017).

Environmental taxes stimulate the sustainable development of enterprises. Enterprises wishing to limit the amounts paid to the state budget must reduce harmful substances into the environment (Cremer *et al.,* 2004; Min Yu *et al.*, 2020). The impact of environmental taxes on enterprises' sustainable development is poorly understood, and there is a lack of empirical research. The researchers focus on issues related to tax systems' shape, tax rates and the development of instruments supporting environmental protection (Bashir *et al.*, 2020; Bădîrcea *et al.*, 2020).

3. Research Methodology

The paper's primary purpose is to assess the impact of environmental taxes on sustainable development of manufacturing enterprises in emerging and developing economies in the European Union in 2008-2019. According to the methodology of the International Monetary Fund, the analysis covered countries that are classified as emerging and developing economies, including Bulgaria, Croatia, Hungary, Poland, and Romania. The research sample includes manufacturing enterprises due to their significant contribution to the development of economies and their significant negative impact on the natural environment.

The central hypothesis (H) is as follows: *"There is a variation in the impact of types of environmental taxes on manufacturing enterprises' sustainable development in emerging and developing economies in 2008-2019"*. This differentiation results from the analysed countries' economies' specificity, differences in the size of individual environmental taxes in total taxes. Taxes on energy have the largest share in environmental taxes, although energy consumption in the industry varies from country to country (e.g., very high in Poland). The sub-hypotheses include:

- *H_1: "In the emerging and developing economies, there is a positive trend in the sustainable development of manufacturing enterprises in 2008-2019". Sustainable development is a consequence of the implementation of a more restrictive environmental policy, increased environmental awareness of entrepreneurs and the public, and access to new sources of financing;*
- *H_2: "The higher the number of enterprises, the higher the energy tax revenues". The assumption here is that the greater the number of enterprises, the greater the pollution of the natural environment;*
- *H_3: "Energy taxes are crucial for the sustainable development of manufacturing enterprises". The critical impact of taxes on energy results from the specificity of the operation of industrial enterprises.*

The research consists of five stages. In the first step, we create indicators of the sustainable development of manufacturing enterprises (SI_{sd}) by normalizing diagnostic variables. We use the following formula:

$$SI_{sde} = SI_{econ} + SI_{soc} + SI_{env} \quad (1)$$

where SI_{econ} is the indicator of economic development; SI_{soc} means the indicator of social development; SI_{env} is the indicator of environmental development.

To calculate the indicators of sustainable development, and its components, we use explanatory variables. We created the economic development indicator based on the following variables:

— stimulants ($x_1 \ldots x_8$): total number of companies in a country, turnover or gross premiums (million euro), production value (million euro), value added at factor cost (million euro), gross operating surplus (million euro), total purchases of goods and services (million euro), gross investment in tangible goods (million euro), investment rate (investment/value added at factors cost) (%);
— destimulants (x_9, x_{10}): share of personnel costs in production (%), average personnel costs (thousand euro).

Indicator of social development of manufacturing enterprises includes:
— stimulants ($x_{11} \ldots x_{19}$): wages and salaries (million euro), social security costs (million euro), total number of employees in a country, turnover per person employed (thousand euro), apparent labour productivity (thousand euro), gross value added per employee (thousand euro), growth rate of employment (%), number of persons employed per enterprise, investment per person employed (thousands euro);
— destimulants (x_{20}): personnel costs (million euro).

To create the environmental indicator, we use following destimulants ($x_{21} \ldots x_{28}$) (tons) carbon dioxide emission, methane emission, nitrous oxide emission, sulphur oxides emission, ammonia emission, carbon monoxide emission, nitrogen oxides emission, generation of total waste.

Then, we transform the explanatory variables to unify their measuring scales using the following formulas (Aviazian 2005; Szanduła 2014):

— for the stimulants:

$$z_{ij} = \frac{x_{ij} - \min\limits_i \{x_{ij}\}}{\max\limits_i \{x_{ij}\} - \min\limits_i \{x_{ij}\}}, z_{ij} \in [0; 1] \quad (2)$$

— for the destimulants:

$$z_{ij} = \frac{\max\limits_i \{x_{ij}\} - x_{ij}}{\max\limits_i \{x_{ij}\} - \min\limits_i \{x_{ij}\}}, z_{ij} \in [0; 1] \quad (3)$$

where: z_{ij} stands for the normalized value of the *j*-th variable in the *i*-th year; x_{ij} is the value of the *j*-th variable in the *i*-thyear; $\min\limits_i \{x_{ij}\}$ is the lowest value of the *j*-th variable in the *i*-th year; $\max\limits_i \{x_{ij}\}$ is the highest value of the *j*-th variable in the *i*-th year.

To calculate the indicator of sustainable development of enterprises (SI_{sde}), as well as its sub-indices (SI_{econ}, SI_{soc} and SI_{evn}), we assume the same impact of different indices on the aggregate measure. We use the following formula:

$$SI_i = \frac{1}{n} \sum_{j=1}^{n} z_{ij}, (i = 1,2, \ldots, n) \quad (4)$$

where: SI_i stands for the indicator in the *i*-year; *n* is the number of metrics; others as above.

In the second stage, we collect data on manufacturing enterprises' environmental taxes and determined selected descriptive statistics.

In the third stage, we examined the statistical dependencies between sustainable development indicator and the types of environmental taxes using the Pearson Correlation Coefficient, described by the formula (Asuero *et al.*, 2006; Engle 2009):

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i-\overline{x})(y_i-\overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\overline{x})^2}\sqrt{\sum_{i=1}^{n}(y_i-\overline{y})^2}},\ r_{xy} \in [-1;1] \quad (5)$$

where: r_{xy} stands for the Pearson's correlation coefficient; n is the sample size; x_i, y_i are the individual sample points indexed with *i*; $\overline{x}, \overline{y}$ are the sample means.

Fourth, in order to assess the links between the sustainable development of enterprises and environmental taxes, we apply a regression analysis. The simple linear regression of y on x is given by the following formula (Schmidheiny, 2019):

$$SI_{sdi} = \alpha_0 + \alpha_1 T_{en\,i}, + \alpha_2 T_{en(t-1)\,i} + \alpha_3 T_{pol\,i}, + \alpha_4 T_{pol(t-1)\,i} + \alpha_5 T_{tran\,i} + \alpha_6 T_{tran(t-1)\,i} + \varepsilon_i \quad (6)$$

where: SI_{sdi} is an dependent variable; α_0 is the intercept, $\alpha_{1..}\ \alpha_{6.}$ are the slope; ε_i denotes the i-th residual; i- is an observation index, T_{eni} is an energy taxes in $i-$year, T_{poli} is an pollution taxes $i-$year, $T_{trani}-$ transport taxes $i-$year

The estimated model is given by the equation:

$$SI_{sd} = \hat{\alpha}_0 + \hat{\alpha}_1 T_{en_i} + \hat{\alpha}_2 T_{en(t-1)_i} + \hat{\alpha}_3 T_{pol_i} + \hat{\alpha}_4 T_{pol(t-1)_i} + \hat{\alpha}_5 T_{tran_i} + \hat{\alpha}_6 T_{tran\,(t-1)_i} + \varepsilon_i = \widehat{SI_{sd}}_i + e_i \quad (7)$$

so the residual for each observation is as follows:

$$e_i = SI_{sd\,i} - \widehat{SI_{sd}}_i = SI_{sd\,i} - (\hat{\beta}_0 + \hat{\alpha}_0 + \hat{\alpha}_1 T_{en_i} + \hat{\alpha}_2 T_{en(t-1)_i} + \hat{\alpha}_3 T_{pol_i} + \hat{\alpha}_4 T_{pol(t-1)_i} + \hat{\alpha}_5 T_{tran_i} + \hat{\alpha}_6 T_{tran\,(t-1)_i}) \quad (8)$$

For regression analysis, we use the most common estimation method for linear models called the ordinary least squares (OLS) regression. The OLS procedure minimizes the sum of squared residuals (Raykov and Marcoulides, 2013):

$$s(\hat{\alpha}_0, \hat{\alpha}_1) = \sum_{i=1}^{n} e_i^2 = \sum_{i=1}^{n} (\mathrm{SI}_{\mathrm{sd}_i} - \widehat{\mathrm{SI}_{sd}}_i)^2 = \sum_{i=1}^{n} [\mathrm{SI}_{\mathrm{sd}_i} - (\widehat{\alpha_0} + \hat{\alpha}_1 \mathrm{T}_{\mathrm{en}_i} + \hat{\alpha}_2 \mathrm{T}_{\mathrm{en(t-1)}_i} + \hat{\alpha}_3 \mathrm{T}_{\mathrm{pol}_i} + \hat{\alpha}_4 \mathrm{T}_{\mathrm{pol(t-1)}_i} + \hat{\alpha}_5 \mathrm{T}_{\mathrm{tran}_i} + \hat{\alpha}_6 \mathrm{T}_{\mathrm{tran\ (t-1)}_i})]^2 \rightarrow min \quad (9)$$

Solving the minimization problem results in the following expressions (Yan and Su, 2009):

$$\hat{\alpha}_0 = \overline{\mathrm{SI}_{\mathrm{sd}}} - (\hat{\alpha}_1 \overline{T_{en}} + \hat{\alpha}_2 \overline{T_{en(t-1)}} + \hat{\alpha}_3 \overline{T_{pol}} + \hat{\alpha}_4 \overline{T_{pol(t-1)}} + \hat{\alpha}_5 \overline{T_{tran}} + \hat{\alpha}_6 \overline{T_{tran(t-1)}}) \quad (10)$$

$$\hat{\alpha}_1 = \frac{\sum_{i=1}^{n} (T_{eni} - \overline{T_{en}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{eni} - \overline{T_{en}})^2} \quad (11)$$

$$\hat{\alpha}_2 = \frac{\sum_{i=1}^{n} (T_{en(t-1)i} - \overline{T_{en(t-1)}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{en(t-1)i} - \overline{T_{en(t-1)}})^2} \quad (12)$$

$$\hat{\alpha}_3 = \frac{\sum_{i=1}^{n} (T_{poli} - \overline{T_{pol}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{poli} - \overline{T_{pol}})^2} \quad (13)$$

$$\hat{\alpha}_4 = \frac{\sum_{i=1}^{n} (T_{pol(t-1)i} - \overline{T_{pol(t-1)}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{pol(t-1)i} - \overline{T_{pol(t-1)}})^2} \quad (14)$$

$$\hat{\alpha}_5 = \frac{\sum_{i=1}^{n} (T_{trani} - \overline{T_{tran}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{trani} - \overline{T_{tran}})^2} \quad (15)$$

$$\hat{\alpha}_6 = \frac{\sum_{i=1}^{n} (T_{tran(t-1)i} - \overline{T_{tran(t-1)}})(SI_{sdi} - \overline{SI_{sd}})}{\sum_{i=1}^{n} (T_{tran(t-1)i} - \overline{T_{tran(t-1)}})^2} \quad (16)$$

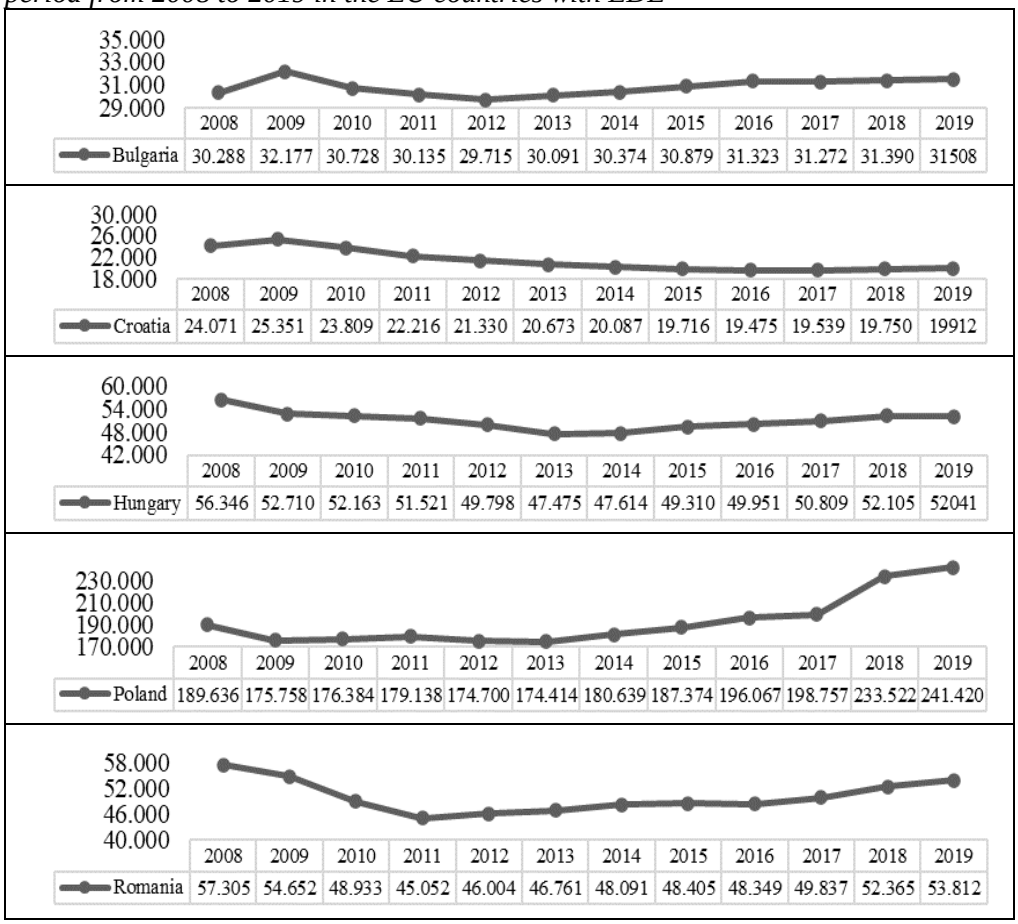
4. Results

We examine the manufacturing enterprises operating in the period from 2008 to 2019, in the EU countries with emerging and developing economies, including Bulgaria, Croatia, Hungary, Poland and Romania. During the research period, in the EU countries with EDE, Poland has the highest average share of manufacturing enterprises, while Croatia has the lowest. Poland has about 55%, Croatia has approximately 6% (Bulgaria 9%, Hungary 15%, Romania 17%). Comparing 2008 and 2019, in Poland and Bulgaria, the number of manufacturing enterprises increases (in Poland increases by 51784, in Bulgaria increases by 1220), while in Croatia, Hungary and Romania the number of manufacturing enterprises decreases (in Croatia decreases by 4159, in Hungary decreases by 4305, in Romania decreases by 3493). Figure 1 presents the research sample - number of manufacturing enterprises operating in the period from 2008 to 2019 in the EU countries with EDE.

We create the indicators of economic, social, environmental and sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU

countries with EDE. All analyzed indicators show a positive trend. Table 1 presents indicators of economic, social, environmental and sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.

Figure 1. *Research sample - number of manufacturing enterprises operating in the period from 2008 to 2019 in the EU countries with EDE*



Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat], access: 06.01.2021*.

One of the components of the indicator of sustainable development of enterprises is the indicator of economic development of enterprises. We create the indicator of economic development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE based on analytical indicators relating to enterprises' economic development. The mean value of the indicator is 0.56 (median 0.61) in Bulgaria, 0.41 (median 0.36) in Croatia, 0.62 (median 0.65) in Hungary, 0.57 (median 0.60) in Poland, 0.51 (median 0.52) in Romania. The highest value of the indicator is 0.71 in Bulgaria (2019), 0.93 in Croatia (2008), 0.84 in Hungary (2019), 0.84 in Poland (2019), 0.80 in Romania (2008). The lowest value of the indicator is

0.29 in Bulgaria (2009), 0.15 in Croatia (2013, 2014), 0.16 in Hungary (2009), 0.15 in Poland (2009), 0.25 in Romania (2009).

Table 1. *Indicators of economic (SI_{eco}), social (SI_{soc}), environmental (SI_{env}) and sustainable (SI_{sd}) development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE*

Country	Indicator	Year											
		2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Bulgaria	SI_{eco}	0.63	0.29	0.31	0.46	0.51	0.59	0.60	0.64	0.61	0.66	0.68	0.71
	SI_{soc}	0.55	0.20	0.26	0.37	0.41	0.49	0.57	0.64	0.67	0.67	0.71	0.76
	SI_{env}	0.17	0.83	0.71	0.59	0.79	0.69	0.62	0.59	0.58	0.69	0.70	0.72
	SI_{sd}	0.45	0.44	0.43	0.47	0.57	0.59	0.60	0.62	0.62	0.67	0.70	0.73
Croatia	SI_{eco}	0.93	0.40	0.25	0.27	0.17	0.15	0.15	0.31	0.50	0.56	0.63	0.63
	SI_{soc}	0.70	0.27	0.23	0.27	0.24	0.25	0.28	0.45	0.76	0.45	0.46	0.48
	SI_{env}	0.08	0.39	0.42	0.53	0.64	0.92	0.95	0.87	0.90	0.94	0.98	0.98
	SI_{sd}	0.57	0.35	0.30	0.36	0.35	0.44	0.46	0.54	0.72	0.78	0.82	0.83
Hungary	SI_{eco}	0.61	0.16	0.43	0.64	0.56	0.53	0.66	0.73	0.70	0.76	0.80	0.84
	SI_{soc}	0.54	0.12	0.34	0.52	0.50	0.54	0.66	0.78	0.81	0.85	0.91	0.97
	SI_{env}	0.21	0.70	0.65	0.57	0.72	0.78	0.64	0.60	0.71	0.78	0.81	0.84
	SI_{sd}	0.45	0.33	0.47	0.58	0.59	0.62	0.66	0.70	0.74	0.80	0.84	0.89
Poland	SI_{eco}	0.60	0.15	0.28	0.51	0.44	0.48	0.59	0.72	0.74	0.74	0.79	0.84
	SI_{soc}	0.62	0.24	0.36	0.45	0.48	0.52	0.66	0.74	0.77	0.77	0.82	0.86
	SI_{env}	0.19	0.87	0.67	0.43	0.51	0.52	0.46	0.49	0.52	0.51	0.50	0.60
	SI_{sd}	0.47	0.42	0.44	0.46	0.48	0.51	0.57	0.65	0.68	0.67	0.70	0.77
Romania	SI_{eco}	0.80	0.25	0.38	0.50	0.53	0.46	0.57	0.55	0.53	0.52	0.52	0.52
	SI_{soc}	0.59	0.14	0.31	0.52	0.52	0.50	0.60	0.63	0.72	0.71	0.76	0.80
	SI_{env}	0.01	0.63	0.65	0.65	0.70	0.88	0.91	0.87	0.87	0.95	0.96	0.98
	SI_{sd}	0.47	0.34	0.45	0.56	0.59	0.61	0.69	0.68	0.71	0.73	0.75	0.82

Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat], access: 06.01.2021.*

Another component of the indicator of sustainable development of enterprises is the indicator of social development of enterprises. We create the indicator of social development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE based on analytical indicators relating to enterprises' social development. The mean value of the indicator is 0.53 (median 0.56) in Bulgaria, 0.40 (median 0.37) in Croatia, 0.63 (median 0.60) in Hungary, 0.61 (median 0.64) in Poland, 0.57 (median 0.60) in Romania. The highest value of the indicator is 0.76 in Bulgaria in (2019), 0.76 in Croatia (2016), 0.97 in Hungary (2019), 0.86 in Poland (2019), 0.80 in Romania (2019). The lowest value of the indicator is 0.20 in Bulgaria (2009), 0.23 in Croatia (2010), 0.12 in Hungary (2009), 0.24 in Poland (2009), 0.14 in Romania (2009).

The third component of the indicator of sustainable development of enterprises is the indicator of environmental development of enterprises. We create the indicator of environmental development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE based on analytical indicators relating to enterprises' environmental development. The mean value of the indicator is 0.64 (median 0.69) in Bulgaria, 0.72 (median 0.89) in Croatia, 0.67 (median 0.71) in Hungary, 0.52 (median 0.51) in Poland, 0.76 (median 0.87) in Romania. The highest value of the indicator is 0.83 in Bulgaria in (2009), 0.98 in Croatia (2018, 2019),

0.84 in Hungary (2019), 0.87 in Poland (2009), 0.98 in Romania (2019). The lowest value of the indicator is 0.17 in Bulgaria (2008), 0.08 in Croatia (2008), 0.21 in Hungary (2008), 0.19 in Poland (2008), 0.01 in Romania (2008).

The indicator of sustainable development of enterprises is compose of the sum of indicators of enterprises' economic, social and environmental development. We create the indicator of sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE based on indicators of economic, social and environmental development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE. The mean value of the indicator is 0.57 (median 0.60) in Bulgaria, 0.54 (median 0.50) in Croatia, 0.64 (median 0.64) in Hungary, 0.55 (median 0.51) in Poland, 0.62 (median 0.65) in Romania. The highest value of the indicator is 0.73 in Bulgaria in (2019), 0.83 in Croatia (2019), 0.89 in Hungary (2019), 0.77 in Poland (2019), 0.92 in Romania (2019). The lowest value of the indicator is 0.43 in Bulgaria (2010), 0.30 in Croatia (2010), 0.33 in Hungary (2009), 0.42 in Poland (2009), 0.34 in Romania (2009). Table 2 presents descriptive statistics of indicators of economic, social, environmental and sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.

Table 2. *Descriptive statistics - indicators of economic (SI_{eco}), social (SI_{soc}), environmental (SI_{env}) and sustainable (SI_{sd}) development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE*

Country	Indicator	Descriptive statistics				
		Mean	SD	Med.	Max	Min
Bulgaria	SI_{eco}	0.56	0.13	0.61	0.71	0.29
	SI_{soc}	0.53	0.17	0.56	0.76	0.20
	SI_{env}	0.64	0.16	0.69	0.83	0.17
	SI_{sd}	0.57	0.10	0.60	0.73	0.43
Croatia	SI_{eco}	0.41	0.23	0.36	0.93	0.15
	SI_{soc}	0.40	0.17	0.37	0.76	0.23
	SI_{env}	0.72	0.29	0.89	0.98	0.08
	SI_{sd}	0.54	0.19	0.50	0.83	0.30
Hungary	SI_{eco}	0.62	0.18	0.65	0.84	0.16
	SI_{soc}	0.63	0.24	0.60	0.97	0.12
	SI_{env}	0.67	0.16	0.71	0.84	0.21
	SI_{sd}	0.64	0.16	0.64	0.89	0.33
Poland	SI_{eco}	0.57	0.20	0.60	0.84	0.15
	SI_{soc}	0.61	0.19	0.64	0.86	0.24
	SI_{env}	0.52	0.15	0.51	0.87	0.19
	SI_{sd}	0.55	0.10	0.51	0.77	0.42
Romania	SI_{eco}	0.51	0.12	0.52	0.80	0.25
	SI_{soc}	0.57	0.18	0.60	0.80	0.14
	SI_{env}	0.76	0.26	0.87	0.98	0.01
	SI_{sd}	0.62	0.14	0.65	0.82	0.34

Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat]. access: 06.01.2021.*

We collect data on manufacturing enterprises' environmental taxes in the period from 2008 to 2019 in the EU countries with EDE, including taxes of energy, pollution and transport. Most of the manufacturing enterprises' environmental taxes have a positive trend. The exception is the manufacturing enterprises' pollution and transport taxes in the period from 2008 to 2019 in Bulgaria and Poland - a negative trend. A negative trend is also in Croatia (pollution taxes) and Romania (transport taxes). Table 3 presents taxes of energy, pollution and transport of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.

Table 3. *Taxes of energy (T_{en}), pollution (T_{pol}) and transport (T_{tran}) of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE [million euro]*

Country	Tax	Year											
		2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Bulgaria	T_{en}	103.10	78.90	69.30	117.43	104.74	117.12	118.36	122.96	108.08	122.84	112.97	126.86
	T_{pol}	12.27	6.57	4.07	3.59	1.01	4.89	3.7	3.26	3.73	4.14	1.77	3.15
	T_{tran}	13.24	10.18	8.05	5.30	6.54	5.80	7.08	6.60	6.43	6.51	6.24	6.38
Croatia	T_{en}	25.19	26.06	22.64	22.36	20.30	21.98	32.91	33.07	34.88	38.19	42.92	40.48
	T_{pol}	3.27	2.54	2.01	1.21	0.89	0.64	0.300	0.21	0.63	0.21	0.48	0.52
	T_{tran}	16.23	13.22	13.73	13.32	13.57	13.47	13.03	13.11	13.87	15.27	14.72	15.63
Hungary	T_{en}	59.77	50.92	40.38	39.97	37.27	236.36	241.16	237.91	268.90	293.92	262.22	264.12
	T_{pol}	12.87	18.89	16.83	17.99	41.95	36.86	31.77	46.01	55.34	58.27	61.27	62.74
	T_{tran}	8.70	11.42	12.59	12.75	14.84	14.77	13.82	13.97	14.17	14.71	14.79	14.98
Poland	T_{en}	1183.55	977.83	1099.62	1229.18	1218.66	1097.22	1142.59	1246.25	1181.93	1308.62	1651.40	1728.04
	T_{pol}	197.93	171.14	187.39	194.49	152.82	75.67	142.72	169.14	144.00	137.91	128.15	130.58
	T_{tran}	54.67	41.04	39.69	38.82	41.75	38.98	38.93	36.52	37.29	40.7	36.03	38.21
Romania	T_{en}	823.22	796.47	977.38	989.70	1013.93	1134.47	1456.00	1626.14	1701.57	1458.68	1652.36	1725.02
	T_{pol}	1.94	1.58	1.58	1.72	2.10	2.16	1.91	1.94	1.94	2.15	2.10	3.40
	T_{tran}	11.35	8.61	10.06	9.81	11.34	12.56	11.81	11.96	11.49	8.17	8.44	8.51

Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat], access: 06.01.2021.*

Environmental taxes of enterprises consist, inter alia, taxes of energy. We collect data on manufacturing enterprises' energy taxes in the period from 2008 to 2019 in the EU countries with EDE. The mean value of the energy taxes is 108.56 million euro (median 115.05 million euro) in Bulgaria, 30.08 million euro (median 29.49 million euro) in Croatia, 169.41 million euro (median 237.14) in Hungary, 1255.41 million euro (median 1201.11 million euro) in Poland, 1279.58 million euro (median 1295.24 million euro) in Romania. The highest value of the energy taxes is 126.86 million euro in Bulgaria in (2019), 42.92 million euro in Croatia (2018), 293.92 million euro in Hungary (2017), 1728.04 million euro in Poland (2019), 1725.02 million euro in Romania (2019). The lowest value of the energy taxes is 69.30 million euro in Bulgaria (2010), 20.30 million euro in Croatia (2012), 37.27 million euro in Hungary (2012), 977.83 million euro in Poland (2009), 796.47 million euro in Romania (2009).

Environmental taxes of enterprises also consist taxes of pollution. We collect data on manufacturing enterprises' pollution taxes in the period from 2008 to 2019 in the EU countries with EDE. The mean value of the pollution taxes is 4.35 million euro (median 3.72 million euro) in Bulgaria, 1.08 million euro (median 0.64 million euro)

in Croatia, 28.40 million euro (median 39.41) in Hungary, 152.66 million euro (median 148.41 million euro) in Poland, 2.04 million euro (median 1.94 million euro) in Romania. The highest value of the pollution taxes is 12.27 million euro in Bulgaria in (2008), 3.27 million euro in Croatia (2008), 62.74 million euro in Hungary (2019), 197.93 million euro in Poland (2008), 3.40 million euro in Romania (2019). The lowest value of the pollution taxes is 1.01 million euro in Bulgaria (2012), 0.21 million euro in Croatia (2015), 12.87 million euro in Hungary (2008), 75.67 million euro in Poland (2013), 1.58 million euro in Romania (2009, 2010).

Environmental taxes of enterprises also consist taxes of transport. We collect data on manufacturing enterprises' transport taxes in the period from 2008 to 2019 in the EU countries with EDE. The mean value of the transport taxes is 7.36 million euro (median 6.53 million euro) in Bulgaria, 14.10 million euro (median 13.65 million euro) in Croatia, 13.46 million euro (median 14.07) in Hungary, 40.22 million euro (median 38.96 million euro) in Poland, 10.34 million euro (median 10.70 million euro) in Romania. The highest value of the transport taxes is 13.24 million euro in Bulgaria in (2008), 16.23 million euro in Croatia (2008), 14.98 million euro in Hungary (2019), 54.67 million euro in Poland (2008), 12.56 million euro in Romania (2013). The lowest value of the transport taxes is 5.30 million euro in Bulgaria (2011), 13.03 million euro in Croatia (2014), 8.70 million euro in Hungary (2008), 36.03 million euro in Poland (2018), 8.17 million euro in Romania (2017). Table 4 presents descriptive statistics of taxes of energy, pollution and transport of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.

Table 4. *Descriptive statistics - taxes of energy (T_{en}), pollution (T_{pol}) and transport (T_{tran}) of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE*

Country	Tax	Descriptive statistics				
		Mean	SD	Med.	Max	Min
Bulgaria	T_{en}	108.56	17.03	115.05	126.86	69.30
	T_{pol}	4.35	2.74	3.72	12.27	1.01
	T_{tran}	7.36	2.14	6.53	13.24	5.30
Croatia	T_{en}	30.08	7.61	29.49	42.92	20.30
	T_{pol}	1.08	0.96	0.64	3.27	0.21
	T_{tran}	14.10	1.04	13.65	16.23	13.03
Hungary	T_{en}	169.41	105.76	237.14	293.92	37.27
	T_{pol}	38.40	17.86	39.41	62.74	12.87
	T_{tran}	13.46	1.79	14.07	14.98	8.70
Poland	T_{en}	1255.41	211.10	1201.11	1728.04	977.83
	T_{pol}	152.66	32.95	148.41	197.93	75.67
	T_{tran}	40.22	4.67	38.96	54.67	36.03
Romania	T_{en}	1279.58	342.47	1295.24	1725.02	796.47
	T_{pol}	2.04	0.45	1.94	3.40	1.58
	T_{tran}	10.34	1.53	10.70	12.56	8.17

Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat], access: 06.01.2021.*

We use the Pearson Correlation Coefficient to determine the linear relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' environmental taxes. We estimate the linear dependence of energy, pollution and transport taxes of manufacturing enterprises on the indicator of sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE. Practically in all analyzed countries, the Pearson Correlation Coefficient between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' environmental taxes shows a very strong, strong or moderate linear relationship ($p < 0.05$). The exception is Romania, the Pearson Correlation Coefficient between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' transport taxes shows a very weak linear relationship ($p < 0.05$). The Pearson Correlation Coefficient is in the range of 0.08-0.92. The highest linear dependence level is in Romania (0.92, the linear relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' energy taxes in the period from 2008 to 2019), while the lowest is in Romania (-0.08, the linear relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' transport taxes in the period from 2008 to 2019).

In most cases, the variables show a positive trend. The exception is the indicator of sustainable development of manufacturing enterprise and manufacturing enterprises' pollution and transport taxes in the period from 2008 to 2019 in Bulgaria and Poland - a negative trend. A negative trend is also in Croatia (the linear relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' pollution taxes in the period from 2008 to 2019) and Romania (the linear relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' transport taxes in the period from 2008 to 2019). Table 5 presents Pearson's Correlation Coefficient between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' environmental taxes in the period from 2008 to 2019 in the EU countries with EDE.

Table 5. *Pearson's Correlation Coefficient between SI_{sd} and T_{en}, T_{pol}, T_{tran} of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.*

Country	Indicator	Tax	
Bulgaria	SI_{sd}	T_{en}	0.75
		T_{pol}	-0.54
		T_{tran}	-0.58
Croatia	SI_{sd}	T_{en}	0.90
		T_{pol}	-0.43
		T_{tran}	0.66
Hungary	SI_{sd}	T_{en}	0.83
		T_{pol}	0.91
		T_{tran}	0.75
Poland	SI_{sd}	T_{en}	0.78

		T_{pol}	-0.45
		T_{tran}	-0.45
Romania	SI_{sd}	T_{en}	0.92
		T_{pol}	0.69
		T_{tran}	-0.08

Source: *Own study based on Eurostat [https://ec.europa.eu/Eurostat], access: 06.01.2021.*

We use the Ordinary Least Squares (OLS) regression method to determine the relationship between the indicator of sustainable development of manufacturing enterprises and manufacturing enterprises' environmental taxes. We estimate the impact of energy, pollution and transport taxes of manufacturing enterprises on the indicator of sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE. A statistically significant impact of the explanatory variables on the dependent variable is in all EU countries with EDE in the period from 2008 to 2019. The variables affecting the indicator of sustainable development of manufacturing enterprises in Bulgaria are taxes of energy (0.0031, positive impact) and taxes of energy from the t-1 period (0.0029, positive impact).

The coefficient of determination is 0.8059, which means a good fit to the model's data. The variables affecting the indicator of sustainable development of manufacturing enterprises in Croatia are taxes of energy (0.0131, positive impact), taxes of pollution from the t-1 period (-0.0526, negative impact) and taxes of transport (0.0824, positive impact). The coefficient of determination is 0.9614, which means a perfect fit to the model's data. The variables affecting the indicator of sustainable development of manufacturing enterprises in Hungary are taxes of energy (-0.0007, negative impact), taxes of pollution (0.0107, positive impact), taxes of transport (-0.1117, negative impact) and taxes of transport from the t-1 period (0.0983, positive impact). The coefficient of determination is 0.9775, which means a perfect fit to the model's data. The variables affecting the indicator of sustainable development of manufacturing enterprises in Poland are taxes of energy from the t-1 period (0.0004, positive impact) and taxes of transport (-0.0324, negative impact). The coefficient of determination is 0.6849, which means a satisfactory fit to the model's data. The variables affecting the indicator of sustainable development of manufacturing enterprises in Romania are taxes of energy (0.0003, positive impact) and taxes of pollution (0.0802, positive impact). The coefficient of determination is 0.8920, which means a good fit to the model's data. Table 6 presents the results of Ordinary Least Squares (OLS) regression method the impact of energy, pollution and transport taxes of manufacturing enterprises on the indicator of sustainable development of manufacturing enterprises in the period from 2008 to 2019 in the EU countries with EDE.

The equations obtained by the Ordinary Least Squares (OLS) regression method:

Bulgaria:
$$SI_{sd} = -0.0644\ const + 0.0031\ T_{en} + 0.0029\ T_{en(t-1)}$$
Croatia:

$$SI_{sd} = -0.9454\ const + 0.0131\ T_{en} - 0.0526\ T_{pol(t-1)} + 0.0824\ T_{tran}$$

Hungary:

$$SI_{sd} = 0.5872\ const - 0.0007\ T_{en} + 0.0107\ T_{pol} - 0.1117\ T_{tran} + 0.0983\ T_{tran(t-1)}$$

Poland:

$$SI_{sd} = 1.3473\ const + 0.0004\ T_{en(t-1)} - 0.0324\ T_{tran}$$

Romania:

$$SI_{sd} = 0.0628\ const + 0.0003\ T_{en} + 0.0802\ T_{pol}$$

5. Conclusions

The sustainable development of enterprises is a significant and current research problem. Business entities taking measures to reduce pollutant emissions and the amount of waste contribute to the continuity of processes related to natural resources protection and the sustainability of economic processes. Implementation of sustainable development by enterprises is associated with the need to adapt to the changing environmental conditions, continuously learning and reorienting the company's goals towards increasing value for contractors.

Sustainable development of enterprises includes the triad of economic goals, social and environmental. It depends on many exo- and endogenous factors that have a decisive influence on competitiveness and expansion of business entities. One of the environmental instruments that influence the sustainable development of enterprises is environmental taxes. The task of environmental taxes is to stimulate entrepreneurs to undertake environmentally friendly activities. Environmental taxes include taxes on energy, pollution, transport and natural resources.

The research results indicate that the primary research hypothesis is correct, it means that "there is a variation in the impact of types of environmental taxes on manufacturing enterprises' sustainable development in emerging and developing economies in 2008-2019". Manufacturing enterprises pay three types of taxes, on energy, pollution, and transport. The crucial is energy and transport. Moreover, as indicated by the Pearson Correlation Coefficient results and the estimation with the Ordinary Least Squares Method, environmental taxes have a statistically significant impact on the sustainable development of industrial enterprises. However, the directions of this impact are different. This impact may result from the specific functioning of the analyzed countries, different development levels of the enterprise sector, and differences in the number of registered entities.

In all analyzed countries, the Pearson correlation coefficient between sustainable development of enterprises and energy taxes is positive and statistically significant at the level of $p < 0.05$. A positive relationship between sustainable development of

manufacturing enterprises and taxes on pollution or transport taxes occurs in Hungary. A negative relationship between sustainable development and pollution or transport taxes is in Bulgaria and Poland.

The first sub-hypothesis (H1) is correct because "in the emerging and developing economies, there is a positive trend in the sustainable development of manufacturing enterprises in 2008-2019". This trend is due to business perception changes, environmental restrictions, and increased environmental awareness of customers.

The second sub-hypothesis (H2) is also correct, because "The higher the number of enterprises, the higher the energy tax revenues". The assumption here is that the greater the number of enterprises, the greater the natural environment's pollution. Pollution reduction is gradual rather than stepwise.

The third sub-hypothesis (H3) is also correct, because "Energy taxes are crucial for the sustainable development of manufacturing enterprises". The critical impact of taxes on energy results from the specificity of the operation of manufacturing enterprises.

Environmental taxes are an essential instrument supporting the sustainable development of enterprises. They allow for their proper control and growth. The study results indicate that it is necessary to introduce changes to environmental taxes, increase their efficiency, and increase the importance of environmental taxes as an essential fiscal burden in countries on the path of sustainable development. The economic system requires further action and work on environmental tax reform. Therefore, it is essential to have a more active policy of governments and the entrepreneurs themselves, as they have a fundamental influence on economic policy and stable and sustainable development in the future.

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