Anna MISZTAL, Ph.D.
Faculty of Economics and Sociology, University of Lodz
e-mail: anna.misztal@uni.lodz.pl
ORCID: 0000-0002-7455-5290

SUSTAINABLE DEVELOPMENT OF MANUFACTURING ENTERPRISES IN THE SOCIO-ECONOMIC CONTEXT. THE CASE OF POLAND AND GERMANY[1]

Summary

Purpose – The article aims to assess the impact of contemporary external socio-economic determinants, including globalization, eco-innovation, social development, and macroeconomic stabilization, on the sustainable development of manufacturing enterprises in Poland and Germany from 2008 to 2020.

Research method – This paper is empirical. The survey covers the manufacturing enterprises in Poland and Germany. The first part discusses the conceptual background related to the sustainable development of enterprises in a socio-economic context. The empirical part includes the methodology and results of the study. To determine the relationship between socio-economic factors and sustainable development, the author uses the Least Square Method (OLS) and Seemingly Unrelated Regression (SUR).

Results – The research results show a statistically significant relationship between the variables. Socio-economic indicators are vital determinants of the sustainable development of manufacturing enterprises. The models show that the impact of individual exogenous determinants is different in Poland and Germany.

Originality/value/implications/recommendations – The statistical assessment of the socio-economic impact on enterprises' sustainable development is relatively poorly understood. The issue is new, contemporary and requires further analysis. The exogenous socio-economic factors are important for enterprises sustainable development. It is important to launch macroeconomic efforts to implement sustainable development goals. The results show a different impact of socio-economic indicators on the sustainable development of manufacturing enterprises, which may indicate that the enterprise development depends on many factors that are different in analysed countries.

Keywords: sustainable development, socio-economic conditions, manufacturing enterprises

JEL Classification: D22, E00, E20, Q01

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1. Introduction

Enterprise sustainable development means increasing profitability through simultaneous economic activities, employee development, caring for local communities and investments in environmental protection. It is economic, social, and environmental development. Sustainable development depends on external factors, including socio-economic determinants and internal ones related to enterprises' financial and property situation, business models and strategies, and social and environmental issues.

The scientific studies conducted so far indicate that the sustainable development of enterprises depends on the level of GDP [Pieloch et al., 2021, pp. 8669–8698], innovation [Kijek, Kasztelan, 2013, pp. 103–112], employment rate [Comporek et al. 2022] and socio-economic awareness [Dalevska et al., 2019]. Most researchers analyse the impact of individual partial variables on the level of sustainable development of individual enterprises [Ondov et al., 2022].

A novelty in the paper is using the macroeconomic stabilization pentagon, human development indicator, eco-innovation, and globalization index to assess the impact of socio-economic development on the sustainable development of manufacturing enterprises in Poland and Germany.

The article aims to assess the impact of contemporary external socio-economic conditions, including globalization (Glob), eco-innovation (Eco_{In}), social development (HDI), and macroeconomic stabilization (M_S), on the sustainable development of manufacturing enterprises (Sus_D) in Poland and Germany from 2008 to 2020. The author focuses on two countries with different levels of economic development, various legal regulations, and different approaches to environmental protection, but closely cooperating and economically related. The research period covers the time from the economic crisis in 2008, the time of recovery, until the coronavirus pandemic. The choice of determinants was limited to a few key external socio-economic factors, including fundamental factors important for enterprises' functioning and stable development. Macroeconomic conditions and globalization strongly impact enterprises' financial and property situations. Thanks to eco-innovation, enterprises can reduce the negative impact of their activities on the natural environment.

The central research hypothesis is as follows: "There are differences in the strength and direction of the impact of individual socio-economic determinants on the sustainable development of Polish and German manufacturing enterprises from 2008 to 2020". The author used the Least Square Method and the Seemingly Unrelated Regression to verify the hypothesis. The data for the study comes from Eurostat, the World Bank, and the Human Development Report Office of the United Nations Development Program.

The paper consists of the following parts: the introduction, conceptual background, research methodology, research results, and conclusions. The literature review selected publications due to their citation and availability in the Web of Science databases. The conclusion presents findings and directions for future research.

2. Conceptual background

Climate change and the degradation of the natural environment due to the rapid development of manufacturing required a new look at management processes. The answer to the exhaustion of resources and to threats to the natural environment is the concept of sustainable development [Rogers et al., 2007; Blewitt, 2008; Cramer et al., 2018, pp. 972–980; Bos, Gupta, 2019; Boeren, 2019; Lam et al., 2020, pp. 440–454]. It means lasting and stable economic, social, and environmental development, and it can be considered on a macro-and microeconomic scale [Boeren, 2019, pp. 277–294; Adamik, Sikora-Fernandez, 2021]. The fundamental issue is to preserve natural resources for future generations. Implementing the idea requires action from all participants of socio-economic life, including the cooperation between states, organizations, institutions, enterprises, and people [Chapman et al. 2018; Black, 2020, pp. 228–234].

The sustainable development of an enterprise means development in three spheres: economic, social, and environmental. Enterprises on the path of sustainable development take efforts to improve the financial and property situation, support the development of employees, ensure appropriate conditions and quality of work, properly train and motivate staff, implement ecological investments, reducing the negative impact of their activities on the natural environment [Matinaro et al., 2019; Pieloch et al., 2021, pp. 8669–8698; Misztal, 2021]. Taking this type of action may be dictated by the pragmatism associated with the possibility of gaining a competitive advantage building a positive image and brand. The implementation of the idea is also related to the increased environmental awareness of the management of enterprises. It may also result from an external force in environmental protection standards and regulations that an economic entity must meet [Mokhova, Zinecker, 2014; van der Waal, Thijssens, 2020; Misztal, Kowalska et al., 2021].

Sustainable development is making a profit today without compromising the possibility of achieving it in the future. Therefore, it is necessary to consider social and environmental issues in all business spheres [Witek-Crabb, 2005, p. 564; Trojanowski, 2015, p. 244]. Activities for sustainable development include tasks aimed at meeting the needs of all company stakeholders, both current and future [Dyllick, Hockerts, 2002, pp. 130–141]. Sustainable development is a business strategy that meets the company's current needs and protects, supports, and strengthens stakeholders and natural resources that will be important in the future [Hart et al., 2016, pp. 401–415].

The practical implementation of sustainable development requires enterprises to define priority goals, formulate an appropriate strategy and adopt a sustainable business model (a plan created by a company to maximize profit, develop employees' potential, and achieve environmental tasks]. The possibility of implementing the idea at the enterprise level depends on several factors, which can be divided into two groups [Broman, Robèrt, 2017, pp. 17–31; Powe, 2020, pp. 1523–1527]:

–　external, including macroeconomic conditions, environmental policy, glob-
alization, social development, ecological awareness of people, support for
pro-ecological activities, eco-innovations,
–　internal:, the size, type and scale of activity, financial and property situation,
access to external sources of financing environmental goals, and the envi-
ronmental attitudes of managers.

The strength and direction of influence of both groups of determinants on the
sustainable development of enterprises are varied. There is also no agreement on
which of these groups is more significant.

Stable economic growth with a coincidental increase in the environmental aware-
ness of customers should positively affect the sustainable development of enter-
prises. However, there is a risk here, as striving only to improve the level of GDP
per capita may contribute to the significant degradation of the natural environment.
Hence, it is necessary to introduce strict legal regulations on nature protection and
counteract climate change [Weber, 2014; Iwu et al., 2015; Matinaro et al., 2019;
Bocken et al., 2019].

Globalization, which leads to an increase in competitiveness, should also contrib-
ute to a change in the perception of modern business and the need to consider the
rules and regulations in the field of environmental protection. Undoubtedly, eco-in-
novations are crucial for sustainable development because they reduce the negative
impact of economic activities on the environment.

Several internal factors determine the sustainable development of an enterprise.
The key issues focus on the financial sphere and the environmental attitudes of
managers. Ecological solutions carry certain costs, very often unacceptable to small
enterprises. Therefore, sustainable development depends on the size of the enter-
prise and the scale of its activities. The availability of external financing sources is
also important here. Sustainable business requires a long-term approach and consent
to limit current profits to benefit future ones [Drobyazko et al., 2019; Comporek
et al., 2022].

3. Research methodology

The main aim of the research is to assess the impact of globalization (Glob), eco-
innovation (EcoIn), social development (HDI), and macroeconomic stabilization
(MS) on the sustainable development of manufacturing enterprises (SusD) in Poland
and Germany from 2008 to 2020.

The central research hypothesis is as follows: "There are differences in the
strength and direction of the impact of individual socio-economic determinants on
the sustainable development of Polish and German manufacturing enterprises from
2008 to 2020". The research questions are as follows:
–　Are the dynamics of sustainable development of manufacturing enterprises
positive?
–　Is economic development more rapid than social and environmental deve-
lopment?

–   Is macroeconomic stability crucial for sustainable development?
–   Are the determinants influencing economic development the same as the ones influencing the social and environmental development of enterprises?

The research consists of the following steps:

–   creating indicators of sustainable development and its economic, social, and environmental components, based on the formula:

$$Sus_{D\,ij} = E + S + Env$$
$$= \sum_{i=1}^{n} \frac{E_{ij}}{maxE_{ij}} + \sum_{i=1}^{n} \frac{minE_{ij}}{E_{ij}} + \sum_{i=1}^{n} \frac{S_{ij}}{maxS_{ij}} + \sum_{i=1}^{n} \frac{minS_{ij}}{S_{ij}} + \sum_{i=1}^{n} \frac{minEnv_{ij}}{Env_{ij}}$$

where: Sus_d, E_{ij}, S_{ij}, Env_{ij} stands for the indicator in the *i*-year; *n* is the number of metrics.

The economic indicator (E) contains the following analytical indicators:

–   stimulants: turnover or gross premiums written, production, gross operating surplus, total purchases of goods and services, gross investment in tangible goods,
–   destimulants: personnel costs – million euro.

The social indicator (S) contains the following analytical indicators:

–   stimulants: wages and salaries, employees – number, apparent labour productivity,
–   destimulants: accidents at work.

The environmental indicator (Env) contains the following analytical indicators:

–   destimulants: carbon dioxide, methane, nitrous oxide, sulphur oxides, ammonia, carbon monoxide.

Creating indicators of socio-economic conditions, based on the formula:

–   globalization indicator (the KOF Globalization Index) (Glob):

$$Glob = Glob_E + Glob_S + Glob_P$$

where: GlobE is the integrated indicator of economic globalization, GlobS is the integrated indicator of social globalization, GlobPis the integrated indicator of political globalization.

–   human development indicator (HDI):

$$HDI = \sqrt[3]{LEI \cdot EI \cdot II} = \sqrt[3]{\frac{LE-20}{85-20} \cdot \frac{MYSi+EYSi}{2} \cdot \frac{\ln(GNIpc)-\ln(100)}{\ln(75,000)-\ln(100)}}$$

where: LEI – Life Expectancy Index; EI – Education Index; MYSi – Mean Years of Schooling Index; EYSI – Expected Years of Schooling Index; LE – Life expectancy at birth; GNIpc – Gross national income at purchasing power parity per capita

–   eco-innovation indicator (Eco$_{In}$):

$$\text{Eco}_{In} = \frac{Eco_{InIN} + Eco_{InA} + Eco_{InO} + Eco_{InSE} + Eco_{InREO}}{n}$$

where: Eco_{InIN} – eco-innovation inputs; Eco_{InA} – eco-innovation activities; Eco_{InO} – eco-innovation outputs; Eco_{InSE} – eco-innovation socio-economic outcomes; Eco_{InREO} eco-innovation resource efficiency outcomes.

–   macroeconomic stabilization pentagon (M_S):

$$M_S = [(\Delta GDP * U) + (U * HICP) + (HICP * G) + (G * CA) + (CA * \Delta GDP)] * k$$

where: $a = \Delta GDP * U * k$ presents a triangle area called the real sphere triangle and characterizes the relation between the rate of economic growth and unemployment rate; $b = U * HICP * k$ stands for the stagflation triangle which depends on the unemployment rate and inflation rate; $c = ICP * G * k$ is defined as the budget and inflation triangle; $d = G * CA * k$ is called the financial equilibrium triangle and depends on the budget and the current account balance; $e = CA * \Delta GDP * k$ means the external sector triangle and shows the variability of current account balance and the rate of economic growth; the value of coefficient is calculated as $k = \frac{1}{2}\sin 72° = 0{,}475$; other designations as above.

–   creating the model 1 (the OLS method), based on the formula:

$$Sus_{D\,i} = \hat{\beta}_0 + \hat{\beta}_1 Glob_i + \hat{\beta}_2 Glob_{i(t-1)} + \hat{\beta}_3 Eco_{In\,i} + \hat{\beta}_4 Eco_{In\,i(t-1)} + \hat{\beta}_5 HDI_i + \hat{\beta}_6 HDI_{i(t-1)} + \hat{\beta}_7 M_{Si} + \hat{\beta}_8 M_{S\,i(t-1)} + e_i$$

where: β_0 is the intercept, β_1 is the slope; ε_i denotes the *i*-th residual; I is an observation index; other like above.

–   creating the model 2 (the SUR), based on structural equations:

$$\begin{cases} E = \hat{\beta}_0 + \hat{\beta}_1 Glob_i + \hat{\beta}_2 Glob_{i(t-1)} + \hat{\beta}_3 Eco_{In\,i} + \hat{\beta}_4 Eco_{In\,i(t-1)} + \hat{\beta}_5 HDI_i + \hat{\beta}_6 HDI_{i(t-1)} + \hat{\beta}_7 M_{Si} + \hat{\beta}_8 M_{S\,i(t-1)} + \hat{\beta}_9 S + \hat{\beta}_{10} Env + e_i \\ S = \hat{\beta}_0 + \hat{\beta}_1 Glob_i + \hat{\beta}_2 Glob_{i(t-1)} + \hat{\beta}_3 Eco_{In\,i} + \hat{\beta}_4 Eco_{In\,i(t-1)} + \hat{\beta}_5 HDI_i + \hat{\beta}_6 HDI_{i(t-1)} + \hat{\beta}_7 M_{Si} + \hat{\beta}_8 M_{S\,i(t-1)} + \hat{\beta}_9 E + \hat{\beta}_{10} Env + e_i \\ Env = \hat{\beta}_0 + \hat{\beta}_1 Glob_i + \hat{\beta}_2 Glob_{i(t-1)} + \hat{\beta}_3 Eco_{In\,i} + \hat{\beta}_4 Eco_{In\,i(t-1)} + \hat{\beta}_5 HDI_i + \hat{\beta}_6 HDI_{i(t-1)} + \hat{\beta}_7 M_{Si} + \hat{\beta}_8 M_{S\,i(t-1)} + \hat{\beta}_9 E + \hat{\beta}_{10} S + e_i \end{cases}$$

The formula for the SUR estimator is as follows:

$$\sqrt{R} \cdot (\hat{\beta} - \beta) \xrightarrow{d} N\left(0, (\frac{1}{R} X^T \cdot \left(\sum -1 \otimes I_R\right) \cdot X)^{-1}\right)$$

where R – the number of observations, Ω – covariance matrix, X – equations, IR – the R-dimensional identity matrix; $\otimes$ denotes the matrix Kronecker product; $\widehat{\sum}$ – the matrix, y – vector.

4. Research results

Table 1 presents selected indicators describing the socio-economic situation in the analyzed countries. There is an increase in these indicators in both countries, indicating stable development and improved conditions and quality of life. Germany shows much higher eco-innovation indicators of economies, the standard of social life and macroeconomic stability.

TABLE 1.

Socio-economic indicators in Germany and Poland (2008–2020)

| Country	Germany				Poland			
Indicator	Glob	Eco_{In}	HDI	PSM	Glob	Eco_{In}	HDI	PSM
2008	83.61	130	0.92	0.6	83.88	39	0.83	0.37
2009	82.8	132	0.92	0.54	83.79	40	0.83	0.37
2010	83.7	134	0.93	0.61	83.4	40	0.84	0.35
2011	84.18	126	0.93	0.65	83.37	38	0.85	0.38
2012	84.5	127	0.93	0.65	84.23	41	0.84	0.4
2013	84.59	138	0.94	0.64	85.08	30	0.86	0.45
2014	84.77	135	0.94	0.69	86.6	53	0.86	0.48
2015	85.22	132	0.94	0.71	87.27	44	0.86	0.51
2016	85.54	135	0.94	0.73	87.26	56	0.87	0.52
2017	86.44	139	0.94	0.71	86.12	59	0.87	0.56
2018	86.51	137	0.95	0.75	85.47	59	0.88	0.57
2019	86.57	123	0.95	0.77	85.76	59	0.88	0.59
2020	87.01	133	0.95	0.79	87.12	63.8	0.89	0.62

Source: own elaboration on the basis: [www 1; www 2].

Chart 1 shows the indicator of the sustainable development of manufacturing enterprises in the period 2008–2020. There was a positive trend of the indicator in Germany and Poland, which should be assessed positively. It means that enterprises' implemented programs and activities are essential for sustainable development.

CHART 1.

**Sustainable development of manufacturing enterprises
in Germany and Poland**
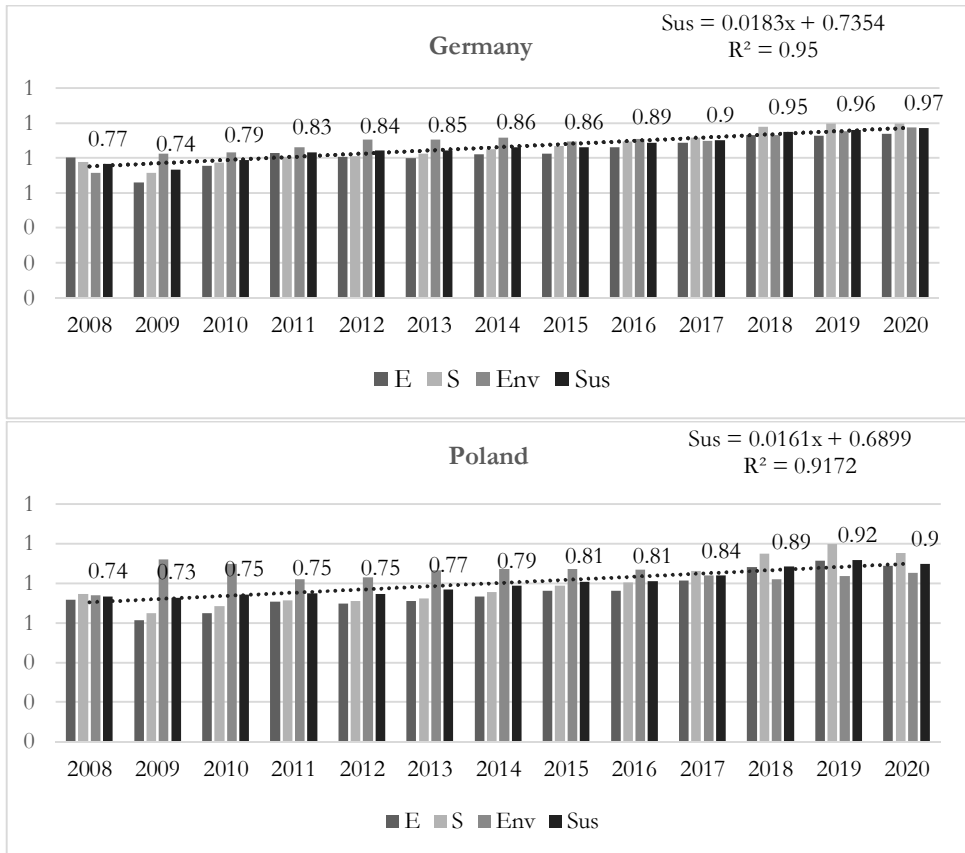
Source: own elaboration on the basis: [www 3].

Table 2 shows the results of the OLS estimation. The sustainable development of enterprises in Germany is influenced by eco-innovation, social development, and macroeconomic stability from the previous period. The impact of the PSM (-1) variable is negative, which means that maintaining macroeconomic stability does not go hand in hand with sustainable development. The sustainable development of Polish manufacturing enterprises is influenced by globalization (a negative impact) and the previous period's macroeconomic stability. The negative impact may result from the fact that globalization increases enterprises' competitiveness and focuses intensely on maximizing profits in the short term, which affects the social and environmental dimensions of enterprises' development.

The OLS regression: dependent variable (Sus$_D$) in Germany and Poland (2008-2020)

		Coefficient	Std. Error	t-ratio	p-value
Germany	Const	−9.28	0.39	−23.98	<0.0001
	EcoIn	−0.0009	0.00	−3.47	0.01
	HDI	11.15	0.45	24.88	<0.0001
	PSM(-1)	−0.28	0.05	−5.570	0.00
	Descriptive statistics and tests				
	Mean dependent var	0.87		S.D.	0.07
	Sum squared resid	0.00		S.E. of	0.00
	R-squared	1.00		Adjusted R-	1.00
	F(3. 25)	973.86		P-value(F)	0.00
	Log-likelihood	50.82		Akaike	−93.64
	Schwarz criterion	−91.70		Hannan-	−94.36
	rho	−0.14		Durbin-	2.25
Poland		Coefficient	Std. Error	t-ratio	p-value
	const	1.51	0.35	4.35	0.00
	Globalization	−0.01	0.00	−2.98	0.02
	PSM(-1)	0.88	0.07	12.03	<0.0001
	Descriptive statistics and tests				
	Mean dependent var	0.81		S.D.	0.07
	Sum squared resid	0.00		S.E. of	0.01
	R-squared	0.96		Adjusted R-	0.96
	F(3. 25)	122.98		P-value(F)	0.00
	Log-likelihood	36.36		Akaike	−66.71
	Schwarz criterion	−65.26		Hannan-	−67.25
	rho	−0.06		Durbin-	1.94

Source: own elaboration on the basis: [www 1; www 2].

The results of the SUR estimation (Table 3) indicate a strong differentiation as to the impact of individual variables of socio-economic development on the economic, social, and environmental development of industrial enterprises. The economic development of German enterprises is positively influenced by globalization and negatively by eco-innovation (eco-innovation requires costs and therefore reduces the financial result) and macroeconomic stability from the previous period (maintaining macroeconomic stability may affect the need to implement appropriate regulations in the field of inflation and interest rates, which may limit the ability to obtain loans to develop enterprises).

The macroeconomic stability of the previous period and economic development positively impact social development. The macroeconomic stability and economic development from the previous period positively influence environmental development.

**The SUR regression: dependent variable (E, S, Env) in Germany
and Poland (2008-2020)**

	Dependent	OLS	Coefficient	Std.	t-ratio	p-	R2
Germany	E	Const	−5.59	0.58	−9.72	0.00	0.97
		Glob	0.08	0.01	10.24	0.00	
		EcoIn	−0.00	0.00	−3.18	0.01	
		PSM(-1)	−0.44	0.15	−2.9	0.02	
	S	const	−0.08	0.06	−1.36	0.21	0.96
		PSM(-1)	0.32	0.14	2.32	0.05	
		E	0.87	0.12	7.37	0.95	
	Env	const	0.46	0.05	8.77	0.00	0.86
		PSM	0.34	0.09	3.70	0.01	
		E(-1)	0.25	0.09	2.76	0.02	
Poland	E	const	1.81	0.63	2.86	0.02	0.90
		Glob	−0.02	0.01	−2.42	0.04	
		PSM(-1)	1.28	0.14	9.09	0.00	
	S	const	2.61	0.57	4.54	0.00	0.95
		Glob	−0.03	0.01	−4.18	0.00	
		PSM(-1)	1.65	0.12	13.26	0.00	
	Env	const	−0.32	0.62	−0.51	0.62	0.56
		HDI	1.80	0.84	2.14	0.06	
		E	−0.48	0.15	−3.3	0.01	

Source: own elaboration on the basis: [www 1; www 2].

The economic enterprise development in Poland is negatively affected by globalization and macroeconomic stability from the previous period (this may indicate that these enterprises must cope with increasing market competition and are characterized by relatively low labour productivity). Globalization negatively affected social development and macroeconomic stability from the previous period positively impact on rhe social development. Environmental development is influenced by the human development index and negative economic development. The negative impact of economic development in Poland and Germany on the ecological component of industrial enterprises may indicate that these entities are constantly focusing their activities on the desire to maximize profit.

5. Conclusions

Sustainable development of enterprises aims to ensure a specific equilibrium between maximizing profits, increasing the company's assets base, and supporting employees, local communities, and environmental protection. The sustainable development of enterprises depends on several internal and external factors. The undertaken analyzes were limited only to external issues, including the socio-economic conditions in the analyzed countries.

Research results show that sustainable development and its three pillars: economic, social, and environmental development, depend on various socio-economic factors. The main research hypothesis, "There are differences in the strength and direction of the impact of individual socio-economic determinants on the sustainable development of Polish and German manufacturing enterprises from 2008 to 2020", is true. Sustainable development of manufacturing enterprises depends on eco-innovation (negative correlation indicating that ecological innovations do not translate into the development of the analyzed sector, human development, and macroeconomic stabilization from the previous period) In Poland, sustainable development depends on globalization (negative correlation points out that perhaps due to the increased competition, enterprises are focusing on economic indicators and macroeconomic stabilization).

The sustainable development of manufacturing enterprises in Germany and Poland has a positive trend. It is a positive phenomenon because enterprises take active efforts to achieve economic, social, and environmental goals.

Economic development does not show higher dynamics than social and environmental development. It is more rapid than the environmental development in both countries, but it shows lower growth dynamics than the social development. At the same time, the impact of macroeconomic stability from the previous period on sustainable development was noted. This correlation is negative in Germany, indicating that maintaining macroeconomic stability will undermine sustainable development in the future. In Poland, these relations are positive.

The impact of the socio-economic factors on economic, social, and environmental development in the analyzed countries is varied. External factors may influence economic, social, and environmental development slightly differently.

In recent years, there has been an improvement in enterprises' socio-economic conditions and sustainable development. Of course, German economy is at a higher level of development in terms of opportunities and results. In Poland, positive changes are taking place, which is visible in the case of the individual studied socio-economic indicators. A weakness of the Polish economy is its low innovation level and the low level of ecological investments. Governments must take further steps to support innovation and investments (financial and non-financial programs supporting the development of environmentally friendly technologies).

The study has significant limitations. The results are influenced, among others, by the selection of indicators for the models, being limited only to external variables, the choice of estimation methods or the adopted research period.

Further research will focus on attempts to assess a larger group of external and internal factors for the sustainable development of enterprises in the European Union countries.

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