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NEXUS BETWEEN FINANCIAL DEVELOPMENT AND SUSTAINABLE DEVELOPMENT GOALS (SDGS). EUROPEAN UNION PERSPECTIVE

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Abstract. In environmental, social, and governance (ESG) risk conditions, implementing Sustainable Development Goals (SDGs) becomes a key priority. This involves not only direct financing but also establishing a support system through sustainable financial products and services, supported by the development of financial markets, especially in terms of sustainability. Financial development varies across countries, prompting an examination of the relationship between the SDGs and financial development in the European Union countries. 27 countries were studied from 2008 to 2021 using the Financial Development Index (FDI) and 55 indicators from the SDGs database. Panel data analysis was conducted, utilizing geostatistics and econometrics, including the cartogram method, descriptive statistics, dynamics, relative growth indicators, and panel unit root tests. The analysis revealed that financial development expressed by the immediate and delayed FDI is the Granger cause of shaping the SDGs. The most robust relationships were diagnosed for FDI and SDG2, SDG5, SDG8, SDG11, SDG12, and SDG16. The article makes an original contribution to research because, to the best of the authors' knowledge, no similar research on FDI and SDGs has been conducted so far, and the research results may constitute a basis for authorities influencing FDI and SDGs.

Keywords: financial development, sustainable development, SDG, European Union, ESG, sustainability.

JEL Classification: Q01, G40, D70.

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1. Introduction

The implementation of the Sustainable Development Goals (SDGs) began in 2016 (Allen et al., 2018), and the SDGs themselves result from the so-called Agenda 2030, adopted in 2015 in New York by all 193 member states of the United Nations. Since the implementation of the SDGs, many journal papers have appeared with research results that concerned many research dimensions, including the effectiveness of the implementation of the SDGs by individual countries (Allen et al., 2018); dependencies between goals (Fonseca et al., 2020), financing the SDGs (Barua, 2020; Lagoarde-Segot, 2020); the role of innovation and technology in achieving the SDGs (Wahab et al., 2022; Abbasi et al., 2022); SDGs and financial inclusion (Jia et al., 2021), or green finance and SDGs (Lee, 2020). Research on the impact of financial development on the SDGs, or research on the relationship between individual SDGs and

financial development, usually covers the perspective of one country, such research was conducted, for example, for Pakistan (Abbasi et al., 2022), Jordan (Fraihat et al., 2023), or African countries (Mlachila et al., 2016). Several studies cover a broad approach to the relationship between sustainability and the SDGs (Boar et al., 2020); and SDGs and management in financial institutions (Rendtorff, 2020); SDGs and financial institutions (Alqashouti, 2022; Nanwani, 2019); or SDGs and bank profitability (Ozili, 2023). Due to the growing number of texts about the SDGs, articles on literature reviews are also an essential trend in publications (Allen et al., 2018; Pizzi et al., 2020). Despite many publications on the SDGs, there is a research gap in examining the direct relationships between the SDGs and financial development, including between financial development and individual SDGs. Understanding the relationship between financial development and the SDGs is essential because the prevailing view in the literature is that financial development can both support and inhibit the achievement of the SDGs (Then, 2023). Furthermore, from the perspective of the research problem, it is essential to know the relationship between FDI and the SDGs at the level of each goal and the level of individual countries because the degree of achieving the SDGs differs significantly between countries. Understanding these relationships is crucial for conducting the right sustainable development policy, i.e., one that most rationally steers the achievement of strategic SDGs, because achieving the same level of advancement of individual SDGs is not possible simultaneously in different socio-economic and geopolitical conditions. There will always be countries that are leaders in achieving the SDGs and countries that are catching up. Hence, it is essential to diagnose whether financial markets and their development level impact the dynamics of the SDGs in individual countries. To our knowledge, no publication explains these problems or examines them this way. The article aims to explore the relationship between FDI and the SDGs and fill the research gap. Two research hypotheses were formulated: *H1*: *financial development contributes to achieving SDGs*. *H2*: *the link between FDI and SDGs is not the same for all SDGs*, *and some SDGs react strongly to FDI*. The article poses the following research questions: is there a relationship between financial development (FDI) and the SDGs? Is this relationship equally strong for all SDGs? Are there any differences between the FDI relationship and the SDGs at the level of individual goals? How did respective countries cope with the implementation of the SDGs? And how the processes of reducing differences in implementing the SDGs occurred between countries. The article has particular value in research as it contains recommendations for decision-makers that may positively influence the implementation of state policies in SDGs and financial markets.

The paper is organized as follows: introduction is Section 1; Section 2 presents literature review. Section 3 presents the data and variables; explains research results and methodological framework. Section 4 provides discussion. Section 5 outlines conclusions and recommendations.

2. Literature review

The financial sector is a set of institutions, markets, instruments, and legal regulations that enable the flow and allocation of capital. The financial system fosters economic growth by supporting capital accumulation and promoting technological advancements, mobilizing and pooling savings, and creating and transmitting investment information (Nastu et al., 2020).

Financial development is the result of the efficient operation of financial instruments, markets, and intermediaries in ensuring the financial sector's economic efficiency (Word Bank, 2024).

The measure of the level of financial development is the Financial Development Index (FDI). According to the definition of the International Monetary Funds, it is "relative ranking of countries on the depth, access and efficiency of their financial institution and financial market". The most commonly used indicators of financial development can be broadly defined as financial depth, banking ratio and financial activity (Valickova et al., 2015). Financial depth, measured as the ratio of the financial system's liquid liabilities to gross domestic product (GDP), illustrates the size of the financial sector. The banking ratio is described as the ratio of bank credit to the sum of bank credit and central bank domestic assets (King & Levine, 1993). However, the ratio of private domestic loans granted by depository banks to GDP (Cole et al., 2008), the ratio of loans granted to private enterprises to total domestic credit (King & Levine, 1993) and the ratio of private domestic loans granted by depository banks and other financial institutions to GDP, are used as measures of financial activity (Andersen & Tarp, 2003).

The analysis of the literature on the subject allowed for identification of the most common directions of research in the field of financial development. The most common focus of research is the relationship between financial development and economic development. However, the results obtained in this regard are not clear. A positive relationship between financial development and economic growth was showed by, among others, Khan and Senhadji (2003), Valickova et al. (2015), Li et al. (2024), Pal and Mahalik (2024), Tian et al. (2024), Khayati and Terzi (2023), Al Khatib et al. (2023). Aluko and Opoku (2022) showed that financial globalization has a positive impact on financial development. Additionally, Guru and Yadav (2019) pointed out that the development indicators of the banking sector and the stock market stimulate economic growth. However, Purewal and Haini (2022) emphasized that although both financial markets and financial institutions promote economic growth, the impact of financial markets on economic growth is weaker.

The literature also includes studies that indicate a bidirectional relationship between financial development and economic growth (Lenka & Sharma, 2020). In turn, El Khoury et al. (2021), Chen and Ji (2023) and Odhiambo (2023) demonstrated that financial development does not always support the economic growth. According to their research results, some developing countries are still not positioned to benefit from financial development because of existing barriers that need to be monitored and eliminated.

An issue of interest to scientists is the relationship between financial development and investments, including those related to the concept of sustainability. Nguyen et al. (2023) studied the relationship between economic development and foreign direct investment (FDI) inflows to Vietnam during 1996–2021. The results showed that the Financial Development Index significantly influences the attraction of inward FDI. An et al. (2023) pointed out that the influence of financial institutions on the inflow of capital from foreign direct investments is stronger than that of financial markets.

Yan and Chen (2023), in a study analyzing panel data from thirty Chinese provinces and cities between 2010 and 2020, revealed that financial development positively influences high-tech industries. Manisha and Aneja (2023) based on data from the Indian manufacturing sector from 1998–2017 showed a long-term relationship between financial development and the productivity growth of the manufacturing sector.

An important direction of research is the impact of financial development on the scope and nature of investments, including those related to the implementation of Sustainable Development Goals. Ji et al. (2022) demonstrated that industrial modernizations and innovations in technology are crucial channels through which financial development helps reduce carbon intensity, with both factors exerting positive spatial effects. Teklie and Yağmur (2024), Shobande et al. (2024), Shobande and Ogbeifun (2022) in independent studies also confirmed that financial development positively impacts the reduction of carbon emissions and supporting sustainable development. Zhao and Yang (2020) further showed that regional financial development has a significantly delayed inhibitory effect on CO_2 emissions.

Different results in the analyzed area were obtained by Yudaruddin et al. (2023) who, examining greenhouse gas emissions in Indonesia in the period 2000–2019, showed that an increase in the Financial Development Index led to increased greenhouse gas emissions. Ofori et al. (2023), in turn, demonstrated that the impact of financial development on environmental pollution varies depending on the chosen indicator. Financial development causes the highest pollution effect for the private sector compared to foreign direct investment, while the Financial Development Index decreases environmental pollution. A similar bidirectional relationship between CO_2 emissions and financial development was pointed out by Emenekwe et al. (2022).

Li et al. (2024) indicated that the use of renewable energy reduces the financial market index in the long and short term. Qin et al. (2021) further showed that improvements in financial development, renewable energy and human capital index reduce greenhouse gas emissions. Shoaib et al. (2020) suggest that more funds should be invested in clean energy projects to improve the financial system. However, Ünlü et al. (2022) highlighted that the risk of a credit gap, considered a key indicator of systemic banking crises, can be mitigated by increasing the demand for renewable energy.

SDGs are extension of the Millennium Development Goals (MDGs) (De Jong & Vijge, 2021), but they treat the concept of sustainable development in a more thorough way (Chopra et al., 2022). They constitute a set of internationally agreed priorities (Park & Park, 2024) that are implemented at different institutional levels, i.e. global, national and local. Sustainable Development Goals are incorporated into action strategies at the level of governments, including local governments (Bisogno et al., 2023; Masuda et al., 2022), enterprises (Fiandrino et al., 2022; Ordonez-Ponce & Talbot, 2023) and programs teaching by academic centers (Leal Filho et al., 2023; Nelles et al., 2022).

Although the Sustainable Development Goals are the same for all countries, research in this area has shown both common areas and differences in the implementation of sustainable development strategies in individual countries (Allen et al., 2018; Ricciolini et al., 2022; Çağlar & Gürler, 2022; Reverte, 2022; Kuc-Czarnecka et al., 2023).

The Sustainable Development Goals are often the subject of research. The literature analysis allowed for distinguishing two main research trends. The first group of studies examines and maps the interdependencies between the SDGs (Zhu et al., 2022; Pakkan et al., 2023; Xiao et al., 2023; Fonseca et al., 2020). The second group focuses on studying the relationships of SDGs with other variables, such as energy efficiency (Zakari et al., 2022; Chien, 2022), environmental policy (Wang et al., 2022; Henderson & Loreau, 2023), financial performance

(Khan et al., 2021; Lee, 2020), green finance (Sachs et al., 2019; Ronaldo & Suryanto, 2022), and economic growth (Singh et al., 2022).

Previous research focused on analyzing the impact of financial development (FD) on individual SDGs (Fokam et al., 2023; Kanat et al., 2023; Timbi & Abdala, 2024; Chisadza & Biyase, 2023). To the best of the authors' knowledge, no research has yet explored the relationship between the level of financial development and the achievement of all Sustainable Development Goals (SDGs). Our study fills this research gap by providing answers to the questions if there is a relationship between FD and SDGs in individual EU countries and whether the relationship between FD and SDGs is equally strong for all Sustainable Development Goals. The research also examines if there is a convergence process in the implementation of SDGs between the countries studied.

3. Data

The study was conducted with the example of 27 European Union countries. The time scope of the study was 2008–2021. Secondary data, i.e. Financial Development Index (FDI) and 55 indicators (see Appendix, Tables A1 and A2) illustrating the implementation of sustainable development (so-called SDG) were used in the pre-analysis. All variables were logarithmically transformed. This was necessary due to the nature of the models and the need to achieve appropriate variable properties. Those variables that could not be logarithmized were excluded from the analysis (the domain of the logarithmic function is determined by the set of positive real numbers). In further analysis, the FDI indicator and 13 selected sustainable development indicators (SDGs) were included in the full study (Table 1). The choice of indicators for the study was dictated by the need to select indicators that had appropriate statistical features for the study (including stationarity at a specific level – Table 2).

Table 2 presents the results of the panel unit root test. It contains the results of the occurrence of a unit root, i.e. it evaluates the data properties in terms of data stationarity. Four tests were adopted to verify stationarity: (1) Levin, Lin & Chu t; (2) Im, Pesaran and Shin W-stat; (3) ADF – Fisher Chi-square; (4) PP – Fisher Chi-square. As it follows, all variables were stationary, so simple models with a lagged variable can be used (without verification of cointegrating relations, without additional transformations – to first differences, or without taking into account additional variables). This is also a premise for assessing the suitability of variables for the study. They are characterized by a desired attribute.

Figure 1 shows the spatial differentiation of financial development, measured by the FDI coefficient (average value for the analyzed period: 2008–2021). It is worth mentioning that FDI in dynamic terms followed a downward trend in the EU and most EU member states. A decrease of 9% in FDI in 2021 compared to the base period – 2008 (Figure 2). As the cartogram shows, there are visible disproportions between Western Europe and Central and Eastern Europe in financial development. The Central-Eastern Wall is characterized by much lower values. Figure 2 presents the relative increases/decreases in the studied variables.

The highest growth dynamics were recorded in the following variables: Percentage of senior management positions held by women, share of women in national parliaments, 135% each in 2021 compared to 2008, and area under organic farming, approximately 110%. The rate of urban waste recycling also recorded a spectacular increase of approximately 58% in

2021 compared to the base period. However, a high rate of decline was also recorded, including road traffic deaths (by approx. 50% in 2021 compared to 2008) or lethal accidents at work per 100 000 workers (by approx. 31% in 2021 compared to 2008).

Therefore, the dynamics of changes in the analyzed Sustainable Development Goals, understood through the prism of key SDG indicators, were different. On the one hand, the pace of change in some indicators was faster, but on the other hand, the changes were multidirectional. Some indicators recorded declines in the analyzed period, while others saw intense increases. They could be dictated by the phenomenon of convergence or divergence between the examined EU countries, and on the other hand, they could be the result of financial development measured by the FDI index.

Table 1. Variables used in the analysis (source: own elaboration)

Variable	Full name	Unit	Source	No of SDG
FDI	Financial Development Index	Index	Ineternational Monetary Fund, n.d.	–
AFIPAWU	Agricultural factor income per annual work unit (AWU)	Chain linked volumes (index 2015=100),	Eurostat, n.d.-a	2
AUOFOTUAA	Organic farming area	% of total utilised agricultural area (UAA)	Eurostat, n.d.-b	2
FAAWPTW	Lethal accidents at work per 100 000 workers	Number/100 000 workers	Eurostat, n.d.-c	8
GSTARAD	Government support R&D in agriculture	EUR per inhabitant	Eurostat, n.d.-d	2
ISOGDPBIS	Share of investment in GDP by institutional sectors	% of GDP, total investment	Eurostat, n.d.-e	8
PHBWISMP	Percentage of senior management positions held by women	% of positions, Board members	Eurostat, n.d.-f	5
PWCIEUIBIEC	Population that trusts in EU institutions by institution	European Commission, % of population	Eurostat, n.d.-g	16
RMC	Consumption of raw material	tonnes per capita	Eurostat, n.d.-h	12
RROMW	Rate of urban waste recycling	% of total waste	Eurostat, n.d.-i	11
RTD	Deaths in road traffic, by type of roads	Rate	Eurostat, n.d.-j	11
SHBWINP	Share of women in national parliaments	% of seats	Eurostat, n.d.-k	5
TLTURBS	Overall unemployment rate in long-term by sex	% of active population (aged 15–74)	Eurostat, n.d.-l	8
TYPNIENIEAT	Total number of young people who are neither in employment nor in education or training	% of population aged 15–29	Eurostat, n.d.-m	8

Table 2. Panel unit root tests (source: own computation)

Variable	Item	Levin, Lin & Chu t	Im, Pesaran and Shin W-stat	ADF – Fisher Chi-square	PP – Fisher Chi-square
FDI	statistic	–5.1847	–2.4037	84.7756	121.9930
	p-value	<0.0001	0.0081	0.0047	<0.0001
AFIPAWU	statistic	–4.4420	–2.4141	89.9943	70.3821
	p-value	<0.0001	0.0079	0.0015	0.0664
AUOFOTUAA	statistic	–5.1793	1.4001	73.8638	80.6077
	p-value	<0.0001	0.9193	0.0376	0.0109
FAAWPTW	statistic	–4.3049	–2.1805	86.5722	83.0143
	p-value	<0.0001	0.0146	0.0032	0.0068
GSTARAD	statistic	–3.6632	–1.9871	76.8324	67.2125
	p-value	0.0001	0.0235	0.0223	0.1069
ISOGDPBIS	statistic	–4.1634	–2.2408	89.2685	131.8720
	p-value	<0.0001	0.0125	0.0018	<0.0001
PHBWISMP	statistic	–9.1067	–2.5432	84.6709	82.0197
	p-value	<0.0001	0.0055	0.0048	0.0083
PWCIEUIBIEC	statistic	–4.2941	–3.1413	91.8873	86.7003
	p-value	<0.0001	0.0008	0.0010	0.0031
RMC	statistic	–6.2573	–5.1212	143.1970	194.3500
	p-value	<0.0001	<0.0001	<0.0001	<0.0001
RROMW	statistic	–5.2163	–1.1343	78.1915	116.8540
	p-value	<0.0001	0.1283	0.0173	<0.0001

Note: Test for unit root in level. Automatic selection of maximum lags – automatic lag length selection based on the Schwarz Information Criterion. In all analysed cases, the optimal lag number was equal to 1 year. Newey-West automatic bandwidth selection and Bartlett kernel.

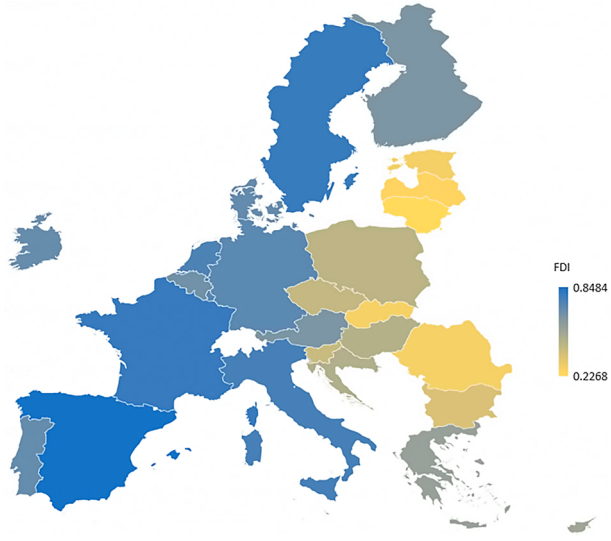

Figure 1. Spatial diversification of financial development measured by the average FDI index in EU countries in 2008-2021. Basemap from © GeoNames (n.d.) Microsoft (n.d.), OpenStreetMap (n.d.), TomTom n.d. (generated by MS Excel) (source: own elaboration based on data from Tables 3 and 4)

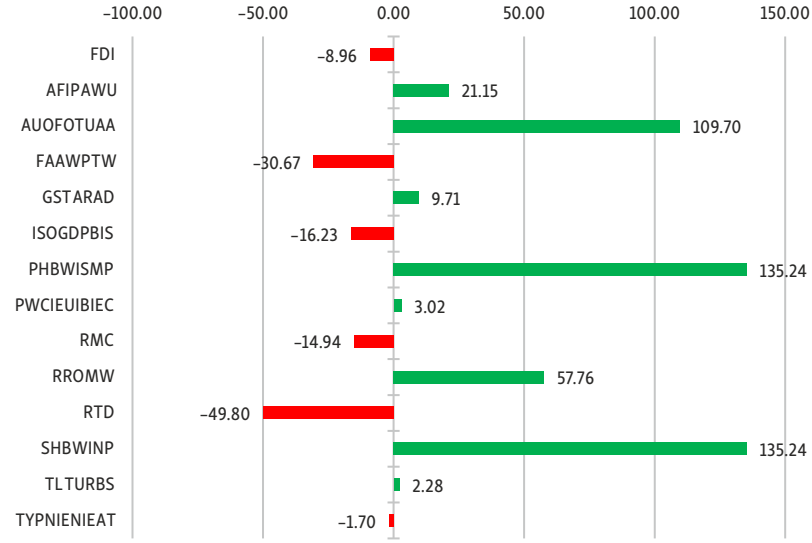

Figure 2. Percentage changes in the studied variables for EU countries (together) in 2021 compared to 2008 (source: own calculations based on data sourced in Table 1)

The picture of financial development and key indicators of the implementation of Sustainable Development Goals is complemented by descriptive statistics, including average values and the coefficient of variation. Tables 3 and 4 present the average values of the analyzed variables for the studied countries in the period 2008–2021. A clear division into Western European and Central-Eastern blocks is also noticeable for the agricultural factor income per annual work unit (AWU), Percentage of senior management positions held by women, share of women in national parliaments, total number of young people who are neither in employment nor in education or training and road traffic deaths variables. However, in the measure of road traffic deaths, lower values of road accidents were recorded in Western Europe than in Central and Eastern Europe.

It is worth mentioning in the context of the volatility index that in terms of FDI, the countries examined in the analyzed years were characterized by a low coefficient of variability. Only Slovenia achieved a volatility index of 18%. The OSGDPBIS analysis looks similar. The greatest variability in this respect was recorded for Ireland (40%), Greece (30%), Bulgaria (27%), Cyprus (21%) and Romania (17%). The remaining indicators of the implementation of sustainable development were characterized by a significant level of differentiation in the analyzed period for individual countries (Appendix, Table A3).

Table 3. Average FDI indicators and those expressing Sustainable Development Goals in EU's countries in 2008–2021 (variables 1–7) (source: own calculations based on data sourced in Table 1)

Country	FDI	AFIPAWU	AUOFO TUAA	FAAW PTW	GSTA RAD	ISOGD PBIS	PHBW ISMP
Austria	0.64	18 953.21	21.21	3.17	4.53	23.38	18.26
Belgium	0.66	36 479.21	5.20	1.88	3.91	23.24	22.69
Bulgaria	0.37	7041.29	1.54	3.54	2.84	20.13	15.72
Croatia	0.49	5611.93	4.41	2.61	1.38	21.01	19.13
Cyprus	0.53	18 441.64	3.90	2.33	8.89	18.91	7.89
Czechia	0.43	17 717.93	13.42	2.41	4.48	26.43	13.78
Denmark	0.69	35 741.00	7.88	1.40	15.32	20.41	24.69
Estonia	0.29	12 828.79	16.88	2.71	7.06	26.56	7.88
Finland	0.64	21 797.00	10.34	1.24	15.46	22.98	29.65
France	0.80	31 302.50	5.01	2.72	5.22	22.60	31.46
Germany	0.72	29 140.57	6.81	1.03	9.92	20.41	24.79
Greece	0.56	15 614.71	8.15	0.89	3.16	13.51	9.35
Hungary	0.48	8003.36	3.40	2.07	3.26	22.63	12.19
Ireland	0.69	17 529.71	1.41	2.17	20.16	27.08	15.46
Italy	0.77	20 124.07	11.93	2.52	5.04	18.52	22.34
Latvia	0.26	5767.21	11.95	3.54	3.90	22.86	26.26
Lithuania	0.23	5929.93	6.61	3.93	2.61	19.93	15.07
Luxembourg	0.73	21 412.29	3.60	3.30	0.56	18.04	10.79
Malta	0.52	13 062.14	0.35	2.27	1.37	19.62	5.65
Netherlands	0.75	44 036.71	3.04	0.58	9.39	20.34	25.41
Poland	0.45	5426.14	3.62	2.07	1.72	19.48	16.59
Portugal	0.69	10 051.57	7.07	3.55	1.99	17.96	13.65
Romania	0.28	3732.71	2.14	4.98	1.36	25.06	12.35
Slovakia	0.28	14 105.79	9.50	1.96	2.58	21.28	20.07
Slovenia	0.42	5425.93	8.48	2.30	4.33	20.34	19.74
Spain	0.85	28 675.71	8.06	2.08	10.29	20.07	18.23
Sweden	0.79	24 318.43	17.02	0.92	5.21	23.87	31.38

Table 4. Average FDI indicators and those expressing Sustainable Development Goals in EU's countries in 2008–2021 (variables 8–14) (source: own calculations based on data sourced in Table 1)

Country	PWCIEU IBIEC	RMC	RROMW	RTD	SHBWINP	TLTURBS	TYPNIE NIEAT
Austria	43.79	23.74	58.99	5.54	18.26	1.71	9.17
Belgium	56.29	14.05	53.76	6.56	22.69	3.14	12.30
Bulgaria	47.64	18.39	27.99	9.53	15.72	4.83	21.16
Croatia	42.29	13.71	17.32	8.92	19.13	6.34	17.50
Cyprus	38.64	25.81	13.77	6.51	7.89	3.44	16.14
Czechia	40.57	16.84	26.64	6.71	13.78	1.89	11.45

End of Table 4

Country	PWCIEU IBIEC	RMC	RROMW	RTD	SHBWINP	TLTURBS	TYPNIE NIEAT
Denmark	58.29	23.39	47.03	3.73	24.69	1.26	8.53
Estonia	53.50	26.24	25.19	5.78	7.88	3.14	12.91
Finland	56.57	45.25	37.59	4.71	29.65	2.10	10.14
France	36.36	13.87	38.99	5.32	31.46	2.61	12.84
Germany	42.36	15.86	65.71	4.21	24.79	2.16	10.24
Greece	30.07	15.50	17.91	8.49	9.35	11.24	20.79
Hungary	54.57	12.12	28.34	6.60	12.19	3.07	13.76
Ireland	49.86	12.54	37.97	3.81	15.46	4.57	16.34
Italy	39.64	12.41	41.56	5.89	22.34	5.82	23.44
Latvia	42.64	15.34	23.53	9.14	26.26	5.01	14.81
Lithuania	56.50	17.86	31.77	8.64	15.07	3.94	12.69
Luxembourg	58.86	31.03	48.42	5.98	10.79	1.61	7.12
Malta	51.71	12.70	11.02	3.12	5.65	2.56	10.63
Netherlands	56.50	8.59	52.38	3.26	25.41	1.54	6.56
Poland	49.00	17.04	25.25	8.94	16.59	2.45	14.14
Portugal	50.43	17.69	25.92	6.67	13.65	5.53	12.44
Romania	53.86	22.02	11.01	10.37	12.35	2.86	22.04
Slovakia	51.00	15.37	21.93	5.89	20.07	7.61	16.04
Slovenia	42.14	17.69	43.94	6.13	19.74	3.24	8.68
Spain	34.50	11.48	33.71	4.17	18.23	7.92	18.34
Sweden	55.43	24.90	46.21	2.86	31.38	1.96	7.19

Detailed descriptive statistics are included in the supplementary file – Table S1.

4. Methods

The article uses several statistical methods, including geostatistics and econometrics. The actual study was preceded by a pre-analysis in which the variables were examined in terms of spatial diversity, dynamics of change, and stationarity. For this purpose, the cartogram method, descriptive statistics (mean and coefficient of variation based on standard deviation and mean), dynamics and relative growth indicators, and panel unit root tests were used, i.e. (1) Levin, Lin, and Chu t (Levin et al., 2002; Kłos-Adamkiewicz et al., 2023); (2) Im, Pesaran and Shin W-stat (Im et al., 2003); (3) ADF-Fisher Chi-square (Choi, 2001); (4) PP-Fisher Chi-square (Zoundi, 2017). Based on similar properties in terms of stationarity, 14 variables were selected for the main analysis.

The main analysis prepared 13 cause-and-effect models of the impact of financial development on the implementation of SDGs, measured by specific indicators (Table 1). 13-panel models were built (employing the least squares method). The original model specification included random effects. This approach was necessary to use the Hausman test (Guggenberger, 2010) for correlated random effects. In all analyzed cases, this test indicated the need to re-estimate the models to a form with fixed effects. The model specification takes into

account not only the variable levels but also the first-order lag. All analyzed relationships in the models concerned immediate and delayed relationships. R-squared, adjusted R-squared (to compare models to each other – correction by the number of degrees of freedom), and the generalized Wald test for the significance of the entire model (see F-statistics) were used to evaluate the models.

In all analyzed models, the Wald test was additionally taken into account (Table 6) for the joint significance of FDI and FDI lagged by one year (FDI (–1)). The Wald test (Gregory & Veal, 1987) was necessary to confirm joint significance in the entire modeled system, and not in isolation from the rest of the model components. The assumption was then tested whether the coefficients at FDI and FDI (–1) were equal to zero. The Wald test in this sense allowed for confirmation of causality.

Based on the estimation of structural parameters in 13 models, a dependency graph was presented – considering the relationships between financial development (FDI) and indicators of the implementation of SDGs in the sense of immediate and delayed causality. In addition, the phenomenon of convergence was also examined, which involves catching up with the implementation of the SDGs by countries with lower capabilities in this field than countries that have higher potential and better results in implementing the SDGs.

Based on a panel model with fixed effects, beta convergence, the so-called beta-convergence. They are somewhat autoregressive in nature, so they could be conventionally formulated as:

$$\ln\left(y_{it}\right) = a + \left(1+b\right) ln\left(y_{it-1}\right) + \gamma \ln\left(FDI_{it}\right) + \delta \ln\left(FDI_{it-1}\right) + \mu_{it}, \quad (1)$$

where: y_{it} – the appropriate indicator for achieving the sustainable development goal (from Table 1) in country i and year t; y_{it-1} – the appropriate indicator for achieving the sustainable development goal lagged by 1 year in country i and year t ; FDI_{it} – Financial Development Index in country i and year t ; FDI_{it-1} – Financial Development Index lagged by 1 year in country i and year t ; a – constant; $(1 + b)$, γ, δ – structural parameters of the model; μ_{it} – random component of the model.

The rate of beta-convergence can be calculated from the formula (Kusideł, 2013):

$$\beta = -\ln\left(1+b\right), \quad (2)$$

if $\beta > 0$, then the process of convergence between countries takes place;
if $\beta < 0$, then the process of divergence between countries takes place.

The half-life factor, which indicates how long it takes to reduce the differences by half, can be calculated based on (Kusideł, 2013):

$$hl = \frac{ln2}{\beta}. \quad (3)$$

5. Results

Thirteen-panel cause-and-effect models were built, examining the impact of financial development (expressed by FDI) on Sustainable Development Goals (expressed by the variables in Table 1). Yearly delays are also taken into account. Faced with the dilemma of choosing a model with fixed effects or a model with random effects, a Hausman test was performed (correlated random effects, cross-section random effects test – Table 5).

Table 5. Hausman test – Correlated random effects (source: own computation)

Model number	Causes			Effect	Hausman test (Chi-squared statistic)	p-value	Selecting the model version
Model 1	FDI,	FDI (–1),	AFIPAWU (–1) →	AFIPAWU	58.1919	<0.0001	fixed model
Model 2	FDI,	FDI (–1),	AUOFOTUAA (–1) →	AUOFOTUAA	57.1272	<0.0001	fixed model
Model 3	FDI,	FDI (–1),	FAAWPTW (–1) →	FAAWPTW	154.0411	<0.0001	fixed model
Model 4	FDI,	FDI (–1),	GSTARAD (–1) →	GSTARAD	93.8038	<0.0001	fixed model
Model 5	FDI,	FDI (–1),	ISOGDPBIS (–1) →	ISOGDPBIS	94.5042	<0.0001	fixed model
Model 6	FDI,	FDI (–1),	PHBWISMP (–1) →	PHBWISMP	24.9453	<0.0001	fixed model
Model 7	FDI,	FDI (–1),	PWCIEUIBIEC (–1) →	PWCIEUIBIEC	70.2120	<0.0001	fixed model
Model 8	FDI,	FDI (–1),	RMC (–1) →	RMC	150.7465	<0.0001	fixed model
Model 9	FDI,	FDI (–1),	RROMW (–1) →	RROMW	44.6275	<0.0001	fixed model
Model 10	FDI,	FDI (–1),	RTD (–1) →	RTD	82.6798	<0.0001	fixed model
Model 11	FDI,	FDI (–1),	SHBWINP (–1) →	SHBWINP	24.9453	<0.0001	fixed model
Model 12	FDI,	FDI (–1),	TLTURBS (–1) →	TLTURBS	64.7086	<0.0001	fixed model
Model 13	FDI,	FDI (–1),	TYPNIENIEAT (–1) →	TYPNIENIEAT	61.2828	<0.0001	fixed model

Note: Reject the hypothesis that random effect is appropriate.

As shown by the results of the Hausman test, the null hypothesis that models with random effects are appropriate was rejected in favor of the hypothesis that fixed effects should be taken into account. Therefore, it was necessary to re-estimate the model panels to a form with fixed effects. Table 6 shows the results of the estimation of panel models with fixed effects. In addition to the structure parameters, standard error, t-statistic, and p-value were also estimated. Based on F-statistics, the generalized significance of the model can be estimated. All models are statistically significant and have high cognitive value.

Table 6. Results of estimation 13-panel models with fixed effects of influence FDI on SDGs by least squares (source: own computation)

Model 1	Dependent variable: AFIPAWU				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	AFIPAWU(–1)	0.6234	0.0455	13.6968	<0.0001
	const	3.4046	0.4152	8.1993	<0.0001
	FDI	–0.1885	0.1979	–0.9524	0.3416
	FDI(-1)	–0.132	0.1949	–0.6773	0.4987
	Cross-section fixed (dummy variables)				
	R-sq.			0.9588	
	Adjusted R-sq.			0.9551	
	F-statistics (p-val.)			257.5818 (<0.0001)	
Model 2	Dependent variable: AUOFOTUAA				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	AUOFOTUAA(-1)	0.7551	0.0294	25.6578	<0.0001
	const	0.2077	0.102	2.0358	0.0426
	FDI	–0.0646	0.242	–0.2667	0.7899
	FDI(-1)	–0.3352	0.2399	–1.3972	0.1633
	Cross-section fixed (dummy variables)				
	R-sq.			0.9662	
	Adjusted R-sq.			0.9632	
	F-statistics (p-val.)			316.6133 (<0.0001)	
Model 3	Dependent variable: FAAWPTW				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	FAAWPTW(-1)	0.2216	0.0551	4.0193	0.0001
	const	1.1636	0.1614	7.2089	<0.0001
	FDI	–0.0248	0.3482	–0.0712	0.9433
	FDI(-1)	0.9757	0.3463	2.8173	0.0051
	Cross-section fixed (dummy variables)				
	R-sq.			0.7955	
	Adjusted R-sq.			0.7771	
	F-statistics (p-val.)			43.0646 (<0.0001)	
Model 4	Dependent variable: GSTARAD				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	GSTARAD(-1)	0.4224	0.0546	7.7401	<0.0001
	const	0.3418	0.1946	1.7565	0.08
	FDI	–0.1452	0.4505	–0.3223	0.7474
	FDI(-1)	–0.547	0.4467	–1.2246	0.2216
	Cross-section fixed (dummy variables)				
	R-sq.			0.8779	
	Adjusted R-sq.			0.8668	
	F-statistics (p-val.)			79.5715 (<0.0001)	

Continue of Table 6

Model 5	Dependent variable: ISOGDPBIS				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	ISOGDPBIS(-1)	0.631	0.0355	17.7807	<0.0001
	const	0.9691	0.1251	7.747	<0.0001
	FDI	–0.0624	0.1126	–0.554	0.5799
	FDI(-1)	–0.1507	0.1111	–1.3561	0.176
	Cross-section fixed (dummy variables)				
	R-sq.			0.813773	
	Adjusted R-sq.			0.796949	
	F-statistics (p-val.)			48.3692 (<0.0001)	
Model 6	Dependent variable: PHBWISMP				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	PHBWISMP(-1)	0.8198	0.0269	30.5089	<0.0001
	const	0.2277	0.1138	2.0013	0.0462
	FDI	–0.4931	0.2593	–1.9014	0.0581
	FDI(-1)	–0.0069	0.2589	-0.0268	0.9786
	Cross-section fixed (dummy variables)				
	R-sq.			0.9011	
	Adjusted R-sq.			0.8922	
	F-statistics (p-val.)			100.8702 (<0.0001)	
Model 7	Dependent variable: PWCIEUIBIEC				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	PWCIEUIBIEC(-1)	0.6031	0.0444	13.5725	<0.0001
	const	1.3296	0.196	6.7837	<0.0001
	FDI	0.0029	0.1719	0.0169	0.9865
	FDI(-1)	–0.2969	0.1705	–1.7415	0.0825
	Cross-section fixed (dummy variables)				
	R-sq.			0.7512	
	Adjusted R-sq.			0.7287	
	F-statistics (p-val.)			33.4183 (<0.0001)	
Model 8	Dependent variable: RMC				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	RMC(–1)	0.5844	0.0346	16.9103	<0.0001
	const	0.9898	0.115	8.6057	<0.0001
	FDI	–0.0687	0.1241	–0.5534	0.5804
	FDI(-1)	–0.2021	0.1227	–1.6464	0.1007
	Cross-section fixed (dummy variables)				
	R-sq.			0.9412	
	Adjusted R-sq.			0.9359	
	F-statistics (p-val.)			177.2090 (<0.0001)	

Continue of Table 6

Model 9	Dependent variable: RROMW				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	RROMW(-1)	0.7274	0.0262	27.7803	<0.0001
	const	0.64	0.1031	6.2077	<0.0001
	FDI	–0.623	0.2251	–2.7672	0.006
	FDI(-1)	0.1291	0.2222	0.5812	0.5615
	Cross-section fixed (dummy variables)				
	R-sq.			0.9248	
	Adjusted R-sq.			0.918	
	F-statistics (p-val.)			136.0890 (<0.0001)	
Model 10	Dependent variable: RTD				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	RTD(-1)	0.5898	0.0378	15.6105	<0.0001
	const	0.8979	0.1267	7.0853	<0.0001
	FDI	0.1867	0.1761	1.0604	0.2898
	FDI(-1)	0.1608	0.1708	0.9419	0.347
	Cross-section fixed (dummy variables)				
	R-sq.			0.8991	
	Adjusted R-sq.			0.8899	
	F-statistics (p-val.)			98.5963 (<0.0001)	
Model 11	Dependent variable: SHBWINP				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	SHBWINP(-1)	0.8198	0.0269	30.5089	<0.0001
	const	0.2277	0.1138	2.0013	0.0462
	FDI	–0.4931	0.2593	–1.9014	0.0581
	FDI(-1)	–0.0069	0.2589	–0.0268	0.9786
	Cross-section fixed (dummy variables)				
	R-sq.			0.9011	
	Adjusted R-sq.			0.8922	
	F-statistics (p-val.)			100.8702 (<0.0001)	
Model 12	Dependent variable: TLTURBS				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	TLTURBS(-1)	0.8153	0.0265	30.8098	<0.0001
	const	0.9387	0.1287	7.2953	<0.0001
	FDI	0.529	0.2988	1.7705	0.0776
	FDI(-1)	0.5872	0.2953	1.9885	0.0476
	Cross-section fixed (dummy variables)				
	R-sq.			0.9044	
	Adjusted R-sq.			0.8957	
	F-statistics (p-val.)			104.6565 (<0.0001)	

End of Table 6

Model 13	Dependent variable: TYPNIENIEAT				
	Var.	Coef.	St. er.	t-Stat.	p-val.
	TYPNIENIEAT(-1)	0.7126	0.0376	18.9527	<0.0001
	const	0.9458	0.1175	8.0521	<0.0001
	FDI	0.2329	0.1285	1.8128	0.0708
	FDI(-1)	0.0943	0.127	0.7422	0.4585
	Cross-section fixed (dummy variables)				
	R-sq.			0.9376	
	Adjusted R-sq.			0.932	
	F-statistics (p-val.)			166.3281 (<0.0001)	

Note: The negative impact of FDI on the selected SDG indicator is marked in red. The (-1) mark next to the variable means a delay of one year. Abbreviations used in the table: Var. – Variable; Coef. – Coefficient; St. er. – Standard error; t-Stat. – t-Statistics; p-val. – p-value; R-sq. – R-squared.

As can be seen from the structure parameters, the greatest and positive impact on the SDGs has their delayed representations, in the case of variables such as agricultural factor income per annual work unit; area under organic farming; share of investment in GDP by institutional sectors; percentage of senior management positions held by women; population that trusts in EU institutions by institution; consumption of raw material; rate of urban waste recycling; deaths in road traffic, by type of roads; share of women in national parliaments; overall unemployment rate in long-term by sex; total number of young people who are neither in employment nor in education or training.

In the case of the two variables lethal accidents at work per 100,000 employees, and government support to R&D in agriculture, the lagged FDI has the greatest impact on their formation.

Analyzing the results for the 13 models presented in Table 6, one may have the impression that FDI and FDI (–1) are statistically insignificant. It would be possible to draw such a conclusion, but only in an isolated system, not in a combined one. Therefore, the significance of the total coefficients for FDI and FDI (–1) was verified using the Wald test (Table 7), which confirms that none of them can be removed from these models, as they are significant in the entire modeled system combined. It can be assumed that financial development expressed by the immediate and delayed Financial Development Index is the Granger cause of shaping the SDGs.

Therefore, after verifying the significance of the coefficients using the Wald test, a graphical relational model (Figure 3) of the causality of immediate FDI and FDI delayed by one year for the SDGs was prepared, understood through the prism of the analyzed indicators of the implementation of these goals (Table 1). After decomposing the model and its structural parameters into elementary parts, several important conclusions can be drawn, namely that Sustainable Development Goals are not flexible in relation to financial development. Several, however, almost proportional elasticity can be distinguished in the case of delayed financial development on fatal accidents at work and in the case of the immediate impact of financial development on raw material consumption.

Table 7. Results of the Wald test (source: own computation)

Null Hypothesis: Coeff (FDI) = Coeff (FDI (–1)) = 0				
Number model	test statistic	value	df	p-value
Model 1	F-statistic	3.0932	(2, 321)	0.0467
	Chi-square	6.1865	2	0.0454
Model 2	F-statistic	3.5267	(2, 321)	0.0305
	Chi-square	7.0534	2	0.0294
Model 3	F-statistic	10.3135	(2, 321)	<0.0001
	Chi-square	20.6270	2	<0.0001
Model 4	F-statistic	3.1498	(2, 321)	0.0442
	Chi-square	6.2995	2	0.0429
Model 5	F-statistic	4.6155	(2, 321)	0.0106
	Chi-square	9.2310	2	0.0099
Model 6	F-statistic	4.8732	(2, 321)	0.0082
	Chi-square	9.7464	2	0.0076
Model 7	F-statistic	4.1167	(2, 321)	0.0172
	Chi-square	8.2333	2	0.0163
Model 8	F-statistic	6.2945	(2, 321)	0.0021
	Chi-square	12.5891	2	0.0018
Model 9	F-statistic	6.7929	(2, 321)	0.0013
	Chi-square	13.5858	2	0.0011
Model 10	F-statistic	4.0563	(2, 321)	0.0182
	Chi-square	8.1125	2	0.0173
Model 11	F-statistic	4.8732	(2, 321)	0.0082
	Chi-square	9.7464	2	0.0076
Model 12	F-statistic	17.9730	(2, 321)	<0.0001
	Chi-square	35.9460	2	<0.0001
Model 13	F-statistic	8.2710	(2, 321)	0.0003
	Chi-square	16.5421	2	0.0003

The instant impact of financial development on sustainability implementation indicators was not in all cases the same as in the case of delayed causality. The lagged causality of financial development on the implementation of Sustainable Development Goals was stronger in the case of variables such as organic farming area; government support to R&D in agriculture; lethal accidents at work per 100,000 employees; share of investment in GDP by institutional sectors; overall unemployment rate in long-term by sex; population that trusts in EU institutions by institute.

Based on formulas 1–3, the beta-convergence index and the time necessary to reduce the differences by half were calculated. As Table 8 shows, based on 13-panel models, the estimated beta-convergence index was positive. This means that there was a process of convergence between the countries studied in the implementation of the Sustainable Development Goals. Countries that have lower capabilities in implementing Sustainable Develop-

ment Goals are trying to catch up with countries that implement sustainable development policies more effectively. The higher the beta-convergence rate, the faster countries reduce differences by half. The fastest process of reducing the differences by half is noticeable for the indicators: lethal accidents at work per 100,000 employees and government support to R&D in agriculture, this process lasts 6 months and 10 months, respectively. However, the

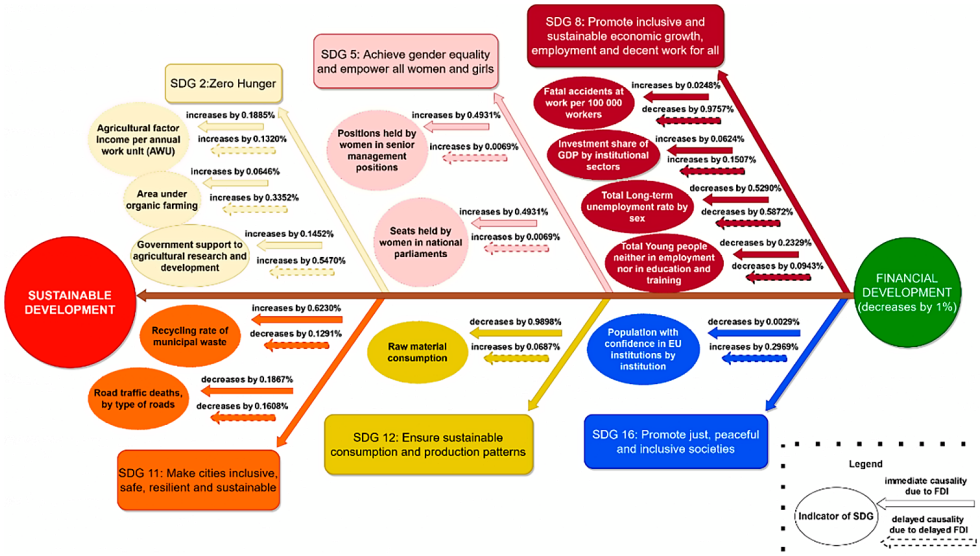

Figure 3. A causality model between financial development and sustainable development goals (source: own elaboration)

Table 8. Beta-convergence model of sustainable development by goals from causality model between financial development and Sustainable Development Goals (source: own computations)

Model	Variable	Beta-Convergence	Time to reduce differences by half	No. SDG
1	AFIPAWU	0.4725	1 year and 6 months	2
2	AUOFOTUAA	0.2809	2 years 6 months	2
4	GSTARAD	0.8619	10 months	2
6	PHBWISMP	0.1987	3 years and 6 months	5
11	SHBWINP	0.1987	3 years and 6 months	5
3	FAAWPTW	1.5070	6 months	8
5	ISOGDPBIS	0.4605	1 year and 7 months	8
12	TLTURBS	0.2042	3 years and 5 months	8
13	TYPNIENIEAT	0.3388	2 years and 1 month	8
9	RROMW	0.3183	2 years and 3 months	11
10	RTD	0.5280	1 year and 4 months	11
8	RMC	0.5372	1 year and 4 months	12
7	PWCIEUIBIEC	0.5057	1 year and 5 months	16

Note: If the beta-convergence coefficient is positive, then there is a process of convergence between countries. However, if the beta-convergence coefficient is negative, then there is a process of divergence between countries.

process of equalizing opportunities (understood as reducing differences) takes the longest in the case of indicators such as percentage of senior management positions held by women; share of women in national parliaments; and overall unemployment rate in long-term by sex; after about 3.5 years.

To sum up, the process of reducing differences by half does not take relatively long. EU member states are trying to implement sustainable development policies in selected areas, using their potential and catching up with countries with greater opportunities to meet these goals.

The research confirmed that there are differences in the achievement of SDGs between individual European Union countries, although the implementation of SDGs in individual countries shows convergence. Countries with lower capabilities to implement Sustainable Development Goals are trying to catch up with countries that are more effective in implementing sustainable development policies. In relation to the level of financial development, differences were also shown between individual EU countries, however in the period covered by the study (2008–2021) the coefficient of variation for countries under study was low. Our study confirmed the strongest impact of the level of financial development on the implementation of SDG 2 (Zero Hunger), SDG 5 (Gender Equality), SGD8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), SDG12 (Responsible Consumption and Production) and SDG 16 (Peace, Justice and Strong Institutions). The results show that Western European countries, where financial markets are better developed, perform better in achieving Sustainable Development Goals. On this basis, it can be inferred that an effective financial system, including financial markets, stimulate the process of sustain able development.

6. Discussion

In our study, we focused on analyzing how financial development (FD) is linked with Sustainable Development Goals (SDGs), demonstrating that financial development contributes to achieving these goals. Similar research was undertaken by Dutta and Saha (2022, 2023) in two independent studies, the results of which were included in publications from 2022 and 2023. They showed a positive relationship between FD and sustainable development. However, the authors note that policymakers need to monitor possible drawbacks of FDs that may undermine their contribution to sustainable development.

Our study shows that the strongest relationship between the SDGs and FD exists for SDG 2. The obtained results are in line with the research results of Fokam et al. (2023), who, based on panel studies in 40 African countries, confirmed that financial development reduces malnutrition. The main transmission channels through which financial development contributes to the reduction of malnutrition were identified as: education, health care expenditure and access to electricity.

This study also reveals the relationship between the level of financial development and the implementation of SDG 5 – gender equality and SDG 8 – decent work and economic growth. The results of this study are consistent with those obtained by Kanat et al. (2023), who, based on data for Pakistan from 1985–2022, showed that financial development reduces gender inequality and reduces poverty. The positive impact of financial development on reducing

poverty was also demonstrated by Timbi and Abdala (2024) based on data from 29 countries in Sub-Saharan Africa. However, Chisadza and Biyase (2023) noted that financial development reduces inequality in emerging and least developed countries, but such an effect is not statistically significant for developed countries. The development of the banking sector reduces income inequality in emerging and least developed countries, while the development of capital markets may increase inequality in developed countries. Additionally, Raifu et al. (2023) showed a unidirectional negative correlation between financial development and unemployment, especially total unemployment and male unemployment among youth and adults. They confirmed that financial development reduces the unemployment rate both overall and for youth and men. Younsi and Bechtini (2020) indicated that income inequality hinders economic growth in BRICS countries.

The results of our research confirm the strong relationship between financial development and SDG 16 – peace, justice and strong institutions and SDG 11 – sustainable cities and communities. The positive impact of economic and financial development and institutional quality in the process of closing the income gap was demonstrated by Neagu et al. (2023). Ofori et al. (2023) based on their research, showed that quality regulations have a positive impact on reducing environmental pollution. Institutional management contributes to reducing pollution through strong legal regulations and corruption control.

Bodenhorn and Cuberes (2010) found a strong positive relationship between financial development and later urban growth in the northeastern U.S. between 1790 and 1870. Additionally, Zhang et al. (2023) confirmed that financial development enhances the sustainable competitiveness of cities in developing regions. Consequently, local governments should prioritize expanding the scale and quality of financial development, boosting financial efficiency, and actively promoting the liberalization of financial markets and the innovation of financial products.

7. Conclusions

The SDGs and the factors determining their achievement have become one of the most critical issues in research and economic practice. The SDGs support the achievement of sustainable development assumptions and, above all, support lowering the negative impact of human activity on the environment, which is one of the main priorities in the conditions of growing ESG risk. The review of research shows that limited attention is devoted to the analysis of the relationship between FDI and the SDGs; hence, the article attempts to fill this gap. The paper aims to examine the relationship between the SDGs and financial development in the European Union countries and diagnose which SDGs' financial development has the most significant impact on their implementation. The study was conducted in the period 2008–2021 with the example of 27 European Union countries. Financial Development Index (FDI) and 55 indicators were the basis for analysis. After selection, FDI indicator and 13 selected indicators were the basis for the final research. Panel data analysis was used in the research process, and several quantitative methods, including geostatistics and econometrics, including the cartogram method, descriptive statistics, dynamics, and relative growth indicators, and panel unit root tests were used, i.e., Levin, Lin, and Chu t; Im, Pesaran and Shin W-stat; ADF-Fisher

Chi-square, PP-Fisher Chi-square. The study's original research approach and novelty are expressed in the article, identifying the most important and influential research trends in investigating the links between financial development and SDGs. At the same time, none of the articles already published that we know of examines so broadly the relationships between all SDGs and FDI at the level of European Union countries. Usually, studies cover one SDG or group of SDG goals or show the perspective of one country or group of countries. Hence, the article provides much broader knowledge about the relationships between all SDGs and FDI than the publications published. The significance of the research is expressed through their direct impact on public strategies and policies, including sustainable development policy, financial market development strategies at the level of individual countries, and redistribution policy because knowledge about the interactions between the SDGs and financial development and the strength of these interactions is essential in the process of allocating public funds or creating regulations and an environment for the development of financial markets.

Based on research results, we proved that a relationship between financial development (FDI) and the SDGs exists, and that financial development contributes to achieving SDGs (research hypothesis 1). The analysis showed that the link between FDI and SDGs is not the same for all SDGs and that some SDGs react strongly to FDI (research hypothesis 2), like SDG2. Also, the relationship between SDG5, SDG8, and FDI is more vital than that of other SDGs. FDI has a positive impact, especially in mitigating hunger (SDG2) and reducing gender inequality (SDG5) and poverty (SDG8). There is also a strong positive impact between FDI and SDG11 (sustainable cities and communities) and SDG16 (peace). These findings confirm both research hypotheses.

The research showed that among EU countries, there are two groups of countries that differ in achieving SDGs – countries that have lower capabilities in implementing sustainable development goals (Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia) and countries that implement sustainable development policies more effectively (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Spain, Sweden). Countries that are performing poorly in achieving the SDGs are taking action to catch up with countries that are implementing the SDGs more effectively. The most visible reduction in differences concerns variables such as lethal accidents at work per 100,000 employees and government support for R&D in agriculture; this process lasts six months and ten months, respectively. However, equalizing opportunities (understood as reducing differences) takes the longest in the case of indicators such as percentage of senior management positions held by women, share of women in national parliaments, and the overall unemployment rate in long-term by sex after about 3.5 years. The research results may be helpful for decision-makers in the government and private sector responsible for implementing the SDGs and their financing. In particular, the government sector responsible for creating the environment for the functioning of financial markets should take action to support the development of financial markets, as these markets positively impact the achievement of the SDGs. Government actions may concern fiscal policy and support programs for financial institutions to encourage them to engage in activities to implement the SDGs. In turn, public policies towards enterprises and households should be aimed at supporting expenditures consistent with individual SDGs

through a system of preferential loans and grants and promoting green behavior through a system of tax reliefs and exemptions. Policymakers should also pay attention to the specific impact of SDGs not strongly linked to FDI by providing public co-financing for these SDGs.

The authors acknowledge the limitations of the study, particularly related to data access and the research methodology. Future work will concern in-depth study on the relationship between FDI and the SDGs most closely related to FDI – SDG2, SDG5, SDG8, SDG11, and SDG16.

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Author contributions

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APPENDIX

Table A1. Analyzed indicators that express the sustainable development goals (source: own elaboration)

ABBREVIATION	FULL NAME	No of SDG
ACO2EPKMFNPC	Average CO_2 emitted by new passenger cars per km, g CO_2/km	12
AEFA	Agriculture emissions of ammonia, kg/ha	2
AFIPAWU	Agricultural factor income per annual work unit (AWU) (source: EC services), Chain linked volumes (2010), 1000 EUR/AWU	2
APILITPFW	Adult participation in learning in the past 4 weeks, % of population aged 25–64	4
AUOFOTUAA	Organic farming area, % of total utilised agricultural area (UAA)	2
CMUR	Rate of circular material utilization, % of material input for domestic use	12
CPISS	Corruption Perceptions Index, scale from 0 (high corruption) to 100 (no corruption)	16
EIDBP	Dependency on imported energy by products, imports as % of total gross available energy	7
ELFEATBS	People that leave education and training early, % of population aged 18–24	4
EP	Energy productivity, Purchasing power standard (PPS) per kg of oil equivalent	7
ERBC	Rate of employment, by citizenship, % of population aged 20–64	8
EUIFDCBCIG	Imports to EU from developing countries by groups of country income, mln EUR, Development assistance committee (DAC); bln EUR	17
FAAWPTW	Lethal accidents at work per 100 000 employees	8
FEC	Final consumption of energy, Tonnes of oil equivalent (TOE) per capita	7
FECIHPC	Final consumption of energy in households per capita, kilogram of oil equivalent	7
GDEORD	Gross domestic spending on Research & Development, % of GDP	9
GEG	Gender employment gap, aged 20–64, % of total population	5
GGGD	General government gross debt, % of gross domestic product (GDP)	17
GGTEOLC	General government Total spending on law courts, EUR per inhabitant	16

Continue of Table A1

ABBREVIATION	FULL NAME	No of SDG
GSTARAD	Government support to R&D in agriculture, EUR per inhabitant	2
HCORPS	Rate of housing cost overburden by poverty status – EU-SILC survey, % of population	1
HLYB	Healthy life years at birth, years	3
ISOGDPBIS	Share of investment in GDP by institutional sectors, % of GDP, total investment	8
ISOTB	Income share of the bottom 40% of the population, % of income	10
NGGE	Net emission of greenhouse gas, tonnes/capita	13
NGGEOTLU	Net emission of greenhouse gas of the Land use, Land use change and Forestry (LULUCF) sector, kilo tonnes	13
ODAASOGNI	Official development assistance as percentage of gross national income (source: OECD, n.d.), % of gross national income (GNI)	17
PATTEPO	Patent applications to the European Patent Office (source: EPO, n.d.), Per mln inhabitants	9
PEC	Primary consumption of energy, Tonnes of oil equivalent (TOE) per capita	7
PHBWISMP	Percentage of senior management positions held by women (source: Eurostat, n.d.-f), % of positions, Board members	5
POTLFDTCR	Persons outside the labour force because of caring duties, % of total population aged 20–64	5
PPAGDPPC	Purchasing power adjusted GDP per capita	10
PRIPRAST	People exposed to risk of income poverty after social transfers,%	1
PUTKHAWBPS	Population incapable to adequately heat their homes by poverty status, % of population	7
PWCIEUI	Population that trusts in EU institutions – European Parliament, % of population	16
PWCIEUIBIEC	Population that trusts in EU institutions (source: Eurostat, n.d.-g), European Commission, % of population	16
PWCIEUIBIECB	Population that trusts in EU institutions (source: Eurostat, n.d.-g), European Central Bank (ECB), % of population	16
RDPBS	Employment in R&D, % of active population, All sectors	9
RGDPPCCH	Real GDP per capita, Chain linked volumes (2010), EUR/capita	8
RMAROPG	Relative median at-risk-of-poverty gap, % distance to poverty threshold	10
RMC	Consumption of raw material, tonnes per capita	12
RROMW	Rate of urban waste recycling, % of total waste	11
RTD	Deaths in road traffic, by type of roads (source: Eurostat, n.d.-j), rate	11
SHBWING	Share of women in national governments, % of seats	5
SHBWINP	Share of women in national parliaments, % of seats	5
SHDR	Severe housing deprivation rate, % of population	11
SOEITTR	Proportion of environmental taxes in total tax revenues, % of total taxes, Total environmental taxes	17
SOPWGOVGPH	Percentage of individuals reporting good or very good perceived health, % of population aged 16 or older	3

End of Table A1

ABBREVIATION	FULL NAME	No of SDG
SOREIGFEC	Percentage of renewable energy in gross final energy consumption, %	7
SRUNFMCBDR	Self-reported unmet medical care needs by detailed reason, % of population aged 16 and older, Too high cost or too far or long time of waiting	3
TEABS	Tertiary educational attainment by sex, % of population aged 25–34	4
TERBS	Total employment rate by sex, % of population aged 20–64	8
TLTURBS	Overall unemployment rate in long-term by sex, % of active population (aged 15–74)	8
TPLIHCTTSFN	Total population residing in households that report suffering from noise, % of population	11
TYPNIENIEAT	Total number of young people who are neither in employment nor in education or training, % of population aged 15–29	8

Table A2. Coefficient of variation for the studied variables (1–7) in 2008–2021 (in %) (source: own computations)

Country	FDI	AFIPAWU	AUOFOTUAA	FAAWPTW	GSTARAD	ISOGDPBIS	PHBWISMP
Austria	6	9	14	19	12	5	52
Belgium	4	10	30	29	31	3	51
Bulgaria	2	37	67	12	24	27	20
Croatia	2	19	60	19	65	12	24
Cyprus	10	17	31	52	26	21	39
Czechia	14	18	13	16	16	4	33
Denmark	3	33	28	16	19	8	25
Estonia	7	25	26	31	33	10	12
Finland	5	12	28	23	22	4	15
France	3	14	49	13	12	4	43
Germany	4	16	20	19	18	3	37
Greece	12	10	17	24	30	30	39
Hungary	11	22	43	16	44	12	28
Ireland	6	16	23	20	7	40	51
Italy	2	11	28	15	17	8	64
Latvia	14	30	21	21	41	14	19
Lithuania	13	25	22	19	21	12	18
Luxembourg	2	14	23	37	73	6	53
Malta	3	16	47	51	49	11	58
Netherlands	4	9	20	29	28	7	31
Poland	3	21	21	35	50	8	33
Portugal	5	20	52	32	31	14	67
Romania	4	16	44	25	47	17	27
Slovakia	4	32	17	19	47	7	31
Slovenia	18	15	19	26	26	15	27
Spain	3	14	19	10	24	14	43
Sweden	2	9	18	25	17	5	17

Table A3. Coefficient of variation for the studied variables (8–14) in 2008–2021 (in %) (source: own computations)

Country	PWCIE UIBIEC	RMC	RROMW	RTD	SHBWINP	TLTURBS	TYPNIE NIEAT
Austria	13	6	4	23	52	22	5
Belgium	9	7	2	22	51	19	9
Bulgaria	12	14	19	19	20	40	15
Croatia	12	16	59	28	24	50	17
Cyprus	31	28	23	25	39	69	16
Czechia	24	8	38	22	33	51	10
Denmark	10	11	9	36	25	39	13
Estonia	14	9	20	29	12	68	18
Finland	7	8	11	15	15	25	9
France	12	8	7	16	43	15	5
Germany	17	4	3	16	37	41	12
Greece	41	28	9	32	39	42	20
Hungary	9	21	27	19	28	52	17
Ireland	25	26	7	26	51	62	26
Italy	18	15	22	17	64	26	8
Latvia	15	16	53	23	19	54	23
Lithuania	11	18	53	32	18	54	16
Luxembourg	5	12	6	29	53	20	10
Malta	12	17	26	31	58	43	18
Netherlands	11	10	7	12	31	46	17
Poland	8	9	45	26	33	55	10
Portugal	24	17	19	18	67	44	18
Romania	8	23	40	18	27	26	15
Slovakia	16	21	68	30	31	39	11
Slovenia	20	19	36	28	27	41	16
Spain	27	27	12	25	43	42	15
Sweden	11	6	7	23	17	23	13