THE CONTRIBUTION OF THE EU FDIs TO THE REDUCTION OF ROMANIA'S MANUFACTURING PRODUCTION CO_2 EMISSIONS: HIGHER EXPORTS AND GDP GROWTH

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Abstract
Reducing the CO_2 footprint of Romanian manufacturing production under the positive influence of the EU foreign direct investments (FDIs) can have a substantial contribution to Romania's presence on the EU common market. Moreover, it might contribute to the increase the country's GDP. To prove the assumptions, the author developed an econometric model that he called *„A predictive model of the CO_2 emissions inter-country interaction"*, based on multiple linear regression, using a highly unique and latest database published by Eurostat, in 2022. He also designed several scenarios regarding the positive impact on the Romanian economy based on reducing the CO_2 emissions generated by the EU FDIs. In the base scenario, a 1.5% annual reduction of the CO_2 emissions generated in Romania due to the FDIs originating from the EU Member States could stimulate an 1% annual increase of the intra-community deliveries. This impact would determine an increase of Romania's GDP by 0.3%. To have a realistic contribution to achieving the goal of a net zero economic model, the EU FDIs should obtain, between 2025 – 2050, a ten-time decreasing rhythm of their CO_2 emissions. From minus 0.4%, the actual average decrease annual level between 2010 – 2020, the FDIs must decrease their emissions by 4% per year. This would increase Romania's annual intra-deliveries by 2.6%, adding 0.8% per year to Romania's GDP growth.

Keywords
Foreign direct investments, GDP, CO_2 emissions, trade

JEL Classification
F00, F40, F45

Introduction

As a European Union Member State, Romania benefits from a large internal market and participates in the free movement of goods, services, and EU investment allocation. This

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integration has encouraged economic growth and social development. After joining the EU, Romania also experienced a sharp development in several key manufacturing sectors with higher technological intensity, enabling its further integration into the EU value chains. However, when it comes to curbing CO_2 emissions, Romania reports both progress and challenges. But, like many other countries, Romania's economy heavily relies on fossil fuels and on several energy-intensive activities. Those have been, over time, significant contributors to the state budget, to jobs creation and for the country's expansion on the foreign markets. However, Romania's economic landscape has a mixed image. The bright spots are made from the consistent share of renewables in the power mix. Romania has a low share of the CO_2 emissions per capita and its GDP growth is disconnected from generating new CO_2 emissions. The grey spots represent the low share of investments in the decarbonization of the energy-intensive manufacturing sector. While the EU trade is starting to prioritize sustainable practices and environmentally friendly production and goods, Romania must comply with these standards when exporting raw materials and products within the EU market.

Given the importance of this paradigm change, the objective of this paper was to demonstrate the positive impact of rerouting the foreign direct investments made in Romania by other EU member states towards low carbon manufacturing processes. The author demonstrated that the Romanian economy might gain, in this way, a larger access to the broader European market, ultimately reflecting in a higher GDP growth.

1. Review of the scientific literature

Romania's presence on the foreign markets and, especially on the EU common market, has been in the past 15 years a continuous growth. According to Eurostat, during 2010 – 2020, the average annual growth rate of Romanian exports on the EU market was 6%. This high level was due not only to the increase of the export share of the industrial sectors with above-average technological intensity, but also because the competitiveness of Romania's exports was based on low prices, low production costs and low-cost labour force. (Bostan, 2016)

In the race to capture new opportunities on the foreign markets, during 1990 – 2012, *"Romania practised a non-competitive, unproductive export, selling either raw natural products or products with a rudimentary level of processing, obtained from derelict industrial facilities that were abandoned for lack of competitiveness."* (Ciutacu & Chivu, 2015).

Due to these factors, Romania had to manage many challenges and some of them remained partially unresolved. Thus, achieving sustainability related objectives in the manufacturing sector was often left behind. Research conducted by Batrancea, et al. (2020) concluded that, during 2005 – 2017, Romania's *„sustainable economic growth was significantly influenced by the level of the CO_2 emissions"* and the authors recommended that Romania *"should encourage green investments in order to reduce pollution levels."*

The International Trade Center (2021) draws attention to the fact that Romania has a large opportunity to increase its presence in the EU common market. According to the available data, Romania has the potential to spur by 70% the value of its intra-EU deliveries, which would represent a leap from EUR 45.7 bn to EUR 77.5 bn. The author identified that the biggest opportunities are waiting in the main three Western EU markets – Germany, EUR 7.27 billion, Italy – EUR 3.73 billion and France – EUR 3.08 billion. Combined, all together represent almost 45% of the potential value increase.

Therefore, one solution to close the gap between the actual and potential intra - EU deliveries of Romania is to determine the EU's private and public consumption spending habits to stimulate the EU FDIs to reduce their CO_2 footprint generated in the Romanian manufacturing sector. Otherwise, as Eicke and Goldthau (2021) pointed out, *„uneven access to low carbon finance and technology may give rise to energy transition frontrunners and laggards."*

A survey carried out by Deloitte (2022) tried to identify whether locally based Romanian companies have plans to reduce their CO_2 emissions and what is the connection between emissions and competitiveness. The survey concerned the opinion of 110 CFOs. From the results obtained, it emerged that 54% of the respondents claimed that the companies they work for have decarbonization plans, as follows: 14% have plans to reach net-zero emissions, 24% plan to reduce them by at least 50% of CO_2 emissions and 16% proposed a reduction in emissions of up to 50%. Conversely, 39% of the representatives of the surveyed companies reported that the companies they work for do not have concrete plans to reduce emissions, while 7% stated that reducing emissions is not an objective. An aspect that should be mentioned is that the largest share of companies with decarbonization plans is found in the industrial production sector, namely 67%.

In the new paradigm of competitiveness, companies and investors are beginning to view carbon emissions not only as a cost generator, but as an incentive for value creation, being pushed in this direction by the new climate policies. However, as Porter and der Linde highlighted, (1995) *„properly designed environmental standards can trigger innovations that lower the total cost of a product or improve its value. Such innovations allow companies to use a range of inputs more productively—from raw materials to energy to labour—thus offsetting the costs of improving environmental impact and ending the stalemate. Ultimately, this enhanced resource productivity makes companies more competitive, not less."*

The causal relationship between FDIs, CO_2 emissions and economic growth sparked the attention of numerous researchers. Gokmeno and Taspinar (2015) tested in scientific research *„the validity of the pollution haven hypothesis"* in the case of Turkey's economy. Horobet et. al. (2021) demonstrated in another analysis, that *„FDIs, exports, and imports have positively impacted the reduction in CO_2 emissions"* in the case of the European Union.

In a previous scientific paper, the author highlighted the works of other several analysts regarding the critical role of foreign direct investments in reducing the emissions. For example, in a study about Latin America and FDIs, several scientists highlighted the fact

that, during the period 1980 – 2007, FDI inflows in energy-intensive industries could have been related to a steady rise in CO_2 emissions (Blanco, Gonzales and Ruiz, 2013).

On the other hand, other studies have shown that the presence of FDIs stimulated technological innovations which contributed to reducing carbon emissions (Lin, et al., 2022). In a study focusing on foreign direct investment in Asia (Sarkodie and Strezov, 2019), it was shown, using the Kuznets curve, that foreign direct investment increased CO_2 emissions in China and Indonesia.

Another study (Lee, 2013) found that foreign direct investment has increased energy consumption in the G20 member states; however, it has not demonstrated a direct and possible increase in CO_2 emissions. On the other hand, the IMF (Borga, 2021) has conducted comprehensive research to analyse the impact of the FDIs on increasing CO_2 emissions in the host economy. The IMF looked at carbon emissions in relation to FDI's Gross Fixed Capital Formation and those embodied in Multinational Enterprises Output / Exports and the conclusion was that FIDs can have a direct impact on increasing carbon emissions.

For Romania to reach the sustainable goal of a net zero CO_2 economy, the National Committee for Macroprudential Supervision of the National Central Bank (2021) estimated that the decarbonization process will require a level of investments in the amount of EUR 60 billion. Regarding the overall picture of the total FDIs made in Romania, the amount increased from EUR 42.7 billion in 2007 to about EUR 100 billion in 2021. The top five countries as a source of FDIs were, in 2021, Germany (EUR 14.9 billion), Austria (EUR 10.7 billion), France (EUR 9.7 billion), Italy (EUR 7.9 billion) and the USA (EUR 7.8 billion) which represented a share of over 50% of the total FDIs. The EU countries in this hierarchy are also identified as Romania's main export markets.

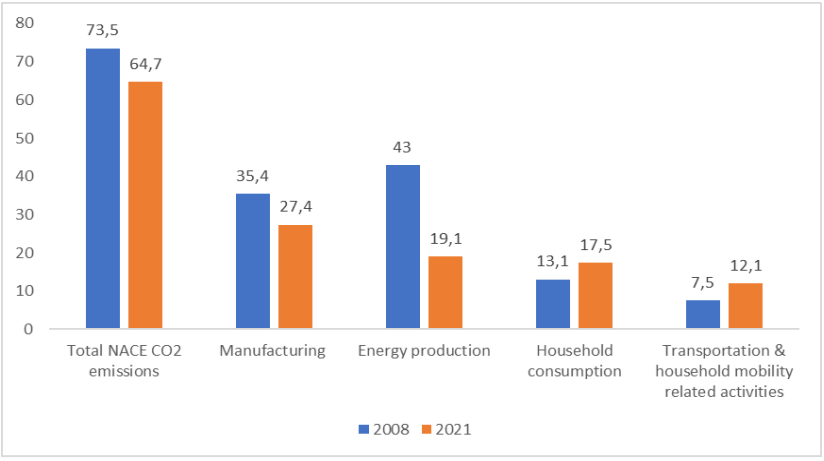
Therefore, one solution identified by the author to finance the decarbonization needs of Romania might be through rerouting an important share of the EU FDIs net inflow from carbon-intensive operations to zero-carbon ones. In a such scenario, the EU FDI net inflow level estimated by the author for the period 2025 – 2050 should reach, on an annual basis, more than EUR 2.4 billion, which represents more than 55% of the annual EU FDI net inflow recorded during 2007 – 2021, namely EUR 4.5 billion.

The investment needs are obvious. The Romanian industrial production exports contribute to the local economy's presence in the foreign markets, especially in the EU common market. More than 90% of the first 200 Romanian exporting companies have EU ownership. The total value of intra- and extra-EU Romanian industry exports reached the threshold of EUR 67.1 billion in 2021, representing a share of 89.5% of Romania's total exports, according to National Institute for Statistics available data, while these companies have more than 65% share of Romania's total exports.

At the same time, the local industry sectors contribute with the highest weight in the formation of the country's Gross Value Added, namely 23.5% in 2021, according to Eurostat data. However, companies that are active in the primary and secondary sectors are exposed to the risks of the energy transition, while these firms generate *"more than*

40 percent of the added value produced and accumulate more than 50 percent of the assets of all companies in the country." (BNR, 2021)

Graphic 1. The evolution of CO_2 emissions, in tons, in Romania, during the period 2008 – 2021



Source: author own calculation based on Eurostat data

The strategic repositioning of the EU FDIs should also unleash a decrease in the volume of the CO_2 emissions that FDIs are responsible for, in Romania. According to the FIGARO (Eurostat, 2021) database, EU FDIs generated within Romanian manufacturing activity, during 2010 – 2020, an annual average of 3.8 million tons of CO_2. This evidence underlines, once again, why a large share of a fresh green EU FDI net inflow should contribute to decarbonizing the manufacturing activity.

2. Research methodology

The author analysed the current issue using a quantitative research, based in a positivist and, at the same time, an interpretive manner. The author used a transversal and longitudinal approach and, taking into account the mechanisms of the traditional gravity model, the author developed an econometric model that he called *„A predictive model of the CO_2 emissions inter-country interaction"*. This model was based on performing a multiple linear regression using IBM SPSS analysis software. The author wanted to highlight the impact of the CO_2 emissions generated in the local economy due to the demand of the EU public and private final consumption expenditures respectively of the EU FDI's.

In this sense, the author used the data below:

- Exp_RO = The value of Romania's exports to the EU, the dependent variable

- PS_13 = CO2 emissions (expressed in tonnes) due to the public expenditures of the EU Member States associated with demand for products from Romania
- PS_14 = CO2 emissions of households (expressed in tons) resulting from final consumption expenses associated with demand for products from Romania
- P51G = CO2 emissions (expressed in tons) associated with investments supporting imports from Romania
- HH_CO2 = Total CO2 emissions generated by the final consumption of the EU households associated with the final consumption of goods and services

Table no. 1. Data used in the multiple linear regression

YEARS	Exp_RO	PS13_CO2	PS14_CO2	P51G_CO2	HH_EU_CO2
2010	25.751.202.000	680.692	5.421.852	3.749.691	746.906.361
2011	30.841.093.000	799.479	6.612.614	4.069.105	687.700.062
2012	30.098.772.000	669.716	6.227.695	4.277.230	669.120.248
2013	32.474.227.000	618.144	5.763.644	3.466.071	702.217.742
2014	35.154.476.000	654.282	5.352.802	3.529.623	669.909.428
2015	37.869.177.000	685.887	6.125.031	3.502.504	684.090.884
2016	40.581.058.000	710.821	6.708.167	3.748.113	656.159.278
2017	44.910.276.000	871.997	8.030.056	4.261.133	646.581.310
2018	49.092.666.000	847.634	8.257.498	3.802.524	689.983.620
2019	50.256.257.000	938.380	8.914.713	4.135.609	689.179.926
2020	45.777.742.000	836.412	6.961.385	3.792.317	616.227.604

Source: author own calculation based on Eurostat and FIGARO data

To obtain a better interpretation of the regression coefficients and to avoid a possible high degree of variation due to the high values available to him, the author transformed these data into logarithms. Thus, after logarithmizing the data, the following values resulted:

Table no. 2. The logarithmic values of the indicators used in the second linear regression

YEARS	LN_Exp_RO	LN_PS13_CO2	LN_PS14_CO2	LN_P51G_CO2	LN_HH_EU_CO2
2010	23,97	13,43	15,51	15,14	20,43
2011	24,15	13,59	15,70	15,22	20,35
2012	24,13	13,41	15,64	15,27	20,32
2013	24,20	13,33	15,57	15,06	20,37
2014	24,28	13,39	15,49	15,08	20,32
2015	24,36	13,44	15,63	15,07	20,34
2016	24,43	13,47	15,72	15,14	20,30
2017	24,53	13,68	15,90	15,27	20,29
2018	24,62	13,65	15,93	15,15	20,35
2019	24,64	13,75	16,00	15,24	20,35
2020	24,55	13,64	15,76	15,15	20,24

Source: author own calculation

3. Results and discussions

In making the linear regression model, the author elaborated on the following:

- Summary of the model
- Matrix of regression coefficients
- Diagnosis of collinearity

The multiple regression model highlighted that the values of the four independent variables can be relevant enough to predict the value of LN_EXP_RO, the dependent variable. The R-squared value was .981, which suggests that about 98.1% of the variation of the dependent variable LN_EXP_RO can be explained by the variation of the three independent variables. Furthermore, the adjusted R-squared value is .938, suggesting that this model is well-fitted and not over-explained. It has a predictive capacity of 93.8%,

i.e., a good capacity to explain the result, and the included independent variables are relevant in predicting the value of Romania's exports to the EU.

Another evidence that suggests the consistency of the model is that the Estimated Standard Error showed a relatively low degree of dispersion of the residuals and the Sig F. Change indicator of <.001 showed that the independent variable is influenced by at least one of the dependent variables to be statistically relevant.

Table no. 3. Model summary of the multiple linear regression

R	R Square	Adjusted R Square	Std. The error of the Estimate	R Square Change	F Change	Change statistics		Sig. F Change
						df1	df2	
,981	,963	,938	,05514	,963	38,755	4	6	<,001

Source: linear regression results provided by SPSS

Looking at the Coefficient matrix, the regression coefficients showed the relationship between the dependent variable LN_EXP_RO and the independent variables LN_PS13_CO2, LN_P14_CO2, LN_P51G_CO2 and LN_HH_EU_CO2. To interpret this matrix, the author chose to analyse the data from right to left.

Table no. 4. Coefficient matrix result

	Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity	t
Constant	57,382	9,018		6,363	<.001		
LN_PS_13_CO2	,026	,319	,016	,081	,938	,154	6,475
LN_PS_14_CO2	1,309	,254	1,009	5,146	,002	,161	6,193
LN_P51G_CO2	-1,493	,287	-,517	-5,205	,002	,628	1,592
LN_HH_EU_CO2	-1,540	,377	-,343	-4,090	,006	,885	1,129

Source: results obtained by the author based on data provided by SPSS

Therefore, the values of collinearity tolerance and inflation variation factor are within the appropriate parameters, i.e., greater than 0.1 in the case of tolerance and below 10 in the case of VIF. The t and Sig values demonstrate the statistical significance of the coefficients. In the present case, LN_PS13_CO2 has no statistical significance, as the t value of 0.081 is very small and the Sig value of 0.938 is very high. As for the t and Sig

results for the other independent variables, they show a statistical relationship with the dependent variable illustrated by the formula: LN_EXP_RO = 1.309(LN_PS14CO2) – 1.493(LN_P51G_CO2) – 1.540(LN_HH_EU_CO2)

The above-mentioned formula suggests that there is a complex relationship between CO2 emissions of private consumption expenditures, foreign direct investments and export growth. While the CO_2 emissions from private consumption can contribute to an increase in Romanian exports, reducing the CO_2 emissions from investments made by the EU Member States and the households' consumption patterns turning towards green products might also influence Romania's exports.

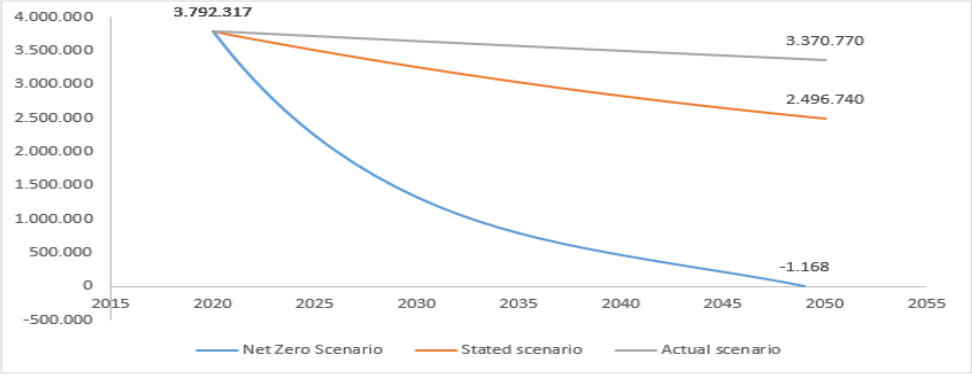
This paradox can be explained by examining the dynamics at play. The consumption expenditures of the EU households demand growth in Romania for exports. However, to meet the export demand, unsustainable raw materials are often used, leading to higher CO_2 emissions.

Paradoxically, as consumption expenditures increase, demand and export values are stimulated. Simultaneously, as investments focus on reducing emissions and becoming more sustainable, certain goods become more appealing in terms of sustainability objectives. If households, in return, consume these goods, they can also contribute to a reduction of overall CO_2 emissions.

The interplay between private consumption, investment choices, and emissions has complex implications for export growth and sustainability goals. However, the FDIs, in certain conditions, might accelerate Romania's decarbonization path.

Giving the results, the author designed three scenarios: Actual Scenario, Stated Scenario and Net Zero Scenario.

Graph no. 2. Estimated evolution of the CO_2 emissions generated by the EU FDIs in the Romanian manufacturing sector



Source: Author's own calculations based on FIGARO data and IBM SPSS data

The Actual Scenario assumes that the evolution of the CO_2 emissions generated in the Romanian manufacturing sector by the EU FDIs will continue to decrease by 0.4% year on year, keeping the same pace of the decline during 2021 – 2050 as it was during 2010 – 2020. In this scenario the CO_2 emissions in the manufacturing sector resulting from the EU FDIs will not reach the carbon neutral objective in 2050, resulting in a gap of 3.3 million tons of CO_2.

In the Stated Scenario, based on the results obtained from the linear regression model, the CO_2 emissions generated by the FDIs will decline much faster, but it would not be enough and will miss by a long shot the carbon neutral objective in 2050. The gap will amount to 2.5 million tons. However, in a such scenario, Romanian exports within the EU markets will be further incentivized with a 1% annual increase if the emissions resulting from investments will decrease by 1.5%. This will also determine an increase in Romania's GDP by 0.3%, considering the level of the Romanian GDP recorded in 2020.

However, to have a realistic contribution to achieving the goal of a carbon-neutral path, the EU FDIs should obtain, between 2021 – 2050, a twenty-five-time decreasing rhythm of the CO_2 emissions compared with the annual average level recorded during 2010 – 2020. From minus 0.4%, the EU FDIs must decrease their CO_2 emissions by an average of 10% per year to support Romania's struggle to achieve the net zero objective. This is the core of the Net Zero Scenario, which reveals that the EU FDIs will achieve negative carbon emissions in the Romanian manufacturing sector in 2049. This evolution might trigger, according to the author's calculations, a 6.6% annual increase growth of Romania's manufacturing intra-EU deliveries. Also, the decarbonization of the EU FDIs in the Romanian manufacturing sector will ensure an annual GDP growth of 1.98%.

Conclusions

Reducing the CO_2 emissions associated with foreign direct investments from the European Union has the potential to influence positively Romania's export growth.

As Romania strives to transition to a greener economy, attracting FDIs that align with sustainable practices must become a priority. By implementing environmentally friendly technologies and practices, these investments must contribute to reducing carbon emissions and promoting a cleaner environment.

The positive effects of these efforts are evident in the increased export performance of Romania. As the country adopts cleaner and more sustainable production methods, its export products will become more appealing to environmentally conscious EU markets.

By reducing the CO_2 emissions associated with the FDIs, Romania will enhance its reputation as a responsible and sustainable business destination. This will not only attract more foreign investors but might also foster a stronger trade relationship with EU member states, leading to expanded export opportunities.

Furthermore, the reduction in CO_2 emissions from FDI supports Romania's commitment to global climate change mitigation efforts. Proving also that is a responsible global citizen, Romania might ad its contribution to the overall goal of limiting global warming and addressing environmental challenges.

The growth in exports resulting from reduced CO_2 emissions associated with FDI has a multi-faceted impact. It drives economic growth by boosting trade and attracting foreign investment, while also promoting sustainable development and environmental stewardship. This positive cycle creates a win-win situation, benefiting both Romania's economy and the global fight against climate change.

In conclusion, the positive impact of reducing CO_2 emissions associated with FDI from the EU is evident in Romania's increased exports and economic growth. By embracing sustainability, Romania will not only attract green investments but also strengthens its trade relationships, fosters economic growth, and contributes to global efforts in addressing climate change.

** The current article is part of Vlad Epurescu's scientific doctoral research - Analysing how companies engaged in economic activities in Romania can successfully participate in international trade.*

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