EFFECTS OF FOREIGN DIRECT INVESTMENT ON THE ECONOMY AND ENVIRONMENT

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Abstract: Classical theories linking increased CO2 emissions to a country's economic development supported by foreign direct investment in industrial plants, coking plants, ironworks, shipbuilding, and other heavy industries marked the 20th century, with large MNCs seeking refuge in underdeveloped economic development. The second millennium of Croatia began with deindustrialization, both due to the extinction of large state-owned industrial losers and due to transformation and privatization, where the interest of capital was in the financial and tourism sectors. This does not mean that FDI was not present, but the expected greenfield investments were missing, especially after joining the EU. To what extent FDI has influenced the increase in carbon emissions is the subject of research in this paper.
Keywords: FDI, GDP, CO2

1. Introduction

The economic growth and development of each country, in modern international economic relations, are most closely related to the ability of the national economy to invest in new technologies and scientific research. Insufficient own resources, especially in the case of small countries, impose the need to raise foreign capital and raise the international competitiveness of individual economies. Raising competitiveness enables the equal inclusion of the state in the international division of labor and the growth of its participation in the exchange of goods and services with other countries.

Of the several possible forms of foreign capital, the last few decades have been characterized by the rapid growth of foreign direct investment. While investment activity among economically developed economies, although the most important part of international investment activity, does not attract excessive attention from political structures, the public, or scientists, investments by developed countries in developing countries cause numerous scientific and political controversies.

There is a consensus that foreign direct investment can significantly contribute to the economic development of less developed countries, but also numerous examples of concrete

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activities of multinational companies, the world's most important investors, pointing to the damage that foreign investment activity has had, both economically and for the sustainable development of individual countries.

The Republic of Croatia, as a small, transitional, and medium-developed country, due to low domestic accumulation and the need for rapid renewal of obsolete capital assets and the acquisition of modern technology, is forced to rely on foreign development in its development. A significant part of foreign funds, from independence until today, has been in the form of foreign direct investment.

Until joining the EU, foreign direct investment was considered a solution to all Croatian problems, respectively it was justifiably considered that the entry of new capital and new technologies into Croatian companies will stimulate economic growth and competitiveness. However, the consequences of the financial and economic crisis of 2008 slowed down international capital movements, and the opening of new markets in the Far East changed the direction of capital movements. The entry into the Union itself created numerous advantages for Croatian companies, and facilitated trade with members but did not bring the expected inflow of investment. Of the desired numerous greenfield and brownfield investments, as well as mergers and acquisitions, the realization was below expectations due to the stated objective, but also numerous subjective reasons. More precisely, investments in tourism and trade arrived, but they were absent in basic industry and agriculture. The shifts that have been noticed in recent years, especially in the field of IT and green technologies, will certainly, in addition to attracting foreign capital, contribute to the competitiveness of the Croatian economy.

2. Features of FDI

FDI is a strategic and long-term form of investment in a particular foreign market. It is a form of entry in which companies set up their businesses, and buy or take over existing businesses. The purpose of FDI is the presence and control of operations in foreign markets, which avoids intermediaries and consequently can make higher profits. Due to their direct presence in the foreign market, companies will have to adapt to the market conditions there, which means that they will have to change production and develop a more appropriate way of communicating with consumers. Whether this approach suits the company or not depends on the situation in the country (Šenk Ileršić, 2013).

With the help of FDI, the company acquires ownership of the factors of production in foreign markets (capital, technology, labor, statehood, equipment, and production plant). FDI's are one of the most demanding forms of market entry, as there are many more risks than other simpler forms of entry, and firms opting for FDI's need to invest more in establishing a direct presence in a foreign market (Cawusgil et al., 2017).

The purpose of FDI is to acquire ownership of a company abroad and thus the ability to manage and run that company. In order to control a foreign company, it must own a certain share of that company, the share of which is required for that depends on the regulations and the size of the company.

FDI's are important to the state because they bring new jobs, and new technology, increase economic growth and employment in the chosen state. Larger countries with larger markets and better infrastructure, lower wage costs, better education systems, lower tax rates, and better investment incentives have more FDI than others. Many countries use investment incentives to attract incoming FDIs by providing foreign investors with financial and non-financial support,

subsidies, bargains, statehood, and tax breaks. Therefore, foreign firms often choose a state that offers more investment incentives (Skellington, 2016).

There are 1) direct and 2) portfolio investments. In the case of portfolio investments, the company does not seek control over the company and its management, with the investor referring only to a certain part of the foreign company. Certain rules for controlling this share are not specified. In common practice, 10% is called the minimum share in which the investor has a perceived impact, and the estimate of the share varies and may even fall below the set percentage. On the other hand, in the case of direct investment, there is the very connection and control of the firm, with the firm of the investor-state having a greater ability to maneuver in managing the host and thus its majority stake (Moosa, 2002). As the management of a company is mainly related to ownership, except in the case of a contractual relationship, a foreign investor can be a full, majority, equal, or minority owner. Such is his ability to manage and control a company abroad (Bezić, 1996).

When analyzing FDI-related motives, a distinction should be made between the motive and the investor's interest. Although in both cases the ultimate goal is profitability, sometimes the motive has an altruistic background, examples of which are found in investors who are emotionally attached to the recipient country. Thus, some wealthy individuals or owners of large companies from the Croatian diaspora considered it their obligation to invest in Croatia not solely on profit. Other motives are investing for personal promotion (The Trump Organization in Slovenia). Unlike motives, interest can always be expressed in monetary terms.

Businesses have several motives for choosing FDI. Therefore, their motives can be important: access to markets, raw materials, and technology avoiding market barriers, lower costs, proximity to the customer, and monitoring competition. These interests can be grouped into the following four groups of motives (Cawusgil et al., 2017): resource search motives, market search motives, efficiency search motives, strategic goals, and strategic asset motives.

The location preferences of foreign investors do not depend on the type of activity performed by the company, but on the motives for the investment and whether it is a new investment or an additional investment in addition to the existing investment. Different types of investment incentives are needed to attract FDI with different motives. Thus, for example, export-oriented FDIs are less affected by the size of the local market compared to FDIs designed to replace imports (Dunning, 1998).

2. Analysis of the relationship between FDI, GDP, and payments balance

The dynamics of FDI movements in the world have an upward trend except in times of global crises.

Despite the drastic decline in global FDI flows during the crisis, international production continues to play an important role in supporting economic growth and development. Overall FDI flows remained positive, thanks to MNK's capital stocks accumulated in foreign subsidiary networks. The following table presents the indicators of FDI dynamics for the period from 1990 to 2020.

Table 1. Global dynamics of FDI movements from 1990 to 2020 in billions of US dollars

	1990.	2005-2007.	2017.	2018.	2019.
FDI inflow	205	1.425	1.647	1.437	1.530
FDI outflow	244	1.464	1.605	871	1.220
FDI input stocks	2.196	14.607	33.162	32.784	36.377
FDI output stocks	2.255	15.316	32.851	31.219	34.351
Cross-border M&A	980	7.292	6.940	8.157	5.074

Source: UNCTAD (2021)

The historical experience of declining foreign direct investment shows that, although financial flows and transactions can recover relatively quickly, the real recovery of investment takes more time to accelerate. Policy responses are important factors shaping the post-crisis investment environment. The last major global crisis that offers parallels with the COVID-19 pandemic in terms of its impact on global FDI flows was the 2008 global financial crisis. That crisis, in addition to causing a short-term shock to FDI, also coincided with a shift in long-term trends. In the decade since then, foreign direct investment growth has been significantly lower than before the crisis. Numerous other crises - regional and global, financial, debt or currency crises and with different economic consequences - have affected foreign direct investment and the operations of multinational companies over the last few decades. Experience from these crises, given their impact on investment on the one hand, and the role of investment during the recovery phases on the other, may offer some lessons for exploiting its potential for sustainable recovery.

All previous experiences and research on the impact of global financial crises, as well as other global and regional crises on FDI and the role that FDI played during and after the crisis, show that (UNCTAD, 2021):

- investments respond to crises and economic problems in a way that is different from other capital flows;
- its response varies depending on the development status of economies, and varies according to industry and type of investment; and
- investment policies during and after the crisis can be crucial in determining the extent and scope of foreign direct investment's contribution to recovery.

Investment responses to the Global Financial Crisis (GRP) and the COVID-19 crisis show similarities and differences that vary depending on the type of investment. FDI, in addition to investing in new production capacity, also includes intra-company financial flows and mergers and acquisitions (M&A) transactions, especially in developed countries. However, portfolio investments are closely linked to financial markets and are often more reactive to short-term economic conditions. Greenfield investments are more in line with real economic trends and directly affect tangible activities. International project financing, which is often used for large infrastructure projects that require more investors, usually involves a significant component of debt affected by interest rates and financial market trends. Yet, like greenfield investments, they are more closely linked to the real economy.

3.1. Effects of FDI on the Croatian economy

The extent to which foreign direct investment has brought real benefits to the Republic of Croatia is a question that affects almost all spheres of Croatian political, economic and social life. The specificity of the Republic of Croatia is related to the war events from 1990 to 1995 when the priorities of state governance were focused on the establishment of the state and its integrity, which ultimately led to bypassing capital flows and disorientation in the

transformation and privatization of economic entities. It was only after 1995 that a significant inflow of foreign direct investment began, but this delay was widely felt, especially concerning other transition countries: Slovenia, Hungary, the Czech Republic, Slovakia, Poland, Romania, and Bulgaria, which were already in the process of negotiating integration. The European Union.

In addition, Croatia had a long-term (compared to these countries) accession negotiation process, which was completed only in mid-2013, which further slowed down FDI inflows. It is therefore justified to analyze the flows and accumulated stocks of FDI in the periods before and after accession to the European Union.

In the Republic of Croatia, the attitude towards foreign direct investment has changed significantly since independence. In the first years after independence, official policy wanted to keep nationalized companies in domestic ownership, while attracting foreign capital at the disposal of the Croatian diaspora. Based on such an attitude, legal regulations were adopted, as well as operational financial measures (managerial loans, etc.) by which domestic entrepreneurs in the privatization process favored foreign investors. This resulted in the sale of a large number of companies to domestic investors and several Croatian emigrants.

In the second half of the 1990s, the attitude towards the participation of foreign capital in the privatization process began to change. The change was caused by several factors. First, is the failure of the previous model of privatization, which "disappeared" companies with a long history of successful business with a decline in industrial production, declining state budget revenues based on income and income taxes, and rising expenditures on social benefits. Second, the privatization process, based on a non-transparent assessment of the company's value, left the state budget without significant resources at a time of war expenditures and post-war reconstruction costs. Third, efforts to break out of a kind of international isolation were accompanied by the preference of certain countries by enabling their companies to buy the most profitable Croatian companies under favorable conditions or participate in infrastructure projects in Croatia.

Only in 2000 did a systematic policy of attracting foreign capital begin to be defined, a legal framework was created to guarantee security for foreign investors, the first Investment Promotion Act was passed, the legal position of domestic and foreign investors was equalized, and the Export and Investment Promotion Agency was re-established. (2002) and lowers the income tax rate.

The attitude towards foreign direct investment in Croatia at that time could be characterized as pragmatic nationalism (Matić, 2004), which understands both the advantages and disadvantages of foreign direct investment. The advantages are reflected in their possible positive impact on economic growth, exports, employment, and transfer of modern technology and management and marketing knowledge and skills. Deficiencies in capital aspirations to maximize profits that often lead to redundancies, reduction or suppression of workers' rights, within company profit transfers based on non-transparent trade and accounting procedures, rapid closure of production in one, and their relocation to another country offering lower costs or some other privileges.

3.2. Analysis of the effects of FDI on the balance of payments

The impact of foreign direct investment on the balance of payments can be observed in two ways. The first is the recording of foreign direct investment in absolute terms on the revenue side, which can be an indicator of a certain macroeconomic stability of the recipient country, but also the interest of the profits of the investment provider. The second way is to record the effect

on which foreign direct investment increases revenues through increased exports of goods and services. Theories that analyze the effects of foreign direct investment on exports and thus on the balance of payments can be divided into:

- The standard theory of international trade deals with the question of whether international movements of factors of production and international trade flows are substitutes or complementary;
- The theory of multinational companies whose basic idea is that companies must have some advantages to become multinational. It is understandable to assume that companies can operate in foreign countries only with production costs that are higher than the costs of domestic companies. Without certain advantages to compensate for such an inferior position, their business abroad would not be sustainable.

MNK owns a product or process that gives it some monopoly power in a foreign market and/or has a reason to produce abroad and/or has an incentive to take advantage of it internally. Businesses may have different motives to become multinational.

Different motives define different types of foreign direct investment, which in turn can have different effects on the country of origin and, more importantly, on balancing the balance of payments of the recipient country and its exports. The effects of various types of foreign direct investment on the exports of the recipient country are summarized in the following table.

Table 2. Expected effects of various types of foreign investment on international trade from the perspective of the recipient country

Motive	Effect on international exchange	
	Import	**Export**
Market oriented	Increased	Unchanged
Resource oriented	Unchanged	Increased
Strategic investments	Indefinitely	Indefinitely

Source: Vukušić (2005)

Resource-oriented investments, as Vukušić states "include investments motivated by existing natural resources and labor in the recipient country".

Strategic investments include taking over local businesses. Predicting the macroeconomic effects of foreign direct investment on exports is very difficult if it is known that most foreign investment is market or resource-oriented.

The experience of other countries that have undergone restructuring suggests that the inflow of foreign direct investment may boost exports. Although Croatia was relatively successful in attracting foreign investment, measured by the cumulative amount of investment per capita, due to stagnant exports in the same period, such effects were absent in our country.

The connection between exports and the inflow of foreign direct investment was investigated by Vukušić (2005). The survey covered 21 branches of the Croatian manufacturing industry in the period from 1996 to 2002 and was based on parameters: exports, productivity index, average monthly gross wages, gross value added, domestic investment (investment in new fixed assets), employment, price index, and foreign direct investment.

The result of the research showed that there is a positive and significant impact of foreign direct investment on exports, although at a relatively low rate. An increase in the level of foreign investment of 1% leads to an increase in exports of 0.09%. For this research, the possible effects of foreign direct investment on exports of goods and services on the balance of payments

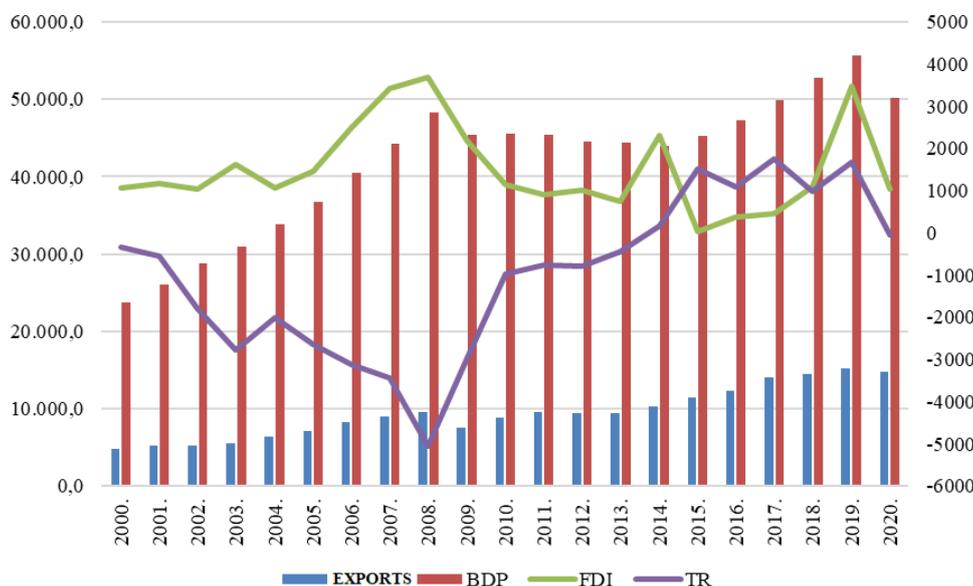in correlation with the size of Croatia's gross domestic product in the period from 2000 to 2020 are analyzed.

Chart 1. Comparative indicators of the current account of the balance of payments, exports of goods and services, GDP, and foreign direct investment in the period from 2000 to 2020 in millions of EUR)
Source: Processing according to HNB data

The graphical presentation of indicators that directly or indirectly affect the current account of the balance of payments separates foreign direct investment and current account after 2007, but at the same time monitors the growth of exports and gross domestic product. Such trends indicate an increase in imports, which has a more pronounced effect on the balance sheet than exports, but also the likely predominance of market-oriented investments.

When the above parameters are analyzed in correlation with each other, as shown in the following table, then the correlation of the variables can be observed.

Table 3. Correlation of FDI, GDP, Exports of goods and services and current account (TR) of the balance of payment

			FDI	BDP	Export	TR
2000 - 2020	**FDI**	Correlation	1,000	0,687	0,400	-0,627
	BDP	Correlation	0,687	1,000	0,259	-0,784
	Export	Correlation	0,400	,259	1,000	-0,069
	TR	Correlation	-0,627	-0,784	-0,069	1,000

Source: Author's calculation with the support of SPSS 24 according to the HNB

The attached table shows:

– moderately positive correlation between foreign direct investment and gross domestic product, but also a moderately negative correlation with the current account of the balance of payments;
– significant negative correlation between GDP and TR.

From the regression analysis and on which TR depends and GDP, FDI and EXPORTS are independent variables, the coefficients are derived as shown in the following table.

Table 4. TR balance of payments regression model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,870	0,756	0,713	1009,72228

a. Predictors: (Constant), EXPORT, FDI, BDP
b. Dependent Variable: TR

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. error	Beta		
1	C	34,442	1336,407		0,026	,980
	FDI	-0,717	0,244	-0,394	-2,935	,009
	GDP	-0,167	0,066	-0,780	-2,535	,021
	Export	0,751	0,174	1,304	4,324	,000

Dependent variable: TR

Source: Source: Author's calculation with the support of SPSS 24 according to the HNB and DZS

Interpretation of the parameters obtained by multiple linear regression reads it can be concluded:

If FDI increases by 1%, then TR balance of payments will decrease by 0.717 % on average. This indicator speaks of the moderate correlation of foreign direct investment (FDI) with the change of the independent variable (TR);

If GDP increases by 1%, then the current account will decrease by 0.167%. This indicator speaks of the inelasticity of GDP to the change of the independent variable TR;

If exports increase by 1%, then the current account will increase by 0.751% on average. This indicator speaks of the moderate elasticity of exports (IZV) to the change of the independent variable TR.

The values of the parameters lead to the general conclusion that the current account of Croatia is moderately elastic to changes in FDI and exports, while inelastic to changes in GDP.

The results of individual testing of regression variables lead to the conclusion that all independent variables are individually important because $t > 0.05$.

4. FDI and sustainable development

There is no doubt that foreign direct investment plays an important role in economic growth and economic development, especially when domestic savings are not sufficient for domestic investment needs. But while foreign direct investment is important for economic growth and development, it can also be a cause for concern when considering the environmental consequences of economic growth caused by foreign direct investment.

Existing empirical evidence on the link between foreign direct investment and environmental degradation is not convincing enough because on a theoretical basis the link between foreign direct investment and the environment has three key dimensions (Shahbaz, et al., 2018).

First, according to The Pollution Haven Hypothesis, poor environmental regulation in the host country can attract foreign direct investment by for-profit companies that want to

circumvent costly regulatory compliance in their home countries. Therefore, this way of thinking implies that foreign direct investment can lead to environmental degradation.

Second, the pollution asylum hypothesis reveals that, by applying a universal environmental standard, multinational companies participating in FDI will strive to spread their greener technology to their business partners in the host country. The opposite potential effects imply that foreign direct investment can have positive or negative effects and lead to improved environmental quality or greater environmental degradation.

Third, this problem is also explained by the effect of scale, which suggests that the effect of scale would occur to the extent that multinational FDI operations would significantly contribute to the host country's industrial production and, in turn, increase overall pollution (environmental degradation).

The financial sector has an important role to play in the development and stability of the economy. The GRP highlighted the importance of the financial sector to the real economy. Financial and economic stability are two sides of the same coin. It is also important to consider the environmental consequences of the financial sector, in particular the role that financial development plays in environmental degradation. Three important channels explain the connection between financial development and energy consumption. First, financial development attracts more foreign direct investment and boosts economic growth, leading to increased energy consumption.

Second, the process of effective financial intermediation caused by the development of the financial sector creates more consumer credit and increased consumption of energy goods and services.

Third, the development of financial and capital markets facilitates investment and leads to increased energy consumption.

Of course, it can be argued that in the context of the environment, the question is not whether financial development increases energy consumption, but the main question is whether the result will be an increase in CO_2 emissions, ie environmental degradation.

The impact of foreign direct investment on the sustainability of economic growth implies the participation of these capital funds in the development of a sustainable development economy.

The fact that Croatia is largely in line with its sustainable development strategies within its development strategies does not diminish the importance of the basic assumptions to be adopted for the development of the economy of the future (Dragičević, 1996):
1) to know and separate the development that is a part of history, from the modern trends of global development, in which the economy is only a part of it,
2) to know the meaning of the paradigm of the new, sustainable development as an important development concept of modern developed countries and
3) create preconditions for joining new, sustainable development in accordance with specific economic, political, natural, regional, cultural, and environmental specifics.

Sustainable development is economic growth and development that carries responsibility for the environment and society. The path to such a way of doing business is a path that leads through eco-efficiency, innovation, new technologies, and quality.

The Republic of Croatia is still in a complex economic and social situation, further aggravated by the consequences of "closing" the economy due to the COVID-19 pandemic, the earthquakes in Zagreb and Banovina, as well as reduced tourist traffic. Namely, even after more

than three decades of independence, there is still a structure in the manufacturing sector mainly based on outdated technologies, hierarchically-centrally organized large and unprofitable systems (shipbuilding…). As capital is a crucial driver of production for new investment, the inflow of fresh capital is becoming one of the most important issues for Croatia. Given that the current economic structure cannot provide it in the medium term, inflows are possible only through loans from global financial institutions and foreign direct investment.

In Croatia, this process took place spontaneously during the transition period. Without a development strategy, and in a lack of capital, extremely unfavorable arrangements have been taken over indiscriminately, and foreign investment in some projects of questionable quality has been enabled. Foreign investment usually brings new and modern technologies, and these are, as a rule, less harmful than existing technologies. When foreign investors take over domestic companies, their efforts are focused on modernization, which includes reducing pollution. However, there are incidents for which domestic institutions, which should ensure environmental protection, are equally responsible.

The situation with unselected investments has gradually changed to become transparent and environmentally friendly only after accession to the European Union. Although the trend of FDI inflows has not changed significantly, the goals they are moving towards have changed and in particular, have strengthened dreams and takeovers in the food industry and tourism.

The impact of foreign direct investment on the economic growth of the recipient country is more pronounced in countries where institutions are more effective in protecting property rights, and in those where bureaucracy is more efficient, thus supporting investment decisions and facilitating the adoption of foreign technologies.

Integrity (anti-corruption) and bureaucracy efficiency significantly affect investment and economic growth, indicating that administrative efficiency is at least as important a determinant of investment and economic.

4.1. Kuznets' environmental paradigm

The Environmental Kuznets Curve (EKC) is a controversial concept that first appeared in the literature in the early 1990s. According to this paradigm, environmental degradation/pollution increases with economic growth, but when the economy reaches a certain level of per capita income, ie a turning point, pollution begins to decline (Šimurina & Dobrović, 2011). In other words, environmental problems increase faster than income in the early stages of development, and at higher levels of income degradation slows down relative to GDP growth.

The EKC hypothesis implies that even though pollution is inevitable in the early stages of development, economic growth will ultimately be one of the solutions to the pollution problem. This relationship between economic growth and environmental quality is graphically represented in the form of an inverted U and assumes that economic development will ultimately lead to improved environmental quality is intuitively attractive and has significant implications for economic policy.

Economic growth, which has so far been considered the main cause of environmental degradation, in this case, is a solution to the problem, so policymakers should promote growth to cross the income milestone as soon as possible. Testing the validity of the ECC hypothesis is of great interest due to the growing problem of environmental pollution that may be irreversible, so environmental protection measures are crucial.

In the context of the effects of FDI on the economic growth of the Republic of Croatia, the consistency of the Kuznets paradigm will be examined concerning the assumption that FDI has

a positive and significant impact. However, when these effects are observed in a long time series t then due to the impact of the crisis of GRP and COVID 19, EU accession, and the asymmetry of greenfield and brownfield FDI then it is possible to expect different results.

4.2. The connection between innovation in energy research and carbon emissions

The importance of technological innovation is of great importance for production processes, as well as for overall economic growth (Çalışkan, 2015). Technological innovations significantly affect the association of economic entities. This is evident in Schumpeter's (1942, pp. 82-89) notion of "creative destruction", which is an evolutionary process involving the destruction of inefficient and weak sectors of the economy, as well as the development of new technologies and new industries. Likewise, technological innovations have environmental consequences. It is logical to claim that technological innovation that leads to structural changes in the production process will also affect the environment. Technology is an important channel through which economic growth affects environmental degradation. Because of this impact, numerous studies have encouraged the application of technologies that can improve the quality of the environment. Progress leads to the creation of cleaner and environmentally sustainable technologies.

4.3. Green transition sphere of interest for FDI

According to LiderMedia, the current situation with the uncertainty of fossil fuel supply has updated the old ones and encouraged many new investors in green energy. Thus, in the next two years, RP Global intends to start an investment of about 200 megawatts of wind and photovoltaic power plants worth between 200 and 250 million euros in Croatia. In five years, they would like to start building an additional 300 megawatts, so the total value of these investments would rise to 500 to 600 million euros. VSB Group, which has been operating in the field of wind and solar power plant development for 25 years and has so far built more than 650 wind turbines and 58 solar power plants around the world worth more than two billion euros, announces the development and construction of new projects in Croatia worth 400 million euros.

As a country with a strong maritime orientation, Croatia is interested in investments that would be in line with the European Green Plan (Sopta, et al., 2020):

The European Green Plan is a strategy for achieving sustainability of the EU economy. This is intended to translate climate and environmental challenges into opportunities in all policy areas and to ensure a fair and inclusive transition. The European Green Plan includes an action plan for:
- Improving the efficient use of resources by moving to a clean circular economy
- Restoration of biodiversity and reduction of pollution.

An efficient combination of renewable gas (biomethane) and electricity, together with existing gas networks, makes the optimal way to decarbonize the EU energy system, making its constitution fully renewable.

There is great potential for the production of low-carbon renewables and hydrogen in large quantities within the European Union. The Climate Gas study "Gas decarbonization pathways 2020 to 2050" (Peters, 2020) describes how a large amount of 1,700 TWh of hydrogen could be produced in the EU by 2050. In the transition to a clean EU zero-emission energy system, hydrogen and biomethane will play a major role in the efficient combination with renewable electricity. The European Commission has a clear ambition to boost hydrogen growth as early

as 2030, as highlighted in its Hydrogen Strategy (Europien Commission, 2020) and Energy Integration Strategy (EC, 2020), both published on 8 July 2020.

The transition period until 2050, for the transition to environmentally neutral propellants, is a necessity arising from insufficiently researched technology of supply of ecologically neutral energy sources and thus the choice of ship propulsion. In addition, it should be taken into account that between the decision of the ship owner on which installation and which energy source to use and the beginning of the operation, it is necessary to consider the free capacities of the shipyard, the capacity of making propulsion machines and the fuel supply schedule to each port of Short sea Shipping – SSS (Bukša, 2005).

4.4. Empirical model of the relationship between FDI and CO2

This research examines the relationship between FDI and CO2 emissions and includes economic growth, financial development, and innovation in energy research in Croatia's carbon function. Existing evidence suggests that direct investment can affect carbon emissions through the effects of scale, technique, and composition. The effect of the scale states that foreign direct investment can increase CO2 emissions by affecting economic activity as a result of economic liberalization. Economic liberalization leads to higher production, which increases energy consumption and therefore affects the quality of the environment by increasing carbon emissions. The model follows research conducted by Shahbaz, Ali Nasir, and Roubaud (2018) who, on the example of France as a developed country, created a model for an empirical way to calculate the impact of FDI on greenhouse gas emissions.

The impact of technology includes the impact of the transfer and dissemination of new technology as well as the introduction of new environmental regulations on environmental quality. FDI encourages the implementation of advanced and energy-efficient technology to improve domestic production. This implies that the impact of technology can affect the quality of the environment through the introduction, development, and dissemination of advanced and energy-efficient technology. This suggests that energy-efficient technologies are the cause of stricter environmental regulations that should improve the quality of the environment by reducing carbon intensity (Pazienza, 2015).

The impact of the system is linked to the structural shift of the economy from agricultural to industrial and from industrial to service sectors. The first (industrial) consumes more energy than the second. The impact of system performance depends on competitive advantages and the productive specialization of the economy.

Financial developments can affect carbon emissions through effects on consumers, businesses, and wealth. A stable financial system benefits consumers by giving them access to loans to buy expensive things, such as houses, cars, refrigerators, air conditioners, washing machines, and a whole range of household appliances, which of course affects energy demand and thus environmental quality (Mahalik, et al., 2017). Business performance shows that the financial system channels financial resources to their destinations by offering loans to companies at a lower interest rate, increasing investment opportunities. Financial development also helps companies improve their existing and new investments, which increases energy demand and affects environmental quality by increasing carbon emissions (Mahalik et al., 2017).

Expenditure on research and development in the energy sector encourages energy innovation, which reduces energy intensity and improves environmental quality by reducing carbon emissions (Komen, et al., 1997). Following the above theoretical background, it is possible to model the general carbon emission function as:

$$C_t = f(U_t, G_t, E_t, R\&D_t) \qquad (1)$$

where: Ct CO2 emissions per capita; Ut = real FDI per capita; Gt = real GDP per capita; Et = energy consumption per capita; R & Dt = real expenditure on research and development and energy innovation.

By transforming the observed variables into natural logarithms for the use of multiple linear regression models. This is because, by logarithmic variables, consistent and more reliable empirical results are obtained, compared to the linear case. The multiple linear regression model gives direct estimates of elasticity since they are the coefficient of explanatory variables. The log-linear specification of the carbon emission function is modeled as follows:

$$\ln C_t = \beta_0 + \ln \beta_1 FDI_t, + \ln \beta_2 GDP_t + \ln \beta_3 E_t + \ln \beta_4 FIN_t + \ln \beta_5 R\&D_t + \varepsilon \qquad (1)$$

where the variables are the natural logarithms of the variables from equation (1), and it is assumed that the ε error follows the normal distribution.

4.5. Data

This study uses time-series data ranging from 21 years from 2000 to 2020. Data on CO2 emissions per capita (metric tons), real GDP per capita (€), real foreign direct investment per capita (€), energy consumption (kg of oil equivalent), and real domestic credit to the private sector (€) were collected from the World Development Indicators (World Bank, 2022), HNB (2022), DZS (DZS 2021).

Data on the public budget in expenditure on energy research and development (€) are collected from the database of the European Commission. Data on R&D allocations as a percentage of GDP per capita were obtained from the Sustainable Development Goals portal (2022). Data on the total population were collected from the CBS data (2022), and are used to convert all variables into units per capita. This has advantages in terms of standardization, as well as ease of comparison (units of measurement) and subsequent discussion and concluding. A realistic estimate adjusted for inflation is also used.

Table 5. Dynamics of basic parameters per capita from 2000 to 2020

Year	Euro per capita			KG OE PC	T PC	Natural logarithms				
	GDP	FDI	R&D	ENG	CO2	lnGDP	lnFDI	lnR&D	lnENG	lnCO2
2000	5.351	269,35	50,30	2.210,00	4,00	8,58504	5,59601	3,91799	7,70075	1,38629
2001	6.044	289,73	56,81	2.212,00	4,50	8,70682	5,66893	4,03978	7,70165	1,50408
2002	6.688	262,00	63,54	2.230,00	4,70	8,80807	5,56834	4,15161	7,70976	1,54756
2003	7.206	402,88	68,46	2.256,70	5,00	8,88267	5,99863	4,22621	7,72166	1,60944
2004	7.847	265,20	80,82	2.240,00	4,90	8,96789	5,58048	4,39228	7,71423	1,58924
2005	8.539	362,85	73,44	2.200,00	5,00	9,05240	5,89399	4,29641	7,69621	1,60944
2006	9.405	622,93	69,60	2.215,80	5,30	9,14900	6,43443	4,24272	7,70337	1,66771
2007	10.272	858,40	81,15	2.230,00	5,20	9,23718	6,75507	4,39628	7,70976	1,64866
2008	11.216	921,40	98,70	2.225,00	5,00	9,32510	6,82589	4,59209	7,70751	1,60944
2009	10.549	545,65	88,61	2.220,00	4,80	9,26379	6,30198	4,48426	7,70526	1,56862
2010	10.615	288,43	78,55	2.234,90	4,70	9,27002	5,66444	4,36375	7,71195	1,54756
2011	10.608	223,75	79,56	2.234,90	4,30	9,26936	5,41053	4,37651	7,71195	1,45862
2012	10.430	253,85	78,23	2.234,90	4,20	9,25244	5,53674	4,35959	7,71195	1,43508
2013	10.423	184,20	84,43	2.234,90	4,00	9,25177	5,21602	4,43588	7,71195	1,38629
2014	10.368	577,78	80,87	2.234,90	3,90	9,24648	6,35918	4,39285	7,71195	1,36098
2015	10.755	5,80	90,34	2.234,90	4,00	9,28313	1,75786	4,50360	7,71195	1,38629
2016	11.324	92,10	97,39	2.234,90	4,10	9,33468	4,52287	4,57869	7,71195	1,41099
2017	12.101	111,75	104,07	2.234,90	4,20	9,40104	4,71626	4,64505	7,71195	1,43508
2018	12.896	271,13	125,09	2.234,90	4,30	9,46467	5,60258	4,82904	7,71195	1,45862
2019	13.678	868,80	151,83	2.349,00	4,10	9,52354	6,76711	5,02273	7,76174	1,41099
2020	12.408	261,38	138,97	2.360,00	4,30	9,42610	5,56596	4,93426	7,76642	1,45862

Source: Author's processing with the support of SPSS 24

4.6. Empirical Findings and Discussion

To begin with, we perform descriptive statistics and Pair-wise Correlation Analysis, and the results are shown in the following table.

Table 6. Descriptive Statistics and Pair-wise Correlation Analysis (2000-2020)

Variable	ln CO_{2t}	ln FDI_t	ln GDP_t	ln ENG_t	ln $R\&D_t$
Mean	1,4995048	5,6068238	9,1762471	7,7145652	4,4372181
Median	1,4586200	5,6025800	9,2524400	7,7119500	4,3928500
Maximum	1,36098	1,75786	8,58504	7,69621	3,91799
Minimum	1,66771	6,82589	9,52354	7,76642	5,02273
St. Dev.	,09769693	1,07496408	,25217504	,01736208	,27104381
Skewness	,249	-2,348	-1,003	2,438	,424
Kurtosis	-1,389	8,040	,302	5,701	,411
ln CO_{2t}	1				
ln FDI_t	0,480	1			
ln GDP_t	-0,216	-0,46	1		
ln E_t	-0,256	0,093	0,464	1	
ln $R\&D_t$	-0,244	-0,012	0,887	0,718	1

Source: Author's processing with the support of SPSS 24

Table shows that CO2 emissions are less volatile than economic growth. The variability of energy consumption is higher compared to CO2 emissions, but lower than economic growth. GDP volatility in energy R&D expenditure is higher compared to CO2 emissions, energy consumption, and economic growth, but lower than FDI. Correlation analysis reveals a positive correlation between GDP and CO2 emissions. Energy consumption and foreign direct investment are positively correlated with CO2 emissions. The correlation between financial development and the public budget in expenditure on energy research and development (energy innovation) with CO2 emissions is negative. Energy consumption, financial development, foreign direct investment, and the public budget for energy research and development expenditures are positively correlated with economic growth. The correlation between foreign direct investment and GDP in R&D expenditure is positive. A positive correlation also exists between GDP in energy R&D expenditure and FDI.

4.6.1. Multiple linear regression mode

The multiple linear regression model discussed in this part of the paper is based on the indicators in Table 1 and data on CO2 emissions per capita taken from World Development Indicators.

The goals of multiple linear regression are:
- Investigate how independent variables explain a significant part of the variability of a dependent variable, ie whether there is a relationship between them and if so, how much.
- Determine which part of the variability of the dependent variable can be explained by independent variables, ie the strength of their connection;
- Determine the structure of the connection and
- Predict the values of the dependent variable.

The results of regression analysis on log values from Table 1 obtained by computer support are presented and explained below:

Table 7. The results of regression analysis - Model Summary

Model Summary; Sample 2000 - 2020; Included observations 21; Method: Least Squares					
Model	R	R Square	Adjusted R Square	Std. The error in the Estimate	Durbin-Watson
1	0,573ᵃ	0,328	0,382	0,12248967	0,493

Source: Author's processing with the support of SPSS 24, based on the data in Table 1

"R" indicates the value of the multiple correlation coefficient. It serves to determine the prediction quality of the dependent variable LNCO2, and a value of 0.573 represents an acceptable level of prediction.

"R Square" represents the decision coefficient, ie the dispersion ratio of the dependent variable that can be explained by the independent one. A value of 0.328 represents 32.8% of the variability of the dependent variable which can be explained by the independent variables so that the bond strength is moderate.

Table 8. The results of regression analysis - ANOVA

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0,063	4	0,016	1,952	0,151
	Residual	0,128	16	0,008		
	Total	0,4191	20			

Source: Author's processing with the support of SPSS 24, based on the data in Table 1

The F-value in the ANOVA table tests the regression model. F (4.16) = 1.952; p> 0.05 which indicates that the selected model is good.

Table 9. The results of regression analysis - Coefficients

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. error	Beta		
1	(Constant)	16,442	15,496		1,061	,304
	LNFDI	,046	,019	,505	2,437	,027
	LNGDP	-,074	,204	-,190	-,361	,723
	LNENG	-1,919	1,981	-,341	-,969	,347
	LNRD	,063	,242	,175	,261	,797

Source: Author's processing with the support of SPSS 24, based on the data in Table 1

Dependent Variable: LNCO2

Interpretation of the parameters obtained by multiple linear regression reads it can be concluded:

1) If foreign investment increases by 1%, then CO2 emissions per capita will increase by 0.046% on average. This indicator speaks of the marked inelasticity of FDI to the change of the independent variable CO2 per capita.

2)   If GDP increases by 1%, then CO_2 emissions per capita will decrease by 0.074% This indicator also speaks of the inelasticity of GDP to the change of the independent variable CO_2 per capita.

3)   If energy consumption per capita increases by 1%, then CO_2 emissions per capita will decrease by 1.9%. This indicator speaks of the inelasticity of energy consumption to the change of the independent variable CO_2.

4)   If R&D spending increases by 1%, then carbon emissions will also increase by 0.063%. This indicator speaks of the inelasticity of R&D allocation to the change of the independent variable CO_2 per capita

The values of the parameters lead to the general conclusion that CO_2 emissions per capita in Croatia are inelastic to changes in individual perimeters of impact, which can be seen in Table 2.

Table 20. The elasticity of regressor change concerning regressors

Regressors	Link	Elasticity coefficient (%)
LNFDI	+	0,046
LNGDP	-	0,074
LNENG	-	1,919
LNRD	+	0,063

Source: Author's processing with the support of SPSS 24, based on the data in Table 1

To examine the significance of the obtained results (regression coefficients), an individual statistical test was performed.

$$H0 : \beta1 = 0$$

$$H1: \beta1 \neq 0$$

The null hypothesis says that the FDI variable does not affect the expected value of the CO_2 variable. Alternatively, the first hypothesis claims the opposite, i.e. it explains that the FDI variable has an impact on the CO_2 variable. With a significance level of 5% ($\alpha = 0.05\%$), the hypotheses were tested using p-values. Since for all regressors, the p-value is greater than α, the null hypothesis H0 is accepted, ie no single variable affects the expected value of the CO_2 variable with a significance level of 5%.

The results of individual testing of regression variables lead to the conclusion that no single variable is individually significant (does not explain the dependent variable) in the model with a significance level of 5%.with numeration should be centered, as in the following example. It is recommended to format rows with formulas with Microsoft Word (MathType, Equation editor).

Conclusion

What makes this research interesting is that the carbon footprint in the form of CO_2 emissions per capita in the Republic of Croatia was analyzed from the aspect of FDI over two decades in the 21st century. This is a period in which the effects of major global crises (GFK and COVID 19), as well as significant periods and turning points in the economic and political life of the Republic of Croatia, came to the fore. The beginning of the observed period, the beginning of the century marked the completion of the privatization of the financial system, which was supported by the inflow of FDI in the form of obligations to rehabilitate banks and privatized companies. It was also a time of stabilization of the exchange rate, which was an additional incentive for foreign investors to enter the Croatian market. Another important period was the fulfillment of the negotiating chapters for accession to the EU, which happened only in 2013.

The initial European momentum was followed by a period of moderate growth in FDI inflows and a slow economic recovery. These fluctuations in FDI inflows were also reflected in the trends of CO2 emissions in a not so pronounced but still significant correlation.

The highlights of the research are:

- The Republic of Croatia has been attracting a high inflow of foreign direct investment in recent years.
- FDI degrades the environment and thus supports the hypothesis of a pollution haven in Croatia.
- Financial development and innovation in energy research reduce carbon emissions and improve the quality of the environment in Croatia.
- Financial development and innovation in energy research must play an important role in improving the quality of the environment in Croatia.

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