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Foreign Direct Investment as an Indicator of Environmental Policy

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Abstract

This article examines the problem of direct foreign investment in the context of the environmental policy of different countries of the world. Today, science has quite contradictory conclusions regarding the assessment of the effectiveness of direct foreign investments and its links with ecology. In Ukraine, direct foreign investment is largely believed to originate from offshore zones. Ukrainian companies are very often the "investors". This significantly narrows down both the innovative component of the country's environment and the changes expected to be brought by direct foreign investment, including in terms of ecological development. Based on the data of the State Statistics Service of Ukraine, the direction of the rational policy of direct foreign investments was determined from the standpoint of identifying its connections with environmental indicators. It is empirically substantiated that the policy of regulating waste generation, the policy of spending on environmental protection, and the level of innovativeness of the country are promising. This article presents forecast models of the development of the areas of foreign direct investment policy formation identified in the study.

Keywords

Foreign Direct Investment; Environmental Policy; Environmental Problems; Environmental Results; Environmental Criteria

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Introduction

An important activity in the effective functioning of the economic system of the State is the direct foreign investments. In general, it contributes to the growth and production, the improvement of the welfare of citizens, and the growth of the innovativeness of a country. However, along with significant positive effects, foreign direct investment (FDI) can invoke a number of negative effects. They are manifested by the technological dependence and monopoly, the growth of the structural unemployment, as well as the emergence of significant environmental problems. Taking into account a practical experience, research, and scientific conclusions, the problem of FDI in the context of environmental challenges requires urgent actions aimed at eliminating or reducing negative impacts. However, in the global context, solving environmental issues sometimes acquires political interventions and certain manipulations. Taking into account the global warming and the nature of the risks it is accompanied by, the actions of the governments of different countries working to reduce CO_2 emissions, reduce pollution and improve the relevant legislative environment look quite logical. It is believed that, to limit global warming to 1.5°C by the end of the century, and to combat environmental degradation and stop the catastrophic loss of biodiversity, CO_2 emissions must be reduced.

But sometimes such measures are not aimed at finding the best solution for the climate and the environment, but at increasing bureaucratic pressure and lobbying the interests of certain groups. The fight against greenhouse gas emissions sometimes legalizes even quite destructive actions related to the destruction of reserves and nature conservation zones. Some states justify the eviction of people from their places of permanent residence in order to receive donor funds and protect the environment. In addition, climate protection activities are a component of a certain strategy of geopolitical influence, whereby rich countries gain access to poor regions or countries. Arjjumend (2017) explores the issue of environmental standards in the context of regulatory change. Argues that weak states are subject to significant dependency and "corporate takeover", leading to a loss of state sovereignty.

Significant politicization complicates the real solution to environmental problems that are related to modern challenges and threats. FDI flows are subject to the influence of certain factors, among which we highlight macroeconomic (openness of the economy, its stability, productivity), political (development of the institutional environment, political stability), economic (tax burden, presence of special zones, trade restrictions) and national (specific). These include geographic location, infrastructure, GDP per capita, natural resources, and tits abundance. However, contemporary science ~~today~~ has important, but contradictory, conclusions regarding the assessment of the effectiveness of FDI in the context of its linkages with ecology.

Li *et al*. (2019) examine the impact of FDI on environmental outcomes. According to their findings, foreign direct investment has a negligible effect on environmental performance for their sample of 40 countries. There is a differentiation of influence between developed and developing countries; direct investment has a positive and significant effect on environmental performance in developed countries and a negligible effect in developing countries. Solarin and Usama Al-Mulali (2018) argue that foreign direct investment increases pollution in developing countries, while it reduces pollution in developed countries. Research by Opoku and Boachie (2020) of African countries found that FDI generally has a negative impact on the environment. Tran, Tran and Vo (2022) study the negative impact of foreign investments on the strictness of environmental regulation. Fahad *et al.* (2022) argue that environmental regulation promotes technological innovation in Chinese industry and the attraction of greater foreign investment. Wang *et al.* (2014) conclude that Chinese investors bring massive job creation to the host economy, but limited technology transfer to the local economy, large capital, as well as access to the Chinese market. However, Chinese investments carry significant risks and losses from inappropriate corporate social behavior. Gallagher and Qi (2021) report that China's foreign investment flow ranked second in the world after Japan with $130 billion in 2018.

By total capital, China is now the largest investor in the least developed countries and the largest investor in Asia, and the fifth largest investor in Africa.

It is worth noting that along with significant positive effects on the economic situation of the countries where these investments go, there are quite active discussions about their social and environmental impact. Local communities of individual countries to which these investment flows are directed to organize protests against the local environmental impact of certain investment projects, which sometimes leads to the breakdown of contracts (for example, Myitsone on Irawaddy[1] hydropower project in Burma, various mining and hydropower projects in Latin America). In an environmental context, China is a major polluting country, where along with economic growth there are negative side effects: air and water pollution. Scientific results by Hanif *et al*. (2019) confirm the contamination hypothesis. Empirical scientific results obtained by Shah *et al*. (2022) show that the inflow of foreign direct investment has a positive effect on population mortality and renewable energy sources. Nguyen's (2020) study focuses on Vietnam. The author assesses the real impact of foreign direct investment and the openness of the economy (trade) on the environment. The results show that FDI has a positive effect on CO2 emissions in the short run, but not in the long run. The results of the study also show the actual shortcomings of foreign direct investment and production activities in Vietnam's export enterprises. Based on the results of this research, the author provides means for controlling CO_2 emissions. Dardati and Saygili (2020) examine the relationship between foreign ownership and the environmental performance of firms. Based on data from Chile, they found that export-oriented foreign firms have lower emission intensity than horizontally affiliated and domestic firms. Chung (2014) finds strong evidence of a pollution effect in the pattern of Korean foreign direct investment. Zugravu-Soilita (2107) concludes that foreign direct investment increases pollution in middle capital countries with weak environmental regulations.

Research by Doytch (2020) focuses on examining the impact of foreign direct investment at the sector level on four ecological footprints (EF): Consumption EF, Production EF, Import EF, and Export EF. At the same time, the level of development of the country was taken into account. The author obtained the following results:

1. High-income countries interpret the environmental impact of foreign direct investment in the context of consumption. Low- and middle-income countries experience the environmental impact of production-related investments;
2. The export of the environmental footprint associated with direct foreign investment falls disproportionately in middle-income countries; high-income countries have no trace (evidence of ecological refuge);
3. In high-income countries, foreign direct investment in financial services reduces the environmental impact of production. The general conclusion is the detrimental role of foreign direct investment in non-financial services.

Taking into account the highly controversial aspects of this topic in the global context, we believe that the issue of determining the direction of a rational foreign direct investment policy in terms of a possible solution or avoidance of environmental problems for Ukraine requires scientific efforts. The purpose of this study is to substantiate the rational policy of direct foreign investment through the identification of their connections with individual indicators of the ecological and innovative state.

Research Methodology

The analytical part of this study is based on the materials of the State Statistics Service and covers the period 2011-2020. The data for which statistical information could be obtained for the relevant periods were

[1] https://archive.internationalrivers.org/resources/the-myitsone-dam-on-the-irrawaddy-river-a-briefing-3931

included. The list of factors for identifying correlations between direct foreign investments was determined as a result of studying scientific sources.

The research used the method of correlation analysis. In particular, pair correlation to determine the degree of density of connections between direct foreign investment and individual indicators that determine the environmental status or performance of a direct foreign investment in the context of environmental consequences or innovations. This made it possible to identify those with high or medium degrees of correlation (correlation coefficients >0.3) and to predict potential directions for improving foreign direct investment policies in the context of strengthening its environmental component. Calculations and graphical interpretation of the results were performed in the Excel environment using the correlation analysis package.

Results and Discussions

Environmental Criteria and its Relationship with FDI

Liberalization and globalization have significantly expanded the flow of foreign direct investment, including in environmental projects. When evaluating the impact of foreign direct investments, it is worth considering its consequences. The first aspect is related to the establishment of internal high environmental standards by the country in which the investment is expected. In this case, there is a risk that investors, seeking to avoid strict regulation, will move to regions or countries with less strict rules. The second aspect is related to the impact of multinational companies on the environment and its environmental sustainability. In the absence of environmental requirements, the impact of foreign investments can be negative. The hypotheses by Doytch (2020) and Jbara (2007) determine the relationship between foreign direct investment (FDI) and environmental outcomes (Table 1).

Table 1: The main hypotheses of the relationship between direct foreign investment and environmental indicators

The name of hypothesis	*The essence of the hypothesis*
Pollution Asylum Hypothesis	Foreign direct investment is directed to countries with weak environmental regulations. That is why enterprises with ecologically dirty production technologies move from more developed countries to less developed ones.
Hypothesis of the halo of foreign direct investment	Transnational companies contribute to the dissemination of better knowledge and environmental practices among local firms to improve environmental legislation and environmental standards in less developed countries. Their activities are believed to be associated with more developed countries that have the capacity and resources to disseminate better knowledge and environmental practices.
Kuznets ecological curve hypothesis	It assumes an inverted U-shaped relationship between pollution and income. This determines that countries pollute more at the stage of industrialization, and as they develop, they reduce the share of their "dirty" sectors of the economy through trade in them.

The analysis of the scientific conclusions of scientists and the main hypotheses regarding the relationship between foreign direct investment (FDI) and environmental results shows that, to date, no unified approaches and criteria have been formed that should determine the indicators of the assessment of such an impact. Hence, the main provisions of scientific empirical conclusions of scientists are debatable.

The European Commission quite actively supports projects in the field of financing climate measures. In 2021, the European Investment Bank Group (EIB, 2021a) signed financing for a total amount of EUR 94.89

billion. This amount was divided between the European Investment Bank (65.36 billion euros) and the European Investment Fund (30.50 billion euros). Of the total funding, 86.74 billion euros were allocated to projects within the EU, and 8.14 billion euros to projects around the world. Statistics from the European Investment Bank show that annual EIB lending for climate action in developing countries averaged 36% between 2016 and 2020. In 2020, green finance, which involves climate action and environmental sustainability, was 26 billion euro, or 40% of total allocation (EIB, 2021b).

When assessing foreign direct investments, the criteria by which environmental standards are measured are of great importance. They mainly include: the actual measurement of pollution emissions, the index of environmental efficiency, and the indicator of environmental legislation. An alternative for the indicator of pollution emissions is the use of costs to reduce their level, but this indicator is difficult to use in international comparisons. Environmental efficiency indices provide an assessment of the country's proximity to the established goals of environmental policy. It combines two groups of indicators: ecosystem viability and ecological health. In general, the toolkit of environmental policy in the context of its rigidity is divided into market and non-market. The market uses tools to deter polluting enterprises. Non-market sets clear directives, standards and limits.

According to the data of the World Economic Forum 2017 and the strict environmental standards, Ukraine ranks 110th out of 136 countries. Its indicator is 3.3 points out of 7. The countries with the highest environmental ratings (6.2) are Switzerland, Sweden, Finland, and Austria. The lowest is Yemen having 1.7 rank (Travel and Tourism Competitiveness Report, 2017). The third approach is to cover the scope of environmental legislation. For example, in the US, the Environmental Protection Agency (EPA) assigns each state a status of environmental achievement or non-achievement in accordance with the federal standards. Those regions that received a negative status are obliged to introduce stricter rules for polluting enterprises. This automatically means an increased compliance costs for businesses (Cole, Elliott and Zhang, 2017). Shkarupa (2020) proposes to attribute the characteristics of the level of their eco-destructive impact and decarbonization, the efficiency of using the land resources, and introducing the renewable energy technologies to the indicators of environmental sustainability. This will help carry out a targeted evaluation of the effectiveness of the adopted policy. It should manifest itself in the development of smart energy networks, the transition to a carbon-neutral economy, the reduction of emissions/discharges of harmful substances into the natural environment, and the increase in the specific weight of renewable energy sources in the structure of the country's energy balance.

Justification of the Rational Policy of FDI

In order to study the actual connections of direct foreign investments and identify its impact on environmental indicators in Ukraine, a correlation analysis was conducted between foreign direct investment (Table 2) and individual indicators that determine the environmental status. Summarizing the scientific conclusions, the following ecological indicators were identified: emissions of greenhouse gases; waste generation; expenses for the protection of the natural environment and environmental protection measures; the land area of nature reserves; use of mineral fertilizers; application of organic fertilizers; consumption of energy from renewable sources; the general level of innovativeness of the country.

Table 2: Foreign Direct Investments, in million USD

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Investment	48198	51705	53704	38357	46009	47706	47765	46894	54210	52091

Source: SSSU (2021a); NBU (2020); SSSU (2014); SSSU (2020a)

The statistical data presented in table 2 indicate uneven inflows of foreign direct investment into the economy of Ukraine during the study period. The peculiarities of foreign direct investments in Ukraine are

that they are owned by foreign residents or controlled by foreign companies. In general, it is worth noting the low share of foreign direct investments from the developed countries of the world. There is a fairly high level of them from round-tripping FDI countries (Cyprus, British Virgin Islands, Liechtenstein, Belize, Ireland). Offshore investments have a negative impact on the investment potential of Ukraine and are a threat to achieving sustainable economic development. It is worth pointing out that these are often the funds of Ukrainian investors who invest funds in Ukraine through offshore zones, which leads to its "circulation". Chinese companies are showing interest in direct investment in Ukraine. For example, in 2019, in the Chortkiv-West industrial park, Chinese investors agreed to build a corn processing plant with a total investment of $600 million (Markevych, 2021). The analysis of the dynamics of total greenhouse emissions (table 3) during the studied period shows a trend of its reduction. In the context of the general ecological situation, this forms the basis for a positive forecast of a certain improvement in the ecological state.

Table 3: Total emissions of greenhouse gases, in thousand tons

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Emission	6877.3	6821.1	6719.8	5346.2	4521.3	4686.6	4230.6	4121.2	4108.3	3675.3

Source: SSSU (2021b)

However, the results of the correlation analysis based on the statistical data used in this study indicate a low corelation between the amount of direct investment and the total amount of greenhouse gas emissions (correlation coefficient 0.08) (Table 3). The specified connection should not be taken into account in the further modeling of the directions of state policy regarding foreign direct investments in the context of its greening. The analysis of statistical information on the generation and management of waste for the studied period of 2011-2020 shows certain fluctuations of this indicator in dynamics. At the end of the period, its growth is observed (Table 4).

Table 4: Generation and management of waste, in million tons

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Waste	14372	14857	15112	12205	12506	12394	12442	12972	15399	15635

Source: SSSU (2021c)

Correlation analysis of the relationship between foreign direct investment and the indicator of waste generation (Table 4, Figure 1) revealed a strong correlation dependence (coefficient 0.83). At the same time, the growth of the volume of direct foreign investments in Ukraine contributes to the accumulation of waste. This correlates with the scientific research of many authors who obtained similar results when studying other countries of the world. The existence of a correlation dependence determines its consideration as a potential direction of improving the government's policy regarding foreign direct investments in terms of strengthening its greening through effective waste management.

An important direction is the consideration and study of current costs for environmental protection (Table 5). It is worth noting that during the study period, this indicator is characterized by sharp fluctuations, which indicates the absence of clear strategic guidelines on the part of the State management of financing the environmental protection measures.

Analysis of the correlation between foreign direct investment and current environmental protection costs (Table 5) indicates the existence of a moderate relationship between the factors (correlation coefficient 0.36). The dependence established by this research makes it possible to take into account the specified factors in further modeling and development of the policy of foreign direct investments in terms of its environmental orientation.

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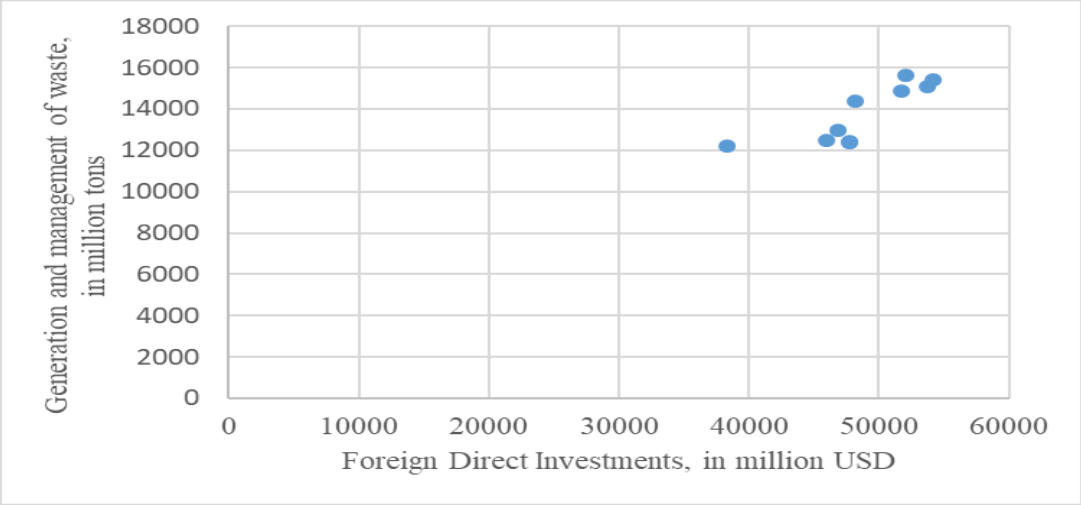

Figure 1: Correlation between foreign direct investment and waste generation

Table 5: Current environmental protection costs, in million USD

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cost	1505	1741	1792	1164	769	735	758	901	1057	1040

Source: SSSU (2021d)

The ecological efficiency index is of great importance in a study of foreign direct investment. It is 49.5 for Ukraine. According to this indicator, Ukraine is ranked 60th out of 180 countries in the world (EPI Results, 2020). Considerable attention in the study of foreign direct investments is directed to determining its impact on the rate of depletion of productive physical land. In the pan-European context, according to the Sustainable Nitrogen Management Index (SNMI), which determines the balanced and effective use of nitrogen fertilizers with the maximum yield of agricultural crops, Ukraine ranks first in the rating (EPI Results, 2020). However, the results of the study revealed a weak relationship between foreign direct investment in Ukraine and the use of mineral and organic fertilizers (Tables 6 and 7, correlation coefficients 0.27 and 0.24, respectively).

Table 6: Mineral fertilizers, in thousand tons

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fertilizer	1266.9	1346.6	1493.8	1471.7	1415.0	1728.9	2028.1	2346.3	2338.3	2483.9

Source: SSSU (2021e)

The specified connections are not recommended to be taken into account when modeling the directions of State policy regarding foreign direct investments in the context of its greening.

Table 7: Organic fertilizers, in thousand tons

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Ferilizer	9954	9685	9652	9898	9663	9163	9274	11649	11382	10210

Source: SSSU, (2021e).

It is important in this study to establish a relationship between foreign direct investment and the area of the nature reserve fund, as it is one of the Indicators of the progress of green growth (Table 7) (Pecheniuk *et al.*, 2022).

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Table 8: Land area of nature reserves, in thousand ha

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Area	1382	1565	1576	1688	1769	1997	1997	1997	2064	2066

Source: State Statistics Service of Ukraine (2020b)

The correlation between foreign direct investment and the land area of nature reserves is expressed by a correlation coefficient of 0.12, which indicates its low density. The specified relationship is insignificant, therefore, it will not be taken into account in the further modeling of the directions of State policy regarding foreign direct investments in the context of its greening. One of the theoretical directions for identifying the influence of foreign direct investment is the growth of energy consumption from renewable sources (Table 9). In Ukraine, at the end of the studied period, there is an increase in the consumption of this type of energy. However, this study has revealed a low density of connection between foreign direct investment and consumption of energy from renewable sources (correlation coefficient = 0.24). Therefore, this direction will not be included in further research.

Table 9: Total supply of energy from renewable sources, in thousand toe (ton on energy fuel)

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy	2514	2476	3166	2797	2700	3616	3907	4303	4335	5685

Source: SSSU (2018); SSSU (2021f)

For the objectivity of this research, it is important to take into account the presence or absence of correlation between foreign direct investment and the level of innovativeness of the country, which includes the graduates of doctoral studies, higher Education, international joint publications, citation of publications, expenses for scientific research work in the public sector, expenses for research and development in business, innovative products/processes, marketing innovations, innovative cooperation, public-private joint publications, private co-financing of State research and development, patent applications, applications for obtaining trademarks, application design, export of medium and high-tech products, export of knowledge-intensive services (Table 10).

Table 10: The level of innovativeness of Ukraine

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Innovation Score	35	35	37	39	37	39	35	32	30	30

Source: EC (2021)

The correlation coefficient between foreign direct investment and the level of innovation is (-0.57). It demonstrates the presence of an average degree of inverse correlation dependence, in which the level of innovativeness of the country decreases as the level of foreign direct investment increases.

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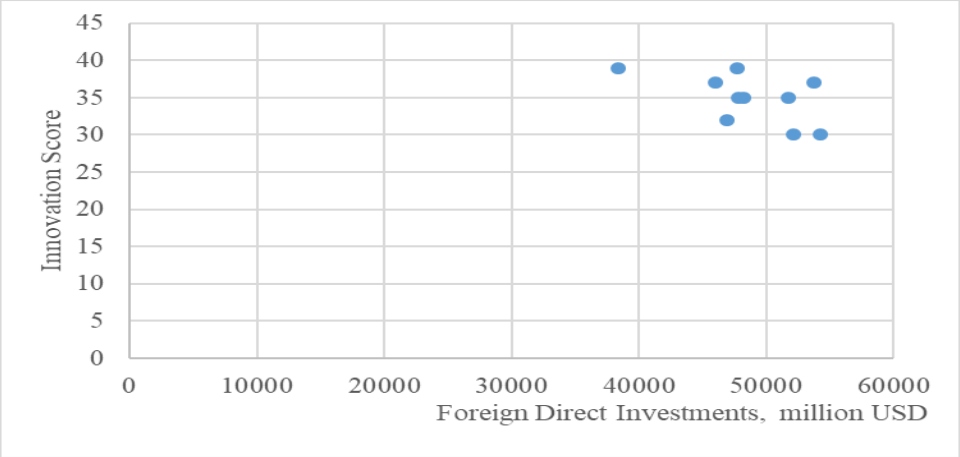

Figure 2: Correlation between direct foreign investment and the level of innovativeness of the country

This correlation dependence can be included in the model for the formation of directions of State policy regarding foreign direct investments in the context of its greening. The identified correlational dependencies make it possible to determine potential areas of improvement of State policy regarding foreign direct investments in the context of strengthening its environmental component. These include: waste generation, expenses for the protection of the natural environment and environmental protection measures, and the level of innovativeness of the country.

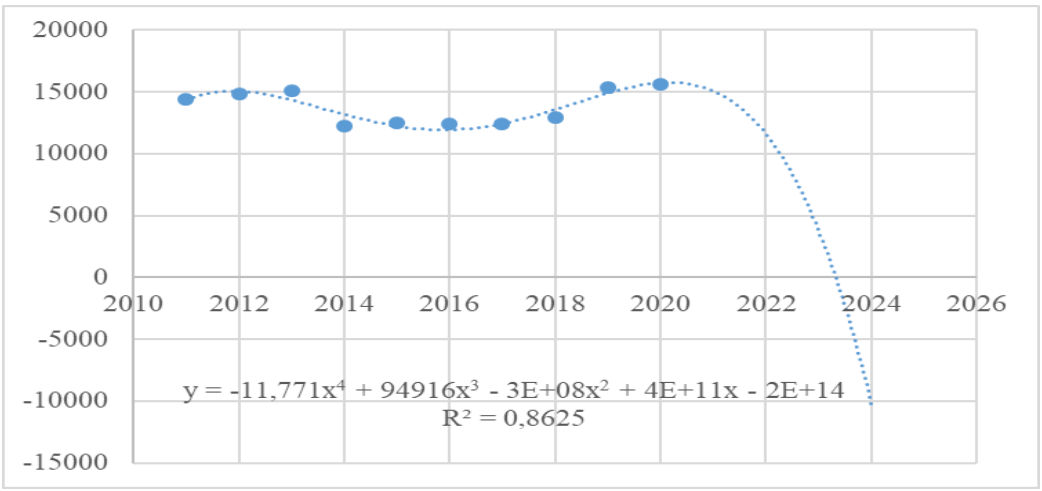

Figure 3: Forecast values of waste generation

The forecast value of waste generation (Figure 3) indicates the possible dynamics of its level of reduction, which could give grounds for a positive assessment of the nearest ecological prospects. The approximation coefficient is 86%, which determines the level of realism of the forecast. However, the study does not take into account the consequences of military actions in Ukraine, which can lead to a radically opposite result of forecasting this indicator.

The forecast of current costs for environmental protection (Figure 4) shows their growth until the end of 2024. In the context of the revealed correlation dependence between foreign direct investments (average degree of linear relationship), this factor can affect the growth of foreign direct investments, and vice versa. Foreign investment can contribute to increasing these current costs.

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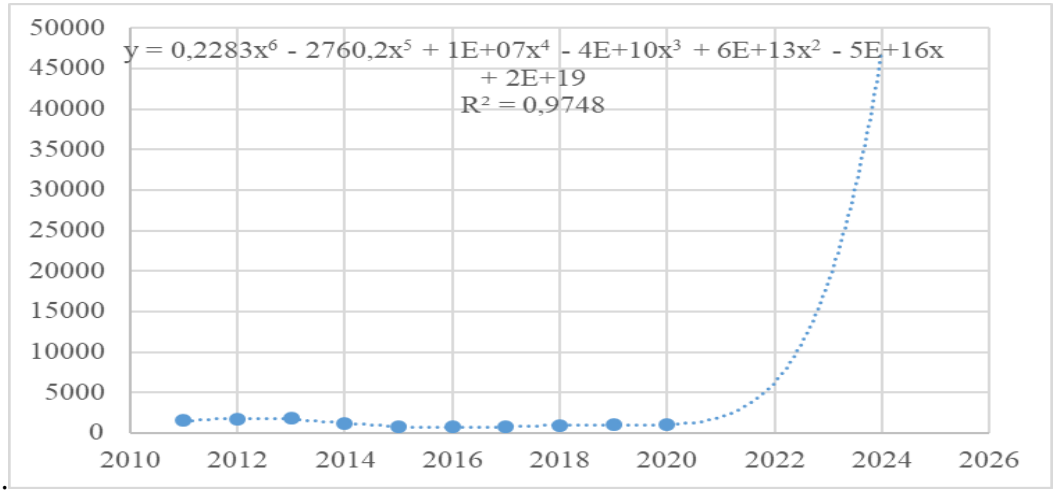

Figure 4: Forecast of current costs for environmental protection

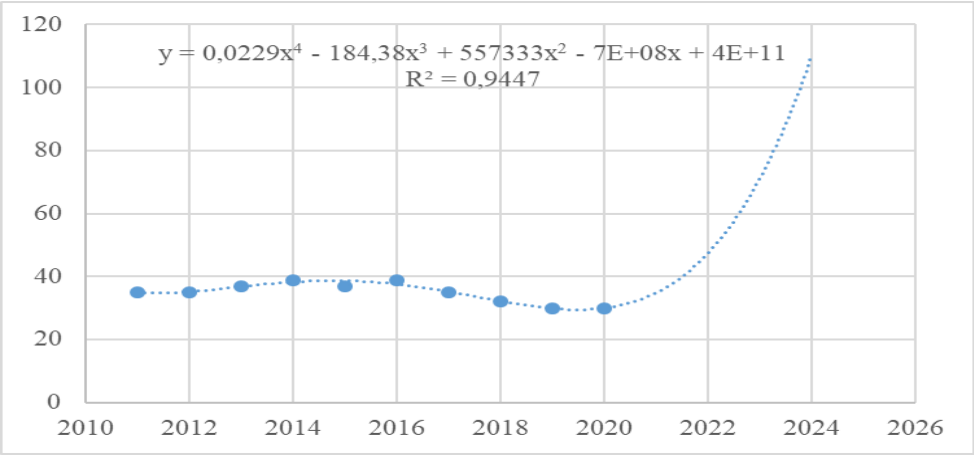

Figure 4: Forecast of the level of innovativeness of Ukraine

The coefficient of approximation for this forecast is relevant and is 94%. The forecast of the level of innovativeness of Ukraine shows positive dynamics for the indicator in the near future. In this context, it is worth noting that in Ukraine there is a crisis situation with the financing of scientific research and the activation of innovative activities, especially during the period of martial law. For example, for the period from 2010 to 2018, the volume of expenses decreased by 1.6 times, while almost all European countries adhere to the State policy of increasing spending on scientific research.

Conclusion

A feature of foreign direct investments in Ukraine is that they largely originate from offshore zones. This narrows down its innovative component and the changes it can bring in terms of ecological development. Empirical substantiation of the policy of foreign direct investment determined that its directions can be the regulation of waste generation, a policy of regulating the costs for environmental protection, as well as the level of innovativeness of the country. The forecast models developed in this study indicate a tendency to decrease the volume of waste generation in Ukraine, which will likely affect the volume of foreign direct investment. The growth in the forecast model of the indicator of the innovation of the country also indicates a possible reduction in the volume of foreign direct investments in the near future. The forecasted trend of

increasing costs for environmental protection gives grounds for the assumption of a possible slight increase in the volume of foreign direct investments but may also indicate inflationary processes. Our forecast did not take into account the impact of military operations on various aspects of foreign direct investment. This can affect the accuracy and reliability of the predictive models. Thus, in general, Ukraine's foreign direct investment policy in the context of environmental or innovation indicators should be based on a pragmatic approach that understands its contradictory impacts on the recipient country.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*	*Author 4*	*Author 5*
Conceived and designed the research or analysis	Yes	No	No	No	No
Collected the data	Yes	No	Yes	No	Yes
Contributed to data analysis & interpretation	Yes	Yes	No	Yes	No
Wrote the article/paper	Yes	Yes	Yes	Yes	Yes
Critical revision of the article/paper	Yes	Yes	Yes	Yes	Yes
Editing of the article/paper	No	Yes	Yes	Yes	Yes
Supervision	No	Yes	No	Yes	No
Project Administration	Yes	No	No	No	No
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