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THE IMPACT OF IT EXPORTS ON ECONOMIC DEVELOPMENT: A COMPARATIVE ANALYSIS OF UKRAINE AND EUROPEAN COUNTRIES

ABSTRACT

Information technologies have become an integral part of the modern economic environment and social life in Ukraine and the EU. The development of the IT industry in various countries demonstrates significant potential to stimulate economic growth. The article is aimed at assessing the impact of IT exports on the macroeconomic indicators of Ukraine, Poland, Estonia and Germany in order to formulate recommendations for the development of the IT industry in Ukraine. The study examines the impact of the export of IT services on GDP, GDP per capita, foreign direct investment and unemployment rate on the example of these countries by calculating the Fechner correlation coefficient.

Based on the analysis of data from 2012-2022, it has been discovered that IT exports have a considerable positive impact on GDP and GDP per capita. In EU countries, the export of IT services also positively influences FDI attraction and the employment level. Despite the growth in the export of IT services, Ukraine shows adverse tendencies in the FDI volumes and increasing unemployment. In Ukraine, there is an inverse weak relationship between the amount of FDI and the IT service exports (Fechner correlation coefficient -0.2727) and a direct moderate relationship with the unemployment rate (Fechner correlation coefficient 0.4545). Considering the complexity of the challenges to the functioning of the economy during the war, the IT sector alone is unable to negate the impact of all threats to the economy of Ukraine.

However, the share of IT exports in the total volume of service exports in Ukraine amounted to more than 45% in 2022. That is, on the one hand, the IT sector is developing despite the war (somewhat slower in 2022 compared to previous years); while on the other hand, a strong imbalance remains in Ukraine regarding the predominant increase in the export of IT sector services. According to the results of a comparative analysis with EU countries, we can say that the export of IT services can become a driver of investment attractiveness and decrease unemployment in Ukraine in the future.

Keywords: IT business, IT export, EU countries, unemployment, foreign direct investment, GDP, economic growth, GDP per capita, population welfare

JEL Classification: F19, L86, O52

INTRODUCTION

In the context of accelerating digitization of all spheres of life in modern society, the IT sector is strengthening its influence on economic development in almost all countries. Today, digitalization is present in education, public administration, medicine, public services and entertainment. The impact of the IT sector on economic development in the countries where this industry has significant export potential is particularly noticeable. In addition, all countries developing the field of digital technologies have a relatively high innovation and investment potential and, consequently, a competitive economy. The export of digital technologies has a powerful multiplier effect on the country's economy, as well as on technological innovations in its individual sectors and transformation processes in social development. This is not only due to the traditional positive effect on the economy from the growth of the export volume. The IT sector development

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contributes to increasing digital literacy in society, improving the level of education and inflow of investments into the high-tech industry in the state.

It ought to be remarked that European countries are substantial players in both the production of IT technology and the consumption of the digital industry's services and technologies. In the context of this, the governments of European countries are putting a lot of effort into fostering favourable conditions for the functioning of the IT sector, for instance, designing tax support programs for start-up culture, and creating science and technology parks.

Ukraine also aspires to become one of the centres of IT development and a key exporter of IT services in the European region. Therefore, it is necessary to study and compare the impact of export volumes on pivotal macroeconomic indicators, specifically economic growth, investment attractiveness, and the labour market in Ukraine and among European countries. It is important to understand what macroeconomic advantages Ukraine can get by supporting and focusing on the development of this sector of the economy. The comparative analysis in our study is aimed at Ukraine and three EU member states: Estonia, Germany, and Poland. The choice of countries for analysis is due to several reasons.

Estonia is interesting for comparison due to its widespread e-government usage, the development of the start-up ecosystem and the use of tax incentives to foster the IT sector. It is important to mention that Ukraine has already borrowed the positive experience of Estonia in the development of the IT sector, in particular, the concept of e-residency and the expansion of the scope of support for electronic services in the public services at the national and regional levels.

Germany is the most economically powerful country in the EU in terms of GDP and one of the leaders in Europe in the implementation of IT technologies. Germany's largest cities (Berlin, Munich, Hamburg) are centres of innovation hubs and clusters.

Another country was chosen for comparison with Ukraine, Poland - a country that we share a common border with, through which the main flows of Ukrainian exports and imports pass. Cooperation and various forms of collaboration regarding the development of information technologies have been established between our countries. In Poland, in recent years, a sufficiently favourable environment for the development of innovations and broad digitalization of all spheres of social life, ensured by stable economic growth, has been created. Compared to leading European countries, Poland has fairly low wages in the IT sector, while the competitiveness of the economy is quite high, the country has an open export-oriented economy and one of the highest absolute figures for customs payments to the EU budget (7th place among all EU countries (Eurostat, 2023). All of the aforementioned factors, along with a favourable tax regime for the IT sector, make the information technology sphere in Poland an attractive investment destination for domestic and foreign investors.

LITERATURE REVIEW

Studies of trends and specifics of IT market development in European countries are presented in numerous reports of international organizations. For instance, the "IT Market in Eastern Europe" (2019) report features a thorough overview of this market in Eastern Europe and the Baltic countries. The report reveals the latest trends in the industry and examines the current state of information technology in Ukraine, Hungary, Poland, Belarus, Romania, Moldova, the Czech Republic, Bulgaria and the Baltic region. The report is aimed at helping businesses, investors and decision-makers to choose the most favourable IT direction for attaining mutually beneficial collaboration.

In the report by the European Investment Bank (2023), by surveying 12,800 European companies and comparing the results with a sample of American companies, the level of digitalization of European businesses, in particular after the COVID-19 pandemic, was analysed by an industry group (sector), firm size, class and country.

A study conducted for the European Commission by McKinsey & Company (2020) examined a range of high-impact technologies and applications (e.g., artificial intelligence, high-performance computing, advanced robotics, virtual and augmented reality). In addition, the potential impact of digital and new high-impact technologies on the economy was modelled with the application of macroeconomic incentives proposed in this study, resulting in a GDP increase of EUR 2.2 trillion in the European Union (EU-27 and the United Kingdom) by 2030.

A number of authors have also extensively explored the development of Industry 4.0, which is based on information technologies. Naudé et al. (2019) appraised the Industry 4.0 preparedness in eight Central and Eastern European countries. The authors describe three distinct periods of industrialization since 1990 and provide a comprehensive explanation of the I4.0 concept. The measures that reflect the three key dimensions of I4.0 readiness, including governance, technological and entrepreneurial competencies, were utilised. The authors concluded that Hungary, the Czech Republic, Slovenia and Lithuania are the most apt for I4.0, while Romania, Bulgaria and Slovakia are the least ready among the CEE countries.

The research on the problems of technological innovation development in Central and Eastern Europe along with the proposed ways to overcome them are covered in the study by Radosevic, S. (2017). In his 2018 study Szakacs, G. concentrated on examining the importance of robots in production automation production processes in European businesses.

It is also worth focusing on such an integral component of the development of digitalization and information technologies as cyber security. Different types of cybercrimes, the reasons for their significant increase in recent years, the determination of the approximate cost of losses from cybercrime to the global economy, as well as the mechanisms for combating said problem were proposed by Lewis, J. (2018).

In a study by Mohamed et al. (2022) the relationship between technological innovation and economic growth in developing countries was analysed. It was found that an increase in the indicators of technological innovation (that is, an increase in R&D and education spending, growth in the number of patents and scientific research works, as well as the volume of high-tech exports) leads to economic growth. Moreover, in the short term, an increase in these indicators directly affects the increase of GDP, and in the long term, there is a two-way causal relationship between them.

The results of other studies by the same authors (2022) indicate that 93% of the changes that have occurred in 20 selected developing countries in terms of economic growth are associated with a knowledge economy. Furthermore, it was found that a number of indicators of the knowledge economy, particularly IT advancements, along with the development of digital technologies and innovations in general have a positive effect on facilitating the GDP growth in these countries.

Xi Wang et al. (2022) in their publication explore the impact of export volumes and, accordingly, the export policy of the state on the level of industrialization of the country, the share of the manufacturing sector, including the technological sector, in economic growth and the level of growth in general.

AIMS AND OBJECTIVES

The purpose of the study is to analyse the relationship between the volume of IT service exports and macroeconomic indicators in Ukraine and the number of selected EU countries (Estonia, Germany, Poland), to determine the role of IT exports in spurring economic, as well as to propose possible ways that the government can provide support for the sector.

METHODS

To study the correlation (stochastic) relationships (in particular, to assess the tightness (strength) of the relationship and determine its direction) between certain indicators of economic development, the standard of living, the investment levels, unemployment and the volume of IT exports, we used the method of comparing parallel series of two indicators, based on the calculation of the Fechner correlation coefficient. Fechner's coefficient analysis makes it possible to estimate the degree of correspondence between the directions of deviation of individual values of factor and resultant indicators from their average values. Apart from that, Fechner's correlation coefficient is utilised to test for the relationship between small series of data. The calculation of the Fechner's coefficient is completed step by step according to the following algorithm:

1. First of all, the average values for each variable (X and Y) are determined;
2. Next, the signs of deviation (–, +) from the average value of each variable are specified;
3. If the signs match, an A value is assigned; if not, a B value is assigned;
4. The number of A and B values are determined and the Fechner coefficient is calculated using the following formula (Marmoza A. T., 2013):

$$K_F = \frac{n_a - n_b}{n_a + n_b} \quad (1)$$

where: n_a is the number of matching signs of individual deviations from the average; n_b – the number of non-matching signs;

5. At the end, the tightness and direction of the relationship are identified. The Fechner coefficient varies within [-1; +1].

   If $K_F < 0$, the relationship is inverse.

   If $K_F > 0$, the relationship is direct.

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To obtain a qualitative assessment of the strength of the connection, Chaddock's scale, presented below, is used in the study:

$\|K_F\|$	**0**	**[0.1-0.3]**	**(0.3-0.5]**	**(0.5-0.7]**	**(0.7-0.9]**	**(0.9-0.99]**	**1.0**
Relationship	None	Weak	Moderate	Evident	Strong	Very strong	Functional

To study the impact of the development of the IT sector, in particular the IT export indicator, on the country's economy, we have chosen the following resultant macroeconomic indicators: GDP, GDP per capita, foreign direct investment and the unemployment rate. These indicators largely determine the level of development of the country's economy, the potential for economic growth and the well-being of the state's citizens.

The development of the IT sector contributes to the automation of production processes in various industries and spheres of the economy, which simultaneously leads to a reduction in production costs, speeds up logistics and makes the production and financial cycles of the country's enterprises shorter. All these factors, in turn, foster an increase in business activity levels and promote the growth of GDP and GDP per capita. In addition, it is the IT industry services that have a high share of added value, and have a multiplier effect on other economic sectors through creating demand for the emergence of innovative business and financial models, innovative medical, educational and security solutions, which also affects the level of the country's GDP and the standard of living (GDP per capita).

The steady growth of the IT sector makes the economy more appealing to foreign and national investors. Often, global investors look for potentially profitable and innovative projects in other countries. The countries-exporters of IT services are innovation-directed and offer new business models and digital solutions for various sectors of the economy, which makes them attractive to foreign investors.

In our opinion, the development of IT can significantly affect the level of unemployment in the country, because the development of the industry with high-value-added allows for the creation of additional jobs not only directly in the IT field but also in adjacent industries. Furthermore, the development of digital services makes it possible to work remotely, as well as to raise the educational level remotely, which also affects new employment opportunities for citizens.

Research hypotheses

The level of development of the IT sector and, in particular, the export of IT services affects the macroeconomic indicators of the state.

1. An increase in the export of IT services leads to an increase in the gross domestic product (GDP) of the country and an increase in GDP per capita. The growth of the export of IT services boosts economic activity due to raised consumption and investment, advancement of human capital and innovative development of the economy. That is, with the growth of exports and services, the state's GDP and GDP per capita increase. We put forward this hypothesis in the context of the fact that the high incomes of IT industry workers lead to an upsurge in consumer demand for goods and services, which stimulates the development of many other sectors of the economy and generally leads to economic growth. Of course, there is also a more traditional impact to estimating the impact of the growth of any export on the country's GDP - all revenues from the export of IT services count as an inflow of foreign currency into the economy, which has a positive effect on the GDP, as well as the macroeconomic and currency stability in general. An increase in the companies' income results in higher tax capacity and ultimately leads to an increase in tax revenues to the budgets of various levels. In the context of high technological capacity and the high value-added products of the IT sector, employees in the IT field receive greater incomes, while companies yield higher profits, which, in turn, contribute to the increased well-being of citizens and GDP per capita. Companies that successfully export IT services have more opportunities to expand their activities and investments, which promotes overall economic growth.
2. The increase in the export of IT services leads to a rise in direct foreign investment in the state. A high level of export of IT service exports presupposes the presence of a developed infrastructure, particularly in the domains of Internet communication and communication technologies in general. The growth in the export of IT services indicates the presence of a qualified workforce in the country, as well as the availability of high-quality education. The general level of innovativeness and competitiveness of the economy can also attract investors in countries-exporters of IT services; mechanisms for managing business processes, regardless of the investment area in such economies, are also more effective. It is worth noting that substantial development of IT exports is preceded by business deregulation, favourable taxation of the sector, and stronger protection of intellectual property rights, which also contributes to the improvement of the business and investment climate.

3. The growth of IT services exports reduces the unemployment rate. The increase in the volume of IT service exports can significantly reduce the level of unemployment and, on the contrary, increase employment in the economy. High-tech sectors of the economy have a greater impact on the labour market than other branches, as they can engage a larger number of adjacent areas of the economy. The demand for IT specialists, and experts in the technological fields of communications, cyber security, electronics and computer technologies is expanding. At the same time, the growth of IT specialists' incomes boosts the demand for quality real estate, security infrastructure, transport, health care, recreation and sports, which stimulates the development of these industries as well and, hence, expands employment in these areas.

RESULTS

The analysis of the impact of IT exports on the economy shall begin with Germany. The primary data for analysis is presented in Table 1.

Table 1. Values of IT service exports and selected macroeconomic indicators for Germany. *(Source: calculated by the authors according to the data of the World Bank (2024) and Federal Statistical Office of Germany (2024))*

Years	ICT service exports, USD million	GDP, current USD million	GDP per capita, current USD million	Foreign direct investment, net inflows, current USD million	Unemployment, total (% of the total labour force)
2012	25.323.8	3.527.143.2	43.855.9	65.443.1	5.4
2013	22.866.5	3.733.804.6	46.298.9	67.199.7	5.2
2014	21.374.6	3.889.093.1	48.023.9	19.532.1	5.0
2015	22.663.9	3.357.585.7	41.103.3	62.475.6	4.6
2016	25.553.1	3.469.853.5	42.136.1	64.744.2	4.1
2017	29.474.5	3.690.849.2	44.652.6	109.486.0	3.7
2018	33.589.3	3.974.443.4	47.939.3	166.915.6	3.4
2019	33.445.7	3.889.177.6	46.805.1	73.974.5	3.1
2020	35.796.9	3.887.727.2	46.749.5	160.800.7	3.9
2021	41.992.6	4.278.503.9	51.426.8	95.904.0	3.6
2022	42.096.2	4.082.469.5	48.718.0	47.374.9	3.1
Average (2012–2022)	30.379.7	3.798.241.0	46.155.4	84.895.5	4.1

To evaluate how the volume of IT services exports affects GDP, GDP per capita, foreign direct investment and the level of employment in this country, the presence, closeness and direction of the connection between the indicators ought to be analysed. The signs of deviations of the factor and result indicators for Germany according to the Fechner correlation coefficient calculation methodology are presented in Table 2.

Table 2. Signs of factor indicator and result indicator deviations (Germany).

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ICT service exports, USD million	-1	-1	-1	-1	-1	-1	1	1	1	1	1
GDP, current USD million	-1	-1	1	-1	-1	-1	1	1	1	1	1
GDP per capita, current USD million	-1	1	1	-1	-1	-1	1	1	1	1	1
Foreign direct investment, net inflows, current USD million	-1	-1	-1	-1	-1	1	1	-1	1	1	-1
Unemployment, total (% of the total labour force)	1	1	1	1	1	-1	-1	-1	-1	-1	-1

According to our calculations, the Fechner correlation coefficient between the volume of exports of IT service exports and GDP is 0.8182 (a strong direct relationship), and between the volume of IT service exports and GDP per capita is 0.6364 (an evident direct relationship) (Figure 1, a-b).

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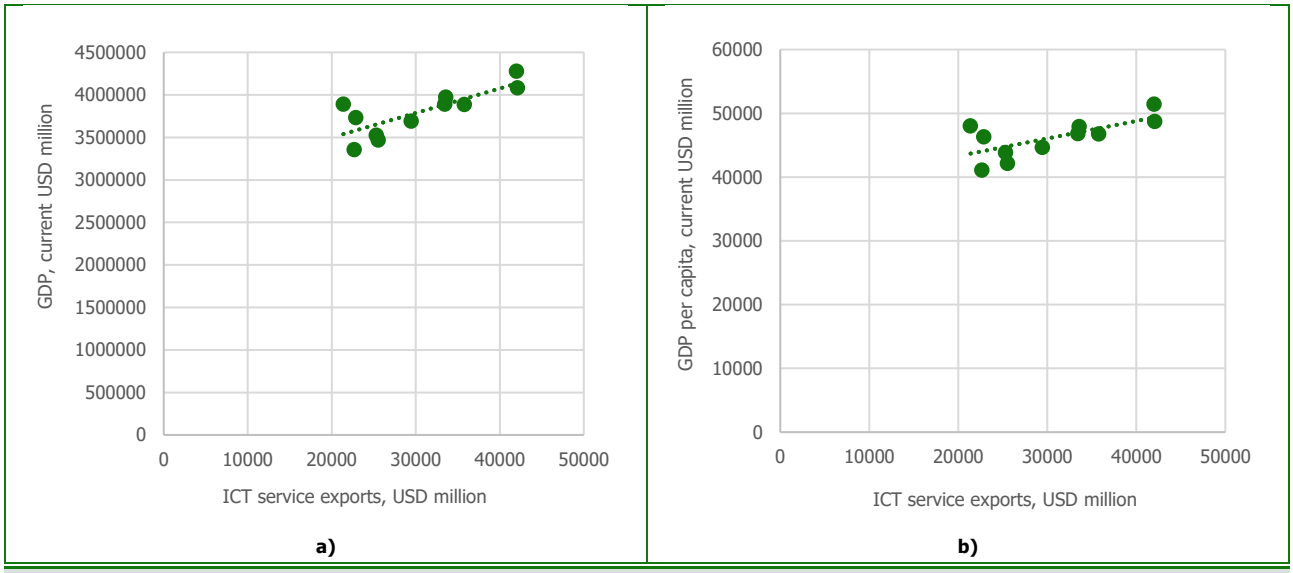
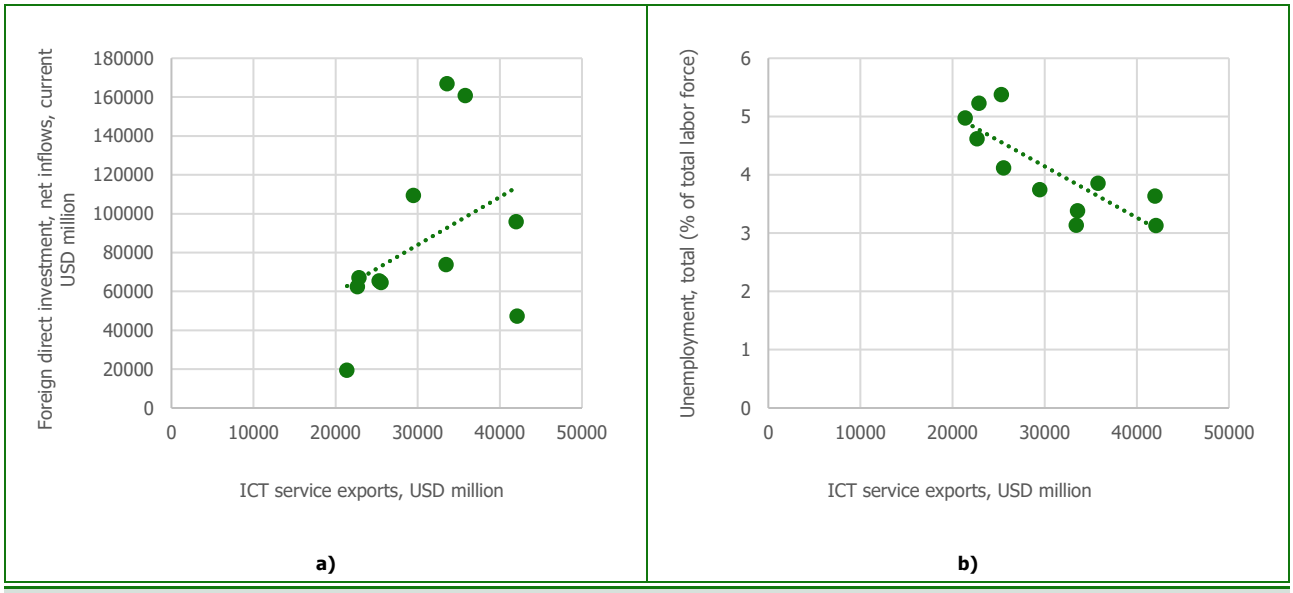


Figure 1. The Impact of IT Export Volumes on GDP (a) and GDP per Capita (b) in Germany.

The calculation results indicate that as the volume of IT services exports rises, GDP and GDP per capita also tend to increase. This means that an increase in the volume of exports of IT sector services has a positive effect on Germany's economic growth (GDP growth and GDP per capita). The influence of the export of IT services on the volume of foreign direct investment and the level of unemployment in Germany is graphically presented below (Figure 2, a-b).



Figures 2. The impact of IT export volumes on foreign direct investment (a) and the unemployment rate (b) in Germany.

The Fechner correlation coefficient between the volume of IT services exports and the volume of FDI for Germany is 0.4545, which denotes a direct moderate relationship between the indicators. The growth of IT service export volumes, respectively, enhances the investment climate and facilitates the attraction of foreign direct investment in the German economy.

The growth of IT service exports substantially improves the situation in the labour market and the employment level in Germany. There is a strong inverse relationship between the growth of exports of IT services and the level of unemployment (Fechner's correlation coefficient -0.8182), indicating that changes in the volume of exports of IT services have a considerable impact on the unemployment rate. The development of the IT sector in the economy leads to the acceleration of business activity and the creation of additional new jobs in auxiliary and adjoining industries.

The relationships respective indicators for Estonia should also be examined. Primary data for analysis, as well as the signs of deviations of selected indicators according to the Fechner correlation coefficient calculation methodology are presented in Tables 3-4.

Table 3. Values of IT service exports and selected macroeconomic indicators for Estonia. *(Source: calculated by the authors according to the data of the World Bank (2024) and Statistics Estonia: Foreign trade application (2024))*

Years	ICT service exports, USD million	GDP, current USD million	GDP per capita, current USD million	Foreign direct investment, net inflows, current USD million	Unemployment, total (% of the total labour force)
2012	508.4	23.019.2	17.403.2	1.787.3	10.0
2013	580.9	25.115.8	19.056.0	1.097.9	8.6
2014	646.1	26.634.1	20.261.1	1.781.6	7.4
2015	509.3	22.890.8	17.402.0	-715.5	6.4
2016	576.3	24.072.8	18.295.3	925.8	6.9
2017	733.8	26.924.4	20.437.8	1.735.8	5.8
2018	961.4	30.624.7	23.165.8	1.232.4	5.4
2019	1.042.2	31.081.9	23.424.5	3.071.1	4.5
2020	1.132.9	31.370.4	23.595.2	3.758.3	7.0
2021	2.115.0	37.191.2	27.943.7	7.540.4	6.2
2022	2.440.9	38.100.8	28.247.1	1.646.9	5.6
Average (2012–2022)	1.022.5	28.820.5	21.748.3	2.169.3	6.7

Table 4. Signs of factor indicator and result indicator deviations (Estonia).

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ICT service exports, USD million	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
GDP, current USD million	-1	-1	-1	-1	-1	-1	1	1	1	1	1
GDP per capita, current USD million	-1	-1	-1	-1	-1	-1	1	1	1	1	1
Foreign direct investment, net inflows, current USD million	-1	-1	-1	-1	-1	-1	-1	1	1	1	-1
Unemployment, total (% of total labour force)	1	1	1	-1	1	-1	-1	-1	1	-1	-1

For indicators that demonstrate general economic growth and improvement in the citizens' welfare (GDP and GDP per capita) with the volume of exports of IT services, the Fechner correlation coefficient for Estonia is 0.8182 (direct strong relationship). Graphically, the relationship between the amount of IT services exports and one of the indicators (GDP) is illustrated below (Figure 3).

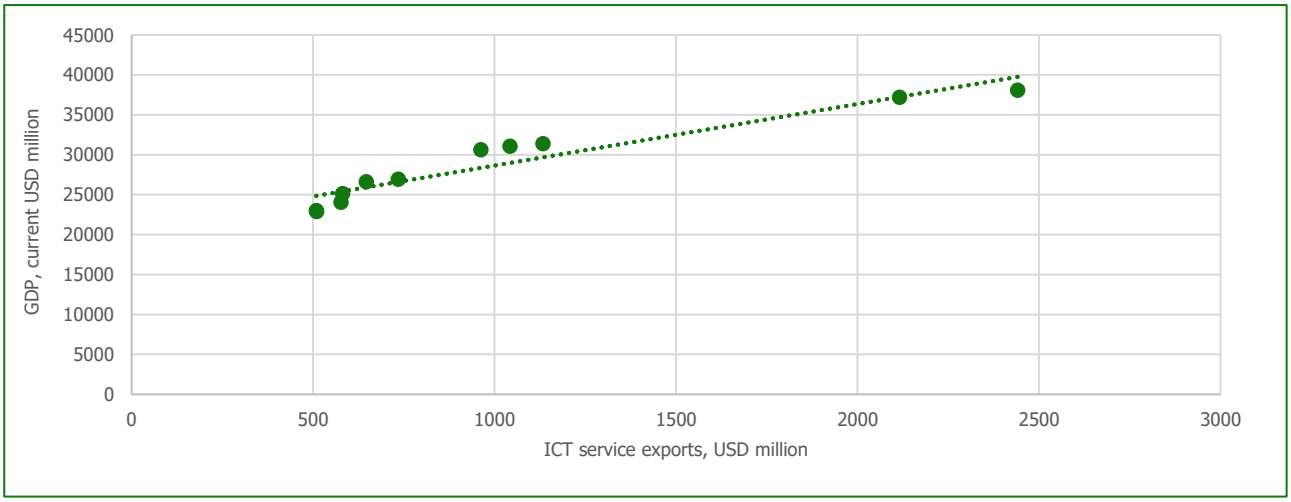


Figure 3. The impact of IT service export volumes on GDP in Estonia.

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Similarly to Germany, in Estonia, the rise in IT service exports has a notable impact on economic growth and the well-being of the population (GDP and GDP per capita are increasing).

The following figures graphically display the relationships between IT service exports with foreign direct investment and the unemployment rate (Figure 4).

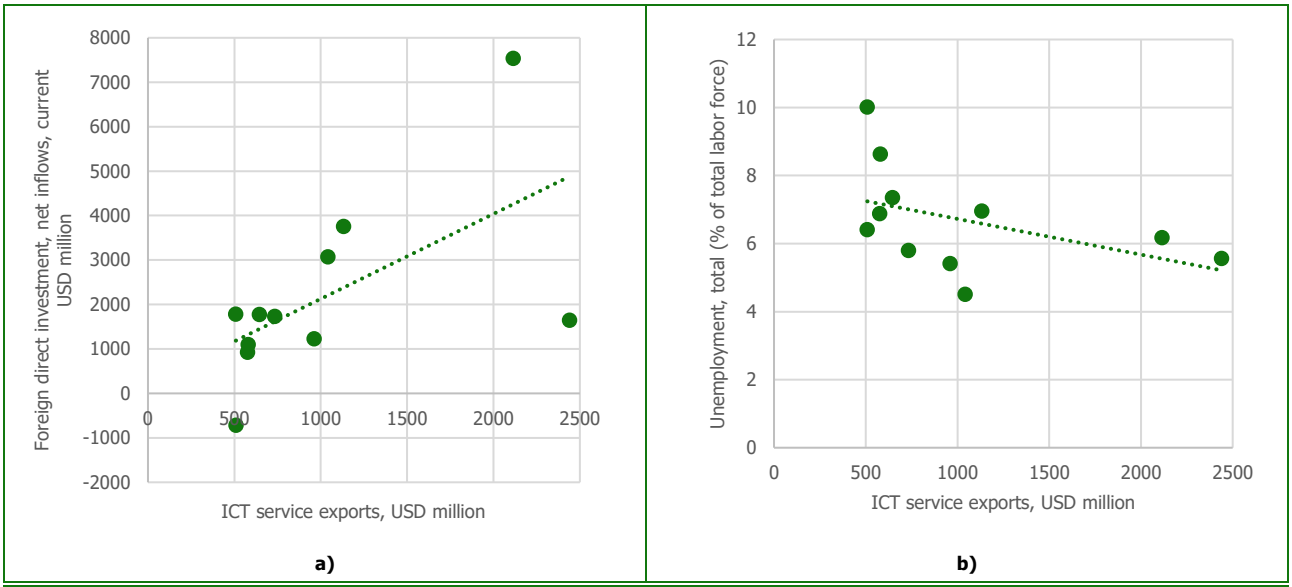

Figure 4. The Impact of IT service export volumes on foreign direct investment (a) and unemployment (b) in Estonia.

A surge in the export of IT services allows for more FDI attraction into the Estonian economy. Consequently, the development of the IT sector contributes to the enhancement of the overall investment climate in the state. There is a strong direct relationship between the volume of IT exports and foreign direct investments - the Fechner correlation coefficient is 0.8182

(Figure 4, a). Regarding the relationship between the unemployment rate and the volume of IT service exports, the Fechner correlation coefficient makes up to -0.2727 (inverse weak relationship). Compared to the previously analysed country, Estonia, the increase in the volume of IT industry exports has a less prominent effect on the labour market.

The next step would be to analyse the corresponding indicators concerning Poland. Initial data and calculation results are offered in Tables 5 and 6.

Table 5. Volumes of IT service exports and selected macroeconomic indicators of Poland. *(Source: calculated by the authors according to the data of the World Bank (2024))*

Years	ICT service exports, USD million	GDP, current USD million	GDP per capita, current USD million	Foreign direct investment, net inflows, current USD million	Unemployment, total (% of the total labour force)
2012	2.880.0	495.230.5	13.010.8	7.180.0	10.1
2013	3.416.0	515.762.0	13.558.3	1.029.0	10.3
2014	4.225.0	539.080.5	14.181.9	20.455.0	9.0
2015	4.394.0	477.111.3	12.560.1	15.598.0	7.5
2016	5.322.0	470.024.6	12.378.8	17.750.0	6.2
2017	6.392.0	524.641.2	13.815.5	11.999.0	4.9
2018	7.998.0	588.779.9	15.504.5	19.204.0	3.8
2019	8.606.0	596.058.5	15.700.0	17.619.0	3.3
2020	9.426.0	599.442.8	15.816.8	19.151.0	3.2
2021	11.580.0	681.346.1	18.050.3	36.172.0	3.4
2022	13.481.0	688.125.0	18.688.0	36.900.0	2.9
Average (2012–2022)	7065.5	561418.4	14842.28	18459.73	5.862545

Table 6. Signs of factor indicator and result indicator deviations (Poland).

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ICT service exports, USD million	-1	-1	-1	-1	-1	-1	1	1	1	1	1
GDP, current USD million	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1
GDP per capita, current USD million	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1
Foreign direct investment, net inflows, current USD million	-1	-1	1	1	-1	-1	1	1	-1	-1	1
Unemployment, total (% of the total labour force)	-1	-1	-1	1	-1	-1	-1	1	-1	-1	-1

According to the results of the analysis of 2012-2022, there is a functional direct relationship between the export volume of the IT industry, GDP and GDP per capita in Poland (Fechner's correlation coefficient for both indicators is 1). The relationship solely between GDP and the volume of IT exports is depicted below (Figure 5).

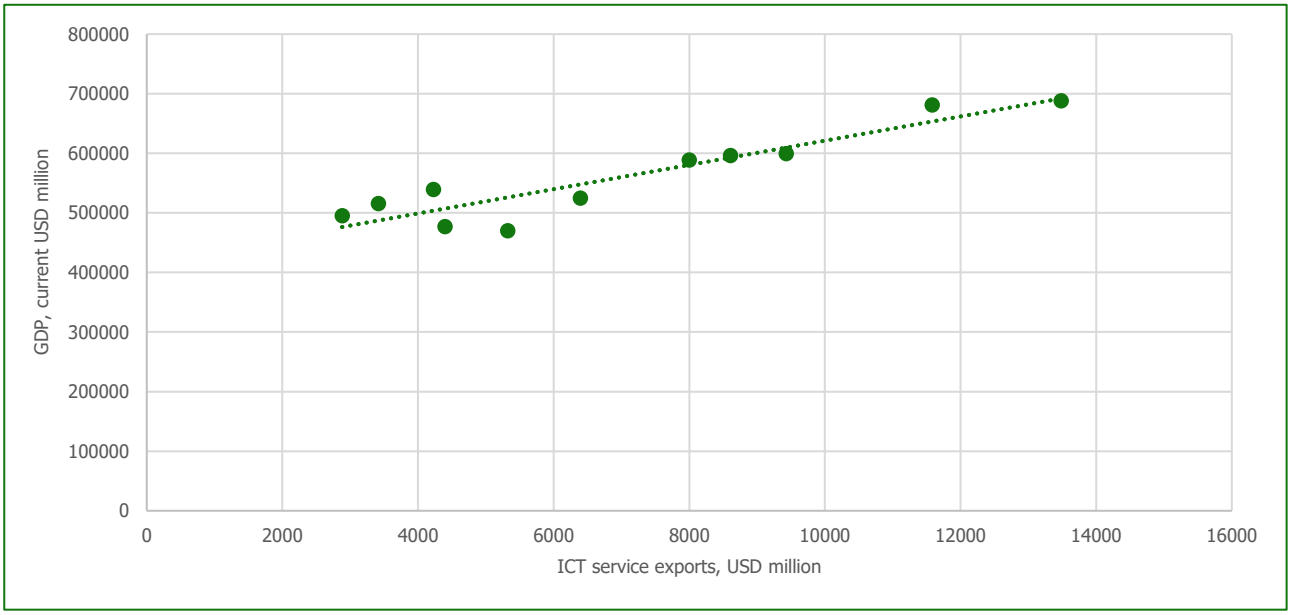

Figure 5. The Impact of IT Service Export Volumes on GDP in Poland.

As for Poland, the dependence between IT exports and indicators of macroeconomic growth (GDP and GDP per capita) is very significant, i.e., the rise in exports of IT sector services is an influential factor in the standard of living and the GDP growth.

As apparent from Figure 6-a, there also exists an evident direct relationship between IT exports and FDI for Poland (0.6364 – Fechner correlation coefficient). The development of the IT sector and the growth of IT industry exports make Poland's economy more appealing for foreign investments.

The impact of the growth of IT exports on the labour market and employment in Poland is also positive (Figure 6-b). The Fechner correlation coefficient between the indicators of export of IT services and the level of unemployment is -0.81818 (which signifies an inverse strong relationship).

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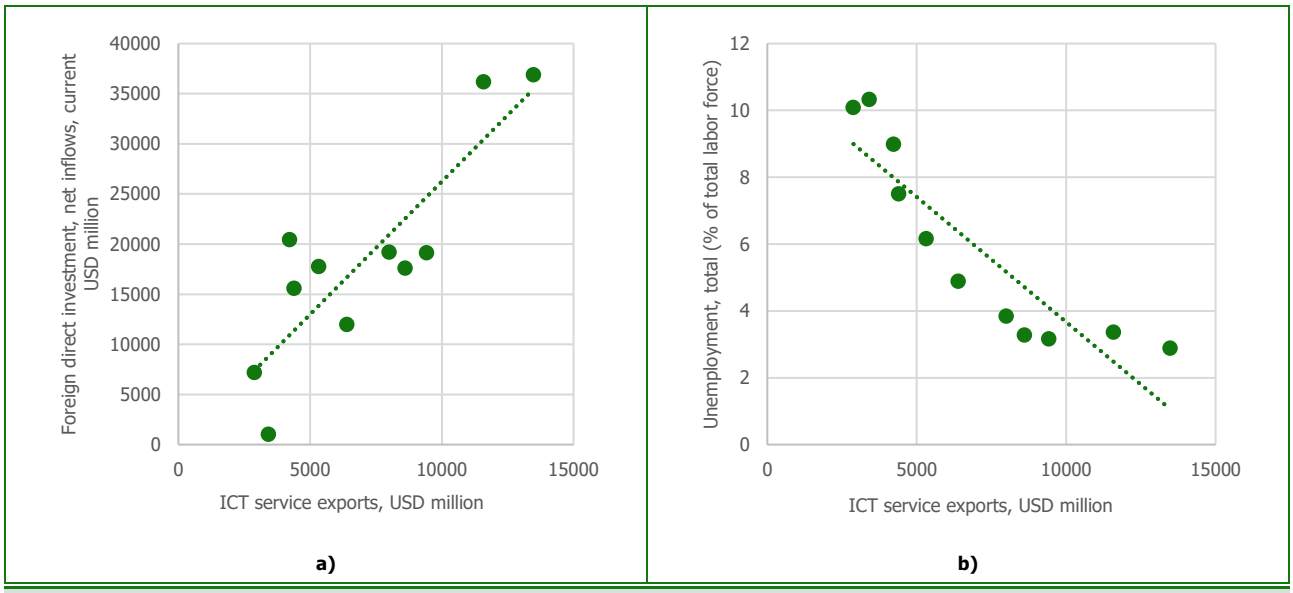

Figure 6. The impact of IT service export volumes on foreign direct investment (a) and unemployment (b) in Poland.

Ukraine's indicators would be the last subject for analysis. Macroeconomic indicators and the results of variable rank calculations are presented in Tables 7-8.

Table 7. Volumes of IT service exports and selected macroeconomic indicators of Ukraine. *(Source: calculated by the authors according to the data of the World Bank (2024) and National Bank of Ukraine (2024))*

Years	ICT service exports, USD million	GDP, current USD million	GDP per capita, current USD million	Foreign direct investment, net inflows, current USD million	Unemployment, total (% of the total labour force)
2012	1.321.0	182.591.8	4.004.8	8.175.0	7.5
2013	1.782.0	190.498.8	4.187.7	4.509.0	7.2
2014	2.042.0	133.503.9	3.104.7	847.0	9.3
2015	2.105.0	91.031.0	2.124.7	-198.0	9.1
2016	2.310.0	93.355.9	2.187.7	4.128.0	9.4
2017	2.760.0	112.090.5	2.638.3	3.680.0	9.5
2018	3.473.0	130.891.1	3.096.6	4.975.0	8.8
2019	4.331.0	153.883.0	3.661.5	5.796.0	8.2
2020	5.181.0	156.617.7	3.751.7	304.0	9.5
2021	7.107.0	199.765.9	4.827.8	7.954.0	9.8
2022	7.521.0	160.502.7	4.534.0	247.0	21.21
Average (2012–2022)	3.630.3	145.884.7	3.465.4	3.674.3	10.0

Table 8. Signs of factor indicator and result indicators deviations (Ukraine).

Indicators	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ICT service exports, USD million	-1	-1	-1	-1	-1	-1	-1	1	1	1	1
GDP, current USD million	1	1	-1	-1	-1	-1	-1	1	1	1	1
GDP per capita, current USD million	1	1	-1	-1	-1	-1	-1	1	1	1	1
Foreign direct investment, net inflows, current USD million	1	1	-1	-1	1	1	1	1	-1	1	-1
Unemployment, total (% of the total labour force)	-1	-1	1	1	1	1	-1	-1	1	1	-1

The Fechner correlation coefficient between IT exports and GDP, GDP per capita for Ukraine is 0.6364, which indicates an evident direct relationship. Graphically, only the relationship between IT exports and GDP is portrayed.

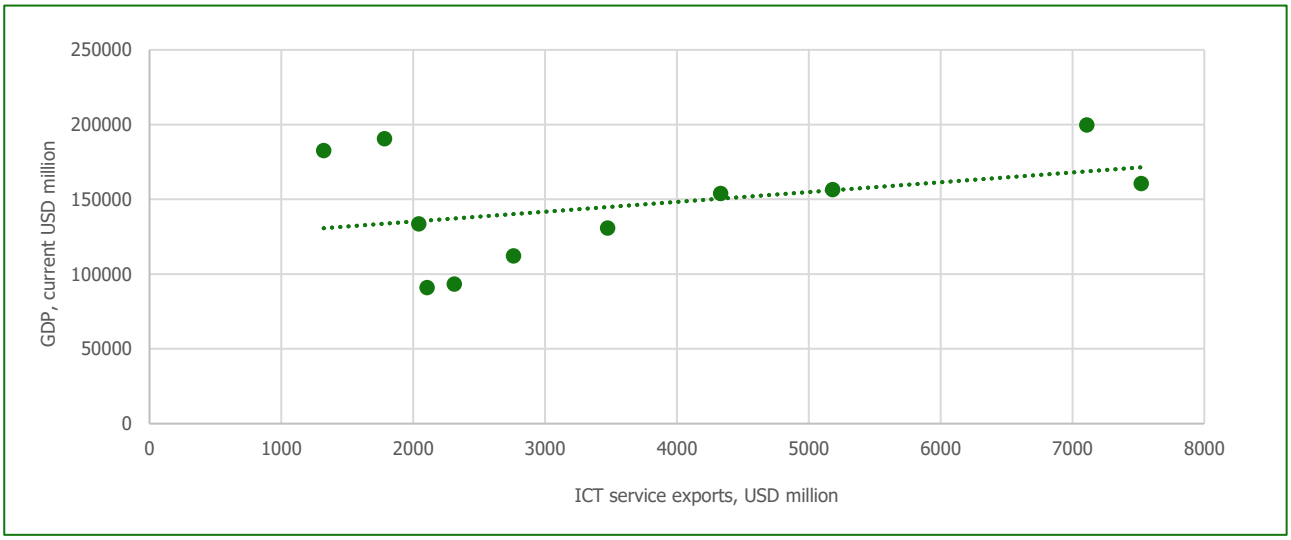

Figure 7. The impact of IT service export volumes on GDP in Ukraine.

The increase in the volume of IT services exports has an evident positive effect on economic growth in Ukraine. With the increase in the said category of export in Ukraine, the growth of both GDP and the GDP per capita can be observed. The correlation of these indicators with the export of IT services for Ukraine is somewhat weaker compared to Germany, Poland and Estonia. As for FDI and the unemployment rate, there is a reverse correlation between these indicators and IT exports for Ukraine, compared to other analysed states (Figure 8, a-b).

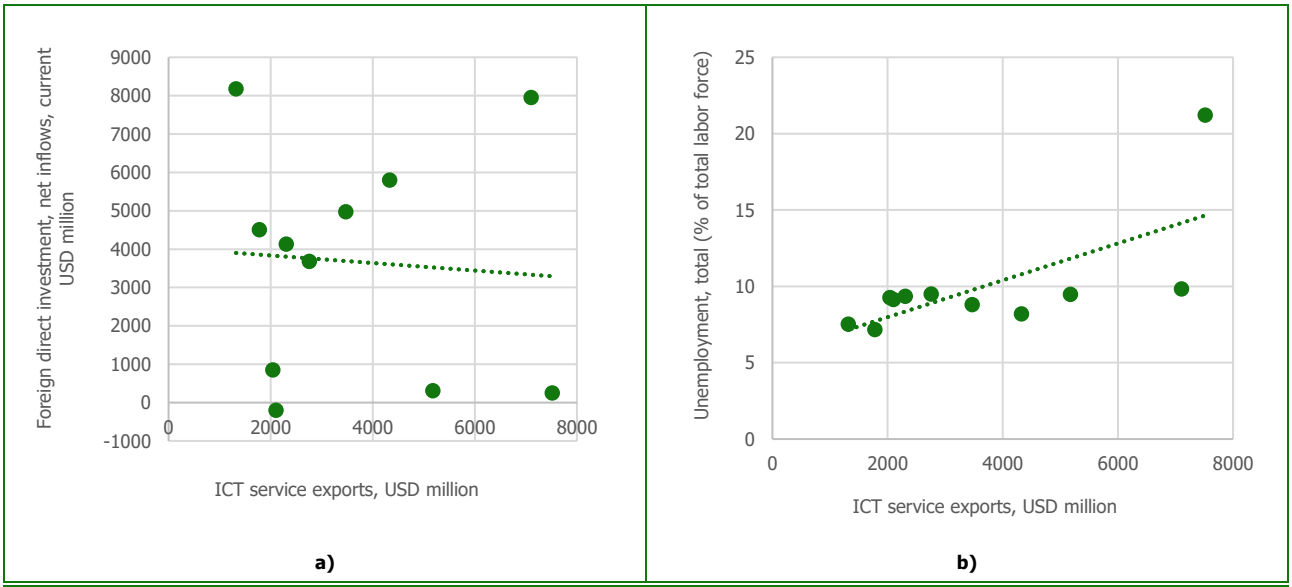

Figure 8. The impact of IT service export volumes on foreign direct investment (a) and unemployment (b) in Ukraine.

The correlation coefficient -0.2727 signifies the presence of a weak inverse relationship between the export of IT services and FDI (Figure 8-a). This means that an increase in the volume of IT exports is followed by a decrease in foreign direct investment, although this connection is weak. A direct moderate relationship was detected between the unemployment rate and IT exports (Fechner correlation coefficient 0.4545). Hence, in contrast to Germany, Poland, Estonia, in Ukraine, the increase in the volume of IT exports is accompanied by an increase in the level of unemployment and vice versa.

The Fechner correlation coefficients between the volume of IT exports and selected macroeconomic indicators for Ukraine, Germany, Estonia and Poland are aggregated in Table 9.

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Table 9. Correlation relationships between IT export volumes and selected macroeconomic indicators in different countries.

	Ukraine	Germany	Estonia	Poland
IT export - GDP	0.6364	0.8182	0.8182	1
IT export – GDP per capita	0.6364	0.6364	0.8182	1
IT export -foreign direct investment	-0.2727	0.4545	0.8182	0.6364
IT export -unemployment level	0.4545	-0.8182	-0.2727	-0.8182

It is also worth noting that the shares of IT sector services in the export of services for each of the analysed countries are fundamentally different (Table 10).

Table 10. Shares of IT sector services values in the export of all services by country. *(Source: calculated by the authors according to the data of the World Bank (2024))*

Indicators/ Years	Information and communication technology service exports, USD million	Service exports, USD million	Share of ITC service exports in service exports, %	Information and communication technology service exports, USD million	Service exports, USD million	Share of ITC service exports in service exports, %
Country	**Germany**			**Estonia**		
2012	25.323.77	255.914.13	9.9	508.42	6.024.23	8.44
2013	22.866.5	276.805.67	8.26	580.9	6.673.13	8.7
2014	21.374.6	303.309.3	7.08	646.15	7.149.61	9.04
2015	22.663.9	280.879.6	8.07	509.3	5.859	8.7
2016	25.553.1	293.160.24	8.72	576.3	6.102.2	9.44
2017	29.474.53	321.567.9	9.16	733.78	6.917	10.61
2018	33.589.27	356.846.4	9.41	961.4	7.874.1	12.21
2019	33.445.7	366.606.2	9.12	1.042.2	8.041	12.96
2020	35.796.9	332.069.4	10.78	1.132.9	6.534.23	17.34
2021	41.992.6	407.226.29	10.31	2.115	10.138.3	20.86
2022	42.096.18	428.704.28	9.82	2.440.93	11.287	21.63
Country	**Poland**			**Ukraine**		
2012	2.880	40.180	7.2	1.321	22.089	5.98
2013	3.416	43.796	7.8	1.782	22.613	7.88
2014	4.225	47.770	8.8	2.042	14.884	13.72
2015	4.394	44.270	9.9	2.105	12.442	16.92
2016	5.322	48.914	10.9	2.310	12.448	18.56
2017	6.392	58.057	11	2.760	14.243	19.38
2018	7.998	68.336	11.7	3.473	15.836	21.93
2019	8.606	70.435	12.22	4.331	17.465	24.8
2020	9.426	66.612	14.15	5.181	15.564	33.29
2021	11.580	81.123	14.27	7.107	18.391	38.64
2022	13.481	95.362	14.14	7.521	16618	45.26

DISCUSSION

Numerous scientific studies highlight how IT innovation, exports, and investment contribute to economic growth across various European and states.

The connections between innovation activities, as well as the contribution of the IT sector and per capita economic growth in 19 selected European states, were investigated by Maradana et al. (2017). The researchers utilised the economic tools

to examine primary data from the 1989-2014 period, to conclude, that innovation, especially the high-technology exports, substantially boosts the economic growth of the country.

The in-depth analysis, conducted by Dempere et al. (2023) in the "Impact of innovation on economic growth, foreign direct investment, and self-employment" study covers the effect of innovation on GDP, FDI, and self-employment in 120 countries, many of them European. It was found that innovation favourably affects GDP and local infrastructure, and the crucial role of the IT sector in these tendencies was pointed out.

In our research, we focused on the comparison of Ukraine with three European countries in the context of the impact of IT exports on economic growth (GDP and GDP per capita), foreign direct investments and unemployment.

Germany is one of the leading EU economies, with a developed IT sector; Estonia is one of the leaders in the IT-sphere among the EU countries; Poland and Ukraine show significant progress in the development of the IT sector during the analysed period, but in all these countries the role of the IT sector and, in particular, of IT exports in the economic growth of the country is different.

As evident from the research results, all the hypotheses formulated at the beginning are valid for the EU member states - Estonia, Poland, and Germany. The direct strong relationship between the volume of IT exports, GDP and GDP per capita indicates the importance of the IT sector and the development of its export potential as a key factor in economic growth and improving the standard of living in these countries.

The second hypothesis is also accurate. The increase in IT exports positively correlates with the amount of foreign direct investment. This relationship is strong for Estonia (close direct relationship according to the Fechner correlation coefficient) and medium for Germany and Poland (moderate direct and evident direct relationship according to the Fechner correlation coefficient for these countries, respectively). That is, the strongest positive impact on the inflow of foreign direct investment has been the growth of IT product exports in Estonia from all analysed countries.

The third hypothesis was also confirmed for the selected EU countries. In Germany and Poland, the increase in the volume of IT exports has a strong positive impact on the labour market and employment, which is confirmed by a strong inverse relationship between the indicators of the unemployment rate and IT exports (Fechner correlation coefficient -0.8182). For Estonia, this effect is less distinct, although the growth of IT export volumes also reduces the unemployment rate (weak inverse relationship, Fechner's correlation coefficient -0.2727).

Let us delve deeper into the analysis of the research results for each of the countries. Another aspect of the development of the IT sector, namely the share of IT exports in the total volume of services exports, should be pointed out. As can be seen from the data in Table 10, the share of IT exports in Estonia has had a steady upward trend since 2012 and reached almost 22% in 2022. Evidently, the country pays particular attention to the development of the sector, which brings its results - there is a strong positive impact on the growth of GDP and GDP per capita, the growth of the direct foreign investments in the state (the Fechner correlation coefficient between these three indicators and the volume of IT service exports is 0.8182). The impact on employment is weak, but the labour market itself in Estonia is not quite large. Estonia, at the same time, is one of the leaders in the field of start-ups and innovative digital entrepreneurship among European countries. It is renowned, in particular, for its project "Estonia E-Republic" (e-Estonia), which involves large-scale digitalization of government services and public life.

The share of IT exports in the total export of services in Poland is growing somewhat more slowly and accounts for approximately 14% in 2020-2022, the country is famous for its developed outsourcing infrastructure. That is, the IT industry has also become an integral sector of the Polish economy and affects macroeconomic indicators, economic growth and the investment climate, which is confirmed by the results of our research. IT service exports have a functional direct relationship with GDP and GDP per capita (Fechner correlation coefficient of 1 for both indicators) and a direct average (evident according to the Fechner correlation coefficient of 0.6364) connection to the amount of FDI.

IT exports accounts for a small share of Germany's service exports amounting to 9-10% over the past 6 years. However, the absolute values of IT exports have been steadily growing. Germany is one of the leading economies in Europe with developed innovative technologies and a high level of technical education and scientific research. According to our research, the increase in the volume of IT exports in Germany has a positive effect on the growth of GDP and GDP per capita (a strong and evident direct relationship - Fechner correlation coefficients of 0.8182 and 0.6364 for the two indicators, respectively). Additionally, unemployment and IT exports in Germany are closely inversely connected (Fechner's correlation coefficient -0.8182, inverse strong relationship). The development of IT exports contributes to the reduction of the unemployment rate, as qualified workers find high-paying jobs within the country, and therefore labour migration decreases. Moreover, the development of IT has a multiplier effect on the economy in general, because, in the context of higher

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solvent demand for workers in the industry, jobs are created in other economic sectors. In addition, the export of IT products has an evident positive effect on the attraction of foreign direct investment (Fechner correlation coefficient 0.6364) primarily due to innovativeness, technological efficiency of the German economy and the use of advanced management methods and practices.

As for the economy of Ukraine, the study showed some noteworthy differences compared to other countries, as the hypotheses are only partially confirmed for Ukraine. In our opinion, this is related to the substantial impact of negative external factors on the economy of Ukraine and the extreme circumstances in which the Ukrainian economy has been functioning during the analysed period.

The first hypothesis of the study, regarding the direct influence of IT service exports on GDP and GDP per capita, is verified for Ukraine as well as for the analysed European states (Fechner correlation coefficients of 0.6364 for both indicators). However, this relationship is merely evident, while it is strong for EU countries, which indicates that the influence of adverse factors on economic growth and the population welfare is so powerful in Ukraine that it does not allow the IT industry to decisively determine macroeconomic trends in our country.

Contrary to the proposed hypotheses and the calculations made for the aforementioned EU countries, there is a direct moderate relationship between IT exports and the unemployment level in Ukraine. It should be pointed out that, firstly, Ukraine has a generally higher unemployment level compared to the analysed EU states. Secondly, in our opinion, the discovered discrepancy occurs due to the specifics of the analysed period (2012-2022). In 2014, many people in Ukraine lost their jobs because of the war and occupation. As a result, employment decreased and the unemployment rate increased consequently, particularly due to the sharp increase in the number of internally displaced persons from the east to the central or western regions of Ukraine [Ministry of Finance of Ukraine, 2024: State Statistics Service of Ukraine, 2024]. Within one year, in 2014, unemployment increased by 2% compared to 2013 amounting to 9.27%. In 2022, since the beginning of the full-scale invasion, the tendency of drastic change in the unemployment rate much like in 2014 repeated, only on a tremendously larger scale. The unemployment rate in 2022 reached 21.21%, due to the devastating impact of the war, which led to the mass closure of businesses, a significant loss of GDP, and the migration of a substantial number of the population to other regions and abroad. Of course, many did not manage to quickly adapt and find a job, which also added to the increase in the unemployment rate. Considering the extent of the unemployment problem, even a momentous increase in IT exports cannot significantly affect the unemployment issue in Ukraine.

Regarding the FDI and IT service exports, the hypothesis stating a positive direct relationship between these indicators was not confirmed for Ukraine either. Firstly, the amount of foreign direct investment in Ukraine does not have a clearly defined upward or downward trend throughout 2012-2022. Thus, in 2014-2015, investors reacted to the beginning of the war in Donbas by reducing and withdrawing foreign direct investment (from USD 4509 million in 2013 to USD 847 million in 2014; in 2015, the outflow of FDI amounted to USD -198 million, Table 7). After the positive tendencies of 2016-2019, FDI sharply decreased in the context of a decline in the dynamics of business activity in Ukraine during the crisis associated with the 2020 coronavirus disease pandemic, when investors chose investment objects in countries more resistant to macroeconomic shocks. In 2022, amidst a full-scale Russian invasion of Ukraine, FDI decreased by 32 times compared to 2021 (from USD 7954 million to USD 247 million). As in the case of unemployment, even a successful and powerful IT industry, which increases exports, cannot neutralize the influence of external factors of such force.

At the same time, despite the influence of all external factors, the IT industry is one of the powerful drivers of the economy. From 2012 to 2022, there was a clear upward trend in the share of IT exports in the export of services; Ukraine also demonstrated a notable increase in the absolute volume of IT service exports. The growth from 1321 million dollars in 2012 to 7521 million dollars in 2022 reflects the effective development of the IT industry, even despite the crisis and war. Such dynamics of IT exports could also be explained by the fact that even in wartime, this industry's specialists can work completely remotely. In addition, despite the war, distance education programs in this field are actively developing. In addition, Ukraine has implemented a separate tax regime for enterprises in the IT sector (Diya.City has been operational since January 1, 2022) and the concept of electronic residency.

In addition, Ukraine has introduced a separate tax regime for enterprises in the IT sector (Diia.City has been operating since January 1, 2022) and the concept of electronic residency (effective in Ukraine since April 1, 2023) (Verkhovna Rada of Ukraine, 2010; 2021; 2022).

E-residency envisages the introduction of a special status that allows a foreigner to conduct business activities in Ukraine completely online. E-residents can remotely manage their affairs, open and dispose of bank accounts, sign documents with an electronic signature, and pay taxes on preferential terms.

CONCLUSIONS

Based on the results of the research, a number of conclusions can be drawn. The IT sector has a strong position in all analysed countries: Germany, Estonia, Poland, and Ukraine. In the EU states, exports have a significant positive effect on GDP, GDP per capita, FDI, and the level of employment. The share of IT product exports has been growing significantly in recent years, especially in Estonia (21.6% in 2022) and Poland (14.1% in 2022).

In Ukraine, IT is a key sector of the economy and an integral part of services exports (45.3%). The export of IT services has positive affects the economic growth (GDP and GDP per capita), but it cannot fully mitigate the negative tendencies in FDI and the unemployment rate due to the significantly prevailing impact of external threats to the economy of Ukraine, especially in terms of investment and employment. However, it is important for Ukraine to maintain positive trends in the functioning of the IT sector and the export of products in this field. In the short term, it provides new job places and serves as a source of foreign currency inflow to a country that desperately needs such influxes during an ongoing war. In the long term, as can be seen from the comparative analysis with the EU countries, IT export makes it possible to provide additional FDI, reduce the unemployment rate, boost economic growth, and increase the level of the population's income.

In order for Ukraine's IT industry to reveal the full potential of a positive impact on macroeconomic indicators and provide a multiplier effect on the development of other economic sectors, Ukraine needs to proceed with the implementation and usage of tax incentives, develop educational programs and support exporters of IT products. After Ukraine's victory, the IT sector has good prospects to become a driver of the development of the Ukrainian economy and, despite strong competition, to occupy a leading position in the world market.

ADDITIONAL INFORMATION

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Resources: *Lesia Tkachyk*
Supervision: *Mariya Rubakha*
Validation: *Lesia Tkachyk*
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Visualization: *Nazar Demchyshak Demchyshak*
Project administration: *Mariya Rubakha*
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Writing – original draft: *Mariya Rubakha, Lesia Tkachyk*

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

REFERENCES

1. Bharosa, N., Lips, S., & Draheim, D. (2020). Making e-Government work: Learning from the Netherlands and Estonia. In S. Hofmann et al. (Eds.), Electronic Participation. ePart 2020. Lecture Notes in Computer Science (Vol. 12220). Springer, Cham. https://doi.org/10.1007/978-3-030-58141-1_4
2. Compagnucci, S., Berni, G., Massaro, G., & Masulli, M. (2017). Thinking the future of European industry: Digitalization, Industry 4.0 and the role of EU and national policies. EU Study 3.17. iCom, Institute for Competitiveness. https://www.i-com.it/wp-content/uploads/2017/09/Report-Industria-Europea-.pdf
3. Dempere, J., Qamar, M., Allam, H., & Malik, S. (2023). The impact of innovation on economic growth, foreign direct investment, and self-employment: A global perspective.

DOI: 10.55643/fcaptp.5.58.2024.4446

Economies, 11(7). https://doi.org/10.3390/economies11070182

4. European Commission. (2017). Key lessons from national Industry 4.0 policy initiatives in Europe. Digital Transformation Monitor. May. https://es.sistematica.it/docs/379/DTM_Policy_initiative_comparison_v1.pdf
5. European Commission. (2020, September). Shaping the digital transformation in Europe. DG Communications Networks, Content & Technology. https://digital-strategy.ec.europa.eu/en/library/shaping-digital-transformation-europe
6. European Investment Bank. (2023). Digitalisation in Europe 2022–2023: Evidence from the EIB Investment Survey. https://www.eib.org/en/publications/20230112-digitalisation-in-europe-2022-2023
7. Eurostat (2023). Official Website Retrieved from https://ec.europa.eu/eurostat/statistics-explained
8. Export value of IT services from Germany from 2002 to 2020. (2020). Statista. https://www.statista.com/statistics/462302/export-value-it-services-germany/
9. Federal Statistical Office of Germany. (2024). Foreign trade. https://www.destatis.de/EN/Themes/Economy/Foreign-Trade/_node.html
10. IT and Telecommunication. (2024). https://www.trade.gov.pl/en/industries/services/it-and-telecommunication/
11. IT Market in Eastern Europe: Full overview of top software development destinations. (2019). https://s3-eu-west-1.amazonaws.com/new.n-ix.com/uploads/2019/10/29/2019-IT_Market-Eastern-Europe-Report.pdf
12. Largest exporters of IT products and services in Poland in 2022, by revenues from export. (2022). Statista. https://www.statista.com/statistics/1257496/poland-largest-exporters-of-it-products-and-services-by-revenues/
13. Lewis, J. (2018, February). Economic Impact of Cybercrime – No Slowing Down. McAfee. https://www.csis.org/analysis/economic-impact-cybercrime
14. Mohamed, M.M.A., Liu, P., & Nie, G. (2022). Causality between Technological Innovation and Economic Growth: Evidence from the Economies of Developing Countries. *Sustainability, 14*(6), 3586. https://doi.org/10.3390/su14063586
15. Mohamed, M.M.A., Liu, P., & Nie, G. (2022). Do Knowledge Economy Indicators Affect Economic Growth? Evidence from Developing Countries. *Sustainability 2022, 14(8),* 4774. https://doi.org/10.3390/su14084774
16. Marmoza, A. T. (2013). Teoriia statystyky. Kyiv: "Tsentr uchbovoi literatury".
17. Ministry of Finance of Ukraine (2024). Official web-site. https://www.mof.gov.ua
18. National Bank of Ukraine (2024). Official web-site. https://bank.gov.ua/
19. Naudé, W., Surdej, A., & Cameron, M. (2019). The past and future of manufacturing in Central and Eastern Europe: Ready for Industry 4.0? IZA – Institute of Labor Economics. https://docs.iza.org/dp12141.pdf
20. Radosevic, S. (2017). Upgrading Technology in Central and Eastern European Economies, IZA World of Labor, 338 (Feb). https://wol.iza.org/uploads/articles/338/pdfs/upgrading-technology-in-central-and-eastern-european-economies.pdf
21. Rana, P. Maradana, Rudra, P. Pradhan, Saurav, Dash, Kunal, Gaurav, Manju, Jayakumar, & Debaleena, Chatterjee (2017). Does innovation promote economic growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship*, *6*(1). https://innovation-entrepreneurship.springeropen.com/articles/10.1186/s13731-016-0061-9
22. State Statistics Service of Ukraine (2024). Official web-site. http://www.ukrstat.gov.ua
23. Statistics Estonia: Foreign trade application (2024). https://data.stat.ee/profile/country/ee/?locale=en
24. Szakacs, G. (2018, February 7). Enter the Robots: Automation Fills Gaps in East Europe's Factories. Thomson Reuters. https://www.businessinsider.com/r-enter-the-robots-automation-fills-gaps-in-east-europes-factories-2018-2
25. Verkhovna Rada of Ukraine. (2010). Podatkovyi kodeks Ukrainy. https://zakon.rada.gov.ua/laws/show/2755-17#Text
26. Verkhovna Rada of Ukraine. (2021). Pro stimuliuvannia rozvytku tsyfrovoi ekonomiky v Ukraini. https://zakon.rada.gov.ua/laws/show/1667-20#Text
27. Verkhovna Rada of Ukraine. (2022). Zakon № 2654-IX "Pro vnesennia zmin do Podatkovoho kodeksu Ukrainy ta deiakykh inshykh zakoniv Ukrainy shchodo osoblyvostei opodatkuvannia pidpryiemnytskoi diialnosti elektronnykh rezydentiv". https://zakon.rada.gov.ua/laws/show/2654-20#Text
28. World Bank Open Data (2024). https://data.worldbank.org/
29. Xi, Wan, Shehla, Anjum Ajaz Kazmi, & Chun Yee, Wong (2022). Manufacturing, Exports, and Sustainable Growth: Evidence from Developing Countries. *Sustainability, 14*(3). https://doi.org/10.3390/su14031646
30. Yarovyi, A. T., & Strakhov, Y. M. (2015). Bahotovymirnyi statystychnyi analiz: Nachalno-metodychnyi posibnyk dlia studentiv matematychnykh ta ekonomichnykh fakhiv. Odessa: Astroprint.

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ВПЛИВ ІТ-ЕКСПОРТУ НА ЕКОНОМІЧНИЙ РОЗВИТОК: ПОРІВНЯЛЬНИЙ АНАЛІЗ УКРАЇНИ ТА КРАЇН ЄВРОПИ

Інформаційні технології стали невід'ємною частиною сучасного економічного середовища в Україні та країнах ЄС. Розвиток ІТ-галузі в різних країнах демонструє значний потенціал для стимулювання економічного зростання. Метою дослідження є оцінка впливу ІТ-експорту на макроекономічні показники України, Польщі, Естонії та Німеччини для формування рекомендацій щодо розвитку ІТ-індустрії в Україні. У статті досліджено вплив експорту ІТ-послуг на ВВП, ВВП на душу населення, прямі іноземні інвестиції та рівень безробіття на прикладі цих країн за допомогою розрахунку коефіцієнта кореляції Фехнера.

На основі аналізу даних 2012-2022 рр., виявлено, що ІТ-експорт має значний позитивний вплив на ВВП й ВВП на душу населення. У країнах ЄС експорт ІТ-послуг також позитивно впливає на залучення ПІІ та зайнятість. Україна, попри зростання експорту ІТ-послуг, демонструє негативні тенденції обсягів ПІІ та зростання безробіття. В Україні між обсягом ПІІ та експортом ІТ-послуг існує обернений слабкий зв'язок (коефіцієнт кореляції Фехнера -0,2727) та прямий помірний – із рівнем безробіття (коефіцієнт кореляції Фехнера -0,4545). Зважаючи на складність викликів для функціонування економіки в часі війни, ІТ-сектор не здатний нівелювати вплив усіх загроз для економіки України.

Однак частка ІТ-експорту в загальному обсязі експорту послуг в Україні зростає до понад 45% 2022 року. Тобто, з одного боку, ІТ-сектор розвивається, незважаючи на війну (дещо повільнішими темпами 2022 року), з іншого боку, в Україні зберігається потужний дисбаланс щодо переважного нарощування експорту послуг ІТ-сектора. За результатами порівняльного аналізу з країнами ЄС, можемо стверджувати, що експорт ІТ-послуг може стати чинником інвестиційної привабливості та зменшення безробіття в Україні в майбутньому.

Ключові слова: ІТ-бізнес, ІТ-експорт, країни ЄС, безробіття, прямі іноземні інвестиції, ВВП, економічне зростання, ВВП на душу населення, добробут населення

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