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tel. +48 42 635 55 77

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The Innovation Gap of National Innovation Systems in the European Union

Edyta Dworak https://orcid.org/0000-0001-9789-6752
Ph.D., Assistant Professor, University of Lodz, Department of Institutional Economics and Microeconomics
Lodz, Poland, e-mail: edyta.dworak@uni.lodz.pl

Maria Magdalena Grzelak https://orcid.org/0000-0003-4353-9893
Ph.D., Assistant Professor, University of Lodz, Department of Economic and Social Statistics, Lodz, Poland
e-mail: maria.grzelak@uni.lodz.pl

Abstract

The main aim of the paper is to assess the innovation gap between the national innovation systems (NIS) of the European Union (EU) and the average level of innovation of EU economies. The study takes into account NIS identified in the literature, i.e., (a) developed systems and (b) developing systems.

In the theoretical part of the paper, the literature in the fields of NIS and the innovation gap is reviewed, the definitions and selected classifications of NIS around the world are presented, and the concept of the innovation gap between countries is defined. In the empirical part, the level of innovation in EU economies is assessed using Hellwig's synthetic development indicator. In order to measure the level of innovation in individual NISs, arithmetic means of national values of the synthetic measure of development (innovation) are used. The innovation gap is calculated as the quotient between the level of innovation of individual NISs analyzed in the study and the average level of innovation in EU economies. The study covered 2010 and 2021.

The paper formulates the following research hypothesis: the level of innovation in EU economies is determined by the type of NIS. Consequently, developing system countries are less innovative and, thus, are characterized by an innovation gap in relation to the EU average. The results of the study confirm the hypothesis. The relationship between the innovation level of the EU economies and the type of NIS, as well as the assessment of the innovation gap between the national innovation systems of the EU and the average level of innovation of the EU economies, constitute the value-added of the paper.

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Introduction

For several decades, innovations have been an important area of research for economists worldwide. On a microeconomic scale, the implementation of innovations leads to an increase in enterprises' competitiveness through lowering production costs, improving the quality of products and expanding their range, or better meeting consumers' needs. These activities increase the competitiveness of enterprises and, consequently, entire economies. On a macroeconomic scale, innovations are perceived as one of the main factors of economic growth and development. Innovation is always the result of the interaction between people, organizations, and their environment. This understanding of innovation is in line with the national innovation system (NIS) concept, which plays an important role in the innovation policy of all developed market economies.

The main aim of the paper is to assess the innovation gap between the NISs of the European Union (EU) and the average level of innovation of EU economies. The study takes into account the NISs identified in the literature (Godinho, Mendonca, and Pereira 2003), i.e., (a) developed systems, which include dynamic, stable, and unevenly developed systems, and (b) developing systems, comprising catching up and unbalanced systems.

The paper formulates the following research hypothesis: the level of innovation in EU economies is determined by the type of NIS. Consequently, developing system countries are less innovative and are thus characterized by an innovation gap in relation to the EU average. The results of the study confirm the hypothesis. The relationship between the innovation level of the EU economies and the type of NIS, as well as the assessment of the innovation gap between the national innovation systems of the EU and the average level of innovation of the EU economies, constitute the value-added of the paper.

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The study covered 2010 and 2021. For several variables, the most recent data come from 2020. The choice of years was dictated by the availability of the most recent statistical data and the desire to show the innovation gap of NIS over an extended time horizon. The data used in the study were obtained from Eurostat and OECD databases.

The concept and classifications of the national innovation system. The definition of the innovation gap

The NIS concept was created in the late 1980s and has become the focus of the following economists: Freeman (1992), Lundvall (1992), Nelson and Rosenberg (1993), Patel and Pavitt (1994) and Edquist (1997). Research on NIS continues in the 21st century. The definitions formulated by contemporary authors are presented in Table 1.

Table 1. Definitions of the national innovation system

A network of economic agents, together with the institutions and policies that influence their innovative behavior and performance.	Mytelka (2003)
An evolutionary system in which enterprises in interaction with each other and supported by institutions and organizations such as industry associations, R&D, innovation and productivity centers, standard setting bodies, universities and vocational training centers, information gathering and analysis services, and banking and other financing mechanisms play a key role in bringing new products, new processes and new forms of organization into economic use.	Wangwe (2003)
Creating an efficient innovation system and business environment that encourages innovation and entrepreneurship, comprising firms, science and research centers, universities, think tanks, and other organizations that can tap into and contribute to the growing stock of global knowledge, which can adapt it to local needs, and that can use it to create new products, services, and ways of doing business.	Goel et al. (2004)
A network of interacting policies, institutions and organizations whose holistic functionality depends on the quality of cooperation between the various component parts.	Manzini (2012)
A unity of enterprises of various patterns of ownership that individually or through interaction with each other provide the formation and dispersion of innovation technologies within a definite state; […] it encourages the implementation of the derived technologies into production and development of new products saleable in the world market; among such organizations there are scientific institutions (R&D institutes, institutes of higher education, private laboratories, scientific departments of corporations – all of them can be summarized under the term „creators of innovation"); then, „infrastructural" enterprises–technoparks, innovative technology centers, venture funds; agencies conditioning the innovation climate and governmental bodies: ministries and specialized departments; the small, medium and big businesses as the first and the final consumer and as one of the primary initiators of innovation.	Garifullin, Ablaev (2015)
A multilevel concept where national, regional and sectoral innovation systems can coexist and co-evolve together in the same country.	Carayannis, Grigoroudis, Goletsis (2016)

A network of economic agents, together with the institutions and policies that influence their innovative behavior and performance.	Mytelka (2003)
The institutions, human capital and interactions among them that facilitate the creation and diffusion of knowledge.	Maloney (2017)
An innovation system encompasses all the organizations and institutions involved in the innovation process and the *na onal* innovation system gives special attention to those institutions and organizations which are located in or rooted in a nation state. The system is open and one crucial characteristic of the national innovation system is its capacity to absorb and use knowledge developed abroad.	Chaminade, Lundvall, Haneef (2018)

Source: the authors' own compilation.

The literature on the subject also includes many typologies of national innovation systems, distinguished based on various criteria (Schmoch, Rammer, and Legler 2006; Weresa 2014, pp. 66–70), e.g., from the point of view of the type of innovation that dominates in a given system, and the areas that determine the development of the system (Patel and Pavitt 1991, pp. 35–58; Schmoch, Rammer, and Legler 2006). The criteria also include institutional factors (e.g., educational, scientific, technological, and innovation regulations) (Amable, Barre, and Boyer 2008; Kotlebova, Arendas, and Chovancova 2020, pp. 717–734) and how science and the economy interact (OECD 2000, pp. 168–172; Bal-Domańska, Sobczak, and Stańczyk 2020; Gorączkowska 2020).

An attempt at a multi-level NIS typology is a universal approach using hierarchical cluster analysis based on the following classification criteria (developed by Godinho, Mendonça, and Pereira, and is hereinafter referred to as the GMP classification) (Weresa 2012; Dworak, Grzelak, and Roszko-Wójtowicz 2022):

- the internal market, described by the following indicators: GDP in absolute terms, GDP per capita, and population density;
- institutional conditions, measured by income inequality, life expectancy, demographic structure, and corruption index;
- tangible and intangible investments, as shown by expenditure on R&D and education per capita and as a % of GDP;
- theoretical and applied knowledge, described in terms of the percentage of the population with secondary and tertiary education, the percentage of students of exact sciences, the number of research workers in relation to total employment, and the number of publications per capita;
- the structure of the economy, presented by the share of high-tech industries in exports and GDP, and the turnover of domestic R&D companies on a global scale in relation to GDP;

- connections between the economy and the environment, measured by the balance of foreign trade and direct investment in relation to GDP, broadband Internet connections;
- knowledge diffusion, described by the following indicators: Internet access, cellular network density, number of ISO 9000 and ISO 1400 certificates per capita;
- innovation, measured by the number of patents and trademarks per capita.

Based on the above-mentioned measures, two main types of NIS were distinguished: (1) developed innovative systems, (2) developing innovative systems. Within these NIS types, three sub-types are distinguished in each group, some of which have their types listed.[1] This typology is presented in Table 2.

Table 2. Typology of national innovation systems according to Godinho, Mendonça, and Pereira (the GMP classification)

NIS Type	NIS Subtype	NIS Kind	Countries belonging to a given NIS Type
T.0	Hongkong		
T.1. Developed innovation systems	T.1.1. Dynamic NIS	Ireland, the Netherlands, Switzerland, Finland, Sweden, Singapore	
	T.1.2. Stable functioning NIS	T.1.2.1.	Germany, Great Britain, France, Italy, South Korea, Taiwan
		T.1.2.2.	USA, Japan
		T.1.2.3.	Canada, Norway, Australia, Austria, New Zealand, Spain
	T.1.3. Unevenly developed NIS	Denmark, Belgium, Luxembourg	
T.2. Developing innovation systems	T.2.1. Catching up NIS	T.2.1.1.	Portugal, Greece, Poland, Hungary, the Czech Republic, Slovenia
		T.2.1.2.	Malaysia, Malta
		T.2.1.3.	Latvia, Estonia, Lithuania, Slovakia, Ukraine
	T.2.2. Unbalanced NIS	T.2.2.1.	Russia
		T.2.2.2.	China, Brazil, South Africa, Thailand, Argentina, India, Mexico
		T.2.2.3.	Turkey, Colombia, Bulgaria, Indonesia, the Philippines, Peru, Romania
		T.2.2.4.	Egypt, Cyprus, Chile, Venezuela
	T.2.3. Unshaped NIS	T.2.3.1.	Algeria, Iran, Vietnam, Morocco, Bangladesh
		T.2.3.2.	Pakistan, Kenya, Ethiopia, Tanzania, Sudan, Nigeria, Congo, Myanmar

Source: Weresa 2012, p. 46; Godinho, Mendonca, and Pereira 2003.

1 The classification includes all the countries that currently belong to the EU, with the exception of Croatia.

The theoretical background for the innovation gap is formed by different studies on the technological gap in the world economy (Posner 1961, pp. 323–341; Krugman 1979) and recently in Central European countries (Kubielas 2013; 2016, pp. 7–10; Kowalski 2020, pp. 1966–1981).

Kubielas (2013, p. 137) defines the innovation gap as the differences in technological advancement between countries. He proposes a number of methods to measure its size, e,g, the distance between the level of technological activity of a particular country and the countries at the technological frontier, calculated either as a ratio of the number of patents per capita or the share of research expenditure in value-added or national income. The literature review also shows indirect measures such as the share of high-tech products in exports in relation to a similar indicator for the technology frontier (Sałamaga 2020, p. 362), the relationship between the performance (labor productivity) of a given branch of the country in relation to the country on the technological frontier or in aggregate terms the relation of GDP per capita to the corresponding indicator of the technological frontier (Kubielas 2013, p. 137).

The last two approaches identify the technological gap with a productivity or income gap. The global technological frontier is deemed to be the GDP level that can be achieved using the given inputs of capital and labor and the best possible technologies (Growiec 2012). This level of GDP is now achieved by the U.S. economy, in which the distribution of specialization (between the four Pavitt sectors) is the standard for a technology leader (Kubielas 2016, p. 7). The highest competitive advantages are demonstrated by the science-based sector, followed by the specialized supplier sectors; the consecutive sectors; the scale-intensive and traditional, supplier-dominated sectors are characterized by negative indices of the revealed comparative advantage, of which the traditional is the lowest on the scale of revealed advantages of the U.S. economy (Kubielas 2013, p. 153).

In the literature, there is also the concept of the innovation gap, understood as the distance of individual economies to the modern technological frontier, which is identified with the last stage of socio-economic development of economies, i.e., the emergence of a knowledge-based economy (Dworak 2012, pp. 27–32). To investigate this approach to the innovation gap, there should be a point of reference, which involves the initial conditions of building a knowledge-based economy formulated in the literature (e.g., Kleer 2009).

The United Nations defines the innovation gap generally as the distance between those who have access to technologies and know how to use them effectively and those who do not (Kraciuk 2006). The innovation gap can be considered from the perspective of creating new technology in the home country, as well as from the perspective of its transfer from other countries and effective adaptation to the needs and national capabilities.

In summary, measuring the innovation gap means estimating the distance between the economy and the most developed economies of Europe and the world, known today

as knowledge-based economies, in many areas, e.g., innovation, education, and the institutional system. Estimating the innovation gap is possible by comparing synthetic measures of innovation (Mielcarek 2013; Weresa 2014, p. 64).

Assessing the innovation gap between the national innovation systems in the European Union based on an original synthetic indicator of economic innovation

The innovation level of EU economies in 2010 and 2021 was first assessed (for several variables mentioned below, i.e., X1, X2, X3, X4, and X5, the most recent data come from 2020). The complexity of innovation means that there is no one-size-fits-all indicator to measure it at the macroeconomic level. We assessed innovation using Zellwig's synthetic development indicator, called the synthetic measure of development (SMD). The selection of potential diagnostic variables was based on the Oslo methodology (OECD/Eurostat 2018). The input data set included 13 variables – potential diagnostic indicators (Eurostat n.d.):

X1 – R&D expenditure in euro per capita – all sectors,

X2 – R&D expenditure in euro per capita – business enterprise sector,

X3 – R&D expenditure in euro per capita – government sector,

X4 – R&D expenditure in euro per capita – high education sector,

X5 – High-tech patent applications to the EPO (European Patent Office) per million inhabitants,

X6 – EU trademark applications per million population,

X7 – Students in tertiary education by age group as a % of the corresponding age population,

X8 – Total high-tech trade in million euros as % of total (imports),

X9 – R&D personnel as % of the labor force,

X10 – High-tech exports as % of total exports,

X11 – Employment in knowledge-intensive activities as % of total employment,

X12 – Product or process innovative enterprises engaged in cooperation as % of innovative enterprises,

X13 – Triadic patent families per million inhabitants.

The set of potential diagnostic variables was verified in terms of the information value of the variables. This verification was performed using statistical procedures that took into account the discriminant and information capacity of the variables (Panek 2009, pp. 18–23). Three indicators were removed from the set of potential diagnostic indicators: X11 – due to low volatility and X2 and X4 – due to too much correlation with other indicators. Ultimately, the set of diagnostic features comprised the following indicators: X1, X3, X5, X6, X7, X8, X9, X10, X12, and X13.

As a result of applying Hellwig's economic development measure, a synthetic measure of economic innovation was determined for the EU countries in 2010 and 2021. Then, on its basis, the level of innovation of the national innovation systems of the European Union was assessed. It was assumed that the level of innovation of a given NIS is determined by the arithmetic mean of the synthetic measure of innovation of the economies of its constituent countries. In order to calculate the innovation gap, it was also necessary to determine the average EU level of innovation in 2010 and 2021, which was, respectively: 0.2250 and 0.1642.

The previous stages of the study allowed us to determine the innovation gap between individual NISs and the average level of innovation in EU economies. In the study, the innovation gap index is defined as the quotient between the value of the synthetic measure of innovation for a given NIS and the average value of the synthetic index of innovation of the EU countries' economies.

The indicator of the innovation gap takes the following form (Weresa 2014, p. 64):

$$L_{pt} = \frac{SII_{pt}}{SII_{UE_t}}, \tag{1}$$

where:

L_{pt} – the innovation gap index (innovation gap) for a given NIS in year t,

SII_{pt} – the value of the synthetic measure of innovation for a given NIS in year t,

SII_{UEt} – the mean value of the synthetic measure of innovation of the EU countries' economies.

A value of the innovation gap index exceeding 1 means that the analyzed system presents a higher level of innovation than the EU average. In contrast, a value lower than 1 indicates that an innovation gap exists between a given system and the EU average.

In order to assess the changes in the level of the innovation gap over time, a formula presenting the difference between the innovation gap index (L_{pt}) in a given year and the value of this index for the base year should be used. It is written as follows (Weresa 2014, p. 64):

$$D_{pt_1} = \left[\frac{SII_{pt_1}}{SII_{UEt_1}}\right] - \left[\frac{SII_{pt_0}}{SII_{UEt_0}}\right] \quad (2)$$

where:

D_{pt_1} – index of changes in the level of the innovation gap between a given NIS and the EU average in 2021 (t) compared to 2010 (t_0),

The index of the change in the innovation gap level (D_{pt_1}) takes values from –1 to +1. Negative values indicate an increase in the innovation gap between a given NIS and the EU average, while positive ones indicate a decrease. Nevertheless, the index only indicates the direction of change; it does not allow us to determine whether the distance shortens or the previously gained advantage is gradually being lost (Weresa 2014, p. 65). Therefore, it is necessary to analyze the index of changes in the level of innovation gap (D_{pt_1}) in relation to the index of the innovation gap (L_{pt}).

Table 3. The innovation gap index for a given NSI in relation to the EU average (L_{pt}), and the index of changes in the level of the innovation gap between a given NSI and the EU average (D_{pt_1}) between 2010 and 2021

			SII_{UEt}	SII_{pt}	L_{pt}	D_{pt_1}
2010	Dynamic NIS	NIS Subtype	0.2250	0.3474	1.544	
	Stable functioning NIS	Germany, Great Britain, France, Italy, Austria, Spain		0.2722	1.2097	
	Unevenly developed NIS	Denmark, Belgium, Luxembourg		0.3582	1.592	
	Catching up NIS	Portugal, Greece, Poland, Hungary, Czech Republic, Slovenia, Malta, Latvia, Estonia, Lithuania, Slovakia		0.1524	0.6773	
	Unbalanced NIS	Bulgaria, Romania, Cyprus		0.1287	0.572	
2021	Dynamic NIS	Ireland, Netherlands, Finland, Sweden	0.2289	0.3587	1.567	0.023
	Stable functioning NIS	Germany, Great Britain, France, Italy, Austria, Spain		0.2905	1.269	0.0593
	Unevenly developed NIS	Denmark, Belgium, Luxembourg		0.3786	1.653	0.061
	Catching up NIS	Portugal, Greece, Poland, Hungary, Czech Republic, Slovenia, Malta, Latvia, Estonia, Lithuania, Slovakia		0.1548	0.676	– 0.0013
	Unbalanced NIS	Bulgaria, Romania, Cyprus		0.0960	0.4193	– 0.1527

Source: author's own compilation based on Eurostat n.d.

Based on the data presented in Table 3, it can be concluded that in 2010, three NISs (developed NISs) – dynamic, stable, and unevenly developed systems – were characterized by a higher innovative position than the EU average. There was an innovation gap in relation to the EU average between the other NISs (developing NISs) – catching up and unbalanced systems. Additionally, in 2021, three systems (developed NISs) – dynamic, stable, and unevenly developed – were among the NISs with a higher innovation position than the EU average. The two remaining systems (developing NISs) – catching up and unbalanced – showed an innovation gap in relation to the EU average.

As for the innovation gap seen over time, it should be emphasized that from 2010 to 2021, the dynamic, stable, and unevenly developed NISs (developed NISs) improved their positions in relation to the EU average, while for the catching up and unbalanced NSIs (developing NISs), the innovation gap increased compared to the EU average.

Conclusions

The research hypothesis formulated in the introduction to the paper has been positively verified – the level of innovation of EU economies is determined by the type of NIS. Thus, countries belonging to the developed NISs (i.e., Ireland, the Netherlands, Finland, Sweden, Germany, Great Britain, France, Italy, Austria, Spain, Denmark, Belgium, and Luxembourg) are characterized by an innovative advantage over countries belonging to the developing NISs (Portugal, Greece, Poland, Hungary, the Czech Republic, Slovenia, Malta, Latvia, Estonia, Lithuania, Slovakia, Bulgaria, Romania, and Cyprus).

The developed NISs owe their advance in innovation rankings to the synergy of several factors: an appropriate state policy that is based on supporting the R&D and education sphere (Roszko-Wójtowicz and Grzelak 2020, p. 658), creating an efficient and friendly institutional environment, as well as mobilizing social capital, which is conducive to the development of creativity and cooperation skills.

The developing NISs, which are predominantly new EU member states[2], were characterized by the presence of an innovation gap in relation to the EU average, which means that despite many benefits that resulted from integration with the EU, they still have not closed the innovation gap to the most developed European economies. Nevertheless, the gap did narrow slightly. The developing NISs are not effective; they are burdened with the following drawbacks: the dependence of many elements of these systems on the public finance sector, the relatively low level of public and private expenditure on R&D, the unfavorable structure of scientific research, the lack of permanent links between science and industry, which results from insuffi-

2 The developing NISs include countries that joined the European Union in 2004 and 2007, and Portugal and Greece.

cient social capital, low-quality education, and a lack of institutions and incentives for patent activity, which leads to low patent rates in these countries.

The added value of the paper is the demonstration of the relationship between the level of innovation of the EU economies and the type of NIS, as well as the assessment of the innovation gap between the national innovation systems of the European Union and the average level of innovation of the EU economies.

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Luka innowacyjna narodowych systemów innowacji w Unii Europejskiej

Głównym celem artykułu jest próba oceny luki innowacyjnej dzielącej narodowe systemy innowacji Unii Europejskiej od przeciętnego poziomu innowacyjności gospodarek krajów UE. W badaniu uwzględniono narodowe systemy innowacji (NSI) wyodrębnione w literaturze przedmiotu, tj. (a) systemy rozwinięte i (b) systemy się rozwijające.

W części teoretycznej artykułu dokonano przeglądu literatury przedmiotu w zakresie problematyki NSI i luki innowacyjnej, przedstawiono definicje i wybrane klasyfikacje NSI na świecie, jak również zdefiniowano pojęcie luki innowacyjnej między krajami. W części empirycznej oceniono poziom innowacyjności gospodarek krajów UE za pomocą syntetycznego miernika rozwoju Z. Hellwiga. Z kolei do pomiaru poziomu innowacyjności poszczególnych NSI zastosowano średnie arytmetyczne krajowych wartości syntetycznego miernika rozwoju (innowacyjności). Lukę innowacyjną obliczono między poziomem innowacyjności wyodrębnionych w badaniu NSI a średnim poziomem innowacyjności gospodarek UE. Badaniem objęto lata 2010 i 2021.

W artykule została sformułowana następująca hipoteza badawcza: poziom innowacyjności gospodarek krajów UE jest determinowany rodzajem NSI i w związku z tym kraje należące

do systemów rozwijających się są mniej innowacyjne i tym samym charakteryzują się luką innowacyjną w stosunku do średniej unijnej. Wyniki analizy pozwoliły pozytywnie zweryfikować tę hipotezę.
Wartością dodaną prezentacji wyników analizy zmieszczonej w artykule jest wskazanie związku między poziomem innowacyjności gospodarek krajów UE i rodzajem NSI, jak również oszacowanie luki innowacyjnej między narodowymi systemami innowacji UE a średnim poziomem innowacyjności gospodarek krajów UE.

Słowa kluczowe: innowacja, innowacyjność gospodarki, narodowy system innowacji, luka innowacyjna

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The Role of FDI in the Sustainable Development of the European Union

Janina Witkowska https://orcid.org/0000-0002-8698-4623
Ph.D., Full Professor at the University of Lodz, Faculty of Economics and Sociology, Department of World Economy and European Integration, Lodz, Poland, e-mail: janina.witkowska@uni.lodz.pl

Abstract

This paper aims to examine the role of international business behavior in the sustainable development of the European Union (EU) and to answer two questions: (1) To what degree could international business contribute to the development of a "green economy" under the uncertainty caused by the COVID–19 pandemic?; (2) In what way could host countries attract "green" and socially responsible foreign direct investment (FDI)?

The statistical analysis of international business involvement in environmentally harmful sectors/industries of the EU economy indicates that the share of such investments in most member states did not exceed 20% of the total FDI stocks between 2015 and 2020. The structure of investments changed in half of the analyzed countries towards sectors/industries that were less harmful to the environment. These changes and high requirements for domestic and foreign companies within the framework of the EU's environmental policy allow us to conclude that international business contributed to the ecological transformation of the EU.

On the other hand, changes in the structure of FDI stocks located abroad by the EU Member States in environmentally harmful sectors/industries were multidirectional. Six of the EU states remained net exporters of direct investment in these sectors/industries. The involvement of foreign direct investors in the new EU Member States in sectors that are important for implementing the Sustainable Development Goals (SDGs) of the 2030 Agenda was not very high. It was characterized by high volatility and did not play a significant role in their economies. Attracting "green FDI" and socially responsible investments requires changes in policy towards foreign investors. They should include facilitating foreign investment, including investments aimed at sustainable development, incentives for investors to engage in "green investments", and making investment agreements more flexible to combat climate change.

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Keywords: foreign direct investment, sustainable development, European Union, ecological issues

JEL: F01, F23, F64

Introduction

The COVID–19 pandemic caused severe disruptions in global foreign direct investment (FDI) flows and other areas of international relations. They resulted in a decline in global and regional FDI flows, including those to and from the European Union (EU). At the same time, achieving ambitious goals for the implementation of sustainable development on a global scale (SDG 2030) and the reduction of greenhouse gas emissions, including the EU's gradual achievement of climate neutrality and an inclusive social policy, require the involvement of both national and international corporations.

This article tries to answer the following questions:

1. To what extent can international business contribute to the sustainable development of the EU's "green economy" under the uncertainty caused by the COVID–19 pandemic?
2. How can host countries attract "green" and socially responsible foreign investment?

Changes in FDI flows in the global economy and the EU during the COVID–19 pandemic

There was already a slowdown in international capital flows in the form of FDI in the pre-pandemic period. It was reflected in a decrease in the average growth rate of global FDI flows (only 1% in the last decade, compared to 8% between 2000 and 2007 and 20% before 2000) (UN/UNCTAD 2019, p. 5). Global FDI flows amounted to USD 1.5 trillion in 2019. The COVID–19 crisis reduced them to USD 1 trillion in 2020, i.e., by 35% compared to the previous year (UN/UNCTAD 2021a, p. X, 248). This decline particularly affected developed countries, where the inflow of FDI was reduced by 58% (UN/UNCTAD 2021b, p. X). The most significant declines were recorded in Europe – by 80%, and the EU – by 73%. At the same time, North America experienced a slightly smaller decrease, i.e., by 42% (UN/UNCTAD 2021b, p. X and own calculations). However, FDI inflows to developing countries decreased by 8%, although regional trends also show the diverse situation of individual groups of countries. It was particularly evident in Asia, which recorded an increase of 4% in 2020, while the coun-

tries of South America were affected by a decrease of as much as 45%. At the same time, Africa experienced a 16% decrease (UN/UNCTAD 2021b, pp. X–XI).

Uneven decreases in **FDI inflows** resulted in a change in the global geographical structure of FDI in favor of developing countries, which accounted for 2/3 of the annual global FDI inflow in 2020 compared to less than 1/2 in 2019.

The scale of changes in the size of FDI inflows in the world economy and selected regions between 2010 and 2020 is shown in Figure 1.

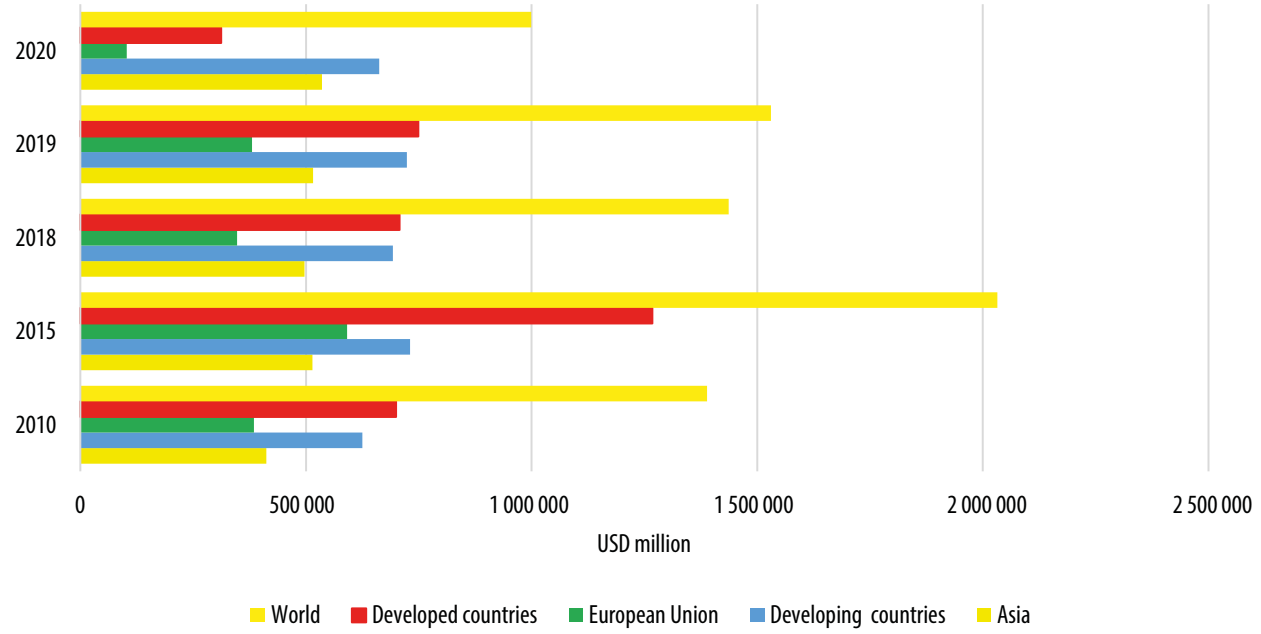

Figure 1. FDI inflows, the world economy and its regions, 2010–2020, USD million

Source: UN/UNCTAD 2016, pp. 196–197; 2021a, pp. 248–249 and own elaboration.

The data on the change in global and regional FDI flows presented above reflect the reactions of foreign investors to economic shocks caused by the pandemic. The decline in FDI flows in the global economy was deeper than the decline in global GDP and trade. According to UNCTAD's early forecasts, global FDI in 2021 was expected to increase moderately, i.e., from 10% to 15%, compared to the difficult year of 2020 (Zahn 2021). However, UNCTAD data for 2021 indicate a relatively rapid rebound of global FDI flows. It is estimated that global FDI flows increased by 77% in 2021 to USD 1.65 trillion, exceeding the size of these investments before the crisis (UNCTAD 2022, p. 1).

Preliminary data on the sectoral structure of FDI in 2021 indicate that foreign investors were interested in investments in infrastructure, i.e., a sector supported by favorable long-term financing, measures under economic recovery packages and foreign investment programs. In contrast, the propensity to invest in industry and global value chains (GVCs) was low. *Greenfield* investments were 30% below pre-pandemic levels in all industries. The exception was the information technology (IT) sector, which fully

recovered. The boom observed in cross-border mergers and acquisitions in the services sector was also noted in the IT sector (UNCTAD 2022, p. 1).

Factors that will determine the further activity of foreign investors in the post-pandemic period include how quickly economies emerge from the economic crisis caused by the pandemic, the possibility of further outbreaks of COVID–19 infections, the potential impact of economic recovery support packages on FDI flows, the political situation and related international tensions, and conditions for international business determined by national regulations. It should be borne in mind that the FDI cycle is delayed in relation to the economic cycle (Zahn 2021, p. 3). Furthermore, the war in Ukraine and the associated uncertainty will negatively impact FDI in 2022, especially in Central and Eastern Europe.

FDI and sustainable development during the pandemic

The relationships between the activities of international corporations, FDI flows, and sustainable development, including ecological and social aspects, have been the subject of research (Budnikowski 1998; OECD 1999; UNCTAD 1999; Wysokińska and Witkowska 2004; Witkowska 2011).

FDI can have both negative and positive effects on the environment. The negative impact is associated with investors' use of land and natural resources and the potential increase in consumption and change of consumption models in the host countries in a direction that is harmful to the environment. Hypotheses about the possibility of creating *pollution havens* have been formulated. The creation of *pollution havens* results from differences in environmental protection standards between investors' home countries and the host countries. There may also be a problem of *cascading pollution havens*, when companies invest abroad to contract their "dirty" production processes with other companies, thus creating an image of an environmentally friendly company (OECD 1999, p. 14).

In turn, the positive impact of FDI on the environment is associated with investors using more advanced and cleaner technologies in their subsidiaries abroad. They also transfer knowledge and good management practices, including environmental management. In this way, the level of environmental protection in the host country becomes more like that in developed countries (the *pollution halo effect*) (OECD 1999, p. 14).

In addition to the factors mentioned above, the impact of FDI on the environment depends on the sector/industry structure of these investments, corporate social responsibility (CSR) in the sphere of environmental protection, and the environmental policy of the host country. **Economic activities classified as environmentally harmful** are: mining and quarrying, the textile industry, the leather industry, pulp and paper production, the production of chemical products, the production of rubber and plastic products, the production of cement, glass and ceramics, the production of metals and metal

products, large-scale plant cultivation, and animal husbandry. From the point of view of FDI recipient countries, it is important whether the incoming investments are located in areas of economic activity considered to be harmful to the environment or if they are "green FDI", i.e., investments that help achieve environmental goals and, in particular, reduce greenhouse gas emissions (Sauvant, Stephenson, and Kagan 2021).

The efforts undertaken by individual countries to pursue sustainable development in the environmental and social spheres are part of the implementation of the *Sustainable Development Goals* (SDGs) within the United Nations' framework of the 2030 Agenda for Sustainable Development. Therefore, it is essential to involve foreign investors in activities to help achieve the goals adopted in this Agenda. **SDG-related sectors** include:

- infrastructure, including transport, energy (power generation and transmission), and telecommunications,
- energy from renewable sources (installations for all types of sources),
- water supply and treatment (for industry and households),
- the health sector (investment in infrastructure, e.g., the construction of hospitals),
- agriculture and food production (investments in agriculture, research and rural development),
- education (infrastructure investments, e.g., building schools) (UN/UNCTAD 2021a, p. 8).

According to the above classification, **international infrastructure investments** are seen as supporting the sustainable development of the countries in which they are implemented. However, the importance of **international productive investments** in raw material extraction, processing, and services linked to *global value chains* (GVCs) for sustainable development is not ignored. As a result of the disruption to global value chains during the COVID–19 pandemic, multinational companies involved in comprehensive international production networks need to make them more flexible or restructure them and improve the reliability of supply chains. One option is to shift production capacity closer to the home country. Another is to disperse it in many locations. However, these strategies will not be without implications for capital flows in the coming years, including for the achievement of the SDGs. In turn, international infrastructure investments involve both private and public entities – multinationals, investment funds, and financial institutions. Different financing mechanisms (financial and debt instruments) are used. As a result, only some international infrastructure investments translate into FDI. However, due to investors' stability and long-term interest in managing international infrastructure projects, such flows are similar to FDI (UN/UNCTAD 2021b, pp. 158–159).

The collapse of global and regional FDI flows during the pandemic significantly impacted the level of investments necessary to achieve SDGs, especially in developing countries. According to UNCTAD assessments, *greenfield* investments in developing regions decreased by 33% in 2020 compared to the period before the pandemic, and funding for international projects decreased by 42%. All SDGs in developing regions recorded a collapse in the inflow of international private investment. These were two-digit decreases, i.e., from 35% in the education sector to 67% in the water supply and treatment sector, with the exception of investments in renewable energy sources, which saw a decrease of 8%. The shock caused by the pandemic strengthened the decrease in investments in these sectors, which was observed even before the pandemic (UN/UNCTAD 2021a, p. 8).

The rebound of global and regional FDI flows in 2021 did not significantly improve investment flows to the SDGs sectors. The total value of announced *greenfield* investments and project financing agreements increased by 55%, but mainly due to the conclusion of a few very large contracts in the renewable energy sector. The number of investment projects in sectors important for achieving SDGs in developing countries increased by only 11%. The sectors with the highest growth were renewable energy and municipal services, financed by international financial projects (UNCTAD 2022, p. 3).

In the context of a substantial collapse of investments in 2020 in sectors important for achieving the 2030 Agenda goals, and the lack of a breakthrough rebound of these investments in 2021, assessments of the prospects for achieving these goals, with the help of international business, must be cautious. They will largely depend on the policies pursued by individual countries for the sustainable recovery of economies during the crisis caused by the COVID–19 pandemic and on the situation in Central and Eastern Europe.

The role of FDI in the ecological transformation of the EU

The impact of international enterprises and their FDIs on the economies of the host countries occurs on many levels. Therefore, we examine the extent to which FDI flowing to EU Member States is located in polluting industries and whether its share in the total inward FDI stocks changes during the analyzed period. The same questions have been raised for FDI from EU investors in industries that pollute the environment. In addition, we analyzed FDI inflows to sectors/industries that are important for implementing SDGs in the new member states.

The statistical analysis was conducted based on OECD data on the sector/industry structure of FDI for 2015, 2019, and 2020. The limitations that emerged in the analysis were:

- data on the FDI stocks were available for only 22 EU Member States, which are also members of the OECD, and on FDI flows for only eight new EU Member States;
- reported data on sector/industry FDI in the analyzed countries was incomplete;
- the confidential nature of the data and their secrecy by the reporting countries resulted in a lack of data for sectors that are important for achieving the SDGs;
- lack of data due to values being close to zero;
- a high degree of data aggregation.

Based on the available data, the sector/industry classification for FDI stocks in 2015, 2019, and 2020 includes:

1) mining and quarrying,
2) the manufacture of textiles, wearing apparel, wood and paper products; printing and reproduction,
3) the manufacture of petroleum, chemical, pharmaceutical, rubber and plastic products,
4) the manufacture of metal and machinery products, except electrical equipment.

The third area (*the manufacture of petroleum, chemical, pharmaceutical, rubber and plastic products*) includes environmentally important investments. However, it also includes investments in the pharmaceutical industry, which were generally not classified as polluting.

Due to the above limitations and difficulties in terms of comparisons, it was not possible to perform a complete statistical analysis of the examined issue. Nevertheless, the analysis provides some information on the role of FDI in the ecological transformation of the economies of the EU Member States. It also provides information on the transfer of environmentally harmful production beyond the borders of individual countries.

The shares of **inward FDI stocks** located in environmentally harmful sectors/industries of selected EU Member States and **outward FDI stocks** in these sectors/industries in total inward and outward FDI stocks, respectively, are illustrated in Figure 2 and Figure 3.

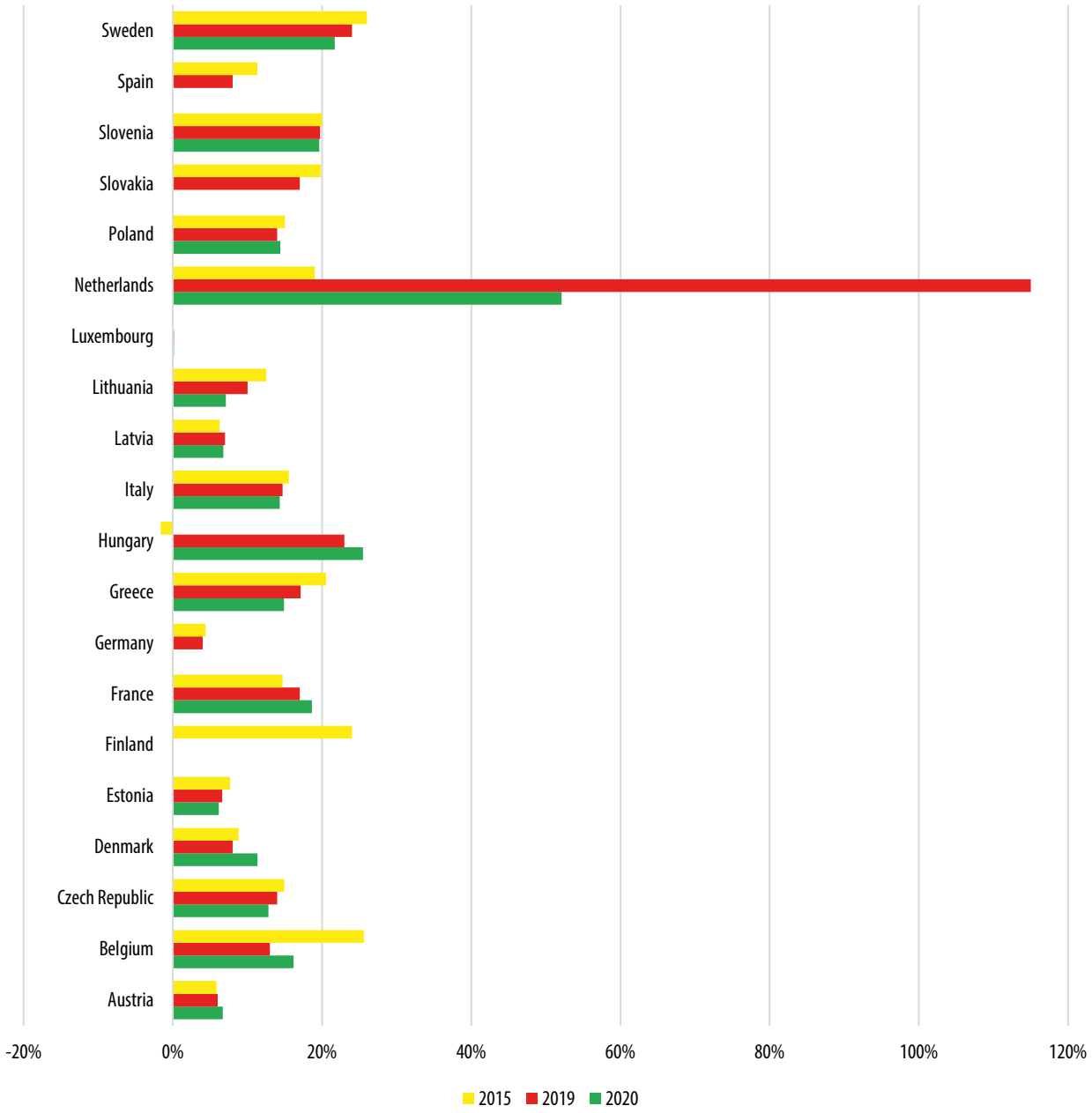

Figure 2. Share of environmentally harmful sectors/industries in the total inward FDI stocks for selected EU Member States, 2015, 2019, and 2020

Source: developed based on OECD 2021.

For most of the analyzed EU member states, the FDI stocks located in environmentally harmful industries do not exceed 20% of the total FDI stocks in these countries. The exception is Hungary (25% in 2020), Sweden (22% in 2020), and the Netherlands (52% in 2020) (OECD 2021 and own calculations). However, the result for the Netherlands is not reliable due to the large disinvestments observed in that country. Investments in environmentally harmful sectors, related to total investments suddenly shrinking, do not correctly reflect the situation there.

More than half of the analyzed EU member states recorded a decrease in the share of foreign investments in environmentally harmful industries or a stabilization of their

shares between 2015 and 2020. This group includes both old and new EU Member States. The increase in shares – ranging from 1 to 4 percentage points – was observed in only a few countries, i.e., Austria, Denmark, France, Latvia and Hungary. It demonstrates the ongoing change in FDI structure in the Member States towards sectors and industries that are less harmful to the environment.

For **FDI stocks located abroad** in environmentally harmful industries, there was a significant variation in the involvement of EU member states in this type of investment (see Figure 3). Three groups of countries are distinguished here.

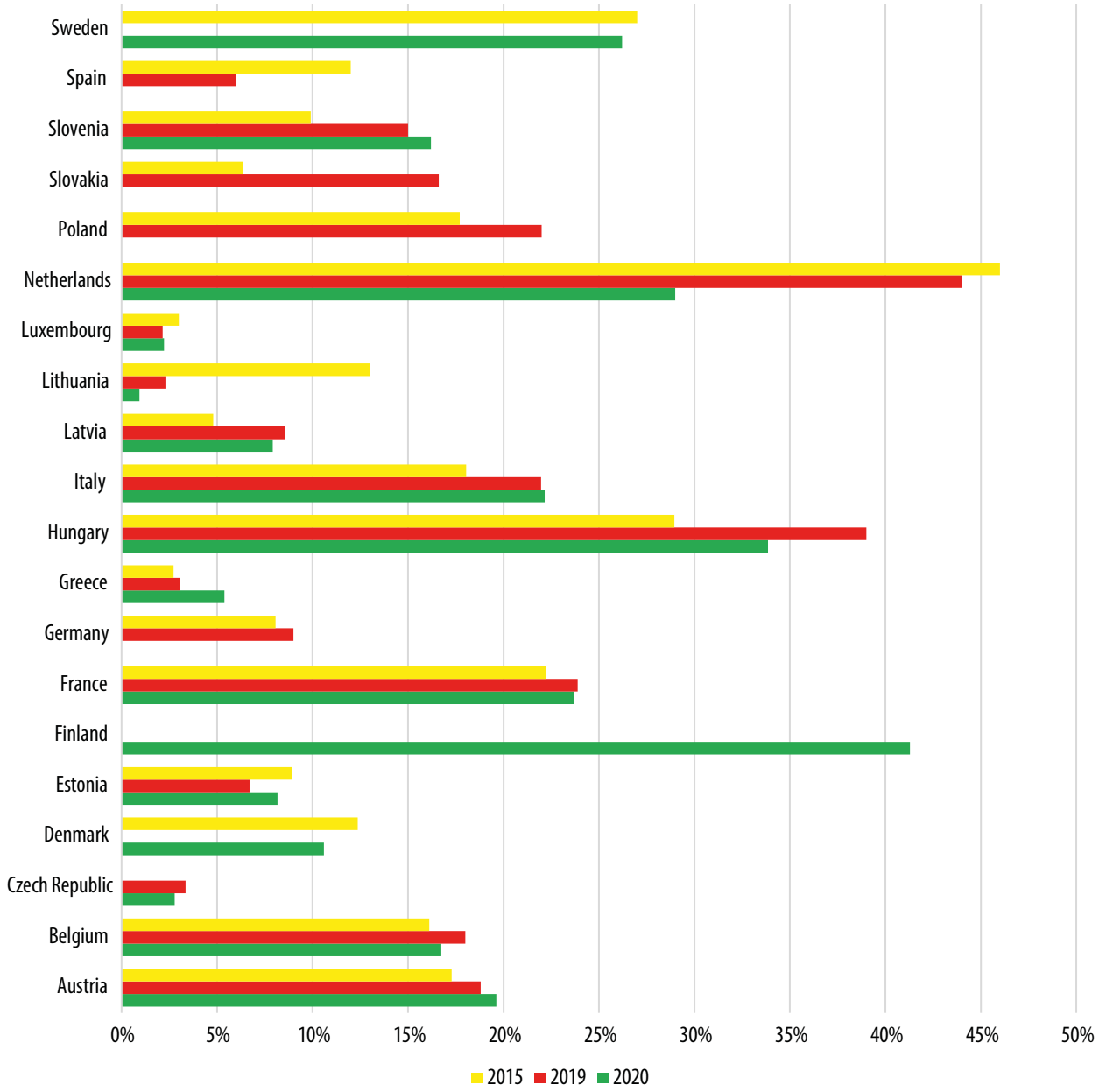

Figure 3. Share of environmentally harmful sectors/industries in total outward FDI stocks for selected EU Member States, 2015, 2019 and 2020

Source: developed based on OECD 2021.

The first group includes countries where the shares of the analyzed investments in the total outward FDI stocks are relatively high, i.e., in the range of 20% to 41%. In 2020, this group included: Finland (41%), Hungary (34%), the Netherlands (29%), Sweden (26%), France (24%), Italy (22%) and Austria (20%), as well as Poland (22% in 2019) (OECD 2021 and own calculations).

The second group includes countries whose share of FDI stocks in environmentally harmful industries ranged from 10% to 19% of total outward FDI stocks in 2020 (Belgium – 17%, Slovenia – 16%, and Denmark – 11%, and Slovakia – 17% in 2019). The third group includes countries with shares below 10% in the analyzed years. This group included both the new EU Member States (the Czech Republic, Estonia, Lithuania, and Latvia) and the old Member States (Greece, Luxembourg, Germany) (stats.oecd.org and own calculations).

The differences in the involvement of EU Member States in environmentally harmful FDI can be partly explained by the following:

- Investors from some Member States, especially the old ones, continue to take into account traditional location factors and shift environmentally harmful production abroad;
- Investors from the new Member States are still poorly able to invest abroad, especially in capital-intensive sectors;
- Individual large transactions, e.g., in the petrochemical industry, may affect the sectoral and industry structure of FDI stocks, with a relatively low involvement of a given country in FDI abroad.

Figure 4 presents data on the absolute values of inward and outward FDI stocks to and from environmentally harmful sectors/industries in selected EU Member States in 2020. It allows determining which of the analyzed countries remain, despite the pandemic conditions, **net exporters** of direct investments in these sectors/industries. According to the available data, the **net exporters are the old EU Member States**, i.e., Austria, Belgium, Denmark, France, Sweden, and Italy. Due to a lack of data, the position of Finland cannot be determined.

A more comprehensive explanation of the effects of the involvement of the identified net exporters in the host countries' environmentally harmful sectors/industries would require additional research on the dominant environmental strategies of foreign investors, the technologies used, and their involvement in social responsibility in the environmental dimension. The geographical distribution of investments would inform whether such investments are mainly located in developing countries or also in the new EU Member States.

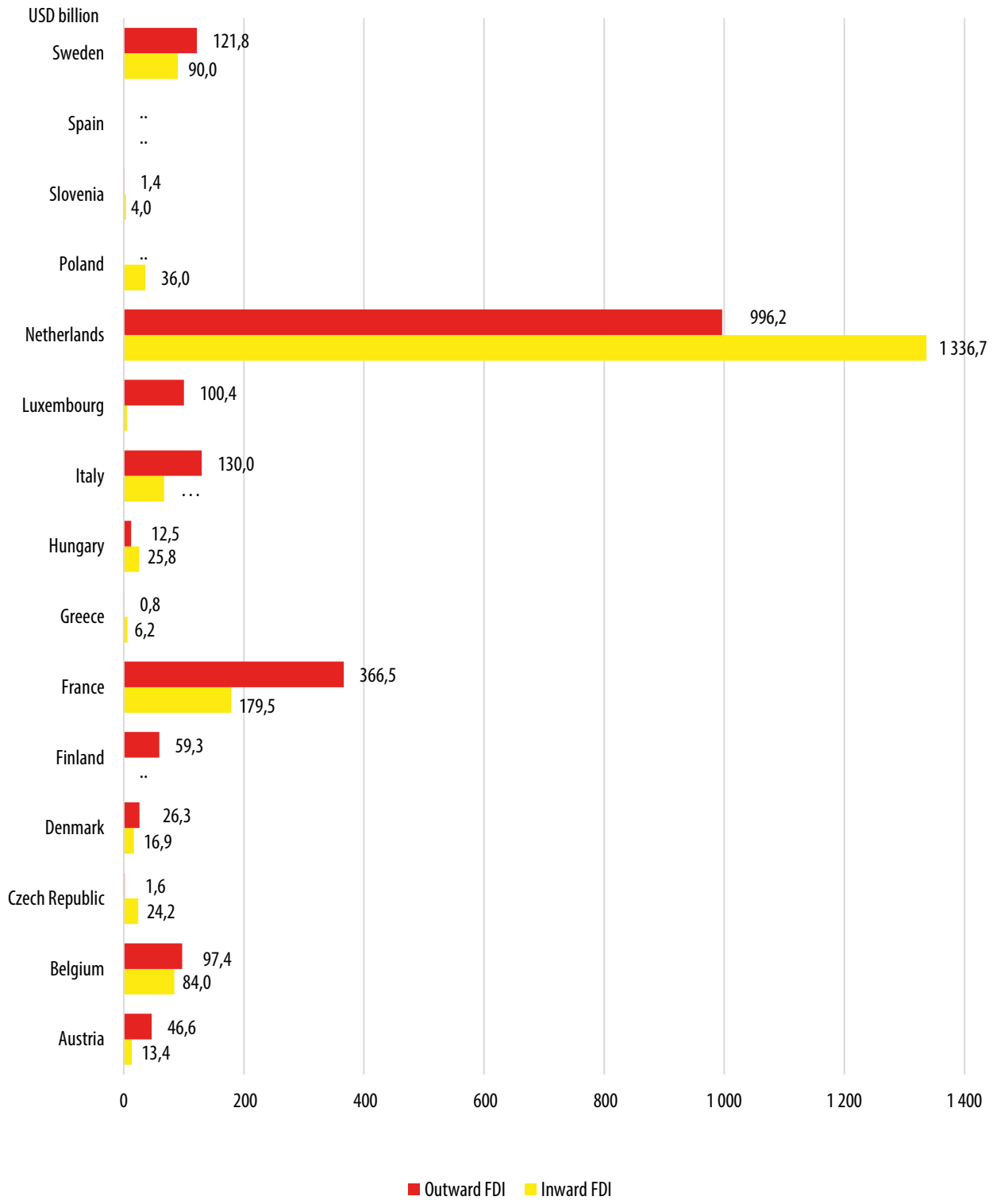

Figure 4. Differences in FDI stocks in environmentally harmful sectors/industries for selected EU Member States, 2020, USD billion

Source: developed based on OECD 2021.

The new EU Member States are interested in FDI inflow, which mainly FDI contributes to modernizing their economies. In addition to the technology transfer they expected as part of the FDI inflow to the processing industries, investments in sectors

vital for achieving the SDGs of the 2030 Agenda are also important. On the one hand, the situation of the new EU Member States is influenced by their policy toward foreign investors. Some areas of the economy may be treated as strategic by them. On the other hand, foreign investors seem to show limited interest in investing in this area.

Data on the share of FDI inflows to sectors important for achieving the SDGs of the 2030 Agenda in the total annual FDI inflows to the analyzed new EU member states are illustrated in Figure 5.

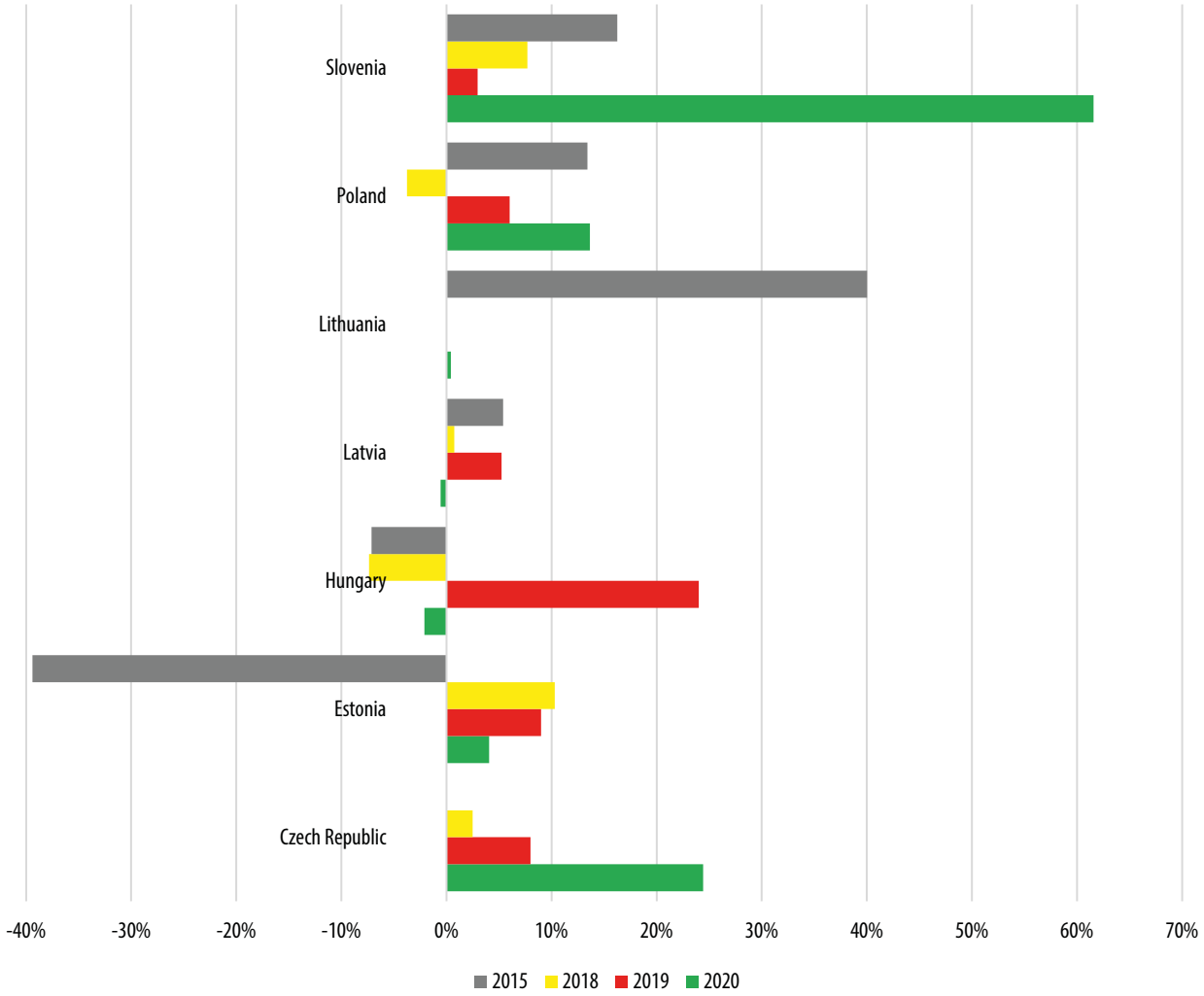

Figure 5. Share of FDI inflows to sectors important for SDG 2030 in the total annual FDI inflows for selected new EU Member States, 2015, 2018, 2019, 2020, %

Source: Developed based on OECD 2021.

The shares of investment flows to sectors considered important for the achievement of SDGs of the 2030 Agenda in the total annual FDI flows reach highly volatile values in the analyzed new EU member states. In 2020, which was generally characterized by a decrease in the share of these sectors in global FDI flows, in three countries, i.e., Slovenia, the Czech Republic and Poland, these shares were higher than in previous years.

In other countries, changes in shares ranged from –2%, –1% (disinvestments) to +4%. At the same time, data for 2015 and 2018–2020 indicate that there were no stable FDI inflows to these countries in the analyzed sectors (stats.oecd.org and own calculations).

Policy towards foreign investors aimed at sustainable development in the post-pandemic period

Traditional policy towards foreign investors

Policies that support the recovery of economies after the shocks caused by the pandemic should take into account the current role of FDI in the economies of the host countries and shape the operating conditions for foreign investors to achieve the goals of sustainable development.

The aim of traditional policies towards foreign investors is to strengthen the net benefits for the host country. Expectations related to FDI inflow are sometimes very high and include increasing financial resources and investments, strengthening technological potential, increasing export competitiveness, creating new, qualitatively better jobs, de-monopolization and promoting competitive behavior and environmental protection. These objectives can not always be achieved because there are phenomena that adversely affect the effectiveness of the policy toward foreign investors. These include information and coordination failures in international investment processes, stronger foreign investors eliminating local competition, the possibility for transnational corporations to exploit, for some time, the existing advantages of the host country (e.g., low labor costs) and then withdraw as these advantages erode, and weak bargaining and regulatory capacity (especially of less developed countries) (UNCTAD 1999, pp. XXIV–XXXIV).

Two approaches to constructing a policy towards foreign investors were observed in practice. The first is a traditional **policy of strengthening location advantages by offering incentives**, sometimes very extensive. The prisoner's dilemma was revealed here. The use of incentives by other countries forced the particular country to use them as well, despite the threat of adverse effects. Secondly, there was an awareness that attracting foreign investors requires **that the economic "foundations" of the country be strengthened**. It means expanding and modernizing the infrastructure, increasing the supply of trained employees as a result of appropriate educational policy, achieving economic and political stability, and improving long-term economic growth prospects (Oman 2000, pp. 9–13). Over time, problems that have arisen in investment policies include protecting investors' interests versus the interests of the host countries and settling disputes between them, as well as issues of screening investment projects.

New ideas and concepts of policy towards foreign investors after the pandemic

The following data confirm that the attitude towards foreign investors in the host countries is changing in the long run. There is a gradual shift from liberal politics and the use of incentives to more restrictive policies. During the pandemic, this shift intensified. While the proportion of liberalization measures applied to restrictive measures was approximately 90% to 10% in 2003, the shares of these groups of measures in the pandemic year of 2020 amounted to 59% and 41%, respectively (UN/UNCTAD 2021a, pp. 16–17). In that year, the policy towards foreign investors in developed countries was dominated by restrictive or regulatory measures (81% of all adopted measures). They involved taking precautionary measures to protect sensitive domestic businesses from foreign acquisitions. It contrasted with the situation in developing countries, where only 14% of the introduced measures were regulatory or restrictive (UN/UNCTAD 2021a, pp. 16–17).

The COVID–19 pandemic revealed **shocks and uncertainty** about further impacts on the economy, including capital flows in the form of FDI, on the side of both host countries and foreign investors. Applying anti-pandemic policies in health care in the host countries affected foreign investors in particular countries. They also negatively affected the recent decisions on investments abroad. The additional obstacles that emerged included low predictability and transparency of legal regulations for foreign investments, difficulties in starting investments, the lack of incentives for foreign investors to engage in SDGs sectors, the use of screening procedures for investment projects, and the temporary revocation of visas for employees.

In order to eliminate the general adverse effects of the pandemic crisis in the sphere of FDI inflows and, in particular, those concerning sustainable development, various **concepts of changes in policy towards foreign investors** of the host countries have been formulated. They include (Nimac 2020; Stephenson 2021; Sauvant, Stephenson, and Kagan 2021; Thrasher 2021; World Trade Organization 2022):

- facilitating foreign investment, including investments aimed at sustainable development,
- changing the approach of the host countries' governments to shaping the policy towards FDI, with particular emphasis on promoting FDI,
- encouraging the involvement of investors in "green investments",
- making investment agreements more flexible to combat climate change in the recipient countries,
- introducing investment partnership programs between countries through the cooperation of investment promotion agencies.

The **facilitation of foreign investment** is currently being negotiated in the WTO. A joint initiative of WTO member countries (developing countries and least developed countries – LDCs) was launched in 2017 to develop a multilateral agreement on facilitating development-friendly investment (*Investment Facilitation for Development*). One hundred and eleven countries joined the initiative successively; formal negotiations began in September 2020, and the expected date of concluding the negotiations is the end of 2022 (World Trade Organization 2022). The issues discussed by the countries participating in this initiative are:

- improving the transparency and predictability of investment policy measures,
- simplifying and speeding up administrative procedures for investments,
- strengthening the dialogue between governments and investors and promoting the introduction of responsible business practices by companies, as well as preventing and combating corruption,
- providing special and dedicated treatment and technical assistance to developing countries and LDCs and building their position.

The impact of the pandemic on FDI flows confirmed the importance of this initiative for all stakeholders and the need to finalize the negotiations rapidly.

According to another recommendation, **economic support** during the pandemic for entities affected by government restrictions should cover both domestic companies and foreign subsidiaries of international enterprises (Nimac 2020, p. 1). Barriers to FDI inflow to sensitive sectors introduced during a pandemic should be clearly defined, limited in time, and subject to verification. The task of investment promotion agencies should be to support foreign investors operating in the economy to help them stay in the market.

On the other hand, in the phase of emerging from the crisis, the governments of the host countries should consider **reformulating their policy towards foreign investors** to help overcome the effects of the pandemic on FDI flows and to activate the driving forces for sustainable and technological development. Changes in the approach to policy should cover four stages (Nimac 2020, pp. 2–3).

In the first stage, it would be necessary to review the FDI strategy to ascertain whether investors were in segments of the economy that were resistant to the effects of the pandemic. Such segments included the production and supply of medical equipment, the pharmaceutical industry, services supported by IT technologies, logistics, and some media. The review should also identify those segments that could benefit from the transformation and re-formatting of global value chains. It should be used to consider which segments of the economy fit best into the national objectives, e.g., sustainable development, green economic growth, and industrial development 4.0.

The second stage should be the approval of priority segments. It would require the formulation of country policy priorities by the relevant institutions (ministries, agencies responsible for business registration and activities in the area of issuing licenses, work permits, visas, and incentive management) in cooperation with the investment promotion agencies.

The third stage is implementing policy reforms towards foreign investors to improve the value of current and emerging priority segments. It would require:

- phasing out investment screening mechanisms for monitoring that were introduced during the pandemic crisis;
- linking incentives for investors to new priority segments of the economy; and
- reviewing international investment treaties and applicable law to address pandemic issues (e.g., clarifying rights and obligations under force majeure conditions).

The fourth stage would be to promote new priority segments of the economy among foreign investors, involving investment promotion agencies. It would be essential to involve the investment promotion agencies in the aftercare of investment projects in the post-investment phase.

When sustainable development, including the reduction of CO_2 emissions, becomes a priority investment direction for countries, **policy concepts are also formulated to encourage green investments**. The host countries' proactive policy should focus on (Sauvant, Stephenson, and Kagan 2021):

- encouraging or requiring (if necessary) multinationals to make their foreign subsidiaries carbon-neutral; reporting and publishing information on the carbon footprint of these subsidiaries should be mandatory; this would relate to companies of a specific size;
- using financial and non-financial incentives for carbon neutral FDI, including the creation of a "Recognized Sustainable Investor" category (Sauvant and Gabor 2021); the criterion for inclusion in such a category would be the investment's climate neutrality or positive impact on the climate;
- combining taxes with carbon emission levels in investment projects, according to the rule: lower emissions, lower taxes; in addition, governments could facilitate the use of green finance as a source of capital for CO_2-neutral FDI projects;
- supporting the emergence of carbon-neutral investment projects by creating platforms that facilitate the pooling of capital with investment opportunities.

Foreign investors' **home countries** also have a responsibility to promote green investment. They can support outgoing FDI with investors' compliance with the climate pro-

tection standards in force in the home country. It may be combined with the requirement for domestic investors to publish data on carbon emissions in large investment projects abroad. Measures that are used by home countries to reduce the risks of investments abroad – political risk insurance or guarantees – can be combined with carbon dioxide emissions. The principle should be: the lower the CO_2, the more favorable the offered conditions of insurance against political risk and guarantees. The home countries should not allow carbon-emitting industries to be relocated abroad. Preferential financing of investment projects should be associated with low emissions that result from their implementation (Sauvant, Stephenson, and Kagan 2021, pp. 1–2).

The concept mentioned above is in line with the idea of making **investment agreements between countries more flexible** to enable them to meet their commitments to **limiting climate change**. Most investment agreements focus on investment protection without addressing the impact of investment on the host countries' economies. Thus, the agreements do not create conditions for introducing investment policy measures that favor climate-friendly foreign investments or counteract investments that are harmful to the climate. The international investment regime is not adapted to the current needs of countries, lagging behind their actions, referred to as "green industrial policy". As part of this policy, countries are introducing incentives for the renewable energy sector and energy transformation and discouraging reliance on fossil fuels. The EU is also changing the concept of industrial policy towards supporting the green economy (Kawecka-Wyrzykowska 2020, pp. 11–35; Thrasher 2021, pp. 1–3).

Only a few new international investment agreements contain provisions that address the challenges of climate change. These challenges are addressed by facilitating increased investment in environmentally friendly goods and services. It is seen as the continued dominance of liberalization investment regimes over the right of governments to regulate critical sectors within the framework of a "green industrial policy". Therefore, it is proposed that countries be granted the right to support renewable energy production and that investments in the fossil fuel sector be discouraged (Thrasher 2021, pp. 1–3). This proposal could become a viable solution if the action of a group of WTO members (including the EU) regarding the phasing out of fossil fuel subsidies and allocating these funds to financing a green, sustainable economy is supported. Subsidies for fossil fuels were estimated at USD 500 billion in 2019 (World Trade Organization 2021).

The introduction of **investment partnership programs between countries**, through the cooperation of investment promotion agencies, is a concept that would make it possible to increase FDI flows and promote sustainable investments (Stephenson 2021, pp. 1–3). This cooperation may concern the partnership between investment promotion agencies from different countries on sharing knowledge and good practic-

es and the partnership between investment promotion agencies and outgoing investment agencies.

The discussion on various aspects of foreign investment policy, which are conducive to recovery from the pandemic crisis and to sustainable development, points to the need to adapt this policy to new conditions and challenges. The conclusion of WTO negotiations on a new agreement on investment facilitation would create a framework within which changes in national policies could take place, taking into account the interests of the negotiating parties and companies making investments abroad. The solutions proposed must consider the existing provisions adopted in the Agreement on Trade-Related Investment Measures (TRIMS), GATT/WTO, the Agreement on Subsidies and Countervailing Measures, GATT/WTO, and the principle of national treatment, which OECD members are bound to respect with regard to foreign investors.

The EU's investment policy during the recovery from the COVID–19 pandemic

Under the Treaty on the Functioning of the European Union (The Treaty of Lisbon), the EU acquired new competencies in external relations, including FDI, in the common commercial policy (Art. 206). The Treaty confirms the division of competencies between the Union and the member states (Art. 207) (TFEU 2012).

The impact of the common investment policy on capital flows in the form of FDI is achieved by concluding investment agreements between the EU and third countries, regulations on how to resolve investment-related disputes, and regulations on the common framework for the screening of FDI entering the EU.

From the perspective of the sustainable development of the EU, investment agreements between the EU and third countries, including environmental, climate change, and social issues, as well as regulations on the screening of FDI flowing into the EU and practical actions taken in this regard, are of particular importance.

The EU has undertaken numerous negotiations on trade and investment agreements with the grouping's external partners, which can be perceived as part of the implementation of the investment policy. Agreements concluded and currently being negotiated are either comprehensive cooperation agreements, which also include investment provisions, or agreements aimed mainly at facilitating investments and their protection in mutual relations. The new generation agreements concluded by the EU with partner countries include provisions on sustainable development that result from the commitments stemming from the 2030 Agenda. By implementing trade agreements, the EU wants to achieve the objectives of social justice, respect for human rights, high labor

standards and environmental protection. So far, it has negotiated and signed 14 such agreements (European Commission 2022)[1].

The EU has established a common framework for screening incoming FDI, with regulations entering into force in April 2019 (European Union 2019). The general justification for the introduction of screening was to protect the public interest in the expansion of foreign investors from third countries in strategic EU sectors. Therefore, efforts have been made at the EU level to create a new investment policy instrument, which has a potentially restrictive character. Its use should safeguard the key strategic interests of the EU and the member states in the global economy. Although the main objectives of adopting this regulation were different, this instrument could also safeguard the EU's interests in terms of sustainable development.

The EU's investment policy, aimed at sustainable development, is complemented by the activities of international and national businesses within the CSR framework. Of the several identified dimensions of CSR (Carroll and Shabana 2010), the social, economic, and environmental dimensions are of fundamental importance for supporting sustainable development.

The EU promotes the responsibility of enterprises for their impact on society. It promotes the integration of CSR into various forms of private business activities to achieve SDGs (European Commission 2011; 2019). The EU also adopted a new European Consensus on Development in 2017 as a common framework for EU and Member States' actions (European Commission 2019). Assuming a convergence of corporate social responsibility/corporate social conduct with the UN 2030 Agenda for Sustainable Development and the UN Guiding Principles for Business and Human Rights, the EU focuses on practical actions to lead to their implementation. The social involvement of business, including their international involvement, is part of balancing the EU's development.

Conclusion

The COVID–19 pandemic caused a drastic decline in FDI flows on a global and regional scale in 2020. Due to foreign investors' high sensitivity to the changing economic, political and institutional conditions in the host countries and their home countries, the recorded decreases in FDI in the first period of the pandemic were more significant than for GDP and international trade. Developed countries, including the EU, experienced the most significant decline, i.e., by 73%, compared to the year before the pandemic. Some

1 These are agreements with Canada, Central America, Colombia, Peru and Ecuador, Georgia, Japan, Mercosur, Mexico, Moldova, Singapore, South Korea, Ukraine, and Vietnam.

EU Member States recorded disinvestments, and only a few saw a slight increase in FDI flows. Although global FDI flows rebounded in 2021, in the EU, growth was only 8%.

The pandemic threatened the implementation of SDGs on a global scale. The collapse of FDI in sectors important for SDGs (i.e., infrastructure, renewable energy, water supply and treatment, health, agriculture and food production, and education) makes these objectives more difficult to achieve, especially in developing countries. The EU, which implements the *European Green Deal* strategy, is also facing constraints resulting from a decrease in the involvement of foreign investors in the economies of the Member States and a change in the sectoral structure of their investments. The war in Ukraine and its consequences for the energy security of Europe and other regions are now becoming a serious threat.

The statistical analysis of international business involvement in the EU economy in environmentally harmful sectors/industries indicates that the share of such investments between 2015 and 2020 in most member states did not exceed 20% of total FDI stocks. In addition, the structure of FDI stocks changed towards sectors/industries that were less harmful to the environment. Considering the high requirements for economic entities resulting from the EU's environmental policy, it can be assumed that international business contributed to the ecological transformation of the EU.

On the other hand, changes in the structure of FDI stocks located abroad in polluting sectors/industries by investors from EU member states do not allow for a clearly positive conclusion. There are significant differences between the member states in the scale of investor involvement in sectors/industries that are harmful to the environment. The changes in the investment structure between 2015 and 2020 were multidirectional. It should also be noted that several of the old Member States were net exporters of direct investment into these sectors/industries.

An analysis of the involvement of foreign direct investors in sectors important for the implementation of the SDGs of the 2030 Agenda in eight new EU Member States indicates that such investments are not very high in value and are highly volatile. It can also be assumed that they do not play a significant role in their economies.

FDI recipient countries carry out investment policies that are supposed to help achieve economic goals, including sustainable development. The policies towards foreign investors are evolving. In the longer term (2003–2020), there was a gradual shift from liberal policies and the use of incentives to more restrictive policies. While emerging from the pandemic and eliminating shocks and uncertainties in the sphere of capital flows in the form of FDI, various concepts of changes in the current policies towards foreign investors have appeared. With regard to supporting the sustainable development of FDI recipient countries, it may be helpful to facilitate foreign investments, including investments aimed at sustainable development, encourage the involvement of investors in green investments, and make investment agreements more

flexible to combat climate change in the receiving countries. The introduction of specific solutions to countries' investment policies will be possible after the conclusion of negotiations on a multilateral agreement within the WTO on facilitating development-friendly investments (*Investment Facilitation for Development*).

In the EU's common investment policy, investment agreements between the EU and third countries, which include environmental, climate change, and social issues, as well as regulations and actions regarding the screening of FDI inflows into the EU, are of particular importance for achieving the EU's sustainable development goals.

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Rola BIZ w zrównoważonym rozwoju Unii Europejskiej

Celem artykułu jest zbadanie roli międzynarodowych zachowań biznesowych w procesie zrównoważonego rozwoju UE oraz udzielenie odpowiedzi na dwa pytania, a mianowicie: (1) „W jakim stopniu międzynarodowy biznes może przyczynić się do rozwoju »zielonej gospodarki« w warunkach niepewności spowodowanej pandemią COVID–19?"; (2) „W jaki sposób kraje otrzymujące mogłyby przyciągnąć „zielone" i społecznie odpowiedzialne bezpośrednie inwestycje zagraniczne (BIZ)?"

Analiza statystyczna zaangażowania biznesu międzynarodowego w gospodarce UE w sektorach/gałęziach uciążliwych dla środowiska wskazuje, że w latach 2015–2020 udział tego typu inwestycji w większości krajów członkowskich nie przekraczał 20% ogółu skumulowanych BIZ. Struktura inwestycji zmieniała się w przypadku połowy badanych krajów w kierunku sektorów/gałęzi mniej uciążliwych dla środowiska. Zmiany te oraz wysokie wymogi wobec firm krajowych i zagranicznych w ramach polityki ochrony środowiska UE pozwalają wnioskować, że biznes międzynarodowy przyczyniał się do transformacji ekologicznej UE. Natomiast zmiany w strukturze skumulowanych BIZ ulokowanych przez kraje członkowskie UE za granicą w latach 2015–2020 w sektorach/gałęziach uciążliwych dla środowiska były różnokierunkowe. Sześć spośród analizowanych krajów UE pozostawało nadal eksporterami netto bezpośrednich inwestycji w tych sektorach/gałęziach. Zaangażowanie bezpośrednich inwestorów zagranicznych w nowych krajach członkowskich UE w sektorach ważnych dla realizacji celów zrównoważonego rozwoju – SDGs Agendy 2030 osiągało niezbyt duże wartości, cechowało się dużą zmiennością, nie odgrywając znacznej roli w ich gospodarkach. Przyciąganie „zielonych BIZ" i społecznie odpowiedzialnych inwestycji wymaga zmian w polityce wobec inwestorów zagranicznych. Powinny one dotyczyć ułatwień dla inwestycji zagranicznych, w tym inwestycji ukierunkowanych na zrównoważony rozwój, zachęt do angażowania się inwestorów w „zielone inwestycje", uelastycznienia umów inwestycyjnych w celu przeciwdziałania zmianom klimatycznym.

Słowa kluczowe: bezpośrednie inwestycje zagraniczne, zrównoważony rozwój
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Foreign Direct Investment Inflow Dynamics: The Case of Central and Eastern Europe

Kunofiwa Tsaurai https://orcid.org/0000-0001-8041-1181
Ph.D., Full Professor at the University of South Africa, Department of Finance, Risk Management and Banking, Pretoria, South Africa, e-mail: tsaurk@unisa.ac.za or kunofiwa.tsaurai@gmail.com

Abstract

This study investigates the dynamics of foreign direct investment (FDI) inflows into Central and Eastern European countries (CEECs) using panel data (1994–2020) analysis methods such as fixed effects, fully modified ordinary least squares (FMOLS) and random effects. Specifically, the study examined what factors could account for the mixed pattern of FDI inflows into CEECs. The mixed results from the existing empirical literature on FDI inflow dynamics triggered the undertaking of this study to contribute to the ongoing debate on the subject. The study notes that infrastructural development, economic growth and domestic investment had a significant positive influence on FDI across all three panel data analysis methods. Other variables that were found to have had a significant positive effect on FDI include (1) complementarity between infrastructural and financial development (fixed effects, random effects), (2) trade openness (fixed effects) and (3) savings (random effects, FMOLS). A significant negative impact of the exchange rate on FDI was observed under the FMOLS. CEECs are therefore urged to implement policies to increase infrastructural development, financial development, trade openness and savings to enhance the inflow of FDI. Future studies should investigate the minimum threshold levels of the explanatory variables of FDI.

Keywords: foreign direct investment, Central and Eastern Europe, panel data

JEL: C23, C33, F21, N44

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Introduction

The three sub-sections that constitute this part include the background of the study, the contribution to the literature, and the organization of the paper. Foreign direct investment (FDI) brings capital, skills, technology and networking, all of which enhance economic growth in the receiving country (Romer 1986). More recent empirical research that supports the FDI-led growth hypothesis includes, but is not limited to, Gui-Diby (2014), Melnyk, Kubatko, and Pysarenko (2014), Long, Yang, and Zhang (2015) and Okwu, Oseni, and Obiakor (2020). Consistent with Makhoba and Zungu (2021), there appears to be a consensus regarding the positive influence of FDI on economic growth. Despite the overwhelming evidence that economic growth is enhanced by FDI, such information is not enough to help develop policies aimed at attracting FDI. The investigation of the macroeconomic determinants of FDI fills in that gap.

Several empirical studies have attempted to examine the determinants (macro) of FDIs. Table 2 in Section 3 of this paper shows that FDI determinants were found to be varied, mixed, and inconclusive and that there we are still far from a generally agreeable list. The empirical studies also do not agree on how each variable influences FDI, as some show a positive whilst others have a negative impact. Some methodological weaknesses were also observed in the existing empirical research on the determinants of FDI, while others wrongly assumed that FDI and its independent variables are characterized by a linear relationship. The few prior studies that focused on Central and Eastern European countries (CEECs) used outdated data. To the best of the author's knowledge, none investigated the impact of a complementarity variable (trade openness and infrastructural development) on FDI. This study fills these gaps.

The five ways in which this study contributes to literature are enunciated in this section. Firstly, to the best of the author's knowledge, this is the first study to determine if a complementarity variable is one of the determinants of FDI in CEECs. Secondly, unlike prior empirical research on the determinants of FDI, this study used the most recent data (1994–2020). Thirdly, unlike prior research, this study considers that the relationship between FDI and its explanatory variables is non-linear.

Seven more sections constitute the rest of this paper. Section 2 is a theoretical literature discussion on the determinants of FDI, and Section 3 reviews the empirical literature, whilst Section 4 presents and describes the FDI trends for CEECs between 1994 and 2020. Section 5 is the research methodological framework, Section 6 focuses on data analysis and the discussion of the results, while Section 7 concludes.

Theoretical literature review

Table 1. Theoretical praxis of the explanatory variables

Explanatory variables	Theoretical views	Impact
Trade openness (OPEN)	Denisia (2010) argued that trade openness is a direct outcome of good government policy; therefore, it is one of the locational advantages of FDI. It also noted that external shocks experienced by countries characterized by higher levels of trade openness might not be favorable to FDI inflows.	+/-
Economic growth (GROWTH)	The eclectic paradigm hypothesis argued that one of the locational advantages of FDI is economic growth (Denisia 2010), a view supported by Jorgenson (1963).	+
Savings (SAV)	Consistent with Romer (1986) and Lucas (1988), savings stimulate both domestic and foreign investment, ensuring the sustainable and long-term growth of the host country's economy. Domestic savings (% of GDP) was used as a measure of savings in this study.	+
Personal remittances (REMIT)	According to Azam and Haseeb (2021), international capital flows normally follow each other; hence, FDI and personal remittances flow together in the same direction. By contrast, personal remittance inflow enables the labor exporting country to have its own home-grown reservoir of financial resources to stir economic growth, reducing the overreliance on FDI inflows. Either way, personal remittances are expected to influence FDI. Personal remittances received (% of GDP) is the measure of personal remittances used in this study.	+/-
Exchange rate (EXCH)	Aliber (1970) argued that strong domestic currencies chase away FDI because foreign investors get little for their foreign currencies. The argument was supported by Moosa (2010), whose study noted that countries whose currencies are very strong have more appetite to invest in other countries because they can still afford to access capital at higher interest rates and still makes a profit.	+
Financial development (FIN)	According to Kaur, Yadav, and Gautam (2013), developed financial markets ease foreign investors' entry and exit constraints, apart from smoothing foreign and domestic market linkages. Financial markets which are deep and developed enhance the productivity of foreign capital through their ability to efficiently distribute financial resources (Ezeoha and Cattaneo 2012).	+
Domestic investment (DINV)	Consistent with Lucas (1988), the environment that spurs domestic investment is like the one that attracts foreign investment. In other words, increased domestic investment enhances sustainable economic growth, itself a locational advantage of FDI, as argued by Jorgenson (1963). The measure of domestic investment used in this study is gross capital formation (% of GDP).	+
Infrastructural development (INFR)	According to Craigwell (2012), developed infrastructure acts as a support network for the new technology brought in by foreign direct investors. The conducive environment brought by a developed infrastructure attracts foreign direct investors (Denisia 2010).	+

Source: author's compilation.

Empirical literature review

Table 2. Empirical research on the determinants of foreign direct investment

Author	Unit of analysis	Approach	Findings
Tampakoudis et al. (2017)	Middle-income countries	Panel data analysis	The significant positive influence of trade openness, population growth and economic growth on FDI was observed in middle-income countries.
Abel et al. (2021)	Zimbabwe	Autoregressive Distributive Lag (ARDL)	Wages, interest rates, inflation, economic growth and trade openness heavily determined the inflow of FDI into the mining sector of Zimbabwe.
Tocar (2018)	Literature review analysis	Literature review analysis	Salaries, agglomeration, liquidity and market size were factors that positively influenced FDI inflows.
Kumari and Sharma (2017)	Developing countries	Panel data analysis	Trade openness, human capital development, interest rates and market size were noted as the key factors that attracted FDI.
Tsaurai (2017)	BRICS	Fixed effects, pooled OLS	Trade openness, economic growth, exchange rate stability, human capital development and financial development significantly enhanced FDI inflows.
Bryna (2021)	Indonesia	Panel data analysis	Financial development, human capital development, and market size were found to be significant positive factors that drove FDI inflows into Indonesia.
Azam and Haseeb (2021)	BRICS	Fully Modified Ordinary Least Squares (FMOLS)	Trade openness, market size, economic growth and tourism were the major drivers of FDI inflows.
Majavu (2015)	South Africa	Vector Error Correction Model (VECM)	Economic growth enhanced FDI, whilst financial crises had a deleterious influence on FDI in South Africa.
Malefane (2007)	Lesotho	Multi regression analysis	An export-oriented promotion strategy was one of the major factors that attracted FDI into Lesotho.
Boğa (2019)	Sub-Saharan African countries	Panel data analysis	Trade openness, natural resource availability, economic growth, financial development and telecommunication infrastructural development were observed to have attracted FDI into Sub-Saharan African countries.
Wijaya et al. (2020)	Indonesia	VECM	Inflation, economic growth, interest rates, infrastructural development and exchange rates attracted FDI in Indonesia.
Pradhan (2011)	SAARC countries	Vector Autoregressive (VAR) approach	Exchange rate, economic growth, population growth, current account balance, inflation and trade openness were found to be significant positive determinants of FDI.

Author	Unit of analysis	Approach	Findings
Agiomirgianakis, Asteriou, and Papathoma (2004)	OECD countries	Panel data analysis	Human capital development, trade openness and infrastructural development positively influenced FDI.
Coy and Cormican (2014)	Japanese and Ireland	Descriptive statistics	A low corporate rate was found to be instrumental in attracting FDI.
Ashurov et al. (2020)	Central Asian region	Generalized methods of moments	Economic growth, trade openness, previous FDI and tax revenue had a significant influence on FDI.
Mahbub and Jongwanich (2019)	Bangladesh	Time series data analysis	A good regulatory framework, economic growth, political stability and financial development significantly attracted FDI inflows.
Asiedu (2002)	Africa	Panel data analysis	Better infrastructure and a higher rate of return were found to have attracted FDI into non-Sub-Saharan African countries.
Çevis and Çamurdan (2007)	Transition economies	Panel data analysis	Inflation, economic growth, interest rates and trade openness were the major determinants of FDI in transition economies.
Asong, Akpan, and Isiye (2018)	BRICS and MINT countries	Pooled time-series cross-sectional data analysis	Significant factors that attracted FDI into BRICS and MINT countries include infrastructural development, market size and trade openness. Institutional quality and natural resource availability also attracted FDI in an insignificant manner.
Hintosova et al. (2018)	Visegrad group of countries	Pooled ordinary least squares (OLS)	Wages and human capital development were found to have significantly positively influenced FDI.
Erdogan and Unver (2015)	88 countries	Panel data analysis	Human capital development, financial development, market size, inflation, economic growth and unemployment were found to have attracted FDI inflows.
Silveira, Samsonescu, and Triches (2017)	Brazil	VECM	Wages, economic growth and productivity were observed to have attracted FDI in Brazil.
Rashed, Yong, and Soon (2021)	Africa	Panel data analysis	Corruption had a deleterious impact on FDI. On the other hand, economic growth enhanced FDI in Africa.
Mansaray (2017)	Sierra Leone	Error Correction Model (ECM)	Trade openness and economic enhanced FDI inflows in Sierra Leone.
Mupimpila and Okurut (2012)	Southern African Development Community (SADC)	SADC	The lag of inflation and infrastructural development had a deleterious effect on FDI. By contrast, economic growth, external debt, inflation, and the lag of FDI had a significant influence on FDI in SADC countries.

Author	Unit of analysis	Approach	Findings
Mottaleb and Kalirajan (2010)	Developing countries	Panel data analysis	A friendly business environment, economic growth and trade openness had a significant positive influence on FDI in developing countries.
Sane (2016)	Economic Community of West African States (ECOWAS)	Panel data analysis	Economic freedom, economic growth, larger market size, financial development, stable macroeconomic environment and exchange rates played a major role in helping to attract FDI into ECOWAS.
Kariuki (2015)	African Union	Fixed effects model	Trade openness, infrastructural development, commodity price index, financial development, and the lag of FDI had a significant positive effect on FDI in the African Union.
Demirhan and Masca (2008)	Developing countries	Cross-sectional data analysis	Trade openness, economic growth and communication infrastructure were observed to have positively and significantly influenced FDI.
Yunus (2020)	Malaysia manufacturing sector	OLS and descriptive statistics	Whilst high levels of domestic investment lured FDI, human capital development was observed to have had a negative influence on FDI in the manufacturing sector of Malaysia.
Abiola (2019)	Nigeria	VAR approach	Infrastructural development's influence on FDI had a negative effect on FDI in Nigeria. However, a significant positive influence on FDI in Nigeria came from variables such as economic growth, inflation, trade openness and exchange rates.
Piteli (2010)	Developed countries	Panel data analysis	Total factor productivity in the receiving country attracted FDI in a very significant positive manner.

Source: author's compilation.

What is more apparent from these two sections of the literature review is that there is no agreed list that spells out the macroeconomic determinants of FDI, making the study on the determinants of FDI far from conclusive. As a result, there is a need for more empirical research.

Foreign direct investment trends for Central and Eastern European (1994–2020)

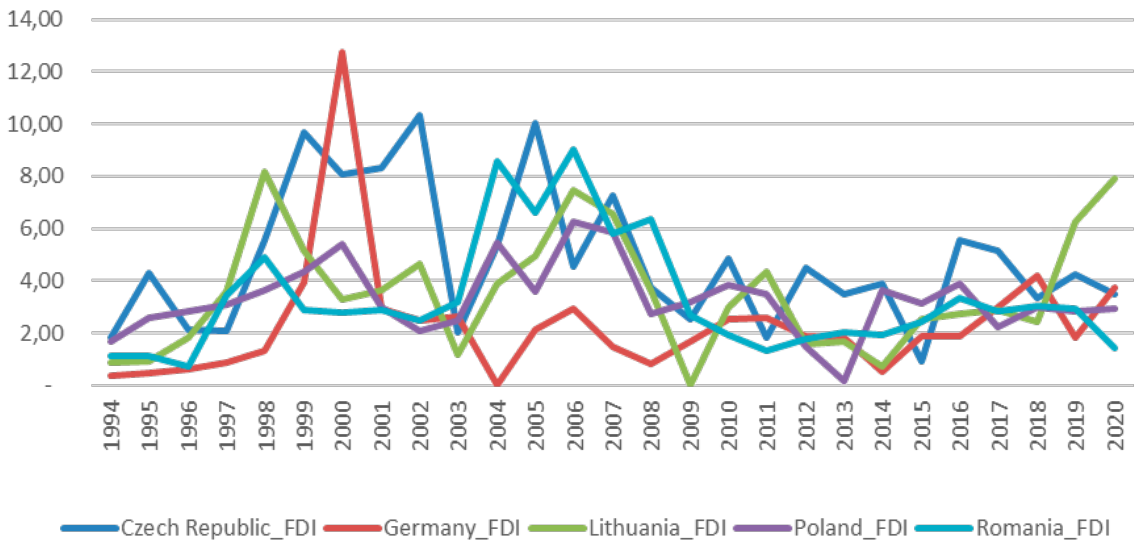

Figure 1. Foreign direct investment net inflows (% of GDP); trends for Central and Eastern European countries

Source: author's compilation.

Net FDI inflows for the Czech Republic increased from 1.84% of GDP in 1994 to 9.69% in 1999, declined by 4.32 percentage points during the four-year period between 1999 and 2004 before further decreasing by 2.82 percentage points, from 5.36% in 2004 to 2.54% in 2009. The period between 2009 and 2014 saw net FDI inflows marginally increasing by 1.32 percentage points, whilst a 0.39 percentage point decline in net FDI inflows was experienced between 2014 and 2020 (from 3.86% in 2014 to 3.47% in 2020).

Germany's net FDI inflows went up by 3.58 percentage points, from 0.34% of GDP in 1994 to 3.92% in 1999, declined by 3.91 percentage points between 1999 and 2004, before experiencing growth of 1.65 percentage points during the subsequent four-year period (from 0.01% of GDP in 2004 to 1.66% in 2009). Germany experienced a 1.16 percentage point decline in net FDI inflows from 2009 to 2014, and then its net FDI inflows jumped from 0.50% of GDP in 2014 to 3.71% in 2020.

The net FDI inflow for Lithuania increased from 0.87% of GDP in 1994 to 5.15% in 1999 before going down by 1.26 percentage points during the subsequent four-year period (from 5.15% of GDP in 1999 to 3.89% in 2004). A further decline of 3.88 percentage points was experienced during the four-year time period between 2004 and 2009. Lithuania's net FDI inflow increased from 0.01% of GDP in 2009 to 0.74% in 2014 before massively increasing by 7.18 percentage points between 2014 and 2020.

Net FDI inflows for Poland went up from 1.69% of GDP in 1994 to 4.36% in 2004, increased by 1.08 percentage points during the subsequent four-year period (1999–2004) before declining from 5.44% in 2004 to 3.19% in 2009. An increase in net FDI inflows of 0.46 percentage points between 2009 and 2014 was observed. Between 2014 and 2020, net FDI inflows plummeted from 3.65% of GDP to 2.91%.

Romania's net FDI inflows went up from 1.13% of GDP in 1994 to 2.90% in 1999, further increased by 5.70 percentage points between 1999 and 2004, before a sharp decline by 5.93 percentage points during the subsequent four-year period (from 8.59% of GDP in 2004 to 2.66% in 2009). Net FDI inflow declined from 2.66% of GDP in 2009 to 1.93% in 2014 before further experiencing a 0.49 percentage point decline between 2014 and 2020).

The net FDI inflows for the five CEECs did not follow a straight line between 1994 and 2020. Thus, several reasons account for the varied nature of the trend lines of net FDI inflows of these countries. The study filled this gap by examining the dynamics behind the mixed trends in net FDI inflows of these CEECs.

Methodological framework

Data: Panel secondary data from 1994 to 2020 was used to examine the determinants of FDI. The World Bank database was the main source of public data. Transparency, accessibility, traceability and reliability are some of the benefits of extracting data from such an international database.

Specification of the general model: Equation 1 represents the general model specification of the FDI function.

$$FDI = f(INFR, FIN, OPEN, EXCH, SAV, REMIT, GROWTH, DINV). \quad (1)$$

The following empirical studies were instrumental in choosing the explanatory variables or independent variables of the FDI function: Agiomirgianakis, Asteriou, and Papathoma (2004), Malefane (2007), Pradhan (2011), Coy and Cormican (2014), Majavu (2015), Kumari and Sharma (2017), Tampakoudis et al. (2017), Tsaurai (2017), Tocar (2018), Boğa (2019), Mahbub and Jongwanich (2019), Ashurov et al. (2020), Wijaya et al. (2020), Abel et al. (2021), Azam and Haseeb (2021), and Bryna (2021). In line with Aye and Edoja (2017), to decisively deal with the multi-collinearity problem, outliers, and abnormally distributed data sets, all the data was used for the main analysis in its natural logarithm format.

Specification of the econometric model: Equation 2 is presented below.

$$FDI = \beta_0 + \beta_1 INFR_{it} + \beta_2 FIN_{it} + \beta_3 (INFR_{it}.FIN_{it}) + \beta_4 OPEN_{it} + \beta_5 EXCH_{it} + \beta_6 SAV_{it} + \beta_7 REMIT_{it} + \beta_7 GROWTH_{it} + \beta_8 DINV_{it} + \mu + \varepsilon. \quad (2)$$

Table 3. Interpretations of econometric signs

β_0	Intercept term
β_0 to β_8	Co-efficient of the independent variables
i	Country
ε	Error term
μ	Time invariant and unobserved country-specific effect
FDIit	FDI net inflows in country i at time t
FINit	Financial development in country i at time t
REMITit	Personal remittances received in country i at time t
OPENit	Trade openness in country i at time t
INFRit	Infrastructural development in country i at time t
GROWTHit	Economic growth in country i at time t
EXCHit	Exchange rate in country i at time t
SAVit	Domestic savings in country i at time t
DINVit	Domestic investment in country i at time t
t	Time

Source: author's compilation.

The impact of the complementarity between infrastructural and financial development on FDI is in line with Dunning (1988). He argued that financial and infrastructural development are locational advantages of FDI. Also consistent with Dunning, when they are both present in the host country in the right proportions, FDI inflow is enhanced. It is for this reason that the complementarity variable as an explanatory variable of FDI was introduced in Equation [2]. FMOLS, random effects and fixed effects are the econometric estimation methods used to estimate Equation [2].

Demirhan and Masca (2008), Mottaleb and Kalirajan (2010), Piteli (2010), Mupimpila and Okurut (2012), Erdogan and Unver (2015), Kariuki (2015), Sane (2016), Mansaray (2017), Silveira, Samsonescu, and Triches (2017), Asong, Akpan, and Isiye (2018) Hintosova et al. (2018) Abiola (2019), Yunus (2020), and Rashed, Yong, and Soon (2021), are some of the few empirical studies that influenced the choice of the measures of the variables employed in this study. Another consideration that played a major role in the selection of the main variables' proxies was data availability.

Table 4. Variables, measures and the sources of data

Variable	Measures used	Data sources
Foreign direct investment (FDI)	Net foreign direct investment inflows (% of GDP)	World Development Indicators
Financial development (FIN)	Domestic credit to the private sector (% of GDP)	World Development Indicators
Remittances (REMIT)	Personal remittances received (% of GDP)	World Development Indicators
Trade openness (OPEN)	Total trade (% of GDP)	World Development Indicators
Infrastructural development (INFR)	Individuals using the internet (% of population)	World Development Indicators
Economic growth (GROWTH)	Gross domestic product per capita	World Development Indicators
Savings (SAV)	Domestic savings (% of GDP)	World Development Indicators
Domestic investment (DINV)	Gross capital formation (% of GDP)	World Development Indicators
Exchange rate (EXCH)	Official exchange rate (LCU per US$, per average)	World Development Indicators

Source: author's compilation.

Presentation, discussion, and interpretation of the results

Pre-estimation diagnostics: The pre-estimation diagnoses covered in this sub-section include correlation analysis, descriptive statistics, panel stationarity tests and panel co-integration tests (see Tables 5, 6, 7 and 8).

Table 5 indicates that the correlation between (1) financial development and FDI and (2) economic growth and FDI is negatively significant. The exchange rate and domestic investment individually had a significant positive relationship with FDI. A non-significant positive correlation was observed between trade openness and FDI, savings and FDI, and personal remittances and FDI. The negative correlation between infrastructural development and FDI was non-significant. Stead (2007) argued that a correlation above 70% (ignoring the sign) shows that there is a problem of multi-collinearity between the variables under consideration. In this case, the multi-collinearity problem exists between financial development and economic growth.

Table 5. Correlation analysis

	FDI	INFR	FIN	OPEN	EXCH	SAV	REMIT	GROWTH	DINV
FDI	1.00								
INFR	−0.13	1.00							
FIN	−0.17**	0.34***	1.00						
OPEN	0.14	0.60***	0.02	1.00					
EXCH	0.35***	−0.09	−0.11	0.37***	1.00				
SAV	0.08	0.44***	0.35***	0.39***	0.64***	1.00			
REMIT	0.02	0.44***	−0.18**	0.55***	−0.13	−0.12	1.00		
GROWTH	−0.23***	0.66***	0.75***	0.13	−0.16*	0.52***	−0.11	1.00	
DINV	0.37***	−0.23***	−0.08	0.10	0.70***	0.49***	−0.14	−0.18**	1.00

***/**/* represents 1%, 5% and 10% significant level respectively.
Source: E-Views.

Table 6. Descriptive statistics

	FDI	INFR	FIN	OPEN	EXCH	SAV	REMIT	GROWTH	DINV
Mean	3.45	43.76	49.76	90.23	7.02	22.55	1.14	15,572.07	23.49
Median	2.93	48.82	48.70	84.64	3.12	22.24	0.61	12,447.44	22.89
Maximum	12.73	89.81	112.42	157.57	38.60	34.82	4.51	48,023.87	36.11
Minimum	0.01	0.03	7.13	37.18	0.17	10.38	0.01	1,323.10	12.66
Standard deviation	2.31	30.96	26.29	31.11	9.64	6.16	1.14	12,743.89	4.35
Skewness	1.33	−0.16	0.55	0.58	1.75	0.05	1.25	1.14	0.55
Kurtosis	5.06	1.48	2.70	2.42	4.70	2.21	3.62	3.41	3.08
Jarque-Bera	63.87	13.58	7.38	9.52	85.34	3.56	37.60	30.33	6.81
Probability	0.00	0.00	0.02	0.00	0.00	0.17	0.00	0.00	0.03
Observations	135	135	135	135	135	135	135	135	135

Source: E-Views.

The range for financial development, trade openness and economic growth exceeds 100, whilst the standard deviation for variables such as economic growth is above 100. Such results indicate outliers in the data set of these variables. Only data for infrastructural development is negatively skewed, whilst the data for the rest of the variables (FDI, financial development, trade openness, savings, exchange rate, economic growth, personal remittances, and domestic investment) is skewed to the right. Except for savings and domestic investment, the other variables' probabilities of the Jarque-Bera criteria equate to zero. Such results mean that the data for most variables do not follow a nor-

mal distribution, consistent with Tsaurai (2021). Following Tsaurai (2020), this study addressed the econometrics problems (data not following a normal distribution pattern, extreme values, multi-collinearity problem) using natural logarithm data for the main data analysis.

Table 7. Panel root tests – Individual intercept

	Level			
	LLC	IPS	ADF	PP
FDI	– 3.91***	– 4.01***	34.40***	53.03***
INFR	– 9.47***	– 9.06***	83.61***	131.50***
FIN	– 0.58	0.28	6.85	5.27
OPEN	– 3.04***	– 0.56	11.15	24.29***
EXCH	– 3.31***	– 1.59*	22.38**	22.34**
SAV	– 0.86	– 0.31	8.82	10.41
REMIT	– 1.26	– 0.16	9.57	8.37
GROWTH	– 1.30*	1.10	3.62	6.60
DINV	– 1.93**	– 2.13**	19.38**	13.25
First difference				
FDI	– 8.53***	– 8.30***	75.19***	110.50***
INFR	– 1.86**	– 4.18**	138***	19.62**
FIN	– 2.98***	– 2.88***	26.05***	41.54***
OPEN	– 5.04***	– 5.45***	47.35***	80.95***
EXCH	– 3.91***	– 3.93***	35.26***	58.51***
SAV	– 5.54***	– 6.72***	60.21***	102.68***
REMIT	– 4.47***	– 4.48***	38.86***	80.50***
GROWTH	– 5.36***	– 4.62***	39.88***	51.77***
DINV	– 8.81***	– 8.41***	75.98***	98.68***

***/**/* represents 1%, 5% and 10% significant level respectively.
Source: E-Views.

This study used Levin, Lin, and Chu (2002), Phillips-Perron-Fisher Chi-Square, Im, Pesaran, and Shin (2003), and the Augmented Dickey-Fuller-Fisher Chi-Square tests as approaches for testing the existence of stationarity. Table 7 shows that not all variables are stationary at level. They are, however, all stationary at first difference, paving the way for the next stage (panel co-integration tests).

Table 8. Johansen Fisher Panel Co-integration test

Hypothesized No. of CE(s)	Fisher Statistic (from trace test)	Probability	Fisher Statistic (from max-eigen test)	Probability
None	6.931	0.7319	6.931	0.7319
At most 1	4.159	0.9399	41.00	0.0000
At most 2	92.10	0.0000	92.10	0.0000
At most 3	239.6	0.0000	127.5	0.0000
At most 4	151.4	0.0000	72.88	0.0000
At most 5	95.77	0.0000	48.94	0.0000
At most 6	57.72	0.0000	34.55	0.0001
At most 7	33.62	0.0002	24.65	0.0061
At most 8	27.36	0.0023	27.36	0.0023

Source: author's compilation from E-Views.

Table 8 indicates that there are, at most, eight co-integrating relationships among the variables, itself evidence that a long-run relationship exists. Consistent with Tsaurai (2021), the existence of a long-run relationship allowed the study to proceed to the next stage (final data analysis).

Main data analysis and discussion of the results: Table 9 presents the main results of the study.

Table 9. Results of final data analysis – The dynamics of foreign direct investment inflows

	Fixed effects		Random effects		Fully Modified Least Squares (FMOLS)	
	Co-efficient	t-statistic	Co-efficient	t-statistic	Co-efficient	t-statistic
INFR	0.21***	2.7973	0.75**	2.1181	0.26**	2.5897
FIN	0.04	0.0898	0.30	1.0108	0.18	0.0372
INFR.FIN	0.38***	3.1793	0.16***	3.3023	0.17	0.1035
OPEN	0.03***	3.4420	0.12	0.5101	0.57	0.7823
EXCH	– 0.44	– 1.5186	– 0.19	– 1.4072	– 0.48*	– 1.6788
SAV	0.05	1.3963	0.21*	1.9050	0.28**	2.1801
REMIT	– 0.03	– 0.2457	– 0.08	– 0.8452	– 0.14	– 1.1320
GROWTH	0.49***	5.3719	0.04***	4.1292	0.61***	3.8172
DINV	0.43***	4.3252	0.18***	3.6916	0.37***	3.6253
Adjusted R-squared 0.5528 F-statistic 19.17 Prob (F-statistic) 0.0000			Adjusted R-squared 0.6317 F-statistic 37.18 Prob (F-statistic) 0.0000		Adjusted R-squared 0.5918 F-statistic 43.19 Prob (F-statistic) 0.0000	

***/**/* represents 1%, 5% and 10% significant level respectively.
Source: E-Views.

Table 9 indicates that infrastructural development had a significant enhancing influence on FDI across all three econometric estimation methods, namely fixed effects, FMOLS, and random effects. These results are in line with Denisia (2010), who noted that FDI is attracted by a conducive investment climate brought by a developed infrastructure.

A non-significant positive influence of financial development on FDI was observed under random effects, FMOLS and fixed effects, consistent with Kaur, Yadav, and Gautam (2013), who argued that developed financial markets are better able to smoothen domestic and foreign markets networks through easing exit and entry challenges of foreign investors.

Fixed and random effects show that the complementarity between infrastructural and financial development significantly enhanced FDI, consistent with Denisia (2010), who indicated that both financial development and developed infrastructure are locational advantages of FDI. The study implied that a combination of more locational advantages of FDI in the host country produces better results. FMOLS also indicated that FDI was positively but non-significantly affected by the complementarity between financial and infrastructural development.

The significant positive impact of trade openness on FDI was observed under the fixed effects approach, whilst random effects and FMOLS produced results showing that FDI was positively but non-significantly affected by openness to trade. These results generally indicate that trade openness enhanced FDI into CEECs, consistent with Denisia's (2010) argument that trade openness is one of the locational advantages of FDI inflows into the host country.

The influence of the exchange rate on FDI under the fixed effects and random effects approaches was negative and non-significant, whilst FMOLS shows a significant negative relationship running from the exchange rate to FDI. These results mean that a depreciation of the local currency reduced FDI inflows into CEECs, in line with Aliber's (1970) argument that a weak domestic currency attracts FDI because foreigners get a higher quantity of domestic currency when they convert their funds.

Random effects and FMOLS show that savings had a significant positive impact on the inflow of FDI, whereas a non-significant positive effect of savings on FDI inflows into CEECs was observed under the fixed effects approach. The results generally align with Lucas (1988), who argued that savings stimulate both domestic and foreign investment, ensuring the sustainable and long-term growth of the host country's economy.

Across all the three panel data analysis methods used, personal remittances had a non-significant reduction impact on FDI, consistent with the argument that personal remittance inflow enables the labor exporting country to have its own home-grown

reservoir of financial resources to stir economic growth, reducing the overreliance on FDI inflows.

The positive impact of economic growth on FDI was found to be significant under the FMOLS, fixed and random effects, consistent with the eclectic paradigm hypothesis, which listed economic growth among a list of locational advantages of FDI (Jorgenson 1963). Domestic investment had a significant positive influence on FDI across all three panel data analysis methods, in support of an argument by Lucas (1988), which implies that the environment that spurs domestic investment is like the one that attracts foreign investment.

Conclusion

This study investigated the dynamics of FDI inflows into CEECs using panel data (1994–2020) analysis methods such as fixed effects, fully modified ordinary least squares and random effects. Specifically, the study examined what factors could account for the mixed pattern of FDI inflows into CEECs. The mixed results from the existing empirical literature on FDI inflow dynamics triggered the undertaking of this study to contribute to the ongoing debate on the subject matter. The study noted that infrastructural development, economic growth and domestic investment had a significant positive influence on FDI across all the three panel data analysis methods. Other variables that had a significant positive effect on FDI include (1) complementarity between infrastructural and financial development (fixed effects, random effects), (2) trade openness (fixed effects) and (3) savings (random effects, FMOLS). A significant negative impact of the exchange rate on FDI was observed under the FMOLS. CEECs are therefore urged to implement policies to increase infrastructural development, financial development, trade openness, and savings to enhance the inflow of FDI. Future studies should investigate the minimum threshold levels of the explanatory variables of FDI.

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Dynamika napływu bezpośrednich inwestycji zagranicznych: przypadek Europy Środkowo-Wschodniej

Opracowanie przedstawia wyniki badania dynamiki napływu bezpośrednich inwestycji zagranicznych (BIZ) do krajów Europy Środkowo-Wschodniej (CEEC) z wykorzystaniem metod analizy danych panelowych (1994–2020), takich jak metoda efektów stałych, w pełni zmodyfikowana metoda najmniejszych kwadratów (FMOLS) i metoda efektów losowych. W szczególności zbadano, jakie czynniki mogą być odpowiedzialne za zróżnicowaną strukturę napływu BIZ do krajów Europy Środkowo-Wschodniej. Różne wyniki prezentowane w istniejącej literaturze empirycznej na temat dynamiki napływu BIZ skłoniły autora do podjęcia się tego badania, aby wnieść wkład w toczącą się debatę. Zauważono, że rozwój infrastruktury, wzrost gospodarczy i inwestycje krajowe miały znaczący pozytywny wpływ na BIZ co potwierdziły wszystkie trzy metody analizy danych panelowych. Inne zmienne, które miały znaczący pozytywny wpływ na BIZ, obejmują (1) komplementarność rozwoju infrastruktury i rozwoju finansowego (metoda efektów stałych, metoda efektów losowych), (2) otwartość handlu (metoda efektów stałych) oraz (3) oszczędności (metoda efektów losowych, FMOLS). Stosując metodę FMOLS zaobserwowano znaczący negatywny wpływ kursu walutowego na BIZ. Zachęca się zatem kraje Europy Środkowo-Wschodniej do wdrożenia polityki mającej na celu zwiększenie rozwoju infrastruktury, rozwoju finansowego, otwartości handlu i oszczędności w celu zwiększenia napływu BIZ. W przyszłych badaniach należy zbadać minimalne poziomy progowe zmiennych objaśniających BIZ.

Słowa kluczowe: bezpośrednie inwestycje zagraniczne, Europa Środkowo-Wschodnia, dane panelowe

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Mortality and Health Spending during the First Year of the COVID–19 Pandemic. Comparing Central, Eastern and Western Europe

Agata Kliber https://orcid.org/0000-0003-1996-5550
Associate Professor, Poznan University of Economics and Business, Poznan, Poland
e-mail: agata.kliber@ue.poznan.pl

Elżbieta Rychłowska-Musiał https://orcid.org/0000-0002-4444-2973
Associate Professor, Poznan University of Economics and Business, Poznan, Poland
e-mail: elzbieta.musial@ue.poznan.pl

Abstract

The article shows the relationships between the COVID and non-COVID deaths during the first year of the pandemic, compared with the stringency of restrictions imposed and the compulsory spending on healthcare. We compare these relationships among European countries, analysing weekly data and applying cointegration models. Regarding the pandemic's intensity, we split the period into two: March – August 2020 and September 2020 – February 2021. We find that, most often, if there was a relationship between the stringency index and COVID or non-COVID mortality, it was usually positive and mortality driven. That suggests that although the governments tailored the restrictions to the growing mortality rate, they were unable to control the pandemic. No relationships, or negative ones, were most often found in these countries where the spending on healthcare was the highest (i.e., Northern and Western European countries). The biggest weekly changes in non-COVID deaths during the second sub-period were observed in the Central and Eastern European countries, where government healthcare expenditures per capita are the lowest.

Keywords: COVID mortality, Stringency Index, non-COVID mortality, Johansen test, cointegration, healthcare spending

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Introduction

This paper aims to critically analyse data on COVID and non-COVID mortality together with the stringency of government restrictions applied in 31 European economies from March 2020 to February 2021. Regarding the pandemic's intensity in these countries, we split this period into two: March – end of August 2020 and September 2020 – end of February 2021. We explore data on weekly mortality changes, together with the values of the stringency indices (SI) in the respective economies. We look for long-run relationships between SI versus COVID and non-COVID mortality and try to find lead-lag dependencies. Since our data is non-stationary, we apply cointegration models. We compare these relationships between countries from all regions of Europe and learn from them. Looking for economic factors associated with the relationship between mortality and stringency, we identify health expenditure as a factor that differentiates countries.

The rest of the paper is organised as follows. Section 2 provides a short overview of the current literature on the links between COVID–19 pandemic mortality, stringency, and health spending. Section 3 describes the data used in analyses. Section 4 outlines the model and research questions, while Sections 5 and 6 present the main findings. We end the article with a discussion and conclusions.

Literature review

Sornette et al. (2020) presented a comprehensive study of COVID–19 mortality during the first wave of the pandemic. They classified countries into five groups and identified population age structure as one of the factors driving mortality during the first phase of the pandemic. They also analysed the links between mortality and government restrictions. Their analysis confirmed that higher stringency of the restrictions during the first wave was significantly and negatively correlated with deaths per million during the early stages of the epidemic. Similar conclusions are presented by Fuller et al. (2021). They stated that the effect of the restrictions was visible if they had been introduced immediately. However, some researchers claim that, in total, the restrictions were excessive, led to the destruction of the economy in many industries (Chudik et al. 2020; Mckibbin and Fernando 2020), and caused many social (Saladino, Algeri, and Auriemma 2020), mental and psychiatric problems (Arendt et al. 2020; Le and Nguyen 2021). Due to the national lockdowns and patients' fear of being infected in hospitals, the treatment of diseases other than COVID–19 was significantly delayed. Some even talk about the "lockdown victims" (Walker et al. 2020).

Papers analysing the relationship between COVID-related mortality and healthcare expenditures indicate either a lack of dependence (Blondel and Vranceanu 2020) or

a negative relationship (Elola-Somoza et al. 2021) during the first sub-period of the first year of the pandemic. Sornette et al. (2020) also mentioned a positive relationship for Western European countries during the first pandemic wave. Stukalo, Simakhova, and Baltgailis (2022) examined the development of key factors of social economy models during the pandemic and formulated recommendations for the post-pandemic period. The most important ones for Central Europe are health care reform, increasing healthcare spending, and diversifying sources of financing for the social sector (e.g. medicine).

The analysis presented in this paper provides an important contribution to the existing scientific literature. First, we investigate the links between pandemic restrictions and mortality to better understand the consequences of efforts taken by governments during that time. The approach based on cointegration models allows us to examine long-run relationships in non-stationary data time series and name the leading variables. In the second part of the research, we point out links between COVID and non-COVID mortality and the mandatory expenditures on healthcare, which gives a clear signal to state governments.

Data

We analyse weekly changes in COVID mortality, non-COVID mortality and Stringency Index. We collected COVID mortality data and the Stringency Index from the Oxford COVID–19 Government Response Tracker (OxCGRT) database, available freely through GitHub (The COVID Tracking Project 2021; Hale et al. 2021). The data covers the period from March 2020 to February 2021. We split this period into two subperiods: March 2020 – end of August 2020 and September 2020 – end of February 2021. Due to the cyclical nature of the data, we aggregated it to weekly frequency. To get the number of weekly non-COVID deaths, we subtract the number of deaths attributed to COVID–19 from the total deaths per week. We collected the data on total mortality from the Eurostat database (Deaths by week) (Eurostat 2021a). To allow for a suitable comparison across countries, we normalize mortality data for population size to deaths per million population.

The SI is a composite measure built on nine indicators and re-scaled to a value from 0 to 100 (Hale et al. 2021). We use it as a measure of the government's response to the pandemic.

Data on health care expenditures are also important for interpreting our results. Data on compulsory government expenditure on health protection (Government/Compulsory Health spending per capita in USD, the annual average 2016–2019) come from the OECD database (OECD 2022).

In Table 1, we present the minimal and maximal SI values versus weekly changes in COVID and non-COVID deaths per million in two subperiods of the first year of the pandemic, as well as healthcare spending in each analysed country.

The minimal and maximal values of the SI index are presented in Table 1, in columns (1)–(2) and (7)–(8). On average, the countries imposed higher constraints in the first phase, which paradoxically was less severe than the second one. In the first phase, the most extreme restrictions were imposed in Serbia (100 points), Croatia (96.30), Cyprus (94.44), and Italy (93.52), while the mildest were in Iceland (53.70), Norway (54.69), and Sweden (64.81). In the second phase, the SI did not exceed 90 in any analysed country, reaching a maximum of 88.89 in Greece, 87.04 in Slovenia, and 85.19 in Germany. Interestingly, Croatia, with one of the highest restrictions, belonged to the group with the lowest SIs in the second period. Serbia also changed its restrictions policy drastically. The countries with the mildest policy in the first phase did not change it in the second.

The minimal and maximal values of weekly changes in COVID deaths (per million people) are displayed in Table 1, in columns (3)–(4) and (9)–(10).

In the first subperiod, the highest maximum was present in a relatively small Belgium (183.09 per million inhabitants). However, as researchers said, it was more like a result of too hastily qualifying many deaths from other diseases as COVID deaths (Stein 2020). The second-highest number was reached by Spain (120.97 per million), followed by France (104.15), the United Kingdom (96.75), and Italy (92.75). We note that the numbers represent weekly changes in the deaths classified as COVID-related, and we can interpret them as the speed of the pandemic spread. These maxima are much lower in Central and Eastern Europe (CEE); the lowest maximal weekly changes of COVID deaths in the first subperiod of the pandemic were 2.12 (Latvia) and 2.20 (Slovakia).

In the second period, the situation changed completely, and the maximal values were higher. The highest maximal values of weekly changes in COVID deaths were observed in CEE, i.e. 178.94 (Slovenia) and 139.31 (Bulgaria). Overall, in 7 of the 12 CEE countries, the maximum exceeded 100 per million citizens. In countries with the highest maxima in the first period (Belgium, Spain, France, Italy, and the United Kingdom), mortality declined in the second period, which may indicate that the epidemic developed more slowly there. The lowest maxima were observed in Northern European countries (except Sweden).

Finally, in columns (5)–(6) and (11)–(12) in Table 1, we present the analogous data for weekly changes in non-COVID deaths. In the first period, the maxima of the weekly changes of non-COVID deaths (per million inhabitants) are quite similar in all countries.

Comparing the maxima of the changes in the first and second subperiods, in some economies, the numbers are not too different. However, in some, the number of non-COVID deaths almost doubled or grew even more. They were mostly CEE countries, e.g. Bulgaria

(311 versus 684), Czechia (217 versus 395.46), and Poland (222 versus 429), among others. In other regions, the respective numbers did not change significantly, e.g. in Norway (157.71 versus 159) or Belgium (371.97 versus 319.51). Sometimes they even decreased, for instance, in the United Kingdom (363 versus 215) or Spain (445 versus 283). The only exception is Portugal, where non-COVID deaths almost doubled (259 versus 493).

Methods and research questions

Our research concentrates on the relationships between the SI and the mortality behaviour in selected European economies. We look for long-run relationships between SI versus COVID and non-COVID mortality and try to find lead-lag dependencies.

We start by testing the stationarity of our series in two subsamples. We performed the ADF and KPSS cross-tests. Most of the series proved to be non-stationary. However, in many cases, the tests were inconclusive. For the sake of consistency, we do not include the results of the test in the article, but they are available upon request. Therefore, we analyse cointegration relationships between two pairs: SI index versus COVID deaths and SI index versus non-COVID deaths, for all the cases where at least one test (ADF or KPSS) concluded the integration of order 1. We note that the lack of a long-run relationship may be a consequence of the stationarity of some series or their non-standard properties, such as fractional integration (see, e.g. Hassler and Wolters 1994 or Lee and Schmidt 1996 for a discussion).

Thus, we address the following research questions:

- [Question 1] Does a long-run relationship exist between the SI index and COVID deaths? If the restrictions are effective, we should observe a negative long-run relationship between the two and short-term adjustment. Two scenarios are possible: either the mortality adjusts to the index, which suggests the effectiveness of the applied tool, or the SI adapts to the mortality, which implies that the governments observe the mortality rate and adjust their policy accordingly. In both cases, we expect a negative long-run relationship between the two variables.
- [Question 2] Does a long-run relationship exist between SI index and non-COVID deaths? We assume that the restrictions – if imposed wisely – should not affect non-COVID mortality. Such a phenomenon would suggest that either the deaths are not correctly classified or – if the relationship is positive – that the restrictions were too harsh, blocking access to the treatment of other diseases.

Cointegration model

The cointegration model is already a classical one in econometric studies. It was proposed by Engle and Granger (1987). We concentrate on a bivariate case here. If both our variables are integrated of order 1 – i.e. are I(1), we first verify whether we can establish a long-run relationship between them:

$$Deaths_t + \alpha \cdot SI_t + z_t = 0, \tag{1}$$

where $Deaths_t$ denotes a change in the number of COVID or non-COVID deaths per million inhabitants between weeks t and $t-1$, SI_t – the number of deaths related to COVID between weeks t and $t-1$, while z_t denotes the error term. If the series are cointegrated, then z_t should be stationary.

Two alternative specifications of the long-run relation model exist:

- the model with a constant $Deaths_t + \alpha_0 + \alpha \cdot SI_t + z_t = 0$,
- the model with trend $Deaths_t + \alpha \cdot SI_t + \delta t + z_t = 0$.

If the cointegration relationship is present in the data, we estimate the error-correction equation (further: ECM), i.e.:

$$\begin{aligned} \Delta\, Deaths_t &= \psi_0 + \gamma_1 \hat{z}_{t-1} + \sum_{i=1}^{K} \psi_{1,i} \Delta SI_{t-i} - \sum_{i=1}^{L} \psi_{2,i} \Delta\, Deaths_{t-1} + \varepsilon_{1,t} \\ \Delta SI_t &= \phi_0 + \gamma_2 \hat{z}_{t-1} + \sum_{i=1}^{K} \phi_{1,i} \Delta Deaths_{t-i} - \sum_{i=1}^{L} \phi_{2,i} \Delta SI_{t-i} + \varepsilon_{2,t} \end{aligned} \tag{2}$$

where $\widehat{z_t}$ is the error term from the regression in Eq. (1) and $\varepsilon_{i,t}$ denotes a white noise process.

The ECM in the first equation states that the changes in mortality are explained by their history, lagged changes in the COVID mortality or stringency index, and the error from the long-run equilibrium in the previous period. The value of the coefficient γ_1 determines the speed of adjustment and should always be negative – otherwise, the system would diverge from its long-run equilibrium path (Pfaff 2008). In our case, it would denote the explosion of mortality.

The second equation can be interpreted as an analysis of the countries' policies. If γ_2 is significant and negative, denoting that the countries responded adequately to the changes in mortality. A positive coefficient would indicate that the restrictions were too severe or long-lasting.

Moreover, if two series are cointegrated, there should be Granger-causation in at least one direction (throughout this paper, we will conclude that one variable leads or lags another). The latter implies that at least one of the error terms should enter equations (2) significantly and with the correct sign (Pfaff 2008).

The Johansen procedure

To investigate the co-integration relationship, we apply the Johansen trace test (Johansen 1991). Let us re-write equation (2) into the vector error correction (VECM) form:

$$\begin{bmatrix} \Delta Deaths_t \\ \Delta SI_t \end{bmatrix} = \begin{bmatrix} \psi_0 \\ \phi_0 \end{bmatrix} + \Pi \begin{bmatrix} \text{Deaths } s_{t-1} \\ SI_{t-1} \end{bmatrix} + \sum_{i=1}^{K} \Gamma_i \begin{bmatrix} \Delta Deaths_{t-i} \\ \Delta SI_{t-i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}. \quad (3)$$

If both the $Deaths_t$ and SI_t variables are integrated of order 1, then the matrix Π has rank $0 \neq r \neq K$, where $K = n$ is the number of variables in the system (in our case, $K = 2$) and r is the number of cointegrating relations. Thus, the following alternatives are possible:

- $r = 0$: no cointegrating relationships between the I(1) variables;
- $r = K$: all variables are stationary;
- $r < K$ (in our case $r = 1$) – then the matrix Π can be expressed as a product of two matrices $\boldsymbol{\alpha\beta}'$, where both matrices are of order $r \times K$ of rank r.

After establishing the long-run relationship, we investigated the lead-lag dependencies between the variables. We do it based on the values and significance of parameters γ_i ($i \in \{1,2\}$) in equation (2). As already mentioned, if the correction occurs, at least one of the parameters should be negative and significant.

Results

Relationships between the stringency index and COVID deaths

Table 2 presents the results of the tests for the long-run relationships between COVID mortality and the SI index. We show the cases where the Johansen test indicated a long-run relationship (at 5% significance) and where at least one of the error-correcting coefficients was significant and had the correct sign. Therefore, we can indicate which variable was the leading one.

We present the estimates of the vector α, normalised to the Deaths variable. We are interested in the cases where the relationship between the variables was negative ($\alpha_{SI} > 0$),

suggesting a decrease in mortality together with an increase in restrictions. We determine the direction of causality based on the short-term adjustment coefficients from the system of error correction equations (Eq. 4). We conclude that SI led mortality when γ_2 is negative and significant. If γ_1 is negative and significant, mortality led SI. The latter denotes the reaction of governments to the death rate. If both coefficients are negative and significant, this implies causality in both directions.

Based on Table 2, we can infer that in the first period, there were only four cases (France, Denmark, the Netherlands, and Portugal) when the SI led the mortality and the increases in the SI and the decreases in the COVID-mortality occurred together. In Luxembourg, the SI also led mortality, but increases in SI and mortality occurred together. SI as a leading variable means that mortality responded to restrictions.

Relationships in both directions appeared in Hungary (negative) and Germany (positive). In all other cases, COVID mortality led the SI, and the relationships were positive (Belgium, Croatia, Iceland). Alternatively, we found no long-run relationship, meaning the restrictions followed an increase in mortality.

In the second subperiod, the negative relationship between SI and deaths was present in Iceland, Portugal, Belgium, Malta, and Switzerland. In Croatia, Germany, and Denmark, the increase in SI co-occurred with the rise in mortality. In half of the cases, SI adjusted to the COVID mortality. However, the reverse was not true, suggesting that although governments tailored the restrictions to the growing mortality rate, they were unable to control the pandemic. In Iceland and Switzerland, the relationships were mutual and led to a decrease in mortality.

Relationships between the stringency index and non-COVID deaths

As mentioned in the introduction, in many countries, severely limited access to medical treatment was a side-effect of the restrictions. Therefore, in some economies, there was an increase in non-COVID deaths, which was an indirect consequence of the restrictions. Therefore, in the second step of the research, we investigate the relationships between SI and non-COVID deaths. The research was designed analogously to the previous investigation. The results are presented in Table 3.

The results are even more complex. Starting with the first sub-period and concentrating on the equation with trends, in all the cases where the Johansen test indicated a long-run relationship between the SI and the changes in non-COVID deaths, the trend was upward in the first phase (Portugal, Romania, Serbia, Germany, Italy, and Norway), apart from Slovenia (a downward trend). Additionally, the relationship between SI and mortality was positive, even if the trend was downward-sloping, suggesting that even without any restrictions, the mortality rate would grow. The positive relationship between the SI and the changes in non-COVID deaths can also be observed for the other six

countries (Bulgaria, Greece, Belgium, Finland, Iceland, and Luxembourg) (equation with constant).

There are two countries where the relationships were negative in the first phase, Romania and Slovakia. The changes in SI preceded the changes in non-COVID mortality in both economies. In each case, the test indicated relationships with a constant (relatively high for both). The constant is interpreted as the average week-by-week change in non-COVID mortality. It means that the average weekly change in non-COVID mortality was still very high in these countries. For example, in Romania, it was 279 deaths per million population per week, and each increase in the SI by 1 point reduced this number by 36 people per 10,000. Most often, the changes in mortality preceded the changes in SI, except for Romania, Slovakia, and Serbia.

Table 1. Healthcare spending per capita in USD, minimal and maximal values of weekly changes of SI (values from 0 to 100), COVID and non-COVID deaths per million in two subperiods

Country	Government Health spending	First sub-period 1.03.2020–31.08.2020						Second sub-period 1.09.2020–28.02.2021					
		SI		COVID deaths		non-COV deaths		SI		COVID deaths		non-COV deaths	
		min	max	min	max	min	max	min	max	min	max	min	max
Norway	5,312	35.94	54.69	0.00	9.22	122.11	157.71	34.11	65.26	0.00	7.93	131.15	159.00
Germany	5,192	42.13	76.85	0.25	20.76	192.97	246.60	49.54	85.19	0.35	73.19	199.73	304.34
Switzerland	4,692	35.19	73.15	0.23	44.83	127.33	217.11	29.17	60.19	0.23	77.76	134.84	255.70
Sweden	4,596	35.19	64.81	–0.10	72.48	147.14	254.37	55.56	69.44	–0.10	91.49	149.81	235.07
Netherlands	4,411	39.81	79.63	–0.53	61.98	147.54	296.76	48.15	82.41	0.82	43.01	156.99	237.94
Denmark	4,369	50.93	72.22	0.00	19.51	162.98	199.58	39.81	70.37	0.52	36.95	161.94	219.78
Luxembourg	4,339	23.15	79.63	0.00	36.74	97.45	185.31	44.44	80.56	0.00	92.66	110.23	214.07
France	4,280	46.30	87.96	0.78	104.15	157.49	291.83	43.98	78.70	1.39	62.09	167.10	243.19
Austria	4,087	35.19	81.48	0.11	15.66	153.56	203.86	36.11	82.41	1.11	99.04	169.10	283.13
Belgium	3,859	50.00	81.48	–8.54	183.09	146.60	371.97	45.37	65.74	1.29	123.82	157.47	319.51
Iceland	3,561	39.81	53.70	0.00	11.72	82.05	175.83	37.96	52.78	0.00	20.51	102.57	164.11
Finland	3,306	32.41	67.59	–0.18	13.90	170.19	212.97	32.41	55.09	0.00	8.12	168.21	217.12
United Kingdom	3,254	22.22	79.63	127.33	96.75	146.23	363.24	60.19	76.85	1.15	50.07	132.65	215.43
Italy	2,556	50.93	93.52	0.66	92.75	177.10	387.96	49.07	84.26	1.16	83.61	184.89	312.38
Czechia	2,513	34.72	82.41	0.00	6.82	179.20	217.01	38.89	81.48	1.49	131.67	190.59	395.46
Malta	2,441	31.48	87.04	0.00	6.79	106.44	235.54	42.59	52.78	4.53	54.35	140.42	258.19
Spain	2,394	41.20	85.19	–14.14	120.97	144.20	445.07	60.65	78.70	8.77	69.64	169.10	283.03
Slovenia	2,145	39.81	89.81	0.00	10.10	157.77	212.61	47.22	87.04	0.00	178.94	169.80	383.37

Country	Government Health spending	First sub-period 1.03.2020–31.08.2020						Second sub-period 1.09.2020–28.02.2021					
		SI		COVID deaths		non-COV deaths		SI		COVID deaths		non-COV deaths	
		min	max	min	max	min	max	min	max	min	max	min	max
Portugal	1,874	37.96	82.41	0.10	21.77	183.20	259.89	56.94	80.56	2.16	196.63	185.26	493.49
Slovakia	1,726	29.63	75.00	0.00	2.20	164.66	217.41	28.70	73.15	0.18	131.33	176.39	383.72
Estonia	1,707	32.41	77.78	– 4.52	12.82	199.01	257.06	32.41	55.56	0.00	39.20	193.74	304.55
Lithuania	1,561	25.93	81.48	0.00	3.67	253.10	301.22	28.70	76.85	0.00	117.55	247.22	512.44
Croatia	1,515	35.19	96.30	0.00	4.87	206.56	273.06	28.70	50.93	3.90	133.97	226.54	435.05
Poland	1,469	36.11	83.33	0.13	5.15	193.12	222.21	23.15	75.00	2.06	91.58	199.67	429.18
Hungary	1,450	49.07	76.85	0.00	9.42	214.38	289.95	40.74	72.22	1.04	126.81	229.81	431.14
Greece	1,361	40.74	84.26	0.00	3.07	188.14	260.38	50.46	88.89	1.82	67.35	205.70	320.06
Romania	1,246	38.89	87.04	0.00	16.32	236.93	289.02	43.52	76.85	13.88	60.14	216.03	446.99
Cyprus	1,084	47.22	94.44	0.00	4.14	73.71	152.40	50.00	84.26	0.00	19.05	78.68	139.97
Latvia	1,039	41.67	69.44	0.00	2.12	240.17	308.56	32.41	60.19	0.00	84.83	252.36	443.22
Bulgaria	1,021	36.11	73.15	0.14	10.07	258.91	311.00	35.19	54.63	4.46	139.31	265.38	684.04
Serbia	N/A	25.93	100	0	10.07	154.28	264.95	51.85	60.19	0.69	46.92	141.69	456.54

Source: own calculations based on the data from OxCGRT – Eurostat 2021b; Hale et al. 2021; OECD 2022 databases.

Table 2. SI versus COVID deaths – results of the Johansen test

Country	α_{si}	α_{COV}	const.	trend	γ_1	p-value	γ_2	p-value	leading
First sub-period 1.03.2020–31.08.2020									
Croatia	–0.28	1	x	–0.85	–0.83	0.00	0.02	0.46	D
Hungary	0.03	1	–1.98	x	–0.02	0.03	0.00	0.00	both
Portugal	0.85	1	x	x	–0.06	0.62	–0.14	0.00	SI
Portugal	0.84	1	–58.36	x	–0.14	0.15	–0.13	0.00	SI
France	0.06	1	x	1.46	0.02	0.35	–0.02	0.00	SI
Germany	–1.29	1	x	x	–0.61	0.05	–0.40	0.02	both
Belgium	–3.87	1	x	x	–0.42	0.01	1.38	0.00	D
Denmark	0.13	1	x	0.24	–0.02	0.56	–0.09	0.00	SI
Iceland	–0.02	1	0.63	x	–0.04	0.04	0.01	0.00	D
Iceland	–0.03	1	x	0.05	–0.11	0.04	0.02	0.00	D
Luxembourg	–17.19	1	x	–35.60	–0.64	0.36	–0.66	0.03	SI
Netherlands	1.02	1	x	3.78	–0.04	0.79	–0.57	0.00	SI
Second sub-period 1.09.2020–28.02.2021									
Croatia	–19.46	1	x	14.01	–0.22	0.34	–3.22	0.00	SI
Portugal	0.85	1	x	–5.98	–0.02	0.61	–0.41	0.00	SI
Germany	–10.80	1	x	16.13	–3.67	0.02	–1.37	0.63	D
Malta	3.53	1	x	x	–0.10	0.01	–0.06	0.89	D
Malta	4.74	1	–282.02	x	–0.12	0.00	0.05	0.90	D
Belgium	171.49	1	–9973.79	x	–0.32	0.28	–2.89	0.00	SI
Denmark	–1.04	1	x	x	–1.52	0.00	–0.02	0.94	D
Denmark	–1.02	1	44.14	x	–2.10	0.00	–0.58	0.24	D
Denmark	–1.07	1	x	0.05	–1.51	0.00	–0.04	0.89	D
Iceland	0.38	1	–20.46	x	–0.11	0.01	–0.28	0.00	both
Switzerland	2.94	1	x	x	–0.21	0.05	–0.55	0.01	both

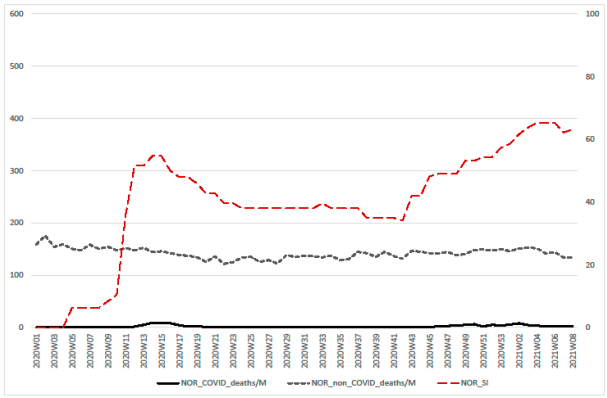
Note: In the last column D denotes that the mortality preceded the changes in SI, while SI – that the changes of restrictions preceded the mortality
Source: own calculations.

Table 3. SI versus non-COVID deaths – results of the Johansen test

Country	α_{si}	α_{nCOV}	const	trend	γ_1	p-val	γ_2	p-val	leading
First sub-period 1.03.2020–31.08.2020									
Bulgaria	–0.17	1	x	x	–0.08	0.02	0.11	0.34	D
Bulgaria	–0.17	1	–279.84	x	–0.06	0.01	0.09	0.19	D
Greece	–0.25	1	–208.75	x	–0.10	0.00	0.18	0.03	D
Portugal	–3.85	1	x	x	–0.82	0.00	0.27	0.51	D
Portugal	–11.76	1	x	–10.18	–0.96	0.00	–0.01	0.97	D
Romania	–4.29	1	x	x	–0.12	0.06	–0.35	0.03	SI
Romania	0.36	1	–279.16	x	0.01	0.77	–0.31	0.00	SI
Romania	–1.23	1	x	–2.55	–0.43	0.00	–0.56	0.15	D
Serbia	–2.17	1	x	–7.07	–0.25	0.30	–1.37	0.00	SI
Slovakia	0.06	1	–183.81	x	0.004	0.54	–0.03	0.00	SI
Slovenia	–1.02	1	x	x	–0.61	0.02	0.46	0.36	D
Slovenia	–1.03	1	–128.41	x	–0.61	0.01	0.45	0.34	D
Slovenia	–0.40	1	x	0.35	–0.55	0.04	0.84	0.08	D
Germany	–2.05	1	x	x	–0.86	0.00	0.17	0.57	D
Germany	–2.05	1	–83.17	x	–0.86	0.00	0.19	0.50	D
Germany	–2.99	1	x	–1.39	–0.95	0.00	0.08	0.79	D
Italy	–3.32	1	x	x	–0.44	0.01	1.11	0.01	D
Italy	–3.30	1	–8.53	x	–0.43	0.02	1.14	0.01	D
Italy	–4.44	1	x	–2.53	–0.73	0.00	1.34	0.03	D
Belgium	–4.96	1	x	x	–0.44	0.01	1.37	0.07	D
Finland	–0.96	1	–145.39	x	–0.63	0.00	1.93	0.00	D
Iceland	–7.52	1	x	x	–0.60	0.00	–0.69	0.65	D
Luxembourg	–0.98	1	x	x	–0.38	0.02	0.53	0.38	D
Norway	–1.70	1	x	x	–0.48	0.00	0.64	0.14	D
Norway	–1.72	1	–64.97	x	–0.49	0.00	0.58	0.18	D
Norway	–2.47	1	x	–0.95	–0.80	0.00	0.99	0.08	D
Second sub-period 1.09.2020–28.02.2021									
Austria	3.64	1	x	x	–0.18	0.03	–0.11	0.10	D
Croatia	20.99	1	x	x	0.23	0.02	–2.35	0.02	SI
Switzerland	0.37	1	x	x	–0.02	0.15	–0.09	0.00	SI
Cyprus	–1.83	1	25.46	x	–0.83	0.00	–0.85	0.36	D
Denmark	–1.85	1	–88.46	x	–0.58	0.00	–0.31	0.41	D

Country	α_{si}	α_{nCOV}	const	trend	γ_1	p-val	γ_2	p-val	leading
Norway	−0.66	1	−111.67	x	−0.70	0.00	−0.38	0.57	D
Poland	1.09	1	−349.42	x	−0.04	0.17	−0.21	0.00	SI
Slovenia	−5.95	1	166.24	x	−1.73	0.00	−1.16	0.49	D
Cyprus	−3.70	1	x	3.38	−1.56	0.00	0.01	1.00	D
Czechia	−6.35	1	x	5.89	−3.57	0.00	−3.59	0.30	D
Denmark	−1.96	1	x	−0.12	−0.78	0.01	−1.49	0.07	D
Iceland	6.99	1	x	3.99	−0.38	0.01	0.42	0.74	D
Portugal	−1.60	1	x	−8.91	−0.55	0.00	0.50	0.51	D
Serbia	−155.30	1	x	26.46	−0.80	0.14	−45.33	0.03	SI
Slovenia	−4.26	1	x	−19.04	−0.34	0.01	−0.15	0.70	D

Note: In the last column D denotes that the mortality preceded the changes in SI, while SI means that the changes in restrictions preceded the mortality
Source: own calculations.



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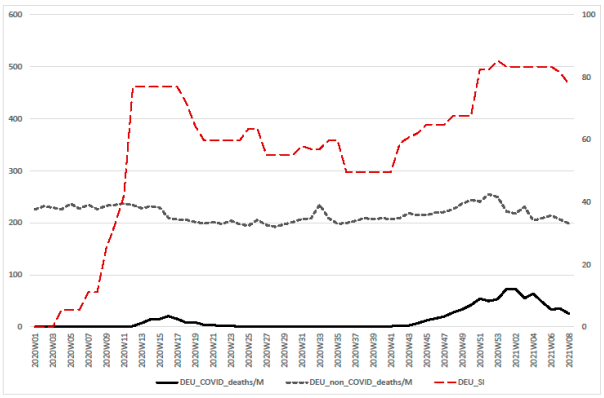

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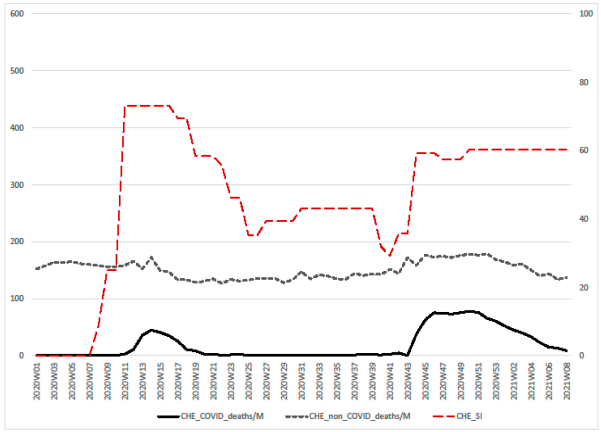

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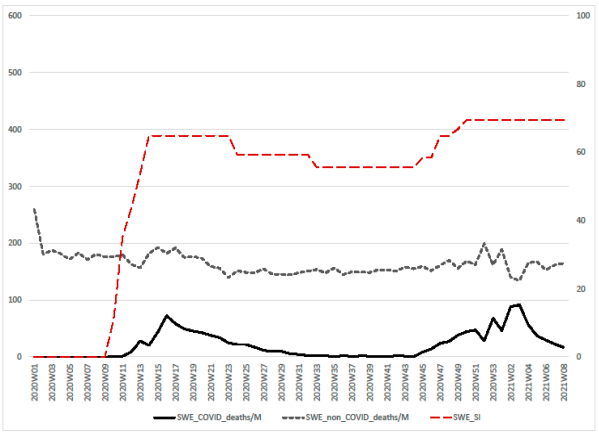

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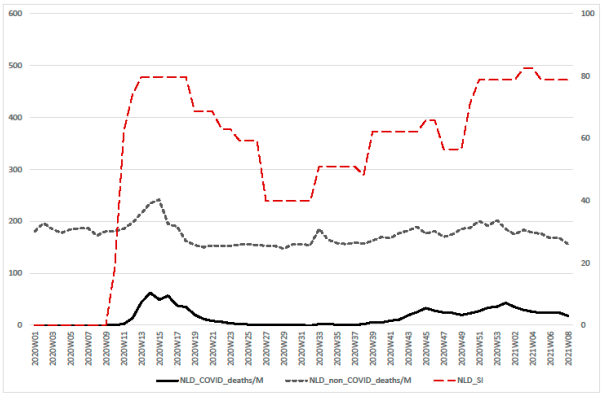

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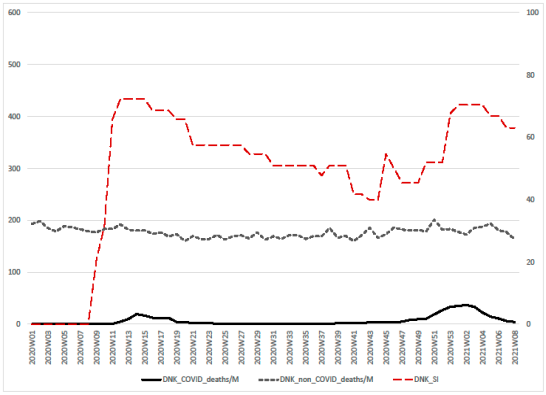

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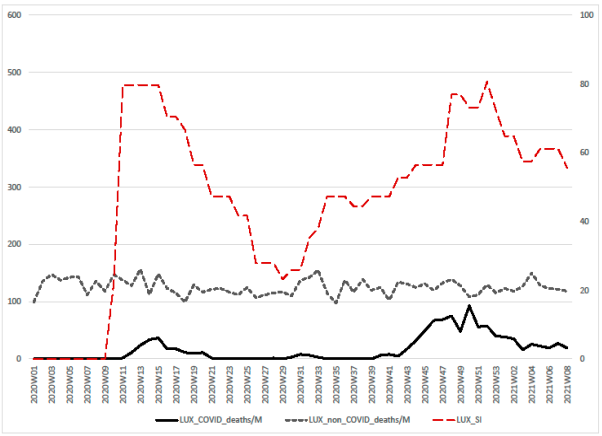

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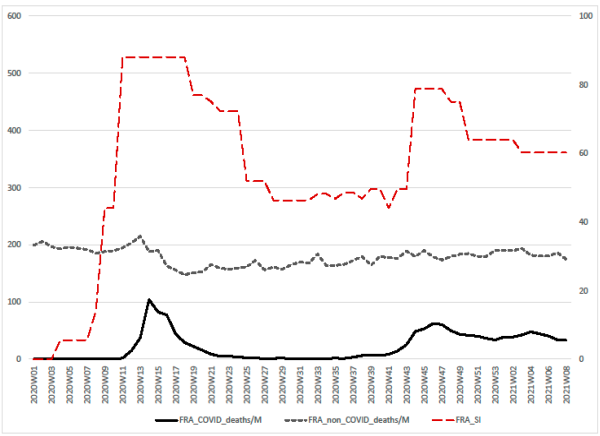

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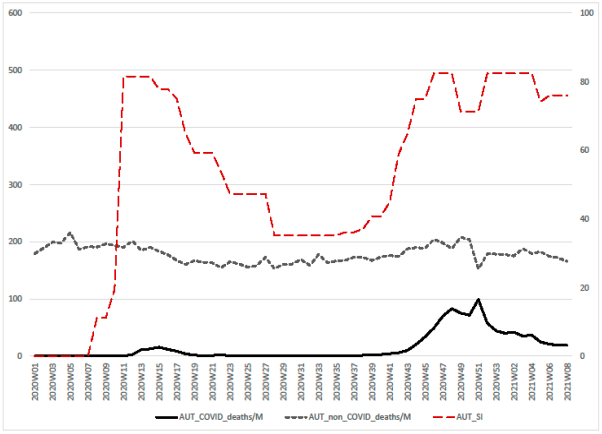

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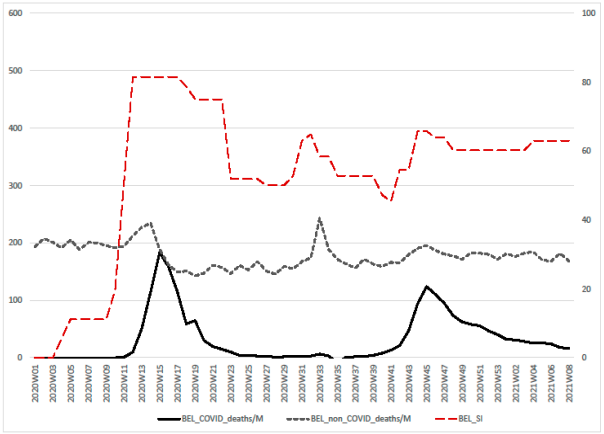

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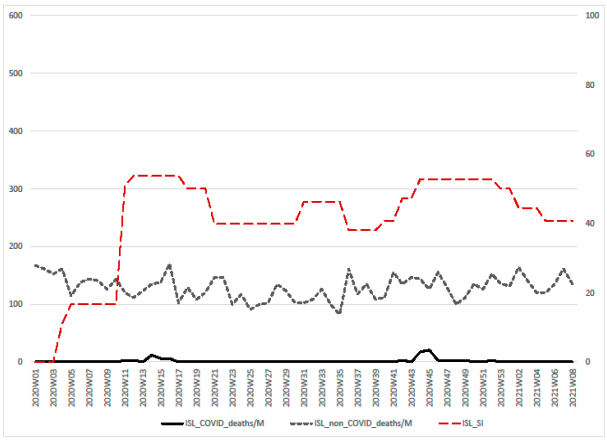

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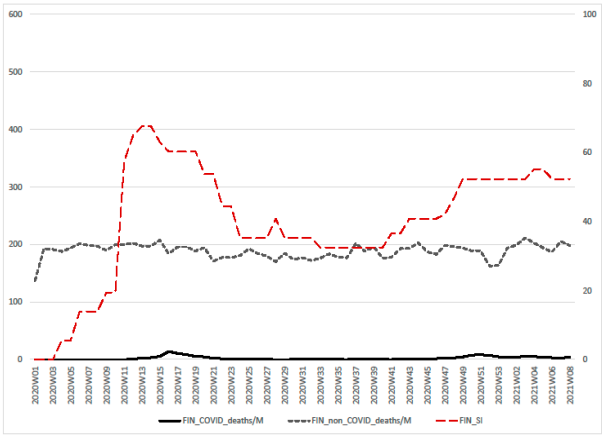

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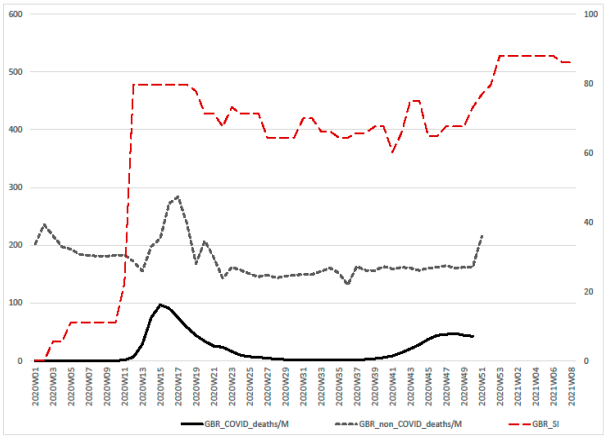

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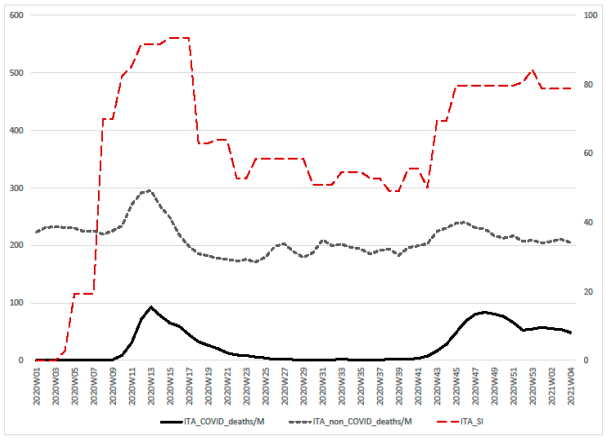

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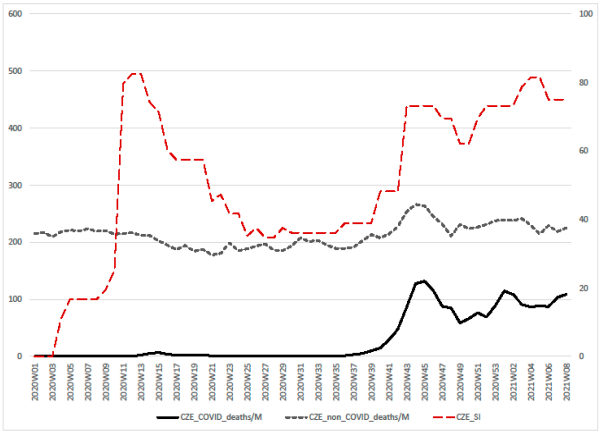

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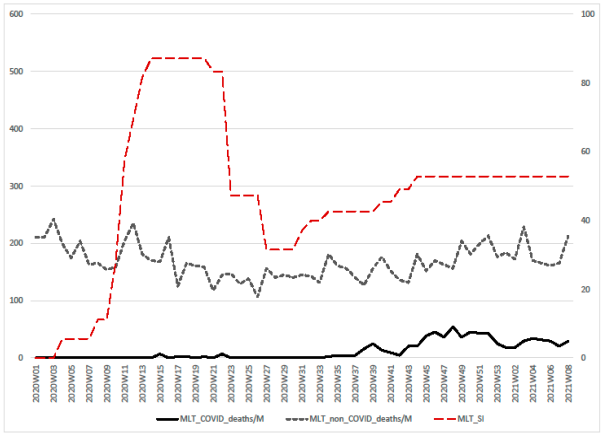

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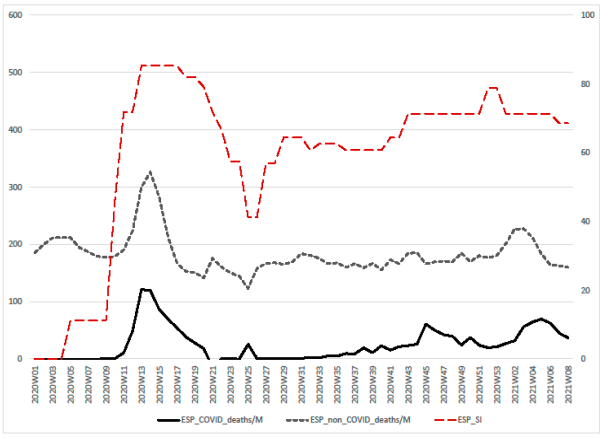

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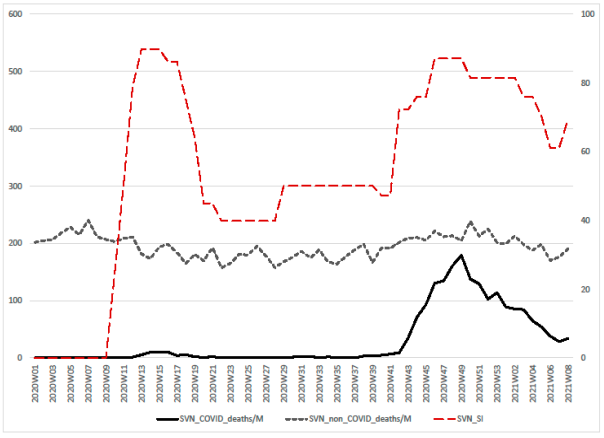

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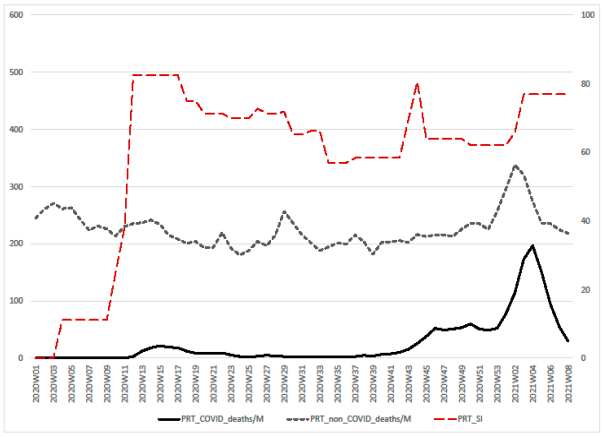

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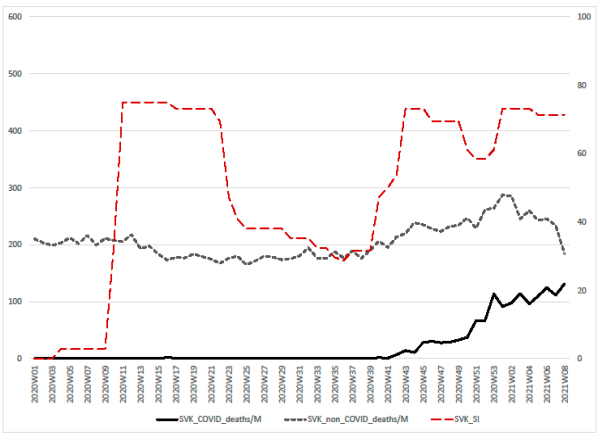

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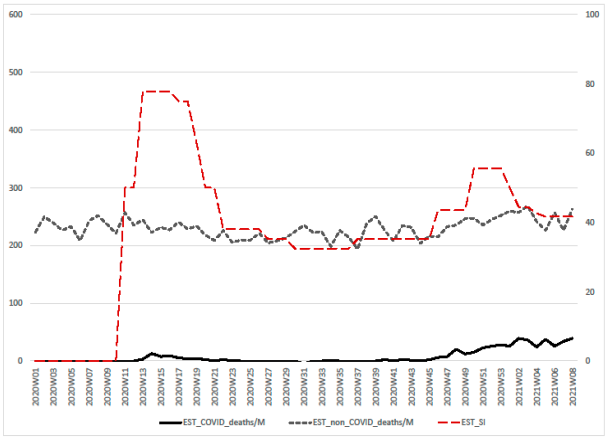

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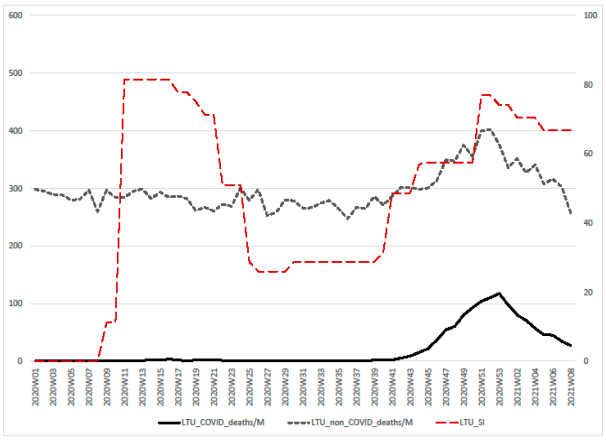

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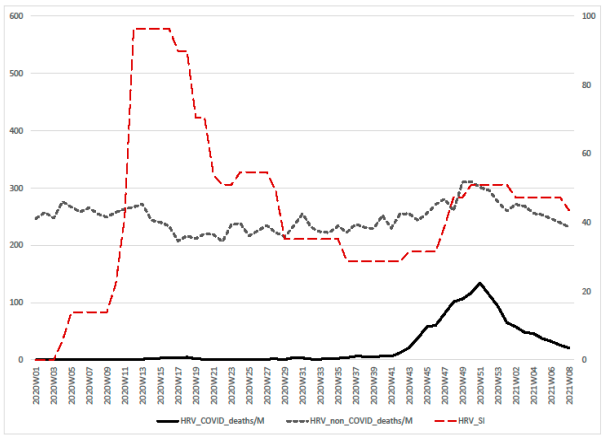

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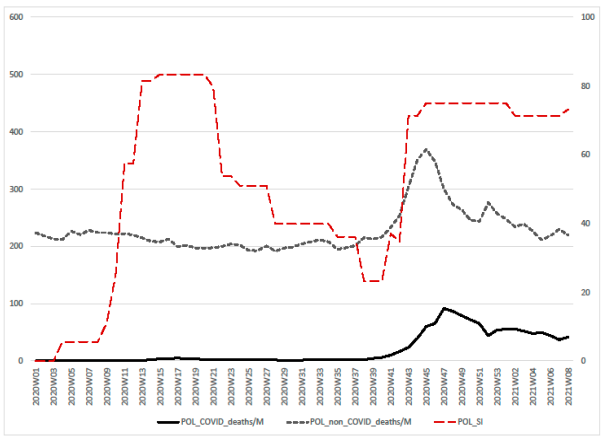

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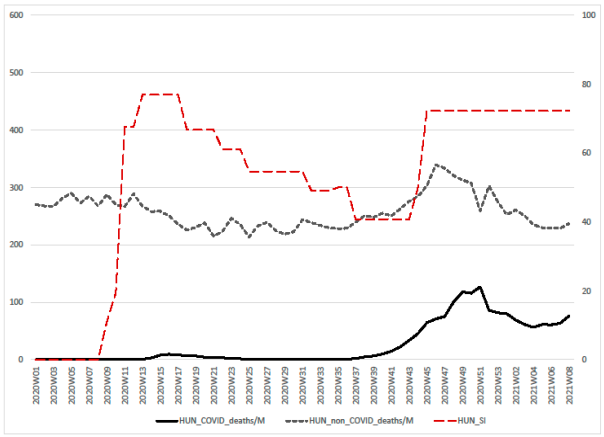

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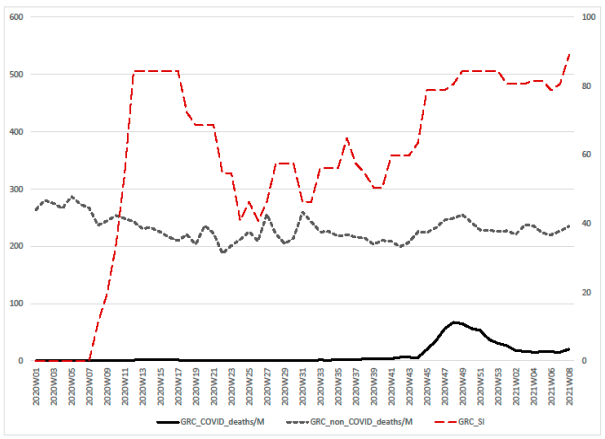

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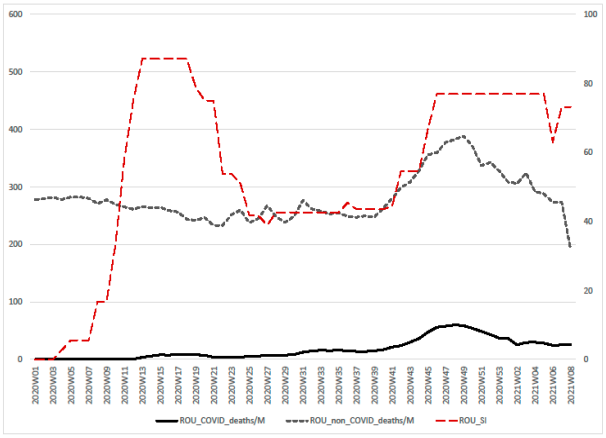
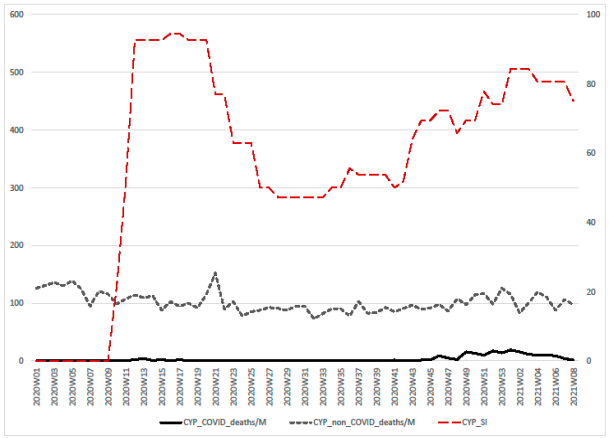


Romania



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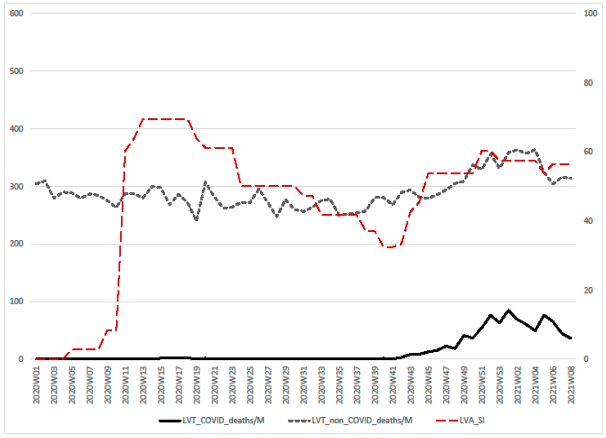
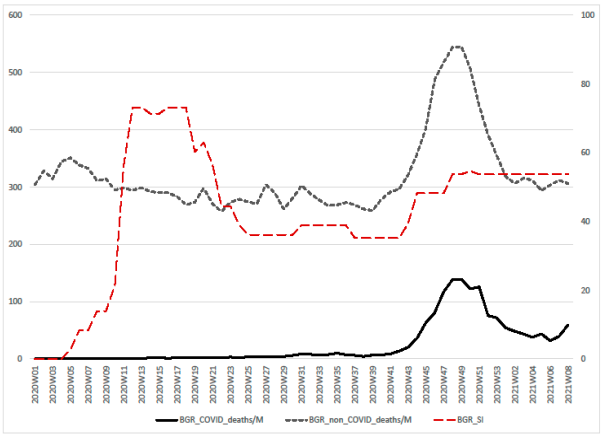


Latvia



Bulgaria

Figure 1. Stringency index (dashed red lines, auxiliary axis) versus COVID deaths per million (solid black line, the main axis) and non-COVID deaths per million (dotted gray line, the main axis) in countries sorted by the average compulsory health spending per capita during 2016–2019 (data in Table 1)

Source: oxCGRT – Eurostat 2021b; Hale et al. 2021; OECD 2022 database.

In the second subperiod, the trend was still upward in Portugal, Slovenia, and Denmark, but downward in Cyprus, Czechia, Serbia, and Iceland, although the relationship with SI was still positive there (except in Iceland). Concerning the relationships with a constant – the latter was positive in Poland, Norway, and Denmark, but negative in Slovenia and Cyprus. In all those cases, apart from Poland, the relationship with SI was positive, i.e. the growth in mortality led the increase in SI. Only in Poland did the growth in SI lead to a decrease in the non-COVID mortality rate. The most striking difference is that the average week-by-week change of non-COVID mortality in Poland was the highest among all the countries, equalling 394 deaths per 1000 inhabitants, while each increase in SI contributed to the decrease of this rate by 1 person per million inhabitants.

The resulting relationship can be interpreted as follows: if the government imposed no restrictions, the non-COVD mortality would increase week by week by 394 per million citizens. This suggests that either some COVID deaths were incorrectly classified as non-COVID deaths or that the non-COVID mortality increased during the pandemic due to the general panic and closure of healthcare facilities. One can formulate similar conclusions for Serbia, where the growth of SI by 1 point contributed to an increase in non-COVID mortality by 155 per million, and the overall trend of non-COVID deaths was downward sloping. However, in the prevailing cases, the increase in non-COVID mortality seemed to enhance the government to increase the general restrictions. A negative relationship was also observed in Switzerland and Croatia.

The restrictions should not affect non-COVID mortality. Therefore, when the relationship is negative, we can conclude that some of the deaths may have been incorrectly classified as COVID ones, and, consequently, we observed a decrease in non-COVID mortality. Another possible explanation is that the stay-at-home restrictions led to a reduction in other deaths, e.g. from car accidents or other infectious diseases. On the other hand, when the relationship is positive, one can conclude that the restrictions were too severe and led to excess mortality.

Links between health spending, COVID, and non-COVID deaths

In the following subsection, we focus on the possible linkages between the COVID and non-COVID fatalities and the condition of the healthcare system, measured by compulsory government expenditure on health protection (Government/Compulsory Health spending per capita in USD, the annual average 2016–2019). The data come from the OECD (2022) database.

Figure 1 is a set of graphs showing the weekly deaths in countries normalised for population size (deaths per million population): deaths because of COVID–19 and deaths because of other causes and the weekly SI. The countries were sorted by the average healthcare spending per capita.

We can see some links between government spending on health and the trajectory of non-COVID deaths. In countries where the expenditure on health is the highest (e.g. Norway, Denmark, Finland), there are no significant changes in the trajectory of non-COVID deaths. However, one or two waves of COVID deaths are clearly visible. It is also related to the age structure of the population and the relatively high life expectancy. The age structure was crucial for mortality, especially in the first phase of the pandemic (Sornette et al. 2020).

Belgium draws our attention with a significant increase in non-COVID deaths between weeks 32 and 34 (August) of 2020 – a consequence of the heatwave (Sciensano 2021). A large number of non-COVID and COVID deaths in the United Kingdom at the beginning of the pandemic can be explained by two phenomena. The number of deaths directly related to COVID–19 was underestimated (Kontopantelis et al. 2021), and the National Health Service was unable to cover the patients who needed it. During the first wave of the Covid–19 pandemic, only a third of people in the UK were able to obtain the hospital care they needed (Davillas and Jones 2021).

The first two countries in Europe caught by the pandemic (Italy and Spain) saw a significant increase in non-COVID deaths during the first weeks of the pandemic, ac-

companied by a wave of COVID deaths. It may stem from the fact that neither the data reporting system was perfect, nor were the healthcare systems able to properly care for all those in need. In Czechia and Slovenia, there was an increase in COVID deaths during the second wave of the pandemic (autumn, 2020). In Czechia, it co-occurred with the increase in non-COVID deaths.

There was a particularly high rise in non-COVID deaths (as well as COVID-related ones) during the second wave of the pandemic in countries where the expenditure on healthcare is low. The situation was particularly alarming in the autumn of 2020 in Bulgaria, Lithuania, Romania, Latvia, and Poland, where the average number of non-COVID deaths per million inhabitants was the highest. For most countries with low health expenditure (except for Estonia, Cyprus, and Greece), the number of non-COVID deaths grew by half, doubled, or even more during the second wave of the pandemic (autumn 2020) (see Table 1).

Discussion and conclusions

The paper presented the results of the analysis of the relationships between COVID and non-COVID mortality and the stringency index during the first year of the COVID–19 pandemic to better understand the consequences of the efforts taken by governments during that tough time. We demonstrated that, most often, if there was a relationship between the SI and COVID mortality (research question 1) or non-COVID mortality (research question 2), it was usually positive and mortality driven. That indicates that the governments responded to the COVID pandemic and adjusted the SI accordingly; however, the mortality hardly ever responded to the restrictions. No relationships, or negative ones, were found in countries where the spending on healthcare was high, i.e. Northern and Western European countries. Especially troubling are the observed weekly non-COVID death changes during the second sub-period of the first year of the pandemic. They are the most alarming for the CEE countries, where government healthcare expenditures per capita are low. The only exception is Czechia (see Table 1), where spending exceeded that of Spain and Portugal.

Almost all CEE economies came through the first subperiod of the pandemic reasonably well (in Romania and Slovakia, the changes in SI preceded the changes in non-COVID mortality, while in Latvia and Slovakia, the lowest maximal weekly changes in COVID deaths occurred in the first subperiod). However, these countries were badly affected during the second autumn subperiod. The maximum weekly change in COVID deaths (per million) in that period ranged from 39.20 (Estonia) to 169.80 (Slovenia), and in 7 of the 12 CEE countries, the maximum exceeded 100 per million citizens. What is equally worrying is that countries in this group noted very high increases in non-COVID deaths during the second subperiod, with maxi-

mum weekly increases ranging from 238.58 (Slovenia) to 544.73 (Bulgaria). Thus, even if the countries succeeded in reducing COVID-related mortality, they failed to mitigate the non-COVID deaths. It might indicate that all the resources in the under-financed health sector were switched to fighting COVID, leaving very little for other illnesses.

It is, therefore, hard to deny that there is a link between the evolution of the pandemic and healthcare expenditures. We are aware that we cannot speak of causality here but co-occurrence. Moreover, the lack of a long-run relationship may be a consequence of the stationarity of some series or their non-standard properties, such as fractional integration. Thus, COVID mortality and SI may have been interconnected in more complex ways, which we have not discovered in our study.

The main conclusion from our research is that the countries where government spending on health (*per capita*) is relatively low should make every effort to minimise disparities in allocating resources for treating various diseases.

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Umieralność i wydatki na ochronę zdrowia w pierwszym roku pandemii COVID–19. Porównanie krajów Europy Środkowej, Wschodniej i Zachodniej

W artykule przedstawiono zależności między liczbą zgonów zakwalifikowanych jako zgony z powodu COVID–19 oraz liczbą zgonów z innych przyczyn w pierwszym roku pandemii, w zestawieniu z surowością wprowadzonych ograniczeń i obowiązkowymi wydatkami na opiekę zdrowotną w większości krajów europejskich. Analizujemy dane tygodniowe i stosujemy modele kointegracyjne. Z uwagi na intensywność zachorowań w badanych krajach, dzielimy okres na dwie podpróby: marzec – sierpień 2020 oraz wrzesień 2020 – luty 2021. Stwierdzamy, że najczęściej, jeśli występowała zależność między SI a umieralnością z powodu COVID lub nie-COVID, to była ona dodatnia, a zmienną wiodącą była umieralność. Sugeruje to, że chociaż rządy dostosowały ograniczenia do rosnącej liczby zgonów, nie były w stanie opanować pandemii. Brak zależności lub zależności ujemne najczęściej występowały w tych krajach, w których wydatki na opiekę zdrowotną były najwyższe (czyli w krajach Europy Północnej i Zachodniej). Największe tygodniowe zmiany liczby zgonów niezwiązanych z COVID w drugim podokresie obserwowano w krajach Europy Środkowej i Wschodniej, gdzie wydatki rządowe na opiekę zdrowotną per capita są najniższe.

Słowa kluczowe: umieralność z powodu COVID, Stringency Index, umieralność z przyczyn innych niż COVID, test Johansena, kointegracja, wydatki na opiekę zdrowotną

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The Impact of COVID–19 on the Level and Structure of Employment in European Union Countries

Małgorzata Markowska https://orcid.org/0000-0003-4879-0112
Associate Professor, Wrocław University of Economics and Business, Wrocław, Poland
e-mail: malgorzata.markowska@ue.wroc.pl

Andrzej Sokołowski https://orcid.org/0000-0002-2787-6665
Professor, Collegium Humanum – Warsaw Management University, Poland
e-mail: andrzej.sokolowski@humanum.pl

Abstract

The paper proposes methods that can be used to evaluate the changes in one year of any measurable phenomenon based on how it performed in previous years. The following economic sections are considered: Agriculture, forestry and fishing/Industry/Construction/Wholesale and retail trade, transport, accommodation and food services/Information and communication/Financial and insurance activities/Real estate activities/Professional, scientific and technical activities, including administrative and support services/Public administration, defence, education, human health and social work/Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies. The paper proposes a new method – called The Triple 2 Rule – to identify changes in employment time series. Trends and autoregressive models are estimated for the period 2008–2019, and 2020 forecasts are calculated. The difference between the forecasted and observed values for 2020 is treated as a measure of the impact of COVID–19. Dynamic cluster analysis based on 2008–2020 data is the second approach. The characteristics and changes in the composition of dynamic clusters give a picture of the impact of 2020. These changes can be considered to have been caused – at least partially – by the COVID–19 pandemic.

Keywords: employment, COVID–19, European Union countries, dynamic cluster analysis, triple 2 rule

JEL: C38, E24, F16, O52

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Introduction

The paper proposes methods that can be used to evaluate the changes in one year of any measurable phenomenon based on how it performed in previous years. These methods are used to identify important deviations seen in 2020 from tendencies observed in employment in European Union (EU) countries. 2020 was the year of the COVID–19 pandemic, followed by restrictions, including lockdowns, as well as some helpful measures offered by governments to the economy. The paper proposes a new method – called The Triple 2 Rule – to identify changes in employment time series. We have tried to identify important changes in employment rates in EU countries, i.e. to point out particular countries, answering the question "where?" The answer to "why?" is much more difficult and needs a deeper, country-specific investigation.

Literature review

The COVID–19 pandemic covered the whole world and every aspect of social life. The first wave of the 2020 pandemic impacted not only demographics with rising mortality rates, but also health services, where hospitals and other units were on the brink of collapse. Lockdowns were the means to stop quick transmission of the virus. Online work was widely introduced, and schools and kindergartens were closed, as were some branches of the economy. Generally, enterprises should be prepared to function in a turbulent environment, but this time, the perturbations went far beyond what anyone had expected just a few months before.

Different effects of the pandemic on the economy have been studied in the literature, such as supply chains breaking up (Maital and Barzani 2020), changes in foreign trade (Cardoso and Malloy 2021), and the collapse of tourism due to border closures and other limitations (Rami and Wahba 2021). The influence on the labour market has been discussed for countries with different economies, cultures and sizes, e.g., Canada (Beland, Fakorede, and Mikola 2020; Qian and Fuller 2020; Lamb, Gomez, and Moghaddas 2021), the USA (Lambert 2020; Rojas et al. 2020), Bangladesh (Hossain 2021), Romania (Radulescu et al. 2021), Turkey (Yüksel 2021), the UK (Mayhew and Anand 2020), Vietnam (Le et al. 2021), Australia (Borland 2020a, 2020b; Lim et al. 2021; Lloyd and Dixon 2021; Walkowiak 2021), Spain (Rodríguez-López, Rubio-Valdehita, and Díaz-Ramiro 2021; Rubio-Valdehita, Rodríguez-López, and Marín 2021), Cameroon (Biwolé 2022), India (Roychowdhury, Bose, and De Roy 2022), Poland (Rosak-Szyrocka 2021), and Japan (Fukai, Ichimura, and Kawata, 2021).

The analysis of the effects of the pandemic on the labour market also took place for economic spaces bigger than just one country, e.g., Europe (Lewandowski 2020; Chi-Wei et al. 2021) and Central America (Webster, Khorana, and Pastore 2022), and the whole

world (ILO 2020; OECD 2020). Several aspects were discussed, such as the labour market crisis (junk contracts) (Koebel and Pohler 2020), self-employment (Beland, Fakorede, and Mikola 2020), the employment gap in parents with small children (Qian and Fuller 2020, Fuller and Qian 2021), new forms of parenthood leave (Doucet, Mathieu, and McKay 2020), the employment of youngsters (Svabova and Gabrikova 2021), the mutual effect of labour market development and the progression of the COVID–19 pandemic (Shishkina, Mamistova, and Sabetova 2021), and unemployment (Lambert 2020; Kalkavan et al. 2021; Chi-Wei et al. 2021).

A sectorial approach was also important, e.g., fashion retailing (Rodríguez-López, Rubio-Valdehita, and Díaz-Ramiro 2021), the retail sector (Rubio-Valdehita, Rodríguez-López, and Marín 2021), industries (Slade 2022), and construction and industry (Radzi, Rahman, and Almutairi 2022). Methods used included predictions using time-series mining (Rakha et al. 2021), modelling (Radzi, Rahman, and Almutairi 2022) and surveys (Rubio-Valdehita, Rodríguez-López, and Marín 2021).

Data

The data were taken from the Eurostat webpage [lfst_r_lfe2en2] (Eurostat n.d.) or the period 2008–2020. The number of people employed is given as a total, and separately for males and females. The economy is divided into the following sections (numbers given in brackets are used in the tables and text of the paper):

- Agriculture, forestry and fishing (1),
- Industry (2),
- Construction (3),
- Wholesale and retail trade, transport, accommodation and food services (4),
- Information and communication (5),
- Financial and insurance activities (6),
- Real estate activities (7),
- Professional, scientific and technical activities, administrative and support services (8),
- Public administration, defence, education, human health and social work (9),
- Arts, entertainment and recreation, other service activities, activities of household and extra-territorial organisations and bodies (10).

Methods

There are two main approaches used in this paper. The first compares predictions for 2020, calculated from the time series models estimated for 2008–2019, with the actual values observed in 2020.

Method 1

The general assumption is that if there was no extra external influence (such as COVID–19 with all restrictions on the economy it imposed), then the observed values in 2020 should follow the pattern observed in 2008–2019. If there is an important deviation from this pattern, we can assume that an "intervention" (using the language of time series analysis) happened. Following the graphical analysis of the time series, we assume that quadratic trend plus first-order autoregression of residuals and classical autoregression (of the process) of order 2, estimated for 2008–2019, are the models to be used to predict the situation in 2020. Finally, three indexes are used:

$$I_1 = \frac{100 * \left(y_{2020} - y_{2019}\right)}{y_{2019}}.$$

I_1 is a simple dynamic measure, and y_t are observed values of the number of people employed in a given section (or totals) per 100 eligible population, 15–64 years old.

$$I_2 = \frac{y_{2020} - \hat{y}^{(1)}_{2000}}{S^{(1)}_{\varepsilon}},$$

where $\hat{y}^{(1)}_t = \widehat{f(t)} + b_3\varepsilon_{t-1}$

$$\widehat{f(t)} = b_0 + b_1 t + b_2 t^2$$

$$\varepsilon_{t-1} = y_{t-1} - \widehat{f(t-1)}$$

$$S^{(1)}_{\varepsilon} = \sqrt{\frac{\sum_{t=1}^{n}\left(y_t - \hat{y}^{(1)}_t\right)^2}{n-w}}$$

I_2 is the standardised difference between trend model f(t) with autoregression of residuals and real value observed in 2020. The standard error of estimation S_ε is a standardisation factor. Estimates b_0, b_1, b_2, and b_3 are obtained by the OLS (Ordinary Least Squares) method based on data from 2008–2019 (n = 12). The number of parameters in the main model is w = 4.

$$I_3 = \frac{y_{2020} - \hat{y}^{(2)}_{2000}}{S^{(2)}_{\varepsilon}},$$

where: $\hat{y}_t^{(2)} = a_0 + a_1 y_{t-1} + a_2 y_{t-2}$

$$S_\varepsilon^{(2)} = \sqrt{\frac{\sum_{t=1}^{n}\left(y_t - \hat{y}_t^{(2)}\right)^2}{n-w}}$$

The model used in I_3 is a classical autoregression (CAR) of the process of order 2, with three parameters (w = 3).

In order to identify important changes in employment imposed by the intervention, we propose the *Triple 2 Rule*. The first of these *Triple 2's* is used for the three indexes proposed above. They indicate important change if the absolute value is bigger than 2. This choice for I_1 is subjective, but for I_2 and I_3, it suggests statistical significance at a 0.05 significance level. The second *2* means that the change is considered important if at least 2 of the three indexes (I's) indicate an important change. Finally, we calculate the geometric average of the modules of the three I's if at least two of them indicate importance, assigning a minus if all I's are negative. In the case of different signs of I's, we take the median instead of the geometric average. The absolute value of this mean should be at least 2 to allow for further interpretation.

For countries characterised by these adjusted (by minuses if necessary) geometric means or medians, we applied Ward's agglomerative cluster analysis method (Ward 1963) to find homogeneous groups of countries where changes in employment sections were similar in 2020. The classification task is [Y, Zt] (Sokołowski 1982; Markowska 2012), where Y (objects) – 27 EU countries, Z (variables) – 10 sections of the economy, t (time) – 2020.

Method 2

Dynamic cluster analysis is the second approach used in the paper. The clustering task is [YT, Z], where Y – 27 countries, T – 13 years (2008–2020), YT – 27x13 = 351 spatio-temporal "objects", Z – 10 sections of the economy.

In the results section, we will look for the countries which changed the cluster they were assigned to between 2019 and 2020.

Results – changes in the total employment rate

The application of Method 1 is illustrated in Figure 1. The EU employment rate per 100 eligible population is in blue. The parabolic trend plus first-order autoregression of residuals is shown in green, while the classical autoregression of second-order is in red. The real value in 2020 is represented by the blue square.

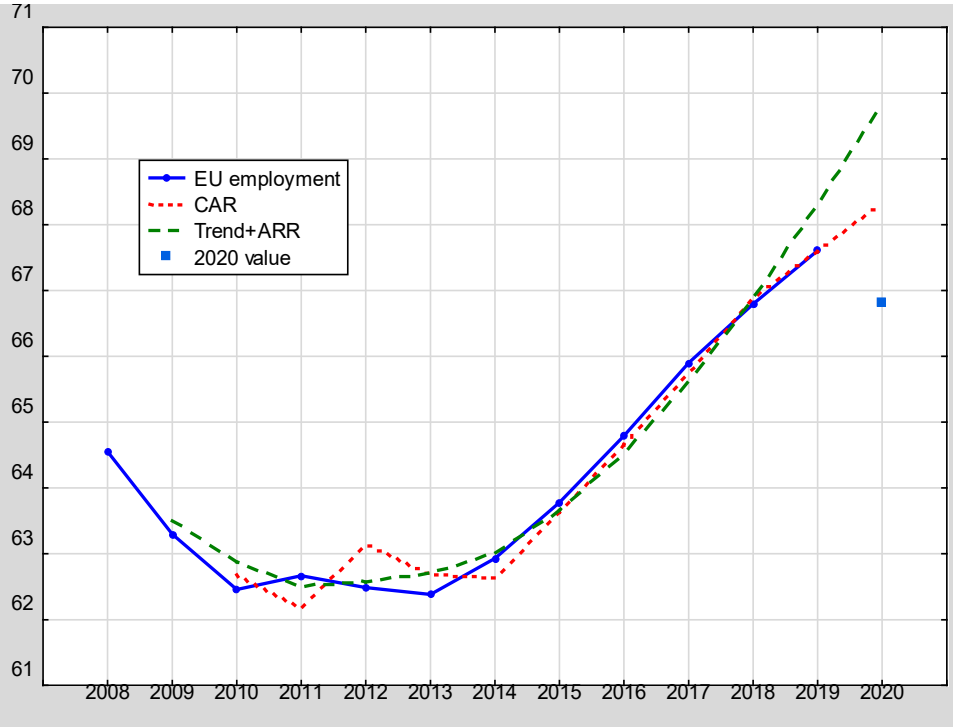

Figure 1. Employment rate in the EU

Source: own calculations.

For this case, we have the following numerical results:

$$I_1 = \frac{66.81 - 67.61}{67.61} = -1.18$$

$$\hat{y}_t^{(1)} = 65.06 - 1.05t + 0.11t^2 + 0.23\varepsilon_{t-1}$$

$$S_\varepsilon^{(1)} = 0.91$$

$$I_2 = -3.18$$

$$\hat{y}_t^{(2)} = 2.79 + 1.68y_{t-1} - 0.72y_{t-2}$$

$$S_\varepsilon^{(2)} = 0.37$$

$$I_3 = -4.04$$

Table 1 presents results for total employment.

Table 1. Predictions vs actual values in 2020 – total employment

Country	I_1 Dynamics: 2020/2019	Difference: Adjusted Trend-Actual	I_2 Standardised difference: Adjusted Trend-Actual	Difference: CAR-Actual	I_3 Standardised difference: CAR-Actual
EU	– 1.18	– 2.89	– 3.18	– 1.50	– 4.04
Belgium	– 0.97	– 1.50	– 2.02	– 2.12	– 3.67
Bulgaria	– 2.34	– 5.85	– 2.88	– 3.36	– 2.01
Czechia	– 0.98	– 3.65	– 2.72	– 0.61	– 2.24
Denmark	– 0.98	– 3.01	– 2.57	– 1.55	– 4.05
Germany	– 0.89	– 1.06	– 0.95	– 0.99	– 1.11
Estonia	– 2.01	– 5.20	– 2.02	– 1.56	– 0.95
Ireland	– 2.67	– 6.70	– 3.11	– 2.44	– 5.19
Greece	– 0.88	– 4.53	– 1.64	– 0.70	– 0.96
Spain	– 4.01	– 7.34	– 3.43	– 3.12	– 2.64
France	– 0.40	– 1.18	– 2.85	– 0.62	– 2.65
Croatia	– 0.19	– 4.33	– 2.02	– 0.08	– 0.07
Italy	– 1.54	– 2.04	– 2.46	– 1.37	– 2.23
Cyprus	– 0.87	– 4.07	– 1.54	– 0.68	– 0.43
Latvia	– 0.88	– 4.68	– 1.74	– 0.95	– 1.08
Lithuania	– 1.77	– 5.38	– 2.41	– 1.73	– 1.47
Luxembourg	– 0.98	– 0.73	– 0.61	– 1.15	– 1.39
Hungary	– 0.51	– 4.15	– 2.00	– 1.03	– 1.15
Malta	– 2.14	– 5.18	– 2.07	– 3.15	– 4.85
Netherlands	– 0.63	– 1.98	– 2.16	– 0.95	– 1.50
Austria	– 1.53	– 1.40	– 3.37	– 1.56	– 4.97
Poland	0.73	– 1.77	– 1.77	– 0.05	– 0.06
Portugal	– 1.96	– 5.97	– 2.95	– 1.05	– 0.88
Romania	– 0.52	– 3.17	– 2.25	0.20	0.13
Slovenia	– 0.66	– 5.09	– 2.80	0.04	0.03
Slovakia	– 1.31	– 4.32	– 2.94	– 1.32	– 2.74
Finland	– 1.25	– 2.30	– 2.02	– 1.52	– 2.02
Sweden	– 2.34	– 3.53	– 3.80	– 1.85	– 3.87

Source: own calculations.

Blue shading indicates important ($I_j < -2$) negative deviations of the values from the prediction (I_2 and I_3), or dynamics lower by at least 2% (I_1). Green indicates growth bigger than expected ($I_j > 2$).

For total employment, all three indices were smaller than –2 in five countries: Bulgaria, Ireland, Spain, Malta, and Sweden. Only I_2 and I_3 are smaller than –2 in Belgium, Czechia, Denmark, France, Italy, Austria, Slovakia, and Finland.

Results – changes in employment rate in sections

The EU economies reacted differently to the perturbations connected with supply chain breaks. In some cases, production had to stop in selected enterprises, in part due to COVID–19 cases among workers. The hotel and restaurant section was generally closed. Schools and universities changed their means of instruction to online education.

Table 2 presents the final identification of important changes in the labour market as pointed out by the indexes and the Triple 2 Rule. The numbers in brackets are the medians used instead of the geometric averages when not all I_j's have the same sign. As expected, Wholesale and retail trade, transport, accommodation and food services was the section hurt most by the pandemic. Information and communication and Finance and insurance activities covered more employers than expected.

Germany was a very interesting case – with strong changes in sections, but the overall result in total employment was not important.

There were different effects of the COVID–19 pandemic on employment in various sections of the economy. According to the Triple 2 Rule, there were important changes in the following countries:

- Agriculture, forestry and fishing: Czechia (–), Greece (–), Spain (–), Austria (+), Poland (+),
- Industry: Czechia (–), Greece (–), Spain (–), France (–), Hungary (–), Germany (+),
- Construction: Germany (–), Ireland (–), Lithuania (–), Malta (–), Sweden (–), Austria (–), Finland (–), Czechia (+), Croatia (+), Slovenia (+),
- Wholesale and retail trade, transport, accommodation and food services: all countries suffered a negative change except Denmark, Greece, France, Croatia, Luxembourg and Romania,
- Information and communication: Bulgaria (–), Germany (+), Cyprus (+), Latvia (+), Slovenia (+), Slovakia (+),

- Financial and insurance activities: Bulgaria (–), Estonia (–), Denmark (+), Germany (+), Ireland (+), France (+), Lithuania (+), Malta (+), Austria (+), Slovenia (+), Finland (+),
- Real estate activities: Lithuania (–), Poland (–), Portugal (–), Germany (+), Ireland (+), Luxembourg (+), Hungary (+), Austria (+), Finland (+),
- Professional, scientific and technical activities, administrative and support services: Germany (–), Ireland (–), Spain (–), Italy (–), Slovakia (–),
- Public administration, defence, education, human health and social work: Malta (–), Sweden (–),
- Arts, entertainment and recreation, other service activities, activities of household and extra-territorial organisations and bodies: Czechia (–), Ireland (–), Spain (–), Croatia (–), Italy (–), Slovakia (–), Finland (–), Sweden (–), Germany (+).

Table 2. Final evaluation of the 2020 intervention on the labour market

Country	Total	Section									
		1	2	3	4	5	6	7	8	9	10
EU	– 2.47			– 3.67	– 6.18		+4.23	+4.71	– 4.69		
Belgium	– 1.93				– 5.29						
Bulgaria	– 2.38	– 1.42			– 4.15	– 2.14	– 2.63				
Czechia	– 1.82	– 2.29	– 2.41	+2.22	– 4.17						– 3.51
Denmark	– 2.16				– 1.93		+2.91				
Germany			+3.48	– 12.91	– 7.20	+9.23	+4.56	+14.95	– 8.18		+6.38
Estonia	– 1.57	– 1.09			– 4.20		(–2.35)				
Ireland	– 3.51			– 3.78	– 5.87		+3.97	+5.91	– 3.39		– 7.72
Greece		– 4.38	– 2.10								
Spain	– 3.31	– 3.00	– 2.36		– 5.58				– 2.77		– 6.31
France	– 1.44		– 2.40				+2.71				
Croatia				+2.63							– 2.73
Italy	– 2.04				– 3.58				– 2.74		– 2.56
Cyprus					– 3.78	(+2.28)					
Latvia					– 2.41	+3.43					
Lithuania				– 2.12	– 3.38		+9.13	– 3.68			
Luxembourg					+2.95			+4.05			
Hungary			– 2.30		– 3.15			+4.42			
Malta	– 2.78			– 6.50	– 3.48		+6.44			– 2.62	

Country	Total	Section									
		1	2	3	4	5	6	7	8	9	10
Netherlands			– 1.75		– 4.67						
Austria	– 2.95	+2.91		(–2.17)	– 3.59		+2.64	+4.04			
Poland		+2.82			– 2.11			– 3.54			(+2.14)
Portugal					– 3.80			– 5.25			
Romania			– 1.38								– 1.94
Slovenia				(+2.35)	– 3.88	+3.41	+2.86				
Slovakia	– 2.19				– 2.62	+6.30			– 2.71		– 2.93
Finland	– 1.72			(–2.41)	– 5.53			+2.98			– 2.92
Sweden	– 3.25			– 2.82	– 5.82		+4.70			– 3.13	– 4.16

Source: own calculations.

The Triple 2 Rule allows us to identify important changes. Not all were negative (–); in some sections and countries, they were positive. The weakest impact was in the Public administration (and other branches) section.

Results – classification of EU countries based on 2020 employment changes indicators

Full data on averages or medians for the economy section is given in Table 3. It was used as an input for cluster analysis to group countries.

Table 3. Averages or medians for the 2020 change in employment

Country	Section									
	1	2	3	4	5	6	7	8	9	10
EU	0.50	– 0.84	– 3.67	– 6.18	2.18	4.23	4.71	– 4.69	– 0.42	– 1.43
Belgium	– 0.84	– 0.85	– 2.15	– 5.29	2.25	2.22	– 0.10	– 1.30	1.33	0.13
Bulgaria	– 1.42	– 1.75	0.46	– 4.15	– 2.14	– 2.63	– 1.67	– 1.41	– 0.08	– 0.42
Czechia	– 2.29	– 2.41	2.22	– 4.17	0.99	– 0.66	0.07	– 0.41	0.54	– 3.51
Denmark	– 1.94	0.38	1.20	– 1.93	– 0.39	2.91	– 1.28	– 2.14	0.99	– 1.58
Germany	0.32	3.48	– 12.91	– 7.20	9.23	4.56	14.95	– 8.18	1.11	6.38
Estonia	– 1.09	– 1.18	1.29	– 4.20	– 2.11	– 2.35	– 0.34	– 0.21	1.03	0.43
Ireland	– 0.49	0.32	– 3.78	– 5.87	1.30	3.97	5.91	– 3.39	– 0.68	– 7.72
Greece	– 4.38	– 2.10	– 1.59	– 0.96	– 1.35	0.57	0.30	0.62	1.60	0.53

Country	Section									
	1	2	3	4	5	6	7	8	9	10
Spain	– 3.00	– 2.36	– 1.56	– 5.58	– 0.56	0.10	– 1.32	– 2.77	– 0.30	– 6.31
France	– 1.11	– 2.40	– 0.07	– 0.67	1.74	2.71	– 0.01	– 0.40	0.79	– 1.63
Croatia	2.02	– 1.51	2.73	– 1.75	– 1.96	1.03	1.79	– 1.25	– 0.84	– 2.73
Italy	0.17	– 0.30	0.89	– 3.58	– 0.17	– 0.80	– 1.58	– 2.74	0.27	– 2.56
Cyprus	0.86	1.05	0.56	– 3.78	2.28	1.81	– 1.19	– 0.72	1.05	– 0.94
Latvia	0.11	0.54	– 1.74	– 2.41	3.43	– 0.22	– 0.48	0.51	– 0.33	1.03
Lithuania	– 3.38	– 0.56	– 2.12	– 3.38	0.37	9.13	– 3.68	1.37	– 1.11	– 1.58
Luxembourg	– 0.03	– 0.52	– 1.34	2.95	– 0.48	1.00	4.05	– 0.18	1.06	– 2.82
Hungary	– 0.07	– 2.30	1.66	– 3.15	2.86	0.94	4.42	2.17	– 1.42	– 0.21
Malta	0.85	– 0.34	– 6.50	– 3.48	– 2.07	6.44	0.50	0.48	– 2.62	0.09
Netherlands	– 0.65	– 1.75	– 0.97	– 4.67	0.68	– 0.35	1.61	– 0.65	1.42	1.54
Austria	2.91	– 1.33	– 2.17	– 3.59	– 0.54	2.64	4.04	– 1.26	– 0.57	0.13
Poland	2.82	– 1.51	1.17	– 2.11	– 0.19	0.78	– 3.54	0.91	0.11	2.14
Portugal	– 0.01	– 1.05	– 0.90	– 3.80	1.23	– 0.88	– 5.25	– 1.31	– 0.95	– 0.02
Romania	– 0.24	– 1.38	0.84	– 0.39	0.47	– 1.68	0.09	– 1.13	0.88	– 1.94
Slovenia	– 0.20	– 1.98	2.35	– 3.88	3.41	2.86	1.75	1.15	1.62	– 1.99
Slovakia	– 2.11	0.36	– 1.04	– 2.62	6.30	– 0.14	1.64	– 2.71	– 1.27	– 2.93
Finland	– 2.09	0.84	– 2.41	– 5.53	0.86	0.44	2.98	1.56	– 0.38	– 2.92
Sweden	– 0.66	– 1.32	– 2.82	– 5.82	0.28	4.70	0.14	– 0.49	– 3.13	– 4.16

Source: own calculations.

The resulting dendrogram from Ward's agglomerative method is shown in Figure 2. The partition (cutting dendrogram) into five groups is justified.

There are five groups of countries:

- Group 1: Austria, Ireland, Spain, Finland, Sweden;
- Group 2: Lithuania, Malta;
- Group 3: Belgium, the Netherlands, Cyprus, Latvia, Slovakia, Hungary, Slovenia, Denmark, France, Greece, Luxembourg;
- Group 4: Bulgaria, Estonia, Czechia, Italy, Romania, Croatia, Poland, Portugal;
- Group 5: Germany.

Differences between mean values were tested by one-way analysis of variance (ANOVA). Only Agriculture, forestry and fishing did not show statistical significance, so it

is not included in Table 4, where average indicators are marked if the absolute value is bigger than 1.

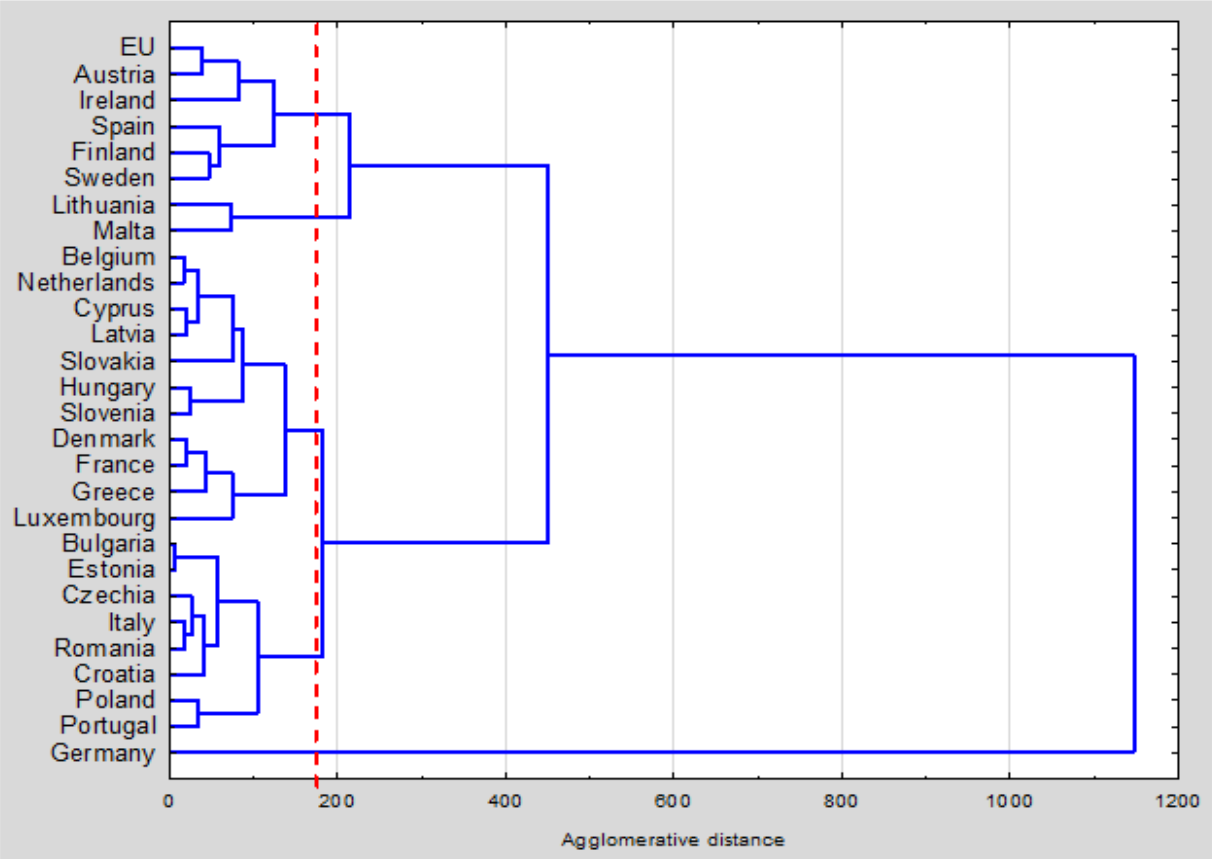

Figure 2. Dendrogram of countries clustered based on the 2020 employment changes indicators

Source: own calculations.

Employment in Wholesale and retail trade, transport, accommodation and food services was severely affected by the situation in 2020 in all groups. Most of the EU countries are in groups 3 and 4. The difference between these groups is that in group 3, there was a slight increase in Information and communication, and in Finance and insurance.

In group 4, there was an increase in Construction, while there was an average decrease in Industry, Real estate activities, and in the Arts, entertainment and recreation, other service activities, activities of household and extra-territorial organisations and bodies. The difference between groups 1 and 2 lies mainly in changes observed in Real estate activities and in Professional, scientific and technical activities, including administrative and support services.

Table 4. Arithmetic averages in groups (agriculture shows no statistical difference between groups)

Country	Number of countries	Industry	Construction	Trade	Information	Finance	Real Estate	Science	Administration	Arts
Group 1	5	–0.77	–2.55	–5.28	0.27	2.37	2.35	–1.27	–1.01	–4.20
Group 2	2	–0.45	–4.31	–3.43	–0.85	7.79	–1.59	0.93	–1.86	–0.74
Group 3	11	–0.87	–0.28	–2.40	1.88	1.30	0.97	–0.33	0.62	–0.81
Group 4	8	–1.39	1.09	–3.02	–0.48	–0.90	–1.30	–0.94	0.12	–1.08
Group 5	1	3.48	–12.91	–7.20	9.23	4.56	14.95	–8.18	1.11	6.38

Source: own calculations.

Germany is a very special case. There was an important increase in some sectors but an important decrease in others. All sectors were involved in these unexpected changes.

Results – dynamic classification of EU countries

In the dynamic cluster analysis approach, the number of objects (sometimes called OTUs – operational taxonomic units) is 351. Each country in each year is a separate OTU. The number of clusters was identified with Ward's method – see Figure 3. The final partition was obtained by the k-means method. We start the presentation of results with the table with mean values of employment rates per 100 eligible population in groups. Groups are named with capital letters, and there is no order in them. Means were compared with ANOVA, and for each variable, the hypothesis of no differences between expected values was rejected (all p-values were equal to 0.0000). The biggest values in columns are marked in green and the smallest in pink.

Values in Table 5 can be quantified into three classes, high/medium/low, using differences in ordered means. The procedure is illustrated in Table 6 for means in the Arts section. Means are ordered from the biggest to the smallest (column 1), and then differences between consecutive ordered means are calculated (column 2).

Using the procedure described above, we found the qualitative characteristics of clusters (Table 7).

The two biggest differences defined the "borders" (marked in yellow) between the three qualitative classes.

Now we can analyse the dynamic composition of groups and their characteristics. The short names are used for sections, but you must bear in mind the full coverage defined at the beginning of the paper.

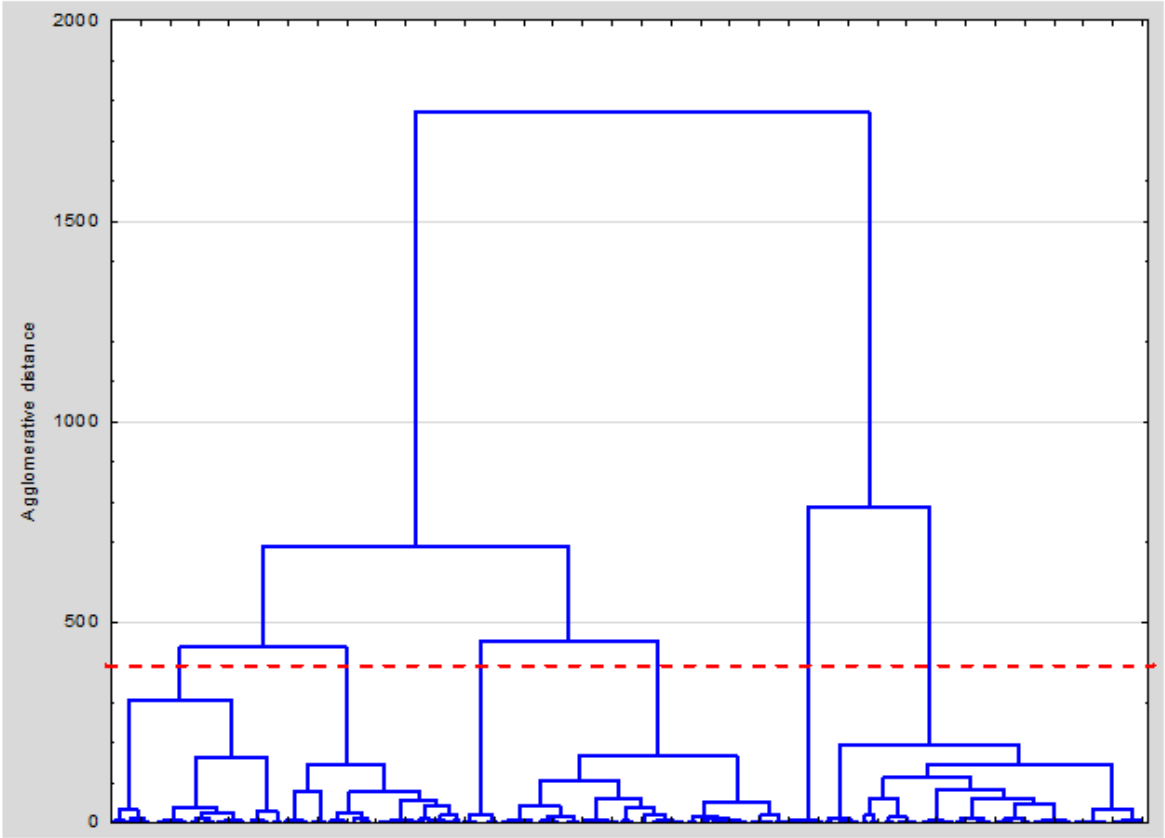

Figure 3. Dendrogram for [YT.Z] clustering task

Source: own calculations.

Table 5. Mean values in dynamic clusters

Group	Section									
	1	2	3	4	5	6	7	8	9	10
A	8.81	11.05	4.15	14.8	1.21	1.21	0.21	3.36	10.80	2.02
B	1.62	10.02	4.47	15.57	2.65	2.17	0.63	7.22	20.50	3.58
C	2.04	9.00	4.67	17.02	1.73	2.24	0.38	5.77	13.39	4.84
D	3.19	16.02	4.95	15.58	1.8	1.49	0.35	4.22	13.55	2.33
E	0.71	3.67	3.79	10.18	2.43	7.45	0.41	6.66	18.85	6.67
F	3.77	12.47	5.99	17.93	2.02	1.59	0.87	5.24	15.17	3.28

Source: own calculations.

Table 6. Quantification of means into three classes – Arts

Means	Differences	Class
6.76		High
	1.91	
4.84		Medium
	1.26	
3.58		Low
	0.31	
3.28		Low
	0.94	
2.33		Low
	0.32	
2.02		Low

Source: own calculations.

The biggest group, B, consists of 108 operational taxonomic units. Then we have groups D (85), F (55), C (47), and A (43). Group membership with changes in time is illustrated in Table 8.

Table 7. Qualitative characteristics of clusters

Group	Section									
	1	2	3	4	5	6	7	8	9	10
A	H	M	M	M	L	L	L	L	L	L
B	L	M	M	M	H	M	M	H	H	L
C	L	M	M	H	M	M	L	M	M	M
D	M	H	M	M	M	L	L	L	M	L
E	L	L	L	L	H	H	L	H	H	H
F	M	M	H	H	M	L	H	M	M	L

Abbreviations: H – high, M – medium, L – low.
Source: own calculations.

Table 8. Composition of groups in 2008–2020

Country	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	'18	'19	'20
Greece	A	A	A	A	A	A	A	A	A	A	A	A	A
Romania	A	A	A	A	A	A	A	A	A	A	A	A	A
Croatia	A	A	A	A	A	A	A	A	D	D	D	D	D
Poland	A	A	A	A	A	A	A	A	D	D	D	D	D
Lithuania	F	D	A	D	D	F	F	F	F	F	F	F	F
Belgium	B	B	B	B	B	B	B	B	B	B	B	B	B
Denmark	B	B	B	B	B	B	B	B	B	B	B	B	B
Germany	B	B	B	B	B	B	B	B	B	B	B	B	B
France	B	B	B	B	B	B	B	B	B	B	B	B	B
Netherlands	B	B	B	B	B	B	B	B	B	B	B	B	B
Finland	B	B	B	B	B	B	B	B	B	B	B	B	B
Sweden	B	B	B	B	B	B	B	B	B	B	B	B	B
Ireland	F	B	B	B	B	B	B	B	B	B	B	B	B
Malta	D	D	D	D	C	C	C	B	C	B	B	B	C
Portugal	F	F	F	D	D	C	C	C	C	C	F	F	B
Cyprus	C	C	C	C	C	C	C	C	C	C	C	C	C
Spain	F	C	C	C	C	C	C	C	C	C	C	C	C
Italy	D	C	C	C	C	C	C	C	C	C	C	C	C
Bulgaria	D	D	D	D	D	D	D	D	D	D	D	D	D
Czechia	D	D	D	D	D	D	D	D	D	D	D	D	D
Hungary	D	D	D	D	D	D	D	D	D	D	D	D	D
Slovenia	D	D	D	D	D	D	D	D	D	D	D	D	D
Slovakia	D	D	D	D	D	D	D	D	D	D	D	D	D
Estonia	F	F	F	F	F	F	F	F	F	F	F	F	F
Latvia	F	F	F	F	F	F	F	F	F	F	F	F	F
Austria	F	F	F	F	F	F	F	F	F	F	F	F	F
Luxemburg	E	E	E	E	E	E	E	E	E	E	E	E	E

Source: own calculations.

Cluster A is characterised mainly by the highest (compared to other clusters) employment in agriculture, forestry and fishing. Greece and Romania stayed for the whole period, and Croatia and Poland left in 2016.

Seven countries constitute Group B for the whole period (Belgium, Denmark, Germany, France, the Netherlands, Finland and Sweden), plus Ireland, which has been there

since 2009. Two countries changed their assignment in 2020: Malta (leaving the group) and Portugal (joining).

Group B has high employment in Information and communication, professional, scientific and technical activities, administrative and support services, and in Public administration, defence, education, human health and social work.

The core of Group C is Spain, Italy and Cyprus, with the partial presence of Malta and Portugal – all Mediterranean countries. It is natural that they have high employment in Wholesale and retail trade, transport, accommodation and food services.

Group D consists of post-communist countries with high employment in industry.

Group E has just one country throughout the 2008–2020 period – Luxembourg, with high employment in five services sections and low in the other five.

Baltic countries plus Austria are in Group F. They have high employment in Construction, Wholesale and retail trade, transport, accommodation and food services, and Real estate activities.

Conclusions

Two methods were proposed in the paper to identify the effects of intervention in yearly time series: one-dimensional and multidimensional. The first method – based on trend and autoregressive models – identifies changes in volume, while the dynamic cluster analysis shows changes in volume and structure.

The proposed Triple 2 Rule made it possible to identify the interventions in the employment index time series for individual sections of economic activity. These changes in already observed employment dynamics were likely due to the COVID–19 pandemic.

Generally, employment in all EU countries (except Romania) was affected by the COVID–19 crisis in 2020 – most severely in Sweden, Ireland and Spain. The biggest changes were observed in Germany, in all sections.

As expected, Wholesale and retail trade, transport, accommodation and food services, and Real estate activities showed the biggest decline in employment.

2020 did not change the structural employment picture of differences between EU countries. Only two countries changed their cluster membership, Malta and Portugal.

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Wpływ pandemii COVID–19 na poziom i strukturę zatrudnienia w krajach Unii Europejskiej

Celem artykułu jest zaproponowanie i zastosowanie metod, które można wykorzystać do oceny zmian w ciągu jednego roku dowolnego mierzalnego zjawiska z punktu widzenia tego, w jaki sposób podążają one za schematem procesu obserwowanego w latach poprzednich. Badania przeprowadzono dla zatrudnienia ogółem oraz zatrudnienia w następujących sekcjach: Rolnictwo, leśnictwo i rybołówstwo; Przemysł; Budownictwo; Handel hurtowy i detaliczny, transport, usługi hotelowe i restauracyjne; Informacja i komunikacja; Działalność finansowa i ubezpieczeniowa; Nieruchomości; Działalność naukowa, fachowa i techniczna, usługi administracyjne i pomocnicze; Administracja publiczna, obrona narodowa, edukacja, ochrona zdrowia i opieka społeczna; Sztuka, rozrywka, rekreacja, inne usługi, działalność gospodarstw domowych i organizacji pozarządowych. Zastosowano dwa podejścia metodologiczne. W ramach pierwszego oszacowano modele trendu i autoregresji na podstawie danych z lat 2008–2019 oraz wyznaczono prognozy na rok 2020. Następnie porównano je z wartościami rzeczywistymi w roku 2020. Zaproponowano tzw. Regułę trzech dwójek. Drugie podejście to dynamiczna analiza skupień. Zmiany w składzie wyodrębnionych grup pozwoliły na ocenę wpływu pandemii COVID 19 na stopy zatrudnienia w roku 2020.

Słowa kluczowe: zatrudnienie, COVID–19, państwa Unii Europejskiej, dynamiczna, analiza skupień, reguła trzech dwójek

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A Review of Top Corporate Sustainability Initiatives and Their Resilience during the COVID–19 Pandemic

Svitlana Turchina https://orcid.org/0000-0002-3110-6647
Ph.D., Associate Professor, Sumy National Agrarian University, Faculty of Economics and Management, Department of Management, Sumy, Ukraine, e-mail: sturchina68@gmail.com

Kateryna Turchina https://orcid.org/0000-0002-0971-2800
Master of Professional Studies, The Pennsylvania State University, Community and Economic Development Faculty, PA, USA, e-mail: Kzt5328@psu.edu

Liudmyla Dashutina https://orcid.org/0000-0002-6421-816X
Ph.D., Associate Professor, Sumy National Agrarian University, Faculty of Economics and Management, Department of Management, Sumy, Ukraine, e-mail: ljutikd@gmail.com

Liudmyla Batsenko https://orcid.org/0000-0003-2859-4448
Ph.D., Associate Professor, Sumy National Agrarian University, Faculty of Economics and Management, Department of Management, Sumy, Ukraine, e-mail: lbatsenko@yahoo.com

Abstract

The main goal of this research is to determine the advantages of implementing corporate social responsibility (CSR) principles and the contribution they make to achieving the sustainable goals of business structures. To achieve this goal, the economic activity of small, medium-sized and large companies from different countries was studied. The article focuses on the economic crisis triggered by the COVID–19 pandemic, which has affected the entire world economy. It is proven that it is easier for companies that have implemented the principles of environmental, social, and managerial sustainability to adapt to change, and they are more resilient. A number of factors that hinder the development of CSR enterprises have been identified: the lack of domestic legislation, including the National Strategy for Corporate Social Responsibility in Ukraine, the lack of state support for CSR development and incentives, a sufficient level of perception

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of the importance of CSR by enterprise management, and, of course, limited financial resources. The paper proposes that the organization of CSR in enterprises should be organically integrated into their governance and managerial strategies. An important condition is the development and adoption of Corporate Codes and the implementation of non-financial reporting. Also, it is important to identify those responsible for its implementation.

Keywords: sustainable development, corporate sustainability, CSR concept, COVID–19, managerial strategies, social activities

JEL: I15, M11, M14, O57

Introduction

Over the past decade, the world's largest organizations, including the United Nations and the World Bank, have focused on sustainable development, which calls on all countries to include them in their policies. The concept of sustainable development is attracting more and more attention and interest from researchers, scientists, civil servants, and even business organizations. The COVID–19 pandemic has changed the way the world works and demonstrated the importance of sustainability in everyday business. This study focuses on a review of the most resilient companies identified by Corporate Knight Ranking, whose rankings have changed the most over the year, and how those companies have responded to the pandemic. Although these companies are located in the most developed countries of the world, we also considered the trend in developing countries, such as Ukraine, which reflect similar indicators and positive direction (Pal and Jenkins 2014).

Corporate sustainability is closely linked to the management of a socially responsible business, but while large corporations have incorporated corporate social responsibility (CSR) into their regular business, small and medium-sized businesses are not fully aware of the role and concept of social responsibility and, therefore, corporate sustainability. A lack of understanding of the benefits of implementing CSR principles and their contribution to achieving sustainable goals leads to the critical need to incorporate them into daily processes and activities. The current stable focus of different companies is on three components: environmental, social, and governance (ESG). The global health crisis, which began in December 2019, has significantly affected the company's operations, and underscored the importance of sustainability. The study focuses on the performance of companies and changes in their rankings from 2020 to 2021, as well as whether the pandemic has affected the sustainability policy of companies whose positions changed most significantly.

Literature review

Historically, CSR accelerated in the mid-twentieth century. Frederick (2006) described the basic ideas of CSR in the 1950s as the role of managers as proxies, philanthropy for overall improvement, and the management of corporate resources. Companies began to be seen not only as providers of services and goods, but also for their contribution to the local community beyond standard operations. Moreover, the relationship between corporations and communities is becoming an integral part of society. The level of involvement should be one of the key strategies of senior leadership (Walton 1967). With the development of CSR after the 1970s, it was no longer limited to charity or corporate resources but included customer relations, employee welfare, and environmental issues.

Corporate performance measurement was associated with "Stakeholder Theory," and the biggest change in the concept occurred in 1986 when Freeman changed the definition of stakeholder to include any group or individual who can be affected by the organization (Diez-Cañamero et al. 2020). This aspect of the theory expanded to include the relationship between management and society on a different level to focus not solely on economic components and profitability.

The 21st century has brought Elkington's concept of the triple outcome, which focuses on how companies can develop sustainable businesses, including environmental, economic, and social pillars (Elkington 1997). The model showed society's dependence on the economy and the economy on the global ecosystem. Elkington identified three main components that a company must consider in order to develop its strategy: people, planet, and profit, reflected in the short title "The Three Ps". He believed that company efficiency requires economic (increased profits), environmental (reduced pollution and waste), and social responsibility (charity, health, and governance). The model is shown in Figure 1.

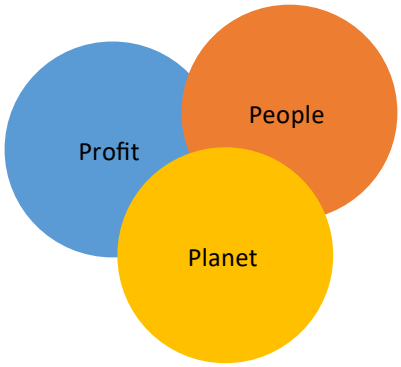

Figure 1. The triple bottom line or the Three P model

Source: authors' compilation.

The CSR concept has become widely used in the national economy to solve environmental, social, and economic problems. Social issues include health, education, culture, poverty, wealth gaps, inequality, retirement, and access to resources. Environmental problems include carbon emissions, climate change, waste reduction and management, and air and water pollution. The basis of the economy is innovative energy and resource conservation technologies, increasing productivity and labor, and developing new products and markets that include market relations around the world. Accordingly, CSR initiatives are designed to build partnerships in society, government, and business to achieve the common goals of improving environmental and social conditions around the world, and to ensure sustainable development that does not endanger future generations.

The successful implementation of CSR initiatives depends on the motivation of businesses to participate in those programs. Based on existing programs, which explain the nature of sustainable business, the base is economic responsibility and profitability.

The further development led to the development of various concepts, among which are corporate citizenship, business ethics, corporate sustainability, community partnership, and ESG for investment.

Methodology

With the rapid evolution of corporate sustainability, the need to measure contributions evolved and led to the formation of rankings by world-leading companies including, but not limited to, the Wall Street Journal Ranking of Sustainably, Corporate Knight "Global 100", "100 best Corporate Citizens" drawn from Russell 1000 by the Corporate Responsibility Magazine/3BL Media, the Dow Jones Sustainability Indexes, and the FTSE4Good index series. In 2020, the World Economic Forum (WEF), in cooperation with the "Big Four" (i.e., PWC, Deloitte, KPMG, and EY), announced "Measuring Stakeholder Capitalism," a set of universal ESG metrics and disclosures. It includes 21 core and 34 expanded metrics organized under four pillars that are aligned with the Sustainable Development Goals (SDG) and principal ESG domains: Principal & Governance, Planet, People & Prosperity.

Corporate Knight's "Global 100 Most sustainable companies" is an annual ranking, based on publicly disclosed data, and it evaluates the corporate sustainability performance of companies around the world. The Global 100 is announced at the World Economic Forum in Davos and presents a background for investment solutions (Parris 2006). Publicly listed companies with gross revenue of a minimum of $PPP-currency $1B are eligible for assessment.

This study is based on companies' publicly available data and their financial performance; therefore, the Global 100 is well suited to support the research.

Twenty-four key-performance indicators (KPIs) are used to evaluate publicly listed companies and may vary based on industry (Corporate Knight 2021b). The metrics are divided into environmental, social, governance, and economic. Each KPI is aligned with the UN's sustainable development goals. All companies, irrespective of the industry group, are assessed on twelve universal KPIs: percentage tax paid, pension fund quality, supplier score, non-male and racial diversity in executive management & board, paid sick leave, sustainability pay link, sanctions deductions, and clean revenue & investment.

Each industry group has a unique share of global influence for each KPI. The greater the influence of the CK Industry Group on a particular performance metric with other CK industry groups, the greater the weight of this KPI. Of the 23 indicators, 14 are weighted according to their impact, and nine have predetermined fixed weights: net income (42.5%), net investment (7.5%), gender diversity on the board (2.5%), gender diversity among managers (2.5%), racial diversity among managers (2.5%), racial diversity on the board (2.5%), pay link stability (5.0%), supplier evaluation (2.5%) and paid sick leave (2.5%). Coefficients of influence calculate the weights of 14 relative indicators.

Research results

The onset of the coronavirus pandemic in late 2019 was a precondition for the world's largest economic crisis of the century, comparable to the Great Depression of 1929–1933. One of the most dramatic consequences of the pandemic is the decline in economic activity around the world. It is important to note that back in October 2019, the IMF forecast growth of the world economy in 2020 at 3.4% and the US economy at 2.1%. However, as a result of the COVID–2019 pandemic and unemployment due to the COVID–19 crisis, the situation has changed dramatically.

Figure 2 shows the trend of the real GDP of the United States, China, some European Countries, and Ukraine from 2018–2020. The devastating impact of the pandemic and the coronavirus crisis on GDP dynamics is obvious.

All countries in the sample show a significant drop in GDP in 2020. The exceptions are China, the country where COVID–19 originated and spread from, and the global crisis caused by it. China's GDP growth in early 2020 slowed significantly compared to previous years, which is perceived as a major sign of declining economic activity in the country. According to the IMF and the World Bank, the recovery of the world economy will take at least 2–3 years.

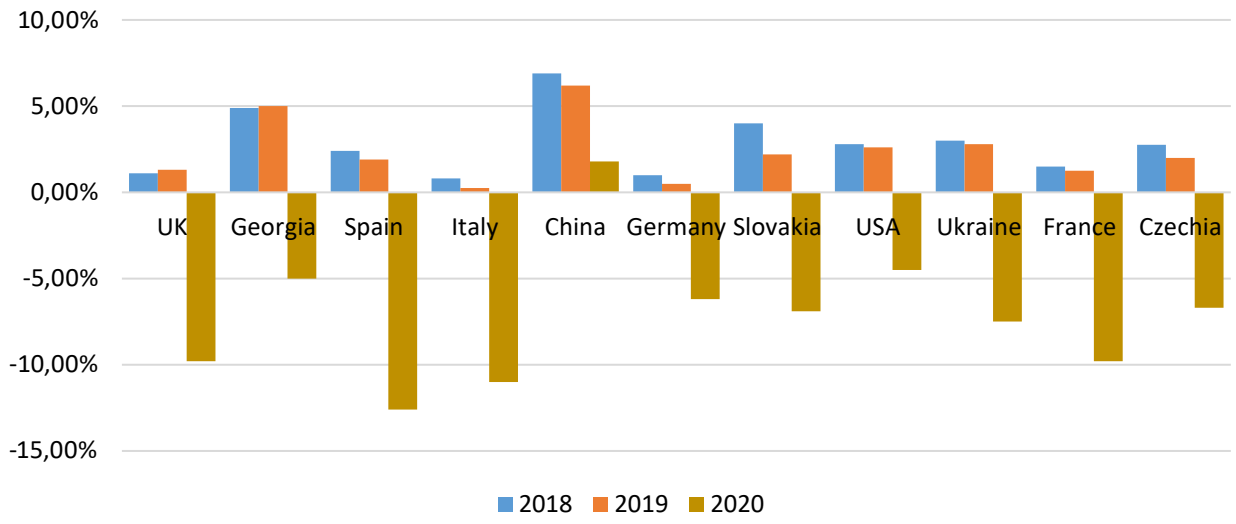

Figure 2. GDP trend in 2018–2020

Source: authors' compilation based on Statista n.d.

Another significant negative consequence of the COVID–2019 pandemic is rising unemployment. The key factor in overall economic stability is full employment. During crises, the labor market tends to shrink to a minimum. Accordingly, the unemployment rate, as one of the main countercyclical indicators during a recession, tends to increase.

According to IMF forecasts, the unemployment rate in the analyzed countries in 2020 should range from moderate 3–5% (Czechia, China, Germany, the UK) to very high 11–17% (Italy, Ukraine, Georgia, Spain), as shown in Figure 3. The world average unemployment is projected at 5.4%; in Ukraine, it is forecast to be 11%.

At the beginning of the global recession, the International Labor Organization (ILO) called on national governments to take urgent action to prevent high coronavirus unemployment. According to ILO estimates, if national governments did not take appropriate action, about 5.3 million people could lose their jobs due to the coronavirus pandemic. It was also expected that underemployment would increase on a large scale, as the economic consequences of the epidemic would lead to a reduction in working hours and wages. All this would result not only in rising unemployment and underproduction of GDP but also in falling personal incomes, reduced consumer demand, and increased mass discontent and social tensions.

To reduce the impact of the COVID–19 crisis, almost all analyzed countries use the measures of expansionist fiscal policy. First, they provide direct and indirect support to households. Direct cash payments to households are widely used. The funds are directed primarily to the needs of the most vulnerable segments of the population, including retirees, children, people with disabilities, and those who have lost their jobs. Many countries

have also introduced indirect support for households: utility subsidies, bank credit holidays, subsidized mortgage programs for individuals, and easier access to social support programs (e.g., temporary unemployment benefits).

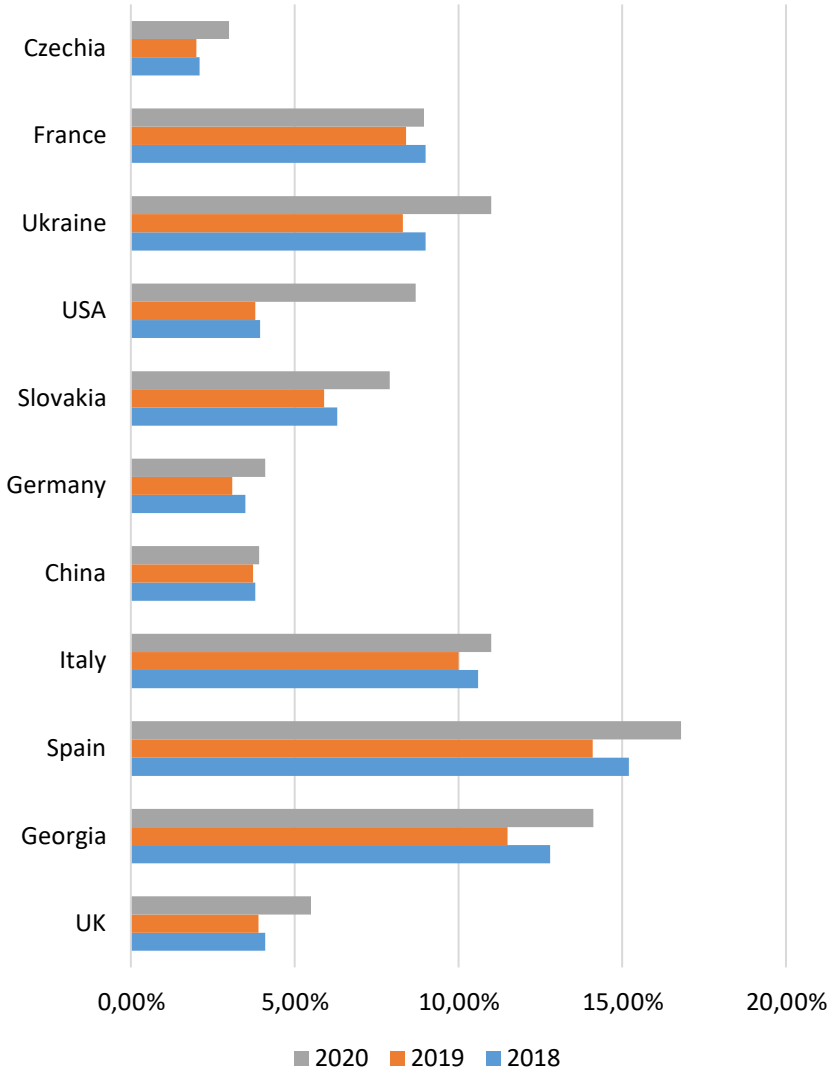

Figure 3. Unemployment trend of different countries during 2018–2020

Source: based on International Monetary Fund n.d.

In terms of business support, the most popular measures to ensure business liquidity have been reducing or deferring taxes, providing tax benefits, reducing the credit burden, as well as providing subsidies for wages. Many countries support enterprises in the most affected industries through direct subsidies. And wage subsidies are supported not only by businesses but also by households. The goal is to keep businesses from mass layoffs, which could lead to rising unemployment and rising social tensions. For example, the US government has implemented a payroll protection program that has provided $321 billion in additional loans to small businesses.

It is fair to say that the only way out of this situation is through the joint efforts of government, community, and business. The fact is that recently, leading international companies that have implemented the principles of environmental, social, and managerial sustainability have found it much easier to adapt to the negative consequences and challenges of the COVID–19 crisis. Moreover, the most successful companies in the world are those for which CSR is not a modern trend, but one of their priority corporate strategies for successful business development.

Thus, in 2020, the World Economic Forum (WEF) proposed a set of universal indicators prepared in conjunction with the Big Four. The Global 100 ranking was revised, and data for the top ten companies were collected and summarized by rating, change, overall score and rating in the peer group . These categories help assess performance for the year and focus on which companies have undergone the most significant changes in position.

Table 1. Top 10 the most sustainable companies by Corporate Knight

Company & Country, Industry	Rank 2021	Rank 2020	Change	Overall Score	Peer Group Rank
Schneider Electric SE, France *Industrial Conglomerates*	1	29	28	83.2%	#1/53
Orsted A/S, Denmark *Power Generation*	2	1	– 1	82.7%	#1/244
Banco do Brasil SA, Brazil *Banks and Investment Services*	3	9	6	81.7%	#1/935
Neste Oyj, Finland *Oil & Gas*	4	3	– 1	80.7%	#1/347
Stantec Inc, Canada *Consulting and Professional Services*	5	57	52	80.5%	#1/23
McCormick & Company Inc, USA *Packaged and Processed Food and Ingredients*	6	22	16	79.3%	#1/225
Kering SA, France *Clothing and Accessory Retail*	7	23	16	78.4%	#1/143
Metso Outotec, Finland *Construction & Engineering Services*	8	18	10	78.4%	#1/251
American Water Works Company Inc, USA *Water Utilities*	9	16	7	77.1%	#1/23
Canadian National Railway Co, Canada *Freight*	10	54	44	77.1%	#1/65

Source: authors' compilation based on Global 100 by Corporate Knight 2021a.

All ten companies represent different industries and lead in their respective peer group. The most significant changes in the ranking belong to Canadian companies, which moved up 52 and 42 positions. Figure 4 shows the share of the top ten sustainable companies by country. Overall, 40% are in North America, 50% in Europe, and 10% in Brazil.

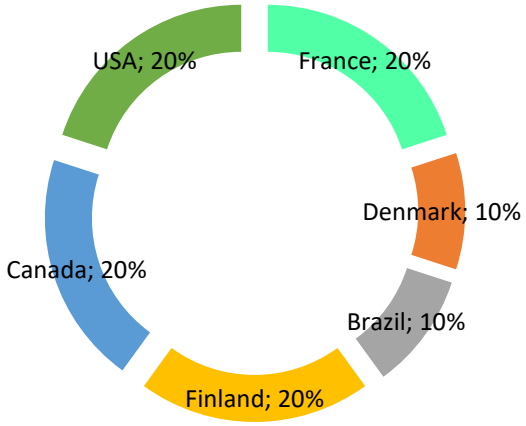

Figure 4. Top 10 Sustainable Companies by Country

Source: authors' compilation based on Global 100 by Corporate Knight 2021a.

Based on the data in Table 1, only three out of the ten were able to maintain positions in the top ten, year after year. Eight companies improved their positions, while only two descended in the ranking. Three companies that significantly improved their positions are Schneider Electric, Stantec Inc, and the Canadian National Railway Co.

Comparing CSR in the EU and US, in the EU, the goals are to develop and implement these policies in a stronger and more regulated manner than in the US. The EU strives to standardize CSR through more statutory policies, while in the US, it remains largely voluntary actions and strategies.

As Hurst points out in his study, 50 percent of European companies have incorporated CSR into their corporate strategy, while only 20 percent of US companies have done so (Hurst 2004). He states, "European companies and government systems seem to be quicker to adopt CSR policies and take the necessary steps to accept them into their culture" (Hurst 2004: 36).

Ayselin Yildiz and Mehmet Gokay Ozerim (2014), who refer to Echo Research Inc., indicate important findings regarding the comparison of CSR practices between US and European firms. One of their findings is that American investment firms pay less attention to the criteria for socially responsible investment than their counterparts in Australia, Europe, and South Africa. They report that 88 percent of US financial institutions do not consider CSR activities a factor when analyzing company performance and importance, and only one-third believe that CSR contributes to better risk management.

To further explore significant improvements and leadership positions, we will review the *Schneider Electric Sustainability Report 2020–2021* (Schneider Electric 2021) and the potential impact of COVID–19 on policies and initiatives. The report begins by acknowledging that the global pandemic has shown how vulnerable the world is to unexpected events. The Schneider Sustainability Impact program has several phases, the first of which ended in 2020, despite the fact that the pandemic was likely to accelerate in the plan for 2021–2025. The next phase includes six long-term commitments that support the UN's SDGs with a greater focus on communities. The report analyzes the effectiveness at environmental, social, and local levels.

The unexpected pandemic and its outcome impacted Schneider's commitment to employees, and from 2021 onward, the company will annually audit living wages and decent work through an independent third party. During the COVID–19 pandemic, Schneider continuously adjusted policies to protect their people, their livelihood, and the communities in which they operate, among which are enhanced safety measures, flexibility at work, access to personal well-being plans, and even providing personal protective equipment to all employees. Additionally, the Global Family Leave Policy was extended from one to two weeks for their employees to care for dependents diagnosed with COVID–19.

The Schneider Foundation has played a special role in supporting vulnerable communities fighting pandemics globally. In April 2020, it launched the Tomorrow Rising Fund, which provides local responses to coronavirus issues to support the resumption of education and training of vulnerable young people and community resilience.

Although the Global 100 does not have access to COVID–19 policies and initiatives, the Schneider Sustainability Report supports companies' focus on sustainability by adapting to global health crises by improving current policies and initiatives and creating new ones.

Stantec Inc, Canada, rose fifty-two places in the ranking and is now Corporate Knights' fifth-most sustainable company. Stantec's sustainability report focuses on companies' contributions to key stakeholders, including employees, clients, and communities. Similarly, Schneider's report focuses on environmental, social, and governance pillars, which are accessed by Corporate Knight. Stantec expanded its sustainability policies by focusing on the global challenges of coronavirus. Moreover, Stantec modified its operations globally and implemented several new initiatives.

In early 2020, the company began the Pandemic Response Plan and Committee. The role of the Pandemic Committee is to monitor the COVID–19 situation and work with leadership, the national government, and the World Health Organization to adjust the response accordingly. The company has created a hub with information and resources for employees to be aware of the situation and tools that are available for colleagues.

Stantec has offices around the world, and for example, in India, to facilitate the transition to remote working, the company provided Internet access and laptops to ensure access to remote work.

During the pandemic, Stantec (2020) adjusted its charitable approaches to help communities in need and extended funds to organizations that help fight the outbreak. The Customer Assistance Program helps to identify vulnerable groups of the population to support utility bills. Stantec has provided its design capabilities to local hospitals to increase bed capacity.

Generally, ESG gradually transits from enterprise expenses to income. The researched companies have demonstrated that their efforts have been transformed into a strong business position, improving the business performance, providing a good working environment for their employees, and keeping a high level of productivity by bringing people to the company where gender, race, and sexual orientation are irrelevant compared to the quality of their work.

While reviewing the leaders in developed countries like France and Canada, the research shows a generally positive trend for countries in Eastern Europe. Interestingly, in Poland, the first organizations to promote and support CSR principles were established after 2000, 13 years after the UN report "Our Common Future" that brought public attention to sustainability. However, since the establishment of the first organizations, the development of CSR has accelerated. In 2009, the Prime Minister appointed an internal-ministerial team to oversee corporate sustainability, and the Warsaw Stock Exchange implemented the Respect Index for socially responsible companies (Hąbek 2013). This is a unique instance when the government dedicates specific governmental bodies to impact and oversee corporate sustainability practices.

Meanwhile, in Ukraine, both the government and businesses have increased their interest in corporate sustainability. Leading Ukrainian companies have signed a UN global agreement, and they implement CSR policies and support and develop socially important projects. Every year, several charitable initiatives and pro bono projects are aimed at protecting the environment, educational supplements, medical and health care, ensuring equal opportunities, promoting law in Ukraine, etc.

According to the Center for CSR Development for 2019, the most common areas of CSR policy were the development and improvement of employees' working conditions, quality education, and partnership for sustainable development. In 2020–2021, according to the Center, 44 companies (21 international companies with offices in Ukraine and 23 domestic ones) were interviewed regarding the CSR project initiatives (Figure 5).

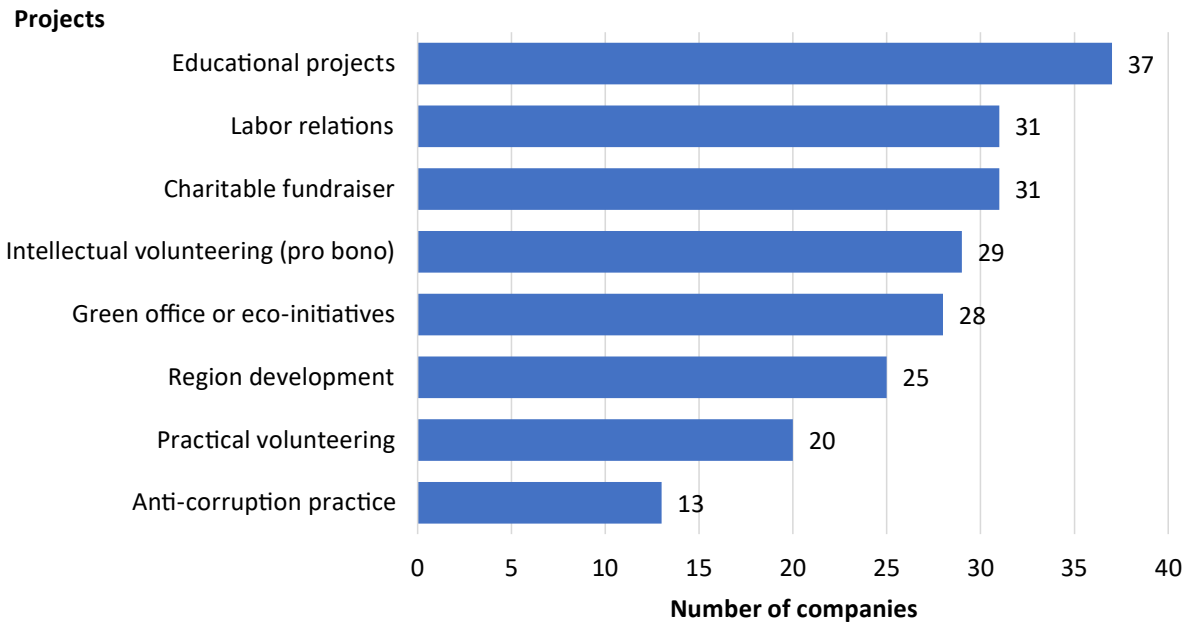

Figure 5. Initiatives of Ukrainian companies on CSR in 2020–2021

Source: formed based on CSR Ukraine 2021.

As we can see from recent years, most Ukrainian companies conduct educational projects (37), improve employees' working conditions and development (31), and organize fundraising. Few companies (20) implement practical volunteering (e.g., maintaining community parks, painting hospital premises) or implement anti-corruption practices (13).

The annual CSR budget for 2020–2021, among the companies that shared this information, varies from UAH 7,000 to UAH 370 million:

- 8% (0–100 thousand UAH);
- 32% (101–500 thousand UAH);
- 40% (1–5 million UAH);
- 16% (10–50 million UAH);
- 4% (over 300 million UAH).

In 2020 during the pandemic, Ukrainian socially responsible companies supported local communities, hospitals, and the government. However, Figure 6 shows that two-thirds of Ukrainian production enterprises did not join COVID–19 countermeasures. Big corporations were more active due to the vast opportunities.

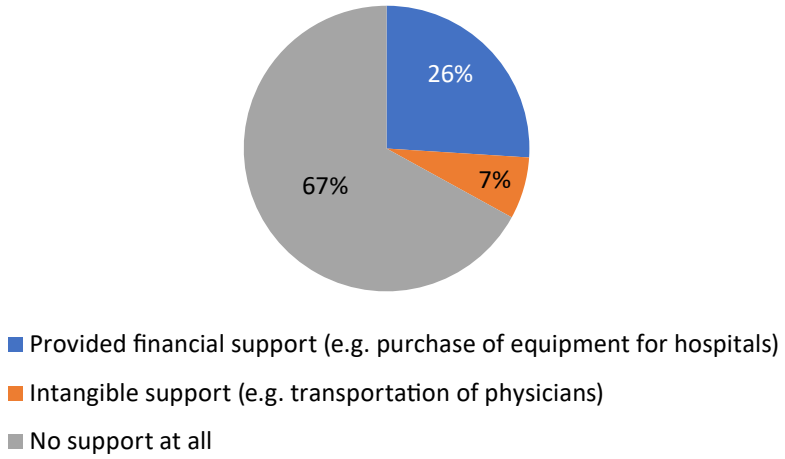

Figure 6. Analysis of Ukrainian companies' activity in the fight against COVID–2019 in 2020

Source: Vorfolomeev 2020.

The type of assistance (Table 2) depended on enterprise size. Larger companies preferred financial support, while small ones preferred intangible support.

Table 2. Ukrainian companies' activity in the fight against COVID–2019 in 2020

The name of the COVID–19 countermeasure	Large enterprises	Medium-sized enterprises	Small enterprises
Financial support	45	22	8
Intangible support	3	8	11
No support at all	52	70	81

Source: Vorfolomeev 2020.

A total of 82 Ukrainian manufacturing companies from more than eight industries took part in the survey. Although the number of respondents cannot show a detailed picture of all enterprises in Ukraine, it does make it possible to analyze the situation and develop further steps.

In general, despite the crisis, Ukrainian business is improving its performance in the field of CSR and transforming business through the prism of ESG.

To build and maintain the reputation of a responsible business, a company must consider CSR as a management task to be part of all of its business activities.

Conclusions

The results of the study suggest that the economic crisis triggered by the COVID–19 pandemic has affected the entire world economy. Each country will directly or indirectly feel the negative impact of the coronavirus on its financial and economic system. However, companies that have implemented the principles of environmental, social, and managerial sustainability find it easier to adapt to change and are more resilient. ESG standards are no longer an exclusive trend, becoming increasingly important for assessing companies' prospects and risks. International experts predict that in the near future, companies with low or no corporate sustainability or social responsibility will have difficulty in obtaining funding, for example, from international financial institutions.

Based on the analysis of companies whose positions on the Corporate Knight Ranking changed significantly, advanced corporate sustainability is closely related to the resilience of companies to the COVID–19 pandemic. All companies analyzed have taken significant steps to put employees and the community first. Their work reflects efforts to improve society and the planet, despite the global crisis, i.e., COVID–19. Corporate sustainable development strategies are embedded in business operations and lead to a new vision so that the needs of our present time do not jeopardize future generations.

Naturally, interest in ESG is growing in developing countries, such as Ukraine, both on the part of the state and business. Leading Ukrainian companies have signed the UN Global Compact, implement a CSR policy, and support and develop socially important projects.

Business leaders understand the importance of social activities to improve the company's image, its competitiveness, and even increase future financial results. In addition, according to business leaders, the development of CSR enterprises is hampered by several factors. Such factors include the lack of domestic legislation, in particular, the National Strategy for CSR in Ukraine, the lack of state support and incentives for the development of CSR, a sufficient understanding of the importance of CSR by enterprise management, and, of course, limited financial resources.

The conceptualization, understanding, and practices of CSR differ between countries as the scope and content of CSR change with time and context. In this context, Ukraine must develop common principles, approaches, and tools, and promote best practices. While we can assimilate a lot from best practices of top-ranking corporate sustainability companies, we also need to address the need for government involvement, like in Poland, as creating an index or special government department can help create more engagement, control, and monitor companies' activities. In our opinion, the organization of CSR in enterprises should be organically integrated into the management and ad-

ministration strategy of each enterprise. An important condition is the development and adoption of corporate codes and the implementation of non-financial reporting. Also, when implementing a CSR policy, it is important to identify those responsible for its implementation.

The COVID–19 pandemic has demonstrated that sustainability is now a requirement of organizations in today's global economy.

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Przegląd najważniejszych inicjatyw na rzecz zrównoważonego rozwoju przedsiębiorstw i ich odporności podczas pandemii COVID–19

Głównym celem badań jest określenie zalet wdrażania zasad społecznej odpowiedzialności biznesu (CSR) oraz ich wkładu w osiąganie zrównoważonych celów struktur biznesowych. Aby osiągnąć ten cel, zbadano aktywność gospodarczą małych, średnich i dużych przedsiębiorstw z różnych krajów. Artykuł koncentruje się na kryzysie gospodarczym wywołanym pandemią COVID–19, który dotknął całą gospodarkę światową. Udowodniono, że firmom, które wdrożyły zasady zrównoważonego rozwoju środowiskowego, społecznego i menedżerskiego, łatwiej jest dostosować się do zmian i są one bardziej odporne. Zidentyfikowano szereg czynników utrudniających rozwój CSR w przedsiębiorstwach: brak ustawodawstwa krajowego, w tym Narodowej Strategii na rzecz Społecznej Odpowiedzialności Biznesu na Ukrainie, brak wsparcia państwa dla rozwoju i zachęt w zakresie CSR, niewystarczający poziom postrzegania znaczenia CSR przez kierownictwo przedsiębiorstwa oraz oczywiście ograniczone zasoby finansowe. W pracy proponuje się, aby organizacja CSR w przedsiębiorstwach była organicznie zintegrowana z ich strategiami zarządzania. Istotnym warunkiem jest opracowanie i przyjęcie kodeksów korporacyjnych oraz wdrożenie sprawozdawczości niefinansowej. Ważne jest również wskazanie osób odpowiedzialnych za jej wdrożenie.

Słowa kluczowe: zrównoważony rozwój, zrównoważony rozwój firmy, koncepcja CSR, COVID–19, strategie zarządzania, działania społeczne

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The Effectiveness of Implementing European Union Structural Funds in the 2014–2020 Programming Period. A Comparative Analysis of Poland and Italy

Krzysztof Lewandowski https://orcid.org/0000-0001-6205-3157
Ph.D., Associate Professor at the University of Lodz, Lodz, Poland, e-mail: krzysztof.lewandowski@uni.lodz.pl

Abstract

The aim of the European Union's cohesion policy is to reduce development inequalities between the regions of the Member States and to increase economic, social, and territorial cohesion. Expenditures on it account for one-third of the European Union (EU) budget. Therefore, the appropriate and effective use of the structural funds plays a very important role.
The purpose of the paper is to show the effectiveness of using the EU's structural funds in two of the largest beneficiary countries in the programming period 2014–2020. The first part of the paper presents the efficiency and effectiveness of using EU structural funds and the barriers related to their implementation, as well as the main characteristics of the 2014–2020 programming period. The second part contains a statistical analysis of the effectiveness of implementing the cohesion policy in Poland and Italy, comparing the amounts of planned and spent funds in the analyzed period. The main method is the statistical analysis, which includes asummary of the amount of allocated funds and their use, as well as a calculation of the percentage of structural funds used. The theoretical part shows potential problems related to the implementation, while the statistical part shows the scale of the problem and the areas with the greatest problems with implementation in both countries.The analysis takes into account thematic objectives, as well as national and regional operational programs.

Keywords: European Union, cohesion policy, structural funds, effectiveness

JEL: F15, F36, R11

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Introduction

Structural funds are the main instruments of the European Union's (EU) cohesion policy. The aim of this policy is to reduce development disparities between regions and member states and increase competitiveness and employment in all regions. The reason for introducing this policy stemmed from the creation of the common market, as well as the pursuit of faster integration of new members of the EU. This policy area currently accounts for around one-third of the EU's budget. The funds are made available when the multiannual programming period starts.

Poland and Italy are among the largest beneficiaries of the EU's cohesion policy. This is due to several elements – a relatively large number of inhabitants in both countries, a low level of GDP per capita in many regions of these countries, and numerous structural problems. Apart from the size of structural funds, Poland and Italy are linked by large regional inequalities. In the research inspired by Kukliński, it was noted that income spreads in these countries are the result of both historical processes and globalization (Kukliński, Malak-Pętlicka, and Żuber 2010).

The following study aims to show the effectiveness of implementing the structural fundsin the 2014–2020 programming period in both countries and to show regional differences in the absorption of these funds. The method of statistical analysis will be used to achieve the goal. It includes a summary of the amount of allocated funds and their use, as well as a calculation of the percentage of structural funds,used broken down into individual thematic areas and operational programs in both countries. This simple analysis will be used to assess the effectiveness of the implemented cohesion policy.

Absorption of the European Union structural funds and its determinants

Absorption capability is seen as the capacity of a given region (member state) to spend the funds allocated to it effectively and efficiently. The absorption of funds by a Member state takes place when it receives a payment from the EU budget as part of co-financing eligible projects. In general, it depends on the conditions under which EU funds were made available – the level of socio-economic and institutional development and the ability to effectively obtain and use the funds granted. This capacity can be analyzed in various dimensions: macroeconomic (expressed in terms of GDP), financial (as the capacity to co-finance programs and projects supported by the EU), and administrative capacity (Incaltarau, Pascariu, and Surubaru 2020, pp. 947–949). For administrative capacity, absorption capacity is determined by the administrative staff's knowledge and skills, the efficiency of managing and paying agencies, the level

of decentralization, transparency and adherence to procedures, the availability of national funds, and the effectiveness of control and monitoring.

Numerous barriers appear when implementing the structural funds, which may adversely affect the absorption capacity of a region or a Member State:

1. Financial barriers – related to the need to co-finance projects and to allocate partof the local or central budget for this purpose.
2. Economic (market) barriers – related to the possibility of obtaining certain goods and services necessary to implement the project.
3. Institutional barriers – related to the operation of state administration, a lack of sufficient knowledge in planning and managing European projects, and a shortage of staff involved in implementing structural funds.
4. Legal barriers – related to legal regulations that hinder the efficient and effective implementation of EU projects.
5. Barriers related to the beneficiaries of structural funds (Godek 2008).

When allocating funds, the European Commission requires an evaluation of the use of support granted and its effectiveness. The effectiveness of the aid granted is treated as a criterion for evaluating the programs by comparing the expenditure incurred for their implementation with the effects of these programs. One of the methods that influencethe effectiveness of structural funds is constant monitoring. In addition, at various stages, program evaluation is carried out to compare the expenditure with actual achievements. The first is carried out before formulating the Common Strategy Framework (*ex-ante* evaluation). It mainly relates to the intervention logic, and it assesses the relevance, coherence, and anticipated effectiveness and efficiency of public intervention. The evaluation is then carried out while the program is being implemented (a mid-term or ongoing evaluation). It indicates the first effects of the implemented activities and whether they are consistent with the ex-ante evaluation and the legitimacy of the selected goals. After the end of the program, an ex-post evaluation is carried out by the European Commission together with the Member State and the managing authority. Its task is to justify the use of resources, assess the effects, and draw conclusions that can be generalized for other activities.

There are still discrepancies in the literature as to the scope of the concepts of efficiency and effectiveness. In economics, efficiency usually measures whether economic activities, programs, or organizations achieve their maximum effect in relation to the expenditure incurred. Effectiveness, on the other hand, is the extent to which previously defined objectives or targets have been achieved (Tracz-Krupa 2015, p. 330).

In 2015, the European Commission launched an initiative called "The EU Budget Focused on Results". It was aimed at changing the spending culture and making the re-

sults a priority for the EU budget, paying attention to the results of the funds, their effectiveness and efficiency, as well as their absorption and compliance with financial rules. These activities were based on the concept of "performance budgeting". This method considers what can be achieved with the available funds, tries to measure the results of spending, links the results to budget decisions and systematically uses performance information (European Parliament 2018). This approach implies a shift in the budgeting focus from inputs (including personnel and resources) to results (outputs and achievements). While the traditional approach to budgeting is based on the control of inputs and changes in different categories of expenditure, performance budgeting is away toallocateresources where goals can be best achieved.

However, performance budgeting remains controversial. On the one hand, this approach has helped local authorities to increase budget transparency and improved the behavior of the state administration (Downes, Moretti, and Nicol 2017, pp. 1–60). On the other hand, it has been criticized for its effectiveness and risks. Critics have noted that performance budgeting loses its transformative potential once it is supported by supranational regulators and promoted at the national level. It may thus lose its primary goalof engaging the local community, becoming a set of spending proposals (Sgueo 2016).

It is too early to judge how performance budgeting will affect the absorptive capacity of regions and Member States. For actions to be consistently focused on achieving concrete results, it is essential that Member States avoid the absorption of significant funds taking place at the end of the programming period, as rushing to absorption may lead to insufficient attention to their cost-effectiveness. For the 2007–2013 and 2014–2020 programming periods, the late adoption of the legislative framework – six months and two weeks before the start of the programming periods, respectively – translated into the late adoption of the operational programs. For both programming periods, most of the operational programs were adopted only after the first year of these periods. This had an impact on the pace and degree of utilization of the allocated funds.

Main characteristics of the 2014–2020 programming period

The EU's cohesion policyis aimed at reducing development inequalities between the regions of the Member States and increasing economic, social, and territorial cohesion. Furthermore, it draws attention to the lagging behind of the least-favored regions or islands, rural areas, areas undergoing industrial change, and regions suffering from severe and permanent natural or demographic handicaps.

For the 2014–2020 programming period, there is a new legislative framework for five funds under the EU's cohesion policy, common agriculture policy, and common fish-

eries policy: the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD), and the European Maritime and Fisheries Fund (EMFF). These regulations were related to the "Europe 2020" strategy. They were aimed at initiating smart, sustainable and inclusive growth in the EU, improving coordination, ensuring the coherent use of the European Structural and Investment Funds and simplifying access to funds as much as possible for entities that may benefit from them.

The objectives and financial instruments of the new programming cycle were defined in Council Regulation (EU) No. 1303/2013 of 17 December 2013 (CPR) and in regulations specific to individual funds. There are two key objectives for the cohesion policy:

1. Investment for economic growth and employment.
2. European Territorial Cooperation.

In order to align ESI Funds as closely as possible with the Europe 2020 strategy, 11 thematic objectives have been set out in the CPR. They identify sectors and areas of intervention where support from the European Structural and Investment Funds can bring the greatest added value. Moreover, the EU institutions encourage the Member States to ensure synergy and coordination of all available instruments at European, national, regional and local levels.

The division of Community funds between individual Member States was included in the Commission Implementing Decision of April 3, 2014. In order to create the financial framework for the funds, the overall resources allocated to the Investment for growth and jobs goal and the European territorial cooperation goal have been allocated. Under the first of these goals, a total expenditure of EUR 317 billion was foreseen, of which EUR 71.9 billion was to be allocated to Poland; Italy was to be the second largest beneficiary, with EUR 29.6 billion. Under the second objective, a total expenditure of EUR 8,865 billion was planned, of which Italy was to receive EUR 993 million, and Poland EUR 612 million. In addition, EUR 4.1 billion was earmarked for expenditure under the Youth Employment Initiative. Italy was to be the second largest beneficiary after Spain, with EUR 863 million. Poland was awarded EUR 252 million, putting it in fourth place. In addition, an expenditure of EUR 63.3 billion was planned under the Cohesion Fund, intended for countries where the Gross Community Product did not exceed 90% of GDP. Poland was again the largest beneficiary with EUR 23.2 billion, while Italy was not eligible.

Regulation (EU) 2017/2305 of the European Parliament and of the Council of 12 December 2017 modified the previous Regulation No. 1303/2013 in the amount of funds allocated to the cohesion policy under its two objectives. The available funds were set at EUR 329.9 billion in 2011 prices, of which 325.9 billion was allocated to the Structural Funds (ERDF, ESF, and CF)

A huge share of the resources – EUR317 billion – was allocated to the Investment for growth and jobs goal, which will benefit three categories of regions:

- less developed regions, where GDP per capita is lower than 75% of the Community average (these include Polish regions, except for the Mazowieckie Voivodeship, and Italian regions of Basilicata, Campania, Calabria, Sicilia and Puglia);
- regions in transition, where GDP per capita is between 75 and 90% of the EU average (in Poland, there arenone; in Italy: Abruzzo, Molise and Sardinia);
- more developed regions, whose GDP per capita exceeds 90% of the EU average (in Poland: Mazowieckie Voivodeship; in Italy: the Center North regions).

The EU has nine regions that are very distant from the European continent, but which are an integral part of the EU. They include five French overseas departments (Martiniique, Guadalupe, Reunion, Guyana, and Mayotte), Dutch overseas territory (Sint Maarten), Portugal's two autonomous regions (Madeira and the Azores) and Spain's Canary Islands. Some funding has also been earmarked for sparsely populated regions in northern Finland and Sweden.

The remainder of the Cohesion Policy funds was allocated for transnational, interregional and cross-border cooperation (€8.9 billion) as well as the Youth Employment Initiative (€4 billion).

Table 1 below presents a breakdown of resources allocated to the structural funds among the Member States, expressed in current prices, in accordance with the Commission Implementing Decision (EU) 2016/1941, which amended the European Commission Regulation of April 3, 2014 (2014/190/EU).

Table 1. Distribution of cohesion policy funds among the Member States in EUR millions in current prices, in accordance with the Commission Implementing Decision 2016/1941

Country	CF	LDR	TR	MDR	PSPD	TC	Total
Austria	–	–	72.3	906.0	–	257.3	1,235.6
Belgium	–	–	1,039.7	949.6	–	263.1	2,252.4
Bulgaria	2,278.3	5,089.3	–	–	–	165.6	7,533.2
Croatia	2,509.8	5,837.5	–	–	–	146.1	8,493.4
Cyprus	294.9	–	–	432.3	–	32.8	760.0
Czechia	6,143.9	14,824.0	–	546.7	–	339.6	21,854.2
Denmark	–	–	87.3	332.3	–	140.1	559.7
Estonia	1,061.5	2,437.7	–	–	–	55.4	3,554.6
Finland	–	–	–	1,004.9	305.3	161.4	1,471.6

Country	CF	LDR	TR	MDR	PSPD	TC	Total
France	–	3,434.3	4,253.3	6,322.0	443.3	1,115.0	15,567.9
Germany	–	–	9,771.5	8,498.0	–	965.4	19,234.9
Greece	3,265.7	7,345.7	2,922.1	2,511.0	–	231.7	16,276.2
Hungary	6,025.4	15,005.2	–	463.7	–	361.8	21,856.1
Ireland	–	–	–	955.3	–	168.8	1,124.1
Italy	–	23,382.8	1,506.2	7,874.9	–	1,136.7	33,900.7
Latvia	1,349.4	3,039.8	–	–	–	93.6	4,482.8
Lithuania	2,048.9	4,628.7	–	–	–	113.8	6,791.4
Luxembourg	–	–	–	39.6	–	20.2	59.8
Malta	217.7	–	490.2	–	–	17.0	724.9
Netherlands	–	–	–	1,020.6	–	389.7	1,410.3
Poland	23,208.0	49,628.7	–	3,777.3	–	700.5	77,314.5
Portugal	2,861.7	16,642.2	324.6	1,237.5	115.7	128.5	21,310.2
Romania	6,935.0	14,607.1	–	693.0	–	452.7	22,887.8
Slovakia	4,168.3	9,130.3	–	328.7	–	223.4	13,850.7
Slovenia	914.0	1,296.1	–	848.6	–	62.9	3,121.6
Spain		2,155.6	14,927.9	11,562.6	484.1	643.0	29,773.2
Sweden	–	–	–	1,491.9	206.9	342.3	2,041.1
UK	–	2,641.0	2,590.6	5,594.6	–	865.6	11,691.8

Note: CF – Cohesion Fund, LDR – Less Developed Regions, TR – Transition Regions, MDR –More Developed Regions, PSPD – Peripheral or Sparsely Populated Regions, TC – Territorial Cooperation.
Source: own elaboration based on Commission Implementing Decision 2016.

Table 1 shows that Poland was by far the most important beneficiary of the cohesion policy in the programming period 2014–2020. The overall size of the allocated funds was more than double that of second-placed Italy. The structure of the allocated funds was different in both countries. Poland received much support from the Cohesion Fund, which Italy did not. In both countries, the largest part of the funds was allocated to less developed regions – in Italy, 69% of the total; in Poland, 64.2%. On the other hand, Italy received greater support for more developed regions and for territorial cooperation.

The programming rules for the 2014–2020 period were set out in Regulation (EU) No. 1303/2013 of the European Parliament (European Parliament 2013) and of the Council of 17 December 2013. This extensive document stipulated, inter alia:

- Creating a common strategic framework for all EU funds related both to cohesion policy (ERDF, ESF, CF) and agriculture and fisheries (EAFRD, EMFF). This should

facilitate sectoral and territorial coordination of the EU's intervention with other relevant policies and instruments.

- Member States focus their support on interventions with the greatest added value in relation to the EU strategy for smart, sustainable, and inclusive growth, taking into account the most important territorial challenges.
- The objectives of the cohesion policy should be achieved within the framework of sustainable development and EU support for the preservation, protection, and improvement of the quality of the environment. To this end, Member States should provide information on supporting the climate change target in line with the ambitious target of allocating at least 20% of the EU budget to these objectives.
- Financial instruments should be used to meet specific market needs in a cost-effective manner and in line with the objectives of the programs, and they should not crowd out private financing.
- Program modification requests by Member States are adequately substantiated and, in particular, indicate the expected impact of program changes on the implementation of the EU's Europe 2020 strategy.
- To help focus on results and the achievement of the objectives of the EU's Europe 2020 strategy, a performance reserve of 6% of the total allocation for the Investment for growth and jobs goal and the EAFRD has been established for each Member State.

An important change was the introduction of the n+3 rule instead of the n+2 rule in force in the 2007–2013 programming period. This rule specifies an additional period to implement and settleprojects and programs co-financed by European funds. In practice, this means that the funds allocated under the 2014–2020 financial perspective can actually be used until 2023 (European Commission 2015). If a Member State fails to use all the funds allocated to the current financial perspective by that time, it will have to return the unused surplus to the EU budget.

The European Commission constantly monitors the spending of resources from the structural funds. Taking into account the funds from the European Structural and Investment Fund and their use in individual countries, the implementation rate was as follows at the end of December 2021.

Table 2 shows that Poland and Italy are not leaders in terms of the pace of implementing structural and investment funds. While Poland's results can be considered average, Italy's achievements are among the weakest. It means that implementation problems also occurred in the previous programming periods (Lewandowski 2013, pp. 222–226).

Table 2. Financial implementation of ESIF 2014–2020 based on the link between planned and spent funds in EU countries. Period covered until 31.12.2021

Country	Implementation rate (in %)	Country	Implementation rate (in %)
Portugal	74	Poland	64
Lithuania	74	Malta	64
Hungary	73	France	64
Slovenia	69	Greece	63
Czechia	68	Austria	61
Ireland	68	Netherlands	60
Finland	68	Croatia	59
Luxembourg	66	Romania	54
Estonia	66	Belgium	53
Sweden	65	Slovakia	52
Germany	65	Denmark	51
Latvia	65	Bulgaria	51
Cyprus	65	Italy	49
UK	65	Spain	43

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. 2014–2020 ESIF Overview*.

The implementation of the cohesion policy in Italy in the programming period 2014–2020

Each EU Member State is obliged to prepare a partnership agreement, which creates a strategic framework for national programming and, thus, the use of structural funds in the period 2014–2020. The funds included in this agreement should be used within operational programs prepared by each Member State, or the institution designated for this. Each program defines its priorities, specific objectives, financial subsidies from the EU, and the corresponding national funding.

The European Commission adopted a partnership agreement with Italy on October 29, 2014, under the Implementing Decision. Later, the values of the allocated Community funds were modified, increasing the pool available for Italy.

The legal bases that define the objectives and policy instruments for the programming period were defined in the 1303/2013 Regulation. It provides that Member States and regions are increasingly faced with the challenges of the impact of globalization, envi-

ronmental and energy problems, aging and demographic change, and technological transformation. Due to the nature of such challenges, the multi-sectoral and multi-dimensional solutions supported by the ESI Funds should be integrated.

Table 3. Financial implementation of ESIF Funds in Italy by thematic objective in EUR millions in current prices. Period covered until 31.12.2021

Theme		Planned	Spent	Implementation rate
1	Competitiveness of SMEs	20,987	11,283	54
2	Environment Protection & Resource Efficiency	9,003	4,765	53
3	Low Carbon Economy	4,768	2,293	48
4	Sustainable and Quality Employment	7,439	5,326	62
5	Social Inclusion	7,595	3,977	52
6	Educational and Vocational Training	6,639	4,552	69
7	Research and Innovation	6,224	3,691	59
8	Climate Change Adaptation and Risk Prevention	6,098	3,369	55
9	Technical Assistance	2,980	1,202	40
10	Network Infrastructures in Transport and Energy	2,703	2,360	87
11	Information and Communication Technology	2,389	1,319	55
12	Efficient Public Administration	1,038	4,86	47

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

Table 3 shows that the highest percentage of implementation (87%) was recorded in the area of the transport and energy infrastructure, as well as in areas related to the labor market. Traditionally, the poorest results relate to administrative activities (40 and 47%), although poor results were also recorded for environmental activities (environmental protection and low-carbon economy).

The next three tables show the use of EU funds, taking into account individual operational programs. During the analyzed programming period, Italy presented a very large number of operational programs – both national and regional.

The following table refers to the use of structural funds in national operational programs.

Table 4. Implementation of EU structural funds by national operational programs in EUR millions (current prices). Period covered until 31.12.2021

National Operational Program		Planned	Decided	Spent
1	Education	3777	3334	1710 (45%)
2	Youth Employment	2830	2429	1625 (57%)
3	Systems for Active Employment Policies	1806	1515	870 (48%)
4	Italy – Rural Network	130	122	63 (48%)
5	Legality	693	710	316 (46%)
6	Research and Innovation	2375	1654	612 (26%)
7	Infrastructures and Networks	1890	1558	1139 (60%)
8	SME Initiative	323	323	205 (63%)
9	Governance and Institutional Capacity	2091	1231	513 (25%)
10	Social Inclusion	1269	1149	546 (43%)
11	Italy – National Rural Development	2860	1881	1296 (45%)
12	Maritime and Fisheries	979	802	460 (47%)
13	Metropolitan Cities	1992	987	506 (25%)
14	Culture	491	483	224 (46%)
15	Enterprises and Competitiveness	4964	5200	2757 (56%)

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

When analyzing individual national operational programs, it is worth paying attention to the large discrepancy in the implementation of the EU funds. The best results were recorded for the operational program SME Initiative (63%) and Youth Employment (57%). The worst results were noted in Governance and Institutional Capacity and Metropolitan Cities (both 25%).

In the 2014–2020 financial perspective, a significant number of regional operational programs were planned for Italy. Three separate operational programs were prepared for each region for projects financed by ERDF, ESF and EAFRD. This analysis takes into account the resources financed from the first two funds, broken down into the Center-North and Mezzogiorno regions[1].

1 Mezzogiorno (Italian South) denotes the area comprising the following regions in the South of Italy: Abruzzo, Basilicata, Calabria, Campania, Molise, Puglia, Sardinia and Sicily.

Table 5. Implementation of EU Structural Funds in Italian Mezzogiorno regions in current prices (in EUR millions). Period covered until 31.12.2021

Regional Operational Program	Planned	Decided	Spent
Abruzzo ESF	139	137	74 (54%)
Abruzzo ERDF	276	249	128 (46%)
Basilicata ESF	290	200	136 (47%)
Basilicata ERDF	551	871	397 (72%)
Calabria ESF / ERDF	2261	2238	1098 (49%)
Campania ESF	837	751	516 (62%)
Campania ERDF	4114	4477	1989 (48%)
Molise ESF / ERDF	129	125	74 (58%)
Puglia ESF / ERDF	4451	5424	3862 (87%)
Sardegna ERDF	930	987	569 (61%)
Sardegna ESF	445	339	234 (53%)
Sicilia ESF	820	887	454 (55%)
Sicilia ERDF	4273	4654	2507 (59%)

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

Table 5 shows that the pace of structural fund absorption in the Mezzogiorno regions is highly diversified. Very good results were recorded for the Puglia ESF/ERDF and Basilicata ERDF programs, but there are also programs where the absorption rate did not exceed 50%. Out of the EUR 19,516 million planned for the Mezzogiorno regions, EUR 12,038 million was spent by the end of 2021, which amounts to 62% of the planned expenditure. These results raise concerns as to whether these funds will be spent by the end of the programming period.

Table 6. Implementation of EU Structural funds in Italian Centre–North regions in EUR millions (current prices). Period covered by 31.12.2021

Regional Operational Program	Planned	Decided	Spent
Bolzano ESF	128	134	90 (70%)
Bolzano ERDF	145	169	89 (62%)
Emilia-Romagna ESF	786	963	702 (89%)
Emilia-Romagna ERDF	482	520	337 (70%)
Friuli-Venezia Giulia ESF	276	280	182 (66%)
Friuli-Venezia Giulia ERDF	231	308	185 (80%)

Regional Operational Program	Planned	Decided	Spent
Lazio ESF	903	1170	825 (91%)
Lazio ERDF	969	1155	745 (77%)
Liguria ESF	355	325	211 (60%)
Liguria ERDF	393	321	208 (53%)
Lombardia ESF	970	882	731 (75%)
Lombardia ERDF	970	903	567 (58%)
Marche ESF	288	244	167 (59%)
Marche ERDF	585	520	244 (42%)
Piemonte ESF	872	951	844 (97%)
Piemonte ERDF	966	865	474 (49%)
Toscana ESF	746	737	572 (77%)
Toscana ERDF	779	1028	579 (74%)
Trento ESF	126	115	96 (76%)
Trento ERDF	92	81	71 (77%)
Umbria ESF	238	188	128 (54%)
Umbria ERDF	412	338	202 (49%)
Valle d'Aosta ESF	53	51	38 (73%)
Valle d'Aosta ERDF	64	75	65 (101%)
Veneto ESF	764	973	615 (80%)
Veneto ERDF	600	566	365 (61%)

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

The situation is more comfortable for the northern and central regions of Italy (Table 6). The overall amount allocated to the Center–North regions was lower than in the South – EUR 13,193 million, and the volume of payments made by the end of 2021 was EUR 9.33 million, which is 71% of the planned expenditure. There is also a wide variation in the pace of implementation of measures, but the overall advancement of implementation was much greater than in the South. Many regions contracted projects with higher than planned value, and in the case of the Valle d'Aosta ERDF program, the payments exceeded the planned amount. In two cases – Umbria ERDF and Piemonte ERDF – less than half of the planned funds were spent.

The implementation of the cohesion policy in Poland in the programming period 2014–2020

The basis for the cohesion policy in Poland is the Partnership Agreement concluded with the European Commission on May 21, 2014. According to this agreement, the cohesion policy in Poland should be implemented within 22 operational programs, which means that the number did not change compared to the previous programming period, 2007–2013. A larger share of allocation was managed by regions (ca 55% of ERDF and 66% of ESF compared to 25% of ERDF in 2007–2013).

Poland should allocate the largest amounts to transport infrastructure (road and rail), but the greatest increase in expenditure was registered in the area of innovation and support for entrepreneurs. In the 2014–2020 period, investments in environmental protection and energy were financed, as well as projects in the fields of culture, education, employment, and counteracting social exclusion. Under the cohesion policy for 2014–2020 at least 50% of funds were allocated to supporting the implementation of thematic objectives that condition smart economic growth, i.e. activities related to strengthening research, technological development and innovation, and increasing the degree of use and quality of information and communication technologies, strengthening the competitiveness of SMEs, or supporting the transition to a low-carbon economy, where entrepreneurs were the main beneficiaries (Oleksiuk 2018).

When analyzing the implementation of programs in the 2014–2020 programming period, a relatively high average (64%) was achieved thanks to the investments in transport and energy infrastructure and multi-topic programs, which accounted for the largest part of the funds. In both cases, 70% of the planned payments were made. However, the advancement of the use of funds for Climate Change Adaptation and Risk Prevention was very poor, where only 10% of planned payments were made.

The subject of the next analysis will be national programs implemented in Poland during the analyzed period.

Table 7. Implementation of structural funds in Poland by theme – total cost of selection and spending (in EUR millions) as % of planned. Period covered until 31.12.2021

	Theme	Planned	Spent	Utilization rate (%)
1	Competitiveness of SMEs	13,691	7,974	58
2	Environment Protection & Resource Efficiency	7,268	4,315	59
3	Low Carbon Economy	8,486	5,612	66

Theme		Planned	Spent	Utilization rate (%)
4	Sustainable and Quality Employment	6,263	4,252	68
5	Social Inclusion	7,946	4,593	58
6	Educational and Vocational Training	2,614	1,750	67
7	Research and Innovation	8,331	4,664	56
8	Climate Change Adaptation and Risk Prevention	294	28	10
9	Technical Assistance	3,563	2,108	59
10	Network Infrastructures in Transport and Energy	26,204	18,398	70
11	Information and Communication Technology	3,487	2,066	59
12	Multiple Thematic Objectives	21,419	14,924	70

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

Table 8. Implementation of structural funds in Poland by national operational program – total cost of selection and spending (in EUR millions) as % of planned. Period covered until 31.12.2021

National Operational Program	Planned	Decided	Spent
Development of Eastern Poland	2,353	2,356	1,622 (69%)
Knowledge Education Growth	5,534	5,528	3471 (63%)
Digital Poland	2,788	2,746	1,510 (54%)
Infrastructure and Environment	32,944	31,079	22,341 (68%)
Smart Growth	10,508	15,579	6,959 (66%)
Technical Assistance	827	774	621 (75%)

Source: own elaboration based on European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

Table 8 shows that for the largest operational programs, the absorption of funds was relatively high – 68% for Infrastructure and Environment and 66% for Smart Growth, respectively, although slightly lower than in the smallest Technical Assistance program, where as much as 75% of funds were spent. In the case of national operational programs, a total of EUR 36.5 million was spent by the end of 2021, which amounts to 66% of the planned expenditures.

Table 9. Implementation of EU structural funds in Poland by regional operational program – total cost of selection and spending (in EUR millions) as % of planned. Period covered by 31.12.2021

Regional Operational Program	Planned	Decided	Spent
Dolnośląskie Voivodeship	2681	2598	1932 (72%)
Kujawsko-Pomorskie Voivodeship	2254	2314	1359 (60%)
Lubelskie Voivodeship	2625	2719	2070 (79%)
Lubuskie Voivodeship	1079	1051	716 (66%)
Łódzkie Voivodeship	2654	2618	1680 (63%)
Małopolskie Voivodeship	3386	3503	2436 (72%)
Mazowieckie Voivodeship	2640	2603	1872 (71%)
Opolskie Voivodeship	1124	1212	915 (81%)
Podkarpackie Voivodeship	2512	2446	1882 (75%)
Podlaskie Voivodeship	1439	1512	1061 (74%)
Pomorskie Voivodeship	2194	2367	1495 (68%)
Świętokrzyskie Voivodeship	1605	1616	1079 (68%)
Warmińsko-Mazurskie Voivodeship	2033	1993	1382 (68%)
Wielkopolskie Voivodeship	2911	2967	2106 (72%)
Zachodniopomorskie Voivodeship	1895	1969	1331 (70%)

Source: own elaboration based on data from European Commission (n.d.), *Cohesion Open Data Platform. Explore 2014–2020 data by country*.

Table 9 shows that the absorption of EU funds from regional operational programs was slightly higher than from national programs. The progress of individual voivodeships varied from 81% for the Opolskie Voivodeship and only 60% for Kujawsko-Pomorskie. In Poland, it cannot be argued that the absorption of EU funds is worse in the less prosperous regions of Eastern Poland (Podlaskie, Świętokrzyskie, Lubelskie and Podkarpackie Voivodeships).

Conclusions

The added value of this article was the determination of the degree of utilization of structural funds in the two largest beneficiary countries of the cohesion policy funds and demonstrating that it is not the mere allocation of funds but their effective implementation that determines the effectiveness of this policy. The theoretical part showed potential problems related to implementation, while the statistical part showed the scale of the problem and the areas in which there are the greatest problems with implemen-

tation in both countries. The analysis showed that Poland and Italy differ significantly in terms of the expenditure structure and pace of absorption of funds.

Taking into account the allocation of funds in Poland, expenditure on road and energy infrastructure played a dominant role in the 2014–2020 period. This was because Poland is also the largest beneficiary of the Cohesion Fund, from which this type of expenditure is financed, and because 15 out of 16 Polish voivodeships are classified as less developed regions. Italy, which did not use this fund, had much more modest expenditures for this purpose. However, expenditures on financing the development of small and medium-sized enterprises, as well as environmental protection, prevailed. They were used in the poorer Mezzogiorno regions and the richer regions of the Center–North.

Although Italy has extensive experience using funds for its cohesion policy, it still has problems with absorption. This is due to the inefficiency of the local administration, mainly in the Mezzogiorno area. This situation is not new, however. In previous programming periods, the country also faced absorption problems. The positive trend is that the resources in the Mezzogiorno regions are being used better than in previous periods. Although the distance to the regions of the Center-North is smaller, it is still noticeable.

Compared to Italy, Poland uses the structural funds more efficiently, at both the national and regional levels. Moreover, in Poland, there is no trend that the regions of Eastern Poland achieve weaker results with the implementation of structural funds. (e.g., the Lubelskie and Podkarpackie voivodeships were even at the top of the ranking).

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Skuteczność wykorzystania funduszy strukturalnych Unii Europejskiej w okresie programowania 2014–2020 Analiza porównawcza Polski i Włoch

Polityka spójności Unii Europejskiej ma na celu zmniejszenie nierówności rozwojowych między regionami państw członkowskich oraz zwiększenie spójności gospodarczej, społecznej i terytorialnej. Wydatki na nią stanowią około jednej trzeciej budżetu Unii Europejskiej, dlatego bardzo ważną rolę odgrywa skuteczne wykorzystanie funduszy strukturalnych.
Celem artykułu jest porównanie efektywności wykorzystania funduszy strukturalnych wśród dwóch krajów, które są największymi beneficjentami polityki spójności w okresie programowania 2014–2020. W pierwszej części artykułu omówiono kwestię efektywności i skuteczności wykorzystania funduszy strukturalnych UE oraz bariery związane z ich wdrażaniem, a także główne cechy okresu programowania 2014–2020. W drugiej części przeprowadzono analizę statystyczną skuteczności realizacji polityki spójności w Polsce i we Włoszech porównując wielkość wydanych i planowanych środków w analizowanym okresie. Główną metodą jest analiza statystyczna obejmująca obliczenie odsetka wykorzystanych funduszy w stosunku do przyznanych środków. W analizie tej uwzględniono cele tematyczne polityki spójności, a także krajowe i regionalne programy operacyjne.

Słowa kluczowe: Unia Europejska, polityka spójności, fundusze strukturalne, skuteczność

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The United States–China Trade War: Timeline, Consequences, and Prospects for the US Economy. An Analysis Based on the Textile Industry

Ewa Stawasz-Grabowska https://orcid.org/0000-0002-2456-552X
Ph.D., Assistant Professor, University of Lodz, Faculty of Economics and Sociology
International Finance and Investment Department, Lodz, Poland, e-mail: ewa.grabowska@uni.lodz.pl

Justyna Wieloch https://orcid.org/0000-0001-5956-2129
Ph.D., Assistant Professor, University of Lodz, Faculty of Economics and Sociology
Department of International Trade, Lodz, Poland, e-mail: justyna.wieloch@uni.lodz.pl

Abstract

In this paper, we investigate the scale of the drop in American imports after it imposed punitive tariffs on Chinese goods. Our analysis spans the whole period of Donald Trump's presidency (January 2017 – January 2021). In contrast to existing studies, which are mainly devoted to the impact of reduced trade flows on the key macroeconomic indicators, we focus on the specific market of textile products, which was among the most affected by the protectionism measures. The quantitative analysis allows us to conclude that the imposed duties severely hit the textile industry, bringing a noticeable drop in US imports of selected groups of products from China. Furthermore, the review of long-term consequences indicates that the ongoing trade war has not only adversely affected the macroeconomic fundamentals of the US economy, but it is also likely to have a long-lasting impact on global supply and production chains.

Keywords: trade war, trade barriers, protectionism, tariffs, US–China relations, international trade, US textile industry

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Introduction

Donald Trump's presidency (January 2017 – January 2021) was marked by economic nationalism, with the idea of "America First" as a leitmotif of his leadership. Admittedly, the Trump administration fought in the economic field with many foreign partners, including the European Union (EU) and the North American Free Trade Agreement (NAFTA), but the fiercest battle took place between the US and China. It is often referred to as the China–United States trade war. Within its framework, the US imposed four rounds of tariffs, which affected thousands of Chinese goods, and made China employ similar retaliatory measures.

At the same time, it is worth noting that reduced trade flows were not the only symptom of the US–China decoupling. It also embraced technology protectionism, reduced approvals for export licenses, imposed sanctions and restrictions on partnering companies, and saw a drop in foreign direct investment flows and a deceleration in people mobility. Some of these trends were observed as far back as 2008, which is attributable to the Global Financial Crisis. Nonetheless, they clearly accelerated under Trump's presidency (García Herrero and Tan 2020).

Finally, at the time of this study, it seems that the transition of power to Joe Biden at the beginning of 2021 has not changed US policy or attitudes towards China. The first hundred days of his presidency did not bring a relaxation in the tensions between the two nations, mainly due to the complexity of these relations, different objectives, the issue of human rights, and intellectual property rights, among others. The latest Gallup survey reveals that only 20% of Americans hold a favourable view of China, which is the lowest level since the questionnaire was first carried out (Younis 2021). Such a perception of China also legitimates the confrontational attitude presented by Biden at the 2021 Virtual Munich Security Conference: "We have to push back against the Chinese government's abuses and coercion that undercut the foundations of the international economic system" (The White House 2021).

In this study, we concentrate on the highly topical subject of the China–United States trade war, which will undoubtedly determine the shape of the global economy in decades to come. In contrast to existing studies, which are mainly devoted to the impact of reduced trade flows on key macroeconomic indicators, we focus on the specific market of textile products, which was among the most affected by the protectionism measures. The textile industry has a significant share in the China-United States exchange, and plays an equally important role in Chinese production and international trade (a detailed explanation can be found in section *US–China trade in textiles*).

In particular, we take the US perspective and investigate the scale of the drop in American imports after it imposed punitive tariffs on Chinese goods. Our approach allows us to disaggregate groups of textile products into individual Harmonized Tariff Schedule

(HTS) codes on an eight-digit detail level (or higher). That way, we are able to more accurately identify the market's exact response to tariff (protectionism) decisions and the time delay between the announcement and the potential changes in the trade pattern. Our analysis spans the whole period of Donald Trump's presidency. Although the effects we try to identify are revealed in the short term, such a sharp change in the trade policy, especially when continued for years, has the potential to bring long-term consequences. We also try to provide a scenario for such changes.

At the same time, though the last months of our sample period coincide with the outbreak and the spread of the COVID–19 pandemic, we do not put it at the centre of our research. The pandemic has been a gamechanger in different dimensions, including international trade; thus, it merits separate analyses. However, they should be based on longer time series than those that were available at the time of this study. The COVID–19-induced crisis started in China at the end of 2019, and the resulting lockdowns in both economies must have played an important role in determining their mutual trade volumes. Nonetheless, our aim is to highlight the effects of the trade war that started well before the outbreak of the pandemic and that dominated the period under analysis.

The rest of the paper is structured as follows. The next section discusses the literature on free trade and protectionism. It also refers to recent studies on the implications of the China–United States trade war on the latter's economy. Section 3 presents a detailed timetable of the Trump administration's measures implemented within the trade war. Section 4 introduces the dataset and lays down the methodology and estimation procedure we use in this paper. The results of the empirical model and the discussion are provided in Section 5. The last section concludes.

Literature review

Free trade and protectionism. Theoretical discussion

A country defining its trade policy might choose free trade or a policy of interventionism. Usually, limitations are applied selectively towards certain partners and/or products. These restrictions comprise tariff and non-tariff measures. The first group includes duties and tariff quotas, while the second includes, among others, sanitary and phytosanitary measures, technical barriers to trade, rules of origin, and subsidies (UNCTAD 2012).

Regardless of the measure applied, its economic effect[1] is similar – a reduction in the total welfare of the country imposing such a measure and the welfare of its trading partners. Usually, studies on the impact of a specific policy tool are conducted with a fo-

1 Although the economic effect is similar, the mechanism in which it occurs is different.

cus on duties, as they are considered to be the "lesser evil" by the General Agreement on Tariffs and Trade/World Trade Organisation (GATT/WTO), but also due to their transparency in imposition and ease of execution.

The starting point for theoretical considerations is the analysis conducted by Krugman and Obstfeld (2003), who tried to quantify the benefits and costs of tariffs from the point of view of both the importing and exporting country. They demonstrated that a tariff increases the prices in the importing country and reduces it in the exporting one. Thus, as a consequence of price changes, consumers in the importing country lose while those in the exporting state profit. From the perspective of producers, the distribution of benefits and costs is contrary. Another winner of such a trade policy is the government of the country imposing duties and collecting revenues.

From the point of view of the importing country, duties increase domestic prices (by the value of the duty) but lower foreign export prices. Thus, domestic production rises while consumption falls. The benefits for producers in the importing country result from the higher surplus (redistributive effect). For the same reason, consumers lose as the surplus falls (consumer effect). Another outcome is related to the diversion of the source of supply. Prior to the introduction of a duty, part of the demand for a given good was covered by foreign producers. However, after imposing a tariff, it is satisfied by domestic producers who, in the previous period, due to high production costs, sold smaller quantities (protective effect). As mentioned before, a third actor, the government, collects the duties, thus increasing its revenues (fiscal effect).

Krugman and Obstfeld (2003) noticed that these gains and losses accrue to different economic agents. As a result, the overall cost-benefit evaluation of a tariff depends on how much we value a monetary unit worth of benefit to each group. It should be noted that losses to the consumer might be accompanied by benefits to the domestic producers and the government. Otherwise, these become so-called *deadweight losses*. Krugman and Obstfeld (2003) distinguish two groups of losses: (1) production distortion losses, which result from the fact that the tariff leads domestic producers to produce too much of this good; (2) domestic consumption distortion losses, which result from the fact that a tariff leads consumers to consume too little of a good. However, when considering the economic consequences of tariffs, it is also important to distinguish whether the imposing country can or cannot affect world prices and thus change its terms of trade. Depending on the size of the country (its ability to change global prices), it may achieve the terms of trade gain that result from the decline in foreign export prices caused by a tariff. If the country is small, the second effect drops out, so the costs of an import tax exceed the benefits, thus reducing its welfare.[2]

2 Graphical illustration of the economic effects of tariffs are available in Krugman and Obstfeld (2003).

Furceri et al. (2019) analysed the impact of an increase in tariffs on selected macroeconomic indicators of the domestic economy. They stated that such a policy leads to a decline in domestic output and productivity, increased unemployment, and higher inequality, but also real exchange rate appreciation, while the effect on the trade balance is relatively small.

Gorman (1958; 1959) and Leith (1971) analysed the impact of tariffs on trade volumes, emphasising the role of elasticity for imported goods as a factor that determines their harmfulness. Gorman (1958) constructed reference models to quantify the impact of an import tax and argued that if the goods in question do not differ in quality and the demand for them is fairly elastic, the volumes of trade with no restrictions are approximately three times higher than in the final tariff equilibrium.

Surprisingly, a country may gain from a trade war, even if its imports are highly elastic compared to its exports. Such an advantage can be achieved when the foreign income elasticity of demand for imports is sufficiently more significant than its own exports. Tokarick (2004) considered the impact of the country on global prices, differentiating big and small states that can or cannot influence their terms of trade. He also considered the role of elasticity, trade shares, and the size of the distortion triggered by the duties. He concluded that a small country, which has no influence on its terms of trade, bears the costs of duties, while for a big country, there is no theoretical basis to claim that most of the costs of the duties will be borne by the country imposing them.

Tokarick (2004) addressed two issues: (1) What would the distribution of the welfare effects across countries be from a marginal change in the home country tariff? And (2) What is the distribution of the cumulative welfare effects of a tariff change in the home country, perhaps relative to free trade, across countries? His research demonstrates that "the home country would be hurt more from a tariff increase if its actual tariff rate exceeded twice its optimal rate, while the foreign country would be hurt more if the home tariff were less than twice its optimal rate. Regarding the second issue, the home country would be hurt more than the foreign country, relative to free trade, if its actual tariff rate exceeded four times its optimal tariff; if the home tariff is less than four times its optimal tariff, the foreign country is hurt more than the home country" (Tokarick 2004, p. 20).

The US–China trade war. Implications for the US economy

The existing literature on the United States–China trade war points to negative consequences for the US economy. These include, among others, an increase in prices, wealth losses, and a deterioration in competitiveness.

Flaaen and Pierce (2019) investigated the impact that the 2018 US tariffs, as well as the retaliatory tariffs imposed by its trading partners, had on the US manufacturing sector.

Their results indicate that the tariffs have not increased domestic activity. On the contrary, they have led to relative increases in producer prices via rising input costs, reduced competitiveness from retaliation, and reductions in manufacturing employment.

Amiti, Redding, and Weinstein (2019) found that import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 bn per month in added tax costs, and another $1.4 bn per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behaviour of US producers by protecting them from foreign competition and enabling them to raise prices and markups. They estimated that the combined effects of input and output tariffs had raised the average price of US manufacturing by 1 percentage point. Finally, they showed that the rise in tariffs had reduced the variety of products available to consumers.

Fajgelbaum et al. (2019) analysed the short-run effects of the return of protectionism on the US economy and found a large impact of the trade war on imports and exports. In particular, their estimates point to an annual loss of $51 bn for the US (0.27% of GDP). After accounting for tariff revenue and gains to domestic producers, the aggregate real income loss amounted to $7.2 bn (0.04% of GDP). Finally, they demonstrated that Republican states were most negatively affected due to the retaliatory tariffs.

Finally, the Tax Foundation (2019) investigated the Economic Impact of US Tariffs and Retaliatory Actions. Their results point to largely negative effects, including reduced economic output (0.23%), income, and employment (by 180,300 full-time equivalent jobs).

The US–China trade war. Background and measures implemented by the US administration

The changes in the American administration held at the beginning of 2017 were followed by promises or actions to protect the domestic market with import duties. Because all the announcements had the power to shape the bilateral relations, we have collected and classified all the communications by type and the potential positive (+) or negative (–) effect on trade. Press releases not followed by any further changes in the trade policy were tagged ***Statement***. When the communication was an ***Administrative decision***, it received such a tag, supplemented with information about whether any actions were taken or not. Finally, some communications informed about changes in import taxes, and were tagged ***Tariff change***. All the communications with tags and expected effects on goods exchange are listed in Table 1 below.

Table 1. Trade war timeline (US perspective)

Date	Announcement/decision	Category
11/05/2017	A joint statement announcing the initial actions of the US-China Economic Cooperation 100-Day Plan under the framework of the *US-China Comprehensive Economic Dialogue*.	Statement (–)
14/08/2017	President Trump asks the United States Trade Representative (USTR) to investigate potential consequences of the Chinese violation of intellectual property rights, innovation, or technology development, justifying actions taken under Section 301 of the 1974 Trade Act.	Administrative decision – no action yet (–)
1/01/2018	The USTR submits a report stating that the US made a mistake in supporting Chinese accession to the WTO.	Statement (–)
22/03/2018	Following the investigation from August 2017, President Trump signs a Memorandum to increase tariffs on Chinese imports.	Tariff change (–)
26/03/2018	The USTR reports to the WTO a case against China's discriminatory technology licensing requirements, which are suspected to be inconsistent with Trade-Related Aspects of Intellectual Property Rights (TRIPS).	Administrative decision – followed with action (–)
3/04/2018	The USTR releases a list of Chinese products that might be subject to the retaliatory tariff under Section 301.	Administrative decision – no action yet (–)
5/05/2018	President Trump announces that he had instructed the USTR to consider $100 bn in additional retaliatory tariffs on China.	Administrative decision – no action yet (–)
6/05/2018	The USTR confirms the decision to impose new retaliatory measures.	Tariff change (–)
19/05/2018	The United States and China release a statement with an obligation to increase Chinese imports from the US and improve efforts regarding intellectual property protection and boost engagement in trade and investments.	Statement (+)
29/05/2018	President Trump announces that the US would impose a 25% tariff on goods worth $50 bn imported from China while the USTR would continue its dispute with China on the forum of the WTO. When acquiring industrially significant technology, the United States will implement specific investment restrictions and enhanced export controls.	Statement (–)
19/06/2018	The Office of Trade and Manufacturing Policy (OTMP) releases a report about the potential threat of Chinese policy and laws.	Statement (–)
19/06/2018	President Trump announces that the USTR was asked to identify Chinese goods worth $200 bn for a potential additional 10% tariff to respond to the Chinese plan to raise duties on American goods worth $50 bn. If China further implements import taxes, the US may respond with duties imposed on goods, worth $200 bn.	Statement (–)
6/07/2018	The US imposes additional import duties on Chinese goods covered by Section 301, which came into effect the following day. It affects goods worth $34 bn. China announces retaliatory measures.	Tariff change (–)

Date	Announcement/decision	Category
6/07/2018	The USTR releases the product exclusion process for Chinese products subject to Section 301 tariffs.	Statement (+)
10/07/2018	The USTR announces the intention to impose a 10% additional tariff on Chinese goods, worth $200 bn.	Administrative decision – no action yet (–)
26/07/2018	At the WTO forum, the US presented the document "China's trade-disruptive economic model" about the Chinese policy's threats to the global economy.	Statement (–)
1/08/2018	The USTR reveals that President Trump was considering increasing the proposed additional tariff from 10% to 25% on Chinese goods, worth $200 bn.	Statement (–)
7/08/2018	The USTR releases the final list of Chinese goods, worth $16 bn, which will be covered with an additional 25% tariff. In response, The Ministry of Commerce of the People's Republic of China (MOFCOM) declared it would impose an additional 25% tariff on American goods, worth $16 bn.	Statement (–)
23/08/2018	The U.S. Customs and Border Protection (CBP) covers goods worth $16 bn with additional import duties. The decision enters into force the following day. China implements retaliatory tariffs on $16 bn worth of American goods.	Administrative decision – followed with action (–)
13/09/2018	President Trump signs the Miscellaneous Tariff Bill (MTB) Act of 2018 with an effective date of 13/10/2018. It is temporary (until December 2020), and lowers or eliminates import tariffs on selected products.	Administrative decision – followed with action (+)
17/09/2018	President Trump carries into effect formerly declared duties on Chinese goods. The first step includes a 10% import tax imposed on goods worth $200 bn, effective 24/09/2018; the second means 25% duties on goods worth $200 bn, effective 1/01/2019. The announcement was followed by retaliatory tariffs varying from 5% to 10% imposed on goods worth $60 bn and effective 24/09/2018.	Tariff change (–)
20/11/2018	The USTR releases a report updating its investigation into Chinese policies and practices in intellectual property rights, technologies, etc., concluding that it had not changed its policy.	Statement (–)
28/11/2018	The USTR releases a statement criticising China's high tariffs on automobiles originating from the US with a declaration of further examination of possible retaliatory actions.	Statement (–)
1/12/2018	President Trump announces that the 10% tariffs imposed on Chinese goods worth $200 bn would not be raised to 25% as planned. China will try to reduce the American trade deficit, and if it fails, those tariffs will be increased to 25%.	Administrative decision – followed with action; duties not increased (+)
19/12/2018	The USTR announces that the Section 301 punitive tariffs on Chinese goods worth $200 bn would not be, at that moment, increased.	Administrative decision – followed with action; duties not increased (+)

Date	Announcement/decision	Category
21/12/2018	The USTR grants exclusions for some requested products worth $34 bn, which were on the 25% tariff list (exclusion is retroactive to 6/07/2018 and effective until 28/12/2019.	Administrative decision – followed with action; duties not increased (+)
25/02/2019	President Trump delays increasing the Section 301 tariffs on $200 bn imports from China from 10% to 25%.	Statement (+)
13/05/2019	The Trump administration proposes considering up to 25% Section 301 tariff on additional $300 bn imports from China. In response, China announces retaliatory tariffs.	Statement (–)
28/05/2019	China remains on the "monitoring list" due to its currency practices.	Statement (–)
29/06/2019	President Trump announces that trade talks with China will resume, withholding the imposing of new 301 section tariffs.	Statement (+)
01/08/2019	President Trump announces the US will impose 10% section 301 punitive tariffs on approx. $300 bn imports from China.	Statement (–)
05/08/2019	China is to be designated a "currency manipulator".	Administrative decision – followed with action (–)
13/08/2019	The Office of the US Trade Representative releases a list of "Tranche 4" products subject to additional 10% tariffs.	Administrative decision – followed with action (–)
23/08/2019	The Trump administration announces it will increase the Section 301 tariffs by 5 pp to 30% for around $250 bn of Chinese goods as of October 1, 2019, as a response to previous retaliatory measures on the side of China.	Administrative decision – followed with action (–)
11/09/2019	President Trump announces a delay in increasing the Section 301 punitive tariffs by 5pp from 25% to 30% on approx. $250 bn of Chinese goods as a response to previous Chinese concessions.	Statement (+)
11/10/2019	President Trump announces that a "phase 1" trade agreement with China has been reached.	Statement (+)
13/12/2019	The Trump administration announces that the "phase one" trade deal with China has been reached.	Statement (+)
01/01/2020	President Trump announces that the "phase one" trade deal between the US and China will be signed on 15 January, 2020.	Statement (+)
13/01/2020	China's designation as a currency manipulator is removed; however, it remains on the US Treasury's "Monitoring List".	Statement (+)
15/01/2020	The United States and China officially sign the "phase one" economic and trade agreement; the Trump Administration announces a reduction of the 15% punitive tariffs on Tranche 4A products from 15% to 7.5%, effective on February 14, 2020. Meanwhile, the scheduled tariffs for Tranche 4B products are suspended.	Tariff change (+)

Source: authors' own compilation based on Lu 2021.

In general, Trump's administration, following his election premises, imposed tariffs on selected goods imported from China. This process was divided into four stages. In the first one, which came into force July 6, 2018, the US enforced a 25% tariff on 818 products from categories such as machinery, manufacturing, inputs, elevators, and aircraft parts, accounting for $34 bn (Shapiro n.d.).

In the second tranche, it imposed an import tax of the same rate on 279 products, including soybeans, automobiles, and chemicals, worth $16 bn. The catalogue of products affected in stages 1 or 2 does not contain goods from section XI: Textile and Textile Articles.

The third tranche came into force on September 24, 2018, with an initial tariff of 10%, increased to 25% on May 10, 2019. It hit 5745 products, from categories like food, beverages, chemicals, wood, and fabrics, representing $200 bn.

In stage 4, the United States Trade Representative (USTR) released two lists: 4A and 4B. Tranche 4A came into effect on September 1, 2019. Initially, products included in list 4A faced an additional tariff of 15%. Due to the US–China Phase One trade deal, it was reduced by half to 7.5% on goods worth $120 bn, effective February 14, 2020. List 4A included items such as food, beverages, chemicals, glasses, blinds, and clothing. At the same time, List 4B, which included goods like electronics, chemicals, food, sports equipment, clothes, and wooden hangers, worth $160 bn, which was planned to come into force on December 15, 2019, was suspended. The detailed schedule of the import tax levy is presented in Table 2.

Table 2. Plan of US tariffs imposed on China

Round	Effective day	Rate of tariff	Number of categories affected*	Value of the products affected ($ bn)
1	July 6, 2018	25%	818	34
2	August 23, 2018	25%	279	16
3	September 24, 2018	started at 10% and escalated to 25% on May 10, 2019	5745	200
4(A)	September 1, 2019	15%	3250	175
4(B)	December 15, 2019	15%	555	160

* products according to the 8-digit HTS codes.
Source: authors' own compilation based on: Shapiro n.d.; V. Alexander & Co., Inc. 2020; Bryant 2022; Lee, Varas 2022.

Data and methodology

US–China trade in textiles

The textile industry was chosen for this research for a few reasons. First, China is the leading global clothing supplier, so levying import taxes should impact its economy. In 2019,[3] China's share in global clothing exports was 30.8%, worth $152 bn. The second most dominant supplier was the EU–27, which accounted for 27% and $136 bn (see Figure 1). Both China and the EU faced an increase in US import taxes, also within textiles. On the other hand, the EU–27 ($180 bn) and the US ($95 bn) are the top importers of these goods. The difference is that nearly half of the EU–27's imports were intra-EU trade (47%).

The US has a trade deficit not only in terms of clothing but generally. In 2019, it was equal to $834 bn (not seasonally adjusted), while for the first three quarters of 2020, it was almost $650 bn. The top three trading partners of the US are Mexico, Canada, and China. With the first two, the US has a trading agreement – the United States–Mexico–Canada Agreement (USMCA), formerly NAFTA, while with the last one, it has the most significant trade deficit (see Figure 2).

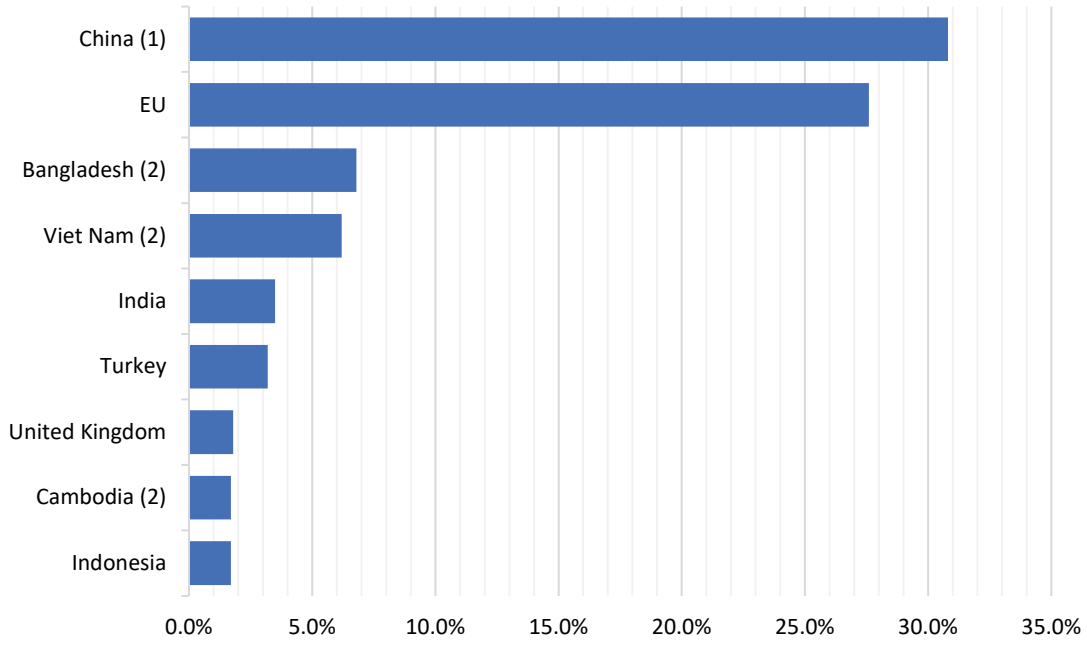

Figure 1. Top exporters of clothing, shares in world exports 2019 (in %)

Note: (1) includes significant shipments through processing zones; (2) estimates
Source: authors' own elaboration based on World Trade Organization n.d.

3 The most recent, full year data available.

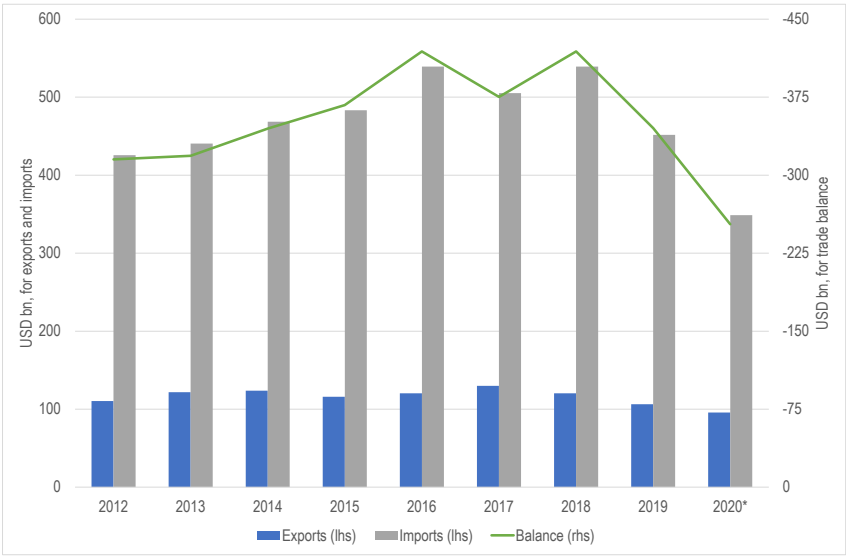

Figure 2. US exports, imports, and trade balance with China, 2012–2020 ($ bn)

Source: authors' own elaboration, based on United States Census Bureau n.d. – data for 2020 covers Q1-Q3.

China is also the US's leading supplier of textiles, with an average share in the analysed period (2012–2020) equal to 36% (Figure 3).

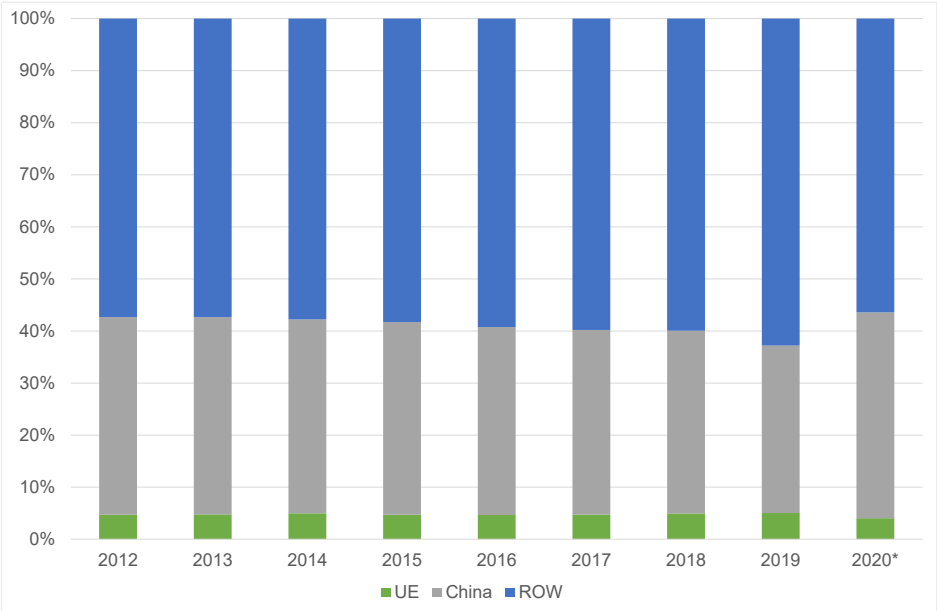

Figure 3. Share in US imports in textile and textile articles (HTS section XI)

Note: ROW stands for Rest of the world.
Source: authors' own elaboration, based on DataWeb n.d. – data for 2020 covers Q1-Q3.

When analysing US–China bilateral trade in textiles, we consider Section XI: Textile and Textile Articles from The Harmonized Tariff Schedule of the United States (HTS), which was enacted by Congress and made effective on January 1, 1989, replacing the former Tariff Schedules of the United States.

The HTS comprises a hierarchical structure for describing all goods in trade for duty, quotas, and statistical purposes. This structure is based upon the international Harmonized Commodity Description and Coding System (HS), administered by the World Customs Organization in Brussels; the 4- and 6-digit HS product categories are subdivided into unique 8-digit US rate lines and 10-digit non-legal statistical reporting categories. Classification of goods in this system must be done in accordance with the General and Additional US Rules of Interpretation, starting at the 4-digit heading level, to find the most specific provision, and then moving to the subordinate categories (United States International Trade Commission 2022).

Methodology

Our study focuses on a group of 30 products with the highest share in US imports of Articles of apparel and clothing accessories, knitted or crocheted (henceforth, textiles). To save space, we present the results for the top 10 products in terms of shares in the US import of textiles. The result for the remaining 20 products (with lower shares) are available upon request.

Table 3. Products with the highest shares in US imports of textiles – top 10

Tariff code	Product	Import share (% of total)
6111.20.10	Blouses and shirts, except those imported as parts of sets (Babies' garments and clothing accessories, knitted or crocheted, of cotton)	12.7
6111.20.50	Trousers, breeches and shorts, except those imported as parts of sets (Babies' garments and clothing accessories, knitted or crocheted, of cotton)	7.3
6217.90.90	Other (Other made-up clothing accessories; parts of garments or of clothing accessories, other than those of heading 6212: Parts)	4.2
6207.91.10	Bathrobes, dressing gowns and similar articles (Men's or boys' singlets and other undershirts, underpants, briefs, nightshirts, pyjamas, bathrobes, dressing gowns and similar articles: of cotton)	3.8
6305.39.00	Other (Sacks and bags, of a kind used for the packing of goods)	3.6
6208.92.00	Of man-made fibres (Women's or girls' singlets and other undershirts, slips, petticoats, briefs, panties, nightdresses, pyjamas, negligees, bathrobes, dressing gowns and similar articles)	3.1
6112.11.00	Of cotton (Track suits, ski-suits and swimwear, knitted or crocheted: track suits)	3.1
6104.44.20	Other (Women's or girls' suits, ensembles, suit-type jackets, blazers, dresses, skirts, divided skirts, trousers, bib and brace overalls, breeches and shorts (other than swimwear), knitted or crocheted: of artificial fibres)	2.6

Tariff code	Product	Import share (% of total)
6209.90.90	Other (Babies' garments and clothing accessories: of other textile materials)	2.4
6114.30.30	Other (Other garments, knitted or crocheted: of man-made fibres)	2.0

Source: authors' own calculations based on DataWeb n.d.

In order to check whether implementing tariffs had a significant impact on the level of imports, the parameters of the following model were estimated for the period before the tariffs were implemented:

$$y_t = \boldsymbol{x}_t \beta + \varepsilon_t, \tag{1}$$

where *yt* denotes the level of imports and ***xt*** consists of monthly dummies and a time trend (if it is significant).

In the next step, counterfactual ex-post forecasts are calculated for the period after the implementation of tariffs based on the formula:

$$\hat{y}_{T'+s} = \quad _{T'+s}\hat{\beta}\,, s = 1, 2, \ldots, S, \tag{2}$$

where *T'* is the period of implementing tariffs.

Next, differences are plotted between the observed and forecasted values:

$$\hat{y}_{T'+s} - y_{T'+s}, \tag{3}$$

where $\hat{y}$ denotes the forecasted value of y and $\hat{\beta}$ is the vector of estimates of β.

Results and discussion

In the first step of our quantitative analysis, the parameters of trend models (with seasonal variables) that explain the development in the US imports of textile products from January 2012 – June 2018 (i.e. before the tariff introduction) were estimated. Then, in the second step, the value of imports[4] was forecast for the period starting in June 2018,

4 Entry data represents Imports for consumption, which measures the total merchandise that has physically cleared through US customs immediately or after withdrawal for consumption. These statistics are calculated with the customs value formula, representing the value of imports as appraised by US Customs and Border Protection (Customs). This value is defined as the price actually paid or payable for merchandise excluding U.S. import duties, freight, insurance, and other charges.

assuming that the imports behaved in the same way as before the introduction of the duties (i.e. under the hypothetical no-tariff assumption).

Figures 4 through 13 present the development of the empirical values of US imports (blue lines) and forecasted values (orange lines) for the period July 2018 – September 2020. In addition to the point forecast, its 95% confidence interval is presented. A careful analysis of the figures allows us to draw a clear-cut conclusion. For the majority of the top 10 goods, a significant decrease in the value of imports is observed in relation to the forecasted values. Moreover, the empirical values are outside the 95% confidence interval. The strongest declines in imports, both in absolute values and with regard to the forecast, were observed for the following categories: 6208.92.00 (of man-made fibres); 6112.11.00 (of cotton); 6104.44.20 (other (Women's or girls' suits, ensembles, suit-type jackets, blazers, dresses, skirts, divided skirts, trousers, bib and brace overalls, breeches and shorts) (other than swimwear), knitted or crocheted: of artificial fibres)). The category "Other (Sacks and bags, of a kind used for the packing of goods)" is the only one for which we identified only marginal deviations of the empirical values from the forecast. It is obvious that after the Trump administration introduced the tariffs, a reduction in US imports from China was recorded. This reduction proved to be statistically significant compared to what would be expected under the alternative scenario of no trade barrier.

In the first quarter of 2020, the deviation between the empirical and forecasted values increased. It is very likely related to the COVID–19 outbreak, which started in China and was followed by a lockdown for both individuals and businesses. The first restrictions were implemented in Wuhan on 23 January 2020 and gradually spilled over into the other cities and provinces. Factories and other business units restored their relatively normal operations in April 2020. Unfortunately, when the supply part was ready to provide their products for exports, the demand side was struggling with the continuously worsening situation, which also resulted in lockdowns or other restrictions.

This fight with the pandemic based on restrictions and shutting down business activities can be observed in all the analysed product groups. However, although we do not attempt to estimate the part of the deviation that the "COVID–19 effect" was responsible for, we still believe that our results regarding the trade war effects hold. This is because the significant differences between the forecasted and empirical values were observed well before the outbreak of the pandemic.

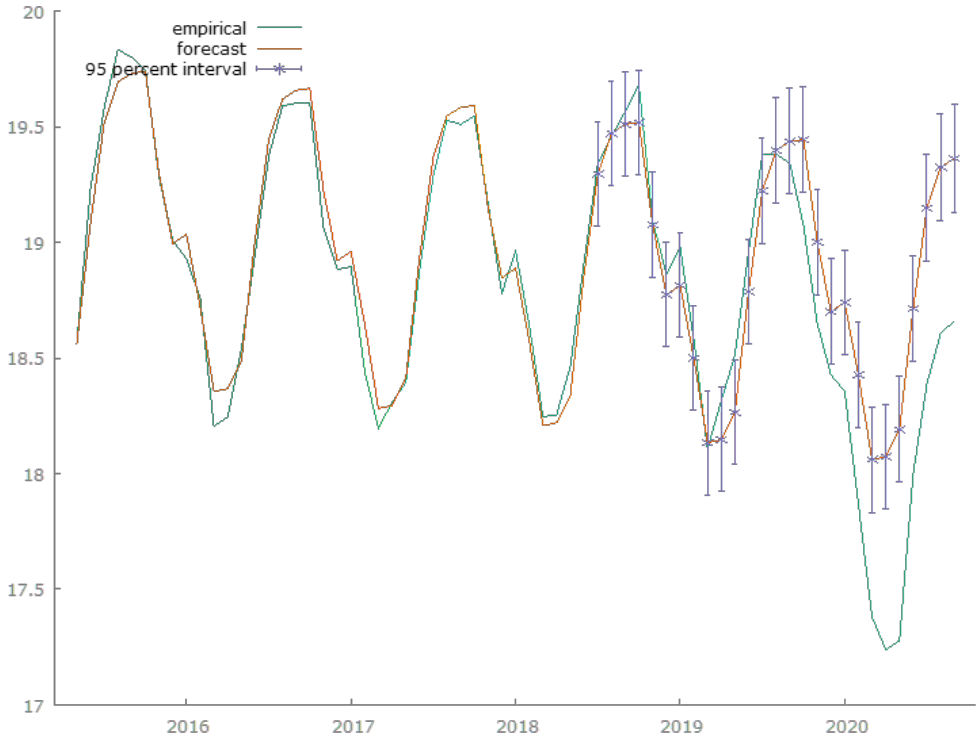

Figure 4. Tariff code 6111.20.10

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

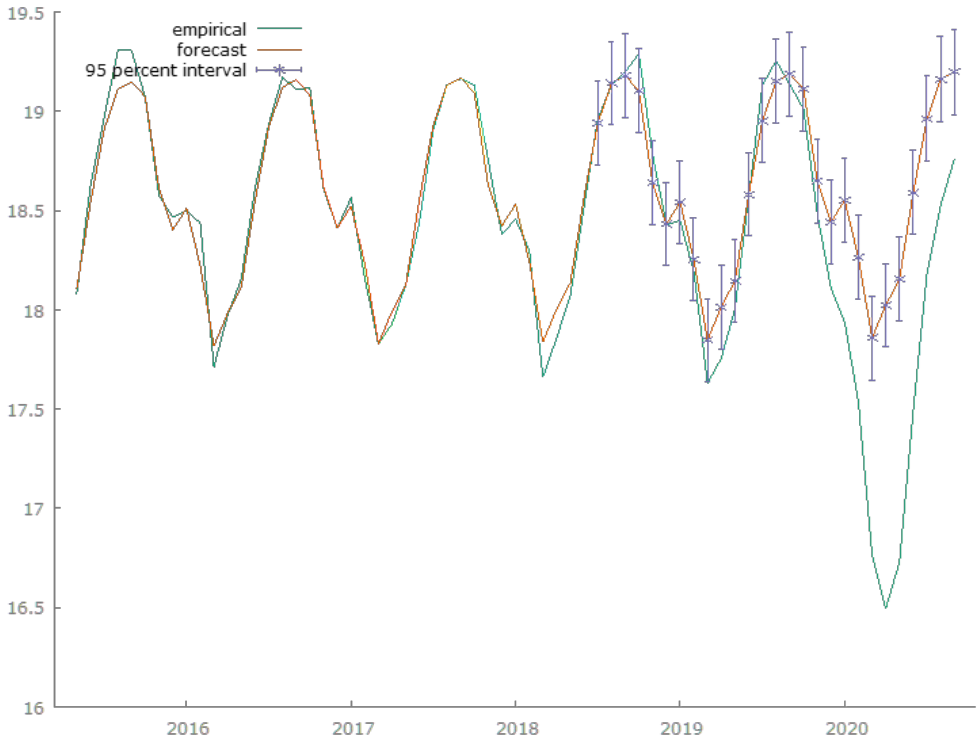

Figure 5. Tariff code 6111.20.50

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

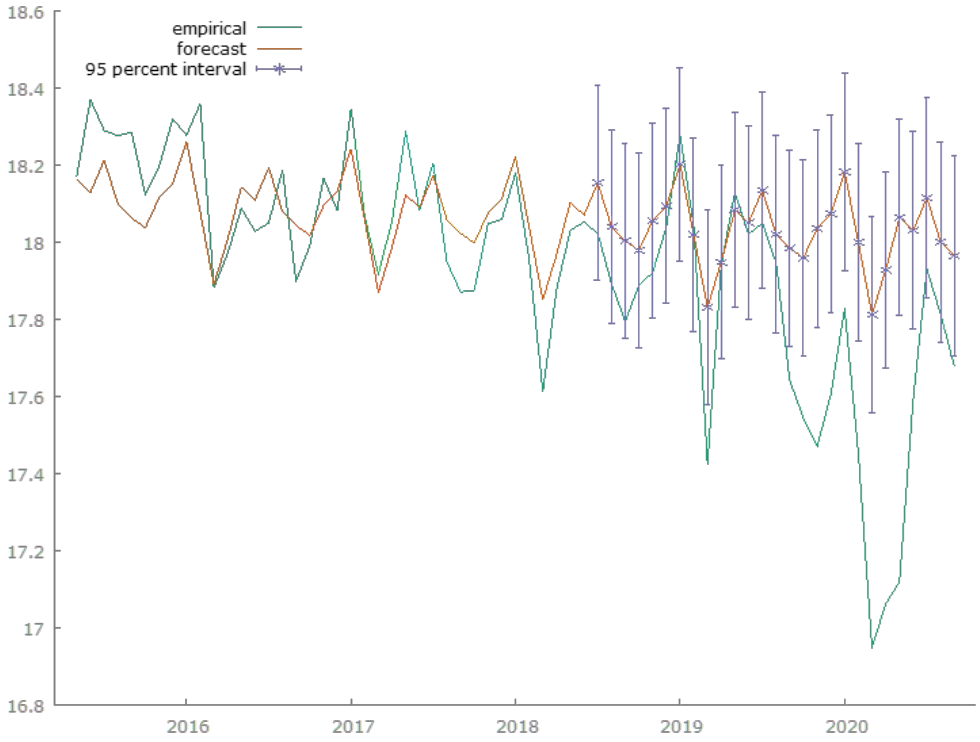

Figure 6. Tariff code 6217.90.90

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

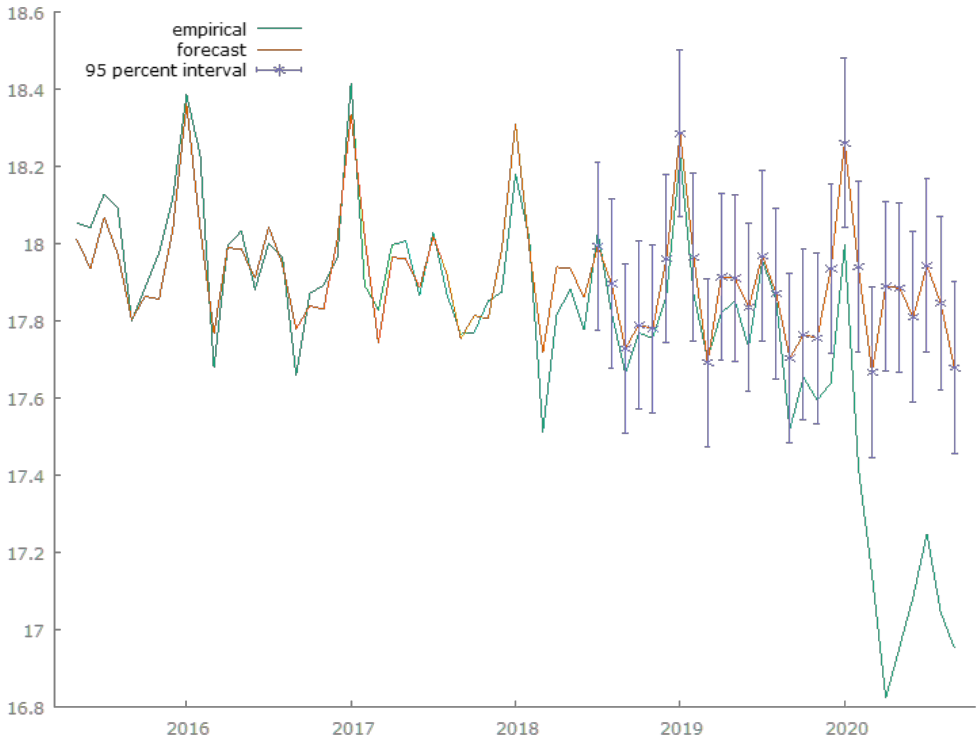

Figure 7. Tariff code 6207.91.10

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

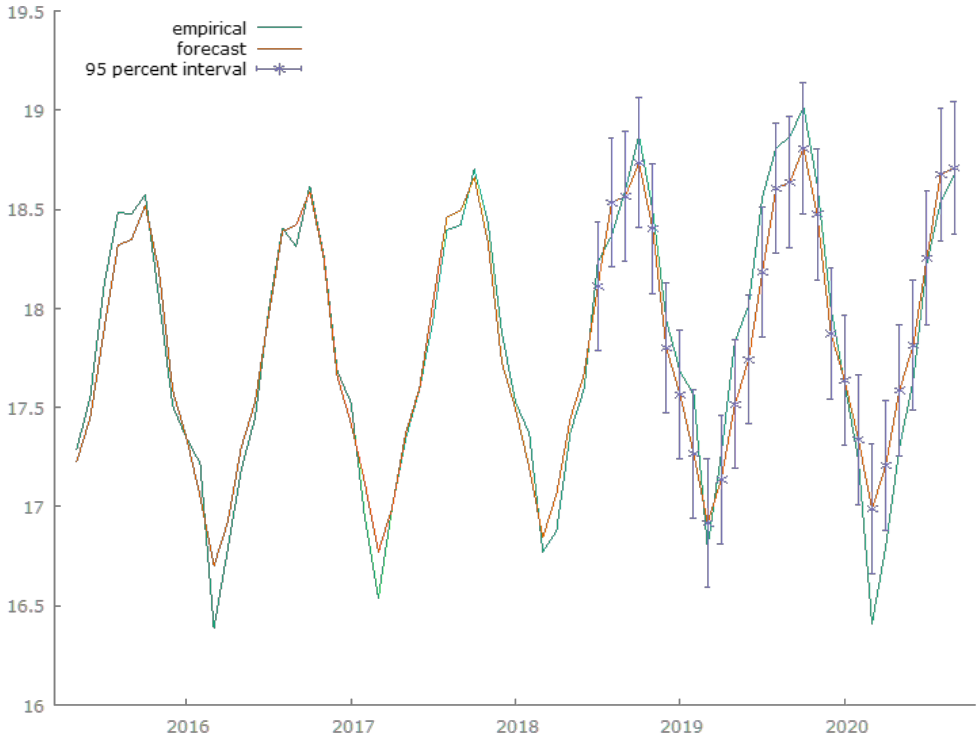

Figure 8. Tariff code 6305.39.00

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

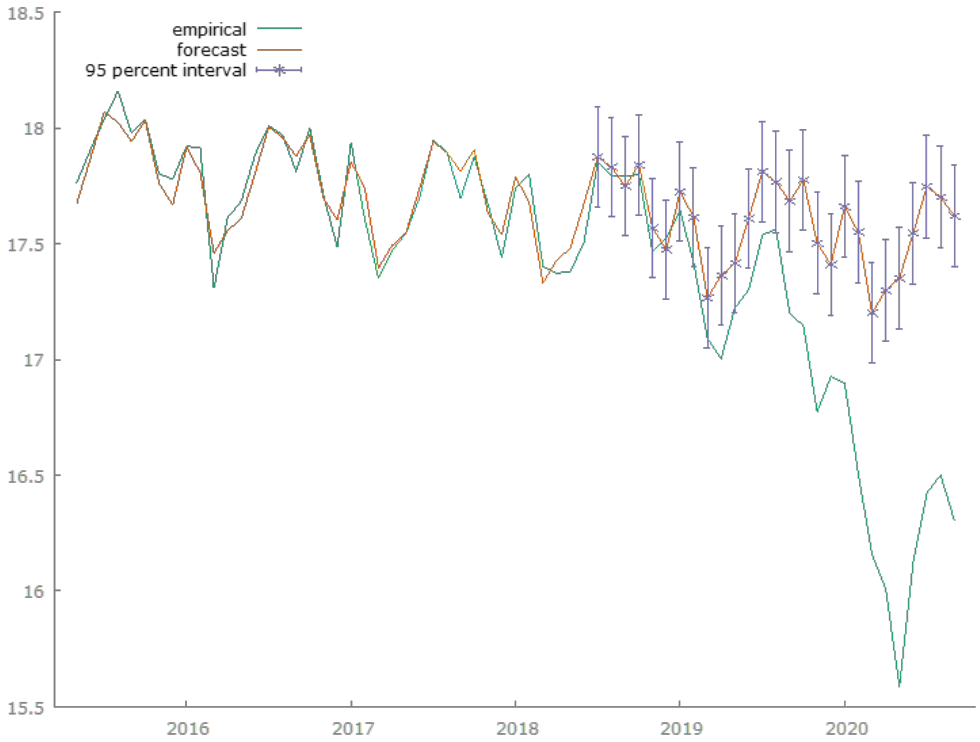

Figure 9. Tariff code 6208.92.00

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

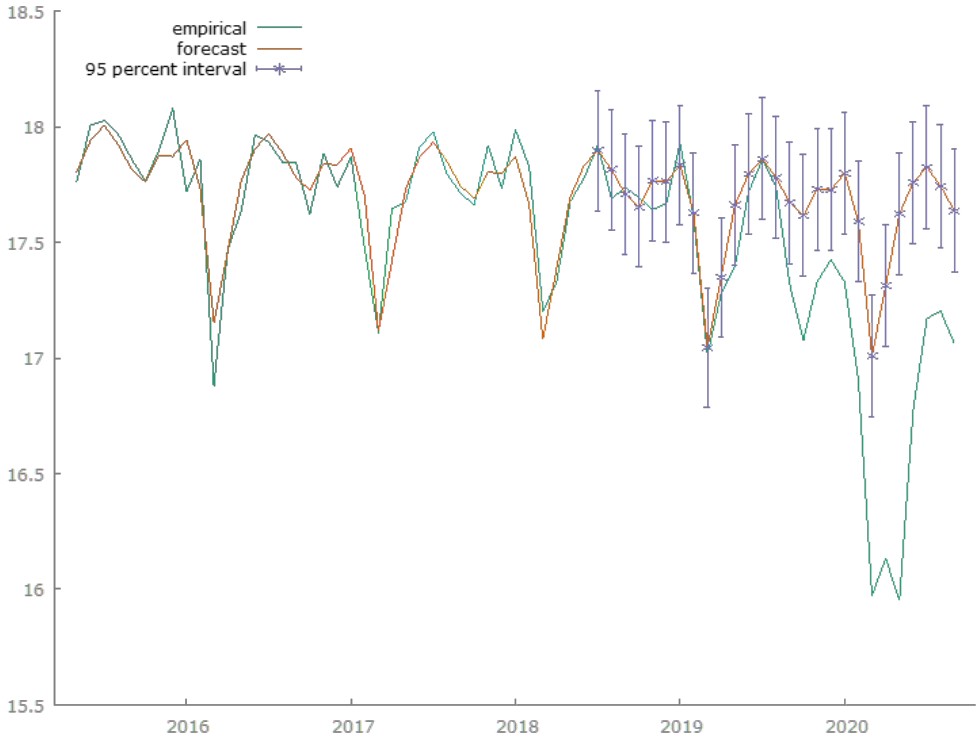

Figure 10. Tariff code 6112.11.00

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

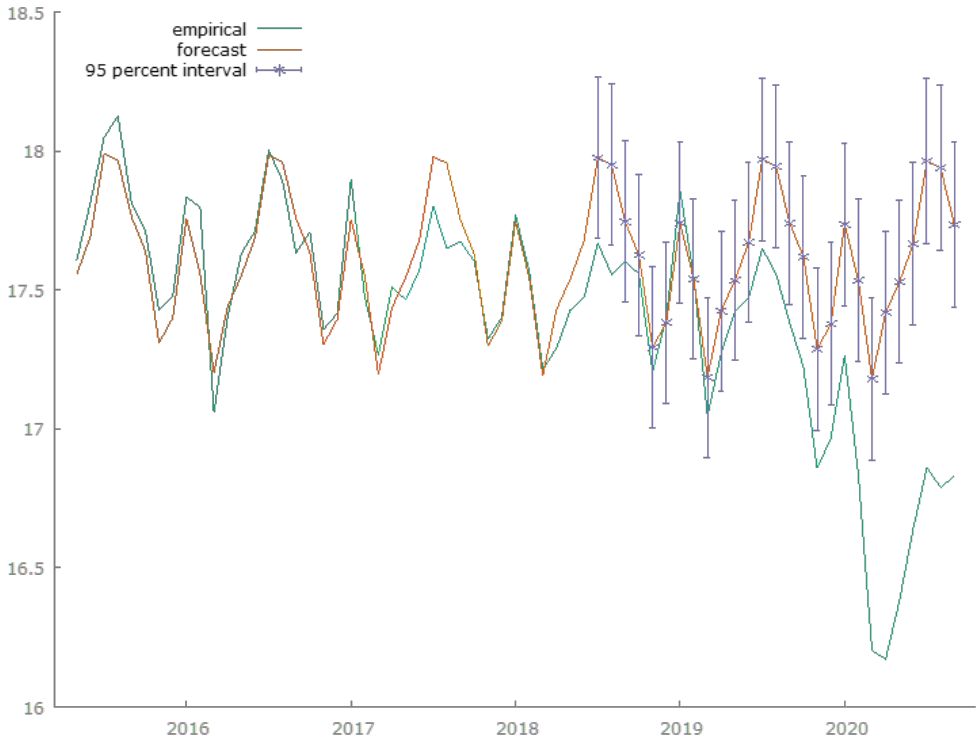

Figure 11. Tariff code 6104.44.20

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

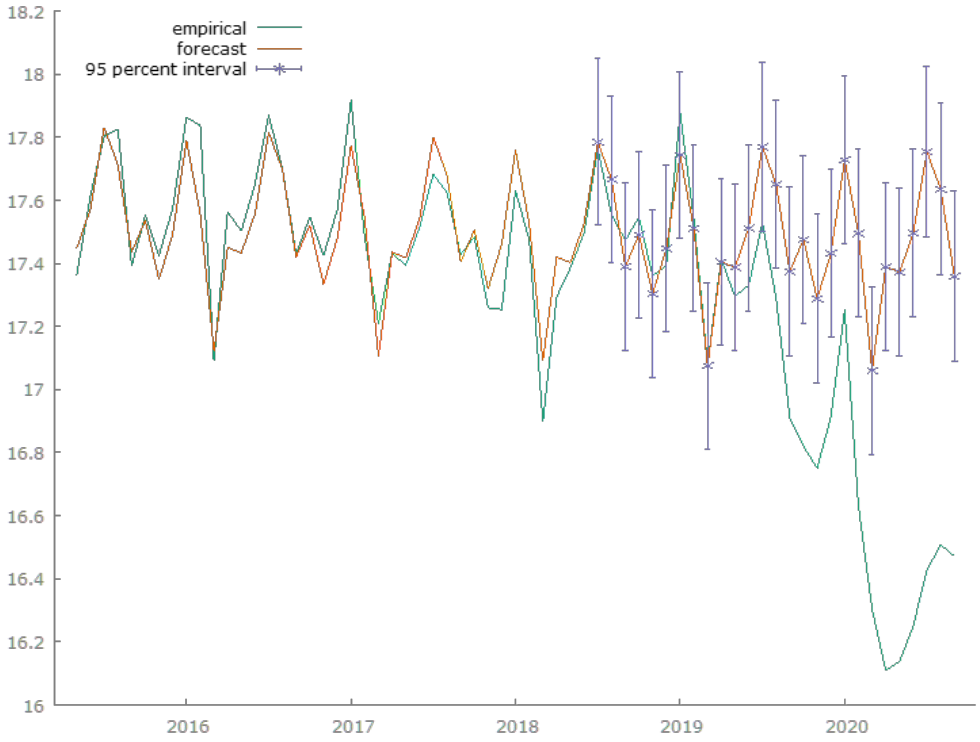

Figure 12. Tariff code 6209.90.90

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

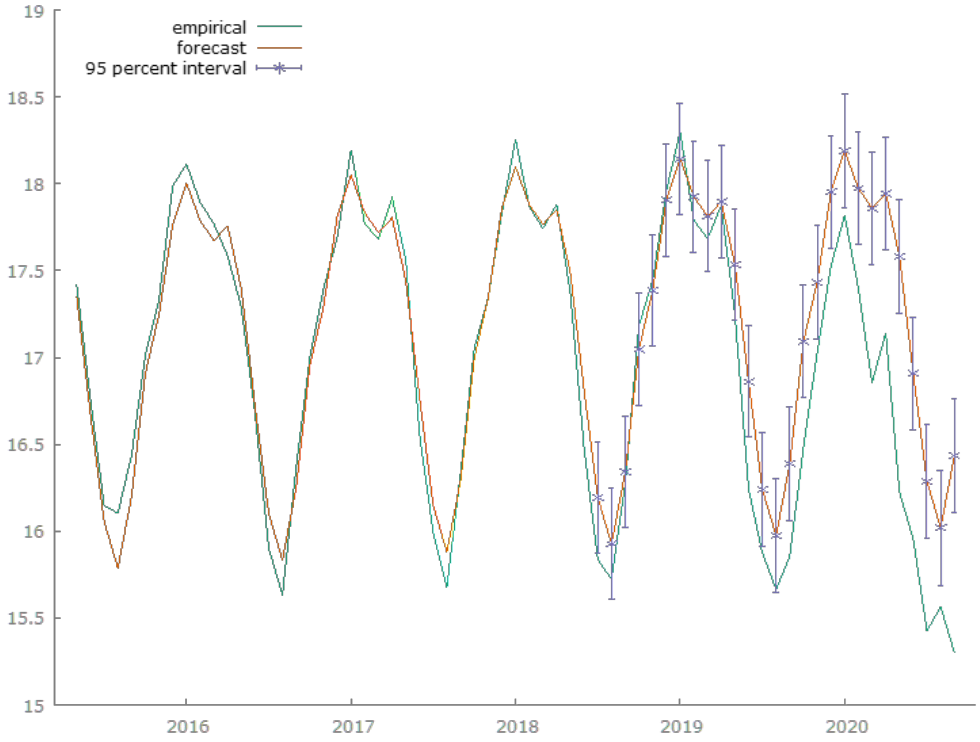

Figure 13. Tariff code 6114.30.30

Source: authors' own calculations conducted in Gretl. Logarithms of imports are presented.

Regarding the changes in trade patterns, long-term consequences, and possible scenarios, the imposed duties might affect the industry threefold. One option is trade diversion, i.e., a shift towards low-cost suppliers from workforce-abundant countries like Bangladesh, India, Vietnam, or Cambodia, accompanied by a relocation of factories from China to those states. The second one assumes price adjustment performed by both Chinese and American parties, whereby Chinese suppliers will lower their selling price while American importers will give up a part of their profit margin to minimally transfer the increased duties to the customers, thus not triggering a fall in demand. The third scenario, and the least possible one, is a shift in demand from imported goods towards American-made ones.

As noted by Rapoza (2020), the first possibility became a reality. Although many US companies are leaving China, they are not coming back home. The American Apparel and Footwear Association (AAFA) stated that increased duties would raise prices on the American market. According to the Organization's CEO, Rick Helfenbein, the average American consumer buys eight pairs of shoes and 68 garments annually (Helfenbein 2019). With additional duties, a family of four would pay at least $500 more to buy basic consumer products and thus face the choice of whether to pay more or buy less. In its statement, the Association emphasised that these duties would affect not only final goods, but also semi-products and equipment used by American manufacturers, thus increasing prices not only of goods "made in China," but also those "made in the USA."

The consequences of the trade war could also bring long-term effects. In August 2019, the yuan-dollar rate was the lowest since 2008, and as the "Wall Street Journal" headline proclaimed, Trade War Becomes Currency War (*Trade War Becomes Currency War* 2019). The Wharton School of the University of Pennsylvania offered potential and not-so-potential consequences for the American economy (Knowledge at Wharton 2019). According to the institution, the trade war with China would lower output for the US economy, and there could be a shift towards households financing US debt. As there would be a reduced inflow of dollars from China, customers would be forced to finance the debt. Additionally, they predicted that the trade war might result in reduced foreign investment flows into the US. The imposed duties would increase the prices of electronics, which would affect businesses, households, and universities. Meanwhile, American farmers could be forced to bear the cost of the conflict, as China suspended purchases of US agricultural products, meaning they would lose that market.

Finally, US importers are moving away from sourcing from China and increasing their investments in other countries. The shift towards more expensive suppliers who were not the first choice has become a permanent tax on US firms and consumers, reducing the consumer's buying power and reducing American firms' competitiveness on the global market. Finally, uncertainty drives US importers to prepare by stockpiling.

Conclusions

The China–United States relations affect the global economy, regardless of the countries' cooperation with a third-party partner. Thus, tensions in these relations and the ongoing trade war are closely observed phenomena.

This paper investigated the scale of the drop in American imports after it imposed punitive tariffs on Chinese goods. Our research focused on the textile industry, which is important from the point of view of the bilateral relations. For the purposes of the study, it was narrowed to a group of 30 products with the highest share in the US import of textiles.

By disaggregating groups of textile products into individual HTS codes on an eight-digit detail level (or higher), we uncovered a clear pattern in the US textile market, i.e., after the Trump administration introduced the tariffs, a reduction in imports from China was recorded. With such detailed analysis, we managed to avoid the risk of drawing overly general conclusions or erroneous conclusions.

Although the quantitative research focused on the short-term consequences, we also provided a review of the effects of the China–United States trade war on the latter's economy in the long perspective. These include, among others, an increase in the Consumer Price Index (CPI), lower economic growth, issues regarding the sustainability of government debt, and reduced foreign investment flows to the US economy.

To the best of our knowledge, our study is the first that concentrates in detail on a particular industry instead of formulating conclusions at the general macroeconomic level. Further analyses could span other industries that account for large shares in mutual trade, or provide cross-industry comparisons. Future research should also bring the impact of the COVID–19 pandemic to the forefront. In particular, using longer time series, an attempt could be made to estimate and compare the effects of the COVID–19 and the trade war in dragging down American imports, or bilateral trade in general. Additionally, the long-term implications of the ongoing trade war formulated in this paper should be enriched by the likely overlapping effects that stem from the pandemic experiences.

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Amerykańsko-chińska wojna handlowa: przebieg, konsekwencje i perspektywy dla gospodarki USA Analiza na przykładzie przemysłu tekstylnego

W niniejszym artykule badana jest skala spadku amerykańskiego importu po nałożeniu ceł na chińskie towary w kontekście tzw. wojny handlowej. Analiza obejmuje cały okres prezydentury Donalda Trumpa (styczeń 2017 – styczeń 2021). W przeciwieństwie do dotychczasowych badań, które poświęcone były głównie wpływowi zmniejszonych przepływów handlowych na kluczowe wskaźniki makroekonomiczne, koncentrujemy się na specyficznym rynku wyrobów tekstylnych, który był jednym z najbardziej dotkniętych środkami protekcjonizmu. Przeprowadzona analiza wraz z badaniem ilościowym pozwala stwierdzić, że nałożone cła istotnie uderzyły w przemysł tekstylny, przynosząc zauważalny spadek importu do USA wybranych grup produktów z Chin. Ponadto przegląd długoterminowych konsekwencji wskazuje, że trwająca wojna handlowa nie tylko negatywnie wpłynęła na makroekonomiczne podstawy gospodarki amerykańskiej, ale prawdopodobnie będzie miała długotrwały wpływ na globalne łańcuchy dostaw i produkcji.

Słowa kluczowe: wojna handlowa, bariery w handlu, protekcjonizm, cła, relacje USA–Chiny, handel międzynarodowy, przemysł tekstylny w USA

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Impact of the Mobile Banking Application Ratings on the Vietnamese Bank Service Income

Tien Phat Pham https://orcid.org/0000-0001-9472-5878
Tomas Bata University in Zlin, Faculty of Management and Economics, Zlin, The Czech Republic
Can Tho University, School of Economics, Vietnam, e-mail: phamphattien@gmail.com

Boris Popesko https://orcid.org/0000-0002-3590-7070
Tomas Bata University in Zlin, Faculty of Management and Economics, Zlin, The Czech Republic
e-mail: popesko@utb.cz

Sinh Duc Hoang https://orcid.org/0000-0001-6382-4056
Tomas Bata University in Zlin, Faculty of Management and Economics, Zlin, The Czech Republic
Ho Chi Minh City University of Foreign Languages – Information Technology, e-mail: sinhhd@huflit.edu.vn

Tri Ba Tran https://orcid.org/0000-0003-3635-1163
Can Tho University, School of Economics, Vietnam, e-mail: tbtri@ctu.edu.vn

Abstract

Based on the relationship between fintech and bank performance and the role of mobile applications in bank operations, we investigate the impact of mobile banking application (MBA) ratings on bank service income. The quarterly data from the 15 biggest Vietnamese commercial banks in 2019–2020 were extracted from the public financial statements and the Google Play Store. The Generalized Least Squares method is applied to process the proposed regression models. We find a positive impact of MBA ratings on bank service income. We additionally explore the MBA quality of a large bank that does not meet customer expectations and how the interaction between MBA ratings and leverage harms bank service income. Finally, users generally appreciate the MBA quality, and COVID–19 does not affect the link between MBA ratings and bank service income. The study provides novel knowledge on customer behavior through MBA ratings and their effect on bank service income in an emerging country.

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Keywords: mobile banking application, ratings, service income, bank, Vietnam

JEL: G00, G20

Introduction

Under the growth of internet infrastructure and mobile devices, especially smartphones, smartphone applications have become indispensable. In the banking industry, besides automated teller machines (ATMs) and telephone and Internet banking, mobile banking applications (MBAs) are the latest technology used to deliver traditional banking products, such as transfers, savings, and credits (Safeena et al. 2012; Shaikh and Karjaluoto 2015). MBAs are one of the outcomes of bank fintech, reflecting banks' adaptation to and competition with fintech companies in the digital world.

According to Lee and Shin (2018) and FindeXable (2020), mobile payments and peer-to-peer lending are the two largest segments of fintech, which are also the main banking segments (basic segment). A fintech company does not need a physical transaction office to distribute its products. Through fintech mobile applications, a fintech company can reduce operating costs resulting in fewer (or no) physical offices, and transactions via smartphone are handled and completed quickly; it is an advanced factor of fintech companies that allows them to compete with the incumbents in the banking industry. The rise of fintech companies increases the pressure to digitize banking (Niemand et al. 2021). We argue that MBA development is the best solution for the current context and long-term banking strategy regarding banks' information technology (IT) investments. There is a positive relationship between MBA and an increase in customer needs, customer satisfaction, and bank performance (Shaikh and Karjaluoto 2015; Daniyan-bagudu et al. 2017; Tam and Oliveira 2017; Shanmugam and Nigam 2020; Meena and Parimalarani 2020).

Additionally, MBA quality and customer satisfaction are critical factors in customer behavior (Sampaio, Ladeira, and Santini 2017; De Leon, Atienza, and Susilo 2020). We argue that if users feel satisfied with the MBA, they will continue to use it; if not, they will stop and find another one to replace it. Therefore, customer satisfaction with the MBA decides the use frequency and might affect the bank's income (from commission and transaction fee).

According to Pagano and Maalej (2013) and Genc-Nayebi and Abran (2017), user feedback on satisfaction and application quality is beneficial. User reviews and ratings on mobile app stores are trusted and reliable feedback. Most scholars are only interested in using mobile app store feedback to evaluate MBAs; in particular, they use MBA ratings to investigate the influence on bank performance. Therefore, in this study, we use

app store ratings for MBAs to examine the effect of MBAs on bank performance, namely bank service income.

The study contributes novel knowledge on the effect of customer behavior on bank performance. Specifically, MBA ratings are used to measure bank customer satisfaction and investigate its effect on bank service income in Vietnam, an emerging country. The key finding is that banks increase service income if customers highly appreciate the MBA quality. Furthermore, based on the findings, we suggest that the relationship between MBA quality, MBA user experience, and bank characteristics should be considered carefully to enhance bank service income.

Literature review

The impact of mobile banking applications on bank performance

MBA development is part of a bank's IT investment (Shaikh and Karjaluoto 2015). The empirical results of the relationship between IT investment and bank performance are varied. Beccalli (2007) found that acquiring the technology negatively affects IT investment, but it is positive with outsourcing. Pham et al. (2021) found that IT investment decreases bank efficiency in Vietnam and Pakistan. In contrast, Wang et al. (2020) explored the positive effect of IT investment on bank performance in Turkey.

One of the outcomes of IT investment is MBAs. However, to date, research into the impact of MBAs on bank performance has attracted little interest. Interviewing 301 respondents using MBAs from Egypt, Mostafa (2020) found the positive effect of MBA quality on customer loyalty and the chance to penetrate niche markets, especially the retail banking market. Using primary data from a survey, Daniyan-bagudu et al. (2017) found a positive effect of MBAs on the financial performance of 22 banks in Nigeria. Meena and Parimalarani (2020) stated that the banking products distributed via smartphone applications reduce the banking workforce, helping to save operating costs and increase banks' profit. However, they create new challenges for the bank, such as cybersecurity and new requirements of the workforce. The review study by Tam and Oliveira (2017) indicated a causality between MBA development and customer behavior change. MBAs change customer behavior in using banking products and shopping online (e-commerce). Increasing customer needs and more transactions via MBAs motivate banks to improve the MBA. Overall, we discuss how the customer factor moderates the relationship between MBA and the bank. The customer attitude with the MBA is a critical factor in bank performance.

User feedback on the app store

Technological innovation is a critical factor in firm competitiveness, and mobile apps are one of the outcomes of technology innovation. Ye and Kankanhalli (2020) found that the customer plays a critical role in mobile app performance, deciding a firm's success, especially in a service industry like the banking sector. Pagano and Maalej (2013) stated that user ratings and reviews about applications are valuable information to application developers and potential users. User feedback reflects the application's quality and user behavior. In 2016, a survey of 301 MBA users in Egypt showed that MBA quality positively correlates with customers' value co-creation intentions (Mostafa 2020).

Mobile application reviews and ratings on app stores have been used in academic research in various fields. For example, in the healthcare industry, Plante et al. (2018) and Schumer, Amadi, and Joshi (2018) used reviews and ratings on the Google Play Store and Apple App Store to evaluate dietary and nutritional apps and a blood pressure-measuring smartphone app, respectively. Consulting mobile app developers, Hu et al. (2019) suggested that the star ratings of apps (cross-apps) on a specific platform (Google Play Store or Apple App Store) is significant for comparison. However, there is a difference in particular app ratings between platforms. Jisha, Krishnan, and Vikraman (2018) found a substantial relationship between security risk and user reviews of mobile apps on the Google Play Store platform. Kapoor and Vij (2020) showed that login time, visual design, navigation design, information design, collaboration, and service quality are significant factors in MBA ratings and reviews in the banking sector.

Consequently, based on the existing publications mentioned above, using users' ratings and reviews on app stores is a valuable tool for measuring MBA quality. Therefore, this study investigates how MBA ratings influence bank service income.

Research methodology

Study scope

Vietnam's commercial banks were selected for investigation for the following reasons. Firstly, Vietnam is an emerging country where numerous people do not have a bank account. However, the IT infrastructure is highly developed, which is suitable for the development of fintech companies and MBAs (Demirguc-Kunt et al. 2018; Nguyen, Dinh, and Nguyen 2020). Secondly, the policy for promoting cashless payments, e-banking activities, and the fintech development of the Vietnamese Government was revealed, which is the background for MBA development (MBSecurities 2018). Finally, finance is a pioneering industry in Vietnam's economic transformation (Vo 2016; Nguyen, Ho, and Vo

2018). We believe that MBAs play a crucial role in bank performance during the transformation. Therefore, we argue that Vietnam's banks are suitable for the study.

The two largest smartphone operating systems globally are Android and iOS, with many applications on Google Play and Apple's App Store. Most smartphones in Vietnam run Android; hence, we selected Vietnamese commercial banks' MBAs on Google Play to collect the reviews. There are fewer constraints about application updates and publishing user reviews on Google Play than on the App Store (Ye and Kankanhalli 2020); thus, users' thoughts are more valuable. Furthermore, we feel free to access the public information about users' reviews on Google Play; it is very useful and suitable for the proposed study.

In December 2019, the first infection of COVID–19 was confirmed in Wuhan, China. The number of infected cases rapidly increased, and COVID–19 became a global pandemic that is still going on. The socio-economic effects of COVID–19 have attracted many scholars. Regarding the primary banking products, Pham and Popesko (2020) gave that in the context of COVID–19, mobile payment has a chance to develop. Zachariadis, Ozcan, and Dinckol (2020) revealed that during COVID–19, there was a significant increase in the number of fintech applications that were downloaded. We believe that users' experience of COVID–19 might differ from the pre-COVID–19 times. Therefore, the time scale consists of two stages: from 2019q1 to 2019q4 (pre-COVID–19) and from 2020q1 to 2020q4.

Model

To investigate the impact of MBA ratings on bank service income, a linear regression was formulated:

$$Service_{it} = \alpha + \beta_1 App_{it} + \beta_2 Contr_{it} + \mu_{it} + \varepsilon_t, \quad (1)$$

where, $Service_{it}$, App_{it}, and $Contr_{it}$ are the service income, MBA ratings, and control variables of bank i at quarter t, respectively. μ_{it} is time-varying across banks and over time. ε_t is the bank effect to cover the specific heterogeneity.

Data

The service income variable consists of the logarithm of service income, net service income, and net service income ratio on return before tax. The control variables consist of bank size and leverage, reflecting the commercial banks' unique features. According to the Vietnamese Stock Exchange Market Commission regulation, listed companies must disclose quarterly financial statements to the media. In Vietnam, Vietstock is the trusted statistical organization and a specialist in the stock market (Pham and Qud-

dus 2021); thus, we select Vietstock as the primary source to collect the financial statements and other important reports of the listed banks. Based on that, the variables were computed.

The MBA rating variables encompass the total star ratings' logarithm and the average star ratings (equal to the total of the star ratings divided by the number of users who rated the MBA). The variables are collected and computed based on public information about star ratings on Google Play.

The strongly balanced panel data from the 15 biggest listed banks (by total assets) in the Vietnamese Stock Exchange Market from 2019Q1 to 2020Q4 was used to investigate the effect of MBA ratings on bank service income.

Results and discussion

To understand the feature of the variables, the descriptive statistics are shown in Table 1.

Table 1. Descriptive statistics

Variable	Measurement	Obs.	Mean	SD	Min	Max
ICS	Logarithm of service income	120	5.813666	.4543262	4.806878	6.630461
NIC	Logarithm of net service income	120	5.622511	.4193595	4.51371	6.486932
ICR	Net service income on return before tax	120	.3519033	.2908266	.046569	1.854991
REV	Logarithm of number of star ratings	120	2.989731	.4701991	2.170262	3.893651
STA	Average of star ratings	120	4.083921	.3568899	2.992366	4.91731
SIZE	Logarithm of total assets	120	8.550459	.3345006	8.00414	9.180948
LEV	Ratio of liability on equity	120	11.88792	4.133809	.6855129	23.3133

Source: the authors' elaboration.

Table 1 shows some interesting data. Firstly, the ICR row shows that the average net service income accounts for over 35% of the return before tax in the sample period, which shows the critical role of service income in total bank income. We argue that with the support of fintech, the weight of service income will be higher in the future. An observation is that income service is the main contributor to bank profit (ICR_{max} is 1.85), or net service income is higher than return before tax, which might be explained by the loss of credit operation (a decrease

in interest income). Meanwhile, the bank can earn more money from fees and commissions. Secondly, the average star rating is so high that STA_{mean} is slightly over 4 stars. The STA_{min} and STA_{max} are rated nearly 3 and 5 stars, respectively. With 5-star rankings on Google Play, we believe that the users evaluate the MBAs as high quality and that they meet their needs. In fact, after reading the comments about the MBAs, we feel that most users are satisfied with using the MBAs. It is the necessary condition that influences bank performance.

Next, according to Gujarati and Porter (2009), if the maximum absolute value of the correlation coefficients between variables is over 0.8, there will be a multicollinearity effect in the regression model. Therefore, the correlation between variables is estimated before processing the regression model. Based on the correlation matrix, a suitable model will be proposed.

Table 2. The correlation between variables

Variable	ICS	NIC	ICR	REV	STA	SIZE	LEV
ICS	1.0000						
NIC	0.9788	1.0000					
ICR	0.2658	0.3060	1.0000				
REV	0.7898	0.7360	0.0561	1.0000			
STA	0.0614	0.1459	−0.1038	−0.1504	1.0000		
SIZE	0.8013	0.7461	0.1334	0.6247	0.0970	1.0000	
LEV	0.1389	0.1227	0.2843	0.0025	0.0382	0.4908	1.0000

Source: the authors' elaboration.

Table 2 shows that the correlations between ICS and NIC, and ICS and SIZE exceed 0.8, i.e., they are 0.9788 and 0.8013, respectively. The correlations between the other variables are less than 0.8. Because ICS and NIC are the dependent variables, they are not being in the same model; thus, the correlation between ICS and NIC does not influence the estimation results. However, the correlation between ICS and SIZE is over 0.8, and SIZE is the control variable; thus, SIZE is excluded from the ICS regression model. Based on that and the proposed model above (equation 1), we formulate three models for the study:

$$\text{Model 1: } ICS_{it} = \alpha_1 + \beta_1 REV_{it} + \beta_2 STA_{it} + \beta_4 LEV_{it} + \mu_{it} + \varepsilon_t, \quad (2)$$

$$\text{Model 2: } NIC_{it} = \alpha_2 + \beta_4 REV_{it} + \beta_5 STA_{it} + \beta_6 LEV_{it} + \beta_7 SIZE_{it} + \mu_{it} + \varepsilon_t, \quad (3)$$

$$\text{Model 3: } ICR_{it} = \alpha_3 + \beta_8 REV_{it} + \beta_9 STA_{it} + \beta_{10} LEV_{it} + \beta_{11} SIZE_{it} + \mu_{it} + \varepsilon_t. \quad (4)$$

Next, the variance inflation factor (VIF) of models 1, 2, and 3 are estimated. Table 3 shows that all VIF statistics are very low, under 4.0, the threshold of VIF for a regression model having under ten independent variables (Gujarati and Porter 2009; Salmerón Gómez et al. 2020). Therefore, the proposed independent variables are suitable for models 1, 2, and 3.

Table 3. The variance inflation factor

	REV	STA	LEV	SIZE
Model 1	1.02	1.02	1.00	–
Model 2	2.27	1.12	1.69	2.94
Model 3	2.27	1.12	1.69	2.94

Source: the authors' elaboration.

Next, the fixed-effect (FE) and random-effect (RE) approaches were applied to estimate panel data regression, and the Hausman test was employed to choose the suitable estimation results between FE and RE.

Table 4. The estimation results by the GLS approach

	Model 1 (ICS)				Model 2 (NIC)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cons	2.501***	2.185***	1.578**	2.409***	−2.001***	−2.957***	−2.949***	−1.933***
	[10.96]	[5.16]	[2.24]	[11.36]	[−3.99]	[−4.95]	[−4.28]	[−3.71]
REV	.768***	.873***	.762***	.772***	.318***	.626***	.322***	.327***
	[26.38]	[7.17]	[25.91]	[27.66]	[7.25]	[5.42]	[7.21]	[7.28]
STA	.211***	.203***	.440**	.220***	.090*	.102**	.350**	.097**
	[4.14]	[3.92]	[2.54]	[4.58]	[1.89]	[2.18]	[2.53]	[2.05]
LEV	.016***	.049	.101	.017***	−.020***	.078**	.057	−.019***
	[5.24]	[1.31]	[1.63]	[5.77]	[−5.16]	[2.27]	[1.27]	[−4.58]
SIZE					.764***	.749***	.747***	.748***
					[10.60]	[10.61]	[10.40]	[9.76]
REV*LEV		−.010				−.029***		
		[−0.88]				[−2.88]		
STA*LEV			−.021				−.018*	
			[−1.37]				[−1.72]	

	Model 1 (ICS)				Model 2 (NIC)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COV				.070***				.016
				[2.58]				[0.60]
Wald statistic	752.72***	757.48***	769.07***	855.74***	749.75***	804.60***	736.98***	770.85***

	Model 2 (NIC)		Model 3 (ICR)					
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Cons	−18.835***	−15.459***	.903**	.726	1.568**	−4.863	6.123	.894**
	[−6.37]	[−2.96]	[2.11]	[1.42]	[2.17]	[−1.59]	[1.13]	[2.07]
REV	5.664***	.331***	.115***	.160*	.116***	1.943**	.122***	.114***
	[6.16]	[7.51]	[3.01]	[1.92]	[3.02]	[2.05]	[3.14]	[2.96]
STA	.106**	3.461***	−.031	−.029	−.173	.007	−1.260	−.032
	[2.51]	[2.69]	[−0.76]	[−0.69]	[−1.36]	[0.15]	[−0.97]	[−0.76]
LEV	−.0164***	−.0184***	.0150***	.030	−.043	.017***	.015***	.015***
	[−4.24]	[−4.11]	[4.35]	[1.22]	[−0.87]	[4.66]	[4.33]	[4.24]
SIZE	2.744***	2.335***	−.115**	−.113**	−.125**	.540	−.747	−.113**
	[7.97]	[3.75]	[−2.04]	[−2.00]	[−2.16]	[1.53]	[−1.15]	[−1.98]
REV*LEV				−.005				
				[−0.61]				
STA*LEV					.014			
					[1.17]			
REV*SIZE	−.630***					−.213*		
	[−5.85]					[−1.92]		
STA*SIZE		−.395***					.148	
		[−2.59]					[1.13]	
COV								.002
								[0.09]
Wald statistic	1039.73***	665.14***	28.33***	29.13***	28.71***	30.95***	27.50***	27.57***

Note: *, **, and *** are the significant level at 10%, 5%, and 1%, respectively
Source: the authors' elaboration.

According to Cheruiyot (2017) and Pham et al. (2021), size significantly impacts a bank's IT activities and performance. The ratio of liability on equity is a unique characteristic of commercial banks compared with other companies, reflecting their risk-taking (Pasiouras, Tanna, and Zopounidis 2009; Buchak et al. 2018; Le 2020). The interaction of bank features (size and risk-taking) and customer behavior affect bank performance

(Ito and Sasaki 2002; Suh and Han 2002). Therefore, besides the original models 1, 2, and 3 mentioned above, we also investigate the effect of the interaction between MBA ratings and bank characteristics on bank service income; thus, REV*SIZE, REV*LEV, STA*SIZE, and STA*LEV are added to the proposed models.

Furthermore, as we mentioned above about the time before and during COVID–19, we set up the dummy variable to express the COVID–19 factor (denotes COV); namely, COV = 0 for pre-COVID–19, and COV = 1 during COVID–19. The COVID–19 variable is added to the proposed models to estimate the effect of COVID–19 on the relationship between bank service income and MBA ratings.

The estimation results from the FE and RE approaches are then handled by the Hausman test to choose the suitable results between FE and RE. We use the Wald/Breusch-Pagan Lagrange and Wooldridge tests to check for heteroskedastic and autocorrelation problems, respectively. The outcome shows that all estimation results by FE or RE approaches have heteroskedastic and/or autocorrelation issues. According to Baltagi (2005) and Gujarati and Porter (2009), the Generalized Least Squares (GLS) approach is used to fix the problem(s). Table 4 shows the estimation results using the GLS approach, which is used to explain the effect of MBA ratings on bank service income. All models are significant at the 1% level, meaning the independent variables are suitable for explaining the change in the dependent variable.

The REV coefficients of all models are positive and significant, which means the number of star ratings on Google Play is a positive factor of service income, net service income, and the ratio of net service income on return before tax. The STA coefficients of model 1 (ICS) and model 2 (NIS) are positive and significant, but are not substantial for model 3 (ICR). The average star rating positively influences the service income (both gross and net service income). The contribution of the service income on the whole return is not affected by the average star rating. These findings are significant evidence that is consistent with the argument we mentioned in the literature review section. A high star rating increases bank service income, which mainly contributes to the whole bank's performance.

Two reasons might explain the positive effect of MBA ratings on bank service income. First, typically, after a few days of installing an MBA and completing a few transactions, users are asked to leave an evaluation of the app in the store. If they feel that the MBA is good and meets their demands, they will leave high ratings, and if not, they will not. As mentioned above, the data show that most MBAs are highly rated, and we argue that it positively affects customer intention for subsequent financial demand. Meanwhile, Mostafa (2020) found that MBA quality has a positive link with customer added value. Therefore, based on that, we believe that a high MBA rating increases the number of transactions and bank service incomes, especially regarding the revenue from mobile transaction functions. Second, besides earning directly from transactions through the app, the bank service income

might increase from cross-selling products when a customer is highly interested in using the app. The collaboration between banks and e-commerce platforms, banks and fintech companies, and banks and insurtech companies, are indispensable trends in the digital era (Puschmann 2017; Yan, Schulte, and Kuo Chuen 2018; Kumar et al. 2021). Based on that, MBA facilitates the development of the partners' products, and relying on it, the banks might expand their influence and benefit from the third parties.

Bank size increases net income service but reduces the net income service ratio before tax. Additionally, the interaction between bank size and mobile banking application review (REV*SIZE and STA*SIZE) is positive with NIC and ICR. We believe that large banks are in the advanced stages of MBA development, and large banks are considered more trusted and reliable than small ones (Ito and Sasaki 2002; Suh and Han 2002). Thus, customers tend to select the MBAs of large banks, increasing bank income service. However, the quality of large banks' apps does not meet users' expectations; thus, the interaction between MBA ratings and bank size negatively affects net income service and service distribution in the whole return.

The LEV coefficients are different between the models, i.e., they significant and positive in columns (1), (6), (11), (13), and (15), significant and negative in columns (5), (9), and (10), and insignificant in the rest of the columns. It might be explained by the banks' different financial structures (Le 2019). According to SBV (2020), few Vietnamese banks meet the requirement of Basel III regarding capital adequacy and risk management. They focus on increasing bank service income, while other banks with high risk tend to earn interest. Additionally, the estimation result shows that the interaction between LEV and MBA ratings is negatively significant in columns (6) and (7), which means the combination of the high leverage and the increase in MBAs is harmful to the income service.

The COVID–19 factor does not influence net bank service income or the ratio of bank service income on return before tax. However, it significantly affects bank service income. During COVID–19, bank service income was positively correlated with star ratings. The Vietnamese Government's COVID–19 pandemic adaptation strategy was appreciated and suitable for the conditions in Vietnam. In fact, in 2020, the Zero-Covid strategy was executed very effectively in Vietnam. Vietnam is mostly in lockdown regarding international connections. However, domestic socio-economic activities are still happening in typical ways, and they seem to be less affected by the COVID–19 pandemic. Thus, there is no distinction between customer behavior in using MBAs between the two periods of the sample. Based on that, the findings on the influence of the COVID–19 factor on bank performance are suitable for the current Vietnamese economic context.

Conclusion

In the digital era, fintech has become a crucial sector in the finance industry; it is both an opportunity and a threat to banks. There are many ways that banks have adapted to the rise in fintech. Developing MBAs is one of the best solutions, and they are also the best result of banks' IT investments. The study is on the significant relationship between IT investment and bank performance and the emerging issue of user ratings on app stores. Based on the review of existing publications, the regression model is formulated to investigate the influence of MBA ratings on bank service income. The quarterly data from the 15 biggest listed banks in the Vietnamese Stock Exchange market from 2019q1 to 2020q4 is aggregated from Vietstock and Google Play. To process the proposed models, the FE and RE approaches were initially applied, but we explored the estimation results with the heteroskedastic and/or autocorrelation problems; thus, we then used the GLS approach to fix these problems.

The findings are: (1) the quality of MBAs on Google Play is highly appreciated by users; (2) there is a significant positive impact of MBA ratings on bank service income; (3) large banks are more advanced in enhancing service income than small banks; however, it seems that the quality of large banks' MBAs does not meet customer requirements; (4) banks have high leverage, and MBA ratings seem to be harmful to service income; and (5) COVID–19 does not affect the relationship between MBA ratings and bank service income in Vietnam.

The reviews on Google Play consist of star ratings and comments, which might be used to measure MBA quality. However, in this study, only star ratings were used to measure the MBA quality; we consider it a limitation. Therefore, we propose that future research should consider the aggregation measure of MBA quality by ratings and comments. In the digital era, the meanings of published comments (unstructured data from the website) are easily understood by powerful tools, such as crawl data, natural language processing, and text mining data (Kang et al. 2020; Xie et al. 2020). We propose that these tools should be used for any future study.

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Wpływ ratingów aplikacji bankowości mobilnej na dochody z usług bankowych w Wietnamie

Na podstawie zależności pomiędzy wynikami przedsiębiorstw FinTech i banków a rolą aplikacji mobilnych w operacjach bankowych zbadano wpływ ratingów aplikacji bankowości mobilnej (MBA) na dochody z usług bankowych. Kwartalne dane z 15 największych wietnamskich banków komercyjnych z lat 2019–2020 pochodziły z publicznych sprawozdań finansowych oraz ze sklepu Google Play. Zastosowano uogólnioną metodę najmniejszych kwadratów do estymacji parametrów proponowanych modeli regresji. Potwierdzono pozytywny wpływ ratingów MBA na dochody z usług bankowych. Dodatkowo zbadano jakość aplikacji MBA dużego banku, który nie spełnia oczekiwań klientów i określono, jak interakcja między ocenami MBA a mechanizmem dźwigni obniża przychody z usług bankowych. Ponadto użytkownicy ogólnie doceniali jakość MBA, a COVID–19 nie wpływał na związek między ocenami MBA a dochodami z usług bankowych. Opracowanie dostarcza nowatorskiej wiedzy na temat zachowań klientów poprzez ratingi aplikacji MBA i ich wpływ na przychody z usług bankowych w kraju wschodzącym.

Słowa kluczowe: aplikacja bankowości mobilnej, ratingi, dochody z usług, bank, Wietnam