The Impact of International Capital Flows on European Union Member States' Digital Health Services in the Frame of COVID-19 Pandemic

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Abstract

The COVID-19 pandemic slowed down life cycle of all economic sectors. The health sector was and hopefully is one of the faster-growing sectors in the world economy. The main aim of this paper is to present the theoretical aspects of the effect of pandemic on health sector and to analyse the affected international capital flows impact on European Union Member States digital health services.

During the investigation, the broad studies on international capital flows, pandemics, and impact on digital health services were analysed. European Union Member States indicators reflecting digital health services and international capital flows, were collected and analysed. Computed coefficients, representing the change associated with a decrease in foreign direct investments, portfolio investments, foreign debt investments and their impact on the number of newly founded digital health start-ups, and the amount of funding for digital health start-ups were presented.

Analyses conducted shows that COVID-19 affected international capital flows have impact on EU Member States digital health services. Negatively affected international capital flows – foreign direct investments, portfolio investments – have high and negative impact on both the number of newly founded start-ups and the amount of funding for digital health start-ups in developed countries and upper-middle countries.

Keywords: international capital flows, impact, digital health, health services, pandemic, COVID-19

JEL Classification: F10; E17; E27

Introduction

The new global pandemic was caused by the COVID-19 virus and since the end of 2019 is still spreading around the world. Although the epicentre of the pandemic was China, there were more than 500.000 cases in 16 EU member states in November 2021. The most affected EU countries were France, Spain, Italy, and the recently ex-EU the United Kingdom. In these countries between 5 to 9 million cases were registered from the beginning of pandemic until November 2021 (Worldometer 2021). To help alleviate the significant public health threat of COVID-19, the World Health Organization (WHO) has reported an international public

health emergency to coordinate international responses to the disease. Since the end of 2019, almost all EU Member States have declared one or few strict quarantines to save human lives which, however, had a significant impact on the countries' economies. The slowdown in the Chinese economy has also disrupted global supply chains. As a result, companies around the world have begun to experience production disruptions. The introduction of strict national quarantines and restrictions on the movement of transport both within and between countries have exacerbated disruptions in the global value chain. Uncertainty has also led to changes in consumption. Existing literature review points that the impact of the pandemic on all regional economies is not yet analysed, and there are few studies of the economic costs of large-scale outbreaks of infectious diseases. There is no one model for evaluation of such a situation. Most of the analyses are based on predictions. Since some of the jobs that disappeared during the lockdown will not reappear when it is lifted, it is hard to evaluate the real impact of pandemic.

The high number of COVID-19 cases and therefore high number of patients in hospitals overloaded national health systems. However, the analyses show, that the health sector is one of the faster-growing sectors in the world economy, particularly when all national economies are suffering due to pandemic. Based on the World Bank data, the share of health expenditures in the GDP of countries was around 8.5% in 2000. While Demir and Khan (2017, 85) marked that the share of public health expenditures in GDP increased from 4% in 2010 to around 4.2% in 2014 globally. In addition to the growing focus on health sectors, FDI in the health sector also has implications for health system outcomes, technology transfer, and efficiency in the health sector. The onset of COVID-19 has accelerated the trend towards the digitization of health services. According to OECD (2021b), FDI flows may increase by more than 30% in 2021 for the success of the public health and economic support policy measures. Therefore, foreign funding and flows are very important at this stage. To fill this gap, this paper will answer the question how international capital flows, affected by the COVID-19 virus, impacted national digital health services. The paper will present the theoretical aspects of the effect of pandemics on national digital health services. It will also analyse the impact of the COVID-affected international capital flows on EU Member States digital health services. Overall, the research objectives of this paper are to:

- find out the similarities between the countries and group them into the clusters, which would be based on the level of their development (e.g., a cluster would include the developed countries to lower-middle ones).
- explore the level of the impact of international capital flows on EU Member States digital health services in the frame of the COVID-19 pandemic.
- create a conceptual model based on the level of the impact of international capital flows on EU Member States digital health services and the level of national development.
- explain the implications of the research for future analyses.

The paper starts with the theoretical background and review of literature on the effect of pandemics and international capital flow to national digital health services. It is followed by description of methods and analysis of international capital flows impact on EU Member States digital health services. It ends with presentation of results of analysis and conclusions.

Theoretical background and relevant literature

The health sector was one of the fastest-growing sectors worldwide before the COVID-19 outbreak. There are three key segments of the health sector: goods, infrastructure, and services. The segments differ due to the degrees of state regulation and private sector participation levels. Private and foreign investors are dominating in pharma manufacturing, distribution of medical goods and technologies, while the public sector dominates health infrastructure and services. This paper concentrates on digital health services, the consequences of its fast growth and perspectives for its furher dynamic development. Based on Precedence Research (2020a) information, "the global digital health market will see a compound annual growth rate of 27.9% from 2020 to 2027, when it will reach 833.44 billion USD".

According to Kirabaeva and Razin (2010, 33) , "International Capital Flows means the inflow and outflow of capital from one nation to another nation. Three main types of international capital flow: foreign direct investment (FDI), foreign portfolio investment (FPI), foreign debt investment (DI)". These international capital flows are mostly evaluated in the economic crises period. However, foreign direct investment in health services has received less attention from researchers and policymakers in the last period (OECD 2021), even though FDI can be welfare-increasing as it refers to cross-border transactions concerning direct investment equity flow among countries.

Foreign direct investment can increase the capacity of health goods and services, thus reducing the pressure on government finances and at the same time improving the quality and choice of host country citizens who can afford private health. On the other hand, it can exacerbate inequalities between higher-income earners and the low-income workers. By diverting resources from public health services, FDI in health can create or degrade a two-tier system that provides high-quality care to the rich and low-quality to the poor. Looking at the previous years, the amount of FDI in health services was low in comparison to the other modes of health trade. This may be caused by the fact that most of the medical facilities are publicly owned and funded. To say nothing of the many legal obstacles (Smith et al. 2009; Jarman & Greer, 2012; Smith, 2004). Nowadays, FDI in health has become increasingly important, not only in developed countries but also in developing ones, as they are responsible for modernization of health infrastructure and innovative medical technologies.

It is usually expected that FDI in the health sector will have a significant impact on health systems due to the growing importance of the sector itself, cost pressures and slowing trade in various countries. Rapid technological innovation and progress, increasing international labor mobility and better connectivity between countries will make attracting FDI to the health sector one of the most promising options.

Chaudhuri and Mukhopadhyay (2012), Chanda (2002), White & Collyer (1998), Lipson (2001), Janjaroen and Supakankunti (2000) analysed the successes and failures of FDI in health services and they concluded that it may depend on some of the following factors:

- the level of health care development in neighbouring countries to the FDI receiving country suggesting that the higher the level of health care development in neighbouring countries the more international trade in health services;
- the extent health sector is commercialized meaning the structure of health care provision markets;
- regulatory framework referring to the structure of rules, arrangements, and law enforcement in the health industry due to the higher health standards, accreditation of health professionals, cross-subsidization of hospitals;
- the characteristics of regional structure where countries are located;
- the regional characteristics also play an important role in attracting FDI due to the factors such as common language, shared culture, higher socio-economic factors, and status of health sector.

Wibulpolprasert et. al. (2004, 11) stress that FDI also may strengthen or weaken the health system. As OECD (2010, 4 and 2019, 106) points out "most of the existing investigations are related to discussions of access to health in terms of population coverage, the relative contributions of public and private spending, and the share of spending covered by prepayment." This paper considers the possible impact on health services caused by international capital flows during the COVID-19 pandemic: was the accessibility of health services improved or affect negatively? This paper focuses on the countries of the European Union where health systems often suffer from underinvestment, in which case FDI can play an important role in filling investment and funding gaps.

Analyse of international capital flows impact on eu member states health services

This section will provide an analysis of the impact of the international capital flows, affected by COVID-19 virus, on EU Member States health services.

Methods

During the investigation, the broad studies on international capital flows, pandemics, and impact on countries' health services were collected, systemized, and analysed. Data of 27 European Union Member States and the United Kingdom (which was still a member statate at the time) were collected and investigated. These countries were selected as they are all located in one region, all are affected by the COVID-19 virus, and all are seeking to avoid new economic crisis. The evaluation of the EU region could show the existing impact on national economic situation for the rest of the world. This article focuses on the analysis of secondary data which is provided in Table 1.

As Outrville (2008, 1) suggested "the determinants of FDI in the health sector are the same as for other sectors: geographic and cultural vicinity, governance and country risk, level of socio-economic development, and availability of quality inputs." The analysis assumes that the impact of international capital flows on a country health services is related to the level of the its economic development. Therefore, 11 indicators were selected (see Table 2) to find the similarities between the countries and group them into clusters. Indicators were selected based on Sustainable development in the European Union – 2015 monitoring report of the EU Sustainable Development Strategy (2015) and Próchniak (2011, 453) empirical studies on economic growth determinants. One determinant – "technological knowledge intensity" – was selected based on the European Commission's Research and Innovation Performance in the EU: Innovation Union progress at the country level (2014).

EU Member States were divided into clusters, according to collected data, which shows their level of economic development by using the K-means algorithm. The K-means algorithm is a repetitive algorithm that divides a data set into K pre-planned, different non-overlapping subgroups (clusters). Each data point belongs to only one group.

Definitions of international capital flows used in evaluations of the impact of other pandemics were selected, coded, and grouped into second-order empirical indicators for further analyses: foreign direct investments, portfolio investments, foreign debt investments.

For the evaluation of the impact on health services, 625 software companies working as digital health services providers in Europe since 2010 – that are still operating and have received funding – were selected. Their activities range is provided in Figure 1. As can be seen, the highest number of EU digital health start-ups provide software, which helps health providers (e.g., medical staff) in their daily work (such software is directed to business process tools for health providers), followed by those that create diagnostic devices for telemedicine services (e.g., home testing, radiology images, artificial intelligence), and consumer health apps to track health.

Table 1. Type of collected data on EU Member States

| Type of data	Unit	Frequency	Range	Source
Gross domestic product (GDP)	US Dollars	Annual	2010-2020	World Bank
Foreign direct investments (FDI)	EUR and % of GDP	Annual	2010-2020	World Bank
Foreign portfolio investment (PI)	EUR and % of GDP	Annual	2010-2020	World Bank
Foreign debt investments (DI)	EUR and % of GDP	Annual	2010-2020	Eurostat
Number of funded and operational digital health services start-ups in Europe	Number	Range data	2010-2020	Statista and The Global Tech Ecosystem (dealroom.co)
Number of start-ups founded	Number	Range data	2010-2020	Statista and The Global Tech Ecosystem (dealroom.co)
Total funding for digital health services start-ups	EUR	Range data	2010-2020	Statista and The Global Tech Ecosystem (dealroom.co)

Source: prepared by the author

Analyses

The K-means algorithm uses within-cluster variation and is one of the simplest non-hierarchical cluster-ing methods. To divide the most similar EU Member States into clusters according to their level of economic development, the K-means algorithm was applied in the further analyses. Collected country data was seg-mented and within-cluster variations were minimized.

Table 2. Collected indicators for similarities foundation between states

Indicator	Unit	Frequency	Range	Source
Country economic size				
GDP per capita	US Dollars	Annual	2010-2020	World Bank
Investments				
Gross capital formation	% of GDP	Annual	2010-2020	World Bank
Gross fixed capital formation	% of GDP	Annual	2010-2020	World Bank
International trade				
Export	% of GDP	Annual	2010-2020	World Bank
Import	% of GDP	Annual	2010-2020	World Bank
Trade	% of GDP	Annual	2010-2020	World Bank
Current account	% of GDP	Annual	2010-2020	World Bank
FDI	% of GDP	Annual	2010-2020	World Bank
Macroeconomic conditions				
Consumer price index	%	Annual	2010-2020	World Bank
Human capital				
Human capital index	Total	Annual	2010-2020	World Bank
Technological knowledge intensity				
R&I level	EU list		2014	EC Research and Innovation Performance in the EU

Source: prepared by the author.
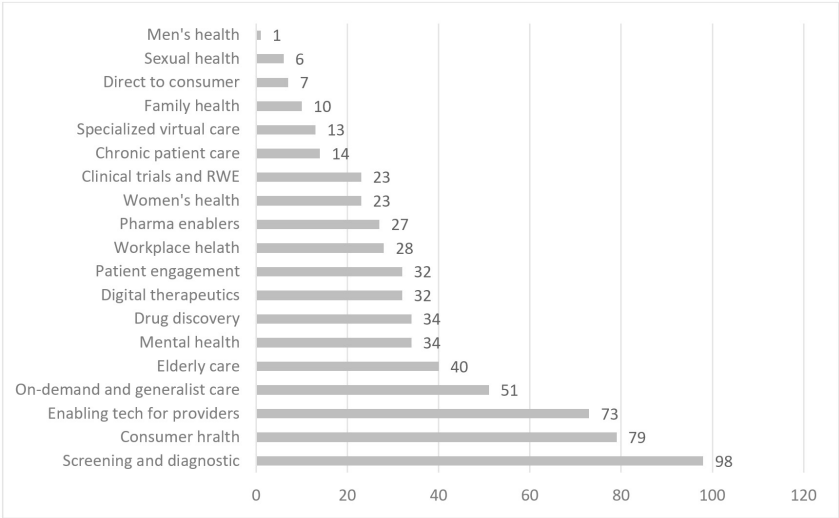
Source: author's own work based on data collected from Statista and The Global Tech Ecosystem (dealroom.co).

Figure 1. EU Digital health start-ups by activity (2010-2020)

One of the K-means algorithm benefits is that the authors can decide how many clusters are created. I divided the 28 EU Member States into three clusters (Table 3). There are three most similar and developed countries in cluster 1, and 16 lowest-level lower-middle countries (Central and Eastern, and Southern Europe) were included in cluster 3. The remaining nine upper-middle countries formed cluster 2.

The number of COVID-19 cases also can be analysed in those clusters. Table 4 shows the average number of COVID-19 virus cases in EU Member States per cluster. The highest number of cases is in cluster 1, which consists of 3 developed countries. Average cases of the virus in clusters 2 and 3 are mostly the same.

The most affected EU Member States (or former EU Member States) were in the United Kingdom (9.241.916 cases), which is cluster 1, France (7.199.332 cases), which is in cluster 2, and Spain (5.025.069 cases) which is in cluster 3. The lowest number of cases (37.813) were recorded in Malta (cluster 3). In total 45.737.386 COVID-19 cases were recorded in the European Union as of November 2021.

Figure 2 shows that since 2010 there were 625 funded and still operational companies working as digital health services providers in Europe. Unfortunately, the real number of funded and operational companies is not clear for the period 2018-2020, as some of the companies did not provided their data or they were not funded. Otherwise, more than 63% of funded digital health start-ups in Europe were founded in the last 5 years, making it a young sector.

The largest share of start-ups in digital health services were founded in cluster 1, which consists only of 3 developed countries (Figure 3). The United Kingdom is a digital health leader with 171 start-ups founded in the analysed period, which is around 63 % of all founded start-ups in cluster 1. Only 73 start-ups were founded in Germany since 2010. In CEE countries, which are part of cluster 3, in total 58 start-ups were founded.

According to Figure 4, the funding for digital health start-ups dynamic is similar to the numbers of founded digital health start-ups with cluster 1 dominating again. The United Kingdom is again the leader attracting

Table 3. Clusters of similar countries

Cluster	Average Covid-19 cases per cluster
Cluster 1	3.530.209
Cluster 2	1.454.112
Cluster 3	1.378.734

Source: prepared by the author based on https://www.worldometers.info (from the beginning of pandemic until November 2021*).*

Table 4. Cases of COVID-19 virus

Cluster 1	Cluster 2	Cluster 3
Austria	Denmark	Bulgaria
Germany	Finland	Czech Republic
United Kingdom	Cyprus	Estonia
	Ireland	Hungary
	Sweden	Lithuania
	Belgium	Latvia
	Netherlands	Poland
	Luxembourg	Romania
	France	Slovenia
		Slovakia
		Greece
		Italy
		Malta
		Portugal
		Spain
		Croatia
3	**9**	**16**

Source: prepared by the author.

the most funding: 2106 mln EUR since 2010, which is around 70% of the whole funding. The CEE countries totaled around 205 mln EUR in founding, while Southern Europe – 165 mln EUR, making cluster 3 countries lagging in terms of funding for digital health. Financing for clusters 2 countries was average.

Furthermore the impact of affected EU Member States international capital flows on start-ups founded and funding for digital health start-ups was evaluated and provided in the figures by these steps:

Estimated number of start-ups founded and amount of funding for digital health start-ups per created cluster, for the period 2010-2020.

Collected each cluster GDP (mln EUR), foreign direct investments, net inflows (% of GDP), portfolio investments, net inflows (% of GDP), and foreign debt investments, net inflows (% of GDP), for the period 2010-2019.

Estimated share of start-ups founded and amount of funding for digital health start-ups per cluster from foreign direct investments, portfolio investments, and foreign debt investments.

Comparative analysis: how would the number of start-ups founded and amount of funding for digital health start-ups per cluster change, if GDP decreased by 1% due to COVID-19 and negatively affect foreign direct investments, portfolio investments, and foreign debt investments.

Figure 5 shows the impact of negatively affected foreign direct investments on digital health services per cluster. It demonstrates computed coefficients representing the change associated with a decrease in
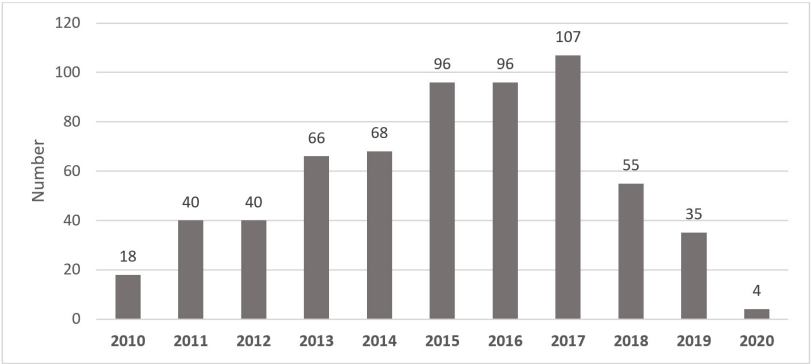
Source: prepared by author based on data collected from Statista and The Global Tech Ecosystem (dealroom.co).

Figure 2. Number of funded and still operational digital health services start-ups in Europe (2010-2020)
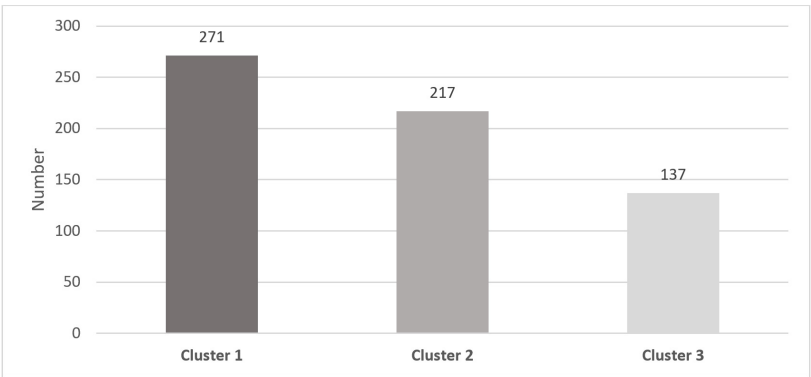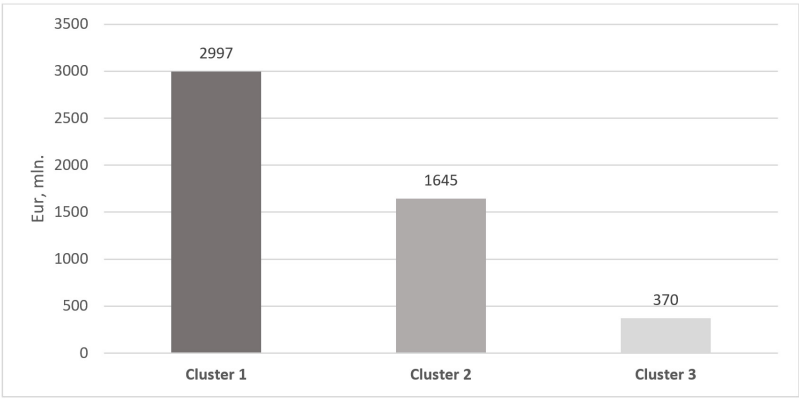

Source: prepared by author, based on data collected from Statista and The Global Tech Ecosystem (dealroom.co).

Figure 3. Number of digital health services start-ups in Europe per clusters founded in 2010-2020

cluster foreign direct investments flow equal to a 1% decrease in GDP. If GDP decreases by 1%, both the number of founded new start-ups and the amount of funding for digital health start-ups in cluster 1 would be highly and negatively affected. The number of founded new start-ups would decrease by 20.57%, and the amount of funding would decrease by 27.46%. This may cause high negative effect for the development of cluster 1 states digital health sector. Negative foreign direct investments would have low negative impact on clusters 2 and 3 number of newly founded start-ups (decrease of 1-2.88%). It can be expected that this will not have a significant impact on the clusters 2 and 3 health sector as a whole. The amount of funding for digital health start-ups would decrease by around 7.5% in cluster 2 and cluster 3 countries. International funding is very important at the grow stage of digital health sector, therefore lower funding may slow down the development of cluster 2 and cluster 3 digital health services.

Figure 6 shows the impact of negatively affected portfolio investments flows, which are short-term, on digital health services per cluster. Here are provided computed coefficients representing the change associated with a decrease in clusters portfolio investments flow equal to a 1% decrease in GDP. Negatively affected portfolio investments flows would highly and negatively affect both the number of founded new
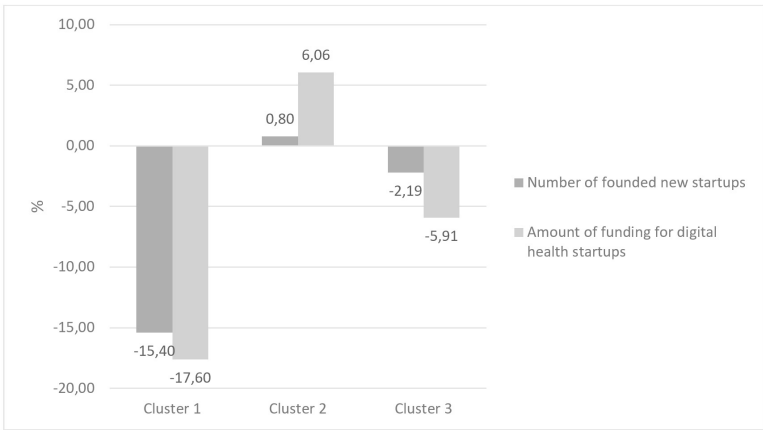

Source: prepared by author, based on data collected from Statista and The Global Tech Ecosystem data (dealroom.co).

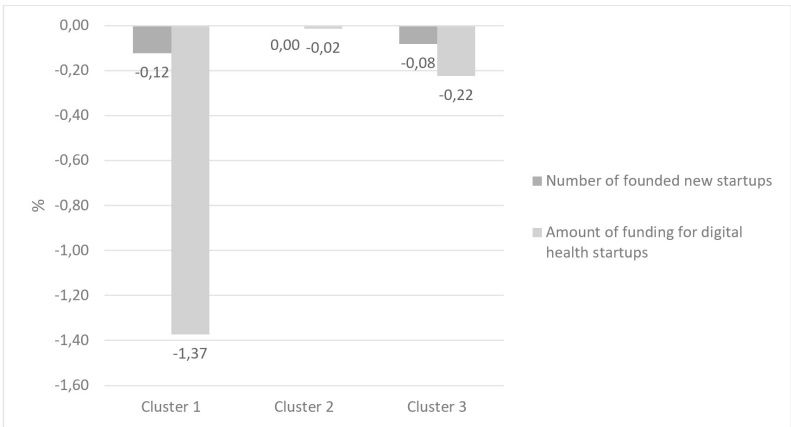Figure 4. Total funding for digital health start-ups (2010-2020)
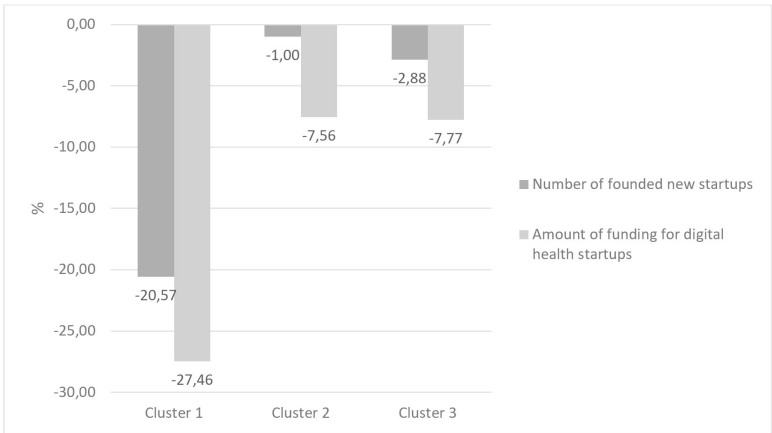
Source: prepared by author based on data provided in Table 1 and Table 2.

Figure 5. The impact of affected foreign direct investments on the number of founded start-ups and funding size for digital health start-ups per cluster.

Source: prepared by author based on data provided in Table 1 and Table 2.

Figure 6. The impact of affected portfolio investments on the number of founded start-ups and funding size for digital health start-ups per cluster

Source: prepared by author based on data provided in Table 1 and Table 2.

Figure 7. The impact of affected foreign debt investments flows on the number of funded new start-ups and funding size for digital health start-ups per ckuster

start-ups and the amount of funding for digital health start-ups in cluster 1. The number of founded new start-ups would decrease by 15.40 %, and the amount of funding would decrease by 17.60 %. Contrary to what is shown in Figure 5, negatively affected short-term flows (portfolio investments flows), would have a small, but positive impact on cluster 2 number of founded new start-ups and medium positive impact on the amount of funding. This paper focuses on the countries of the European Union, where health systems often suffer from under investment, in which case FDI can play an important role in filling investment and funding gaps on the amount of funding, which increase up to 6%. Negatively affected portfolio investments would have a negative medium impact on CEE and Southern Europe countries (cluster 3) number of newly founded start-ups (-2.19%) and amount of funding for digital health start-ups (-5.91%). In other words, negatively affected short-term flows (portfolio investments) may have a strong negative impact on digital health services in cluster 1 countries. Negatively affected portfolio investments may reduce the amount of funding which may influence cluster 3 countries digital health services development.

Impact of affected international capital flows on clusters' Digital Health Services	Developed countries	Upper-middle countries	Lower-middle countries
High	Affected FDI – *high negative* impact on number of new founded startups and amount of funding for digital health startups. Affected PI – *high negative* impact on number of new founded startups and amount of funding for digital health startups.		
		Affected FDI – *medium negative* impact on amount of funding for digital health startups. Affected PI – *medium positive* impact on amount of funding for digital health startups.	Affected FDI – *medium negative* impact on amount of funding for digital health startups Affected PI – *medium negative* impact on amount of funding for digital health startups.
Low	Affected DI – *low negative* impact on number of new founded startups and amount of funding for digital health startups.	Affected FDI – *low negative* impact on number on new founded startups. Affected PI – *low positive* impact on number of new founded startups. Affected DI – *low negative* impact on amount of funding for digital health startups.	Affected FDI – *low negative* impact on number on new founded startups. Affected PI – *low negative* impact on number on new founded startups. Affected DI – *low negative* impact on amount of funding for digital health startups.
	Developed countries	Upper-middle countries	Lower-middle countries

Level of cluster

Source: prepared by the author.

Figure 8. Conceptual model of evaluation of the impact of affected international capital flows on EU Member States digital health services

Figure 7 shows the impact of negatively affected foreign debt investment flows on digital health services per cluster. It provides computed coefficients representing the change associated with a decrease in clusters foreign debt investments flow equal to a 1% decrease in GDP. In this figure, a different situation is observed: negatively affected foreign debt investments would have low negative impact on all three clusters number of founded new start-ups and amount of funding for digital health start-ups (between 0-1.51%).

It can be assumed that negatively affected foreign debt investment flow may not strongly influence digital health services in all selected countries and clusters.

Research results

The main findings of this paper are presented in the conceptual model based on the level of the impact of international capital flows on EU Member States digital health services and the level of their development.

Conclusions

As the COVID-19 pandemic spread around the world, all countries faced economic difficulties. Before the pandemic, the health sector was one of the faster-growing sectors in the world economy and it is still particularly important. Therefore, it is essential to maintain an adequate level of funding to keep the whole health sector growing. International funding and flows are very important at this stage. This paper aimed to analyse what is the impact of international capital flows, affected by the COVID-19 virus, on national digital health services. Main findings include that negatively affected international capital flows (foreign direct investments and portfolio) have high and negative impact on both the number of founded new start-ups and the amount of funding for digital health start-ups in developed countries and upper-middle countries. This may have a strong negative impact on the whole digital health services in developed countries. The reduced amount of funding by foreign direct investments for digital health start-ups may slow down the development of upper-middle and lower-middle countries digital health services. Negatively affected portfolio investments may reduce the amount of funding which may influence lower-middle countries digital health services development too, while negatively affected foreign debt investment flows may not strongly influence digital health services in all selected countries and clusters. More results are provided in the conceptual model, which is based on the level of the impact of international capital flows on EU Member States digital health services and the level of country development. Overall, analyses conducted show that this pandemic has high impact on EU Member States digital health sector.

For future analyses, more international capital flows elements can be added to the investigation as some of the company data, especially about last year's funding amounts, was not available. After this information is published, the investigation may be updated. COVID-19 is still an ongoing pandemic, therefore it is hard to evaluate the real impact of affected international capital flows on EU Member States health services. After the end of this pandemic, the analyses may be revised as well.

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