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Determinants of the imports of essential medical products by European Union

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Abstract

The rapid spread of the COVID-19 pandemic has triggered a marked distortion in the trade of medical products needed to combat its severe effects on the health of infected individuals. This study sought to examine the determinants of imports by the 27 countries of the European Union (EU-27), through a panel data analysis for the period 2015 – 2020. The aim is to shed light on the distinct behavior of imports of each of the seven products classified as essential by the World Customs Organization and the World Health Organization. To that end, economic and social characteristics of the buyer country were treated as explanatory variables, along with the origin of the goods and the effect of the virus in 2020. The results showed that several determinants of imports of medical goods have a homogeneous influence on all of these products. This is also in line with gross domestic product per capita and population, which showed positive and significant coefficients for all products. The level of wealth of a country reflects its purchasing power, and thus capacity to purchase essential goods. Furthermore, an aged population in a territory is indicative of the greater need for essential medical products, which was amplified in 2020 due to the high vulnerability of this group to the symptoms of the virus. The present study confirmed that EU-27 trade agreements curbed the mass entry of non-EU products and that COVID-19 pandemic increased imports of certain products.

Keywords: COVID-19; Medical products; Imports; Panel data

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1. Introduction

Coronavirus disease 2019 (COVID-19) had paralyzed the world for months, sparking a global crisis that had hit all aspects of the economy: a fall in trade and production, skyrocketing unemployment, and rising public debt caused by the huge stimulus packages designed to prevent collapse (Gereffi, 2020). These ramifications triggered rapid social reversal, widened the inequalities, and exposed the precariousness of healthcare in almost all the countries affected. In this context, there is a clear need to maintain international trade relations, both to ensure the supply of essential products and to send a signal of confidence to international markets (OECD, 2020a).

The medical treatment of COVID-19 necessitates a huge volume of supplies that no country has ever predicted. COVID-19 has caused a widespread shortage of certain health-care products, most notably in countries hardest hit by the pandemic. Against this backdrop, trade has gone from being occasionally complementary to domestic supply

to being crucial for facilitating the exchange of products and making it possible to save lives. According to statistics provided by Eurostat, European imports of medical products between January and October 2020 were 14.86% higher than in the same period in 2019, while exports have experienced an even greater impact, being 47.92% higher.

In an attempt to adapt to this new scenario, the authorities of various nations have been forced to take measures involving the removal of certain import restrictions. Notable examples include the elimination of import licensing requirements, the reduction of tariffs, and the suspension of anti-dumping duties on medical supplies. However, the response has not consisted entirely of liberalizing measures; at the same time, temporary restrictions have been imposed on the export of these products to guarantee the adequacy of domestic supply (OECD, 2020b; Baldwin & Evenett, 2020; Evenett & Winters, 2020; Evenett, 2021). More specifically, in Europe, the European Commission imposed restrictions in March 2020 on the export of medical products, not only because of existing shortages but also due to the anticipated increase in demand for an indefinite period (Regulation 2020/402). However, according to Leibovici & Santacreu (2020), this situation has not given rise to a common line of action at a global level; indeed, there has been a markedly heterogeneous response, with countries' trade policies being strongly dependent on their trade balances in medical goods. At the outbreak of the pandemic, 86% of the countries with a trade surplus in these goods imposed restrictive export policies, whereas only 46% of countries with a trade deficit did so.

Apart from the needs created by the pandemic, international demand for medical supplies and products has grown exponentially in recent decades. The trigger has been the aging of the population in middle- and high-income countries, which, together with the substantial increase in health-care expenditure in the developing world and very low tariffs, has led to an abundant supply of low-price, high-quality products (Gereffi, 2020).

The aim of this research was to analyze the determinants of the imports of each of the essential medical products by the 27 countries of the European Union (EU-27), for the period of 2015 – 2020 (in the first 10 months of each year1), such that the previous year reflects the effect of COVID-19 on international purchases. This study sought to answer the following questions:

(i) Is the import of various types of essential medical products needed to combat the pandemic determined by the same factors?
(ii) Are extra-EU suppliers at a disadvantage compared to intra-EU suppliers?
(iii) Has there been a significant change in 2020 compared to previous years in imports of medical products classified as essential?
(iv) Is the import of medical products price-sensitive?

Trade statistics provided by Eurostat, classified as extra- and intra-EU imports, were analyzed in this study. Pooled ordinary least squares (OLS), fixed effects (FE), or random effects (RE) estimation of the panel data were carried out, depending on the results of the corresponding validity test.

The impact of COVID-19 on trade flows of goods and services has been analyzed in the literature (Shaker, 2020; Anghelache *et al.*, 2020). Specifically, Minondo (2020) compared the drop in exports during the COVID-19 crisis with the Great Recession of 2008 – 2009, concluding that Spain is the country in Europe that has registered the biggest drop in trade. Other authors have focused on estimating the determinants of total trade in medical products without exploring the differences among them (Fabus, 2020; Makrevska *et al.*, 2020; Jindřichovská & Uğurlu, 2021). Accordingly, the results of the proposed empirical analysis help shed light on novel aspects that could guide future trade policies in a number of ways: (i) the separate analysis of trade determinants by type of product broadens the spectrum of potential action, by providing detailed information on the specific characteristics of each one; (ii) the analysis of the period of time enables an assessment of the impact of the pandemic, which helps identify and explain which products are most affected; and (iii) the composition of the sample used in the empirical analysis depicts the individual patterns of each country, providing the EU trade policy-makers with ex-ante information for the adoption of possible tariff measures.

This study primarily analyzed the European imports of products classified as essential for combatting COVID-19 by the World Customs Organization and the World Health Organization (WHO). These products are grouped into seven categories:

(i) Test kits and diagnostic instruments (*e.g.*, COVID-19 test kits);
(ii) Disinfectants and sterilization products (*e.g.*, medical strength alcohol, sanitizers, sterilizing equipment, chemical disinfectants, and medical grade chemicals);
(iii) Oxygen therapy equipment (*e.g.*, ventilators and artificial respiration apparatus);
(iv) Medical devices and equipment (*e.g.*, thermometers, stethoscopes, electrocardiographs, and ultrasound machines);

1 This limitation is due to the fact that, at the time of conducting the research, information for 2020 was only available from January to October. The same restriction has been imposed on the rest of the years to ensure the comparability of the annual data.

(v) Medical vehicles and furniture (*e.g.*, ambulances);
(vi) Protective garments (*e.g.*, face masks, eye protection, gloves, and other personal protective equipment);
(vii) Medical consumables (*e.g.*, soap, wadding, gauze, bandages, and cotton sticks).

All of these refer to final products and do not include the raw materials and intermediate goods needed for their manufacture. The leaders in the global trade in products that require more advanced technology, such as medical devices, are large, vertically-integrated multinational companies headquartered in highly-developed industrial economies such as the United States, Germany, Switzerland, the Netherlands, and the United Kingdom, and with production facilities around the world (OECD, 2020b). However, the segment of the least technologically sophisticated products, such as protective garments, is more often outsourced to third-party suppliers, usually in developing countries such as Indonesia or Malaysia, with the guarantee of direct oversight and regulatory certification to ensure quality requirements are met (Bamber *et al.*, 2020).

The rest of the article is organized as follows: Section 2 offers a review of the literature on the trade in medical goods, as well as the impact of COVID-19 on these products. Section 3 explains the estimation methodology used and the variables included in the proposed model. Section 4 details the main results of the study. Finally, Section 5 summarizes the most important conclusions drawn from the research.

2. Literature review and conceptual framework

2.1. Literature review

COVID-19 has sparked the interest of the scientific community, giving rise to studies focusing on almost all spheres of interest, from more general areas such as environmental effects (Zambrano-Monserrate *et al.*, 2020; Casado-Aranda *et al.*, 2021), the economic impact (Hossain, 2021; Pham *et al.*, 2021) or food security (Marti *et al.*, 2021; Bukari *et al.*, 2022; Marchetti and Secondi, 2022), to more specific areas such as education (Chertoff *et al.*, 2020; Sintema, 2020) or the health of children (Roberton *et al.*, 2020; Duan *et al.*, 2020). Likewise, the trade in goods that are essential for combatting the pandemic has been analyzed from various perspectives (Baldwin & Tomiura, 2020; Evenett, 2020a; Vickers & Ali, 2020; Barua, 2020; Hayakawa & Imai, 2021).

As the main supplier of medical products, China has been the focus of numerous studies. Shaker (2020) applies an econometric model to analyze the determinants of its exports, concluding that aging population, infection rates in the destination country, and the wealth of the buyer country are the main drivers of the trade under study. Furthermore, after analyzing the trade in masks and other medical equipment, Fuchs *et al.* (2020) demonstrated that having economic ties with the Asian country is the main determinant of buyer countries to import these products.

Focusing on trade policies, Evenett *et al.* (2020) identified a surge in trade policy activism between February and March 2020, alongside the rise in COVID-19 cases, and found marked heterogeneity among countries in terms of the type of measures imposed and how they were implemented. In the same vein, Hoekman *et al.* (2021) concluded that the application of export restrictions on medical products is strongly correlated with the characteristics of prevailing public procurement regimes, based on the analysis of the relationship between public procurement regimes and trade policies during the first 6 months of the pandemic. Likewise, Curran *et al.* (2021) focused their study on the scope and nature of trade policy and its possible compatibility with existing World Trade Organization (WTO) agreements. Their results revealed that the globalizing process taking place in recent decades has slowed down due to the continual political interventions and the growing trade tensions. According to a study that assessed the impact of restrictions imposed by Malaysia on imports of medical supplies, Ayub (2020) argued that trade policies should be used as an instrument to support public health and that any restrictions standing in the way of this should be eliminated.

Another relevant perspective is the focus on global value chains (GVCs), which have been the subject of numerous studies seeking to shed light on the scarcity of medical supplies, providing information that could help decision-makers (Park *et al.*, 2020; Grumiller & Grohs, 2021). Dallas *et al.* (2021) identified the interactions between the type of state intervention and two structural characteristics of GVCs: the geographical distribution of production and the attributes of the product. By so doing, they demonstrated the mutual constraints of states and GVCs and revealed the major role played by structural factors. However, there is no universally agreed line of action to be taken. While some countries call for greater intervention to prevent excessive outsourcing and the consequent foreign dependency, others applaud GVCs for their flexibility, blaming leaders for undermining the operations defined in the GVCs. Studies such as those by Evenett (2020b) and Gopalakrishnan *et al.* (2020) assessed state intervention in medical product GVCs by conducting comparative analyses of France, Germany, the United Kingdom and the United States, and the Commonwealth countries, respectively. Vickers & Salamat (2020) mapped out supply chains, analyzing major exporters and importers and assessing

the impact of recent trade measures on least developed countries. Their results indicated that global cooperation and support play an important role in bolstering health systems in these countries.

The WTO[2] has also published a series of papers, which provide valuable information on the impact of the pandemic on international relations. These studies explicitly pertain to medical products: they analyzed the business of vaccines, both in terms of development and global distribution (WTO, 2020a); they assessed the related export bans and restrictions (WTO, 2020b); and they studied how these products were treated based on the regional trade agreements (WTO, 2020c). Similarly, the WTO (2020d) and Dugiel & Mikołajek-Gocejna (2020) examined the activities of the European institutions in tackling the negative effects triggered by the collapse of international trade both within the EU and globally.

2.2. Conceptual framework

The international trade in the analyzed medical products has some special features that explain its behavior in times of intense demand. During the span of 2015 – 2020, according to statistical data from Eurostat, the supply and demand of these products displayed an upward trend, with an increasingly large positive trade balance, due to the growing gap between exports and imports (Figure 1).

The present empirical study focuses on the analysis of extra- and intra-EU imports, classified by type of product. The analysis by specific product type did not reveal such a uniform trend. First, the analysis focused on the products that registered negative growth in imports in 2020, namely, test kits and oxygen therapy equipment (Figure 2). This decline was the most pronounced in extra-EU imports of test kits (−9.88%) and intra-EU imports of oxygen therapy equipment (−8.15%).

Conversely, due to their technological simplicity and ease of purchase, the import of protective garments and disinfectants showed an upward trend during the pandemic, regardless of the origin of these products (Figure 3). According to Park *et al.* (2020), the huge increase in demand for surgical masks, eye protection, gloves, and gowns had exhausted stocks, significantly driving up prices and causing a backlog in order fulfillment for 4 – 6 months. The primary challenge is to ensure that critical protection products are supplied and assigned to front-line healthcare workers and other stakeholders in affected countries, especially those most vulnerable to the spread of coronavirus.

2 https://www.wto.org/english/tratop_e/covid19_e/covid_reports_e.htm

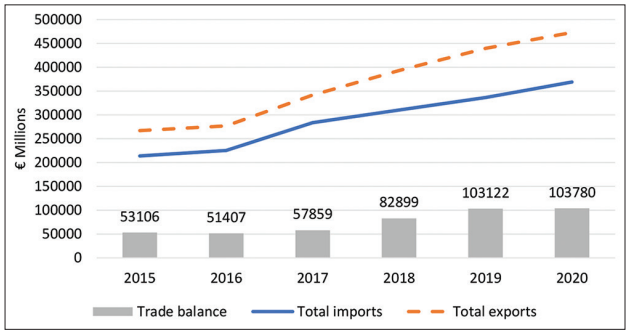

Figure 1. The trend of EU-27 trade in medical products.

Finally, extra-EU import of vehicles and furniture, medical devices, and medical consumables had increased during the pandemic, while intra-EU imports had decreased (Figure 4). Medical devices are produced with advanced technology, with very powerful suppliers in the United States, Switzerland, and the United Kingdom (OECD, 2020b). While medical consumables registered strong positive growth in intra-EU trade in the period 2017 – 2019), the COVID-19 pandemic had in turn amplified the trade with suppliers from outside the EU.

The analysis of all medical products revealed that the intra-EU import volume exceeded the extra-EU volume over the entire period analyzed (Figure 5). These statistics reflect the effectiveness of existing trade agreements among the EU countries, which fosters the development of this type of trade.

Overall, there was a slight increase in 2020 in extra-EU trade in medical goods. This may be due to the uncontrolled demand for these products, which had resulted in a slow-down of trade with member states to meet domestic demand. Although this had prompted a search for other suppliers outside the EU, there was still a considerable gap between intra- and extra-EU trade throughout the period under analysis.

3. Methodology and data

3.1. Methodology

An individual econometric model was specified for each medical product to estimate the determinants of imports by the EU-27 in the period 2015 – 2020. This entails the estimation of seven import functions, one for each product, which include variables associated with the economic and social characteristics of the importing country, as well as the price index and the origin of these products. Special reference is also made to the impact of COVID-19 to detect the possible effects of the pandemic (Equation I).

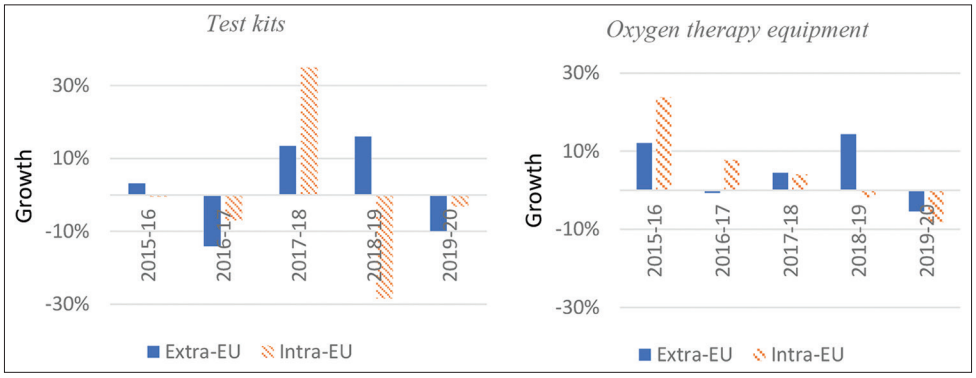

Figure 2. Products with negative growth in imports in 2019 – 2020.

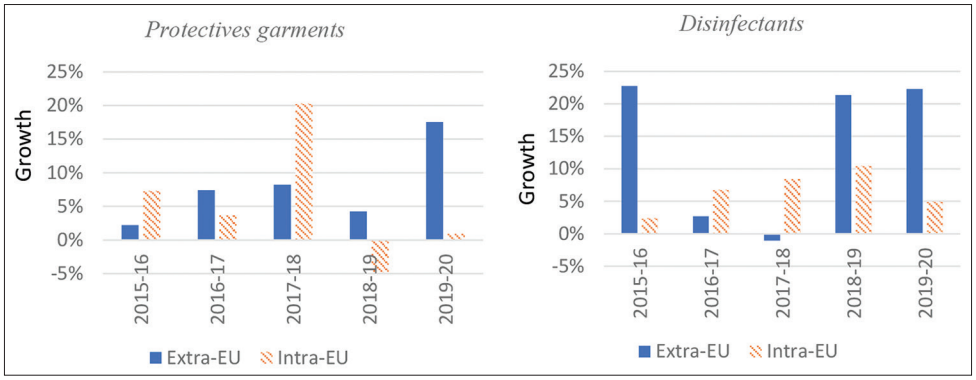

Figure 3. Products with positive growth in imports in 2019 – 2020.

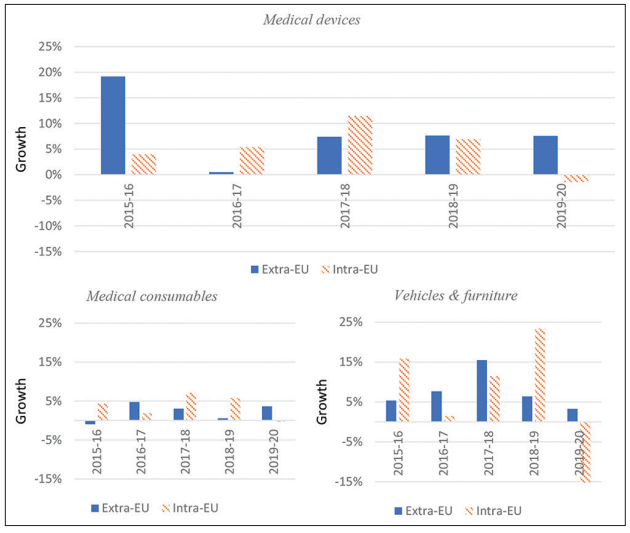

Figure 4. Products with positive and negative growth in imports in 2019 – 2020.

$$Ln(M)_{i,j,t} = \beta_0 + \beta_1 Ln(GDP_{pc})_{j,t} + \beta_2 Ln(Pop65)_{j,t} + \beta_3 Ln(Beds)_{j,t} + \beta_5 HICP_{it} + \beta_4 Dextra + \beta_5 D2020 + \varepsilon_{it} \quad (I)$$

where $Ln(M)_{i,j,t}$ is the napierian logarithm of imports of product "i" by country "j" in year "t"; $Ln(GDP_{pc}))_{j,t}$ is the natural logarithm of the GDP per capita of country "j" in year "t"; $Ln(Pop65)_{j,t}$ is the natural logarithm of the population aged over 65 years in country "j" in year "t"; $Ln(Beds)_{j,t}$ is the natural logarithm of the number of hospital beds in country "j" in year "t"; $HICP_{it}$ is the Harmonised Index of Consumer Price for Health of country "I" in year "t"; Dextra is a dummy variable that takes the value 1 if the imports come from countries outside the EU while the value 0 indicates otherwise; D2020 is a dummy variable that takes the value 1 if the imports were made in the year

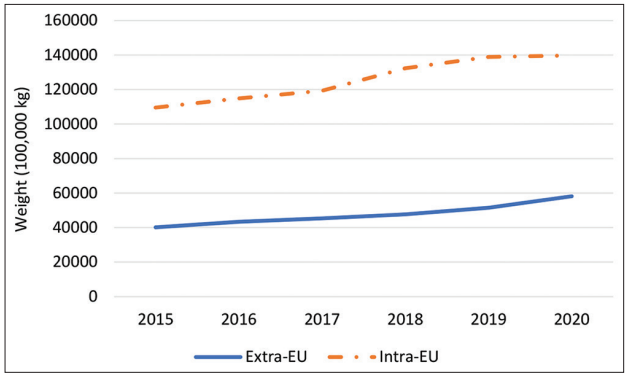

Figure 5. The trend of intra-and extra-EU imports measured in weight.

2020 and the value 0 indicates otherwise; and expected values of $\beta_2, \beta_3, \beta_5 > 0$, and of $\beta_4 < 0$.

In the field of international trade, numerous previous studies have employed regression models with panel data estimated by pooled OLS, FE, and RE (Karagoz & Saray, 2010; Manwa *et al.*, 2019; Tran *et al.*, 2020; Majumder *et al.*, 2020, among others). The Breusch-Pagan and Hausman tests were used to determine the most appropriate estimation method. Based on the interpretation by Wooldridge (2010), pooled OLS assumes that the intercept and slope coefficients are constant across time and space, and the error term captures differences over time and among individuals. The Breusch and Pagan Lagrangian multiplier test was used to select a model, either the pooled OLS or the RE. In this case, two hypotheses were proposed:

H_0: The appropriate model is pooled OLS.
H_1: The appropriate model is RE.

If Prob > Chi2 < 0.05, H_0 can be rejected, and the appropriate model is RE.

To choose between FE and RE, Hausman specification tests were used. Intervariance and intravariability were considered in selecting one model in this case. The proposed hypotheses are:

H_0: The preferred model is RE.
H_1: The preferred model is FE.

If Prob > Chi2 is more than 0.05, H_0 can be accepted, and the preferred model is RE.

3.2. Data and sample

The sample used in the study comprised 324 observations reported by 27 reporters from the EU-27 and 2 partners (one extra-EU and one intra-EU), spanning 6 years (2015 – 2020). Table 1 presents the main statistics of the variables that make up the equations for the panel sample. In addition, two dummies are included: One represents the intra- or extra-EU origin of the products, and the other captures whether COVID-19 had had a notable effect on the trade in these goods. All variables were sourced from Eurostat.

As presented in Table 1, the goods registering the highest volume of imports on average in the period 2015 – 2020 were medical consumables and disinfectants. Germany is the biggest importer of all the medical products analyzed, while the minimum values correspond to extra-EU imports of products by Latvia (test kits), Luxembourg (disinfectants, medical consumables, and oxygen therapy equipment), Estonia (medical devices), and Malta (protective garments and vehicles). Regarding the rest of the variables, the maximum value for GDPpc corresponds to Luxembourg, the maximum number of beds per 100,000 inhabitants and population of people aged over 65 to Germany, and the highest HICP to Finland.

The variable "beds" refers to the available beds in hospitals. Given the lack of information regarding beds for 2019 and 2020, a value was estimated by extrapolating from the trend of the four years before 2019. Regarding population, the analysis was focused on the number of people aged over 65, as this age group is the most vulnerable to COVID-19. GDPpc represents the level of wealth of the importing country valued at market prices; again, the value corresponding to 2020 has been estimated following the predictions by the European Central Bank. As the function in question is an import function, it should

Table 1. Main statistics for the period 2015 – 2020

	Mean	Max	Min	S.D.
Dependent variables: imports (100 kg)				
Medical consumables	994,662	7,852,124	2179	1,476,134
Disinfectants	935,176	14,008,922	529	1,916,699
Protective garments	823,477	5,282,810	11,937	1,023,156
Medical devices	285,353	2,447,977	6757	378,933
Vehicles	127,136	1,455,688	2298	201,364
Oxygen therapy equipment	48,700	535,675	21	92,095
Test kits	47,186	892,633	169	84,692
Independent variables				
GDPpc (Euros per capita)	29,230	102,200	6370	19,420
Beds (per hundred thousand inhabitants)	499	813	200	168
Population of people aged over 65 (persons)	3,268,921	18,090,682	79,805	4,543,532
HICP (annual rate of change)	1.4	7.1	−8.4	1.8

Abbreviations: GDPpc: Gross domestic product per capita; HICP: Harmonized Index of Consumer Price for Health; S.D.: Standard deviation.

include a variable that reflects the price of these products, that is, HICP, which measures the change over time in the prices of consumer goods and services related to the health sector. Table 2 shows the matrix of correlations among GDPpc, beds, population of people aged over 65, and HICP.

Following Gujarati (2004), multicollinearity between independent variables is confirmed if the correlation coefficient is 0.8 or higher and can be classified as severe when the absolute value of the pair-wise correlations between variables is very close to 1. As such, the correlation matrix demonstrates the absence of collinearity.

The statistical information revealed that COVID-19 had impacted the import of almost all essential medical goods, introducing a change to the existing pattern (Figure 6). In 2015, medical consumables had the highest demand, which was superseded by disinfectant in 2020, as the latter is an essential good needed to prevent the transmission of the virus and to sanitize the surfaces in affected areas. Overall, a substantial increase in the volume of import is observed in 2020, with the exception of test kits.

Table 2. Correlation matrix*

	GDPpc	Beds	Pop65	HICP
GDPpc	1			
Beds	−0.373	1		
Pop65	0.007	0.166	1	
HICP	−0.194	0.200	−0.187	1

Abbreviations: GDPpc: Gross domestic product per capita; HICP: Harmonized Index of Consumer Price for Health; Pop65: Population of people aged over 65.

Considering the total import from 2015 to 2020, Table 3 shows the most relevant countries according to their import volume as a share of the total import volume of each product.

Germany led in the intra-EU import (except for disinfectants), accounting for a significantly high share of most products. It is also the leading importer in almost all products in the extra-EU sphere, with the exception of test kits. It is followed by countries such as Belgium, the Netherlands, Italy, and Spain, reflecting their pressing needs arising from the pandemic. In addition, a marked concentration can be observed: the top five importing countries together account for almost 60% of international purchases, rising to 81% in the case of disinfectants. Avendaño (2020) and García *et al.* (2020) reported a similar pattern at the global level: official statistics revealed the high and concentrated participation of developed economies in the trade in medical products, with the United States and Germany occupying the top positions, followed by China.

Figure 7 shows the main suppliers of medical products during the period 2015 – 2020.

Table 3. Top 5 importers of medical product categories (2015 – 2020)

Test kits	Disinfectants	Medical consumables	Medical devices	Oxygen therapy equipment	Protective garments	Medical vehicles & furniture
Extra-EU trade						
DEU (32%)	NLD (37%)	DEU (19%)	DEU (18%)	DEU (44%)	DEU (23%)	DEU (26%)
BEL (14%)	BEL (15%)	NLD (12%)	ITA (14%)	ESP (10%)	NLD (14%)	NLD (12%)
NLD (11%)	SWE (10%)	BEL (11%)	NLD (13%)	NLD (7%)	FRA (14%)	FRA (8%)
FRA (11%)	FRA (8%)	FRA (10%)	ESP (9%)	BEL (6%)	ITA (9%)	ESP (8%)
ITA (7%)	ITA (6%)	IRL (7%)	FRA (9%)	ITA (6%)	ESP (8%)	POL (7%)
Total 75%	Total 81%	Total 59%	Total 63%	Total 79%	Total 69%	Total 62%
Intra-EU trade						
FRA (20%)	DEU (30%)	DEU (17%)	DEU (23%)	DEU (23%)	DEU (17%)	DEU (26%)
DEU (12%)	NLD (16%)	FRA (16%)	FRA (13%)	ESP (19%)	FRA (13%)	FRA (13%)
ESP (11%)	FRA (8%)	BEL (9%)	ESP (10%)	FRA (9%)	BEL (8%)	NLD (7%)
POL (11%)	ITA (7%)	NLD (6%)	BEL (7%)	POL (8%)	CZE (8%)	BEL (6%)
ITA (9%)	BEL (6%)	ITA (6%)	ITA (7%)	ITA (7%)	ESP (7%)	AUT (6%)
Total 63%	Total 67%	Total 54%	Total 58%	Total 66%	Total 53%	Total 58%

Note: A country's import of a product is given as a percentage of total extra- or intra-EU trade in that product (in parentheses).
Abbreviations: AUT: Austria; BEL: Belgium; CZE: Czechia; DEU: Germany; ESP: Spain; FRA: France; IRL: Ireland; ITA: Italy; NLD: The Netherlands; POL: Poland.

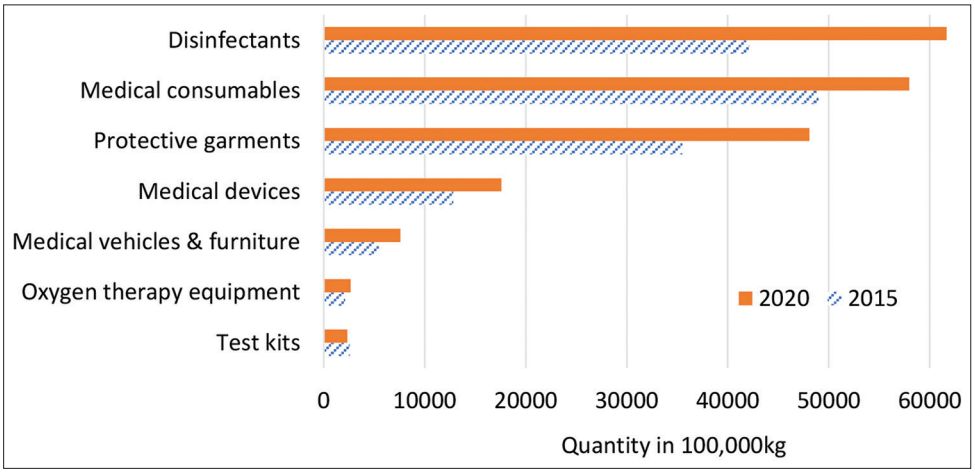

Figure 6. Total import by the EU-27, including extra-EU and intra-EU.

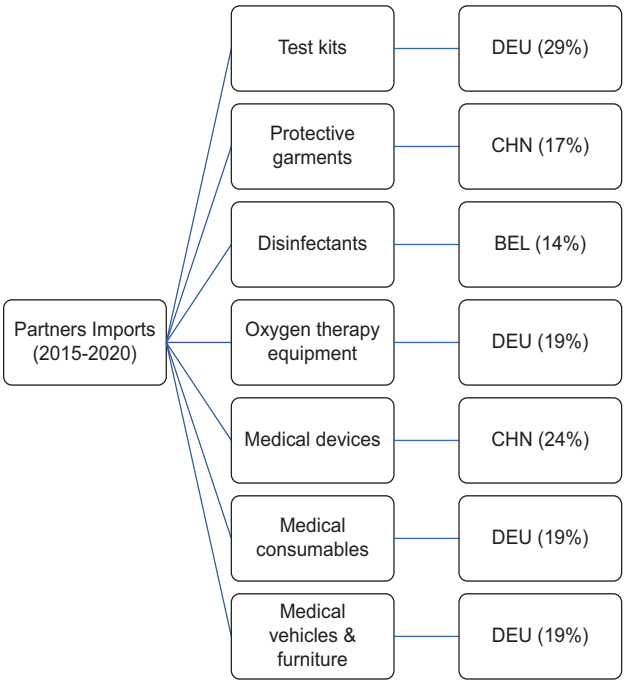

Figure 7. Main suppliers of each product.

According to official statistics, China, Germany, and Belgium led the way in medical supplies. Indeed, China accounts for the supply of 17% of the protective garments and 24% of medical devices sold to the EU-27 as a whole, placing itself in the top position of medical supplies (Figure 7). Germany and Belgium, in addition to holding top positions as suppliers to European countries, are also among the major importers. The OECD (2020b) and García *et al.* (2020) attribute this dual role to the existence of intense intra-industrial trade and the high degree of interdependence between these essential items.

4. Results

Equation I was used for estimation for each of the analyzed products using the most appropriate statistical method. All variables have been log-transformed to eliminate the dependence on the units of measurement and to smooth any variability, thereby standardizing the statistical data and improving the robustness of the estimates.

The results of the Breusch-Pagan and Hausman tests revealed that the estimation of imports of test kits, protective garments, vehicles, and furniture is more consistent when pooled OLS is applied (Prob > Chi2 < 0.05). The Hausman test was significant for three products (disinfectants, medical consumables, and oxygen therapy equipment), indicating that the RE method was more efficient than the FE method in this case. Finally, FE was used for the estimation of medical devices because Prob >Chi^2 < 0.05 in the Hausman test.

In all estimations in Table 4, the goodness of fit (Adj R^2) lies between 0.74 and 0.85; it can thus be confirmed that the set of regressors explains a substantial part of the behavior of the import. GDPpc and population showed positive and significant coefficients for all products, which is expected according to economic theory. The level of wealth of a country reflects its purchasing power, and thus capacity to purchase essential goods. Furthermore, an aged population in a territory has a greater need for essential medical products. The year 2020 saw an increased need for the essential medical products because this age group is the most vulnerable to the symptoms of the virus. In this regard, Shaker (2020) noted that a greater population aged over 65 of the importing country was indicative of a bigger import of medical products from China during the pandemic.

Table 4. Model estimation results

	Pooled OLS	Random effects	Random effects	Fixed effects	Random effects	Pooled OLS	Pooled OLS
	Test kits	Disinfectants	Medical consumables	Medical devices	Oxygen therapy	Protective garments	Medical vehicles and furniture
Ln (GDPpc)	1.380***	0.921***	0.605***	1.034***	0.832***	0.771***	0.884***
Ln (Pop 65)	1.039***	1.081***	0.802***	1.478***	1.229***	0.923***	0.855***
Ln (Beds)	0.502	−0.037	0.311	1.163***	0.382	0.544***	0.646***
HICP	0.010	−0.033**	−0.006	−0.005	0.025*	0.026	0.015
DExtra	−1.703***	−1.756***	−1.735***	Omitted	−1.489***	−0.509***	−0.822***
D2020	0.082	0.400***	0.116***	1.110***	0.063	0.371***	0.117
Cons	−21.56***	−10.59***	−5.69***	−20.53***	−18.76***	−11.32***	−13.76***
Obs	324	324	324	324	324	324	324
Adj R^2	0.857	0.744	0.795	0.805	0.822	0.826	0.857
Breusch-Pagan test							
Chi^2 (1)	0.87	24.24	57.94	11.47	9.36	0.36	0.01
Prob>Chi^2	0.351	0.000	0.000	0.000	0.002	0.547	0.910
Hausman test							
Chi^2 (4)	--	2.60	2.05	16.15	5.23	--	--
Prob>Chi^2	--	0.461	0.725	0.006	0.264	--	--

Notes: (1) Dependent variable: ln imports; (2) ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively; (4) Degrees of freedom of the statistic.

However, the number of beds, which represents an important element of hospital infrastructure, is only significantly related to the import of vehicles and furniture, medical devices, and protective garments. The number of beds reflects the hospital capacity and is therefore related to the essential equipment for hospitals, which is supplied in accordance with their needs.

It has also been shown that price changes, as indicated by HICP, have only a weakly significant influence on the import of medical products (disinfectant and oxygen therapy equipment). This is due to the fact that they are essential goods and not very sensitive to price changes. They are thus considered very inelastic products. On the other hand, the existence of barriers to trade means that the volume of import from EU member states exceeds those from the rest of the world; this is reflected by the negative sign of the dummy *Dextra* in the estimations for all the medical goods. In this respect, Makrevska *et al.* (2020) also confirmed the preference for European products in a global context. EU countries enjoy trade privileges that foster internal trade and make it harder to purchase from countries outside the European agreement. The latter are penalized not only in terms of tariffs but also in the extra bureaucracy that complicates and slows down transactions.

Finally, the dummy D2020 introduced to capture the effect of COVID-19 turned out to be positive and significant for only four of the seven products (disinfectants, medical consumables, medical devices, and protective garments), confirming the major role they play in the fight against the virus. This is reflected by an increase in imports of these products in the first 10 months of 2020 compared to previous years.

5. Conclusion

The economic crisis generated by the measures taken to curb the pandemic has led to major distortions in international trade. Some studies have focused on analyzing important changes in trade policy aimed at mitigating the negative effects of COVID-19, following the imposition of export restrictions and the liberalization of imports. The empirical analysis of this research provides relevant information on the behavior of the determinants of imports of essential medical products, as defined by the WHO, within the EU during the period 2015 – 2020.

In a context in which volume of intra-EU trade generally exceeds that of extra-EU trade, a panel sample of 27 EU countries is used to shed light on the variables that explain the similarities and differences among different types of imported medical products. The wealth of the importing country and the population aged over 65 could explain the volume of import: the greater the purchasing power and the older the population, the higher the volume of imports. However, the number of beds only influences the import

of vehicles and furniture, medical devices, and protective garments needed by hospitals in their fight against disease. It has also been shown that most of the products are not sensitive to price changes because they are inelastic goods indispensable in health sector, which can be hardly replaced by other substitutes. The dummies included in the model indicate, on the one hand, that the pandemic has been the driving force behind the trends in the import of certain products (D2020), and on the other hand, that barriers to trade imposed by the Third-World countries negatively impact the import by European countries (*Dextra*).

The present analysis provides answers to all the questions set out in Section 1:

(i) The import of essential medical products needed to combat the pandemic are generally driven by the same factor, although due to the intrinsic characteristics of each one, some are more dependent on the wealth of the country, while others depend more on the profile of the population.
(ii) Tariff agreements in the EU favor intra-EU trade over goods from other countries.
(iii) The import of some essential products have been severely affected by the growing demand driven by the spread of the virus.
(iv) The essential medical products have low price elasticity as they are essential items.

The research was carried out during the pandemic, coinciding with the first months of the mass vaccination in most high-income countries. The logical continuation of this study would be to analyze the effect of vaccination on the import of medical products, to determine whether the immunization of the population alters demand for these goods. It would also be interesting to study whether countries have adjusted their production to avoid a high degree of foreign dependency and to prevent the collapses during the early months of the spread of the virus. Unfortunately, this study was limited by the lack of a global vision of the problem, which was due to the lack of comprehensive and up-to-date information. We believe that when the pandemic abates to a greater extent, more accurate statistical information will be available for a global analysis to be conducted.

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Conflict of interest

The authors declare no conflicts of interest.

Author contributions

Conceptualization: All authors
Investigation: All authors
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Writing – original draft: All authors
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Ethics approval and consent to participate

Not applicable.

Consent for publication

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Availability of data

The data used in this research can be obtained from Eurostat: https://ec.europa.eu/eurostat/data/database.

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