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Impact of COVID-19 on imports of medical products: A panel data approach

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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 the population. This study seeks to examine the determinants of imports by EU-27 countries, through a panel data analysis for the period 2015-2020. The aim is to shed light on the distinct behaviour 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 are used as explanatory variables, as well as the origin of the goods and the effect of the virus in 2020. The results show that some determinants of imports of medical goods have a homogeneous influence on all of these products. This is the case with the wealth of the importing country and its population aged over 65: the higher the purchasing power and the older the population, the greater the volume of imports. It is confirmed that EU-27 trade agreements curb the mass entry of non-EU products and that COVID-19 has led to higher imports of certain products.

Keywords: COVID-19; Medical products; imports, panel data.

Subject classification codes: **JEL:** C23; F14; I15.

1. Introduction

COVID-19 has paralysed the world for months, sparking a global crisis that has 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). All this has generated a rapid social reversal and huge inequalities, exposing 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 this novel disease requires a volume of supplies that no country could have reasonably

foreseen. COVID-19 has caused a widespread shortage of certain healthcare 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 in order to guarantee domestic supply (OECD, 2020b; Baldwin and Evenett, 2020; Evenett and 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 and 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 ageing of the population in middle- and high-income countries, which, together with the substantial increase in healthcare 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 is to analyse 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 2015-2020 (in the first 10 months of each year), such that the last year reflects the effect of COVID-19 on international purchases. The study seeks to answer the following questions: Do imports of each of the essential medical products needed to combat the pandemic depend on the same factors? Are extra-EU suppliers at a disadvantage compared to intra-EU suppliers? Has there been a significant change in 2020 compared to previous years in imports of medical products classified as essential? Are imports of medical products price sensitive? The analysis is based on trade statistics provided by Eurostat, distinguishing between extra- and intra-European imports. Using a panel data sample, a pooled ordinary least squares (OLS), fixed effects (FE) or random effects (RE) estimation is 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 analysed in the literature (Shaker, 2020; Anghelache et al., 2020). Specifically, Minondo (2020) compare 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 and 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: (1) 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; (2) the period of time analysed enables an assessment of the impact of the pandemic, identifying which products are most affected and why; (3) the composition of the sample used in the empirical analysis gives those responsible for setting EU trade policy a view of the individual patterns for each country, providing them with ex-ante information for the adoption of possible tariff measures.

The sample analysed centres on European imports of products classified as essential for combatting COVID-19 by the World Customs Organization jointly with the World Health Organization (WHO), with seven categories identified:

- *Test kits and diagnostic instruments* (COVID-19 test kits)
- *Disinfectants and sterilization products* (medical strength alcohol, sanitizers, sterilizing equipment, chemical disinfectants, medical grade chemicals)
- *Oxygen therapy equipment* (such as ventilators, artificial respiration apparatus)
- *Medical devices* and equipment (thermometers, stethoscopes, electrocardiographs and ultrasound machines.)
- *Medical vehicles and furniture* (Ambulances)
- *Protective garments* (face masks, eye protection, gloves and other personal protective equipment)
- *Medical consumables* (soap, wadding, gauze, bandages, cotton sticks and similar articles)

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 reviews 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 along with the sample 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), to more specific areas such as social distancing (Cronin and Evans, 2021), 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 analysed from various perspectives (Baldwin and Tomiura, 2020; Evenett, 2020a; Vickers and Ali, 2020; Barua, 2020; Hayakawa and Imai, 2021; Bucciol et al 2020).

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

Focusing on trade policies, Evenett et al. (2020) identify a surge in trade policy activism between February and March 2020, alongside the rise in COVID-19 cases, with the authors finding 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) analyse the relationship between public procurement regimes and trade policies during the first six months of the pandemic, concluding that the application of export restrictions on medical products is strongly correlated with the characteristics of prevailing public procurement regimes. Likewise, Curran et al. (2021) focus their study on the scope and nature of trade policy and its possible compatibility with existing World Trade Organization (WTO) agreements. Their results reveal that the globalizing process taking place in recent decades has slowed down due to continual political interventions and growing trade tensions. Ayub (2020) assesses the impact of restrictions imposed by Malaysia on imports of medical supplies, arguing 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 and Grohs, 2021). Dallas et al. (2021) identify 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 demonstrate the mutual constraints of states and GVCs, and reveal 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) assess state intervention in medical product GVCs, conducting comparative analyses of France, Germany, the United Kingdom and the United States, and of the Commonwealth countries, respectively. Others such as Vickers and Salamat (2020) map out supply chains, analysing major exporters and importers and assessing the impact of recent trade measures on least developed countries. The results indicate that global cooperation and support play an important role in bolstering health systems in these countries.

The WTO has also collaborated by publishing a series of papers, the results of which provide valuable information on the

impact of the pandemic on international relations. These studies explicitly refer to medical products: they analyse the business of vaccines, both in terms of development and global distribution (WTO, 2020a); they assess the related export bans and restrictions (WTO, 2020b); and they study how these products are treated in regional trade agreements (WTO, 2020c). Similarly, the WTO (2020d) and Dugiel and Mikołajek-Gocejna (2020) examine 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 analysed medical products has some special features that explain its behaviour in times of intense demand. In the last five years, according to statistical data from Eurostat, the supply and demand of these products has displayed an upward trend, with an increasingly large positive trade balance, due to the growing gap between exports and imports (Figure 1).

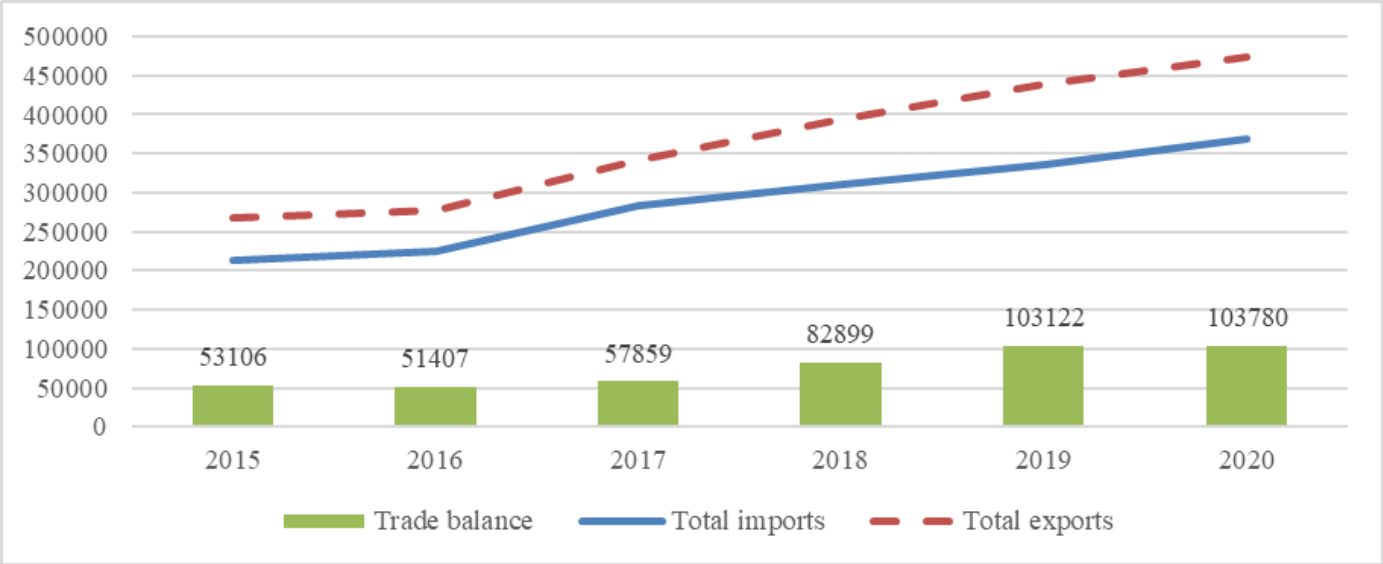

Figure 1. Evolution of EU-27 trade in medical products (€million)

The present empirical study focuses on the analysis of extra- and intra-EU imports, distinguishing by type of product; the analysis by specific product type does not reveal such a uniform trend. In order to compare like with like, the analysis first focuses on products that registered negative growth in imports in 2020, namely *test kits* and *oxygen therapy equipment* (Figure 2). This decline is most pronounced in extra-EU imports of *test kits* (-9.88%) and intra-EU imports of *oxygen therapy equipment* (-8.15%).

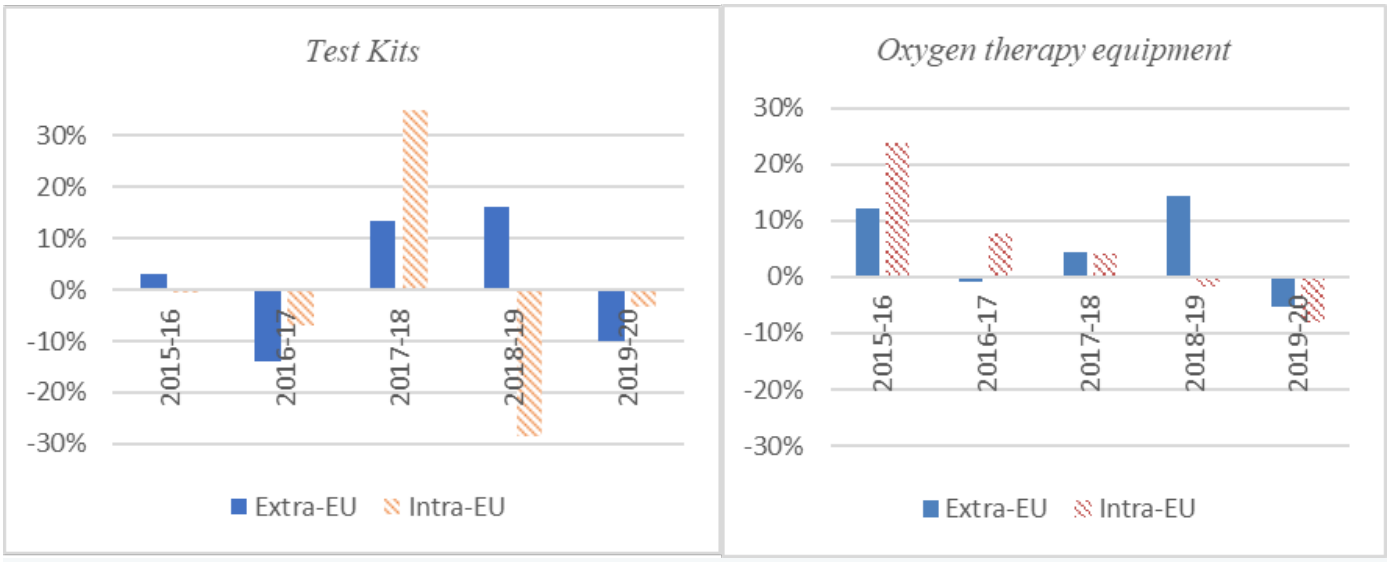

Figure 2. Products with negative growth in imports in 2019-20

Conversely, due to their technological simplicity and ease of purchase, imports of *protective garments* and *disinfectants* show 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 has exhausted stocks, significantly driving up prices and causing a backlog in order fulfilment of between four and six 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.

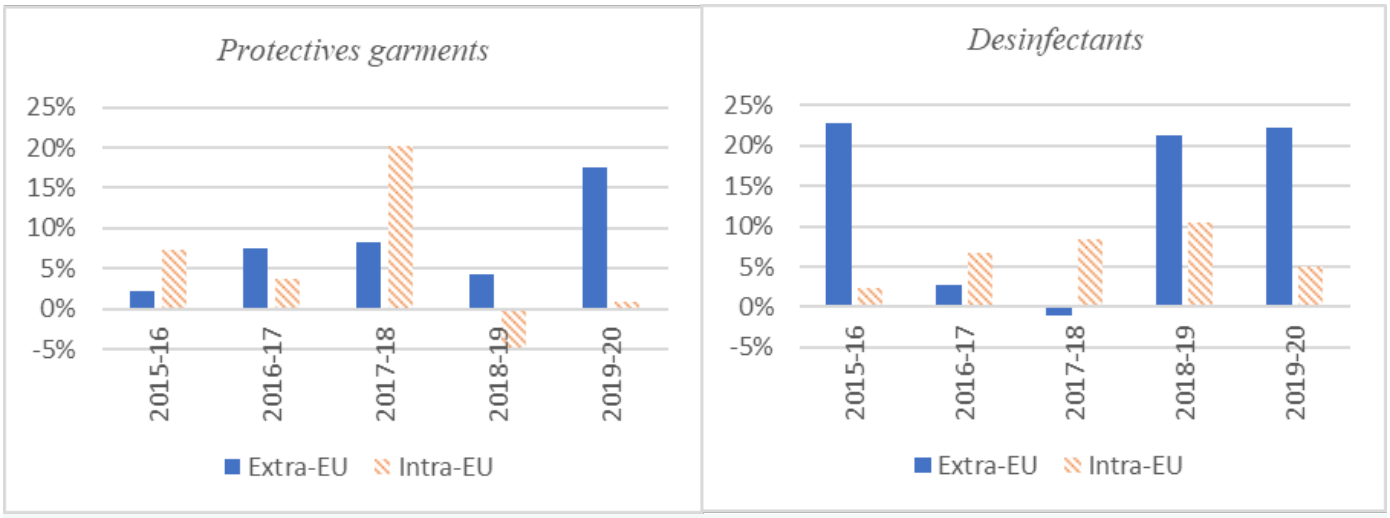

Figure 3. Products with positive growth in imports in 2019-20

Finally, extra-EU imports of *vehicles & furniture*, *medical devices*, and *medical consumables* have increased during the pandemic, while intra-EU imports have decreased (Figure 4). *Medical devices* are products that involve a high level of

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 last two years (2017-2019), however the COVID-19 effect has generated greater trade with suppliers from outside the EU.

Figure 4. Products with positive and negative growth in imports in 2019-20

Analysing all medical products together, the intra-EU import volume exceeds the extra-EU volume over the entire period analysed (Figure 5). These statistics reveal the effectiveness of existing trade agreements between EU countries as a determining factor in the development of this type of trade.

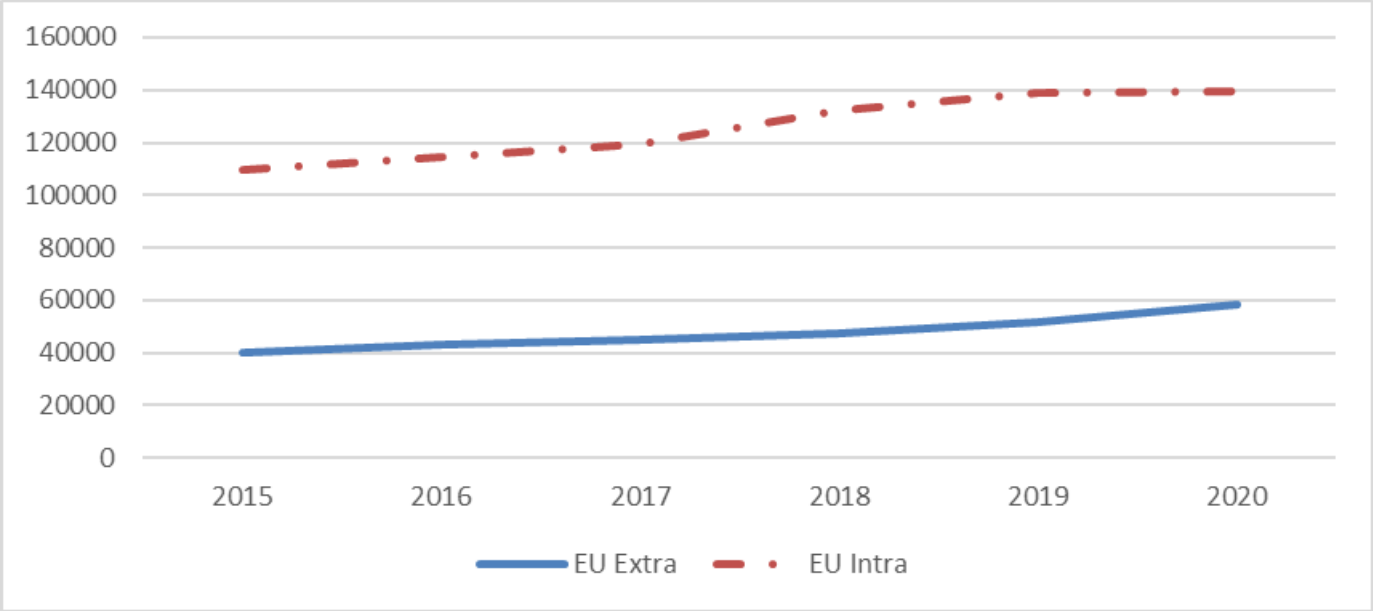

Figure 5. Evolution of intra-and extra-EU imports (100,000 kg)

Overall, there is a slight increase in 2020 in extra-European trade in medical goods. This may be due to the uncontrolled demand for these products, which has resulted in a slow-down of trade with member states in order to meet domestic demand. Although this has prompted a search for other suppliers outside the EU, there is 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 has been 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 in order to detect the possible effects of the pandemic (Equation 1).

$$\text{Ln (M)}_{i,j,t} = \beta_0 + \beta_1 \text{Ln (GDP}_{pc})_{j,t} + \beta_2 \text{Ln (Pop65)}_{j,t} + \beta_3 \text{Ln (Beds)}_{j,t} + \beta_5 \text{HICP}_{it} + \beta_4 \text{Dextra} + \beta_5 \text{D2020} + \varepsilon_{it} \quad (1)$$

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 and 0 otherwise.
- D2020 is a dummy variable that takes the value 1 if the imports were made in the year 2020 and 0 otherwise.
- Expected values of $\beta_{2,}$ $\beta_{3,}$ β_5 >0, and of β_4<0.

In the field of international trade, numerous previous studies have employed regression models with panel data estimated by pooled OLS, fixed effects (FE), and random effects (RE) (Karagoz and Saray, 2010; Manwa et al., 2019; Tran et al., 2020; Majumder et al., 2020,among others). The Breusch-Pagan and Hausman tests are used to determine the most appropriate estimation method. Following 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 individuals. The Breusch and Pagan Lagrangian multiplier test is used for the choice of model between pooled OLS and RE. In this case, two hypotheses are proposed:

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

If Prob>Chi2 is less than 0.05, we can reject H_0, and the appropriate model is RE.

In order to choose between FE and RE, Hausman specification tests are used, with the selection between the two models based on the inter-variance and intra-variability. 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, we can accept H_0, and the preferred model is RE.

3.2. Data and Sample

The sample used in the study comprises 324 observations corresponding to 27 reporters belonging to the EU-27, 2 partners (one extra-EU and one intra-EU) and 6 years (2015 to 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 has had a notable effect on the trade in these goods. All variables have been sourced from Eurostat.

Table 1. Main statistics for the period 2015-2020

Dependent variables: imports (100kgs)				
	Mean	Max	Min	S.D
Medical consumables	994,662	7,852,124	2,179	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	6,757	378,933
Vehicles	127,136	1,455,688	2,298	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	6,370	19,420
Beds (Per hundred thousand inhabitants)	499	813	200	168
Population 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

As can be seen in Table 1, the goods registering the highest volume of imports on average in the last six years are *medical consumables* and *disinfectants.* Germany is the top importer of all the medical products analysed, 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* aged over 65 to Germany, and the highest *HICP* to Finland.

The variable *beds* captures available beds in hospitals; given the lack of information for 2019 and 2020, a value has been estimated by following the trend of the last four years. Regarding *population*, the analysis is focused on the number of people aged 65 years or over, as this is the age group that is 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 include a variable that reflects the price of these products: the *HICP* measures the change over time in the prices of consumer goods and services related to the health sector. In addition, it must be checked that there is no collinearity between the independent variables (Table 2).

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

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 pairwise correlations between variables is very close to one. As such, the correlation matrix demonstrates the absence of collinearity.

The statistical information reveals that the COVID-19 effect has impacted almost all imports of essential medical goods, generating a change in the existing pattern (Figure 6). In 2015, the highest demand was for *medical consumables*, while in 2020 it was for *disinfectant*, as this is considered an essential good needed to prevent the transmission of the virus and clean the surfaces in affected areas. Overall, a substantial increase in the volume of imports is observed in 2020, with the exception of *test kits.*

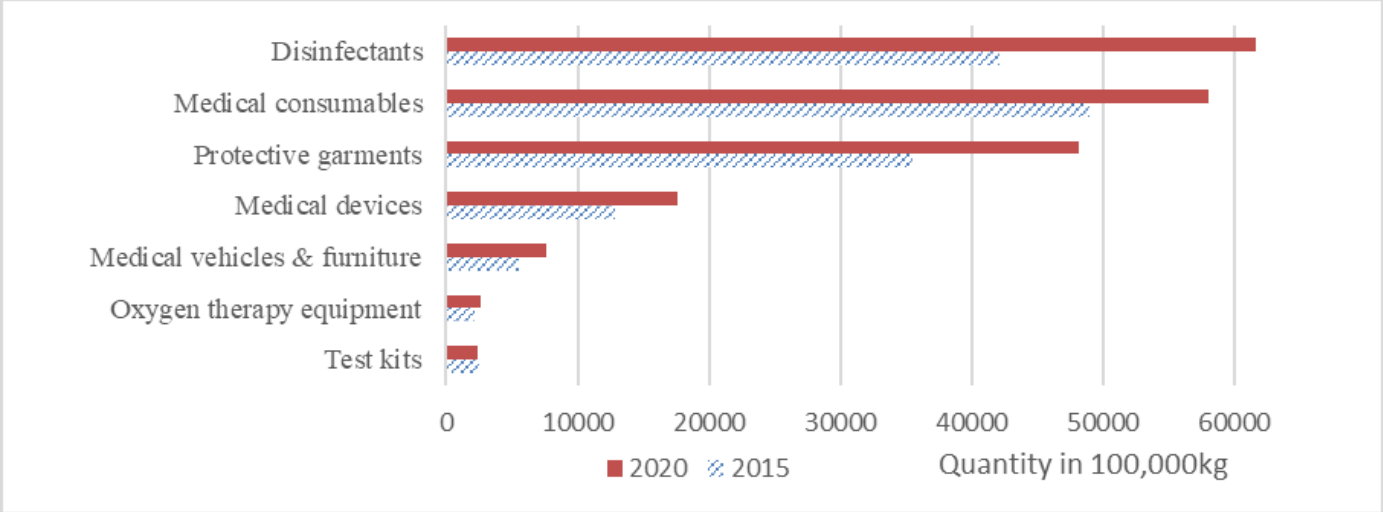

Figure 6. Total imports (Extra +Intra) by the EU-27 as a whole

Taking into account total imports 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, distinguishing between intra- and extra-EU imports.

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

TRADE EU-extra						
Test kits	***Disinfectants***	***Medical consumables***	***Medical devices***	***Oxygen therapy equipment***	***Protective garments***	***Medical vehicles & furniture***
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%**
TRADE EU-intra						
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 imports of a product as a percentage of total extra or intra-EU trade in that product is shown in parentheses.

Germany heads the table in intra-European imports (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 Garcia et al. (2020) report a similar pattern at the global level: official statistics reveal 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.

On the supply side, Figure 7 shows the main suppliers of medical products during the period 2015-2020.

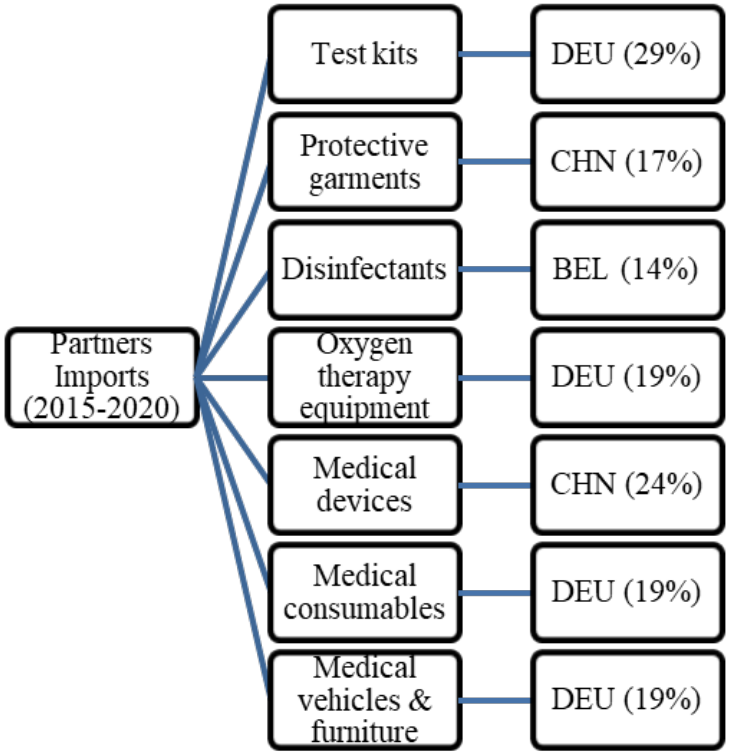

Figure 7. Main supplier of each product as a share of total imports

According to official statistics, China, Germany and Belgium lead the way in medical supplies. Indeed, the Asian giant accounts for 17% of the *protective garments* sold to the EU-27 as a whole and 24% of *medical devices*, placing it in top position (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 Garcia et al. (2020) attribute this dual role to the existence of intense intra-industrial trade and the high degree of interdependence in these essential items.

4. Results

Equation 1 has been estimated for each of the analysed products using the most appropriate statistical method. All variables have been log transformed in order to eliminate the dependence on the units of measurement and smooth any variability, thereby standardizing the statistical data and improving the robustness of the estimates.

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*	*Vehicles &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							
Chi2(1)	0.87	24.24	57.94	11.47	9.36	0.36	0.01
Prob>Chi2	0.351	0.000	0.000	0.000	0.002	0.547	0.910
Hausman Test							
Chi2(4)	--	2.60	2.05	16.15	5.23	--	--
Prob>Chi2	--	0.461	0.725	0.006	0.264	--	--

Note (1): Dependent variable: ln imports.

*Note (2): ***, ** and * denote significance at the 1%, 5% and 10% levels.*

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

In all the estimations, 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 behaviour of the imports. *GDPpc* and *population* show positive and significant coefficients for all products, with the sign as expected according to economic theory. The level of wealth of a country reflects its purchasing power, and thus capacity to purchase goods considered essential. Furthermore, the older the population in a territory, the greater the need to consume essential medical products. In 2020, the effect of the latter variable has been exacerbated by the fact that this group is the most vulnerable to the symptoms of the virus. In this regard, Shaker (2020) notes that the importing country's population aged over 65 is showing a positive relationship with Chinese exports of medical products during the pandemic.

However, the number of *beds*, which represents an important element of hospital infrastructure, is only significant for imports of *vehicles & furniture*, *medical devices*, and *protective garments*. The variable *beds* reflects hospital capacity and

is therefore related to the essential equipment for hospitals, supplied in accordance with their needs.

It has also been shown that price changes, *HICP,* have only a weakly significant influence on imports of medical products (*disinfectant*, *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 imports from EU member states exceed those from the rest of the world; this is reflected in the negative sign of the dummy *Dextra* in the estimations for all the medical goods. In this respect,**Makrevska et al. (2020)** also confirm 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.**

Lastly, 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 in an increase in imports of these products in the first 10 months of 2020 compared to previous years.

5. Conclusions

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 analysing 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 behaviour 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 volumes of intra-EU trade generally exceed extra-EU trade, a panel sample of 27 EU countries is used to shed light on the variables that explain the similarities and differences between imports of types of medical products. Such is the case with the wealth of the importing country and the population over the age of 65: the greater the purchasing power and the older the population, the higher the volume of imports. However, the number of beds only influences the imports of *vehicles & furniture*, *medical devices*, and the *protective garments* needed by hospitals in their fight against disease. It has also been shown that most of the products are not sensitive to changes in health sector prices because they are inelastic goods, extremely necessary and have few substitutes. The dummies included in the model indicate, on the one hand, that the pandemic has been the driving force behind the trends in imports of certain products (*D2020*), and on the other hand, that barriers to trade imposed on third countries have negative effects on imports by European countries (*Dextra*).

The analysis carried out provides answers all the questions raised: (1) the results reveal that imports of the 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; (2) tariff agreements in the EU favour intra-EU trade over goods from other countries; (3) imports of some essential products have been seriously affected by the growing demand driven by the spread of the virus; (4) the results confirm the low price elasticity of demand for these goods, as they are considered essential.

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 analyse the effect of vaccination on imports of medical products, in order to determine whether the immunization of the population marks a turning point in the international 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 suffered during the early months of the spread of the virus. The main limitation of this research is the lack of a global vision of the problem, which was due to the need for up-to-date information. Once the pandemic is over, more accurate statistical information will be available, which will allow a global analysis to be conducted.

Conflict of interest

We confirm that there are no relevant financial or non-financial competing interests to report.

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