Universidad Pública de Navarra
Nafarroako Unibertsitate Publikoa

school of economics
and business administration
facultad de ciencias
económicas y empresariales
ekonomia eta enpresa
zientzien fakultatea

Facultad de Ciencias Económicas y Empresariales

TRABAJO FIN DE GRADO EN ADMINISTRACIÓN Y DIRECCIÓN DE EMPRESAS

INTERNATIONAL TRADE AND DETERMINANTS OF MARITIME TRANSPORT

-AN ANALYSIS OF EUROPEAN COASTAL COUNTRIES-

SILVIA DÍAZ DE RADA GOÑI

Pamplona-Iruña 12 de mayo de 2022

Módulo: Economía Española, Internacional y Sectorial
Director: Antonio Gómez Gómez-Plana

ABSTRACT

Nowadays, 80% of traded goods are shipped by sea. In Europe, around 40% of goods traded among EU members, are seaborne. However, in March 2020 this sector was abruptly stopped causing important disturbances in global supply schemes. For this reason, this paper aims to identify and assess those economic and industry-related factors which shape the shipping industry and eventually, transportation costs. To conduct panel data analysis, 23 European countries (22 EU state members and the UK) have been taken as reference. Results suggest that western and developing economies' growth, as well as productivity gains contributes to enlarge maritime transportation of goods. Also, global fleet growth affects positively port activity as long as, port facilities can accommodate larger ships and other production factors are proportionally enlarged. Finally, oil prices entail a contracting effect due to the lack of available substitutes. Other aspects like port connectiveness and trade concentration are expected to foster trade although, it cannot be statistically asserted.

Key Words: *maritime transportation, shipping industry, freight, port activity, international trade, globalisation.*

RESUMEN

Actualmente, el 80% de los bienes comercializados son transportados por mar. Así como, el 40% del comercio intraeuropeo. Sin embargo, en marzo de 2020 este sector colapsó repentinamente, causando grandes distorsiones en el panorama productivo mundial. Por ello, el objeto de este estudio es identificar y valorar aquellos factores económicos y propios de la industria, que afectan al sector de transporte marítimo. Para llevar a cabo un estudio de panel se han tomado como referencia 23 países europeos (22 estados miembros de la UE y Reino Unido). Los resultados sugieren que el desarrollo económico, tanto de los países occidentales como de las economías en desarrollo, así como las mejoras de productividad contribuyen a aumentar el volumen de bienes gestionado por los puertos europeos. El aumento de la flota mundial, siempre y cuando se adapten las instalaciones portuarias y se aumenten el resto de los factores productivos implicados proporcionalmente, muestra signo positivo. Finalmente, el precio del petróleo conlleva efectos contractivos dada la falta de bienes sustitutivos. Así mismo, se espera que la conectividad de los puertos y la concentración de comercio fomenten la actividad de este sector, pero, esto no puede ser afirmado estadísticamente.

Palabras Clave: *transporte marítimo, industria naviera, flete, actividad portuaria, comercio internacional, globalización.*

Table of Contents

1. INTRODUCTION

The global COVID-19 pandemic has impacted the world in multiple ways. In particular, the transport sector is considered to have been profoundly disrupted and sometimes ignored. Only when the Ever Given obstructed the Suez Canal, did society seem to worry about the becoming of maritime trade. In words of current UNCTAD's trade and logistic branch head- Mr Jan Hoffmann "This incident reminded the world just how much we rely on shipping" since, as he explained, "about 80% of the goods we consume are carried by ships, but we easily forget this" (UNCTAD, 2021a). After this incident, the blockage in April 2022 of the Shanghai's port - the most transited port in the world- evidenced how the transport sector is a key part of global production and supply scheme. Additionally, "eventually, consumers' segment has been the ultimate affected, as they have been affected in multiple ways on a general basis" (Carrière-Swallow et al., 2022). Trade is an important economic activity, not only because of the significant portion of nations' GDP it represents, but because it affects virtually every other sector.

In general, international trade has increased since WWII. This has been significantly provoked by rapid economic globalisation, the entrance of new nations to the global commercial panorama, and a generalised liberalization of economic and financial activities. Consequently, maritime transportation is sometimes considered by scholars as "the backbone of globalisation and lies at the heart of cross-border transport networks that support supply chains and enable international trade" (UNCTAD, 2016).

Indeed, at the European level, the shipping industry throughout direct, indirect and induced effects, generates around two million jobs, and contributes 149 billion euros to EU's GDP (Oxford Economic, 2020). Additionally, for every million euros of GDP it creates it is estimated that another 1.8 million euros are generated elsewhere in the EU economy (Oxford Economic, 2020). Moreover, in Europe, more than 1200 merchant ports are distributed along 100.000 kilometres of coast and it is estimated that around 40% of traded goods within Europe are seaborne (Freire & González Laxe, 2009). Consequently, it is to be expected that, maritime exchange of goods is considered by some experts as an important catalysator of interregional cohesion and economic prosperity (Freire & González Laxe, 2009). Particularly, in the last thirty years, worldwide seaborne trade increased from 3.6 billion tonnes in 1985 to nearly 11.1 billion tonnes in 2019 (UNCTAD, 2021b). Inevitably, the transport sector has experimented transformation in many ways, giving rise to the actual shipping industry scheme. Vessels' size has been considerably enlarged, container shipping captures a larger portion of seaborne trade each time, port facilities have adopted technological and logistic advances and some developing economies such as, China have unseated traditional trade players.

In general, experts agree on the lack of research done to properly understand the shipping industry and associated transportation costs. It is true, a vast number of papers have studied countries, regions or trade partners' trade flows. However, scholars claim that more research as regards of maritime transport is required to fully comprehend how the gears of the shipping industry function. Even at the European level, where research and data collection are conducted for a vast number of industries and other economic and societal aspects, the quality and assortment of data regarding this topic is considerably limited. Thus, regardless of the relevant role developing economies play in current trade panorama, the study will uniquely focus on the European case, since data and research for less developed regions is very limited.

For this reason, this paper aims at assessing European maritime transport industry, and more precisely its ports activity, in order to detect and evaluate which are the main factors shaping its evolution. More concretely, three specific objectives have been set. First, it will attempt to expose the evolution of the European shipping industry in the international context and to enhance its relevance for current global economies. The second objective is to evaluate how identified factors determine shipping industry's performance. Lastly, this study will also attempt to comprehend those circumstances that, as a result of the pandemic, led to an unprecedent global shortage of containers and skyrocketed freight costs.

This paper is structured in three main sections. Next section (Section 2), will present a theoretical analysis of transportation costs and the maritime transport industry. Section 3 defines the empirical analysis of this study (endogenous and exogenous variables included and a brief explanation of the methodology utilised) and presents both descriptive statistics and panel data results. To conclude with this analysis, some final conclusions will be presented in Section 4.

2. THEORETICAL FRAMEWORK

This section will first, assess the evolution of transportation costs and how these affect the overall maritime shipping industry. Afterwards, considering previous literature and experts' insights, the main determinants of maritime transport industry evolution will be identified and studied. This section is expected to provide the reader with a general idea of how this industry functions.

2.1.Transportation Costs

Recently, with the expansion of trade, the term ***trade facilitation*** has gained importance. Especially, after the Trade Facilitation Agreement (TFA) was reached in 2015 under the umbrella of World Trade Organisation (WTO). This concept encompasses "a broader set of issues which directly lie at the intersection of trade and transportation costs" (Blonigen & Wilson, 2018). This comprises aspects such as customs rules, border procedures, port-of-entry infrastructure, among many others. Nonetheless, despite economists and international agencies' efforts, still there is not a broadly accepted definition for trade facilitation. Blonigen & Wilson (2018) propose the following definition, "Trade facilitation includes all the domestic and border systems and procedures that can help move goods and services into and out of a country". This could include logistics, infrastructure, regulation and cultural aspects.

Sometimes, **transportation costs** is an aspect that goes unnoticed to literature, even when these "are often a more important inhibitor to participation in the world economy than are policy barriers to entry into export markets" (Luecke, M., 2009). Moreover, in general, many scholars have also accepted the role shipping costs have had in history when it comes to trade volume's evolution. Many of them argue that, in concordance with the gravity model, countries tend to have more intense trade bounds with neighbour than with far away countries, which to certain extent is attributed to higher shipping costs due to larger routes (Levinson, 2016). Recently, with the onset of the pandemic transportation costs have been a hot topic worldwide since in 2021, transport costs were five times higher than before the pandemic (European Commission, 2021)

Still, the amount of empirical data available regarding this topic is considered to be scarce. In general, international trade data has not provided sufficient specific transportation services information. It is true research has been done regarding trade flows among countries or the relationship between freight rates and the volume of traded goods. However, as Blonigen & Wilson (2018) suggest little investigation has been conducted as regards of the transportation of trade itself and the implications this has on transportation costs.

Blonigen & Wilson (2018) conjecture that a possible explanation for this lack of research in this topic might be the fact that transportation costs are perceived as a "natural barrier" to trade. Meaning that, distant countries are meant to trade less uniquely because it is more expensive to ship goods. Other traditional theories such as Ricardian and Heckscher-Ohlin did directly not contemplate these costs in their basic models, and others like Samuelson (1954) approached them as a fixed portion of the good that is "lost" in the interchange (Blonigen & Wilson, 2018).

In any case, this lack of attention strikes surprising as transport costs have had an important role in shaping history. As historians usually explain, the reduction of these caused by the introduction of the steamship, contributed importantly to economic globalisation. More recently, freight reduction is believed to have made possible just-in time manufacturing, vertically fragmented production processes and global supply chains (Blonigen & Wilson, 2018). In fact, literature has attempted to analyse how this evolution has contributed to offshoring production. Studies have found that even though this reduction in costs have boosted overall trade, this trend is especially notable for intermediate goods which is somehow explained by the arise of international fragmentation of production. Figure 1 shows how freight rates have evolved during the last decade (2011-2021). In general, these have stayed relatively stable until the first quarter of 2020 when the Covid-19 crisis commenced.

Figure 1: China Containerized Freight Index (CCFI) composite index, 2011-2021 (quarterly)

Source: Clarkson- Shipping Intelligence Network, 2022

This increase in freight was caused by an initial abrupt contraction of demand due to lockdown restrictions and a subsequent rapid reactivation of it. By the time demand was reactivated, shipping capacity was importantly constrained by port congestions, long waiting times at ports that kept vessels occupied, and insufficient workforce available. This produced historical inefficiencies and distortions that made freight rated picked up.

Moreover, literature proposes that transportation costs "have taken on a more important relative role in influencing trade as traditional interventions such as tariffs and export subsidies have fallen" (Blonigen & Wilson, 2018). Indeed, some authors highlight the fact that while considerable achievements in terms of **tariffs liberalisation,** especially in developing countries, have been attained, little progress has been made on designing **transportation costs regulations** which have entailed recent abrupt increase in freights. Blonigen & Wilson (2018) accept that transport costs are significantly determined by unchangeable circumstances such as countries' **geographical location** or **cultural barriers.** However, they also claim that this lack of regulation generates trade frictions which inhibit trade.

Shipping costs affect maritime trade flows as well as international trade as a whole. Wilmsmeier et al. (2006) found that these costs can be significantly reduced by enhancing **port efficiency**, upgraded **port infrastructure** and attracting private investment to the sector. These authors did also conclude that even though country isolated improvements can reduce freights, these do also importantly depend on **market competitivity pressures**. Another research work suggested that **private collusive behaviour and cargo-handling restrictions** do usually provoke higher shipping costs (Blonigen & Wilson, 2018). Additionally, other authors such as Hummels et al. (2009) proposed **other market-originated forces** that shape transportation costs. For instance, these found that imported commodities presenting inelastic demands, do usually face higher shipping costs (Hummels et al., 2009). Moreover, beside demand and supply effects which definitely affect shipping costs, governments have historically played a crucial role in affecting maritime trade flows.

Lastly, it is believed that transportation costs cannot be assessed without mentioning **fuel cost**. As it has been suggested by some authors, distance seems to be one of the principal inhibiting forces exporting organizations find. This could be related to the fact, the further away the final destination is, the more people and time is required, and more oil is consumed, which is one of the main operating costs shipping companies have to face. Apparently, crude oil does not have an accessible substitute and its price is considerably volatile, as it can be observed in Figure 2. However, experience shows that when oil prices raise, as has happened in Europe since the onset of the Russian conflict in February 2022, road transport slow down due to unbearable operational costs. Thus, this reasoning might also be applicable for the maritime transportation industry.

Figure 2: Crude Oil barrel price in US dollars.

Source: IMF- Primary Commodity Price System, 2022.

2.2.Maritime Transportation Sector

Thanks, to certain extent, to trade facilitation and globalisation, international trade showed an upward trend reporting historical figures until the financial crisis in 2008. In general terms, experts agree on the essential role the transportation sector has played in the course of these events. Over and above that belief, according to some experts such as Blonigen & Wilson (2018) the transport sector has not only made international trade expansion possible but, it has also contributed to stimulate it. Indeed, these authors claim that "transportation is largely ignored in the economics trade literature" as many times it has failed to identify the synergies created between the transport industry and trading countries' economic development. In compliance with that belief, some years before, Freire & González Laxe (2009) had already supported the positive relationship between economic growth and transport of merchandise.

In compliance with that idea, it is widely accepted that the transport sector, permits merchandise commerce and interconnexion among countries. It guarantees goods provision and enhances nations' specialization and market competitiveness which in turn, fosters economic development. Simultaneously, nations attain to enjoy economies of scale which throughout a multiplier effect, ends up creating welfare and further economic development. More specifically, Freire & González Laxe (2009) found that, in general terms, maritime transport has had a more volatile evolution than economic development along past decades. This suggests that even though, economic development plays an important role when determining global trade flows, there coexist other driven forces which shape transportation sector as well.

Historically, the transportation sector has heavily relied on maritime transport which "carries more than 80 percent of the world's traded goods, most of which sail inside 40-foot-long steel containers stacked by the thousands atop some of the largest vessels ever built" (Carrière-Swallow et al., 2022). **Seaborne trade** is "merchandise (cargo) loaded on a ship at a seaport in country A and unloaded at a seaport in country B. It excludes transhipment cargoes (transferred from one ship to another at the same port) and cabotage cargoes (loaded on a ship and unloaded from a ship at seaports in that same country)" (Blonigen & Wilson, 2018).

In many cases, due to merchandise's nature such as its perishability, weight, volume or shape, maritime transport appears to be the most effective manner in which goods can be displaced from one place of the world to the other. Commonly, as the volume of merchandise which can be transported in a ship is relatively high, this alternative entails lower costs than for instances, air transportation. Considering that transport costs represent around 6% of world's imports total value (Freire & González Laxe, 2009), this aspect is crucial when deciding which transport mode will be used to move merchandise. Additionally, "generally, it is also the most energy-efficient way to carry cargo in terms of energy use per tonne-kilometre transported" (IEA, 2021). However, maritime transport does also imply some disadvantages such as longer travel times, pre-established routes or limited ports' capacity. Therefore, some aspects such as accessibility, quality and reliability of shipping services determine how efficiently goods are seaborne.

Concretely, this industry is said to have undergone a noteworthy transformation in different aspects. Economists have recurrently analysed the evolution of vessels' size which has significantly enlarged global fleet's capacity, and the subsequent reconditioning of ports to receive these, as well as the massive adoption of containers as a manner to mobilise cargo.

These aspects, among others, are believed to be some of the factors which have determined how the maritime transportation sector has behaved during the last decades.

Next a comprehensive analysis of potential seaborne trade flows' explanatory factors will be presented.

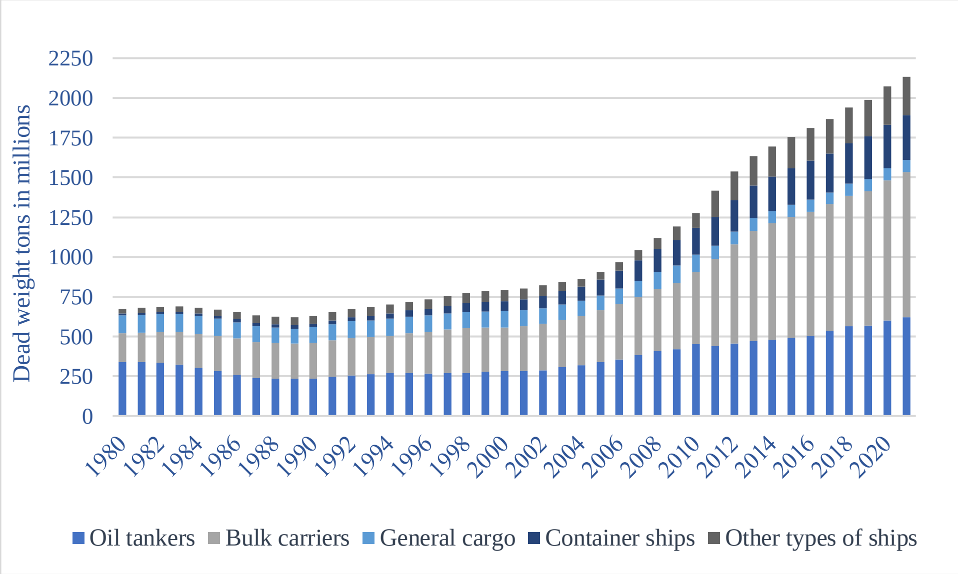
2.2.1. Global Fleet

According to many scholars, maritime industry's historical progress has been reflected in world's fleet. **Shipping capacity** is a limited resource and even though it represents a main determinant of the amount of goods seaborne itself, it does also play a crucial role in shaping shipping costs. Consequently, the size of the **global fleet** and the volume of goods this can handle are two variables frequently subjected to study. Generally, literature uses three different indicators to measure merchant global fleet carrying capacity. These are: total tons shipped, shipped tons per mile travelled, and deadweight tons[1] of merchant fleet available. The latter is considered the most employed unit of measurement (Freire & González Laxe, 2009).

In general, trade escalation has entailed an enlargement of shipping industry's capacity by building more vessels which are more efficient and larger in size (Blonigen & Wilson, 2018). In the last thirty years, seaborne trade "increased from 3600 million tonnes in 1985 to nearly 10000 million tonnes in 2015" (Blonigen & Wilson, 2018). Consequently, world's fleet has grown importantly. As shown in Figure 3, in the late seventies it amounted up to 640 million deadweight tons, whereas in 2021, global capacity had raised up to more than 2100 million deadweight tons UNCTAD (2021c). Nonetheless, as shown in Figure 3, even though global merchant capacity has followed an upward trend, the composition of it according to the type of ships, has changed along decades. For instance, the oil crisis which took place during the seventies, reduced the demand for oil tankers significantly. Contrarily, prior to the financial crisis' onset in 2008, the number of vessel orders increased hastily. More recently, in 2020, despite the contraction in international trade, global merchant fleet grew by 63 million DWT (UNCTAD, 2021a) mainly because of construction lags.

[1] Measures ships' carrying capacity in deadweight tons by subtracting the total weight of the ship when loaded minus its Light Displacement Tonnes (LDT) weight, which represents the weight of the ship itself without cargo.

Figure 3: Merchant fleet by type of ship measured in million Death Weight Tons.



Source: Own elaborated with data retrieved from UNCTADSTAT (2022).

2.2.1.1. Global Fleet Composition

Vessels, which are shipping industry's main asset, "vary widely in size as they provide the whole range of services for a variety of goods" (Blonigen & Wilson, 2018). Some authors classify vessels into general and bulk cargoes according to the kind of merchandise they transport. Others rather take into account the kind of ship itself and propose decomposing fleet into **container, bulk and tanker cargoes**. According to former classification, **general cargoes** ship manufactured goods of different sizes and weights transported as packages (containers or breakbulk). More specifically, **container cargo** is stored in standardized metal "boxes" generally 20 or 40 feet in length, without wheels whereas, **breakbulk cargo** is packaged on pallets or other methods (Blonigen & Wilson, 2018). On the other hand, **bulk cargo** (dry or liquid) is merchandise which cannot be packaged such as coal, grains or crude oil (Blonigen & Wilson, 2018). More concretely, crude oil, gas and other chemical substances are usually shipped in what is known by experts as **tanker vessels**.

The invention of the **container** is considered by some authors as one of the main historical milestones of maritime trade and a discovery that revolutionised the world by reducing the time and cost of waterborne transportation. In words of Blonigen & Wilson (2018), the introduction of containers in the fifties was a determinant innovation for this industry which contributed to a large increase in efficiency. Similarly, Levinson (2016) exposed that international trade was importantly restricted by high shipping costs until that time. In his book, Levinson (2016), claims that the added value of the container relies on its ability to automatize and standardize the process of moving goods from one place to another as containers contributed to an important reduction in inventory and freight costs which in turn, fostered maritime trade and took it to another scale. In general, this adoption has brought supply chain efficiency gains, cost reductions and has contributed to global trading.

Maybe this explains why the largest capacity increase has been observed for the container market. Nowadays, container trade handles the majority of general cargo- other cargo different from bulk merchandise- seaborne trade. Statistics show that “the share of containerization cargoes rose to 16% in 2015, which is three times more than in the 1980s” (Clarksons, 2016). As it can be observed, in 1980 containers’ overall capacity was 10 million tons (almost imperceptible in Figure 3) however, in 2020 it was 280 million tons (UNCTADSTAT, 2022). In other words, this kind of container vessels have expanded its capacity in a 28-fold increase in just forty years.

Nevertheless, despite the rise of container trade, **bulker traffic** (of both liquid and solid bulk cargo) still represents around 40% of total world’s maritime trade volume (Blonigen & Wilson, 2018). As shown in Figure 3, in 1980, bulk carriers amounted a carrying capacity of more than 181 deadweight million tons and represented around 27% of the whole global fleet, nowadays these capture around 40% of the whole and amounts up to 913 deadweight million tons (UNCTADSTAT, 2022).

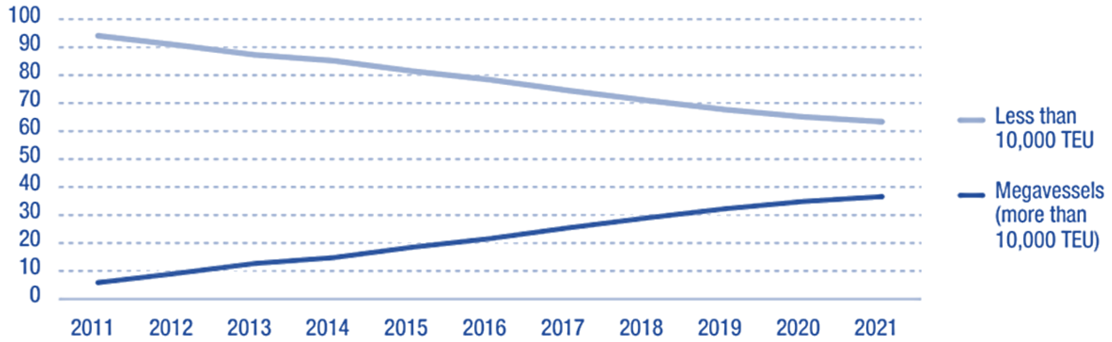
However, as explained by Blonigen & Wilson (2018), this kind of transportation is shaped by some circumstances that characterize this industry. In the first place, cargo’s transported value is low compared to other merchandise such as oil or consumption goods and, in the case of grains, perishable. Moreover, this has to be shipped for long distances at a low speed which keep the vessel occupied for long periods. Therefore, the number of ships needed to transport this basic-need merchandise, which transportation is not interrupted and that occupies ships for long period of times, is elevated compared to other kinds of vessels. On the contrary, the positive aspect is that trade flows are many times stable and predictable.

Lastly, as for **tankers traffic**, the evolution has been relatively stable reaching its zenith in 2004 when shipping rates and oil prices raised due to the booming economic panorama. Even when in 2009 trade shrank, oil’s demand, which is a politically and military strategic commodity, did not fall so importantly due to its inelasticity. Therefore, tanker trade level was kept more or less the same (Blonigen & Wilson, 2018). This stability can be observed in tanker market capacity evolution which has been steadily increased along time. Specifically, crude oil tankers' 340 million deadweight tons carrying capacity used to represent 50% of global fleet in 1980. Nowadays, these represent around 30% of worldwide carrying capacity- because other type of vessels' capacity has grown relatively more- and amount 620 million DWT (UNCTADSTAT, 2022).

2.2.1.2. Vessel Size

Moreover, as it has been already mentioned, maritime transport industry has gone through several transformations. As shown in Figure 4, one of them is the generalised increase in **vessels size**. Data suggests that this increase has been extended to every type of ship with the exception of tanker vessels (Blonigen & Wilson, 2018). According to literature, there coexist a number of potential explanatory reasons. In the first place, experts attribute this tendency to **economies of scale** as larger ships entail labour and fuel savings. Nevertheless, there exists an ongoing debate since some authors claim that these costs reductions might be offset by higher shipbuilding and logistics costs. The second reason seems to be associated to technical development which has permitted **automatization and fuel-efficiency improvements**. Finally, consumption, demand and globalisation are proposed as other potential explanation.

Figure 4: Share of global fleet mega vessels (more than 10k TEU) represent.



Source: UNCTAD (2021c)- *Review of Maritime Transport 2021*

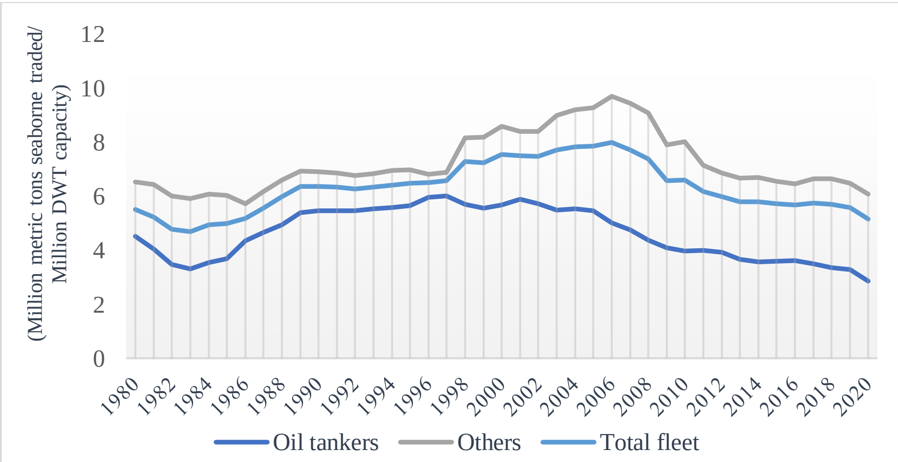
Moreover, this transformation has entailed some inevitable side-effects. In concrete, ports have had to be adapted to handle larger ships and to store and manage increasing amount of merchandise at the same time. This, in turn has had a collateral effect in tightly related industries such as some raw materials, technology or railway and road transport industries. Moreover, it seems important to highlight the fact this conjuncture has contributed as well to port concentration, as it will be explained afterwards.

Lastly, this steadily increase in vessel size is expected to slow down due to practical reasons. In particular, this upward trend is likely to encounter at least three limitations. In the first place, diminishing economies of scale as vessels get bigger. Secondly, "the narrowness and shallowness of some of the world's waterways impose physical constraints" (McKinsey&Company, 2017). And, lastly, the investment required to adapt ports facilities is expected to inhibit further enlargement of ships.

2.2.1.3. Fleet Productivity

In Figure 5 it is possible to observe how overall **fleet and by-type of ship productivity** showed a more or less general upward trend until the financial crisis in 2008, when productivity started to decrease. These might be explained by the fact, prior to 2008 **vessel construction** request increased motivated by good economic expectations. However, when the crisis initiated and trade contracted- especially for occidental economies-, there appeared a **capacity surplus** due to **construction time gaps**, which reduced global fleet productivity.

Figure 5: Global Fleet Productivity (1980-2020).



Source: Own elaborated with data retrieved from UNCTADSTAT (2022).

Despite this last downward trend, authors such as Freire & González Laxe (2009), claim that average global fleet productivity, has increased in general terms since the seventies[2]. This suggests that even though world's merchant fleet has increased during these decades, the manner in which it is utilised has become more efficient. However, as

[2] No data available for merchant fleet carrying capacity at the UNCTADSTAT prior to 1980.

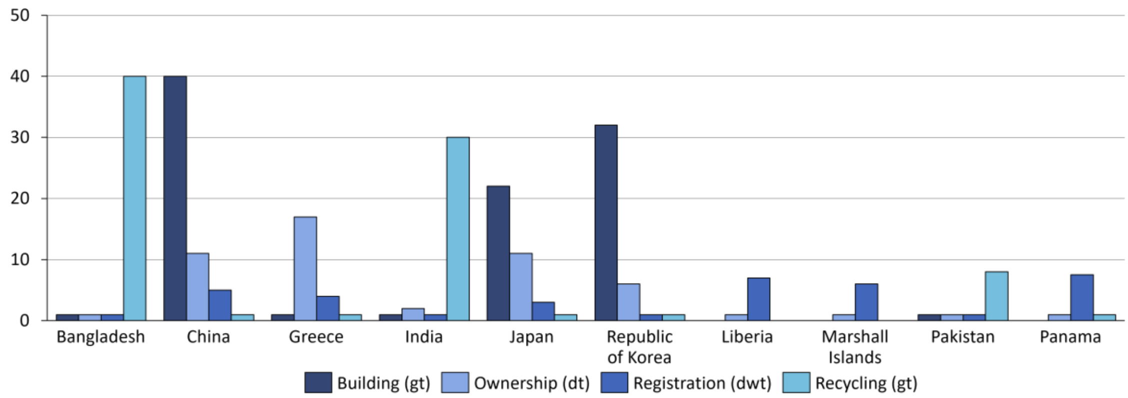
these authors do also explain, these productivity improvements are especially notable for certain kinds of cargoes such as container ships.

Nevertheless, productivity gains are thought to have several causes. In the first place, construction of vessels has move towards larger ships which permit to benefit from economies of scale by reducing fixing costs which has increased productivity per deadweight ton (Freire & González Laxe, 2009). Secondly, routes have been optimized, and shipping flows have been concentrated in some selected ports, known as port hubs. This has also entailed productivity gains. Moreover, the specialization of vessels according to the type of cargo is believed to be a principal determinant of this improvement as it has permitted automatization and exploitation of economies of scale. Lastly, the homogenization of the logistic chain which facilitates transfer of goods, reduces waiting time and improves ports capacity at different points of the process is also considered as a main underlying reason (Freire & González Laxe, 2009). Nonetheless, it is also mentioned that maritime transport productivity has experienced higher volatility due to several economic and political shocks which have had an impact on traded goods (Freire & González Laxe, 2009). Lastly, it seems like worldwide fleet has not been employed so efficiently in recent years which, as pointed before, might be explained by an overproduction of ships in an attempt to modernise this industry's main asset.

2.2.1.4. Fleet Construction, Ownership and Registration

Lastly, as shown in Figure 6, ships are generally not constructed, registered, owned and recycled by the same country. Actually, this is a hotly debate topic nowadays. Figure 6 reflects that in 2020, 94% of global **shipbuilding** took place in China, the Republic of Korea and Japan (UNCTAD, 2021b) since costs are considerably lower. However, "16% of global fleet carrying capacity is registered in Panama" (UNCTAD, 2021b) mainly because of fiscal reasons. Moreover, estimates show that half of the world's fleet is owned by Asian companies, then followed by Greece which is a relevant player in this sector. Lastly, **vessel recycling** takes place mainly in Bangladesh, India and Pakistan which together handle more than 80% of ship recycling (UNCTAD, 2021b). Therefore, reporting estimates regarding the global fleet is not simple.

Figure 6: Building, ownership, registration and recycling of merchant fleet worldwide, 2020



Source: Own elaborated with data retrieved from UNCTADSTAT (2022).

2.2.2. Port Efficiency

Other interesting topic to study is countries' **port system competitiveness**. This is believed to depend on several factors. For instance, literature proposes that it depends on the one side, on accessibility to other countries' ports (**port connectivity**) and, on the other, on general world's maritime transport networks (**shipping connectivity**) (Blonigen & Wilson, 2018). This is because, the higher the connectivity level of a port is, the more efficient it will become to seaborne merchandise there, as it will facilitate the transportation of cargo and reduce cost and time. On the other hand, shipping connectivity is "a measure of the country's access to the transport network of shipping lines" which is measured by the number of vessels calls by shipping lines (Blonigen & Wilson, 2018).

In this sense, a shipping connectivity index that assess country's access to maritime transport network is UNCTAD's **Liner Shipping Connectivity Index (LSCI).** This captures the degree of connectiveness of a country to worldwide shipping networks. LSCI can be considered a proxy for accessibility to global trade through the shipping network as it measures how easy is to access other shipping facilities, routes connection to other regions, frequency of transportation services, etc. In concrete, LSCI is computed with five different components of the shipping sector: number of ships, their container-carrying capacity, maximum vessel size, number of services, and number of companies that deploy container ships in a country's ports (UNCTADSTAT, 2022). A greater value for this index suggests that a country is better connected to world maritime transport networks.

Besides port connectivity, historically, literature has suggested that their efficiency depends as well on other three generally utilised production factors: labour, capital and other production factors which encompass all those final products utilised in this sector and coming from different industries (Freire & González Laxe, 2009). For instance, the time a ship spends moored at a port highly depends on the capacity of the port itself but also, on **labour effectiveness** when unloading the merchandise. On its side, **capital factor** encompasses infrastructure involved in ports and the ships themselves. As Freire & González Laxe (2009) explain, global fleet's productivity is associated to the amount of merchandise that can be shipped in a certain period of time.

2.2.3. International Agreements and Regulation

Another important factor which is believed to have had an important role in shipping trade evolution includes policy choices of governments. These determine how easily agents can export or import goods and, as a result, affect merchandise traded volumes and transportation costs.

2.2.3.1.GATS

Tariffs and trade barriers have been found in several forms and sizes during history in most economies and have one way or another, had an impact on every kind of transportation mode, including maritime transport. However, since the **Uruguay Round**, which took place from 1986 until 1994 and representatives from 123 world nations gathered and committed themselves to cut tariffs and to limit their customs duty rates, tariffs represent a proportionally lower share of transport costs in benefit of shipping costs.

The Uruguay Round resulted in one of the most significant events for transport services, the adoption of the **Global Agreement on Trade Services (GATS)** in 1995. This agreement provided "a credible and reliable system of international trade rules; ensuring fair and equitable treatment of all participants (principle of non-discrimination); stimulating economic activity through guaranteed policy bindings; and promoting trade and development through progressive liberalization". Thus, it is considered that for the first time, the GATS "provided a structure in which policy makers can commit to sets of policy changes in the transport sector" (Luecke, M., 2009).

2.2.3.2. Environmental Regulation

Nonetheless, it is expected that in the coming years new kind of restrictions and barriers to trade will arise. In particular, it seems likely that increasing regulation regarding environmental impact and, more precisely, **emissions-related restrictions** will be imposed to this sector in the near future. According to the IEA (2021), "international shipping accounted for around 2% of global energy-related CO2 emissions in 2020" and, as a consequence, "policies are urgently needed to reduce the carbon intensity of shipping activities (e.g., energy efficiency measures and slow-steaming requirements). Importantly, policies are also needed to encourage the adoption of **low- and zero-carbon fuels** and technologies for oceangoing vessels". Parallelly, the WTO published in 2021 a series of reports about this global issue in which they stated that "The maritime transport industry is under increasing pressure to curb its greenhouse gas (GHG) emissions, which account for approximately 3% of global emissions annually" and "an estimated 15 percent of the world's air pollution annually". It was also highlighted shipping sector's reliance on heavy fuel oil which suggest that **decarbonizing the current global fleet**, composed of more than one thousand vessels, will be costly and arduous. For that, it is claimed in the report that more energy efficient ships will be needed. This last requirement is presented by the WTO as a potential opportunity of investment, as it is estimated that more than one trillion dollars investment will be necessary to transform this industry (World Bank, 2021). Aligned with this perspective, "the International Maritime Organization's (IMO) Initial Strategy on the Reduction of GHG Emissions from Ships mandates that shipping's GHG emissions be reduced by at least 50% below 2008 levels by 2050, and to be fully phased out as quickly as possible within this century" (World Bank, 2021).

2.2.4. Seaborne Trade Concentration

Increase in countries' commercial relationships, which have boosted goods and services exchanges among them, has converted seaports in "critical nodes in the complex network of logistical transport chains" (Leggate et al., 2012). As a consequence, the port industry has been affected and has experimented a transformation in some of its features. Even though, water transport activities are carried out indiscriminately in every coastal country, "shipping companies are looking to exploit every opportunity to realise benefits of scale and are deploying larger vessels and calling at fewer ports" (Leggate et al., 2012). This has concentrated a considerable portion of seaborne trade in a few selected international ports where these larger ships can be moored, and containers and other merchandise can be systematically managed. From shipping companies' point of view, these ports are base locations where to transport large amounts of goods in a relatively economic manner, which will be afterwards shipped by sea or by land to multiple final destinations. These ports play the role of logistic bases where merchandise is frequently re-exported to other country. This permits them to exploit economies of scale and save costs. For that, greater flexibility and speed are demanded from ports and ports services (Leggate et al., 2012). However, not only **port concentration** has taken place, but also **shipping companies' concentration**. The market is controlled by a limited number of shipowner companies. In fact, it is estimated that the five largest shipping companies manage around 65% of trade overall volume (McKinsey, 2017)

Moreover, thanks to these agglomeration forces, which emerge from **scale, location and other positive spillovers**, some ports have attracted industrial activity and have encouraged the near construction of other transportation facilities which connect them to other areas. As these maritime hubs are getting expanded, they have widened its range of services. Nowadays, many times these combine trade, transport and industrial functions where hinterland imported products and exported goods are stored and shipped (Leggate et al., 2012).

In this sense, as shown in Figure 7, Europe, that counts with an extended coastline that goes from the Baltic all the way down to the Mediterranean and the Black Sea, is one of the busiest international port systems. Its port system is not conformed of a homogenous set of ports. Contrarily, it is composed of "large ports as well as a series of medium-sized to smaller ports each with specific characteristics in terms of hinterland markets served, commodities handled and location qualities" (ITMMA/ESPO, 2009). In terms of volume handled the most important port at the European level, is the port of Rotterdam, which also is the fourth largest commercial port worldwide.

Figure 7: Most important European merchant ports.

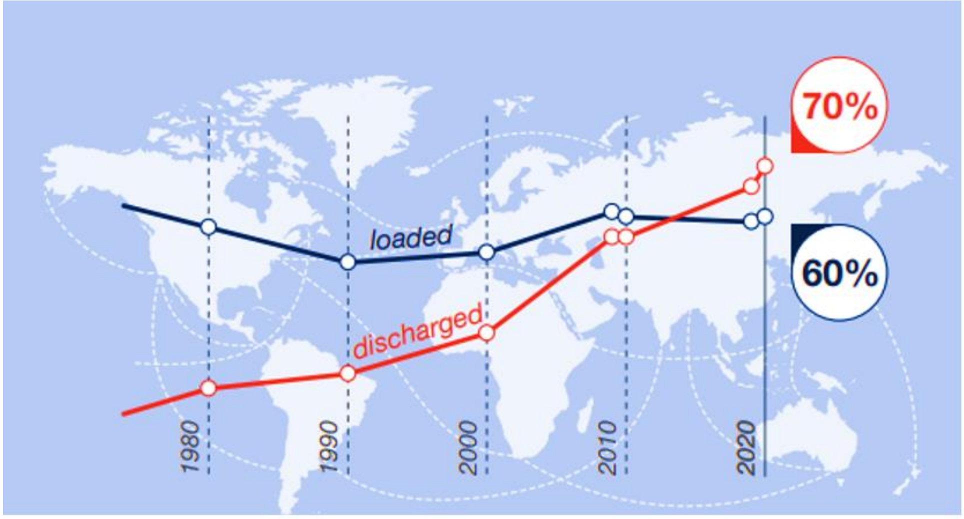
Source: *Urban-e* (2022)

Port concentration is a reality at the European port system. In concrete, the container ports located between Hamburg and Le Havre (see Figure 7), manage about half of the total European container flow and the top fifteen container ports handled around 69% of it (ITMMA/ESPO, 2009). This suggests that seaborne transportation is especially concentrated around the North and Baltic seas. Nonetheless, other important merchant ports can be also found along the Mediterranean coast and the Black Sea.

2.2.5. Developing Economies Ascent

Regardless of European maritime transport sector's relevance, developing economies have become world maritime transport centres. In particular, "in 2020, developing economies accounted for the largest share of global seaborne trade, both in terms of exports and imports. As approximate results show in Figure 8, "they loaded 59.5 per cent and discharged 69.5 per cent of the world total" (UNCTAD, 2021b). These figures are principally explained by Asian and Oceanian participation. In concrete, in 2021, Asian ports managed "66% of all goods discharged and 41% of all goods loaded" (UNCTAD, 2021b). Consequently, "international shipping is often seen as a critical enabler of developing countries' economic advancement" (World Bank, 2021). As a result, some of the most worldwide active "mega-ports"- as named by experts sometimes- are found in developing economies. More precisely, it is estimated that 15 out of the 20 busiest global ports are found in these countries (World Bank, 2021). This is explained by the fact "many small islands, developing states and least developed countries are highly dependent on low-cost international maritime transport for the supply of essential goods such as food, clothing, construction material, or pharmaceuticals" (World Bank, 2021).

Figure 8: Developing Economies share of world maritime trade by volume, 1980-2020.



Source: Source: UNCTAD (2021c)- Review of Maritime Transport 2021.

It is difficult to believe that this change in the global shipping industry panorama has not affected other traditionally shipping powers. Before, many goods were exported by developed countries to developing countries, even if the latter did also produce them, because the former counted with relatively competitive advantage in terms of costs, networks, infrastructures and contacts. However, with emerging economies' development, economies have become more open and commercial relationships have sprung both among developing countries and, between emerging and developed economies. As a result, these regions might have become less dependent on advanced economies' supplies and products, reducing the amount of goods they import from them. Oppositely, as economies develop, demand expands, and consumers get more globalised due to communications. This enlarges developing economies demand for western goods which will likely foster developed countries' shipping industry.

2.2.6. European Integration

European **economic and political integration** has fostered importantly trade among European Union member states. The creation of a **common market** has contributed to the removal of tariffs and other technical trade barriers and has facilitated and fostered cross-border trade. The extinction of borders for trading goods, has increased European transport efficiency and port concentration. Goods can nowadays be shipped to large ports where costs are lower, and then these can be easily transported to any other member state either by sea or by land. Thus, EU trade liberalisation is believed to have promoted **multimodal transportation**

3. EMPIRICAL ANALYSIS

Wrapping up all the considerations exposed in previous section, this section will attempt to evaluate what are those factors that have determined European ports' performance since 1997 until 2019, prior to the pandemic. In order to do so, country level gross weight of goods handled in all ports (measured in thousand tones) variable has been selected. From that starting point, a model has been constructed with a set of explanatory variables which aim to encompass potential aspects affecting seaborne flows. Lastly, results and conclusions have been provided. Overall, this paper aims to provide a comprehensive perspective to understand how this industry have behaved along time and to provide some valuable insight regarding which could be the underlying explanations.

3.1. Endogenous Variable: Port Activity

As for this model, the dependent variable utilised has been extracted from EUROSTAT database. As announced, in this case, *Country level - gross weight of goods handled in all ports measured in thousand tones* series has been selected for European coastal countries (see Annex 1). In compliance with EUROSTAT definition, "the gross weight of each consignment is the weight of the actual goods together with the immediate packaging in which they are being transported from origin to destination but excluding the tare weight of containers". The concreteness of this variable strikes especially crucial since both terrestrial and air transport do also represent a sizeable portion of merchandise transportation. Concretely, in some European economies such as Spain, Portugal or France, in spite of the importance seaborne transport bears, these are characterized for their highly active road transport sector which does also capture a relevant portion of goods carrying. Therefore, considering merchandise transportation as a whole could provide biased results. Moreover, as regards of this variable, it is important to consider that within nations ports vary on their importance, type of goods handled, modernization and so on. However, assessing the water-transport industry at a national scope is expected to reflect European divergences.

Next, exogenous variables utilised for this analysis will be listed below.

3.2. Exogenous Variables

3.2.1. Economic Activity

The tight positive relationship between economic activity and international trade flows and in turn, maritime transport is widely accepted. This is why sample countries' annual gross domestic product (GDP) values in constant terms (base year 2015), which are expected to show a positive effect on the endogenous variable, have been included. Moreover, in order to homogenize monetary units, observations have been changeover to euros. For this purpose, Eurostat's ECU (1974- December 1998) and euro (since 1999 to date) to US dollar exchange rates have been used.

3.2.2. Shipping Sector Productivity

Another traditionally studied variable is productivity. Initially, the intention was to compute productivity taking Euklems & Intanprod[3] variables for Value Added in constant euros for Water Transport services and on the other side, the number of people employed by country for this sector. Nevertheless, a large number of observations were missing for eastern European countries, and values were not fully consistent.

Therefore, despite the suitability of this series to measure shipping industry's productivity, it has been decided to include data from International Labour Organization Statistics (ILOSTAT)[4] which is a leading source of labour statistics. This measure of labour productivity is computed using data on GDP (in constant 2015 international dollars in PPP) derived from the World Development Indicators database of the World Bank. To compute labour productivity as GDP per worker, ILO modelled estimates for total employment are used. It is accepted that the accuracy of this variable is relatively limited as it measures GDP contribution per worker at a general level rather than disaggregated by sectors. However, it has been checked and according to Oxford Economics (2020), EU average productivity is about 63 thousand euros per employee whereas for the shipping industry is more or less 78 ths. euros, which transformed into logarithms will not entail such a big change.

[3] A reference database when it comes to harmonised, industry- level data on production, value added, inputs, labour, investment and capital stocks across EU.

[4] Is the focal point to the United Nations on labour statistics. It elaborates standards to enhance comparability among EU member states, compile and produce labor statistics and qualify states technically in labor statistics.

As regards the expected outcome for this variable, it is believed that productivity will appear with a positive sign, as the higher the productivity of labor is, the faster cargo is loaded and discharged, which in turns permits to handle a larger amount of goods at each port.

3.2.3. Crude Oil Price

Next, barrel of crude oil- which is the main raw material used to produce vessels fuel- price will be included. For this purpose, IMF's Primary Commodity Price System (PCPS) data base which presents market prices for Energy and non-fuel commodities at a disaggregated level will be employed. In concrete, it has been decided to include Average Petroleum Spot Price (APSP) which is a simple average of Dated Brent, West Texas Intermediate and Dubai Fateh crude oil spot prices. Subsequently, as prices are expressed in dollars, the series has been transformed into hundred euros and deflated taking 2015 as reference year.

At first sight oil price is expected to show a negative relationship with a country's sea traded volume. However, crude oil does not have an accessible substitute. Therefore, the relationship might not be so straightforward.

3.2.4. Global Fleet Capacity

Total global fleet (or what is the same, global carrying capacity) available at each moment has been included as a potential explanatory variable for port throughput in a country. Specifically, UNCTAD's *Merchant fleet by flag of registration and by type of ship (annual)*, will be included. This dataset shows merchant fleet[5] (oil tankers, bulk carriers, general cargo vessel, container ships and other type of ships) size measured in dead-weight tons (DWT) since 1980 until date (2022). For those missing observations, the UNCTAD estimates DWT based on Gross Tonnage (GT) and type of ship.

By intuition, it seems like the more ships and the larger these are (measured in deadweight tonnes), the more merchandise will be possible to transport and, therefore, the higher the volume of traded goods seaborne. However, it might be possible to find positive port activity growth rates without enlarging countries' national fleet capacity. In

[5] The variable covers seagoing propelled merchant ships (>100 gross tons), excluding inland waterway vessels, fishing vessels (from 2011 onwards only), military vessels, yachts and offshore platforms and barges.

other words, countries' ports might increase their activity by managing merchandise coming and leaving, for instance, loaded in Asian owned vessels.

3.2.5. Air Traffic

In order to determine whether aerial transport flows do affect the amount of cargo carried by sea, the volume of freight measured in metric tons times kilometres (million ton-km)[6] travelled released in the first place by the International Civil Aviation Organization and subsequently published by the World Bank, will be considered. In compliance with substitutive goods theory, it could be expected to find a negative relationship, assuming that if, for any reason, a good cannot be shipped by sea it will alternatively be sent by air. However, this might not exactly hold as many times goods cannot be indiscriminately freighted either by ship or by plane. Frequently, those goods transported by plane are perishable, raw goods such as food or flowers, or luxury goods which cannot be risked spending weeks inside a container. Thus, the relationship of air traffic and the volume of seaborne trade managed by an economy is expected to be slightly negative.

3.2.6. Least Develop Nations' Economic Growth

To assess the effect of developing economies on western European ports, the annual percentage growth rate of GDP at market prices (based on constant 2015 prices) for the group of developing economies, as presented by the World Bank database will be included. As for this variable, a positive sign is expected as economic development does generally foster trade, which in turn is expected to boost shipping transportation.

3.2.7. European Union Membership

To determine whether belonging to the European Union incentives countries' port activity or not, a dummy variable has been included. This will take value 1 if a country is part of the EU for each certain year and, value 0 otherwise. The sign of this variable is not clear yet as on the one side, European trade liberalisation has fostered overall trade for countries. But, enhanced multimodal transport networks and port concentration might have reduced the volume of goods handled by less efficient nations' ports at the expense of "mega ports".

[6] Freight tonne-kilometres equal the sum of the products obtained by multiplying the number of tonnes of freight, express, diplomatic bags carried on each flight stage by the stage distance

Table 1: Variable Description and Source

Variable	Description	Years	Source	Expec. Relship.
Country level - **Gross weight of goods handled in all ports (Thousand tonnes)**	Log of handled goods at country level (th. Tonnes)	1997-2020	EUROSTAT	n/a
Country level-GDP (ref. price 2015)	Log of national GDP in constant 2015 euros. Transformed into euros with Eurostat's Euro/ECU exchange rates - annual data	1960-2020	WDI and Eurostat	+
Country's Overall Productivity (2015 euros/person employed)	Log of county productivity (GDP-constant 2015 euros-/ employee)	1995-2020	ILOSTAT and Eurostat	+
Oil Price (hundred Euros)	Constant Price in euros (*ref. year 2015*) per barrel of crude oil. Transformed into euros with Eurostat's Euro/ECU exchange rates - annual data.	1990-2020	IMF	-
Global Fleet (ths. DWT)	Log dead weight tons (DWT) in thousands of merchant fleet by flag of registration	1980-2020	UNCTAD	+
Air Traffic (million tons-km)	Volume of freight carried on each flight, measured in metric tons times kilometres travelled.	1973-2020	WDI	-
LDGDP (%)	Least Developed Economies[1] GDP annual growth (annual %)	1981-2020	WDI	+
EUdummy	Dummy variable takes value 1 if country i at year t belongs to the EU and value O otherwise.	1997-2020	n/a	**?**

Source: Own elaborated table.
[1]According to World Bank classification.

3.2.8. Other non-included variables

As it has been aforementioned, the amount of available data for the transport industry, and more concretely the shipping industry is relatively limited. This explains why some of the factor presented in previous section are not represented by a variable in the final model.

For instance, transportation costs have been analysed and it has been stated that these are importantly determined by policy makers' decisions in terms of border and ports' processes, taxes on exports and imports or other burocratic requirements which make trading more difficult. As regards of these factors the World Bank presents some series however, these are just constructed for a few selected countries for a short period of time and present multiple missing values.

Similarly, in 2021, the UNCTAD[7] presented a set of variables such as the average number of days ships spend moored at port or the number of calls each port receives per day, which could be used to measure ports' efficiency. However, these have not been included because these have been collected for a very short period of time. Ports' connectivity was also attempted to be included in the form of the Linear Shipping Connectivity Index. However, this indicator is not constructed for every sample country (Annex 1) and, for those for which data is available this has been only collected since 2006. Moreover, the whole series for most eastern European counties was missing in the first place as these do not collect this type of data yet. Therefore, it has been considered that in order to construct a balance panel data which provides accurate and reliable results, these variables had to be deleted from the model.

In recent times, merchandise shipment has been increasingly concentrated in some selected "mega-ports" motivated by efficiency reasons. This tendency could have been comprised in the model including a series showing how nations' ports size evolution has affected their port activity. But, once again, no data on ports' size has been found.

Lastly, including how international agreements and environmental regulation have affected the volume of goods handled by ports was considered interesting. In relation to international agreements the most important change happened in 1995, when the GATS was created, however it does not make sense to include a dummy variable reflecting this, since that year is excluded from the studied time period (1997-2019). Regarding environmental regulation, in Europe, its establishment is centralised and applies equally for every EU country (this would exclude UK since the Brexit), therefore little variation would have been found for this aspect.

3.3. Methodology: Panel Data Analysis

A panel regression has been selected in order to explore the relationship between nations' historical port activity and other proxy variables, which will be tested for their significance and how they do affect the dependent variable. For the purpose of this empirical analysis, Stata statistical software has been utilised. In particular, this study's panel consist of 23 coastal European countries and spans the period between 1997 to 2019 since subsequent data has been importantly distorted by Covid's pandemics side-effects.

[7] UNCTAD Handbook of statistics

Regardless the lack of some observations for certain variables, the panel is strongly balanced for the whole-time span.

When dealing with longitudinal data, several estimating models can be applied. In this paper Pooled OLS and both panel data Fixed Effects and Random Effects estimators will be evaluated. The former model's results are inconsistent due to the presence of across units and time fixed effects. Thus, considering the nature of the model construction, panel data methodology seems to be more suitable.

On the one hand, panel Fixed Effects estimator assess across countries differences. This means, it studies how the variables included in the model varied for each country and assumes there are some specific constant effects of being a certain country over time that affect the dependent variable. For this particular model, entity fixed effects can be assumed to be constant conditions such as location, cultural factors or number of cross-border coastal kilometres, among others.

On the other hand, Random Effect estimates focus on within units' time series variation and assumes entity fixed effects as random effects, meaning that these are not correlated with the regressors since these are drawn from a large population.

The specific econometric model to be subjected to panel data estimates is the following:

$$\boldsymbol{logPortAct_{i,t} = \beta_0 + \beta_1 \cdot logGDP_{i,t} + \beta_2 \cdot logProdct_{i,t} + \beta_3 \cdot logGlobalfleet_{i,t} + \beta_4 \cdot OilPrice_{i,t} + \beta_5 \cdot LDGDP_{i,t} + \beta_5 \cdot EUdummy_{i,t} + u_{i,t}}$$

The dependent variable, *logpPortAct*, stands for the volume of goods handled at ports in each country annually. On the other side of the equation, *LogGDP* represents each country's annual Gross Domestic Product in constant euros and *LogProduct* is each country overall productivity measured in GDP contribution (in euros) per employee. Moreover, *LogGlobalfleet* stands for worldwide carrying capacity measured in DWT. *Oilprices* is the price of a barrel of oil measured in hundred euros. *LDGDP* encompasses developing economies (according to World Bank classification) annual average GDP growth rate in percentage. Lastly, *EUdummy* is a binary variable that states whether a country is an EU member state or not at each point of time.

It seems important to point out that logarithms have been taken for most variables (including the dependent variable). This reduces observations' volatility, eases coefficients interpretation and eliminates differences in regressors' units of measurement.

Finally, it is crucial to keep in mind that panel regression methods emphasize correlation (or clustering) over time for a given individual, therefore, errors are likely to be correlated over time for a same country, so cluster-robust standard errors that adjust standard errors on the individual, or what is the same: countries, should be included into the model.

3.4. Descriptive Statistics

Before proceeding with panel data outcome interpretation, a general overview of statistics will be provided so as to contextualise the subsequent interpretation of results. First of all, Annex 2 outcome shows that the panel data is well balance as the number of observations (N) for the time period (1997-2019, T=23) for the whole sample (n=23) is the same for almost every series, meaning the panel is well balance.

In the first place, European coastal countries' port activity data shows that as a whole in 2019, just before the onset of the pandemic, handled more than four billion tons of goods. However, it is possible to find wide differences among them. For instance, that same year Maltese port activity was slightly over five million tons whereas other countries such as Netherlands, Italy, Spain, UK or Belgium handled 607.53, 508.07, 496.9, 486.09 and 277.78 million tons each, respectively. However, these figures gain even more relevance if we consider them relatively to each country's real gross domestic product. By doing this it is observed how maritime transport volume is relatively larger for small easter countries such as Latvia, Estonia, or Lithuania as well as, for Greece or Netherlands. This surges because not only are there significant differences among EU27 states' port activities but also in terms of economic activity.

Next, as for EU's waterborne transport sector's productivity, statistics shown in Annex 2 suggest there exist also considerable divergences among sample countries. Their average GDP contribution per employee is around €79.000. However, the between standard deviation suggests that some countries' average productivity for the period studied, surpass hundred thousand dollars (140138.80) whereas others produce almost half of the average figure (31471.85). Moreover, for some countries the improvement for this variable has been significant as it is shown by the within standard deviation.

Regarding global fleet, it can be observed that the variation along time is relatively large. In concrete, between 1997 and 2019, total world's merchant fleet has taken values from 750 million to almost 2 billion DWT.

Another interesting variable to consider are oil prices. For the purpose of this study, it has been assumed that every sample country faces the same price as if all of them composed a unique market. According to Stata's summary statistics (Annex 2), over the time period between 1997 and 2019 oil barrel average price has been 77.71 constant 2015 euros. However, this commodity's price has historically shown high volatility. In particular, the lowest value reported during this period is 20.25 euros and at its peak 158.96 euros.

Moreover, it seem important to highlight the fact that for the studied time period, Least Developed economies' growth rates have presented positive values without exception. These have ranged from 2.44% to 7.66% and on average developing economies' growth rate for the studied period has been 5.04%.

As for air traffic volume, a generalised trend is observed among sample countries. During this period, it is possible to notice that air traffic (measured in tons per km) has steadily increase for most economies. This could be explained first, by an increase in cargo transported or on the other hand, by the fact longer routes are traversed.

Lastly, Annex 2 shows that for most of the observations (almost 84% of them) studied countries were already part of the EU. However, between variation reflects how some countries have belonged to the EU for the whole time period studied (average value for the whole time series equals 1) while others were incorporated in the last years of this period of time (Average value of the dummy equals .3043 which means that around 70% of the observations take value 0). This might be the case of countries like Polonia, Bulgaria or Croatia that joined in 2004, 2007 and 2013, respectively.

3.5. Panel Data Results

Table 2 presents results for Pooled OLS, Fixed Effects (FE) and Random Effects (RE) estimates in the same order this will be commented.

Table 2: Panel estimated results.

Variables	Pooled OLS (Rob-S.E.)	Fixed Effects	Fixed Effects (Rob-S.E.)	Random Effects	Random Effects (Rob-S.E.)
Constant	- 6.3012 **	1.5349	1.5349	- 2.3081 **	- 2.3081
	(1.6706)	(1.1323)	(2.6524)	(.9498)	(2.3280)
lnGDP	.6913***	.2448 ***	.2448 **	.4274 ***	.4274 ***
	(.0224)	(.0519)	(.1088)	(.0422)	(.0903)
lnproductivity	.04751	.0806 **	.0806	.0676*	.0676
	(.0776)	(.0347)	(.0849)	(.0358)	(.0815)
lnglobalfleet	- .0709	.1773 ***	.1773 **	.1224 ***	.1224
	(.0961)	(.0273)	(.0800)	(.0265)	(.0795)
oilprices	- .2004 ***	- .0558 ***	- .0558 *	- .1001 ***	- .1001 ***
	(.7652)	(.0202)	(.0290)	(.0194)	(.0288)
LDGDP	- .0035	.0211 ***	.0211 ***	.0143 ***	.0143 ***
	(.0225)	(.0051)	(.0053)	(.0051)	(.0050)
EUdummy	.1392	- .0582 **	- .0582	- .0853 ***	- .0853
	(.1559)	(.0277)	(.0682)	(.0283)	(.0601)
N	488	488	488	488	488
R-squared					
within		.3731	.3731	.3598	.3598
between		.8052	.8052	.8081	.8081
overall	.8071	.7866	.7866	.8014	.8014
Prob > F	.0000	.0000	.0000		
Prob > chi2				.0000	.0000

Note: Values in parenthesis are standard errors. (***), (**) and (*) represent 1%, 5% and 10% significance level, respectively. All the models and coefficients have been estimated with STATA. For further information regarding variables check Table 1.

3.5.1. Pooled OLS

In the first place, Pooled OLS model predicts around 80 percent (R^2=0.8071) of the variation in the dependent variable-port activity. However, these results are not reliable as the model is underpredicting standard errors which are likely to be correlated within estimates, as each observation for a given country actually provides less than an independent piece of new variance. Still, it is worth taking a look at the summarised output so as to get an idea of how explanatory variables are expected to behave in following models.

It is possible to notice that country's economic growth is expected to positively affect the level of merchandise handled in its ports. Next, productivity shows signs of entailing a positive effect on port activity. However, this cannot be ensured statistically yet. Probably, what strikes the most surprising about these estimates, is the fact that global fleet appears with a negative sign. Nonetheless, as it has been already mentioned, this model fails to capture the heterogeneity and variation of the variables among countries during the time period (1997-2019). Thus, the effect of this explanatory variable should be assessed with the following models. Next, as expected, oil prices are presented with a negative sign and are statistically significant. This concurs with intuition exposed before. Besides, results suggest that the effect the pace at which developing economies grow has on the dependent variable, cannot be guaranteed statistically. Lastly, the dummy variable that represents whether countries are part of the EU common market or not, suggest there exists a slightly positive relationship but, this cannot be statistically asserted yet.

3.5.2. Fixed Effects

Next, results for the Fixed Effects model, present a considerably different image compared to the previous analysed model. It is especially striking the fact that every exogenous variable, at a different level, is statistically significant. Additionally, the output shows that FE model manages to estimate around 37 percent (R^2=0.3771) and 80 percent (R^2=0.8052) of the dependent variable within and between variability, respectively. These values suggest that selected variables explain a relatively small portion of the dependent variable variability along time for each country. In other words, there must exist other factors which have not been considered which explain to a larger extent this variation. Potential explanation could be the existence of new bilateral trade agreements for each country or which party rules at each time, for instance.

Moving on with coefficients' interpretation, in the first place, it is possible to notice that each country's economic activity level has a positive, and highly significant, effect on national ports' throughput level. In concrete, if a country's GDP increases by 1%, port activity is expected to raise by 0.25%. This concurs with scholars' beliefs as they claim that, historically, economic growth and international trade, which in turn affects seaborne transportation, move in the same direction.

Next, productivity gains seem to have a positive and statistically significant effect on port activity for this sample of countries. Nonetheless, the effect is relatively small since a one percent increase in productivity- which is likely very hard to attain- is expected to entail a .08 percent increase in the dependent variable. Therefore, this suggests that maybe not such a large portion of the dependent variable's variability is explained by productivity factors as its t-value equals 2.32 points. Despite the results, nowadays human capital productivity is believed to play a crucial role in vessels' shipment and unloading activities, which in turn, affect the time ships spend at ports. This aspect importantly determines shipping companies' costs and ports' capacity to admit other ships. However, it is true that with the systematization of ports and the automatization of this kind of activities it is expected that each time, labour productivity relevance for this sector will diminish.

As regards of global merchant fleet effect on the port's goods flow, it can be said that this is expected to be highly significant and positive. In concrete, if the global fleet is augmented by 1 percent- which in DWT would be an extremely large increase- the volume of merchandise handled at European ports would increase by .18 percent. This makes sense, as shipbuilding does not guarantee the additional cargo transported could be handled by existing port facilities or the personnel working on them. Similarly, this does not mean there would be additional international demand to justify goods transportation. Therefore, it is believed that if the global fleet was significantly enlarged, several bottlenecks will appear in the shipping industry as happened not long ago when trade was abruptly reactivated after covid extreme lockdown response.

Another factor to be commented on are oil prices. In this case, if crude oil barrel average price increases by one hundred euros, port activity is expected to be reduced by 5.58% which shows a considerable large and significant negative effect on port activity levels since the consequence of such a decrease on worldwide trade will likely be critique. This coincides with the line of thought presented before. As suggested, if oil prices rise these will very likely increase operation costs. Consequently, as happened for road carriers all around Europe in 2022 when oil prices skyrocketed, shipping companies' business activity might become not profitable. Thus, as there are few or none, suitable alternatives to substitute this commodity, this increase in crude's prices is expected to paralyse seaborne activity Additionally, this shock is expected to entail an increase in freight rates.

Economic development in less developed nations is expected to imply a positive and highly significant effect on western ports' activity. As it was expressed before, it was not clear whether this could, on the one hand, lessen European ports' relative importance on the global panorama or, on the other hand, incentivize international trade between these economies and developing economies. This effect might come from two directions. In the first place, it might be possible that economic growth pent up demand for western goods, increasing trade from European producers and suppliers to final consumers in growing economies. And, secondly, another potential explanation could be that, as these economies gain purchasing power and improve their production system, these might become more competitive at the international scheme due to exploitation of economies of scale, relative lower labour costs and productivity gains, therefore, becoming global exporters. This would mean that more goods will be shipped from these countries towards European ports where foreign merchandise would be received and accounted as goods managed at European ports as well.

Lastly, Fixed Effects results suggest that being part of the EU generally entails a detrimental effect on national ports (-.0582) This might be due to the fact that port activity is importantly concentrated in few European countries such as Belgium, Netherlands or Denmark which count with powerful shipping industries. However, the sample contains many other countries in which port activity is not so concentrated. Therefore, results might be biased towards the share of countries for which the portion of goods they handle at their own ports has been decreased in favour of other larger, more active and efficient international ports. Nonetheless, the statistical significance of this coefficient is weak which suggests that the sign of this relationship might easily change for each country.

Next, this same model- Fixed Effects- has been run adjusting standard errors for each individual. At first glance, it is remarkable how standard errors increase indiscriminately for every explanatory variable, reflecting how before there was some error term information lost among countries' observations. This increase is especially important for logged productivity, global fleet, oil prices and the constant term. Precisely, the reduction in these former variables' statistical significance is larger than for the remaining variables. In fact, productivity is no longer a significant variable. Suggesting that it cannot be statistically asserted that productivity gains affect port activity. This might be explained by the fact, countries' overall productivity data has been utilised as it has not been possible to find reliable, accurate and updated databases which disaggregate productivity down to the shipping sector (or similar). Moreover, it is noteworthy that even though both global fleet and oil prices are still shown with a positive and negative sign, respectively, their statistical significance is less strong. Finally, as suggested before, EU membership dummy variable is shown as no significant.

3.5.3. Random Effect

Lastly, even though it is believed that the most suitable model to estimate this model are Fixed Effects, Random Effects will be included for comparative purposes. As for this model without standard error clustering, it is possible to observe that every explanatory variable, except for productivity, is statistically significant with varying degrees. Additionally, its explanatory power is larger than before as it attains to explain around 80 percent (R^2=0.8014) of gross goods handled by ports variable's variability. Table 2 shows that economic development is expected to positively affect the maritime transportation sector in Europe even though, this time the coefficient (0.43) as well as its t-value (10.12) are a bit larger. This means that when looking between variation, this variable acquires importance.

Productivity has a positive sign and has become slightly significant. Thus, it is not completely clear whether nations' productivity improvements have determined seaborne traffic or not for these countries during the time period 1997-2019. Its positive sign suggests it could have had a positive effect even this is statistically weak. Maybe this could be explained by the fact the shipping industry is highly reliable on capital inputs, or because the water transport sector's productivity has not behaved in the same way as the labor productivity as a whole.

Regarding global fleet, oil prices and least developed economies' growth, their signs have not changed. However, their coefficients: .12, -.10 and .01 respectively, have been reduced. This is reflected as well in lower t-values (4.62, -5.16 and 2.78 compared to previous 6.50, -2.76 and 4.14). This might be due to the fact that countries' port activity evolution, analysed over the years, is explained to a larger extent by their own economic performance rather than by worldwide merchant fleet carrying capacity, global oil prices or developing economies growth.

As a final step, if the RE model analysis is repeated adjusting standard errors for countries it is possible to observe how these increase with respect to previous estimation. Additionally, the main difference found is that the global fleet becomes not significant, which might be due to the fact no variation is included by this variable as observations are the same for each country.

Just to finish with this section, some general comments are going to be pointed out. First of all, in order to avoid multicollinearity, air traffic variable has been not included because it showed high correlation with global fleet series (see Annex 3). Moreover, it seems important to point out that within R-square values are lower than expected. This means that the model attains to capture a small fraction of over-time variability for the sample of countries. Additionally, it strikes surprising how FE and RE models' R-square values are pretty similar, meaning this capture a similar portion of variation of the dependent variable. Nonetheless, the former methodology is considered more suitable to estimate this model due to the existence of entity fixed effects.

It also seems interesting to look backwards and assess whether initial intuitions were right or not. Productivity was expected to be highly significant, however, it has been observed how other variables play a more important role in determining seaborne trade flows at European ports. Similarly, although the global fleet is always shown with positive signs as expected it is not completely clear if it is such an important variable shaping port activities as literature has always suggested. As regards of the dummy variable, it has been found that the effect of entering the EU on member states' port activity is not clear. Therefore, this suggests there is not a unique interpretation for the whole sample countries. The effect will likely depend on each country's circumstances.

Lastly, as it has already been exposed, other additional factors of interest have been identified during the analysis of the transportation industry. However, it has not been possible to include them due to the lack of suitable data available.

4. CONCLUSIONS

Recent events such as the Ever-giving incident or the obstruction of Shanghai port due to Covid-19 restrictions, evidenced the crucial role the **transport sector** plays in nowadays worldwide production networks. Nonetheless, surprisingly, this sector has many times been ignored by literature. This, for instance, is reflected in the scarcity of available databases that provide complete shipping industry measures.

Evidence reflects that each time more **cargo** is mobilised (ignoring figures for 2020 and 2021 which were altered by the pandemic and its effects on the shipping industry). Firstly, this seems to be partially explained by the generalised **increase in vessels size,** which in turn has reduced fixed costs. Secondly, overall **global fleet enlargement** has permitted larger volume of goods shipment. Additionally, the **homogenization of regulation**, mainly since the GATS agreement (1995), as well as the **professionalization and systematization** of this sector are also considered determinant of the evolution of this sector. The **concentration of goods flows** into a few "mega ports", which has permitted multimodal transportation networks optimization, has also had a foostering effect. Last but not least, this increase in maritime transport volumes is directly related to nations' **economic development** and **globalisation forces**.

Inevitably, Europe, as a well-connected and influential maritime trader, has been extensively affected by all these factors. Consequently, this paper principal aim has been to describe and assess **European coastal countries' port system** for the last decades and identify those aspects that have, to certain extent, influenced shipping industry expansion. In order to do so a model has been constructed to conduct panel data analysis for 22 European Union coastal countries and the UK. Along, the preparation of the database several obstacles have been encountered due to the lack of available data.

According to this model quantitative results, **countries' economic growth** is the most explicative variable of ports' activity evolution. Concretely, this has a considerable positive effect on the volume of seaborne goods at European ports. Moreover, according to scholars this relationship is even larger for developing economies where maritime trade is sometimes consider a catalysator of international trade and economic prosperity. Surprisingly, **countries productivity gains** are not statistically significant for every estimated model. However, it is possible to infer a positive effect on ports activity.

Next, it has been found that the larger **global carrying capacity** is, the more goods are loaded and unloaded at European ports. However, as happened during the first half of 2020, bottlenecks are expected to arise if ports' installations are not adapted or human capital proportionally increased. Thus, even though shipbuilding has fostered seaborne trade, this would have been impossible without a consistent increase in ports capacity, storage improved facilities or an adequate well-connected multimodal transport network.

As expected, **oil prices** present a negative effect on ports' throughput. In fact, the dimension of this sign is considerably large. This might be explained by the fact, most commercial vessel are propelled with oil and few or none, affordable and accessible substitutes are available nowadays. According to the WTO, this sector fuel-dependence is the main obstacle to reduce its excessive environmental impact.

Despite the ascent of **developing nations'** seaborne transport industry, results show that their economic expansion has positively contributed to port activity. This suggests that, even though in relative terms the share of global goods handled by European ports has been reduced, the total volume of goods shipped by them has risen. This might be explained by an increase in European goods demand in developing markets as their purchasing power raises and population's western products awareness arises.

Lastly, the effect of **entering the EU** on new member states' port activity is not clear. It is believed this will widely depend on countries circumstances. Probably, countries with important international ports experimented a positive effect. Due to free trade within the EU common market, remaining EU countries will likely find more effective to receive goods at largest ports and then, get them to their final destination through inland transport.

This paper has attained to identify and assess what are the main factors that affect the shipping industry and to propose some other for which no data has been found. Moreover, it lays the foundation to furtherly analyse other clashing question related to the evolution of developing countries' shipping industries or to extend this same analysis to worldwide ports. Additionally, proposed insights are considered to explain the events that led to this industry collapse and abrupt increase in freight rates due to the pandemic crisis since 2020. As a whole, the study evidences the relevance of this sector for current global economies and their production schemes.

5. REFERENCES

- Blonigen, B., & Wilson, W. (2018). *Handbook of International Trade and Transportation*. Chektenam, UK: Edwar Elgar Publishing.
- Carrière-Swallow, Y.; Deb, P.; Furceri, D.; Jiménez, D.; Ostry, J.D.; (2022). *How Soaring Shipping Costs Raise Prices Around the World* [Blog]. Available at https://blogs.imf.org/2022/03/28/how-soaring-shipping-costs-raise-prices-around-the-world/?utm_medium=email&utm_source=govdelivery
- Clarksons (2016) Shipping Review Database, Clarksons Research Ltd.
- Clarkson (2022). Shipping Intelligence Network. Available at https://sin.clarksons.net/
- European Commission (2021). *Autumn 2021 European Economic Forecast*. Available at https://ec.europa.eu/info/business-economy-euro/economic-performance-and-forecasts/economic-forecasts/autumn-2021-economic-forecast-recovery-expansion-amid-headwinds_en#documents
- Hummels, D., Lugovskyy, V., & Skiba, A. (2009). The trade reducing effects of market power in international shipping. Journal Of Development Economics, 89(1), 84-97. doi: 10.1016/j.jdeveco.2008.05.001
- ICEX (2022). *Invest in Spain: Logística y Transporte*. [Website]. Available at https://www.investinspain.org/es/sectores/logistica-transporte
- IEA (2021). *International Shipping*, IEA, Paris. [Website]. Available at https://www.iea.org/reports/international-shipping
- IMF (2022). *Primary Commodity Price System*. Available at https://www.imf.org/en/Research/commodity-prices
- ITMMA & European Sea Ports Organization (ESPO) (2009). *Economic analysis of the European seaport system* (pp. 4-23). ITMMA. Available at https://www.espo.be/media/espopublications/ITMMAEconomicAnalysisoftheEuropeanPortSystem2009.pdf
- Freire, M., & González Laxe, F. (2009). *Tráfico marítimo y economía global*. Oleiros (A Coruña): Netbiblo.
- Leggate, H., McConville, J., & Morvillo, A. (2012). *International Maritime Transport: Perspectives*. London: Routledge.

- Levinson, M. (2016). *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* (2nd ed.). New Jersey: Princeton University Press.

- Luecke, M. (2009). *A Handbook of International Trade in Services* edited by Aaditya Mattoo, Robert M. Stern, and Gianni Zanini Oxford: Oxford University Press, 2008. World Trade Review, 8(2).

- McKinsey&Company (2017). *Container shipping: The next 50 years.* McKinsey&Company. Available at https://www.mckinsey.com/~/media/mckinsey/industries/travel%20logistics%20and%20infrastructure/our%20insights/how%20container%20shipping%20could%20reinvent%20itself%20for%20the%20digital%20age/container-shipping-the-next-50-years-103017.pdf

- Oxford Economics (2020). *The Economic Value of the EU Shipping Industry*. London: European Community Shipowners' Associations (ECSA). [Website]. Available at Oxford Economics - The Economic Value of EU Shipping - Update 2020 - Report.pdf (ecsa.eu)

- UNCTAD (2016) *Review of Maritime Transport 2016*. Geneva: United Nations. Available at https://unctad.org/system/files/official-document/rmt2021_en_0.pdf

- UNCTAD (2021a). Shipping during COVID-19: Why container freight rates have surged. [Website]. Available at https://unctad.org/news/shipping-during-covid-19-why-container-freight-rates-have-surged

- UNCTAD (2021b). *Handbook of statistics*. Available at https://unctad.org/system/files/official-document/tdstat46_en.pdf

- UNCTAD (2021c) *Review of Maritime Transport 2021*. Available at https://unctad.org/system/files/official-document/rmt2021_en_0.pdf

- UNCTADSTAT (2022). [Database]. Available at https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx

- Urban-e (2022) *Puerto y desarrollo urbano en Rotterdam*. (2022). [Blog]. Available at http://urban-e.aq.upm.es/articulos/ver/puerto-y-desarrollo-urbano-en-rotterdam-una-verdadera-historia-de-amor/completo

- Wilmsmeier, G., Hoffmann, J., & Sanchez, R. (2006). T*he Impact of Port Characteristics on International Maritime Transport Costs.* Research In Transportation Economics, 16, 117-140. doi: 10.1016/s0739-8859(06)16006-0.

- World Bank (2021). *Charting a Course for Decarbonizing Maritime Transport-Summary for policymakers and industry* (pp. 1-9). Washington. Available at https://openknowledge.worldbank.org/handle/10986/35436
- WTO (2019). *Examen estadístico del comercio mundial 2020*. Available at https://www.wto.org/spanish/res_s/statis_s/wts2020_s/wts2020chapter03_s.pdf
- WTO (2022). Services - *The GATS: objectives, coverage and disciplines.* Available at https://www.wto.org/english/tratop_e/serv_e/gatsqa_e.htm

6. ANNEXES

Annex 1- List of Countries

1. Belgium
2. Bulgaria
3. Croatia
4. Cyprus
5. Denmark
6. Estonia
7. Finland
8. France
9. Germany
10. Greece
11. Ireland
12. Italy
13. Latvia
14. Lithuania
15. Malta
16. Netherlands
17. Poland
18. Portugal
19. Romania
20. Slovenia
21. Spain
22. Sweden
23. United Kingdom

Annex 2- Descriptive Statistics

Variable		Mean	Std.Dev.	Min	Max	Observations
Port Activity	overall	1700044.9	172465.5	3101	607527	N = 488
	between		171311.9	3646.2	534913.3	n = 23
	within		28101.9	53781.5	280959.4	T = 23
GDP	overall	7.57e+11	1.11E+12	5.77e+09	4.62e+12	N = 529
	between		1.11e+12	1.03e+10	3.71e+12	n = 23
	within		2.32e+11	1.56e+11	1.67e+12	T = 23
Productivity	overall	79237.73	30540.1	12969.4	189886.6	N = 529
	between		29293.6	31471.9	140138.8	n = 23
	within		10504.1	60735.3	128985.6	T = 23
Global Fleet	overall	1242740.0	432007.6	755297.9	1989924.0	N = 529
	between		0	1242740.0	1242740.0	n = 23
	within		432007.6	755297.9	1989924.0	T = 23
Oilprices	overall	77.71251	43.49821	20.24509	158.9565	N = 529
	between		0	77.71251	77.71251	n = 23
	within		43.49821	20.24509	158.9565	T = 23
LDGDP	overall	5.036824	1.369168	2.435658	7.662506	N = 529
	between		0	5.036824	5.036824	n = 23
	within		1.369168	2.435658	7.662506	T = 23
Air traffic	overall	1293.94	2262.53	0	10187.72	N = 500
	between		2232.65	1.2934	7530.02	n = 23
	within		344.02	52.1838	3951.64	T = 23
EUdummy	overall	.8393195	.3675836	0	1	N = 529
	between		.2041142	.3043478	1	n = 23
	within		.3085305	.1436673	1.534972	T = 23

Source: own elaborated table with data obtained from Stata.

Annex 3- Correlation Matrix

	Log (PortActivity)	Log (GDP)	Log (Productivity)	Oilprice	Log (Global Fleet)	Log (Airtraffic)	LDGDP	EUdummy
Log (PortActivity)	1.0000							
Log (GDP)	0.7951	1.0000						
Log (Productivity)	0.5178	0.5541	1.0000					
Oilprice	- 0.0713	-0.0037	- 0.0584	1.0000				
Log (Global Fleet)	- 0.0486	-0.0198	0.1415	0.3912	1.0000			
Log (Airtraffic)	- 0.0742	-0.0330	0.0755	0.4917	***0.9455***	1.0000		
LDGDP	- 0.0434	-0.0299	-0.1944	0.2205	-0.3577	-0.1687	1.0000	
EUdummy	0.3139	0.3350	0.4866	0.1938	0.2886	0.2813	- 0.0823	1.0000

Source: Own elaborated table with data obtained from Stata.