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SHORT SEA SHIPPING COMPETITIVENESS AND THE EUROPEAN MARITIME POLICY: A CASE STUDY[1]

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ABSTRACT

In the context of fair and efficient competition among transport modes promoted by the European Union, this paper studies the competitiveness of several *Short Sea Shipping* (SSS) corridors by comparing the generalized costs of different alternatives to move cargo from Spain two largest cities to other European destinations either by road or by using a SSS multimodal corridor. Our methodology shows that, apart from the internalization of the external costs and the existence of bottlenecks in transit times, the freight rates can be also considered as a critical factor in explaining why a particular SSS corridor is more/less competitive than its road alternative. For that reason, we carry out an econometric analysis to determine the main drivers of maritime prices in several SSS routes and quantify to what extent the instruments promoted by EU maritime policy – higher frequencies, fiercer competition or direct subsidies – favour real price reductions on them.

Keywords: Short Sea Shipping; external costs; generalized cost methodology; EU maritime policy.

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INTRODUCTION

Freedom of movement for people and goods represents one of the constitutional pillars of the European Union (EU). The liberalization of transport during the 1980s and the 1990s translated this idea to most passenger markets through several deregulation packages that were progressively implemented by Member States in order to achieve an efficient redistribution of traffic among all transport modes. In the case of freight, however, the dominance of road in most intra-European routes was hardly contestable by the alternative modes, something that was partly explained by its natural competitive advantage.[2] The other part of the explanation laid in the fact – as stated by the European Commission – that "road users were not facing the 'full cost' associated to the mode, that is, a generalized cost that included both its internal and external effects" (COM, 2001).

In fact, the external costs of transport – pollution, congestion and safety issues – have increasingly gained relevance in the European transport policy during the recent decades. The 2011 White Paper (COM, 2011) explicitly assumes that the transport system (as currently defined) is not sustainable and radical changes have to be implemented in the near future with the aim of favouring new transport patterns according to which larger volumes of freight are carried to their destination by the most efficient (combination of) modes.

The promotion of maritime transport, globally considered as more environmentally-friendly and safer than roads, has been one of the main solutions implemented by the European Commission to address this issue. The *Pilot Actions for Combined Transport* (PACT), the *Marco Polo* programmes and other well-funded initiatives have invested more than €750 million in the re-development of coastal trade, now under fancier names such as *Motorways of the Sea* (MoS),[3] in order to bring forward *Short Sea Shipping* (SSS) as "a real competitive alternative to land transport" (COM, 2008). However, after several years of explicit political and financial support by the EU and Member States, SSS has not gained yet a significant market share, and roads remain comfortably placed at the top of the European freight transport market.

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2 According to Eurostat *Transport in figures 2012* report, road transport represents the 45.8% of all intra-European freight movements; 36.9% corresponded to sea, whereas the remaining 17.3% was moved by rail, inland waterways, air and pipelines. See http://europa.eu for details.

3 'Motorways of the Sea' is precisely one of the Trans-European network (TEN-T) initiatives that aim at introducing new intermodal maritime-based logistics chains in Europe. Among its objectives, it is explicitly reckoned the reduction of road congestion through a modal shift, achieved by the promotion of four different SSS corridors through Europe with a weekly scheduled frequency of services. More information can be found at http://ec.europa.eu/transport/maritime/motorways_sea.

There are several factors that could explain this apparent failure and the still unbalanced modal split. One of them, as extensively analysed in the existing literature, lies in the fact that the internalization of external costs has not been fully achieved. As suggested by Janic (2007) or Suárez-Alemán et al. (2012), external costs are a crucial component in the *generalized cost* associated to freight transport. This concept does not only include the rate(s) paid by the shipper for that service, but also the value of the time spent by goods between their origin and their final destination (travel time, loading/unloading, storage, etc.). These internal components of the generalized cost *must be* completed with a corresponding economic valuation of the external costs imposed by that cargo movement to the society as a whole (in terms of its particular contribution to pollution, congestion and safety issues). If not, the users will not face the full price of the transport service, and the resulting market shares will be distorted.

A second factor that possibly explains the persistent dominance of road transport over short sea shipping lies in the existence of bottlenecks and infrastructure obstacles in the maritime logistic chain. Wilmsmeier *et al* (2006), for example, consider that many ports are still unprepared to address the needs of fast cargo movements due to obsolete operational procedures or lack of physical or technical capacity. Even though a large effort has been devoted in many countries to modernize the infrastructure, the fact that ports are still seen as unreliable and slow reduces the attractiveness of maritime transport.

Both these reasons seem to suggest that European transport policies have not offered so far the right incentives to effectively promote SSS as an alternative for the users. Several programs, for example, have been focusing on subsidizing to shippers that chose a maritime alternative or directly favouring higher frequencies. By doing this, the EU has been generating a double inefficiency: road transport has not been forced to assume its external costs and the maritime market have been distorted by artificial means. In other cases, promoting competition has been seen as the main policy instrument.

In this paper we propose a back-to-basics methodology. We want to study the competitiveness of SSS—defined as being as good as or better than other modes in certain routes—using several Spanish corridors as an example. Our database includes information from some of the most important ports located in Southern Europe (connecting Spain with the rest of the continent via the Mediterranean and the Atlantic Ocean). With them, we will first carry out a descriptive analysis and comparison of selected SSS routes in terms of time, freight rates and external costs. We will then rely on the generalized cost methodology to calculate the costs of carrying cargo from Madrid and Barcelona (the country's main economic areas) to several European destinations (London, Paris, Berlin, Rome and Moscow) via different ports in a short sea shipping intermodal chain, and contrast these values with an alternative city-to-city direct road route. This will allow us to identify the role of external costs, time and prices in SSS competitiveness and finally quantify how EU policies have affected the rates.

Our main objective is to discuss whether (and why) our corridors (some of them benefitting from European public funds) are actually a better alternative than road transport or not. Our results suggest that many European funding programs have been promoting several non-socially preferred options in freight transport, and not promoting socially preferred options in others. We consider that the main reason of this failure could be vested in a misunderstanding of the SSS potential, a modal alternative that should only promoted when it is the most efficient transport mode for the society, that is, with the minimum generalized cost.

After this introduction, the structure of this paper is as follows: section 2 describes the current situation of maritime transport policies and analyses its evolution in last decades, with special attention to the external costs issue and the promotion of SSS. In section 3 we briefly discuss the generalized cost methodology framework that allows us to analyse the competitiveness of the Spanish short sea shipping corridors competitiveness from the three different categories of the transport cost function: prices, time and external costs (section 4). In section 5, we calculate the savings that SSS provides in those categories. Section 6 is finally devoted to summarize our conclusions.

EUROPEAN MARITIME POLICIES AND THE PROMOTION OF SHORT SEA SHIPPING

Two major objectives have repeatedly dominated the design of European Union transport polices in recent years: a) to favour environmentally sustainable mobility solutions aimed at meeting the overall transport needs for passengers and goods and, (b) the aperture of transport markets to undistorted competition in order to build an efficient internal market (COM, 2011). It is within this environment where maritime transport policies, and in particular those related to Short Sea Shipping (PPP) promotion, have found their playing field.

With minimal exceptions, the economic literature has recurrently argued in recent years that SSS always outperforms all other comparable transport modes from an environmental perspective (see Paixao and Marlow, 2007 or Medda and Trujillo, 2010). The figures seem undisputable. The specific external costs associated to road transport in euros per ton-kilometre have been estimated as four times greater than SSS ones (0.035 and 0.009, respectively), whereas 0.015 corresponds to rail transport (COM, 2010). In 2010, according to Eurostat, almost 33% of the energy consumption in the EU was associated to transport activities and the 80% of this figure is related to road transport. Furthermore, the transport sector is the fastest-growing energy consumer and the biggest producer of greenhouse effect gases in Europe, so curbing the CO_2 and NO_x requires a decisive change in this sector. The European Commission supports this idea by explicitly stating that "(…) an increased use of SSS would generally be in line with the Community transport and environmental policies, either as part of an intermodal transport chain or as a full substitutive mode, depending on the type of corridor" (COM, 2004).

On the other hand, as COM (2011) sentences, establishing a more balanced modal split between modes that are in direct competition turns into crucial. The European Commission has stated that SSS can help to rebalance the modal split (COM, 2003). However, the internalization of external costs produced by transport has not considered yet in the EU. Therefore, transport prices do not reflect the costs that this activity produces to the society. As Janic (2007) establishes, if the full costs (both internal and external costs) are to be used as the main basis for pricing, the break-even distance will increase for intermodal transport and thus push it to compete in longer distance markets. Thus, a full pricing policy is required at the time to erase distortions in the market and to promote competition.

A third reason that arises when promoting SSS in Europe is the European geography itself. It has been argued that it is one of the main advantages for European competitiveness since around 70% of industrial production is located within 150-200 kilometres from the sea (Paixao and Marlow, 2002). Moreover, the capacity and potential of sea transport in the EU suggests that SSS could become a powerful alternative in many freight markets. As Baird et al (2002) stated, sea transport capacity always could be increased, substantially and speedily, through the addition of more, larger or faster ships.

The first big effort to promote multimodal networks was the *Pilot Action for Combined Transport* (PACT), which financed 167 projects between 1992-2000 with a total budget of €53 million (Brooks and Frost, 2004). The *Marco Polo I* program in 2001 continued the effort with €102 million awarded to 125 projects involving more than 500 companies. It was replaced by *Marco Polo II*, with a budget of €740 million for the period 2007-2013. All these initiatives have tried to promote SSS through giving support to companies that shift freight from road to rail, short sea shipping routes or inland waterways.[4] Within its measures, the *Programme for the promotion of Short Sea Shipping* (COM, 2003) has built up some legislative, operational and technical actions (composed of 14 measures), to advance coastal shipping in the EU and creating SSS Promotion Centres located in 13 European countries. In addition, the *Trans-European Transport Network* (TEN-T) has also been established to develop a multimodal European network which is supposed to be finished by 2030 (TEN-T core network). Its objective for 2030 is that at least 30% of freight traffic which is currently moved by road over a distance of 300+ kilometres should be carried by other modes, such as rail or SSS, and the 50% by 2050 (COM, 2011).

In spite of the financial support that these policies have received, there remain several obstacles that hinder a smooth reordering of market shares and delays achieving effective competition in the internal market and a more sustainable transport mix (COM, 2011). In 1995 road transport represented 42.1% of the total freight transport in EU-27, and sea transport comprised 37.5%. In 2009, these figures changed to 46.6 and 36.8%, respectively; that is, while road transport has increased its market share, sea transport has suffered a decrease, resulting in a relevant gap increase between these alternative modes (from 4.6% to 9.8%).

What are the reasons that explain this apparent failure? The economic literature has not found the answers yet. Yu Ng (2009) investigates the potential competitiveness of SSS in the Baltic Region. Using simulation techniques, the paper shows how SSS could be an attractive mode in transporting cargoes to certain areas within the Baltic region, suggesting that SSS can achieve a fairer modal split within the EU. The study also points out that SSS is more competitive when the usage of maritime corridors represents a higher length in the multimodal route and serves coastal cities.

With respect to environmental concerns, Brooks and Frost (2006) stated that "it is unrealistic for government to expect shippers to move to a more environmentally friendly, modally integrated transport choice if, in so doing, it results in additional costs and reduced competitiveness for them". Considering the British coastal shipping example, Saldhana and

[4] For details, please refer to http://ec.europa.eu/transport/infrastructure/

Gray (2002) showed how managers were in favour of multimodal developments, in particular cooperation between coastal shipping and road haulage, after both the EU and British Government had been conscious of the environmental benefits of coastal shipping compared to road freight transport.[5]

Finally, paying attention to the Spanish case, Martínez and Olivella (2005) considered that SSS provides a cost advantage, but there is no enough justification for the cargo to be passed from road to sea, and also that time spent should be reduced to a minimum. Lastly, García-Menéndez et al (2004) analysed the determinants of modal choice between road and shipping for freight transport in four Spanish exporting sectors. Their results show a high significance of cost, transit time, and frequency of shipments as main determinants of modal choice.

GENERALIZED COST METHODOLOGY: PRICE, TIME AND EXTERNAL COST

The previous analysis suggests that it is possible to make new contributions on the study of the competitiveness of short-sea shipping. Our approach to this concept is based on the idea of the generalized cost, a well-established principle to summarize the shipper's decision in the transport economics literature (Button, 2010).

From a user's viewpoint, the demand for any particular service is inversely related to the full price (P) that must be paid for it. In the particular case of freight transport, any carrier commonly provides its services in exchange for a monetary price ($P = p \cdot d$) in the form of a freight rate (including carriage, taxes, insurance, etc.) per kilometre (p) which is then multiplied by the distance (d). In addition the shipper has to bear the (opportunity) cost of the immobilized cargo during the transport service, which is proportional to total travel time (t) (defined by the ratio between distance and speed, s) and the value of time for the average user (v). A third component, from the society point of view, is given by the external costs associated to each trip, which we can simply summarize into $E = \varepsilon \cdot d$ (also expressed per kilometre).

[5] This paper is focused on the SSS in Europe. Nevertheless, there are several studies that analyze its potential in other regions worldwide. Bendall and Brooks (2011), Le-Griffin and Griffin (2010) and Sánchez and Wilmsmeier (2005) are remarkable examples of the experiences of Australia, North and Latin America, respectively.

With these features the full price or generalized cost of moving cargo between an origin (*O*) and a destination (*D*) becomes:

$$g = P + vt + \mathrm{E} = (p + \varepsilon) \cdot d + v \cdot \left(\frac{d}{s} \right). \qquad \textbf{[1]}$$

Now consider, as showed in **Figure 1**, that the shipper may choose between two alternative transport modes. On one hand, the cargo can be transported directly **by road** between the origin (e.g., Madrid, Barcelona) and the destination (e.g., London, Paris, Rome, Berlin, or Moscow). In that case, expression **[1]** for the generalized cost becomes:

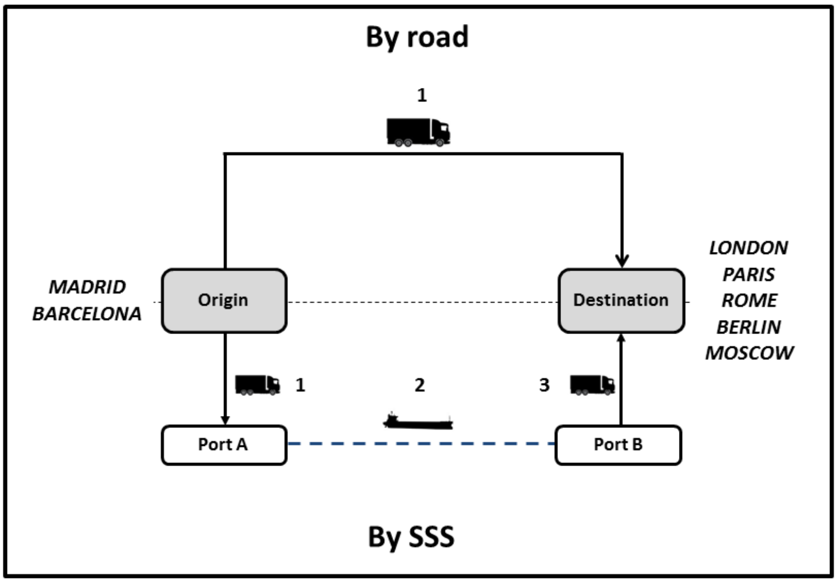
$$g_{ROAD} = (p + \varepsilon_{ROAD}) \cdot d^{O-D} + v \cdot t_{ROAD}^{O-D}, \qquad \textbf{[2]}$$

where both the distance and travel times can be calculated for any given corridor. Alternatively, if the shipper chooses a SSS multimodal transport chain that combines road (between O and port A, and between port B and D) with sea transport (between A and B), the corresponding expression for the generalized cost would be:

$$g_{SSS} = (p + \varepsilon_{ROAD}) \cdot \left(d^{O-A} + d^{B-D} \right) + \left(f + \varepsilon_{SSS} \right) \cdot d^{A-B} + v_i \cdot \left[t_{ROAD}^{O-A} + t_{SSS}^{A-B} + t_{ROAD}^{B-D} + t_{PORT} \right] \textbf{[3]}$$

where the term *f* refers to the maritime freight rate (including loading, unloading and driving to the storage) and $\boldsymbol{t}_{\mathbf{PORT}}$ finally comprises the time spent in ports (i.e., waiting times, administrative procedures or customs in ports, etc.).

FIGURE 1. TWO COMPETING TRANSPORT MODES: SSS VS. ROAD TRANSPORT



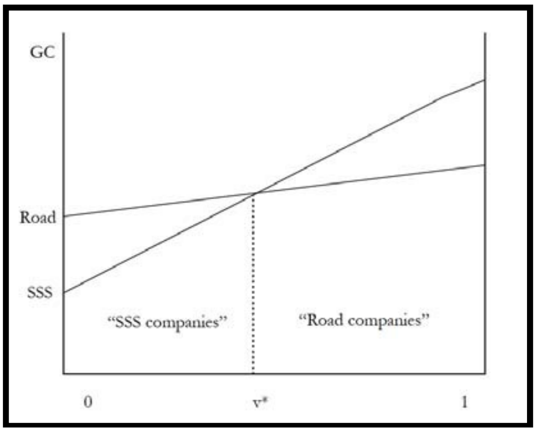
Source: Authors.

To develop a theoretical modelization, we can set out different agents involved in each market. In the road transport option, there is only one agent: shipper 1. The maritime-intermodal option involves sea-shipper, shippers 2 and 3 (to and from ports), and port services. It is noteworthy that the model examines a specific market size, thus the modal split in it. We will determine the generalized cost of each alternative, that is, the whole cost to include monetary cost (price) as well as time cost, in order to obtain a better performance of cost functions and to consider the traditional transport cost models.

Expressions **[2]** and **[3]** above define the alternative specifications of maritime and road transport costs of carrying cargo from O to D. Therefore, in an internalized cost' scenario, each company that wishes to carry cargo from O to destination D should compare both generalized costs, and should choose the one which has the lower whole cost, that is, considering times, prices and external costs.

As noted, different companies have different values of time that are contingent upon product characteristics as perishability, mainly. This feature may lead to companies with very high time values and some other companies with very low time values, that are willing to accept long waiting times in exchange for lower monetary cost. This may be the reason why some companies consider one mode to be more advantageous for its purposes than the other options. In this assumption we know the proportion of companies that will choose each mode, by calculating a value (i.e., a company) where there is no difference between choosing one or another mode. In this, we seek the company that is indifferent to choose one mode or another. Therefore, this company will determine the modal split.

FIGURE 2. TWO COMPETING TRANSPORT MODES: DETERMINING THE MODAL SPLIT



Source: Authors.

The model above for a given market size allows us to calculate the proportion of companies that choose each mode. Now let us analyse the real competitiveness of SSS corridors by contrasting its generalized costs with the road ones. Next section deeply analyses those three components (prices, times and external costs) in different routes.

- CASE STUDY: THE COMPETITIVENESS OF THE SPANISH SSS CORRIDORS

As a case study, in this section we try to estimate the competitiveness of several Spanish SSS corridors, through an analysis of different routes that make use of Spanish and other European ports in intermodal option. According to SPC-Spain[6] data (2011), there are 34 services which link 43 European ports in the Cantabrian shore and 35 services linking 64 European ports, considering SSS as alternative to road transport. We have selected the main ports located in the Iberian Peninsula: Santander Bilbao, Gijón, Ferrol and Vigo, in the Atlantic Ocean; Barcelona, Tarragona, Castellón, Valencia and Cartagena, on the Mediterranean Sea. We have also selected different routes, considering a standardized cargo that has to be carried from two main Spanish economic centres (Madrid and Barcelona) to some of the main European cities (London, Paris, Rome, Berlin and Moscow), as shown in **Figure 3**.

[6] Short Sea Promotion Centre- Spain is part of the European Short Sea Network (ESN) since it was constituted in Paris in 2002. The objective of this association consists of promoting SSS in Europe and it is one of the operational measures that EU has carried out to encourage this mode of transport. For more information see: www.shortsea.es

FIGURE 3. MAJOR SPANISH PORTS CONSIDERED IN THIS STUDY

Source: Authors.

At the same time, the choice of Madrid and Barcelona tries to consider the differences in SSS competitiveness between coastal and non-coastal origin cities (and the same for destination cities). The choice of destinations attempts to reflect different European geographical areas, by considering main economic centres. Data has been obtained from SPC-Spain and the Spanish Port Authority.

The capital city of Madrid is located in the centre of Spain, more than 300 kilometres away from the nearest port. With more than 6 million of inhabitants in its surrounding economic area, and many redistribution chains to the rest of the country, about 72% of the 2000 biggest Spanish companies are located here[7]. We analyse the freight of 18 cargo net tons[8], assuming an average road speed of 65 km/h, and a price per kilometre of 1.1 euros, from Madrid to London, Paris, Rome, Berlin and Moscow. Previous assumptions are considered also by Short Sea Promotion Agency established by European Commission[9].

Barcelona is located in the Mediterranean coast, with more than 1.5 million of inhabitants (the second largest Spanish city after Madrid). With a GDP per capita of 126.4%

[7] http://www.investinspain.org/icex/cda/controller/interes/0,5464,5322992_6261818_6279108_0_10,00.html

[8] This assumption is based on the weight allowed for an intermodal container in a twenty-foot equivalent unit (TEU). The maximum weight for cargo is estimated in 21.6 net tons. Thus, we assume the freight of 18 cargo net tons.

[9] http://www.shortsea.es

over the average EU-27[10], Barcelona is definitely different from Madrid in terms of geographical situation.

FIGURE 4. ROUTES FROM MADRID

Source: Google maps, SPC-Spain.

For all previous ten combinations, we have calculated times, prices and external costs of carrying cargo from each origin-destination pair by road and also by an intermodal chain, through using ports as nodes in maritime corridors; for instance, for the combination Madrid – Rome, we calculate road option generalized costs and different maritime combinations such as Barcelona, Valencia or Castellón origin ports, and Citavecchia, Livorno (Italy) or Fos (France) destination ports.

-PRICES

As we have aforementioned, the main objective of the development of SSS is to encourage a real competition in freight transport by reflecting both external and monetary costs. However, some exogenous factors affect the latter, which finally is one of the main strategic variables in any market: price established by transport operators.

When one firm needs to move a good from one city to another, it compares prices between alternatives; in our case, we are comparing road transport *versus* the mixed system of road-SSS-road, that is, the multimodal alternative. Using the same previous structure of data, we try to establish whether there are some relationships among final total prices, characteristics of the route, competitors in the route, price of substitutive alternative and others.

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[10] Catalonia Regional Government statistics, 2011. http://www.idescat.cat/economia/

To answer these questions we created a database that includes the following variables, all of which are used in the estimations described further on:

(i) **Total Cost per Kilometer$_i$ (*TC_i*)**: this is the endogenous variable, and it represents the cost of the mixed option between two cities, per kilometre. It is in current euros per kilometre. Source: Own elaboration based on *Short Sea Promotion Centre Spain*, shipping lines and *Spanish Freight Road Transport Costs Observatory* data.

(ii) **Subsidized route$_i$**: binary variable that takes value 1 if route considered includes a SSS route that it is directly subsidized by European public funds for creating a SSS route. Source: Different EU funding programs.

(iii) **Maritime frequency (*MF_i*):** this covariate measures the total number of weekly trips between two ports considered. *A priori* we expect an inverse relationship with the endogenous variable. Source: *Short Sea Promotion Centre Spain* and shipping lines.

(iv) **Competitors in the route (*NC_i*):** the number of different competitors that operate in the maritime route *i* at the moment we obtain data. We try to control a competition effect on prices on maritime traffic on each route. Source: *Short Sea Promotion Centre Spain.*

(v) **Distance$_i$**: total number of kilometres between ports of origin and destination. This variable has been included to control for route characteristics and economies of scale in the operations of maritime transport. Source: *Google maps*.

(vi) **Road transport cost (*RC_i*):** this is the total cost, in current euros, of the road alternative to reach the two cities joined. We expect that a higher cost of alternative, a higher level of demand and higher prices in the SSS route. Source: *Short Sea Promotion Centre Spain* based on *Spanish Freight Road Transport Costs Observatory* data.

(vii) **GDP origin and destination**: Gross Domestic Product of region in which both ports are located. In current euros, 2012. Source: *Eurostat.*

Table 1 includes the descriptive statistics of variables considered. We split the sample between subsidized and non-subsidized routes. The database includes 185 observations in 2012.

TABLE 1. DESCRIPTIVE STATISTICS BY SUBSIDIZED ROUTES

Variable	Mean		Std. Dev.		Minimum		Maximum	
	S	Non-S	S	Non-S	S	Non-S	S	Non-S
Total cost per km	2.90	2.99	1.63	1.94	0.76	0.68	6.72	14.5
Maritime frequency	1.05	1.51	0.48	1.41	0.5	0.25	2	6
Competitors in the route	1	1.06	0	0.25	1	1	1	2
Distance	1327.67	1778.1	775.94	1201.2	796	343	2969	3758
Road transport cost	0.82	0.73	0.22	0.30	0.37	0.21	1.22	1.43
% distance by sea	43.5	44.1	18.2	17.8	17.5	7.9	78.6	82.7
GDP region of origin	22600	23561.3	3419.5	3557.5	19100	19100	29700	29700
GDP region of destination	26766.6	27358.2	3671.3	5938.8	22600	13824	31400	40100

Source: Authors. Note: S: Subsidized route; Non-S: Non-subsidized route.

The average total cost per kilometre of a route is 2.90 and 2.99 euros in subsidized and non-subsidized one respectively. This two average data are quite similar and, in fact, no statistical differences are in means, by *t*-test. Non-subsidized routes show more maritime frequencies, competitors, distance and average GDP´s than subsidized ones. However, no significance differences exist among them.

Our main objective is to test what factors affect the total cost using a SSS mechanism. For this reason, we have established a gravitational relationship among variables described in equation [4].

$$TC_i = \beta_0 + \beta_1 Subsidized_i + \beta_2 MF_i + \beta_3 NC_i + \beta_4 \text{Distance} + \\ + \beta_5 RC_i + \beta_6 GDPo + \beta_7 GDPd + \sum_{i=8}^{18} \text{Port effect}_i + \varepsilon_i \qquad \textbf{[4]}$$

The estimations results are included in Table 2. Our empirical strategy has been to include gradually the variables, using subsidized route, frequency and distance as the explanatory variables in the base. All estimations have been made using OLS estimations, considering cluster option in *Stata*, by route, to minimize errors within groups.

TABLE 2. ESTIMATIONS RESULTS (DEPENDENT VARIABLE: TOTAL COST)

Explanatory variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Subsidized route	-0.59 (0.27)*	-0.60 (0.28)*	-0.57 (0.26)*	-0.17 (0.13)	-0.19 (0.08)*
Maritime frequency	-0.07 (0.06)	-0.07 (0.06)	-0.07 (0.06)	-0.08 (0.03)**	-0.19 (0.06)**
Competitors in the route			0.35 (0.31)	-0.11 (0.14)	-0.75 (0.12)***
Distance	-0.001 (0.0003)**	-0.001 (0.0002)**	-0.001 (0.0002)**	2e-4 (6e-5)**	0.0001 (6e-5)
Road transport cost (alternative)		-0.02 (1.68)	-0.018 (1.70)	0.94 (0.27)**	1.04 (0.34)**
% distance by sea				-9.67 (1.59)***	-9.36 (1.23)***
GDP region of origin					6e-5 (4e-4)
GDP region of destination					-6e-8 (6e-6)
Fixed effects by Port of origin	No	No	No	No	Yes
Constant	4.98 (0.93)***	5.00 (1.42)**	4.59 (1.68)**	6.46 (0.64)***	6.21 (0.74)***
Observations	185	185	185	185	185
R^2	0.38	0.38	0.38	0.75	0.79
F-statistic	14.16**	(*)	(*)	(*)	(*)

Note 1: *** 1%, ** 5%, *10% significance test. Standard errors are shown in brackets.
Note 2: (*) Due to use of cluster option, *Stata* does not report the F statistic for conjoint significance.

All variables show jointly significance and the explanatory capacity of the estimated models is quite satisfactory, with a R^2 close to 0.8 in the model **[4]** and **[5]**.

The following conclusions can be drawn from our findings. Firstly, it appears to exist some scale economies in these routes, due to the negative sign of coefficient of "distance". However, when we introduce more explanatory variables distance becomes a non-significant covariate, which rejects this hypothesis.

Secondly, subsidized binary variable shows a negative effect on prices, which means that prices in these routes are lower than in others. Using average prices defined in Table 13, and the coefficient estimated in model **[4]**, we conclude that subsidies incidence is close to 6.4 per cent, i.e., prices are lower in this percentage.

Another interesting result is the effect of competition on prices: both maritime frequency and number of competitors are significant and show a negative effect on prices.

These results induce to foster maritime competition to become more attractive this transport mode.

The effect of alternative cost is positive. This means that higher cost of road transport from pair cities considered, higher prices in the mixed corridor. This outcome maybe is caused by a demand effect on SSS corridor, due to substituibility effect between both alternatives. Finally, the higher percentage of distance moved by sea, the lower the price.

- TIME AND EXTERNAL COSTS

This section examines the *up and down* of maritime transport. On the one side, external costs are pointed out as the main reason for the promotion of this mode, conventionally regarded as environmentally friendly. On the other side, time has not been traditionally considered a competitive variable in maritime: it has been even named as a trade barrier (Hummels, 2001). To completely assess the competitiveness of a SSS route, it is needed to address these full-cost terms.

In previous subsection, we have tried to shed some light on the determinants of SSS monetary price through an econometric specification. Regarding to time and external costs, these estimations are not required. Travelling times depend on distances and speeds; that is, fixed and known factors. There are also other times that are not taken into consideration in this analysis: Port times. These times—defined as the sum of port access time, loading and unloading times of cargo, ship waiting time and time for customs and other administrative procedures— are positively related to estimated levels of port inefficiency. A more detailed analysis should include these variables that influence on SSS competitiveness through the role of ports.

Considering the externalities, here we included the cost in terms of CO_2 emissions. The specific external costs associated to road and SSS in euros per tonne-kilometre have been estimated in 0.035 and 0.009 (COM, 2010). Other external costs such as congestion or accidents are not considered. In any case, its introduction will not change the results and discussions, as we will show later. We could even consider CO_2 cost as a proxy of the whole external cost. It has to be mentioned that we include maritime options which can be preferred by operators taking into account different preferences of them: that is, an operator may prefer to spend more time instead of paying a huge amount of money, or reverse. We do not include some maritime options which are dominated by others: that is, if a maritime corridor takes more time, is more expensive and generate more external costs than other; it is eliminated.[11]

Tables in the Annex A summarize the movement of cargo from Madrid and Barcelona to the main European cities, reflecting external cost and times of different maritime options according to diverse origin-destination ports combinations. Below we report a summary of the different corridors.

-To Paris

From Madrid, road option monetary cost, not considering external costs, is always lower than any maritime option. However, if EU would internalize external costs, the difference between road and intermodal option, by using Gijon (Spain) and Saint Nazaire (France) ports, decreases substantially. Thus, intermodal option would suppose a minimal price increase, but reducing times in more than a 15% (7 hours, approx.). Other maritime options generate higher prices and external costs, and also times. Therefore, Gijon – Saint Nazaire route could be a more competitive option easily by internalizing external costs. An increase of 1.75% in monetary cost would reduce time cost in a 15%, so the companies' choices will finally depend on each time value.

In the route from Barcelona, the competitiveness of SSS corridors is not quite clear. Not internalizing the external costs, there is no discussion in considering road transport as the most competitive option (lower monetary and time costs). However, if external costs are assumed by companies, SSS converts the most competitive in terms of money, but definitely not in terms of times, where almost double to road transport ones.

-To Rome

Let consider now Madrid – Rome route. In this case, as shown in **Table5**, there are eleven intermodal options cheaper than road corridor. There is no discussion about the competitiveness of SSS with Madrid as origin and Rome as destination. The situation of Civitavecchia (Rome) and the Mediterranean Spanish ports such as Barcelona, Valencia, Tarragona or Castellon turns into the real explanation of maritime corridors advantage. Moreover, taking into consideration the times, most of intermodal routes (especially Barcelona-Civitavecchia), take less time in carrying cargo from Madrid to Rome.

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11 All the combinations could be shown previous request to authors.

Regarding to the Barcelona-Rome route (**Table 6**), the analysis is straightforward. Being two coastal cities, with two important ports respectively, there is again no discussion in the competitiveness and potential of SSS for this route. Even not internalizing the external costs, the maritime option is much more competitive than road in every single part of the generalized cost function. All of these previous routes are not (and should still not being) subsidized by European funding programs in terms of monetary cost, due to the fact that they are actually more competitive. In terms of time cost, the most competitive route takes almost the half of road option (from Barcelona to Civitavecchia port, with a reduction from 65.5 to 33.2 hours).

-To London

Now we consider the routes to London. From Madrid, without internalizing external costs, six intermodal corridors are more competitive than road option only considering monetary cost. Concretely, the ones which make use of Bilbao and Santander (Cantabrian Sea) and British ports such us Portsmouth, Plymouth or Poole, or even through Zeebrugge (Belgium) and then, from there to London through English Channel. Moreover, four of them spent less time than road corridor, so shippers should prefer them. Three of the last are subsidized when their generalized costs are always lower than road option generalized cost. What it is more important; if external costs are internalized, three others corridors from Bilbao, Gijón and Ferrol to Saint Nazaire (France) and Antwerp or Zeebrugge (Belgium) ports are more competitive than road transport, although only Gijón-St. Nazaire seems to be competitive according to time cost.

Nevertheless, considering the route from Barcelona, when external costs are not internalized, the preferred option by companies does not match with the social one. As **table 6** highlights, road transport monetary cost is lower than maritime, but it terms of times, the combination Bilbao-Portsmouth ports is more competitive. As internalized prices show, by forcing companies to assume external costs, this last option becomes the one with a lower generalized cost. As seen in the case of Valencia and Genoa ports in the route from Madrid to Berlin, this combination (also with Genoa as destination port) proves the competitiveness of SSS through the internalization of external costs in terms of CO_2 emissions.

-To Berlin

From Madrid, it is straightforward to observe how, considering only monetary cost (the one that actually the shippers perceived) four routes show a lower cost. However, according to times, they all are less competitive, so the shipper choice would finally depend on time value. But if we internalize external costs, the maritime route from Valencia to Genoa becomes the most competitive option, with a lower generalized cost. This route shows the real competitiveness of SSS through the internalization of damages to the society from road transport in terms of CO2 emissions.

Regarding to Barcelona-Berlin route, as **Table 6** shows, Barcelona to Genoa SSS corridor turns into the most competitive option, even when road transport does not internalize its external costs. It is also the best option in terms of times, usually the less competitive variable of maritime transport.

-To Moscow

Finally, we have included a destination where road transport (as unique mode and as part of an intermodal chain) takes more time. As **Table 5** shows, there are five intermodal options that are more competitive than road in terms of monetary costs. Moreover, two of them (Santander and Ferrol, Spain – Kotka, Finland) present lower times than road, in a 20.6 and 18.6% respectively. In a similar analysis than previous cases, we observe how some other corridors become a competitive option by internalizing external costs; they all generate a lower generalized cost (monetary, time as well as external costs) than road.

Finally, in **Table 6** we also analyse the route from Barcelona. Departing from Barcelona port and arriving to Livorno port, the maritime corridor provides a lower monetary cost and also a reduction in terms of external costs, but it is less competitive than road in terms of times. However, the combination of Barcelona and Genoa ports would report a lower cost in terms of money if external costs were internalized, and would reduce times in more than 30 hours.

DECONSTRUCTING OF SSS SAVINGS

From previous analysis, it has been proved how, according to different destinations and distances, some SSS routes would turn into the most competitive option to carry cargo by internalizing external costs. However, in some cases it is not quite clear the best option. Monetary price, times and external costs provide evidences to choose different alternatives. Thus, the final choice will depend on user's time value.

TABLE 3. DECONSTRUCTING SSS SAVINGS. THE CASE OF MADRID

Route from Madrid	Best Origin–Destination ports combination.	Monetary Cost	Time Cost	External Cost	Generalized prices
to Paris	Gijón - St. Nazaire	-6.8%	15.08%	16.54%	Undetermined
to Rome	Barcelona- Civitavecchia	26.9%	49.3%	52.3%	$g_{ROAD} > g_{SSS}$
to London	Bilbao - Portsmouth	35%	40.27%	50.45%	$g_{ROAD} > g_{SSS}$
to Berlin	Bilbao - Zeebrugge	7.44%	-4.70%	44.9%	Undetermined
to Moscow	Santander - Kotka	6.41%	20.6%	40.59%	$g_{ROAD} > g_{SSS}$

Source: Authors.

In **Table 3**, SSS savings are considered by selecting the most competitive origin-destination ports pair for each route from Madrid. As expected, SSS would reduce the external costs in all the cases analysed, reaching in some of them a reduction to the half. Road generalized prices are higher than maritime ones in routes to Rome, London and Moscow: SSS is more competitive not only in monetary or external costs but also in times.

In these cases, no matter what the time values of companies are, we already know the sign of these expressions. However, considering routes to Paris and Berlin, generalized cost expressions, and therefore, the choice of the most competitive mode will finally depend on time values. In Madrid-Paris route, maritime-multimodal option would report lower external and time costs, but would lose competitiveness in terms of monetary costs. But, with an increase of a 6.8% of the latter, a reduction of 15.08% and 16.54% in time and external costs, respectively, would be achieved. Finally, taking into consideration the route from Madrid to Berlin, we found the common case of maritime transport. By using the ports of Bilbao and Zeebrugge, a reduction of monetary and external costs would be reached, but times would be higher.

The lack of data does not allow us to consider the impact of port-related times on those generalized cost functions. Therefore, time cost savings should be faced waiting, load and unload, custom and other administrative procedures times represented by parameter $\mathbf{t_{PORT}}$. Our analysis in terms of costs savings could be considered as a maximum gap in order to keep SSS competitiveness.

Previous analysis is conditioned by the choice of Madrid as origin. Therefore, the results depend on its location: in the middle of the Iberian mainland, far from the coast. In order to see if, as expected, SSS competitiveness increases when origin markets are really close to the shore, we carried out the same analysis but considering the city of Barcelona as origin.

TABLE 4. DECONSTRUCTING SSS SAVINGS. THE CASE OF BARCELONA

Route from Barcelona	Best Origin–Destination ports combination.	Monetary Cost	Time Cost	External Cost	Generalized prices
to Paris	Barcelona-Fos	-6.76%	-88.3%	30.56%	Undetermined
to Rome	Barcelona- Civitavecchia	40.32%	50.11%	76.7%	$g_{ROAD} > g_{SSS}$
to London	Bilbao - Portsmouth	-5.15%	9.34%	30.50%	Undetermined
to Berlin	Barcelona - Genoa	71.28%	13.56%	27.01%	$g_{ROAD} > g_{SSS}$
to Moscow	Barcelona - Genoa	-0.91%	30.63%	15.88%	Undetermined

Source: Authors.

Barcelona, being a coastal city, provides some advantages in the commerce with other coastal cities such as Rome, as shown in **Table 4**. It is probably the most competitive Spanish SSS corridor, due to the European geography, as cost data reflects. Barcelona-Genoa seems to be a highly potential SSS corridor to carry cargo from Mediterranean Spanish coast to Central and East Europe, in terms of generalized costs. As obvious, Barcelona port does not seem to be a proper way to get to London, but maritime option could have also a chance through Bilbao port in the Cantabrian Sea, and Portsmouth in the British coast. Finally, maritime transport from Barcelona to Paris is not really competitive, with an increase in times costs of 88.3% and in monetary cost in 6.76%. Only by internalizing external costs, SSS suits a more competitive option in terms of money, but it also seems that the increase in time is too large to be compensated in the generalized cost function.

CONCLUSIONS

In this paper we have carried out an analysis of Spanish SSS corridors, in order to attempt their potential and competitiveness. Frequently, it is assumed that maritime transport generates longer transit times, and it is seen as the slowest mode of transport. However, the European geography provides a very proper scenario to encourage SSS corridors. In the present analysis, the Mediterranean and Cantabrian coasts have proved to be suitable locations to establish some profitable corridors to central and east Europe.

From non-coastal cities, as Madrid, it has been shown how some SSS corridors reduce transit times in most of cases, especially to Rome (49.3%) or London (40.27%), through

Barcelona and Bilbao ports. Considering a coastal city as Barcelona, these time savings are remarkably important in the routes to Rome (50.11%) and Moscow (30.63%). Generally speaking, the Port of Barcelona seems to be very competitive in the establishment of SSS corridors across the Mediterranean Shore.

At the same time, it is crucial to take into consideration the need of avoiding the external costs provoked by road transport. As expected, SSS corridors generate a substantial reduction in every single analysed route comparing to road transport, and varying from 15.88 to 76.7%. This is mainly the reason why EU has been promoting maritime corridors. However, as mentioned, these savings must be faced to increases in times and monetary cost in order to finally determine the most competitive mode of transport for each route. Only a generalized cost perspective indicates the real competitiveness of a corridor.

However, there are also other variables that have to be considered. Times in ports, as load or unload waiting, customs and other administrative procedures times must be taken into account. In this paper we are not included these time costs because of the lack of data. Nevertheless, the importance of these components is crucial. As the sum of them is the unique variable that we do not control here, our analysis could be useful as a reference to consider the gap that ports have before reducing the competitiveness of SSS corridors to the point of making road the most attractive mode to users. In other words, if the generalized price of SSS in an specific corridor is lower than road in terms of monetary, external and time costs, and the SSS time savings are x hours, then ports should not incur in higher times than x. Here we provide a methodology to determine x in different cases, in an attempt to be useful to port authorities and EU policies.

At the same time, using an own elaborated database, we have estimated a price equation to test what factors affect pricing decisions in a SSS route. The results yield to three main conclusions: firstly, subsidized routes show lower prices than non-subsidized ones. It means that there is a positive incidence on prices from public expenditure on SSS. However, a more detailed analysis is needed in this sense. Second, that higher cost of alternative road transport, higher prices in the mixed corridor. And finally, the importance of competition: prices are lower in routes with higher maritime frequency and higher number of competitors. For these reasons, public policies must to encourage not only the use of SSS by attracting them to firms, but also to improving the levels of competition.

Finally, we should remark that SSS corridors have to be promoted only in cases where it is the most competitive mode of transport, and to know that we have to consider all the variables that compose their different generalized prices and compare among them and also other modes as, mainly, road transport. EU should be worried about reducing the inefficiency in the freight market, by making road to assume the real cost that it produces and promoting those SSS-intermodal corridors that are actually the best alternative to the society.

REFERENCES

Baird A., Hoffman J. and G. Wilmsmeier (2002): "The Chilean Maritime Highway". IAME Panama Conference Proceedings, 13-15 November 2002, Panamá.

Bendall, H.B. and Brooks, M.R. (2011) *Short sea shipping: lessons for or from Australia*. International Journal of Shipping and Transport Logistics. Vol.3, 4, 384-405.

Brooks, M.R., and J.D. Frost (2006): "Short Sea Shipping on the East Coast of North America: Analysis of opportunities and issues". Transportation Planning/Modal Integration Initiative, Canada–Dalhousie University. Project ACG-TPMI-AH08.

Brooks, M.R. and J.D. Frost (2004): "Short Sea Shipping: a Canadian perspective", *Maritime Policy & Management*, 31:4, 393-407.

Button, K. (2010): *Transport Economics*, Elsevier.

COM (2001) White Paper. *European transport policy for 2010: time to decide*. European Commission.

COM (2003) *The Programme for the promotion Short Sea Shipping. Communication from the European Commission*. COD 2003/0155.

COM (2004) Communication from the Commission to the Council the European Parliament, the European Economic and Social Committee and the Committee of the Regions on Short Sea Shipping.

COM (2008) *Communication from the Commission to the European Parliament and the Council*. Greening Transport, 2206.

COM (2010) *Calculation of Modal Shift, Traffic Avoidance and Environmental and other external costs effects*. Marco Polo II Call 2010. Appendix 3. European Commission.

COM (2011) White Paper. *Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*. European Commission.

European Parliament (2010) Decision No 661/2010/EU of the European Parliament and of the Council of 7 July 2010. *Union guidelines for the development of the trans-European transport network*. Official Journal of the European Union L 204.

García-Menéndez, L., I. Martínez-Zarzoso and D. Piñero de Miguel (2004): "Determinants of Mode Choice between Road and Shipping for Freight Transport". *Journal of Transport Economics and Policy*, 38, 3, 447–466.

Hummels, D. (2001) Time as a Trade Barrier. Mimeo, Purdue University, July.

Janic, M. (2001): Integrated transport systems in the European Union: An overview of some recent developments. Transport Reviews: A transnational transdisciplinary journal. Vol. 21:4, 469-497.

Le-Griffin, H.D. and Griffin, M.T. (2010) *Managing empty container flows through short sea shipping and regional port systems.* International Journal of Shipping and Transport Logistics. Vol.2, 1, 59-75.

Martínez, F.X. and J. Olivella (2005): "Short Sea Shipping opportunities for the Pyrenean Cargo Flows", *Journal of Maritime Research*, II, 2, 65-80.

Medda, F. and L. Trujillo (2010): "Short Sea Shipping: an Analysis of its Determinants". *Maritime Policy & Management*, 37:3, 285-303.

Paixao, A.C. and P.B. Marlow (2007): "The Impact of the Trans-European Transport Networks on the Development of Short Sea Shipping", *Maritime Economics & Logistics*, 9, 302-323.

Sánchez, R. and Wilmsmeier, G. (2005) *Short-Sea shipping potentional in Central America to bridge infrastructural gaps*. Maritime Policy and Management: The flagship journal of international shipping and port research. Vol. 32:3, 227-244.

Saldhana, J. and R. Gray (2002): "The potential for British coastal shipping in a multimodal chain", *Maritime Policy and Management: The flagship journal of international shipping and port research.* Vol. 29 (1), 77-92.

SPC-Spain (2011): *Spanish statistical observatory of Short Sea Shipping* 2009-2011. European Short Sea Network.

Suárez-Alemán, A., L. Trujillo and F. Medda (2012): *Short Sea Shipping and Intermodal Competition. A theoretical analysis of European Transport Policies*. IAME Proceedings 2012. Taipei, Taiwan.

Wilmsmeier, G., J. Hoffmann, and R. Sanchez. (2006): "The Impact of Port Characteristics on International Maritime Transport Costs". *Research in Transportation Economics*, 16(1), 117-140.

Yu Ng, A.K. (2009): "Competitiveness of short sea shipping and the role of port: the case of North Europe", *Maritime Policy & Management*, 36:4, 337-352.

ANNEX. TABLES

TABLE 5. ROUTES FROM MADRID

Port A	Port B	Maritime price (€) (1)	Maritime time (hours) (2)	Maritime external costs (€) (3)	Monetary cost (€) (4= 1+road costs)	Total time (hours) (5= 2+ road time)	Total external costs (€) (6= 3+ road ext. costs)	Subsidized	Int. Price (€) (4+6)
To Paris									
		Road Option			**1398**	**43.1**	**423**		**1821**
Gijón	**St. Nazaire**	**450**	**21**	**49**	**1500**	**36.6**	**353**	**No**	**1853**
Bilbao	Zeebrugge	950	44	127	1759	56.4	362	No	2121
Bilbao	Portsmouth	900	30	100	1785	43.4	356	No	2141
Vigo	St. Nazaire	650	30	83	1826	48.1	425	Yes	2251
Santander	Portsmouth	900	30	96	1848	44.3	372	Yes	2220
To Rome									
Barcelona	Civitavecchia	21	800	79	1577	33.2	312	No	1889
Valencia	Livorno	30	850	96	1724	43.1	348	No	2072
Barcelona	Livorno	78	600	68	1761	95.9	407	No	2168
Valencia	Cagliari	30	850	82	1843	44.6	367	No	2210
Tarragona	Genoa	54	638	72	1867	72.0	428	No	2295
Valencia	Genoa	31	852	92	1870	46.0	384	No	2254
Barcelona	Genoa	24	590	63	1895	43.8	442	No	2337
Barcelona	Livorno	21	750	68	1911	38.9	407	No	2318
Valencia	Salerno	52	960	128	1978	67.0	420	No	2398
Castellon	Fos	54	500	57	2086	88.2	509	No	2595
Barcelona	Fos	30	300	33	2100	67.9	550	No	2650
		Road Option			**2160**	**65.5**	**654**	**-**	2814
To London									
Bilbao	Portsmouth	900	30	100	1482	38.7	272	No	1754
Santander	Portsmouth	900	30	96	1545	39.6	288	Yes	1833
Santander	Poole	900	33	90	1611	43.5	300	Yes	1911
Bilbao	Zeebrugge	950	44	127	1738	55.4	356	No	2094
Santander	Zeebrugge	1000	40.1	123	1851	52.4	372	No	2223
Santander	Plymouth	900	30	77	1859	44.4	356	Yes	2215
		Road Option			**1901**	**50.8**	**575**	**-**	**2476**
Bilbao	Antwerp	1050	78	140	1932	91.3	395	Yes	2327
Gijón	St. Nazaire	450	21	49	1948	53.3	477	No	2425
Ferrol	Zeebrugge	1000	102	127	2020	117.4	427	No	2447

TABLE 5. ROUTES FROM MADRID (CONT.)

Port A	Port B	Maritime price (€) (1)	Maritime time (hours) (2)	Maritime external costs (€) (3)	Monetary cost (€) (4= 1+road costs)	Total time (hours) (5= 2+ road time)	Total external costs (€) (6= 3+ road ext. costs)	Subsidized	Int. Price (€) (4+6)
To Berlin									
Cartagena	Bremen	1335	198	331	2319	212.8	617	No	2936
Bilbao	Antwerp	1050	78	140	2367	107.9	516	Yes	2883
Bilbao	Zeebrugge	950	44	127	2378	75.3	534	No	2912
Santander	Zeebrugge	1000	40.1	123	2491	72.3	550	No	3041
Road Option					**2555**	**71.7**	774		3329
Valencia	Genoa	852	31	92	2655	68.5	602	No	3257
Barcelona	Genoa	590	24	63	2680	66.3	660	No	3340
To Moscow									
Bilbao	S. Petersburg.	2700	174	362	4172	205.9	781	No	4953
Santander	Kotka	2600	101.2	343	4286	136.7	824	No	5110
Cartagena	Bremen	1335	198	331	4430	275.1	1203	No	5633
Ferrol	Kotka	2600	102.4	347	4455	141	879	No	5334
Bilbao	Helsinki	2700	150	337	4466	186.4	837	No	5303
Road Option					**4580**	**172.3**	**1387**	**-**	5967
Bilbao	Antwerp	1050	78	140	4589	171.7	1133	Yes	5722
Bilbao	Zeebrugge	950	44	127	4605	139.9	1152	No	5757
Valencia	Livorno	850	30	96	4705	128.3	1176	No	5881
Santand.	Zeebrugge	1000	40.1	123	4718	136.9	1168	No	5886

Source: Own Elaboration. Note: Int. Price refers to Intermodal Price, in this case, road.

TABLE 6. ROUTES FROM BARCELONA

Port A	Port B	Maritime price (€) (1)	Maritime time (hours) (2)	Maritime external costs (€) (3)	Monetary cost (€) (4= 1+road costs)	Total time (hours) (5= 2+ road time)	Total external costs (€) (6= 3+ road ext. costs)	Subsidized	Int. Price (€) (4+6)
				To Paris					
		Road Option			1139	28.4	494	-	2125
Barcelona	Fos	30	300	33	1216	53.5	343	0	2058
Barcelona	Genoa	24	590	63	1685	50.5	444	0	2225
				To Rome					
Barcelona	Civitav.	21	800	79	897	22.2	106	0	1003
Barcelona	Livorno	78	600	68	1081	84.9	201	0	1282
Barcelona	Genoa	24	590	63	1215	32.8	236	0	1451
Tarragona	Genoa	54	638	72	1389	64.6	283	0	1672
Barcelona	Fos	30	300	33	1420	56.9	344	0	1764
		Road Option			1503	44.5	455	-	1958
Castellón	Livorno	102	700	91	1505	114.2	322	0	1827
Valencia	Livorno	30	850	96	1733	43.3	351	0	2084
				To London					
		Road Option			1631	47.1	494	-	2125
Bilbao	Portsm.	30	900	100	1715	42.7	343	0	2058
Barcelona	Fos	30	300	33	1781	62.2	444	0	2225
Santander	Portsmouth	30	900	96	1817	54.4	370	1	2187
Santander	Poole	33	900	90	1883	58.3	382	1	2265
Bilbao	Zeebrugge	44	950	127	1971	59.4	427	0	2398
				To Berlin					
Bcna.	Genoa	24	590	63	590	55.3	454	No	1044
		Road Option			2055	64	622	-	2677
Bcna.	Fos	30	300	33	2164	78.1	550	No	2714
Tarrag.	Genoa	54	638	72	2174	87.1	501	No	2675
				To Moscow					
Barcelona	Livorno	78	600	68	4062	170.1	1029	0	5091
		Road Option			4076	153.5	1234	-	5310
Barcelona	Genoa	24	590	63	4104	117.5	1038	0	5142
Tarragona	Genoa	54	638	72	4278	149.3	1085	0	5363
Bilbao	S.Petersb.	174	2700	362	4405	209.9	852	0	5257

Source: Own Elaboration. Note: Int. Price refers to Intermodal Price, in this case, road.