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The Competitiveness of Short Sea Shipping than Road Transport in the Food Sector: the Olive Oil Case in Spain and Italy

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ABSTRACT

This paper analyses the competitiveness of the Short Sea Shipping (SSS) corridors than the road transport by comparing the operational costs to move food (olive oil) products from Spain to several Italian ports. Many studies show that sea transport features present some very positive points both in economic and environmental terms. Three main scenarios will be considered: road only; road combined with accompanied SSS (the truck driver travels inside the ship); and road combined with unaccompanied SSS. Our findings shows that the transportation cost for the road alternative is about 30% and 34% higher than the short sea option for the exportations from Jaén and southern Catalonia, respectively. Large investments in equipment and infrastructure and the adoption of measures facilitating cooperation between carriers are necessary in order to improve the revealed performance.

1. Introduction

1.1. Context

Transport and transport infrastructure were identified almost at the very early beginning of the European Common Market as a key field for a competitive economy. Is, however, after the White Paper on the transport field from 1992, that the Common Transport Policy is adopted [COM(92) 494, 2/12/1992]. Among other important policies decisions declared in that document, there is one concerning the special transport mode of short sea shipping (SSS). SSS is proposed an alternative means of freight movement, from land modes to the sea, in order to reduce both the congested road networks and improve the competitiveness of the EU economy, and, as suggested by Blonk (1993), associated social costs which cannot be removed unless huge investments in infrastructure are made at the expense of more social costs. Therefore is not only an environmental and economic necessity but also a key factor of European economic cohesion and proximity between regions, namely between West and East Europe (Douet and Cappuccilli, 2011). A further step forward is made in the White Paper European transport policy for 2010: time to decide [COM (2001) 370, 12/09/2001]. This text stands as the cornerstone of the EU policy of decongesting the union's roads. Being the main identified measures internalizing social costs of transport users and the promotion of alternative transport chains as the combination of road or by air, sea and rail. The document also introduces the concept of Motorways of the Sea (MoS), defined as a link between ports, allowing a time, cost and flexibility that are competitive with road transport.

1.2. SSS Definition

A clear conceptual definition of Short Sea Shipping do not exist, determining methodological problems and obstacles for policy making, market analysis, strategic planning and scientific research (Douet and Cappuccilli, 2011; Baindur and Viegas, 2011). Indeed, there are multiple definitions of SSS depending on the context and the kind of vessel (Paixao Casaca

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and Marlow, 2002). In fact SSS can be translated into 'coasting trade', 'regional shipping' or 'marine highway' depending on the context (Brooks, 2009). The definition taken established by the European Commission in 1999 is to be used, stated that SSS is the 'movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe' [COM(99) 317, 29/06/1999]. Therefore SSS include domestic and international maritime transport, including feeder services, and river–sea shipping. Short Sea Shipping competitiveness has been widely studied in the context of multimodal transportation chains, where it competes with road haulage in terms of cost and time (Morales-Fusco et al., 2012, for instance), especially when the routes connecting both ports are Motorways of the Sea, understood as links between ports with higher requirements in terms of time, cost, flexibility, reliability and resilience. In addition, SSS is considered to be environmentally friendlier than land transportation (road mainly). When all externalities from transportation are taken into account, SSS appears to be even more competitive. All of that are heavily supported by the conclusions of multiple projects dealing with the competitiveness of SSS multimodal chains, such as EMMA, COREM, INSPIRE, IPSI (4th EC framework program), D2D or REALISE (5th EC framework program) and scientific literature (Wu and Yang 2013, Kim and Van Wee, 2009, for instance). Not all are advantages from using SSS: the transportation chain becomes more complex and is considered to be less reliable (from the shipper's perception), therefore unless there is a significant decrease in terms of cost (or time) when taking SSS, carriers and shippers usually will not even consider it. Additionally, the shipper (or carrier) is vulnerable to the behaviour of the shipping liner, since the maritime leg accounts for most of the cost of the intermodal transportation chain. However, SSS traffic has experienced a substantial increase in the last years (more than 3% since 2009 when the lowest SSS traffic was registered in EU) (Eurostat, 2015). According to Eurostat (2003), almost 1.5 million tonnes of cargo were moved in the EU-15 in 2001through SSS. Traffic increased by 250,000 tonnes in 2008, before traffic dropped due to the economic crisis in 2009 (1.6 million tonnes). In 2013, SSS traffic was almost 1.8 million tonnes (Eurostat, 2015). UK, Italy, and the Netherlands generated 48.2% of the total SSS traffic. A second group, consisting of Spain, Germany, and France, generated 28.6%. Even with the positive evolution of SSS, the modal split of SSS has decreased over the past years in favour of non-SSS sectors. According to Eurostat, road transportation has a modal share of 44.9% while SSS is 37.2% in 2012 (Statistical pocketbook, 2014). Liquid bulk accounted for 44.8% of the SSS of freight cargo to and from the EU-28 in 2013, followed by dry bulk at 341 million tonnes (19.5%). Containers accounted for 349 million TEUs and RoRo units accounted for 234,8 million tonnes of goods in 2013 (both cargo types accounted for 14.2% and 13.4%, respectively) (Eurostat, 2015). On successful short sea shipping experiences, initiated by the Commission as well as EU Member States, motorways of the sea' concept has been developed, with the aim to shift cargo traffic from the heavily loaded road network to environmentally-friendly waterways (European Commission, 2006). The Motorways of the sea, may, therefore, represent preferential corridors to intensify the exchange of goods from one Member State to another which aim to substitute motorways of land, give access to countries separated from the European Union mainland and enable a better integration of short-sea shipping with other forms of transport surface modes (Paixao Casaca, 2008). The concrete realization of the project of motorways of the sea, however, presupposes the resolution of the main regulatory, technical, commercial and environmental obstacles. In particular, the infrastructure gap in the region in terms of transport requires "improving the quality of infrastructure and services in ports; ensure good connections with the interior of the ports and increase attendance and reliability of navigation services; ensure effective links between the ports, the road network, the railway and inland waterways" (Commission of the European Communities, 2007).

1.3. Benefits of the Sea Link

Over the last few years, many studies have focused on the role and importance of Short Sea Shipping through the analysis of case studies (e.g. Torbianelli, 2000), or comparing, through a cost-benefits analysis, land-transport modes and SSS modes and their environmental contribution (Lombardo, 2004; Kamp, 2003) and analysing the general European shipping policy (Paixao and Marlow, 2002). This studies shows that sea transport features present some very positive points, including geographical, financial, energy and environmental advantages, as well as an underused capacity for expansion, and positive effects on ancillary activities which create employment and economic growth (Paixao Casaca and Marlow, 2007; Hanh et al., 2010). With specific reference to the impact of the SSS adoption, most studies emphasise that the most important effect is linked to the reduction of pollution in the improvements in energy efficiency and the reduction of air pollution (Kamp, 2003). The CO2 efficiency via sea is evident. Buhaug et al. (2009) estimated that this potential ranged from 25% to 75%, through more efficient operations of existing ships, increased energy efficiency in the design of new ships, and introduction of alternative fuels. Eide et al. (2011) concluded that a further 33% could be reduced by 2030 at zero cost, due to the fact that most measures that increase energy efficiency are cost-efficient. So, shipping is often presented as an energy and CO2 efficient mode of transport compared to other modes such as air, truck or rail (Buhaug et al., 2009). However, Harald (2014) and Hjelle (2011) emphasize that modern short sea shipping operation may be superior to trucking alternatives when it comes to carbon emissions under given circumstances, but not always. Despite this substantial potential in increased efficiency, reducing total CO2 emission from shipping will be a challenge due to the growth of the sector. Increased global economic growth is expected to continue to be coupled with an increased need for transportation by sea (Johnson et al., 2014). On the other hand, few studies analyse the operative problems connected to the adoption of SSS modes. Suárez-Alemán et al. (2015) evaluate the competitiveness of selected SSS corridors, from Spain to several European destinations, by comparing the generalised costs of different alternatives. Their findings show that, apart from the internalisation of the external costs and the existence of bottlenecks in transit times, the freight rates should be also considered as a critical factor of the competitiveness of SSS corridor than its road alternative. With specific reference to the agri-food production, a study carry out by Perez- Mesa et al. (2012) shows the benefits of using SSS in intermodal transport in the fruit and vegetables exports sector, showing that the cost of intermodal transport is 14% lower than land transport, highlighting contextually a slight reduction in externalities.

1.4. Goals and Structure

The Short Sea Shipping and Motorways of the sea strategies have attracted a lot of attention in the European Union in the last years because it is considered as a favoured way to alleviate road congestion and to reduce operational and environmental costs. However, there are few studies that highlight the importance and the impact of this alternative means of freight movement for the agri-food productions. In this context, Spain and Italy can play a strategic role in the EU region by exploiting their geographical location at the West of the Mediterranean, assuming the function of catalysts of maritime trades involving both countries of the South and East Mediterranean, and for strong similarity and completion of agriculture (Crescimanno et al., 2011). The aim of this paper is to analyse the economic benefits of sea transport compared to road transport of the food products between Spain and Italy. The costs of transport by sea are analysed for a strategic food sector (olive oil) that represents the food product most exported from Spain to Italy. The most important regions of Spain with regard to the production of olive oil, Jaén (Andalucía, South of Spain), and the most important regions in Italy regarding the potential consumption are chosen: Rome, Milan, Naples, Turin and Genoa. Following Morales-Fusco et al. (2012), three main scenarios will be considered: road only (H1); road combined with accompanied SSS (the truck driver travels inside the ship) (H2); and road combined with unaccompanied SSS (H3). For the first scenario (H1) there are two alternative options, driving with a single driver during the whole trip (H1A) or combining several drivers, usually two (H1B), for the same trip and a tractor unit. The paper is structured as follows. Section 2 describes the main characteristics of the agri-food sector in the two studied countries with specific reference to the olive oil sector. Sections 3 outline the methodological approach adopted. Section 4 shows the application and the different scenarios considered. Section 6 close with some brief considerations.

2. The Reference Scenario of the Agri-Food Trade between Spain and Italy

Agri-food sector is particularly significant in Spain in particular in terms of the weight of the agri-food flows in the total trade ((14.8% of the to- tal exports and 9.9% of imports) (Crescimanno et al., 2014). The analysis of the Spanish agri-food trade shows a comparative advantage of the country in the international scenario. This advantage has been consolidated over the last decade as can be seen by reading of the normalized balance value that shift from 2.12% in the biennium 2004-05 to 11.12% in the biennium 2012-13 (DataComex, 2015). Italy is a privileged partner for Spain, for the geographic proximity, and especially on the export front, catching as many as 10.7% of the Spanish agri-food products hesitate in foreign markets. In contrast, the weight of Italy is modest, as a supply market, with a share of 3.8%. In the last decade (2004-2013 period) emerge a different orientation of Spain both for the end markets and for those of supply, with a drop in the percentage of Italy as a trading partner. A relevant share of agri-food products traded by Spain, moving through the mode of maritime transport that in the decade of reference has become increasingly important for both production output and for those coming into the Spanish market. More specifically, the weight of exports agri-food by sea to total mode shift from 18.0% in the biennium 2004-05 to 21.8% in the 2012-13 biennium; on the import side, the weight shift, in the same period, from 43.0% to 46.5%. With specific reference to the maritime trade of food and agricultural commodities between Italy and Spain, there is a contrasting trend compared with those previously revealed, registering a reduction in the weight of maritime trade between Spain and Italy rising from 7.9% to 4.9% for outgoing goods and from 5.0% to 4.8% for incoming products.

Spain is the world leader when it comes to olive oil production. The country has the best climate in the world for growing olives, which makes Spanish olive oil one of the most important products to the country's agricultural food industry that is the first industrial sector, accounting for 20.5% of net sales, 18.4% of employed people and 15.1% of value added in 2012 (Duarte et al., 2015). With a long history of 6000 years of olive propagation, as well as a great diversity of olive growing micro-climates and now producing over 200 olive varieties, Spain has become the world's largest producer and exporter of olive oil. Spain is a net exporter of olive oil both in terms of value (91.6%) and volumes (73.2%) (UN Comtrade, 2015). A role that has developed over the last decade as is clear from reading the data in Table X. In particular, 1/3 of the olive oil exported from Spain is absorbed by the Italian market (31.8% in value and 36.1% of the volume) while only slightly more than 12% of the olive oil imported from Spain comes from Italy. The dynamics recorded in the last decade show a sharp decline in purchases of Italian oil by Spain.

3. Methodology

3.1. Scenarios Considered

Following the findings and methodology developed in Morales-Fusco et al. (2012) three different transportation scenarios are considered linking the main olive oil production areas and the main consumers in Italy:

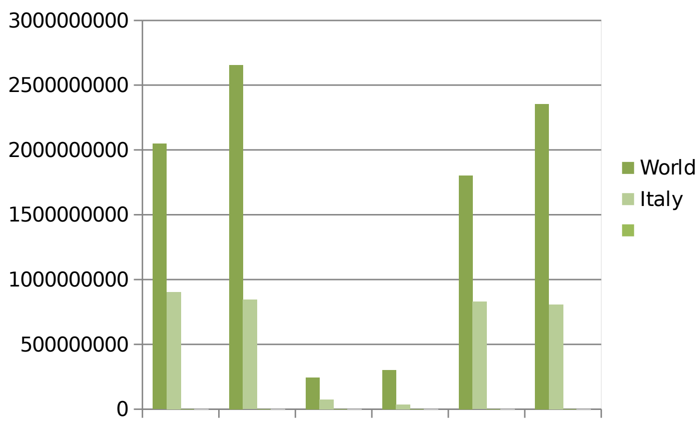
S1 Road only. A single truck does all the transportation from door-to-door).

Table 1. Spanish agri-food trade in thousand Euros

	Total					
	World		Italy		Share (%)	
	Export	Import	Export	Import	Export	Import
2004-05	21,582,723	20,685,565	2,784,713	910,898	12.9	4.4
2012-13	35,090,327	28,066,386	3,745,015	1,078,357	10.7	3.8
	Maritime transport					
	Export	Import	Export	Import	Export	Import
2004-05	3,879.168	8,893,148	220,855	45,368	5.7	0.5
2012-13	7,633.803	13,054,544	182,590	51,626	2.4	0.4

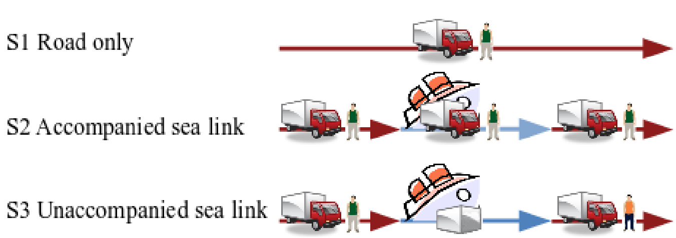
Source: Our elaboration on datacomex

Figure 1: Spanish olive oil trade



Source: UNComtrade data

Figure 2: Transportation scenarios considered



Source: Authors

S2 Accompanied sea link. A single truck does all the transportation but during part of the journey the truck –and its driver- are carried inside a RoRo ship.

S3 Unaccompanied sea link. The truck carries the cargo (in a wheeled platform) to the port where its loaded to a RoRo ship that carries to a destination port where is going to be picked up by a different truck that will carry it to its final destination.

Each methodology has its own benefits and drawbacks, in economical, time, complexity, flexibility and minimum demand terms.

3.2. Cost Structure

At this point, the formulation from Morales-Fusco et al. (2012) and Sauri and Spuch (2010) are to be used with updated values for some of the parameters and adapting it to all existing MoS connections between Spain and Italy. The cost structure developed by Morales-Fusco et al. (2012) is highly dependent on the percentage of empty trips, the number of trips available per year/length of the average journey and the frequency of ship departures (please refer to Morales-Fusco et al. (2012) for a full development of the formulation used). Broadly speaking, costs per unit shipped () is divided in four different semi-independent items:

(Fixed Costs) are the proportional of non-operational-time neither distance-travelled costs incurred by the trucker: The costs from the ownership of tractor units and semitrailers (annual value) assigned to each unit shipped. It considers acquisition, insurance, financing, deprecation, and periodical revision costs plus tracking company structural costs. The annual non-distance-dependant cost is divided according to the number of expected trips per year, and the use of the truck and platform (intensive, shared between different drivers, etc). The number of trips per year is calculated taking the most restrictive value between limitation of driving hours per driver assigned to a truck during a year, the amount of time the tractor unit can work per year and the number of ship departures. (Labour costs) consider all costs related to the operational time of each shipment. Therefore they include both, labour costs and subsistence allowance. Variations between international trips (cases S1 and S2) have a higher hourly cost than when the driver only travels locally (S3) whereas the cost is directly proportional to the length of the trip. The number of empty trips are also considered and their cost is charged proportionally (by time) to all the trips with full cargo. (Variable costs) are in fact the costs related to the total distance travelled (variable cost). The base cost is considered separately for the tractor unit and the semitrailer since in some scenarios the truck and semitrailer do not travel the same distance. This cost is highly dependent on the distance to and from the ports (for S2 and S3) and includes wearing out of tyres, maintenance, repairs, fuel, oil, and for long trips (S1 mainly), tolls. (Freight costs) are the freight cost or cost for the shipping company to carry a semitrailer or a full truck (cabin plus platform). Is the most complex cost to be calculated since, in turn it can be divided on multiple sub-costs as developed in Sauri and Spuch (2010): Capital, operating, bunker, port charges and taxes, and stevedoring costs. Besides the maritime distance between ports, this cost is mainly susceptible to vessel speed, bunker price and ship size, although parameters such cargo composition (% of full trucks versus platforms) can have an affect the final result as well.

4. Study Case

4.1. Input Values

Having established the main formulation to be used, the specific parameters being used are described in Table 2, of land equipment and personnel costs. Parameters used to define the fixed, labour and variable costs.

Moreover, for the maritime leg it has been considered that a RoPax vessel was in operation, with 3000 linear meters, with an average occupancy of 70%, a cargo composed of 50% full trucks and 50% platforms (in units) and operating on a rather high speed, 25 knots on average. The remaining parameters (frequency and distances, either sea, land or local distances) will vary depending on the pairing of origin and destination and route considered.

4.2. Routes Considered – Study Case

The study case focuses on the most important regions of Spain with regard to the production of olive oil, that is: Jaén (Andalucía, South of Spain), with a production about 675.000 tons in 2012, and the South of Catalonia-Aragon. On the second hand, the most important regions in Italy regarding the potential consumption are chosen: Roma, Milan, Napoli, Turin and Genoa. The exiting (as in August 2014) RoRo shipping regular lines between Spain and Italy were (table 3).

From those only the ones with a frequency of service suitable for a Motorway of the Sea service was considered (over 2 departure per week). Therefore, six MoS connections where considered: Barcelona to Civitavecchia, Genoa and Livorno and Valencia to Genoa, Livorno and Salerno.

As a result, for each Origin and Destination pairing, six different maritime connections are feasible. Considering there is one land scenario (and feasible route) and two sea scenarios (six routes each), there are thirteen different routes to be considered for each OD pairing, and ten pairings in total (2 production areas in Spain and 5 potential destinations in Italy), summing a total of 130 routes being studied. Tables 4 and 5 describe the sea and land distances used for the problem definition. For the land connection, the centroids used correspond to the centre of the production area (origins) or the region's capital city (destination nodes).

4.3. Results – Study Case

This section presents the output values by implementing the cost model and input data to each of the 130 route combinations (10 for road and 120 for maritime transportation). The transportation cost per truck for each pairing and route combination is presented in Table 6.

From the above output costs, the following Figures 3 and 4 show the comparison for each origin considered (Jaén and Tarragona/south Catalonia in Spain) to each destination considering the minimum maritime transportation cost involved for each scenario and maritime services.

For the particular case of Jaén (SP) depicted in Figure 3, the cheapest alternative is the SSS alternative with non accompanied truck (truck business model) from Valencia to Genoa for all Italian destinations in exception to Rome, where the unaccompanied truck alternative is the cheapest combination.

Regarding the case of South of Catalonia - Region (Figure 3), the unaccompanied truck scenario from Barcelona is the cheapest option even for the particular destination of Turin, where the road alternative is really competitive in costs. The shipping services from Barcelona to Civitavecchia and Genoa are the most suitable for this particular origin. According to the results, it can be observed that the transportation cost for the road alternative is about 30% and 34% higher than the short sea option for the exportations from Jaén and southern Catalonia, respectively. In general terms, the longer the distance between origin-destination the greater difference in transport costs between road and maritime alternatives. For example, the differences in relative terms between the road and maritime transportation from South-Catalonia to Turin is about 10% whilst from South-Catalonia to Rome is about 56%. Secondly, for each optimal solution in terms of costs, we have estimated the different costs factors considered (fixed, variable, labour and freight rates). These are represented in Figure 5.

From figure 5 it can be observed that for road transportation, labour and variable costs have the biggest share (82%) in the total cost and, for the SSS alternative, the shipping freight cost (about 60%) is the most important in which the operating costs for the shipping company and benefits are included. However, it should be clarified that port taxes and port services are also included, but the corresponding share is less than 15%. Finally, the unit cost per kg is estimated. For the road transportation the unit cost ranges from 0.14-0.20€/kg for exportations from Jaen to main cities in Italy and within the range 0.09€to 0.15€for exportations from South-Catalonia to Italy. By considering the origin-destination distance, the unitary cost (€/kg-km) is about 0.00008€. On the other hand, the unit transport cost for the maritime alternative (SSS not accompanied) are between 0.11-0.14€/kg and between 0.07-0.10€/kg from Jaen and South-Catalonia to main Italian cities, respectively. In terms of unit cost per distance, the estimated cost is about 0.00006€, which represents that road transportation is about 30% higher than SSS alternative, considering non accompanied trailers. However, this option requires a full-integration of the different modes of transportation involved and better flexibility and reliability since no major operator logistics are currently working on these alternative.

5. Conclusions

The agri-food trade between Spain and Italy have grown in recent years due to, firstly, the geographical proximity between the countries of the area, secondly, to growth of Cross-

Table 2. Fixed, labour and variable costs considered

	Tractor unit		Semitrailers	
	International tpt	**Regional tpt**	**Empty**	**Full**
Labor + substance allowance (€/h)	23	18	n/a	n/a
Fixed costs (€/year)	25500		5000	6000
Kilometric costs (€/km)	0.60	0.52	0.030	

Source: Authors

Table 3. Short sea shipping services between Spain and Italy

Origin	Destination	Shipping company	Service frequency
Barcelona (ES)	Civitavecchia (IT)	Grimaldi	6 per week
Barcelona (ES)	Genoa (IT)	Grandi Navi Veloci	4 per week
Barcelona (ES)	Livorno (IT)	Grimaldi	4 per week
Castellón (ES)	Livorno (IT)	DEMLINE	1 each 15 days
Tarragona (ES)	Genoa (IT)	NORDANA Lines	1 each 15 days
Valencia (ES)	Genoa (IT)	Grimaldi	3 per week
Valencia (ES)	Livorno (IT)	Grimaldi	3 per week
Valencia (ES)	Salerno (IT)	Grimaldi	3 per week
Valencia (ES)	Savona (IT)	Grimaldi	1 per week

Source: `www.shortsea.es`

Table 4. Short sea shipping services between Spain and Italy

Port of Origin	Port of destination			
	Genoa	Civitavecchia (Rome)	Livorno	Salerno
Barcelona	640	798	707	--
Valencia	945	--	987	1315

Source: Authors

Table 5. Short sea shipping services between Spain and Italy

Origin	Destination						
	Barcelona Port	Valencia Port	Rome	Milan	Naples	Turin	Genoa
Jaén	797	457	2152	1769	2344	1656	1647
Tarragona / South Aragon	186	244	1547	1164	1739	1051	1042
Port of Genoa	--	--	508	139	708	167	10
Civitavecchia Port (Rome)	--	--	86.7	541	297	588	419
Port of Livorno	--	--	360	301	560	348	179
Port of Salerno	--	--	268	816	55	912	742

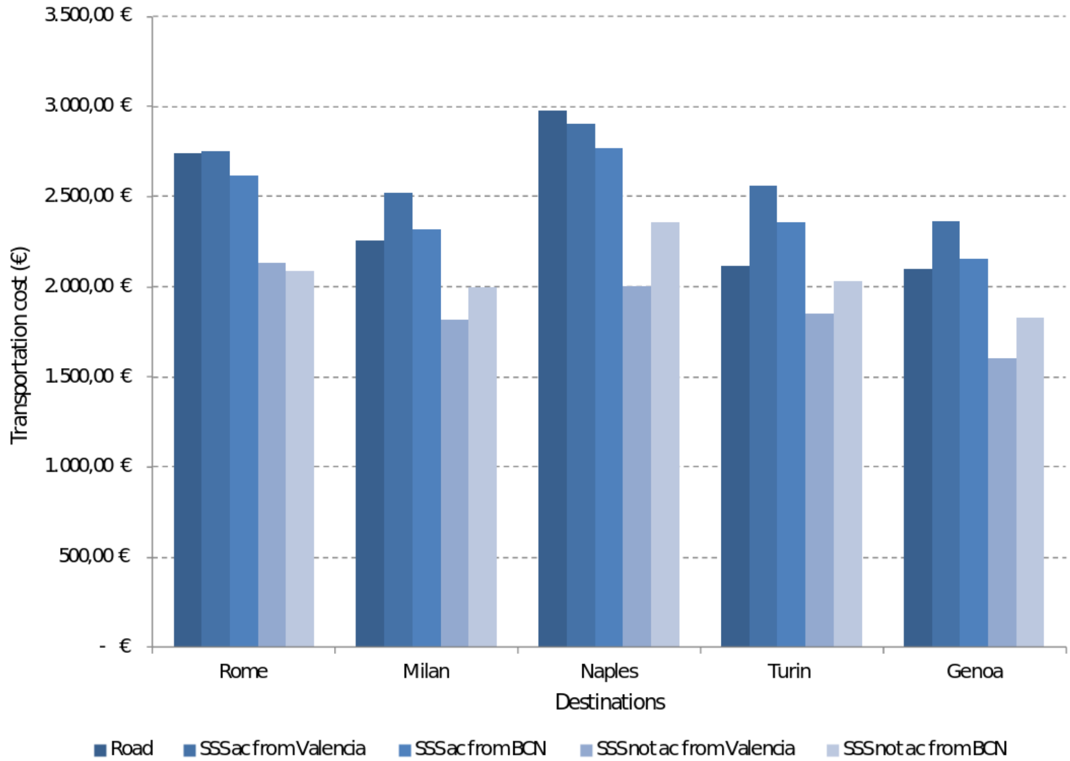
Source: Authors

Table 6. Transportation cost for each pairing and mode of transport (value in €)

		Rome	Milan	Naples	Turin	Genoa
S1 Road only						
Jaén		2.736,80	2.252,10	2.977,00	2.110,70	2.096,90
Tarragona / South Aragon		1.972,30	1.488,20	2.215,90	1.346,30	1.335,10
S2 Accompanied	**MoS**					
Jaén	BCN-GNV	2.709,90	**2.314,60**	2.857,30	**2.349,70**	**2.150,80**
	BCN-CIV	**2.612,40**	2.947,10	**2.767,30**	2.981,70	2.857,20
	BCN-LVN	2.723,90	2.680,40	2.871,20	2.715,00	2.556,10
	VLC-GNV	2.817,80	2.520,10	2.965,10	2.557,00	2.358,20
	VLC-LVN	2.750,40	2.706,90	2.897,80	2.741,60	2.617,10
	VLC-SLN	3.117,90	3.521,70	2.961,00	3.677,50	3.464,80
Tarragona / South Aragon	BCN-GNV	1.973,30	**1.561,40**	2.262,20	**1.582,00**	**1.466,30**
	BCN-CIV	**1.820,90**	2.426,50	**2.084,60**	2.485,90	2.237,30
	BCN-LVN	1.981,20	1.906,60	2.268,90	1.965,20	1.752,80
	VLC-GNV	2.660,80	2.252,90	2.808,20	2.287,80	2.093,60
	VLC-LVN	2.593,50	2.541,50	2.740,80	2.584,60	2.389,10
	VLC-SLN	2.961,00	3.364,80	2.804,00	3.408,20	3.310,20
S3 Unaccompanied	**MoS**					
Jaén	BCN-GNV	2.469,30 €	1.994,30 €	2.725,50 €	2.031,00	1.829,00
	BCN-CIV	**2.080,60 €**	2.660,70 €	2.350,80 €	2.723,10	2.505,40
	BCN-LVN	2.365,10 €	2.290,40 €	2.624,90 €	2.349,20	2.134,40
	VLC-GNV	2.289,10 €	**1.815,00 €**	2.545,80 €	**1.851,30**	**1.603,40**
	VLC-LVN	2.128,30 €	2.053,00 €	2.383,90 €	2.113,90	1.896,90
	VLC-SLN	2.323,70 €	3.025,20 €	**2.000,40 €**	3.148,30	2.931,50
Tarragona / South Aragon	BCN-GNV	1.683,20 €	**1.174,90 €**	1.941,00 €	**1.208,60**	**1.020,20**
	BCN-CIV	**1.264,00 €**	1.878,20 €	**1.518,80 €**	1.938,90	1.723,10
	BCN-LVN	1.531,50 €	1.459,60 €	1.838,30 €	1.515,90 €	1.310,90
	VLC-GNV	2.015,80 €	1.501,40 €	2.270,40 €	1.536,50 €	1.346,20
	VLC-LVN	1.856,30 €	1.728,20 €	2.111,50 €	1.840,60 €	1.580,30
	VLC-SLN	2.000,40 €	2.754,00 €	1.742,20 €	2.875,00 €	2.658,90

Source: Authors

Figure 3: Transportation cost for road and SSS alternatives (accompanied and not accompanied) for export from Jaén (South Spain)



Source: Authors

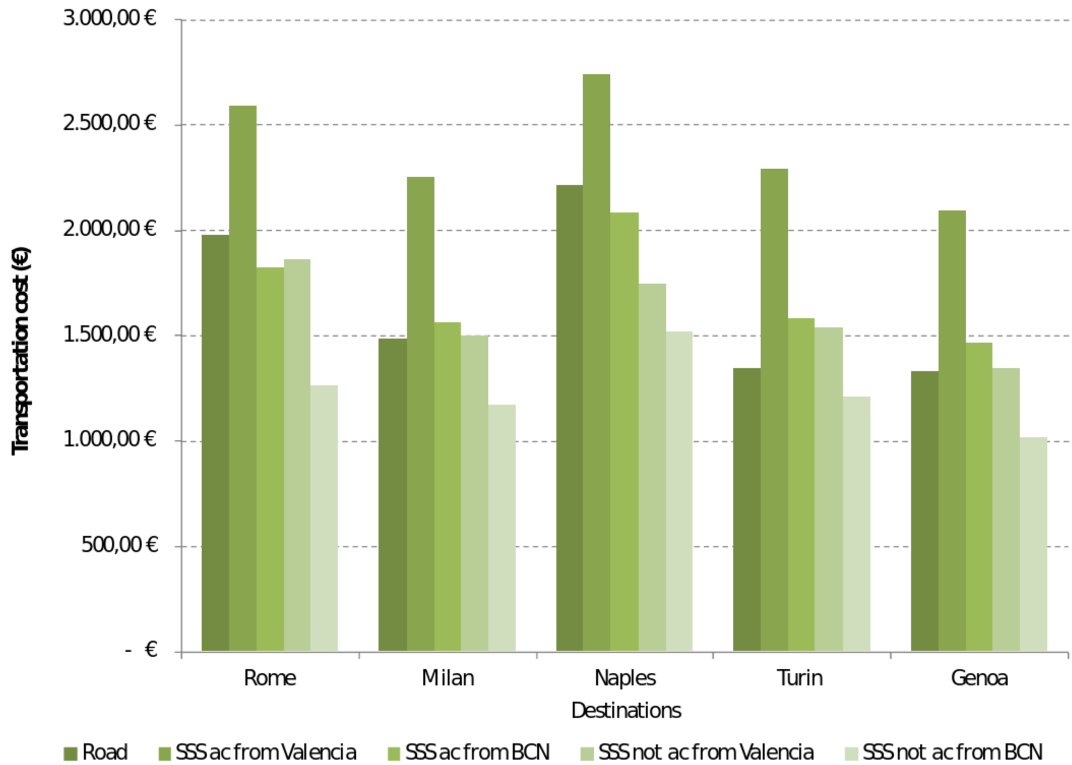
application of agro-food. As to trade, maritime transport has always been the primary way of connection between the two countries. In this scenario, the olive oil sector plays a role significant in relation to the importance of this product in both countries. Despite the growth of transport by sea, this way is not yet sufficiently developed, the reasons could be found through a further investigation traced to point out the inadequate port infrastructure, the lack of logistics services in ports of the Italian peninsula, which created a low frequency of maritime links. The results show that for the particular case of Jaén, the cheapest alternative is the short sea option and, particularly, the shipping service from Valencia to Livorno seems to be the most attractive. However, the service from Valencia to Salerno is better for the region of Napoli since transportation cost from the port to the logistic platform or final consumer is reduced.

For the exports from the south of Catalonia are cheaper by combining road and short sea transport from Barcelona. For destinations closed to Milan, Torino and Genoa, the shipping service from Barcelona to Genoa is the best option, but for Roma and Napoli, it is preferable the shipping service to Civitavecchia.

According to the results, it can be observed that the transportation cost for the road alternative is about 30% and 34% higher than the short sea option for the exportations from Jaén and southern Catalonia, respectively. The unit cost per kg for the road transportation ranges from 0.14-0.20€/kg for exportations and within the range 0.09€to 0.15€for exportations from Jaen and South-Catalonia to Italy, respectively. On the other hand, unit cost per kg are about 25% lower for the SSS unaccompanied trucking model. As suggested by Schimmenti et al. (2008) a good logistical organisation become an important strategic tool for increasing the competitiveness of companies and the transport play a vital role as it represent a significant quota of overall logistic costs. In particular, a reduction of the transport costs directly stimulate export and import. As suggested by Sanchez et al. (2003) just as an increase in the exchange rate, reduction of the costs of transport, makes export more competitive, and a reduction in national customs tariffs lowers the cost of imports.

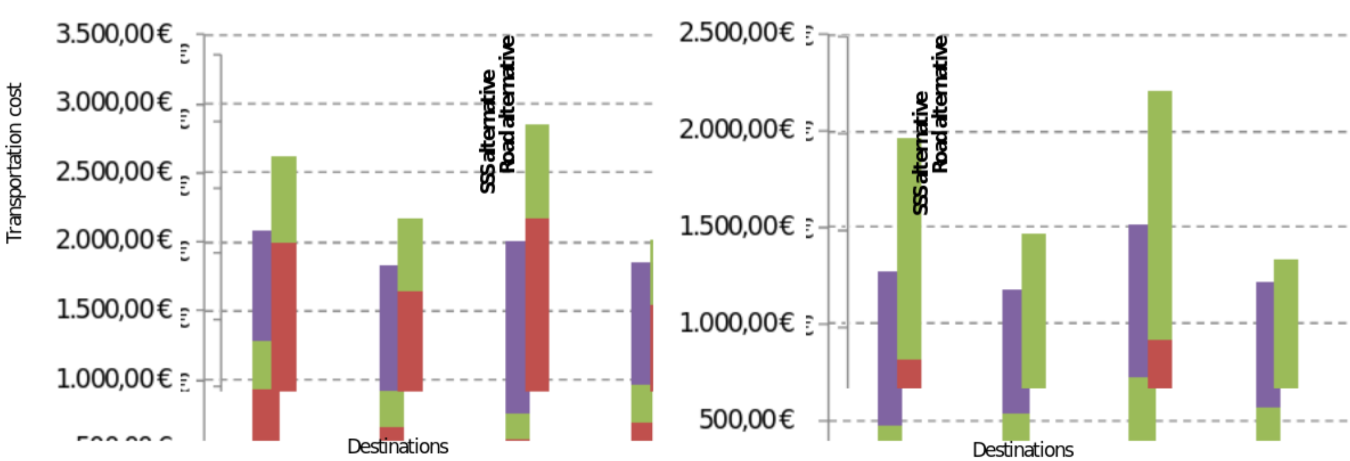
However, to reach an optimal performance in the unaccompanied scenarios it is necessary to make a large investment in equipment and infrastructure, therefore, to ensure a large demand in order to make the investment profitable. Moreover, measures facilitating cooperation between carriers are necessary. Those would allow carriers to take advantage of return trips to the port (with shared pools of semitrailers, aggregation of transport companies or even vertical integration between carriers and shipping companies) as well as reducing the investment risk and giving some market power to the carriers to counteract the monopoly of the shipping company.

Figure 4: Transportation cost for road and SSS alternatives (accompanied and not accompanied) for export from South-Catalonia



Source: Authors

Figure 5: Transportation cost factors for the road and best maritime alternative. Left: Exportations from Jaen region. Right: Exportations from Tarragona-South Catalonia region



Source: Authors

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