The rolling motorway as an alternative to door-to-door unimodal road transport: lessons from the Trieste-Chop project

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1. Introduction

In several documents, the European Commission underlined the need to shift from the current dominant door-to-door unimodal road transport towards a larger use of intermodal transport as a way to ensure a sustainable and efficient transport system. However, the rolling motorway, classified as an accompanied combined transport, is not gaining acceptance in Europe as documented in Subsection 2.1. This paper reviews the literature on intermodal transport, performed either by sea or by rail, in order to understand which are the economic, organizational, infrastructural and political factors that limit its growth. A particular attention is paid to the topic of who makes the decisions regarding the selection and organization of the transport mode.

Next, the paper focuses on the strengths and weaknesses of the rolling motorway and on its potential market demand. After reviewing the not abundant scientific or grey literature on the rolling motorway, the paper illustrates a study aimed at estimating the potential demand for a planned rolling motorway service connecting the Intermodal Terminal of Trieste Fernetti (Italy) and Chop, a city in the western Ukraine, close to the border with Slovakia and Hungary. Both cities are located along the Corridor V Barcelona-Kiev, identified by the EU as a major transport corridor between the southwestern European countries and the northeastern countries. Currently, along this corridor there is a considerable freight transport activity taking place almost exclusively by road. Compared with the other existing rolling motorway services, used mostly to cross the alpine countries of Switzerland and Austria, the one connecting Trieste Fernetti and Chop would be of interest because of its length (about 960 km), and because it involves former socialist countries with a long tradition of freight carried by rail.

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The study of the potential demand for a rolling motorway service, carried out in cooperation with the management of the Intermodal Terminal of Trieste Fernetti, was crucial to assess the economic feasibility of the project and to calibrate it according to the needs of the potential users.

As documented in a vast literature, the choice of the mode of transport depends on many factors including monetary costs, travel time, time of departure, frequency, punctuality, risk of loss and damage, flexibility, organizational and management costs and a series of regulatory, sociological and political factors1. The choice between the road transport currently used and the planned rolling motorway is no exception. Consequently, we thought essential for the study to interview the actors who play a role in selecting, organizing, and carrying out the transport service. Two important actors were interviewed: the freight forwarders and transport companies, and the truck drivers. Part of the interview consisted in a stated-choice exercise that allowed us to estimate a discrete choice mixed logit model and to use it to simulate for the sample the mode choice under various service scenarios.

2. The rolling motorway

The Rolling Motorway (hereafter RoMo), also known as RoLa (from the German term "Rollende Landstrasse", rolling country road), "rolling highway" or "rolling road" (in Dalla Chiara et al., 2008) is a combined transport system, which, in turn, is a type of intermodal transport. In fact, intermodal transport is defined as ''the movement of goods (in one and the same loading unit or vehicle) by successive modes of transport without handling of the goods themselves when changing modes'' (United Nations, 2001). Combined transport is defined as ''an intermodal transport where the major part of the European journey is by rail, inland waterways or sea and any initial and/or final legs carried out by road are short as possible'' (UN/ECE, 2001). Depending on the transport mode included in the main leg of the trip, the combined transport can also be differentiated into maritime or continental transport. For a recent discussion and a comparison of the various definitions, see Reis et al. (2013).

Combined transport can be either unaccompanied or accompanied. The term unaccompanied combined transport is used when the goods travel in swap bodies, standardized containers or semi-trailers. They are loaded on the train either directly at the factory or carried by road to the terminals where they are transshipped to the train. The term accompanied combined transport is used when the whole road vehicle is transported by rail, including the traction cabin and the drivers. The wagons consist in special close-coupled, small-wheeled flatcars. At both ends of the rail link, there are purpose-built terminals which allow the train to be easily loaded and unloaded. The drivers drive the trucks themselves on the train, accompany the shipment in a couchette carriage and then drive the truck by road from the

[1] Previous research by the authors include Danielis et. al. (2005) and Danielis and Marcucci (2007).

terminal to the final destination. Being a combined transport, the longer leg of the trip is the one by rail.

2.1 Recent trend in the use of the RoMo

The RoMo is mainly used in Europe, in Canada and in India. For an overview of the main RoMo service route see Danielis et al. (2009). The recent European data in the accompanied and unaccompanied combined transport traffic reported by the UIRR are reported in Table 1 and Table 2.

Table 1 – Rolling motorway traffic (domestic + border crossing)

Year	1990*	1995*	2000	2005	2006	2007	2008	2009	2010	2011	2012
N° of consignments (10^3)	214	312	460	316	382	390	429	416	448	426	324
Total tkm (10^6)	2500	3000	4201	4299	4271	3573	4000	3766	4138	4217	3407
<300 km	10%	10%	37%	9%	14%	23%	23%	28%	28%	26%	18%
300-600 km	45%	45%	21%	45%	59%	61%	59%	59%	58%	60%	68%
600-900 km	45%	45%	42%	46%	27%	16%	18%	13%	14%	14%	14%
>900 km	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

* Figures based on estimations and assumptions

Table 2 – Unaccompanied traffic (domestic + border crossing)

Year	1990*	1995*	2000	2005	2006	2007	2008	2009	2010	2011	2012
N° of consignments (10^3)	969	1.303	1.507	2.142	2.336	2.563	2.566	2.402	2.641	2.651	2.401
Total tkm (10^6)	19.500	21.000	25.942	32.658	41.104	42.496	41.971	35.133	38.229	38.777	37.394
<300 km	0%	2%	2%	1%	1%	1%	1%	2%	2%	6%	4%
300-600 km	20%	35%	20%	16%	12%	11%	13%	11%	12%	12%	13%
600-900 km	55%	35%	38%	51%	25%	44%	37%	38%	46%	44%	46%
>900 km	25%	40%	37%	32%	62%	45%	49%	48%	41%	37%	37%

* Figures based on estimations and assumptions

According to the Eurostat statistics, in 2012 in the EU27 the freight traffic by road was equal to 1,518,122 million of tonne-km. Jointly, the accompanied and unaccompanied rail traffic has been equal to 40,801 million of tonne-km, that is 2.7% of road. This provides an idea of the scale difference between the two modes. It can immediately also be noted the scale difference between the two: unaccompanied traffic is 7.4 larger than the RoMo in terms on number of consignments and 11 times larger in terms of tkm, and the difference between the two is growing. Both type of combined transport grew up to the economic crises in 2008. They then declined to recover in 2010. In 2011, the RoMo slightly decreased and in 2012 they both dropped, but the decline has been much larger for the RoMo: 24% in terms of consignments and 19% in terms of tkm for the accompanied transport versus 9% in terms of consignments and 4% in terms of tkm for the unaccompanied transport. The explanations of this “black year” according to UIRR (2013) have to do with the reduced economic output (production) and the significant train path shortages on Transalpine rail crossings of Brenner, due to a major reconstruction, and of Gotthard, caused by a landslide.

Major changes at company level took also place. After some years of profitless operation, Hungarokombi decided to stop its activities, effectively eliminating RoMo services in Hungary (the Szeged-Wels relation). The reasons include: a) the dramatically reduced interest from Romanian and Bulgarian road hauliers, whose circulation in Europe – after their countries joined the EU – is no longer limited by permit constraints; b) the increasing track access charges and other railway costs in Hungary, while the state has stopped its RoMo subsidy programme in 2010, and c) the delays experienced in the introduction of the distance-based eTolling in the country. Moreover, Ökombi, the largest European RoMo Operator, had to substantially reorganize its activities in light of the Austrian government diverting subsidies previously available to combined transport towards the single wagonload business.

Table 1 and Table 2 provide also information on the distance covered by the two type of combined transport. The RoMo is mainly concentrated in the 300-600 km distance, with some service in the 600-900 km range but no service above 900 km, whereas unaccompanied transport has its largest share in the 600-900 km and above 900 km routes. Knowing that road transport has no substitute in the very short distance, the RoMo appears to have a role to play in the medium distances, but not in very long distances: most probably, it makes no sense to carry the truck drivers over so long journeys.

2.2 Literature review on intermodal transport

Rail transport, rail-road or sea-road intermodal transport are commonly deemed to be superior to unimodal road transport as a way of moving goods in terms of energy consumption, air pollutants emission and safety. As far as noise is concerned the superiority is more uncertain. Further concerns regard land consumption and community severance. This is why in several European position papers, already in 1995, the European Commission called for a significant modal shift (European Commission, 1995)[2].

This common view is confirmed by many studies[3], but caution should be paid to extend it to every link, moreover the technological development constantly improve the efficiency of the road trucks. For instance, Craig et al. (2013) calculate the overall CO2 intensity of the US intermodal transportation using data supplied by intermodal operators and confirm the assumption that, on average, intermodal improves on the carbon efficiency of truck transportation. They estimate an average carbon intensity of intermodal transport of 67 g CO2/ton-mile, 46% lower than truckload. However, they also estimate it can vary between 29 and 220 g CO2/ton-mile depending on the specific origin–destination lane, concluding that intermodal shipping is more efficient than truckload only in a specific area surrounding

[2] In 2001, the Commission recognized the need to limit the growth of road transport and called for a modal shift towards rail or waterborne transport (European Commission, 2001a, b). Similar arguments are put forward in 2006 in the "Mid-Term Review of the 2001 White Paper" and in 2011 the "White Paper on Transport Policies".

[3] For instance, according to Bitzan and Keeler (2011) a shift of 1% of current US intercity truck freight to intermodal could generate savings of 0.92–2.18 Tg of CO2 per year.

an intermodal terminal, called the carbon market area. Similarly, López-Navarro (2014), comparatively analyzing of the short sea shipping option in Spain, shows that intermodality is not always the best alternative under the environmental point of view. Consequently, the traditional environmental argument to justify this alternative should be used with caution. Also Vanherle and Delhaye (2010) comparing the emissions and external costs involved in road haulage and short sea shipping, conclude that there is no clear winner: short sea shipping scores better than road haulage in terms of CO2 emissions but scores less in terms of NOx, SO2 and PM emission.

Another important aspect is infrastructural. It is a common concern that the estimated growth in European freight transportation would saturate many road infrastructures if the increase were mainly absorbed by road transport. The shift from road to rail would have, hence, the advantage of alleviating the road transport, reducing congestion and the deterioration of the road infrastructure. In fact, the burden of building, maintaining and restoring bridges, highways and roads is becoming increasing unsustainable for the national state budgets. However, the rail infrastructure requires also continuing investments and ameliorations[4]. What is the optimal balance between the two modes and how should infrastructural decisions be taken accordingly is a difficult issue that has been subject to some, but not much research. Nash (1993) has dealt with this issue thorough cost benefit analysis; Conrad (1997) with a theoretical general equilibrium framework; Conrad (2000) based on detailed microeconomic modeling of transportation. More recently, Gorman (2008) finds that approximately a quarter of truck freight travelling in the US could be handled at a 25% lower cost if the rail infrastructure needed to support it existed. He estimates that all levels of US government spend $18.7 billion per year to maintain and expand roadways to support combination trucks and that a 58% savings in public infrastructure investment per gross ton mile can produce an 80% reduction in social costs associated with freight transportation.

All this documents and assumptions notwithstanding, it is estimated that, at the EU level, over 75% of freight (measured in tonne-kilometres) is still transported by road (Cloodt, 2012), while intermodal transport accounts for only approximately 5% of total freight (Savy, 2009).

Many papers discuss the difficulties faced by intermodal transport (e.g., Blauwens et al., 2006a,b; Button, 2010; Frémont and Franc, 2010).

An interesting stream of literature compares road and intermodal transport in terms of costs and travel times. Some papers deal specifically with short sea shipping vs. road only (au-

[4] UIRR (2013) reports about the direct train connection between Ostrava and Verona, launched in collaboration with Cemat and Kombiverkehr. The train covers the 1061 km distance in a scheduled time of 27 hours resulting in a very competitive average speed of 40km/h. The four different electricity systems to be encountered in Italy, Austria and the Czech Republic require several locomotive changes, which will only be omitted once the necessary multi-system locomotive becomes certified in the Czech Republic. The 540m maximum allowed train length – if extended in the future – promises yet further potential efficiency improvements. In an ideal case, a scheduled journey time of well under 24 hours should be possible in the not too distant future.

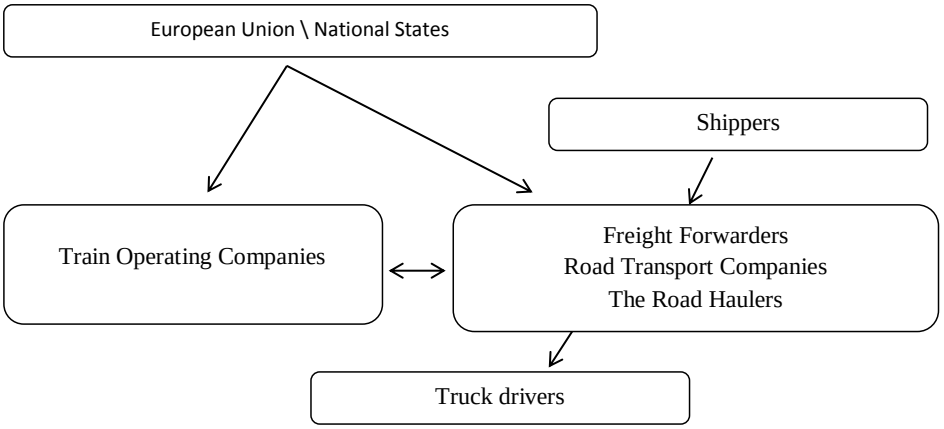
thors Castells and Martinez, 2006; Koi, 2009), other with rail intermodality (Janic, 2007, 2008; Tsamboulas et al., 2007; Tsamboulas 2008). It is found that it is important to compare the private (and possibly social) costs and travel times for specific links. Interestingly, Rich et al. (2011) observed that there is a large structural inelasticity between road and rail. They estimate that in the Scandinavian region, depending on the commodity considered, between 57% and 97% (with an average of 78%) of all transports over less than 500 km has truck as the only alternative. However, it should be mentioned that the generalized costs depend on the infrastructural policies and that economies of scale should be also taken into account.

Another stream of literature extends the analysis to other factors and tries to identify the elements that determine the choice between transport modes. The identification of the mode choice determinants, often via discrete choice modeling, is relevant to be able to model and simulate how each determinant affects modal shift. Marcucci (2013) and Reis (2014) provide recent surveys of this literature. There are some common determinants found relevant in most studies such as monetary costs, travel time, punctuality, risk of loss or damage, and frequency. Other qualitative and institutional factors such as organizational and management costs, regulatory, sociological and political issues are more difficult to be measured and evaluated.

A further stream of literature studies is more firm-, managerial- and logistic- oriented and focuses on the profile of the road transport firms that use intermodal transport and analyze the elements of the relationship between such firms and the shipping companies that operate the lines. This literature stresses the larger complexity of intermodal transport relative to door-to-door unimodal transport (Woxenius, 1998), since it involves streamlining five different types of flows – physical, logical, contractual, financial and relational (Reis, 2010) – between multiple transport agents.

In the case of the RoMo, all the actors depicted in figure 1, play a role, in our view in determining the efficiency and competitiveness of the service offered.

Figure 1 – Actors playing a role in RoMo service



Source: Own illustration

The train operating companies are the central actors since they are responsible for organizing and coordinating the RoMO service. However, they operate with an infrastructural, technical and economic (competing\monopolistic) environment managed by the company managing the rail infrastructure and by the national States\European Union. The regulators set the rail access charges as well as road taxes and driving regulations.

The second crucial actor are the road transport companies who buy the service (in short sea shipping the freight forwarders are deemed the most relevant actor by Bergantino and Bolis, 2004, , 2005, 2008; Bergantino et al., 2013; Feo et. al., 2011). They take the responsibility, organize and manage the goods transport on behalf of and paid for the shipper (manufacturing firm). The shippers are the ultimate payers and can be involved in the mode choice, but the road shipping companies take the actual operative decisions.

The role of the shipper in the decision between road and intermodal transport is controversial. Many discrete choice modeling studies interviewed the shipper (Jiang et al., 1999; Bolis and Maggi, 2003; Norojono and Young, 2003; García-Menéndez et al., 2004; Danielis et. al., 2005, 2007; Arunotayanun and Polak, 2011; Puckett et al., 2011), since it is the shipper who ultimately faces the financial costs and the logistical consequences of a transport activities (i.e., if an input arrives late the shipper production activities are impacted, if an output arrives late the shippers business image is damaged). However, some studies have shifted their attention to the transport shipping companies in the believe that - as Schamm (2006) and Woxenius and Bergqvist (2011) argue - the success of intermodal transport chains depends greatly on the coordinator and on the operations integrator. These roles are play by the forwarders and road shipping companies to whom the logistics deci-

sions are often outsourced by the shippers. However, Eng-Larsson and Kohn (2012) argue that the choice of mode may not depend only on the transport operator, but can also require the shipper's involvement because they might want their firm to be associate to a proactive image in terms of preserving the environment[5]. Some other studies interview both the shipper and the freight forwarder (Garcia and Feo, 2009).

A further term used to identify an important actor is "carrier". The carrier is the transport company who performs the transportation (Crainic et al, 1990) and it can be either the freight forwarder, the haulier or the railway operators. A freight forwarder could be a transport company with own assets (not only acting as intermediary) and\or make special arrangements with other transport companies (Stefansson, 2006; Vassallo, 2007; Truschkin and Elbert; 2013). Finally, the road companies pay truck drivers, either as direct employees or as subcontractors to carry out the actual truck ride.

All this considered our conclusion is that in intermodal transport (but also in road transport) there is not a unique decision maker: mode choice is a joint decision into which several actors are directly or indirectly involved. Depending on many factors such as firm size, type of good, volume, size, frequency and origin-destination of the shipments, level of logistics outsourcing, number and type of actors involved in the transport demand (shipper, freight forwarder,as intermediator or with own assets, haulers or road transport companies play a different role.

Recently, Patterson et al. (2010), recognizing that several actors participate in the decision process, investigate and compare the choices of more than one decision maker. In fact, looking at land transportation where more and more manufacturing firms outsource logistics and transport services to third party logistic providers (3PLP), they argue that most decisions are taken by 3PLPs, including the choice of the mode of transport. In such a case, it makes sense to investigate which is the 3PL's preference structure and whether it differs from that of end-shippers. Patterson et al. (2010) find that 3PLs tend to be more reluctant to use of intermodal carriers than end-shippers and that they are less price-sensitive and more quality-sensitive. This result makes sense given their risk-structure: shippers risk a disruption in the production or delivery process, 3PLs risk their business. If they fail to provide quality, this might affect their reputation and they may be substituted by other 3PLs. Similarly, but in the context of the port choice, De Langen (2007) compares the port selection criteria of Austrian shippers and freight forwarders, finding that shippers and forwarders have similar views on port selection, but shippers have a less price-elastic demand.

The management literature shows that freight transport management is part of the larger set of management issues known as supply-chain management, where a supply chain can be

[5] A rail motorway initiative between Le Boulou (France) and Bettembourg (Luxembourg), run by the Lorry-Rail/Viia rail operator is mentioned by Lopez-Navarro (2014): "This company offers logistics service providers/road haulers using its services a CO2-saving certificate, accrediting the number of kilograms of CO2 that have not been emitted, which is calculated according to the number of semi-trailers the company has transported on the rail motorway. A similar certificate is also issued to shippers.".

broadly defined as a system of organizations, people, technology, activities, information and resources involved in moving a product or service from suppliers to customers. In a supply chain, transport decisions are horizontally integrated with production and inventory decisions, and vertically distributed among the various actors of the supply chain.

How can this evidence be successfully reconciled and dealt with in a discrete-choice modeling framework remains an open question. Hensher and Pucket (2005), building on Hensher and Chow (1999) and Hensher (2003) and focusing on congestion in a urban area, explicitly recognize that agents interact in a retail supply chain and propose an interactive agency choice method as a way of formalizing a framework for studying the preferences of supply chain participants and evaluate their response to policy interventions. They propose four tasks to be studied within a discrete choice analysis framework: 1) identify the types of participants in a supply chain and their commitment to cooperation to achieve specific outcomes; 2) identify alternative distribution networks in a supply chain and evaluate participant support for each of them; 2) identify the factors (or attributes) that each party in the chain considers when deciding what participation structure to support: 3) identify how these networks and influencing attributes can be combined in a choice model to evaluate strategies for freight distribution. This line of research continued with a stimulating series of contributions dealing with various theoretical and methodological issues (e.g., Puckett et al. (2006), Puckett and Hensher (2006), Puckett et al. (2007), Hensher and Figliozzi (2007), Hensher et al. (2007a,b,c), Hensher and Puckett (2007), Puckett and Hensher (2008), Hensher and Puckett (2008a,b,c), Puckett and Hensher (2009). See also the special issue of Transportation Research Part A on Transportation and Social Interactions (2011).

Turning, finally, to the question on how to make an intermodal system work efficiently, Reis (2010) states that the physical, logical, contractual, financial and relational flows between the multiple transport agents should be streamlining. This makes the RoMo, as other types of intermodal transport, inherently much more complex than unimodal road transport, although complying with the road traffic regulation might also prove to be challenging. According to López-Navarro et al. (2011), who studies more than 100 road transport firms involved in short sea shipping between Spain and Italy, trust and shared planning are the central ingredients to make intermodal transport work efficiently. This literature makes it clear that the RoMo (accompanied intermodal transport) lies in between the unimodal road transport and the unaccompanied intermodal transport. A similar conclusion is reached by López-Navarro et al. (2011) in the context of short sea shipping: accompanied short sea shipping is, in organizational terms, less demanding than unaccompanied short sea shipping. However, a further note of concern comes from Eng-Larsson and Kohn (2012) who underline that the road transport companies might have a status quo bias against the rail, highlighting their unwillingness to invest even partially in rail transport operations when it comes into conflict with their own important road transport networks.

Equally relevant is the vast stream of literature of the policies needed to increase the efficiency of intermodal transport and spur its development. Some studies underline the multiple external barriers, including inadequate regulatory framework (Slack, 2001), absence of

an intermodal liability regime and lack of integration between the transport networks (Leinbach and Capineri, 2006). Other studies promote the research of the several support policy that could improve intermodal transport such as terminal network design, intermodal service network design, intermodal routing, drayage operations and ICT innovations. See Caris et al. (2013) for a recent survey.

2.3 The RoMo: strengths, weaknesses and market potential

The RoMo has a series of advantages and disadvantages.

As mentioned, from the shipper point-of-view, an important advantage of the RoMo over other types of intermodal transport is organizational: a road vehicle can be transported by rail without any prior condition, provided it is not oversize. Hence, the RoMo has a degree of flexibility almost similar to road transport and it can be used as a means to gradually substitute road with, eventually, unaccompanied combined transport. Having a good degree of flexibility the RoMo tends to be also used on a spot point-to-point basis, whereas the unaccompanied combined transport is more suited for frequent and consistent deliveries of goods. At the extreme side of the spectrum, there is the pure rail transport, of either singular wagons or block trains, which requires high organizational and infrastructural investments and it is therefore used for regular deliveries of large quantities of goods, which, because of their size or volume, tend to be hauled by rail.

If a transport company uses the RoMo instead of the road, it saves on fuel, highway tolls, time losses due to traffic jams and, in some instances, also on vehicle operating hours. In fact, the RoMo arrives and departs at specific times and in all atmospheric conditions and it never slows down because of the traffic. Moreover, when the rail transport is scheduled for the night, drivers travel in sleeping cars on the same train and are able to fulfill rest period regulations without interrupting the journey. Drivers can drive straight off without the need to take a break, as they would otherwise be obliged by law to do. Additionally, in some cases, night driving or weekend driving prohibitions are not in effect for trucks coming from or going to end-points of RoMos. These properties of the RoMo increase the life of vehicles and allow a firm to optimize the rotation of vehicles and personnel. For trips coming from outside the EU, it is also claimed that the RoMo facilitates time savings in carrying out customs formalities.

From an environmental point of view, according to UIRR (2009), unaccompanied transport is more energy and CO2 efficient than the RoMO. UIRR estimates that relative to road transport unaccompanied transport entails a 29% energy saving, while the RoMo saves up to 11%; unaccompanied transport reduces CO2 emissions by 55%, whereas the RoMo enables a reduction of only 18%.

Focusing on the disadvantages, an important, frequently quoted drawback of the RoMo is the relevance of the deadweight because, besides the load, the whole truck must be carried by rail. This reduces the efficiency of the system considerably. According to Ökombi

(2008) the weight carried is similar to that of the unaccompanied semi-trailer transport. Ökombi (2008) estimates that a RoMo wagon has an own weight of 17.5 tons. Carrying a 44 tons truck the total weight is equal to 61.5 tons. Since a 44 tons truck has an own weight of 12.5 tons, the net transported freight weight is equal to 31.5 tons. When an unaccompanied semitrailer is carried on train, his own weight is 7.5 tons and net load of 30.5 tons is possible[6]. Hence, their conclusion. However, it should also be noted that the total weight in the case of the unaccompanied combined transport is equal to 38 tons. This allows the use of longer trains compared with the RoMo. In fact, in Switzerland in 2005 it has been estimated that the average RoMo train carried 15 trucks, whereas the unaccompanied combined train can accommodate almost 3 times as much trucks. This has important implications when rail capacity is scarce.

Furthermore, it is recognized that the investment and maintenance costs are higher for the RoMo trains than for the unaccompanied trains, mainly because of the different nature of the wagons. With regard to the subsidies needed Metz (2009) shows that in Switzerland the RoMo requires higher subsidies but that the difference between the two techniques is declining.

Other economic and technical disadvantages of the RoMo are that, because of the limited tunnel profile in Europe, one must use for the transport of complete road trains and articulated vehicles special railroad cars with a very low loading floor and with extremely small wheels. This requires a significant design effort also for the wheels and the brakes. In addition, there are, at least partially, the staff costs for the truck drivers who are carried along on the train. Moreover, in certain countries of the European Union, particularly in southern Europe and Great Britain, the railway gauge is not sufficient to transport the 4m-high trucks on rolling road wagons. Freight forwarders also criticize, apart from the cost, the dependency on timetables and the time needed for loading and unloading.

The RoMo market potential is analysed by Reffet et al. (2008) who tried to understand how and under which conditions a road carrier would be ready to use a motorway-of-the-sea or the rail, whether accompanied or unaccompanied, instead of the road. The study was made in order to help the French Government in his decision on how to implement sea motorway services on the Atlantic coast, and also to develop the existing rail and sea services. They interviewed 22 road carriers, users of the alpine RoMo or the Motorway-of-the-sea between Toulon (France) and Civitavecchia (Italy). Their main conclusions are that the size of road carriers companies using both rail and sea services are quite different, while their purpose is the same: move regular and planned freight flows. Quantities and frequencies are variable as well as origins and destinations. The choice between accompanied or unaccompanied transport depends on origins and destinations. Unaccompanied transport is mainly used with short pre- or post-transfers. Companies usually start operating accompanied transport, which is more flexible, testing the quality of service, while preparing their organization for a later use of the unaccompanied option. Unaccompanied transport is mostly a large-sized

[6] Regular freight wagons weigh 20.5 tons with a loading capacity of 38.5 tons for a total of 59 tons.

companies' choice, mainly because they carry high-volumes on a regular basis, own enough trailers, and are able to collaborate with foreign companies or even open subsidiaries in the other country. However, some small-sized businesses managed to optimize their organization to switch to unaccompanied transport too. Either accompanied or not, carriers choose these alternative modes when they allow them to reduce their costs, improve driving time, and still deliver on time with the same quality of service. Environmental issues did not seem to be a criterion for carriers to choose these new modes. Finally, they found that, although quite satisfied with current offers, carriers wish to see higher frequencies for the existing services.

A second scientific article on the market potential of the RoMo is by Dalle Chiare et al. (2008), focusing specifically on the RoMo, called in their case "rolling road" between the Italian and French Alps. It deals with a service that exists since 2003 and uses the Modalohr transshipment technique. The aim of the service was to reduce freight transit through the Frejus tunnel, limiting passage to hazardous tankers. In order to estimate the potential demand for the service two surveys are carried out: one with truck drivers and one with transport companies and forwarders with a seat or branch offices in the province of Turin. The aims were to: validate the O/D data, quantify the route choice, quantify the actual frequency of crossing the Alps by the tunnel, quantify the empty way back travels, and to better understand the problem of collecting the opinions of those road operators directly interested in the new service of combined transport. Although four attributes were considered relevant (travel time, travel cost, service frequency and the organizational structure of the transport company), only travel time, frequency and the accompanied\ unaccompanied transport dummy were included in the model. From the initial sample size of 358 transport operators, only 32 questionnaires remained usable. The results are interpreted by the authors as follows: a) the rolling road system is more attractive for origin–destination shipments in which there is an advantage in travel time, due to recovery of rest time; b) in general the road mode prevails over combined transport, but, with an adequate frequency of the service, the RoMo could attract significant numbers of users estimated between 4% to 9% of the total shipments in the corridor, depending on the frequency. In the case of increased frequency, from the present 4–10 round-trips per day, as planned in 2007, the percentage of users who would use the service comes out to be slightly less than 9% of the total.

Finally, it is interesting to report the view of UIRR, the largest railroad association of RoMo public and private companies. They state there is a business case for RoMo transport in three cases:

- When road haulers of a non-EU country have a limited number of permits granted to them for circulation in the European Union and would nonetheless like to proceed into Europe.

- In instances of crossing a geographical obstacle, such as the Alps, where the achievable average speed is slowed by steep climbs and truckers are forced to pay a substantial road toll.

- If a road hauler has to urgently fulfil his assignment and wishes to progress even at times of driving bans (weekend and holiday), or during the compulsory rest periods of drivers.

3. The RoMo project of the Intermodal Terminal of Trieste Fernetti (Italy)

The Intermodal Terminal of Trieste Fernetti, constructed almost 20 years ago, is located at the Italian-Slovenian border as a node of the intermodal corridor connecting Barcelona to Kiev (Figure 1). The terminal comprises 24,000m² of warehouses, 130,000m² of parking/clearance/storage yards and is directly connected with the railway station of Villa Opicina, with the motorway to Venice (Italy - Switzerland - France - Spain), Tarvisio (Austria - Germany) and Ljubljana (Slovenia - Central Southern Europe). It is located 18 km away from the Port of Trieste and 30 km from the Airport of Ronchi dei Legionari. H24-custom services for transport in transit and for clearances are provided. The terminal offers a wide range of logistic services, including warehousing and cargo handling. It hosts custom offices, revenue guard corps, a road tax office, a phytopathology office, a sanitary control office for animals, vegetables and foodstuff products, 60 freight forwarding agencies, and transport and assistance services to international traffic.

Figure 2 – The Barcelona-Kiev Corridor

In 2010, the management of the terminal was considering organizing a RoMo service connecting: Trieste Fernetti with Chop in the Ukraine. The RoMo would have to run at least once a week in both directions. The research presented in this paper was carried out with the aim to help the managers to evaluate of the market potential for such RoMo service. The management estimated that in 2009 about 50,000 trucks made a stop at the Trieste

Fernetti terminal, of which 26,303 took the Chop-Trieste Fernetti route. This represents a potential demand of about 114 trucks a day[7] (about 4 RoMo trains a day).

4. A survey on the market potential of a RoMo service between Trieste and Chop

4.1 Elements of comparison between RoMo and road transport

In order to have a better understanding of the factors which play in favor or against the RoMo relative to road transport, Danielis et al. (2010) analyzed some cost and quality indicators such as monetary costs, travel time, punctuality, frequency, flexibility, departure time, risk of loss and damage, organizational and management costs, regulatory, sociological and political issues. Most information was derived from the literature or obtained though cost modeling. To appreciate which role these monetary and qualitative factors play in the decision making process of choosing between RoMo and road transport in the case of the planned Trieste Fernetti-Chop service, a series of computer-assisted (mostly) face-to-face interviews was carried out with two actors playing a different role in the supply chain: the truck drivers and the freight forwarders and transport companies,. Unfortunately, due to privacy limitations, it has not been possible to interview the shippers (the sending shipper or the receiving firm) to have more complete data on the relevant actors' preference structure.

The role of the truck driver in the decision making process on the choice between road only and the RoMo was not known a-priori, although we thought it unlikely that the drivers could be the ultimate decision makers. The discrete choice modeling framework allowed us to identify and compare the preference structure of the two types of respondents and to test whether they have similar preferences.

4.2 The interview and the stated choice experiment

The interview consisted of two parts. The first is aimed at understanding the degree of knowledge and experience of the respondent with the RoMo service, the respondents role in the organization of the trip and his preference regarding travel times, dates and destination with the intent of acquiring information on actual cost incurred when traveling by road (fuel, highway tolls, taxes, etc.) and on current travel times. The second part consisted in a stated-preference choice exercise. The attributes and levels reported in Table 3 were used to characterize the alternatives presented to interviewees:

[7] Such figure is estimated dividing the 26,303 by 231 truck available working days (21 days times 11 months).

Table 3 – Attributes and levels

Attributes	Levels
Travel time	14, 16, 18 and 20 hours
RoMo cost	€ 350, 400, 450, 500, 550, 600, 650
Day of the week of departure	Friday, Saturday, Sunday, Rest of the week
Number of sleeping places per compartment	1, 2, 3
Highway toll	0%, +10%, +20%, +30% of current level

Source: Own design

An example of the choice-scenarios presented to the respondents is reported in Table 4.

Table 4 – Choice-scenario: an example

Were the following alternatives available in the market, which one would you choose?		
Alternative 1: RoMo service from Chop to Trieste Fernetti	**Alternative 2: RoMo service from Chop to Trieste Fernetti**	**Alternative 3: Current truck transport**
Travel time: 16 hours	Travel time: 14 hours	Travel time: current
RoMo cost: €800	RoMo cost: €650	Road cost: current
Day of the week of departure: Friday	Day of the week of departure: Saturday	Day of the week of departure: current
N° of sleeping places per compartment: 2	N° of sleeping places per compartment: 3	
no highway toll	no highway toll	current highway toll

Source: Own design

Attributes such as punctuality, frequency, flexibility, organizational and regulatory factors were not included in order to limit the cognitive effort and to concentrate on the attributes that were felt more important based on informal discussions we had with the two stakeholders. The experimental design has been developed using Ngene 1.02, optimizing the d-efficiency indicator[8]. The choice experiment was pre-tested colleting 30 interviews with the truck drivers and the resulting MNL parameter estimates were used as priors. Each interview consisted of 10 choice scenarios.

The administration of the interview allowed us to interact with respondents and to have a frank, open and informal discussion concerning the current difficulties of driving a truck in the enlarged Europe. Truck drivers made many interesting remarks that, although not part of the formal analysis, helped us gaining a better understanding of the social and human

[8] Traditionally to perform CA/SP surveys only orthogonal fractional factorial designs were used. They are characterized by the fact that the attributes are statistically independent (Kuhfeld, 1997). Efficient designs, instead, are not necessarily orthogonal, but capture the maximum amount of information by minimizing the asymptotic joint confidence sphere surrounding the parameter estimates (Rose e Bliemer, 2004, Sandor and Wedel, 2002). An experimental design is called efficient if it yields data that enables estimation of the parameters with as low as possible standard errors. These standard errors can be predicted by determining the asymptotic variance covariance (AVC) matrix based on the underlying experiment and some prior information about the parameter estimates. There are several efficiency measures based on the AVC matrix (Scarpa and Rose, 2008), the most widely used is called the D-error and it is equal to the determinant of the AVC matrix (Rose e Bliemer, 2005).

implications of the transport business. The interviews with the truck drivers were carried out in Russian.

4.3 The sample

We interviewed 60 truck drivers who stop in Fernetti Trieste during their trip, either to perform custom formalities or to rest: the initial 30 interviews have been used to calibrate the design and the remaining 30 to estimate the model. We have been able to fully interview only 9 freight forwarders located within the Trieste Fernetti intermodal center or abroad. Because of privacy concerns of the intermodal center management it was not possible to identify and interview the shippers.

In order to understand the role of truck drivers in the mode decision process, three questions were asked: 1) whether they own the truck, 2) which contractual relationships they have, and 3) who chooses the route. It resulted that most of the drivers interviewed do not own the truck they are driving, which, in fact, belongs to the transport company. However, the drivers are not simple employees, since they share some risks (e.g. fines) and are often paid by shipment (i.e. the faster the trip the larger the gain). Furthermore, it is quite common for them to choose autonomously the route. For all these reasons, we decided to include their interviews in the data set and try to get as much as information as possible about their preferences.

On average, they manifested a medium-to-low knowledge of and experience with the RoMo service. Some of them asserted to have had a previous positive experience in Austria, others reported negative experiences (i.e., accidental damages to the truck), others simply did not know about it. Although their experience with the road transport service can be characterized as being quite good, some drivers reported concerns about delays and/or bribes when carrying out custom formalities at some border crossing and they welcomed the development of the RoMo service as far as these difficulties could be avoided. Some drivers complained about fines for alleged regulation infringements to traffic or truck maintenance regulation, particularly frequent in some eastern European countries. Drivers were particularly interested on how the time spent on the train would count with respect to the current mandatory rest regulation. Their appreciation of the service would much improve if the time spent on the train counts as rest and if time spent driving to access/egress the RoMo terminal would not count as actual driving time.

It is crucial to have information on freight forwarders' and transport companies' point of view since most truck drivers are employed by them. The number of companies potentially interested in using the RoMo service is not large but it was difficult to get in contact with them. For convenience, the potential customers group were divided into the transport companies (or freight forwarders) located within the Trieste Fernetti intermodal center and those located outside it, either in Italy, Ukraine or Russia. The first category was much easier to identify and to contact and, in fact, they were the first we interviewed (7 in total). 15 Russian companies were contacted by phone but only 2 completed the interview. Alt-

hough the sample size is admittedly limited, the companies interviewed are highly representative since they specialize in freight deliveries on the Trieste Fernetti-Chop corridor. These firms are able to organize the forwarding (e.g. custom clearance, trip organization, carrier hiring) and either own or hire trucks. Since, both terms are appropriate, they will be called forwarding and transport companies.

To summarize, we report the results from the interviews to 33 truck drivers (because the initial 30 interviews which allowed us to improve the design efficiency are not included in the final model estimation) and 9 freight forwarding and transport operators. Since each respondent was presented 10 choice scenarios, the data consist of 420 stated choice observations.

4.4 The model

Notwithstanding its small dimension, the sample can be used to test preference homogeneity among forwarding and transport companies on one side and truck drivers on the other. We follow the random utility maximisation paradigm and write the utility function as follows:

$$U_i = asc\_road + \sum_k \beta_{ki}\, x_i + \varepsilon_i \tag{1}$$

where U_i is the utility for alternative i, x_i are the k attributes characterising alternative i. In our model the attribute considered are: travel time, departure time, monetary cost, day of the week of departure, number of sleeping places per compartment, highway toll), asc_road is a dichotomous attribute (1 for road and 0 for RoMo).

In order to estimate the model, the following steps were taken. In order to have a preliminary evaluation of the preference structure of the truck drivers and the forwarding and transport companies, two separate multinomial logit models were estimated. The results are reported Danielis et al. (2010). Hence, a test on whether the two sets of data (i.e. truck drivers and forwarding and transport companies) share the same scale is performed by using an error component model (Hensher et al., 2008) on a parsimonious model discarding the "number of sleeping places per compartment" and the "departure time" variable because they proved to be statistically insignificant. The standard deviation of the error component resulted as statistically insignificant, indicating that the two data sets are comparable. Thirdly, a dichotomous interaction term was inserted in a random parameter logit model (RPL). For the definition and discussion of the properties of the RPL model we refer to Train (2003) and Hensher and Greene (2003). A general formulation of the RPL model assuming an individual n chooses among J alternatives in T choice situations is the following:

$$U_{itn} = \sum_k \beta_{nk}\, x_{itnk} + \varepsilon_{itn} \tag{2}$$

where U_{itn} is the utility of the alternative i in the choice situation t for the individual n; x_{itnk} is the vector of variables observed by the analyst; β_{nk} and ε_{itn} are unobserved and treated as stochastic variables. Furthermore, ε_{itn} is assumed independently and identically distributed extreme-value type I among individuals, alternatives and choice situations. The k model parameters are assumed continuously distributed across individuals with:

$$\beta_n = \beta + \Delta z_n + \Gamma \nu_n \tag{3}$$

where z_n is a vector of individual characteristics affecting the mean of the random parameter distribution and Δ is the associated parameter matrix. The underlying random effect, ν_n is characterised by $E[\nu_n] = 0$, $Var[\nu_n] = diag[\sigma_1, \dots, \sigma_k]$, where σ_k is a known constant. The RPL formulation of Model **Fehler! Verweisquelle konnte nicht gefunden werden.** can be re-written as follows:

$$U_{itn} = asc\_sq + \sum_{k=1}^{K} \beta_{nk}\, x_{itnk} + \varepsilon_{itn} \tag{4}$$

We assumed the variables for which we have a strong a priori regarding the sign (i.e. travel time, monetary cost and highway toll) to be triangularly distributed with a definite sign area, while the variables for which we do not have a strong a priori regarding the sign (i.e. the day of the week of departure and the alternative specific constant) to be normally distributed.

A single covariate z is introduced taking the value of 1 for truck drivers and 0 for freight forwarders and transport companies. The coefficients of the covariate capture how the random parameters vary around the mean when the decision maker is the truck driver.

4.5 The econometric estimates

Although, the two actors play a quite different role in the decision process, pooling together their stated choices after having checked for scale differences allowed us to increase fitness of the model without losing track of the main differences thanks to the use of an interaction term. The results are reported in Table 5.

Overall, the model is highly significant, with an adjusted rho-square equal to 0.41, improving by far the fitness of the two separate multinomial logit models previously estimated. The mean value coefficients for most variables are also highly significant. On average, road transport is ceteris paribus much preferred to RoMo: there is a strong status quo bias in the respondents as stated by Eng-Larsson and Kohn (2012). The travel time, the highway toll and monetary cost variables have the expected negative sign. Note that paying one euro of toll generates a higher disutility than paying one euro of other monetary costs such as fuel or maintenance. Departing on Saturday and Sunday is on average preferred to departing on weekdays, while departing on Friday is statistically insignificant and cannot be distin-

guished from departing on weekdays. This proves that a significant advantage of the RoMo would be its ability to use days of the week when truck driving is normally not permitted.

Table 3 – The estimates for the RPL model.

Variable	coefficient	t-statistics
ASC for road transport	10.233	5.95
Travel time	-0.268	-3.34
Highway toll	-0.092	-5.58
Monetary cost	-0.016	-4.84
Departure on Saturday or Sunday	2.217	3.53
Departure on Friday	0.720	0.99
Interaction terms for truck driver		
ASC for road transport	-7.924	-2.83
Travel time	0.113	1.19
Highway toll	0.095	3.60
Monetary cost	0.005	1.32
Departure on Saturday or Sunday	-2.426	-3.43
Departure on Friday	-1.267	-1.63
Standard deviation or spread		
ASC road transport – std deviation (N)	1.547	3.20
Travel time – spread (T)	0.268	3.34
Highway toll – spread (T)	0.092	5.58
Monetary cost – spread (T)	0.016	4.84
Departure on Saturday or Sunday – std deviation (N)	0.453	0.79
Departure on Friday – std deviation (N)	0.758	2.32
Adjusted rho2 – constants only	0.41	
Number of obs.	420	

Source: Own calculations

The spread for the triangularly distributed variables is, by assumption, equal to the coefficient size. For the normally distributed variable the standard deviation is significant for the road transport alternative specific constant (ASC) and for the departure on Friday. The interaction term, equal to 1 for truck drivers, is highly significant for the road ASC, for highway toll and for the departure on Saturday and Sunday variable and only weakly significant for the other three variables. Such a result indicates that the preference structure of the truck drivers has both differences and similarities relative to the average preference structure of the respondents.

Note that with this methodology, the precise preference structure of the forwarding and transport companies is not estimated. We refrained from estimating it due to low number of available interviews. However, the difference between the average preference structure and that of truck drivers signals a difference between the latter and that of the forwarding and transport companies. Relative to the average values, truck drivers are less but still quite in favor of road transport (10.233-7.924=2.309 vs. 10.233), less sensitive to the highway toll (0.002 vs. 0.092) and opposed to departing on Saturday and Sunday instead of weekdays (-0.208 vs. 2.217). The differences relative to travel time, monetary cost and departing on Friday are weakly significant.

Such differences in the preference structure make sense and could be interpreted as follows. Truck drivers, although still preferring driving to RoMo, are not so against it, since spending some time on the train would allow them to rest and have some social time. The highway toll, being paid by the transport company is not of their immediate concern, whereas they are against travelling on weekends (which would be possible with the RoMo but not with road transport) whereas this would mean an extension of the working activity for forwarders and transport companies.

However, truck drivers do share an aversion to longer travel times and higher monetary costs. To some degree, hence, their opinion most likely parallels that of their employers or of the firms they do business with.

4.6 A simulation

Based on the estimates reported in Table 5, it is possible to simulate the choice between RoMo and road. Note that the model has been estimated on stated preference data (including the current road cost) and not on actual revealed preference data since no RoMo service between Trieste and Chop existed. Consequently, the results should be interpreted as choice probability within the sample and not as forecasted market shares.

Table 6 – The choice between RoMo and road under 4 scenarios

	Base1 scenario		**Base2 scenario**		**Tax Increase scenario**		**Switzerland or Austria scenario**	
	RoMo (week-day)	Road	RoMo (Sat-Sun)	Road	RoMo (Week-day)	Road	RoMo (Week-day)	Road
Monetary cost including the current road toll (€)	1700	1055	1700	1055	1700	1055	1700	1055
Road toll increase (€)						300		660
Travel time (hours)	22	26	22	26	22	26	22	26
Departure day of the week	Week days	0	Saturday or Sunday	0	Week days	0	Week days	0
Average choice	0%	100%	0%	100%	0%	100%	29%	71%
Truck drivers' choice	0%	100%	0%	100%	0%	100%	0%	100%

Source: Own calculations

To the best of our knowledge, the Base1 scenario reflects the current prevailing market data. It includes a RoMo price of €1,700, including RoMo costs of €1,200 (a reasonable estimate according to our informal sources) and €500 fixed truck costs (Danielis et al., 2010). RoMo trains are assumed to depart on a weekday with a travel time of 22 hours. Road transport cost is estimated €1,055 (see Danielis et al., 2010) with a travel time of 26 hours[9]. The estimated choice probability when the decision makers are all the interviewed

[9] Since 26 hours is outside the range of levels used in the interview, the estimate is valid only assuming a linear parameter, as an anonymous reviewer has pointed out.

actors or just the truck drivers are reported in the last two rows. It is estimated that in the base case scenario, the RoMo service has no prospects of being chosen.

The Base2 scenario differs from the Base1 scenario only in one respect: the trains leave on Saturdays or Sundays instead of on weekdays. Although this represents a very interesting opportunity for the transport companies, the model predicts that the probability of choosing the RoMo service would still be zero.

The Tax increase scenario allows for an increase in the road costs due to road taxes of €300 (from 1055 to 1355), imposed by the countries crossed by the trucks, on the top of the Base1 scenario (trains on weekdays). This would mean Hungary and Slovenia, in order to collect revenue from the crossing freight traffic, obtain from the EU the permission to considerably increase their highway tolls. It is not a completely unrealistic scenario. The resulting choice probability for the RoMo would not change anyway.

The last scenario assumes a road tax of €660 (the total monetary cost increases from 1055 to 1721), equivalent to that imposed in Switzerland or Austria where it is motivated by the need of protecting the fragile Alpine valleys from heavy-truck traffic. In this case, the RoMo choice probability increases on average to 29%, whereas no truck drivers would be in favor of using the RoMo service.

To summarize, although the preference structure the truck-drivers is different from that of the forwarding and transport companies, the RoMo service appears to have no probability of being chosen under most circumstances. Only, a high toll increase would enhance its probability of being chosen.

5. Discussion and conclusions

Although there is a consistent and strong political consensus that intermodal transport (intermodal rail transport, specifically) should play a greater role in the movement of freight across continental Europe, the available statistics show only a moderate absolute increase over time and a worrying decrease (especially for the rolling motorway) in the last years.

Understanding why that happened and what can be done is a challenging task for transport analysts. Given the more complex nature of the freight transport operations and of the decision-making process relative to passenger transport, the tools that proved useful for analyzing individuals' decisions are more difficult to apply to firms' decisions. Moreover, since intermodal transport requires the coordination of several firms, all playing an important, yet different role in providing the service, the preferences of each actor and their interplay should be taken into account in order to understand how decisions are made and which factors determine them.

Such a daunting task, methodologically analyzed by several authors, has been also tentatively applied in this case study concerning the planned introduction of a new RoMo ser-

vice connecting Trieste Fernetti (Italy) with Chop (Ukraine). Sharing the difficulty common to freight mode choice studies in gathering a sufficiently large sample, only 42 valid interviews with freight forwarding and transport companies and with truck drivers could be collected. However, the stated-preference preference interviews generated via an efficient design allowed us to estimate a robust mixed logit model containing several attributes of interest. Although, the two actors paly a quite different role in the decision process, we have pooled together their stated choices without losing track of their main differences. The results indicate that:

a) on average, road transport is ceteris paribus much preferred to RoMo by both actors, with the freight forwarders and transport companies showing a stronger adversity to RoMo;

b) travel time and monetary costs are important variables for both actors;

c) the highway toll is a very sensitive variable especially for the freight forwarders and transport companies;

d) the freight forwarders and transport companies appreciate the possibility of using the RoMo on weekends, not much so the truck drivers.

A simple simulation performed with the estimated model allowed us to conclude that under the current circumstance the probability that a RoMo service between Trieste Fernetti and Chop be used is close to zero. A road toll increase of €300 euros would not change the RoMo prospects. Only an increase of €660 euros, setting the road toll to a level equivalent to that imposed in Switzerland or Austria where it is motivated by the need of protecting the fragile Alpine valleys, would increase to 29% the chances for the RoMo to be chosen. However, no equivalent motivation could be advanced in the case of the Trieste-Chop corridor.

Taking into account the results of this study and various other difficulties, the managers of the Intermodal Terminal of Trieste Fernetti decided to postpone the introduction of the planned RoMo service. To this date (May 2014), the project has not been implemented yet.

Although this paper sheds some light on a topic on which there is a scarcity of scientific literature, more research work is certainly needed. We feel that, while the point of view of the truck drivers has been thoroughly tested, more work should be done in order to better grasp the point of view of the transport companies and of the freight forwarders, who undoubtedly represent a crucial decision maker. The focus on a specific corridor has limited the population of shipping companies who could be interviewed. In particular, it was not possible, although the language barrier was overcome, to interview in a reliable way and in a sufficiently large number the Ukrainian and Russian companies who might be interested in using the RoMo service. However, the authors feel that the findings against the economic viability of the service under the current market conditions are quite robust.

Further research need to be carried out in two other directions: a) identifying the differing preference structure of the various stakeholder involved in a supply chain and b) exploring how an agreement is reached as suggested by the interactive agency choice model.

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Abstract

Although there is a consistent and strong political consensus that intermodal transport (intermodal rail transport, specifically) should play a greater role in the movement of freight across continental Europe, the available statistics (especially) for the rolling motorway (RoMo) show only a moderate absolute increase over time and a worrying decrease in the last years.

Understanding why that happened and what can be done about it is a challenging task for transport analysts. This paper adds to the existing literature - not very abundant for the rolling motorway - by illustrating, as a case study, the planned introduction of a new RoMo service, connecting Trieste Fernetti (Italy) with Chop (Ukraine). Sharing the difficulty common to freight mode choice studies in gathering a sufficiently large sample, only 42 valid interviews with freight forwarding and transport companies and truck drivers could be collected. However, the stated-preference interviews, generated via an efficient design, allowed us to estimate a quite robust mixed logit model containing several attributes of interest. The results indicate that: a) on average, road transport is, ceteris paribus, much preferred to RoMo both by freight forwarding and transport companies and truck drivers, with the first showing a stronger adversity towards RoMo; b) travel time and monetary costs are important variables for both actors; c) highway toll is a very sensitive variable especially for the freight forwarders and transport companies; d) differently from the truck drivers, the freight forwarders and transport companies appreciate the possibility of using the RoMo service on weekends.

A simple simulation performed with the estimated model allowed us to conclude that, under the current circumstances, the probability that a RoMo service between Trieste Fernetti and Chop be used is close to zero. A road toll increase of €300 euros would not change the probability of using the RoMo. Only an increase of €660 euros, setting the road toll to a level equivalent to that imposed in Switzerland or Austria, where it is motivated by the need of protecting the fragile Alpine valleys, would increase to 29% the chances of the

RoMo service to be chosen. However, no equivalent motivation could be advanced in the case of the Trieste-Chop corridor.

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