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Analysis of Intermodal and Intramodal Competition in Freight Transport Market between Turkey and Europe

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ABSTRACT

In this paper, we investigate the degree of competition between alternative ro-ro lines operating between Turkey and Europe (intramodal competition). We also aim to analyze whether the land (road) transport is a significant substitute for the ro-ro transport for the trade between Turkey and Europe (intermodal competition). This paper is a part of the economic analysis which we carried out for defining the relevant market in a case in which the Turkish Competition Authority (TCA) investigated the predatory pricing behavior of UN Ro-Ro İşletmeleri A.Ş. (UN Ro-Ro) in 2012. The analysis consists of two stages: We first estimate price elasticities of demand for ro-ro lines by using a logit demand model with firm-level data. Then, 'full equilibrium relevant market' (FERM) test which is a more developed version of the hypothetical monopolist test (HMT) is used in order to run several hypothetical merger simulations for measuring intramodal and intermodal competition. The results show that the relevant market incorporates only seven ro-ro lines, not land transport.

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Türkiye ve Avrupa Arası Yük Taşımacılığı Pazarında İntermodal ve İntramodal Rekabet Analizi

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ÖZ

Bu çalışmada, Türkiye ve Avrupa arasında faaliyet gösteren alternatif ro-ro hatları arasındaki rekabet derecesi analiz edilmiştir (intramodal rekabet). Ayrıca, Türkiye ve Avrupa arasındaki ticaret bakımından karayolu taşımacılığının ro-ro taşımacılığına ikame olup olmadığı incelenmiştir (intermodal rekabet). Bu çalışma, UN Ro-Ro İşletmeleri A.Ş.'nin (UN Ro-Ro) yıkıcı fiyatlandırma davranışlarına ilişkin olarak 2012 yılında Rekabet Kurumu tarafından yapılan bir soruşturmada ilgili ürün pazarının tanımlanmasına ilişkin olarak yapılan ekonomik analizin bir parçasıdır. Analiz iki aşamadan oluşmaktadır. İlk aşamada firma düzeyinde veri kullanılarak logit talep modeli yardımıyla ro-ro hatlarının fiyat esneklikleri tahmin edilmiştir. Daha sonra, varsayımsal tekel testi'nin (hypothetical monopolist test, HMT) daha gelişmiş bir versiyonu olan 'full equilibrium relevant market' (FERM) testi uygulanarak intramodal ve intermodal rekabetin yoğunluğunu ölçmek amacıyla bir dizi varsayımsal yoğunlaşma simülasyonları gerçekleştirilmiştir. Sonuçlar ilgili pazarın yedi ro-ro hattından oluştuğunu, karayolu taşımacılığını içermediğini göstermektedir.

1. Introduction

Turkey, with a coastline of approximately 8000 km, is situated where the European and Asian continents meets. A large part of Turkish foreign trade is carried by sea transport to and from Turkey. Therefore, Turkish shipping has been historically one of the significant industries in Turkey with direct impact upon the economy (Yercan, 1998).

A considerable part of the freight between Turkey and Europe is carried by ro-ro transport[1]. In this paper, we investigate the degree of competition between alternative ro-ro lines operating between Turkey and Europe (intramodal competition). We also aim to analyze whether the land (road) transport is a significant substitute for the ro-ro transport for the trade between Turkey and Europe (intermodal competition). This paper is a part of the economic analysis which we carried out for defining the relevant market in a case in which the Turkish Competition Authority (TCA) investigated the predatory pricing behavior of UN Ro-Ro İşletmeleri A.Ş. (UN Ro-Ro) in 2012 (TCA 2012).

UN Ro-Ro is the leader company in the business of ro-ro transport between Turkey and Europe. Its pricing strategy following a new entry in the market has been the subject of an antitrust investigation between 2011 and 2012. The entrant, UND Deniz Taşımacılığı A.Ş. (UND Deniz), is the company established by the members of the association of transport companies in Turkey. UND Deniz entered the market by opening two new lines from Tekirdağ[2] (Turkey) to Toulon (France) and to Trieste (Italy) on April 2010 and on June 2010, respectively. However, UND Deniz had to quit the market at the end of 2010. A third independent rival, ULUSOY Ro-Ro İşletmeleri A.Ş. (Ulusoy), is present in the market before and after UND Deniz's activity.

The definition of "relevant market" is an important concept of competition law and economics. It is a crucial step in analysing the lawfulness of potentially anticompetitive conduct or of a merger. The

[1] The ro-ro transport is the short name given for the term "roll-on/roll-off". This is an alternative transport mode to land (road) and rail transport for international trade in short and medium distance. In the ro-ro transport, the wheeled cargo such as trucks, trailers, semi-trailers or railroad cars and the freight in them are transported by vessels which are specifically designed for this purpose. Trailers are usually carried without their tractors due to space limitations. Drivers of trucks travel either in the ro-ro vessels or fly to the port location in order to drive for the remaining part of the road.
[2] A city located 150 km west of Istanbul.

principles of the relevant market definition are laid down in the guidelines of antitrust authorities (DOJ and FTC 2010; EC 1997; TCA 2008). Competition authorities must identify the scope of the market before they evaluate market shares, market concentration and other factual evidences. In principle, the relevant market comprises the products or regions which exercise competitive pressure on each other. The basic method for defining the relevant market is to assess demand substitution between alternative products or regions. In the assessment of demand substitution, the ability and willingness of customers to substitute away from one product to another in response to a price increase or a corresponding non-price change such as a reduction in product quality or service is evaluated (DOJ and FTC 2010, p.7). Competition authorities employ the 'hypothetical monopolist test' (HMT) to identify a set of products that are reasonably interchangeable with the product sold by the firm under investigation and to evaluate whether the groups of products in the candidate market are sufficiently broad to constitute a relevant market (DOJ and FTC, 2010, p.7-8). According to the competition authorities in the U.S., this test requires that a hypothetical profit-maximizing firm, which is not subject to price regulation and is the only present and future seller of the products (hypothetical monopolist), likely would impose at least a small but significant and non-transitory increase in price (SSNIP) on at least one product in the market (DOJ and FTC 2010, p. 9).

During the investigation of the TCA about UN Ro-Ro, the assessments on the market definition had an important role in determining the dominance of the firm. The defendant argued that the land transport is a significant alternative to ro-ro transport; hence, the relevant market is larger than the business of ro-ro transport. On the other hand, the investigation team had some factual evidence supporting the view that the ro-ro transport can be a distinct relevant market. If the relevant market is larger than the ro-ro transport and the land transport is a part of it, then UN Ro-Ro would not have dominant position in that market because the volume of trade transported from Turkey to Europe via land transport is significantly higher than that of via ro-ro transport. On the other hand, there was a discussion on the possibility that each ro-ro line or a subgroup of ro-ro lines could constitute separate relevant market(s).

The economic analysis, which we prepared in the Department of Economic Analysis and Research of the TCA, was conducted independently from the investigation team and played a decisive role in the issue of relevant market. Following the investigation, the Turkish Competition Board (TCB) concluded that the relevant market is the ro-ro transport between ports of Turkey and Europe, UN Ro-Ro is the dominant firm in this market and its pricing strategy was predatory. Consequently, UN Ro-Ro was fined (TCA 2012).

Apart from its role in the decision process, the aforementioned economic analysis is also interesting especially for its methodological and technical properties. We used the test called 'full equilibrium relevant market' (FERM) test which is a more developed version of the hypothetical monopolist test (HMT). It does not suffer from some weaknesses of the conventional version of the hypothetical monopolist test which is generally known as the SSNIP test (small but significant and non-transitory increase in prices) in the literature. On the other hand, implementing the FERM test is technically more difficult than the conventional HMT test. The FERM test uses the technique of merger simulation. This technique requires the information on the own and cross price elasticities and market shares of firms, a set of initial prices and technical knowledge on running simulations.

In fact, there are various quantitative methods for defining the relevant market and at least for two decades competition economists are regularly using the well-known time series methods (i.e. price correlations, co-integration, Granger causality) or other methods such as critical loss analysis and hypothetical monopolist test. The two last methods are based on the assessment of the profitability of a hypothetical monopolist imposing a SSNIP. Unlike time series methods, these methods are related to the concept of demand substitution. On the other hand, in the implementation of the critical loss analysis or of the conventional HMT, the prices of other products are kept constant. In other words, in the conventional HMT test, for assessing the effect of the price increase on profitability, only the prices of the products which are subject to the test are hypothetically increased. The prices of alternatives are unrealistically assumed not to react to this increase (DOJ and FTC 2010, p. 9). Ivaldi and Lorinz (2011) introduce the concept of 'full equilibrium relevant market' (FERM) test as an alternative method to the conventional HMT test for defining the relevant market. Ivaldi and Lorinz

(2011) states that the conventional HMT test compares an observed industry equilibrium to a hypothetical out-of-equilibrium outcome and the FERM test compares the same observed industry equilibrium to another hypothetical equilibrium. The FERM test takes into account that a hypothetical monopoly would face different strategic responses from competitors and evaluates proper multiproduct pricing strategy. Since the FERM test takes also into account strategic price adjustments of competitors, it can be said that it is able to evaluate the effect of a form of quick supply substitution.

In the economic analysis mentioned in this paper, in order to implement the FERM test, we first estimate price elasticities of demand for ro-ro lines by using a logit demand model with firm-level data. Then, we run several hypothetical merger simulations for defining the relevant market in UN Ro-Ro case. In simulations, we use two different sets of initial prices in order to take in account the critic known as "cellophane fallacy". According to the lessons learnt from cellophane fallacy, using the current level of prices for defining the relevant market is erroneous and competitive prices should be used. However, there is not a certain rule generally accepted for determining the level of competitive prices. In this economic analysis, we suggest using both the Bertrand prices of a (hypothetically) fully divested industry and the prices of the period in which UN Ro-Ro is claimed to have implemented predatory pricing strategy (October 2010) in order to get the most competitive prices.

This paper is organized as follows: Section 2 briefly explains the transport market between Turkey and Europe. Then, In Section 3, the related literature is reviewed. Section 4 presents the econometric model which is used to estimate the price elasticities of demand for alternative ro-ro lines and simulation technique used are explained. In Section 5, the estimation and test results are presented. Finally, Section 6 summarizes the main conclusions of the study.

2. The transport market between Turkey and Europe

Ro-ro transport has two main characteristics: First, it is an intermodal transport mode in nature. Intermodal freight transport is 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 (European Conference of Ministers of Transport et al., 1997)[3]. Second, ro-ro transport is a kind of Short Sea Shipping (SSS) scheme. SSS is proposed as an alternative mean of freight movement to reduce the number of trucks that daily congest about 4000 km of road networks and associated social costs which cannot be removed unless huge investments in infrastructure are made at the expense of more social costs (European Conference of Ministers of Transport 2001). SSS is also evaluated as an important factor for European economic cohesion and proximity between West and East Europe regions.

In the issue of relevant product market definition, the Turkish Competition Board first analysed qualitatively whether the ro-ro transport and other types of maritime transport are in the same relevant market (TCA 2012). Oil or LNG tankers, dry freight ships or container ships can be grouped under the other type of maritime transport category. The ro-ro transport is distinguished from other maritime transport by the flexibility of handling the freight. As stated above, ro-ro vessels carry trailers which can move directly and promptly after reaching the destination port and does not require special handling capacity. This lowers costs of ports and the risk of damage that the freight encounters. Ro-ro vessels are faster than other cargo ships. This increases the frequency of navigation and reduces the delivery time. This feature is particularly important for trade of valuable goods in a world in which just-in-time principles are increasingly widespread (Torbianelli 2000). In addition, less labour is needed in ro-ro transport than in other cargo ships. Ro-ro vessels carry trailers which contain any kind of commodity, however, ships in the other types are specialised by the type of the relevant commodity they carry such as oil or dry freight. Container ships are mostly used for long distance shipping whereas ro-ro is a short-distance shipping mode. These differences in characteristics are sufficient to accept that the ro-ro transport constitutes a different relevant product market than the other types of maritime transport.

[3] There are various terms (such as intermodal, multimodal, combined and through transport) related to the use of more than one mode in freight transport. They are sometimes used interchangeably and sometimes in different contexts. Multimodal transport is often used loosely and interchangeably with the term 'intermodal transport' because both refer to the transport of goods through several modes of transport from origin to destination (UNESCAP, 2005).

Road transport and rail transport (ro-la)[4] can be alternative modes to the ro-ro transport because the freight can be transported by trucks or railroad cars directly to the final destination throughout all itinerary. On the other hand, they are also complementary modes because once vessels arrives the targeted port, vehicles continue their road by land or rail transport to reach their final destination. As for the logistics originating between Turkey and Europe, ro-la transport cannot be seen as a substitute for ro-ro and road transport in practice due to the insufficient capacity and infrastructure of the ro-la facilities. Although there has been some attempts of Turkish Railways (TCDD) for starting ro-la services, it has never become a significant alternative to ro-ro and road transport for the freight transported to Europe. Ro-la is only used as a complementary mode for trucks while they pass some part of Austria and Hungary. Therefore, road transport seems to be the single significant alternative to ro-ro transport in the trade between Turkey and Europe.

The qualitative factors affecting the demand and supply substitution between ro-ro and road transport can be analysed as follows: It is generally accepted that ro-ro transport is less costly than land transport. Trucks transported by ro-ro vessels depreciate less since they travel less on road. For example, according to UN Ro-Ro, a truck that operates round-trip between Turkey and Germany will make approximately 550.000 km in six years whereas the same truck will only make 200.000 km using the ro-ro service. Lowering depreciation costs is important as trucks are the major investment costs for transport companies (UN Ro-Ro 2014). Ro-ro companies also lower investment and operating costs of logistic firms by providing semi-trailer transport at lower rate than the rate for trailers. When drivers do not travel in the vessels they save from travel time and the logistic firms may employ drivers in other routes. The flights of drivers from Turkey to the closest city to the destination port are arranged by the ro-ro companies and this also creates efficiency for logistic firms. Some countries such as Austria and Hungary impose quotas for land transport and oblige logistic firms to use ro-la transport in some part the road passing these countries. This obligation creates some transaction costs, causes delays and creates inefficiency for logistic firms. Whereas the ro-ro transport to the ports of Trieste and Toulon by-pass these parts of the itinerary and create a cost advantage for the logistic firms. In addition, ro-ro transport lowers the risks of traffic, accident and theft for logistic firms. It also helps reduce CO2 emissions since trucks that choose ro-ro travel a lesser part of their route by road. In addition, the laws of some countries, such as France, force logistic firms to use tractors registered according to the laws of this country. This creates additional arrangements and costs.

As explained above, the road and ro-ro transport can be alternative and also complementary modes of transport for each other in carrying freight between Turkey and Europe. The share of cargo vehicles going from Turkey to Europe using ro-ro transport is %32 in 2011. When we exclude the countries which are not the final destination for the freight carried by ro-ro transport, the share of the ro-ro increase to 48% in 2011.

Table 1
Number of cargo vehicles going from Turkey to Europe

Modes/Year	**2007**	**2008**	**2009**	**2010**	**2011**
Road	278830	287962	227116	222116	214876
Ro-Ro	96604	86850	76022	101020	110572
Total	377441	376820	305147	325146	327459
Share of road	0.74	0.76	0.74	0.68	0.66
Share of ro-ro	0.26	0.24	0.26	0.32	0.34

Source: TCA 2012, 10

[4] In ro-la transport; trucks, trailers or semi-trailers are transported by rail on special wagons which have a driveable track for loading and unloading purposes.

Table 2
Number of cargo vehicles going from Turkey to Europe
(only for countries which are final destinations for vehicles carried in ro-ro transport)

Modes/Year	2007	2008	2009	2010	2011
Road	140252	140419	114537	121681	122610
Ro-Ro	96450	86701	75901	100836	110215
Total	238709	229128	192447	224527	234836
Share of road	0.59	0.61	0.60	0.54	0.52
Share of ro-ro	0.41	0.39	0.40	0.46	0.48

Source: TCA 2012, 11

In Turkey, the first ro-ro line operating between Turkey and Europe was opened in September 2000 by Ulusoy. It operates between Çeşme (İzmir) to Trieste. It was followed by three lines owned by UN Ro-Ro in 2002-2009. All of three lines go to Trieste. UN Ro-Ro has two lines starting from İstanbul, which is the commercial and industrial capital of Turkey. Ambarlı port is at the European side of Istanbul and Pendik port is at the Asian side of the city. The third line of UN Ro-Ro operates between Mersin (an industrial city on the Mediterrenean coast (south) of Turkey) and Trieste. In April 2010, UND Deniz, a new rival entered market by opening a line from Tekirdağ, a city which is 150 km west of İstanbul and is close to industrial regions) to a different destination port, Toulon. This first line between Turkey and France (Toulon) was followed by the leader firm UN Ro-Ro who opened a competing line between Istanbul Pendik and Marseilles. The destination of this line was then changed to Toulon. Finally, the entrant, UND Deniz, opened a second line from Tekirdağ to Trieste in July 2010. However, the lines of UND Deniz could not achieve to compete with the incumbent and the company had to exit the market only 4 months after its entrance to Trieste line and 7 months after its entrance to Toulon line.

Table 3
Ro-Ro lines between Turkey and Europe

Lines	Company	Initiation date of the line	Exit date of the line
Çeşme (İzmir) – Trieste	Ulusoy	September 2000	
İstanbul Ambarlı - Trieste	UN Ro-Ro	January 2002	
İstanbul Pendik - Trieste	UN Ro-Ro	April 2005	
Mersin - Trieste	UN Ro-Ro	March 2009	
Tekirdağ - Toulon	UND Deniz	April 2010	November 2010
İstanbul Pendik – Marseilles (Toulon)[5]	UN Ro-Ro	July 2010	
Tekirdağ - Trieste	UND Deniz	July 2010	November 2010

Source: TCA 2012, 6

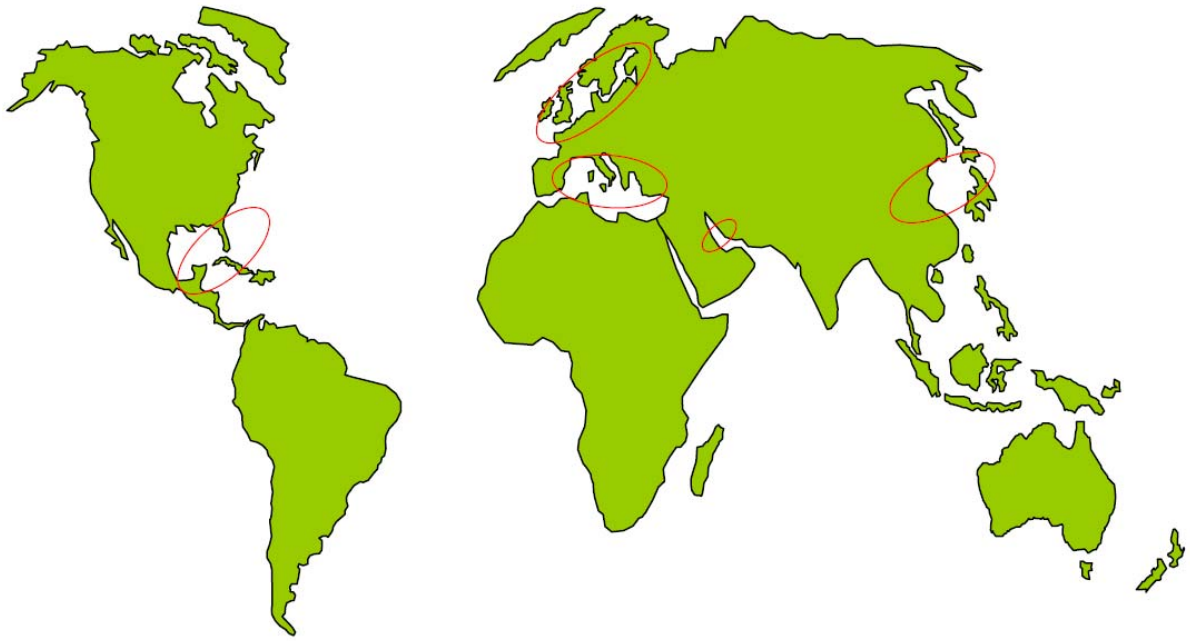
UND Deniz argued that it had to exit due to the predatory pricing of the market leader, UN Ro-Ro. The TCA investigated this claim and finally found that the pricing strategy implemented by the market leader right after the entry of UND Deniz is predatory. In this paper we do not aim to discuss how the abusive behaviour was analyzed by the TCA and how the defendant defended himself, but we aim to explain how the relevant market is defined in this case. In addition, we restrict ourselves to only lines between Turkey and Europe; and we did not take into consideration ro-ro lines between Turkey to Russia, Romania, Ukraine and Egypt since these lines were not subject of the mentioned investigation.

[5] UN Ro-Ro started to operate to Toulon instead of Marseilles after 23.01.2010.

In this study, the eight ro-ro lines below are included in the estimation of the demand model, but the last one (PKP) is not included in the simulation stage of the FERM test because this ro-ro line was out of operation in October 2010, which is the date that we have taken into account in simulations.

1) Pendik-Trieste-Pendik (PTP),
2) Ambarlı-Trieste-Ambarlı (ATA),
3) Tekirdağ-Trieste-Tekirdağ (TTT),
4) Çeşme-Trieste-Çeşme (CTC),
5) Mersin-Trieste-Mersin (MTM)
6) Tekirdağ-Fransa-Tekirdağ (TFT),
7) İstanbul-Fransa-İstanbul (IFI)
8) Pendik-Köstence-Pendik (PKP)

Among these lines, PTP, ATA, MTM and IFI is operated by UN Ro-Ro; TTT and TFT belong to UND Deniz and CTC is operated by Ulusoy. These ro-ro lines operating between Mediterranean ports constitutes one of the most important short sea Ro-Ro trading areas.[6] Torbianelli (2000) defines the ro-ro business between Mediterranean ports as "unique" thanks to its innovative features such as the capital coming from the road transport sector itself and transferring of lorry-drivers by plane.



Picture 1. Short Sea Ro-Ro Trading Areas (Fearnleys 2011)

3. Literature review

In this section, the literature related with intermodal transport and Short Sea Shipping (SSS) is reviewed. In addition, the studies combining demand estimation and simulation techniques are mentioned.

Bontekoning et al. (2004) defines several attributes of intermodal transport: First, in transport practice, intermodal transport is considered as a competing mode and can be used as an alternative to

[6] Other important short sea Ro-Ro trading areas in the world are Caribbean Sea, Baltic Sea, English Channel, Persian Gulf and Sea of Japan (Fearnleys, 2011).

unimodal transport. Second, in the 1980s and 1990s, intermodalism in general has become an important policy issue. The need for an intermodal transport policy has been strongly advocated because of environmental concerns, reasons of overall efficiency and the benefits of co-ordination of modes to cope with growing transport flows (OECD, 1997). Third, handbooks and reference texts about transport started to address intermodal transport separately from other modes such as road, rail, air, and marine transport (e.g. Coyle et al. 2000; Button 1994, DeBoer 1992).

Examining the transport literature, we realize that a substantial number of studies are conducted in order to understand the mode choice process and respective influencing factors. However, there is a scarcity of literature on the mode choice behavior for SSS intermodal transport. The available literature mainly deals with medium to long-distance services (Janic 2007 and Tsamboulas et al. 2007) and the EU co-funded research projects primarily use case studies on long distance services and occasionally medium-distance ones.[7] Several studies examining relevant factors in the mode choice process are as follows:

McGinnis (1990) compared twelve studies on the mode choice process in the United States before and after the 1980 transport deregulation process. The author identified, but did not rank, six key attributes in the mode choice process: freight rate, reliability, transit time, safety, shipper market considerations and carrier considerations. Murphy and Hall (1995) updated McGinnis's initial work and ranked the attributes as follows: reliability, freight rates, carrier considerations, transit time, shipper market considerations and safety. Jeffs and Hills (1990) conducted research to identify the mode choice variables in several industries such as paper, printing and publishing sector in the region of West Yorkshire. By help of the factor analysis technique, the authors identified the following list: reliability, monitoring, safety, security, transit time, flexibility, length of haul, size of shipment and loyalty towards either specific agents or mode of transport. Shinghal and Fowkes (2002) used a logit model to analyze the determinants of mode choice in the Delhi to Bombay (India) corridor for two transport services: road and intermodal service (road and rail). The authors considered a total of four variables: price, transit time, reliability and frequency. A total of 32 interviews were conducted in the firms from different sectors (chemical, technological, industrial and food products). The authors concluded that road transport has a great advantage in all variables and for every sector and that the viability of intermodal services is dependent on reliable, fast and high-frequency services. García-Menéndez et al. (2004) estimated the freight transport demand function using a conditional logit model. They interviewed a total of 157 Spanish firms providing transport services via road and sea. Four industry sectors were considered: furniture, ceramics, textiles and agro-industry. Considering eight explanatory variables, the authors concluded that price, transit time and frequency of shipment were the determinants of mode choice across the various sectors. Zlatoper T.J. and Austrian Z. (1989) surveyed econometric studies of freight transportation demand. Regardless of whether they used aggregate or disaggregate data, the studies typically accounted for freight rates and service characteristics (e.g. transit time and reliability). Results often varied with the commodities analyzed. However, one finding common to almost all studies reviewed was that the freight rates have a significant impact on shipment decisions. There was also evidence that service characteristics were more important to shippers of high-value goods that to shippers of low-value goods. Grue and Ludvigsen (2006) conducted a survey consisting of 246 interviews with freight forwarders and shippers using road and rail transport modes. The aim of the study was to determine the key factors of mode choice in the intra-European freight transport market. Respondents ranked by importance a total of 23 mode choice factors. The results showed that reliability and price of transport were the two most relevant mode choice factors. Reis (2014) is an example of few studies examining mode choice decision in SSS. The author aimed at assessing whether mode choice variables used in medium to long-distance transport services can be used to explain the behavior of agents in short-distance transport cases. A case study of a short distance intermodal transport service was used to test this hypothesis. The competitiveness of the intermodal transport services was compared against a hypothetical road transport service. The simulation results showed a clear advantage for road transport. Intermodal transport only outperforms road transport in a few scenarios in the price variable.

[7] According to a search by Reis (2014) on the EC's TRIP web portal, a total of 134 research projects dealing with intermodal topics are found, but none of them is related with short distance services.

This study witnessed that these variables (either individually or taken together) can hardly ever justify a freight forwarder's choice for intermodality.

Pe´rez-Mesa et.al. (2012) analyzed the use of intermodal transport in the fruit and vegetables exports sector. They employed multi-criteria decision techniques that seek to minimize transport cost and transit time in order to solve the problem of optimal allocation of merchandise between land and intermodal options. Sensitivity analysis has been carried out which quantifies the priority changes that would have to occur among decision makers (exporters) so as to encourage a modal shift including environmental externalities. Furthermore, estimations have been made for the weightings that exporters currently attribute to the analysis variables (cost, time and externalities). The most relevant result is that the cost of intermodal transport is 14% lower than land transport (on average and for the most feasible routes). However, total transit time for intermodal transport is almost twice that for land transport. This scenario means that sea transport of horticultural produce is at present minimal, as the operator believes that sea transport constitutes a greater risk due to the following: reduced control of the merchandise on board, and a greater number of negative effects as a result of prolonged transport of highly perishable products.

Another stream in the transport literature is the port selection studies which aim at assessing the competitiveness of the ports all over the world. Due to the nature of this model being discrete choice, logit model has been used frequently in port selection studies (Woo et al. 2011). For example, Yap and Lam (2006) studied the competitive dynamics between the major container ports in East Asia by analyzing their extent and intensity. The results revealed that Hong Kong and Pusan are beneficiaries from inter-port competition for the past three decades. The study suggested that inter-port competition in the region would intensify in the future as the center of gravity of cargo volume shifts to mainland China.

Yeo G.T and Song D.W. (2006) empirically identify the competitiveness of container ports in Asia by examining factors influencing the perceived competitive edge of each port using the Hierarchical Fuzzy Process, a method embracing human knowledge and/or judgement into a mathematical framework. The findings reveal that Singapore is the most competitive port among the sampled ports.

Haezendonck and Notteboom (2002) provided a comprehensive appraisal to show that interland accessibility, productivity, quality, cargo generating effect, reputation and reliability are critical in enhancing a port's competitiveness. Oceanic and hinterland distances are also found to play a significant role by Malchow and Kanafani (2001). Competing ports aim to capitalize on the factors that contribute to their competitiveness in order to extend their captive hinterland.

Several antitrust authorities of different countries also addressed the issue of competition between different ports and different maritime transport modes. For example, in an opinion of the Turkish Competition Board regarding the privatization of Samsun port, taking into consideration of Samsun port's capacity in terms of ro-ro services, it was suggested that operational rights of the port should not be transferred to a firm that was operating in the market for ro-ro services, in order to prevent a vertical integration that could be potentially harmful for competition. In a merger case Finnlines/Transfennica the Finnish Competition Authority concluded that container traffic had to be distinguished from ro-ro traffic. Because ro-ro vessels can be loaded with moving trailers. In contrast, container ships cannot be used for transporting trailers. For this reason, two means of transport are not substitutable and also many destination ports do not have the necessary infrastructure to unload containers. Therefore, it could be concluded that, those ports having ability to handle containers gain market power, as the containerization trend progresses.[8] Following a similar approach, the OFT has defined the Humber estuary as a distinct geographic market in the provision of ro-ro short shipping services in past merger investigations.[9]

[8] The Finnish Competition Authority did not make a decision containing a detailed analysis, as the parties cancelled the acquisition after negotiations on a package of commitments conducted with the office. However, information regarding this case can be found at OECD report.

[9] OFT (2006), Anticipated acquisition by SvitzerWijsmuller A/S of Adsteam Marine Limited, ME/2520/06

In literature, the number of studies which utilize both demand estimation and simulation techniques to delineate the relevant market is rather limited: The most important study in this area is Ivaldi and Lörincz (2011) which proposed the name of the Full Equilibrium Relevant Market (FERM) Test.[10] Ivaldi and Lörincz (2011) applied SSNIP and FERM tests to the industry of computer servers. This study reported several smaller relevant markets than expected. According to the authors, one reason for this result can be found in the high degree of differentiation among servers that constrains significantly substitution opportunities. The other reason may be the fact that they applied rigorously the principles of relevant market definitions. In practice, relevant market definitions are not implemented formally, they are used only as a framework of thinking about the problem. The proper application of tests might result in more fragmentation in the market structure found (Ivaldi and Lörincz 2011). To be more precise, it should be expected that under FERM there is a tendency to get narrower markets than under SSNIP. Because, price increases by hypothetical monopolist are generally followed by price increases of substitutes outside the candidate market. This in turn reinforces the profitability of the initial price increase and hence induces to narrower market definitions (Davis and Garcés 2010).

Fiuza (2008) also proposed a unified framework for merger simulations and for the several versions of the HMT by building structural models of demand and supply. To illustrate the differences between results of these versions, Fiuza (2008) reported the results of a Monte Carlo experiment using three demand specifications: isoelastic, linear and linearized AIDS, all of them in a two-stage budget setting. This study concluded that the choice of the test version and demand specification can significantly affect the size of the relevant market found, depending on the distribution and magnitude of cross- and own-price elasticities in the potential market.

Another study which establishes a link between simulation of mergers and HMT is Pereira et al. (2013). Pereira et al. (2013) explained their framework as follows: Consider a set of products. Suppose that initially each product is controlled by a different firm, and that the observed prices are equilibrium prices. Suppose now that the hypothetical monopolist controls two products. Compute the equilibrium prices associated with this new property structure. If the average of the hypothetical monopolist's prices at the new equilibrium is higher than the average of those prices at the initial equilibrium by at least 5% or 10%, those two products constitute a relevant product market; otherwise the exercise should be repeated with the hypothetical monopolist controlling an additional product. The relevant product market is the smallest set of products whose prices, in equilibrium are, on average, at least 5% or 10% higher, if controlled by a hypothetical monopolist, than if controlled by separate firms. Pereira et al. (2013) called their approach as the Equilibrium Price Increase (EPI) test. However, as can be seen easily, there is no difference between EPI test of Pereira et al. (2013) and FERM test of Ivaldi and Lörincz (2011).[11] Meanwhile, Pereira et al. (2013) applied this technique to the Portuguese telecommunications market in order to answer the question of whether bundles of telecommunication services can be separate relevant markets. The result of the paper is that bundles may constitute separate relevant markets, thus future competition and regulatory proceedings should consider the potential existence not only of markets of products consisting of individual services, but also of markets of products consisting of bundles.

Comparing our paper with the other studies in the transport literature, we may claim that our study is certainly a contribution to the literature with regard to both academic and policy perceptive. First of all, our paper is one of the few studies addressing the intra-mode competition between an intermodal transport (ro-ro) and a unimodal transport (road) in a comprehensive framework. More importantly, we go further by unveiling the substitutability between the ro-ro lines operating between Turkish and European ports. Although several studies in the literature analysed the substitutability between ports, to the best our knowledge, our study is the first in assessing specifically the competition dynamics between lines rather than ports.

[10] Indeed, the authors of this study proposed this technique in an earlier version of the study, Ivaldi and Lörincz (2005).

[11] Since the term of FERM is more descriptive than EPI, and explains the power of the technique strongly, we prefer to use term of FERM instead of EPI in this study.

4. The model and the FERM test

In this paper, we applied a two-stage analysis in order to run FERM test for the transport market. In the first stage, we used the logit demand model for estimating the demand parameters of the transport market. At the end of this first stage, we derived price elasticities of demand and marginal cost information which will be used in the second stage. In the second stage, using elasticity and cost information from the first stage, we run several hypothetical merger simulations in order to apply the FERM test.

4.1. Logit model and econometric specification

In the logit demand model, the utility of consumers depends on the product characteristics. Consumers are assumed to choose one unit of the product that gives them the highest utility among alternative products.

The logit model is a member of a general class of models known as "product characteristics space" models. In these models, consumer preferences are defined over product characteristics. Compared to "product space models", in which the price coefficient of every substitute is estimated separately, the advantage of product characteristics space models is to avoid the estimation of large number of substitution parameters across products or firms. In the logit model, estimating only one price coefficient is sufficient in order to calculate all cross-price elasticities by assuming some restrictions on the consumer preferences. As a result of these restrictions in the logit model, cross-price elasticities of two different products (i.e.products *k* and *m*) with respect to the price of another product (i.e. product *j*) are equal (Çelen and Kalkan 2013).

Prices are generally endogenous in demand models since they are correlated with the unobserved demand factors. The correlation between error terms and prices causes the ordinary least squares (OLS) estimators to be inconsistent. In linear demand models, in the presence of endogenous prices the method of instrumental variables can be used to obtain consistent parameters. However, in discrete choice models, prices and unobservable demand factors enter the model non-linearly. This creates a problem in the use of standard techniques of instrumental variables to obtain consistent parameters. Berry (1994) shows how linear instrumental variables can be used in discrete-choice models. He introduces the idea of "inverting the market share function" to uncover the mean utility levels. Then, he describes the mean utility level as a function of observable and unobservable product characteristics and prices. After defining the mean utility in this way, he suggests using linear instrumental variables techniques. Another contribution of Berry (1994) is that his method allows using aggregate data at market level which is easier to find than the data at consumer level.

For the transport market, we define the indirect utility of "customer *i*" from choosing ro-ro line *r* as a function of a measure of the "price" of the ro-ro line to customers, p_{rm}; observed ro-ro line characteristics x_{rm} and unobserved ro-ro line characteristics (ξ_{rm}):

$$u_{irm} = \delta_{rm} + \varepsilon_{irm} = \beta p_{rm} + x_{rm}\alpha + \xi_{rm} + \varepsilon_{irm} \quad \text{(for inside ro-ro lines)} \tag{1}$$

$$u_{i0m} = \delta_{0m} + \varepsilon_{i0m} = \beta p_{0m} + x_{0m}\alpha + \xi_{0m} + \varepsilon_{i0m} \quad \text{(for outside transport alternatives)} \tag{2}$$

where $r = 1 \ldots R$, $m = 1 \ldots M$. Subscripts *r* and *m* stand for a particular ro-ro line and month, respectively. δ_r is the mean utility of ro-ro line *r*. The variation in customer tastes enters only through the additive term ε_{irm} (or ε_{i0m}) which is assumed to be identically and independently distributed (i.i.d) across consumers and choices.

The "price" of a particular ro-ro line is calculated by dividing the total revenue obtained in a specific ro-ro line by the total units transported from this ro-ro line in a specific month. The "price" of a particular ro-ro line is shown by the term p_{rm}, where $\beta < 0$.

The category of "outside good" (r=0) is defined in order to assume that a general increase in the price of ro-ro lines will lead to a reduction in aggregate demand of ro-ro transport. In this paper, the above-mentioned eight ro-ro lines from Turkey to Europe are taken as inside goods. For the outside goods, the land transport between Turkey and Europe is chosen because our aim is to evaluate whether ro-ro lines and land transport are substitute for each other.

Errors (ε_{ir}) are assumed to be i.i.d. across individuals and products with the "extreme value" distribution function: exp[-exp(-ε)]. The difference of the two random variables distributed with the extreme value distribution yields the logit distribution. The market share of the ro-ro line r in month m is given by the logit formula:

$$s_{rm}(\delta) = \frac{e^{\delta_{rm}}}{\sum_{k=0}^{R} e^{\delta_{km}}} \tag{3}$$

The mean utility of "outside goods" is assumed to be zero, $\delta_0 = 0$. The difference of the logs of the market shares of each ro-ro line r and that of the "outside good" gives the mean utility of ro-ro line r and is regressed on the price of ro-ro line and ro-ro line characteristics.

$$\ln(s_{rm}) - \ln(s_{0m}) = \delta_{rm} = \beta p_{rm} + x_{rm}\alpha + \xi_{rm} \tag{4}$$

The dependent variable is the log of relative market shares of ro-ro line r and "outside good" in month m. Market shares were calculated by dividing the total units (vehicles) shipped in a specific ro-ro line by total number of units transported between Turkey and Europe via ro-ro and land in month m.

In this study, the only observed ro-ro line characteristic which can affect the demand for ro-ro lines is the price of the lines. In other words, the vector α in Equation (4) was not estimated. Instead, the error term ξ_{rm} which is used for the unobserved ro-ro line characteristics is assumed to have the following error component structure:

$$\xi_{rm} = \sum_{i=1}^{7} h_i .line_i + \sum_{t=2008}^{2010} y_t .year_t + u_{rm} \tag{5}$$

In this equation, the yearly dummy variables ($year_t$) is added in order to capture the product invariant demand shocks specific to a particular year. We expected that the utilities of each ro-ro lines and their market shares would be affected by the economic crises in 2008 and 2009. In addition, the term $line_i$ is the line-specific effects that capture the effects of the time invariant product characteristics (i.e. quality or reputation) of a particular ro-ro line. This term is especially important for our estimation because product fixed effects can improve the fit of the model especially if one is not sure about how well observed characteristics capture the true factors that determine utility (Nevo 2001, 322).

As a result, the equation to be estimated can be written as follows:

$$\log(s_{rm} / s_{0m}) = \alpha + \beta .p_{rm} + \sum_{i=1}^{7} h_i .line_i + \sum_{t=2008}^{2010} y_t .year_t + u_{rm} \tag{6}$$

In the equation (6), subscripts r, m and t represent the eight ro-ro lines, months from January 2008 to December 2011 and years from 2008 to 2010.

Meanwhile, the price of ro-ro lines may be correlated with the unobserved ro-ro line characteristics. In this case, OLS estimation may yield inconsistent estimates. Theoretically, a

consistent parameter can be obtained by using relevant and valid instrumental variables. A relevant instrument should be correlated with the endogenous price variable. A valid instrument should not be correlated with the error term of the model. In demand estimation studies, instrumental variables are generally constructed using data on cost variables since they are assumed to satisfy the criteria of relevance and validity. The instrumental variables used in this paper are fuel-oil and groundage costs.

4.2. FERM Test

"The relevant market" in antitrust cases is defined through the hypothetical monopolist test as the smallest market for which a hypothetical monopolist (or cartel) can impose a profitable price increase. Hence, the antitrust analyst starts from the smallest possible market and then proceeds to add products or geographic regions to this monopoly or cartel until the threshold where the increase becomes profitable. In each iteration of the algorithm, the set of products and regions is called a *candidate market.*

In applying FERM test, we utilized merger simulation technique that is used by competition agencies in estimating the welfare effects of mergers. In this test, the initial industry equilibrium is compared with the new industry equilibrium in which the prices of the candidate relevant market are set collusively by the monopolist or hypothetical cartel. However, according to the lessons learnt from cellophane fallacy, using the current level of prices for defining the relevant market is erroneous and "competitive prices" should be used. If the analysis does not start from competitive prices, there exists the risk of finding the price increases in the candidate markets as unprofitable, which yields wider relevant market definitions. However, there is not a certain rule accepted generally for determining the level of competitive prices. Thus, in simulations, we use two different sets of initial prices in order to take in account the cellophane fallacy. Firstly, we suggest using the Bertrand prices of a (hypothetically) fully divested industry in order to get the competitive prices. In other words, in the first application, we assumed that each ro-ro line is operated by different firms and the prices found in this frame is the result of the competition. Secondly, we assume that the prices of the October 2010 can be used as the initial competitive prices because in this month the complainant (UND Deniz) operated in the market and its claim was that the dominant incumbent firm (UN Ro-Ro) was implementing predatory pricing strategy during this period.

Examining the changes in the ro-ro market, we decided that the most important ro-ro line in this market is PTP. Thus, we started the FERM test by assuming that our first candidate market includes only PTP. Then, as a first step, we merged the second important ro-ro line (ATA) with PTP, and compared the price increases of the PTP and ATA lines with the threshold. When the price increases of the member lines of the candidate market[12] is less than the threshold level, it means that the candidate market cannot be relevant market because it faces considerable competition from other ro-ro lines. In this case, we should enlarge the candidate market by merging the next ro-ro line into the current candidate market. In contrast, if the calculated price increases for the lines included in the candidate market are larger than the threshold, we may conclude that the candidate market is a relevant market due to limited competition pressure from other ro-ro alternatives.

We predicted the effects of mergers of ro-ro lines by solving the system of equations that is composed of the first-order conditions of the merging and non-merging lines in the market. Ro-ro lines are assumed to play a Bertrand-competition with differentiated products. The profit functions and the first-order conditions of the merged lines will be different from their structure before the merger.

The pre-merger system of equations of the first order conditions can be expressed in matrix notation as;

$$s + diag(E_1, E_2, ..., E_n).S.m = 0 \quad (7)$$

[12] As the algorithm of the simulation technique is explained in below, the terms of "lines of the multi-line owner" and "lines of the merged firm" are used instead of "the member lines of the candidate market".

where E_j is the transposed matrix of own-price and cross-price elasticities for the lines of the line group *j*. In the transposed E_j matrix, own-price elasticities are written as diagonal elements while cross-price elasticities are set as the off-diagonal elements. The vector *s* is the vector of the revenue market shares. The matrix *S* illustrates the diagonal matrix of revenue market shares, i.e., *S*=*diag*(*s*). And finally *m* is the vector of price-cost margins.

The own-price and cross-price elasticities of demand can be derived from the market share function given in Equation (8) and (9). In simulations, we use the predicted values of the elasticities. They are calculated by using the estimated demand parameters and the predicted market shares obtained from the logit model. Therefore, the own-price elasticity of line *j* and the cross-price elasticity line *k* with respect to the price of line *j* can be shown as below:

$$\hat{\eta}_j = \hat{\beta}.p_j.(1-\hat{s}_j) \tag{8}$$

$$\hat{\eta}_{kj} = -\hat{\beta}.p_j.\hat{s}_j \tag{9}$$

where $\beta < 0$.

In the logit demand model, tastes for product characteristics are assumed to be constant across consumers and the idiosyncratic shock ε_{ij} is assumed to be i.i.d. across products. This brings a restriction on demand parameters such that the loss of quantity demanded for the product *j* as a result of a price increase, is distributed among the remaining products proportionate to their market shares. In other words, in the logit model, cross-price elasticities of products *k* and *m* with respect to the price of *j* are assumed to be equal: $\eta_{kj} = \eta_{mj}, k \neq m.$

Assuming that in pre-merger situation each ro-ro line owner has a single line, the first-order conditions of the profit maximization problem of every single line show that the price-cost margin of line *j* is equal to the inverse of its own-price elasticity of demand:

$$m_j = \frac{p_j - c_j}{p_j} = -\frac{1}{\eta_j} \tag{10}$$

On the other hand, in the post-merger situation, the equilibrium price-cost margins of multi-line firms can be calculated by solving a system of equations that is obtained from the first-order conditions of multi-line firms. A multi-line owner (the merged firm) will maximize its total profit and will take into account all the cross-price elasticities of the lines in its portfolio. This provides the merged firm an ability to raise its prices as the merger eliminates the competitive pressure among rival products. The increase in prices in this way is known as "unilateral effects" of a merger. The post-merger system of equations will be presented by;

$$\hat{s} + diag(\hat{E}_1, \hat{E}_2, ..., , \hat{E}_n).\hat{S}.\hat{m} = 0 \tag{11}$$

The parameters with the sign (^) show the post-merger values of the relevant variable. In the post-merger situation, the system of equation can be solved for the price-cost margins or for the prices by assuming that unit cost is constant before and after merger.

5. Estimation and test results

We first estimate the demand for ro-ro lines by pooled OLS method. Since the price of a ro-ro service can be correlated with the error term, we also estimate the model by the two-stage least squares (2SLS) method. We detected heteroscedasticity and autocorrelation in error terms. The estimation results of these methods are presented in Table 4.

Since the dependent variable is in logarithmic form of the relative market shares of ro-ro lines, there is no direct interpretation of the coefficients. We find that the price coefficient is statistically significant and negative in all estimations, as expected. Comparing the results between OLS and 2SLS estimation, we observe that there is a bias due to endogeneity of the price of the ro-ro tickets. In 2SLS, coefficients of all variables related with the line-specific effects are found to be statistically significant. It means that the market share of a specific ro-ro line is affected by its time invariant features such as quality or reputation. As for the yearly dummy variables, all variables except 2008 have a significant coefficient. This finding suggests that 2009 and 2010 years have different effects on market shares compared with basis year 2011.

We test for the correlation between instrumental variables and the endogenous regressor (price of ro-ro tickets). For this, we use the tests of underidentification which are carried out by LM statistics. We conclude that our instrumental variables are correlated with the price of lines and therefore they are relevant.

We also test the validity of the excluded instrumental variables by the Sargan test of overidentification. A high value exceeding the critical value leads to the rejection of the null hypothesis that instruments are jointly valid. This test shows that our instruments are not correlated with error terms.

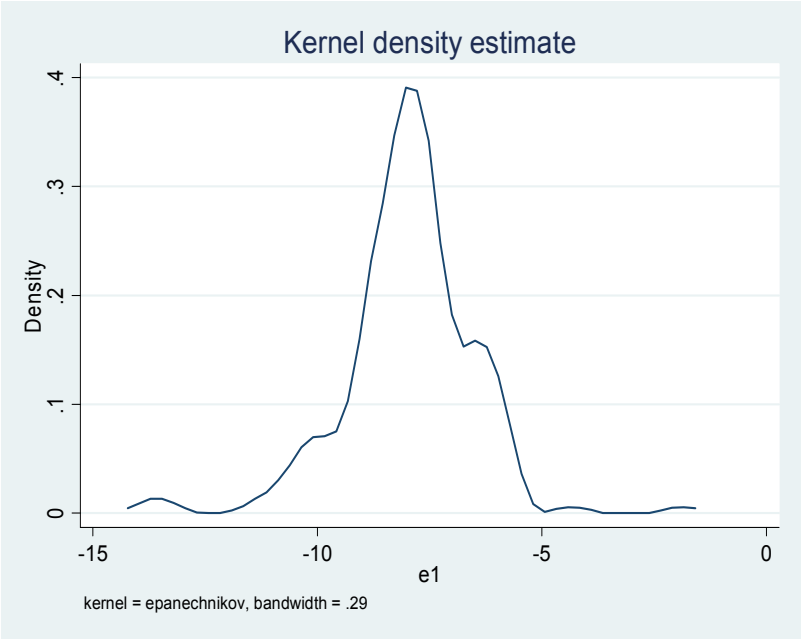
In addition, we test our model for the heteroscedasticy and autocorrelation problems, and find that we do not have these problems.

Table 4
Results of the logit demand model for ro-ro market

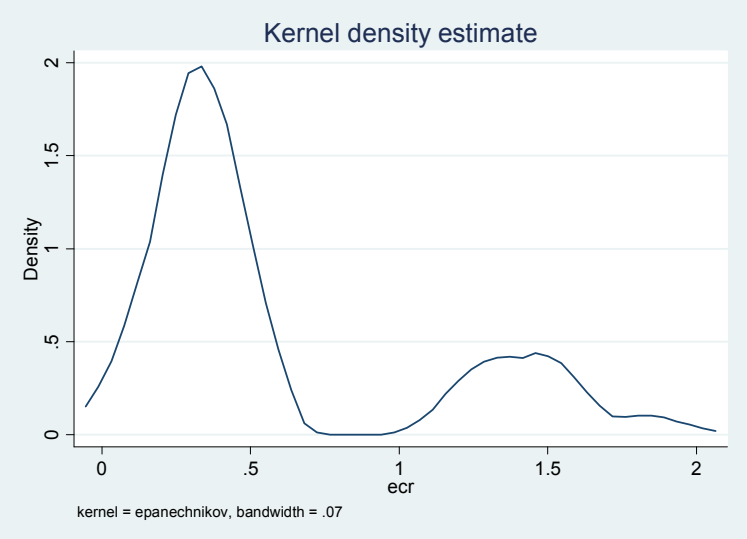
Variables	**OLS**	**2SLS**
p_rm	-0.00087***	-.0096***
	(0.0002)	(0.0026)
Line1	1.6760***	1.3291**
	(0.17981781)	(0.5590)
Line2	2.2166***	1.9619***
	(0.1790)	(0.5525)
Line3	1.7831***	1.9533***
	(0.1923)	(0.5904)
Line4	1.7877***	2.2778***
	(0.1814)	(0.5725)
Line5	-1.0999***	-4.5258***
	(0.3270)	(1.4020)
Line6	3.4674***	2.9040***
	(0.1794)	(0.5722)
Line7	1.9245***	2.2706***
	(0.2103)	(0.6508)
year1	-0.3102***	0.06253204
	(0.0849)	(0.2807)
year2	-0.5119***	-0.9331***
	(0.0775)	(0.2661)
year3	-0.3613***	-0.8657***
	(0.0725)	(0.2649)
_cons	-3.8107***	4.3486*
	(0.2658)	(2.47674)
N	206	206
AIC	184.95	658.003
Underidentification test, LM statistics		12.7
Underidentification test, p-value		0.00175
Sargan test, Chi-sq statistics		1.134
Sargan test, p-value		0.287

***: significance at 1% level; **:significance at 5% level; *: significance at 10% level
Standard errors are given in parentheses.

After estimating the model, we calculated own-price and cross-price elasticities of the ro-ro lines by using equations (8) and (9). In doing this, we used the coefficient of the price from estimation results above and price and market share information from data set. The findings related with price elasticities of the ro-ro lines are shown in the following graphs and table.



Graph 1. Distribution of the own-price elasticities



Graph 2. Distribution of the cross-price elasticities

Table 5
Summary statistics of the price elasticities of demand for ro-ro lines

Variable	Number of obs.	Mean	Std. Dev.	Min.	Max.
Own-price elasticities	206	-7.99	1.43	-13.94	-1.87
Cross-price elasticities	206	0.58	0.503	0.012	1.997

The coefficients obtained from the 2SLS method are used for conducting the FERM test simulations. As stated above, FERM test is conducted according to the two different sets of initial prices in order to take into account the cellophane fallacy. They are competitive prices resulting from a fully divested industry structure, and observed prices of October 2010. The results of these two different scenarios are presented in Table 6 and Table 7 respectively.

Tablo 6
FERM Test results (competitive prices are taken as initial prices)

Scenario	Price Increases (%)						
	PTP	ATA	TTT	CTC	MTM	TFT	IFI
PTP+ATA	0.48	3.71					
PTP+ATA+TTT	0.66	3.75	4.12				
PTP+ATA+TTT+CTC	1.05	4.29	4.76	3.92			
PTP+ATA+TTT+CTC+MTM	1.72	4.84	5.28	4.40	4.33		
PTP+ATA+TTT+CTC+MTM+TFT	2.87	6.01	6.56	5.47	5.38	5.37	
PTP+ATA+TTT+CTC+MTM+TFT+IFI	7.92	10.75	11.37	9.69	9.76	10.04	9.13

Tablo 7
FERM Test Results (current prices are taken as initial prices)

Scenario	Price Increases (%)						
	PTP	ATA	TTT	CTC	MTM	TFT	IFI
PTP+ATA	0.28	2.52					
PTP+ATA+TTT	0.46	2.80	3.22				
PTP+ATA+TTT+CTC	0.91	3.08	3.51	2.93			
PTP+ATA+TTT+CTC+MTM	1.29	3.60	4.14	3.38	3.25		
PTP+ATA+TTT+CTC+MTM+TFT	2.52	4.75	5.43	4.50	4.30	4.19	
PTP+ATA+TTT+CTC+MTM+TFT+IFI	6.04	8.00	9.07	7.66	7.30	7.61	6.89

According to the first row of the Table 6, when the candidate market includes PTP and ATA lines, the prices of these lines increase 0.48% and 3.71% respectively. Thus, even when the threshold is defined as 5%, PTP and ATA lines cannot construct a relevant market. It means that the relevant market should be enlarged.[13]

[13] In this study, in order to stop while iterating for market definition, we accept that price increases of all lines in the candidate market should be larger than the threshold. Instead, two alternative methods may be suggested: First, it may be seen sufficient to observe that not all price increases but just one price increase is larger than the the threshold. Second, the price increases may be weighted by the quantities in the initial industry equilibrium and then this weighted average price

As a next step, we add TTT line to our previous candidate market (PTP and ATA), and simulate this new equilibrium. Then, we compare the before and after equlibrium prices again. As shown in the second row of the Table 6, the price increases of the PTP, ATA and TTT lines are respectively 0.66%, 3.75% and 4.12%. Since the predicted price increases are less than our threshold level (5%), we should enlarge the relevant market by adding a new ro-ro line to our candidate market.

Repeating these iterative steps for each ro-ro line, we find that the price increases are more than the threshold level (5%) when the candidate market includes all seven ro-ro lines. In other words, there exists a significant competition between all seven ro-ro lines while the competitive pressure from land transport is very limited. Thus ro-ro transport including all these ro-ro lines constitutes a separate relevant market. However, this conclusion is only valid when the threshold is defined as 5%. As shown in the bottom line of the Table 6, the price increases in several lines are larger than 5% but less than 10%. It means that the relevant market should be defined larger than ro-ro transport when the threshold is accepted as 10%. In other words, the relevant market may include both ro-ro transport and land transport.

This conclusion does not change when we use the prices of the October 2010 instead of competitive prices, as shown in Table 7: The FERM tests result in rather different relevant market definitions according to the threshold assumption. Threshold of 5% leads a separate market for ro-ro transport while 10% defines a larger market including not only ro-ro but also land transport.

6. Conclusion

In this paper we present the economic analysis that we submitted to the Turkish Competition Board for the relevant market definition in an abuse of dominance case (*UN Ro-Ro*). In this analysis we tried to find whether the collection of seven ro-ro lines between ports of Turkey and ports of Europe (Trieste and Toulon) constitute a distinct relevant market. The best alternative transport service to ro-ro lines is road transport. For this aim, we used firm level data provided by ro-ro companies and estimated a demand function for ro-ro services. Then, we run hypothetical merger simulations in order to predict which combination of ro-ro lines would be able to raise prices above 5% or 10% thresholds of the hypothetical monopolist test. This is known as FERM approach to define the relevant market and is better than just imposing a 5%-10% SSNIP threshold and to see whether it is profitable for the hypothetical monopolist. The advantage of the FERM approach is that it takes into account also the price responses of all other products not included in the candidate market.

We concluded that under 5% threshold, the relevant market is limited to the ro-ro services between Turkey and Europe. However, under 10% threshold the relevant market could be larger. Although this result seems confusing we believe it is not. The European Commission defines the relevant market definition as follows:

> *"The question to be answered is whether the parties' customers would switch to readily available substitutes or to suppliers located elsewhere in response to a hypothetical small* ***(in the range 5 % to 10 %)*** *but permanent relative price increase in the products and areas being considered. If substitution were enough to make the price increase unprofitable because of the resulting loss of sales, additional substitutes and areas are included in the relevant market. This would be done until the set of products and geographical areas is such that small, permanent increases in relative prices would be profitable."*

As can be seen from the definition of EU Commission, the 5% or 10% thresholds (the small price increase) should not be taken as rigid and definite levels. Instead, as the EU Commission defines, the threshold can be any level in the range of 5% and 10%. Thus, it seems to be more logical to define market definitions by examining the price increases in each iteration. To be more specific, as shown in the bottom line of the Table 6, when the candidate market includes all ro-ro lines, the increases in their

increase may be compared with the threshold. This second method is followed by Ivaldi and Lorincz (2011). In literature, there is no any consensus about these approaches. Since our approach leads to the largest market definition, we prefer none of these alternative approaches.

prices are close to 10% from below but still some of them does not exceed it. Thus, this finding supports the conclusion that the relevant market incorporates only seven ro-ro lines. When the initial prices are current prices (those of October 2010) instead of competitive prices, the estimated price increases in the lines exceed 5% only all of the seven lines are combined. Therefore, the relevant market again consists of ro-ro services according to the definition of the EU Commission. However, we should bear in mind that this result is valid for the market conditions of the year 2010. Since then the market has experienced some important events like the exit of UND Deniz from the market and the entry of a new firm called Alternative, one may claim that the market conditions and thus the relevant market definition may be different nowadays.

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