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Abstract: As stated by a European Union Commission Report (2009), Turkey's role as a world trade participant has grown in recent years, particularly as the country has been capitalizing more on its unique geopolitical position. Given the substantial trade volume and deep-rooted relations between Turkey and the EU, due attention should be paid to their trade and economic relations, and steps should be taken to improve these relations. Turkey is the biggest economy that is in a Customs Union (CU) with the EU, but not a member of the EU, along with Andorra, Monaco, and San Marino. When it joined the CU in 1996, Turkey removed all customs duties and equivalent charges as well as quantitative restrictions. However, some EU countries impose quota limits on Turkish road transporters that may indirectly restrict trade between Turkey and the country in question. This study has investigated the effect of road-transport quotas on Turkish foreign trade with EU countries. A gravity model estimated using panel data from 18 selected EU countries between 2005 and 2012 was used for this purpose. Furthermore, as one of the leading sectors using road transportation for Turkish exports to EU countries, the textile sector was analyzed as a case study. The results indicated that quotas have significant effects on total Turkish exports by road transport as well as Turkish textile exports to EU countries. The estimated loss of Turkish exports to the selected countries in the time period analyzed was 10.6 billion dollars of Turkey's total exports by road transport and 5.65 billion dollars of Turkey's total textile exports. Therefore, it can be concluded that the quota limitations are against CU regulations because they limit not only road transportation, but also trade between parties.

Reviewer #1: General Comments

1. The revised paper addresses some of my comments on the original version. Most importantly, it goes in the direction of addressing some of the most important methodological issues. However, I remain concerned that the sample size is too small, and that a gravity model is not the appropriate estimating framework. In addition, results for country and time dummies—the closest specification the paper has to a theoretically-grounded one—are nonsensical for trade transported by road. I therefore have serious concerns about the reliability of the paper's results on the main variable of interest, even though they are, of course, quite intuitive.

2. If the paper is to be published, it needs to explicitly acknowledge the fact that it is limited in scope, data, and methodology, and is therefore just a first attempt to examine the issue. It would do well to suggest other, quite different approaches, for looking at this question in a more robust way in the future.

Response: Due to the impossibility of getting quota data for other countries at the current stage, we were not able to enlarge the sample size but at the conclusion part, we have underlined this issue as the basic limitation of the study.

In addition, as a result of the change made in the measurement of relative endowments, the models with time dummies all have become significant. Therefore, the current models include country and time dummies as suggested by the referee. By this way, we believe that the referee's doubt concerning the reliability of the results will be alleviated.

Specific Comments

1. The sample remains tiny by gravity model standards: typically thousands of observations are used. With fixed effects and such a small number of observations, it is difficult to identify policy effects. The paper needs to deal with, or at least be forthright about, this severe limitation.

Response: As explained above, we have explicitly indicated this issue as an important limitation of the paper.

2. The paper's fundamental problem remains that only one country is used (Turkey) along with its trading partners. Typically, gravity models use bilateral trade matrices that are square, or close to it. Although the paper makes clear why only one country is used—the fact that quotas are not applied to others without accompanying trade measures—the point remains that gravity might not be the appropriate estimating framework to use. The paper should acknowledge that this is a first look at the issue, and could perhaps be improved methodologically in later work.

Response: As explained above, we have explicitly indicated this issue as an important limitation of the paper.

3. The model specification includes GDP per capita and economic similarity. Theoretically grounded gravity models generally do not use these terms, and they should be dropped. In any case, it is called "relative endowments", but typically that would be measured by capital stock per worker, perhaps land per worker, and human capital. GDP per capita does not capture relative factor endowments at all.

Response: We would like to thank the referee for this very important comment. We have changed the proxy measure for relative factor endowments as the difference in capital stock per worker as suggested by Wood (1994). Results based on this proxy measure are found to be more reliable and all the models with time dummies became significant.

4. The dummy specification is crucial in the gravity model context. At an absolute minimum, there need to be country and time dummies. However, the result for trade shipped by road is nonsensical with time dummies (Table 2 column 2)—the control variables have the wrong sign. That gives rise to serious concerns about results on the variable of interest (quota).

Response: After changing the proxy measure for relative factor endowments, the models with time dummies all became significant. Therefore we have completely removed the models without time dummies from the paper.

5. In relation to the quota variable, why is it listed as quota^-1?

Response: In order to add the quota variable to the standard gravity model (in the original form before taking the natural logarithm), we multiply the equation of the standard gravity model by $e^{-\frac{a}{QUOTA_{it}}}$ ***. After taking the natural logarithm to linearize the equation, the quota appears in the resulting linear regression formula as QUOTA^-1. This is why we use QUOTA^-1 instead of QUOTA in all of the tables and regression equations.***

6. The section on total exports should be dropped: there are no useable results in any case, and the policy interest is clearly in the area of exports shipped by road.

Response: the related section is removed from the paper.

7. The simulation still is not correctly done. It can be presented as an impact effect, but it probably overstates the true effect due to the general equilibrium properties of the gravity model. See Anderson and Van Wincoop (2003). The assertion that multilateral resistance does not apply because of the particular countries considered here is untenable in the absence of evidence—and none is provided.

R*esponse: In this model, we only consider one-way trade, from Turkey to EU countries. Trade from EU countries to Turkey is not included in the model. Multilateral resistance would have a significant effect if the quotas issued by a country made Turkey export its goods to another country. In that case, removing the quotas of the country might have decreased Turkey export to other countries. But, this is not the case in this study. If all quotas are used for a specific country, Turkish exporters start to use an alternative route and/or mode which have a higher cost but they do not try to export their products to another EU country. That is why; we think that multilateral resistance does not have a significant effect. The reason that we do not consider multilateral resistance in this paper is not the particular countries considered here. Instead, the real reason is that Turkish companies generally do not sell directly to final consumers or end users in EU, but they are the suppliers of EU companies. If there is demand, they have to deliver their products. However, the transportation costs of Turkish companies increase due to quotas and this has a lowering effect on demand. This is what we aim to show in this paper. Sorry for the first sentence of the third paragraph on page 13, it is very misleading. We have revised it.*

Reviewer #2:

The novelty of the paper is to include a "Quota" variable within the gravity model showing that it affect a lot trade flows.

The author/s addressed almost all the referee's comments in a sufficient. The paper is improved both on the theoretical and empirical side.

However, the paper need English revision from a native English speaker.

Response: The paper is edited by Elsevier editing service.

Highlights

- We develop several gravity models to analyze Turkish exports.
- We especially analyze the effect of quotas on the total exports of Turkey and on the exports of Turkey via road transport.
- Quotas have a significant negative effect on Turkish exports via road transport.
- Quotas have a significant negative effect on Turkish textile sector exports.

Effects of quotas on Turkish foreign trade: a gravity model

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Effects of quotas on Turkish foreign trade: a gravity model

Abstract
As stated by a European Union Commission Report (2009), Turkey's role as a world trade participant has grown in recent years, particularly as the country has been capitalizing more on its unique geopolitical position. Given the substantial trade volume and deep-rooted relations between Turkey and the EU, due attention should be paid to their trade and economic relations, and steps should be taken to improve these relations. Turkey is the biggest economy that is in a Customs Union (CU) with the EU, but not a member of the EU, along with Andorra, Monaco, and San Marino. When it joined the CU in 1996, Turkey removed all customs duties and equivalent charges as well as quantitative restrictions. However, some EU countries impose quota limits on Turkish road transporters that may indirectly restrict trade between Turkey and the country in question. This study has investigated the effect of road-transport quotas on Turkish foreign trade with EU countries. A gravity model estimated using panel data from 18 selected EU countries between 2005 and 2012 was used for this purpose. Furthermore, as one of the leading sectors using road transportation for Turkish exports to EU countries, the textile sector was analyzed as a case study. The results indicated that quotas have significant effects on total Turkish exports by road transport as well as Turkish textile exports to EU countries. The estimated loss of Turkish exports to the selected countries in the time period analyzed was 10.6 billion dollars of Turkey's total exports by road transport and 5.65 billion dollars of Turkey's total textile exports. Therefore, it can be concluded that the quota limitations are against CU regulations because they limit not only road transportation, but also trade between parties.

Keywords: Gravity, quota, Turkey, trade.

1. Introduction

Although world trade has grown twice as fast as world Gross Domestic Product (GDP) in recent decades (Liu and Xin, 2011), in the last quarter of 2008, world trade flows experienced a sharp and sudden collapse and declined by about 12% in 2009, according to the World Trade Organization (WTO). This figure exceeded the decline of 5.4% in GDP for the same period. Although European countries are recovering from significant difficulties brought about by the global economic crisis, there are rising concerns about the sustainability of sovereign debt in a number of these countries. However, several European countries continue to be among the most competitive economies in the world (Sala-i-Martin *et al*., 2012).

Despite the economic crises faced by many countries, Turkey's economy grew by 0.5% in 2012, with a GDP per capita of US$10,666 in 2012 (US$8,626 in 2009) (World Bank, 2014). It has managed to grow over recent years and is now cited as one of the best-performing emerging economies in the world. However, Turkey's ratio of exports to GDP is around 25%, which is less than for some developed and emerging countries such as Germany, where exports represent 49% of GDP. In China, this ratio is 27%, and in Italy, it is 30% (Schwab, 2013; Gros and Selçuki, 2013). Within this comparative setting, Turkey also has great importance as an interconnection among the European Union (EU), the Middle East, and the Caucasus, as well as the Mediterranean, Aegean, and Black Seas (Mueller, 2007). Although Turkey's exports have been competitive, on average, over the past decade, their level of dynamism has fallen according to OECD projections (OECD, 2012), which show that Turkey's export growth rate for goods and services is less than that of other emerging countries such as South Korea and China (Gros and Selçuki, 2013). The EU is Turkey's most important trading partner, even though its share of Turkey's exports has fallen from 56.4% in 2000 to 31.5% in 2012

(Trademap, 2014). The decline in the EU's share is probably mostly attributable to the relative decline of the EU economy compared, in particular, with the more dynamic markets in the Middle East and other natural resource-rich countries (Gros and Selçuki, 2013). In addition, interactions between Turkey and EU countries are regulated by a set of bilateral and multilateral agreements that restrict quantity and capacity by limiting the number of permits available for a truck to make a journey between jurisdictions. Francois (2005) underlined that Turkish manufacturing exports to the EU are subject to technical barriers. Moreover, Turkish authorities claim that the road-transport quota limits submitted by some European countries present important barriers to an increase in trade potential that could emerge if these limits were cancelled (Togan, 2012). Therefore, one of the basic aims of this study is to investigate the validity of this hypothesis.

Road-transport quotas are implemented through licenses allocated to a specific country by a destination or transit country. In this particular case, an EU country allocates a certain number of licenses to Turkey to be used by Turkish trucks. The maximum number of licenses is determined annually. This condition implies that, in a given year, if all licenses allocated to Country X have been used, further trucks from Country X cannot cross the border of the country issuing the transport license. There are several types of road-transport licenses, including a bilateral permit, transit permit, third-country permit, multiple permit, and return load permit. For example, to be able to export goods from Country X to Country Y by road transport, the truck carrying the freight must have transit permits for all transit countries en route from Country X to Country Y, and it must have a bilateral permit for Country Y. Moreover, bilateral and transit permits can be used only once by a given truck; for the next transport movement using the same truck, another permit is necessary. On the other hand, multiple permits can be used as often as required in the specified year.

Turkey is one of four countries that are in a Customs Union (CU) with the EU, but are not EU members, along with Andorra, Monaco, and San Marino (http://en.wikipedia.org/wiki/European_Union_Customs_Union). Therefore, EU countries cannot apply any trade quotas to Turkish products according to CU regulations. However, EU countries can apply road-transport quotas to Turkish trucks because Turkey is not in the EU. In other words, Turkey is the only country subject to a "road-transport quota", but not to a "trade quota".

Transport quotas to Turkey have been implemented by 24 of the 27 EU member states. These quotas cause serious problems for Turkish exports to EU countries and are viewed by Turkish freight forwarders as serious obstacles to the free movement of goods between Turkey and the EU. Goods shipped from Turkey cannot arrive in the destination country using the most economical means of transport, and transit passes are costly. The quotas also cause significant delays in the delivery of goods. A one-day delay in the transportation of goods decreases trade volume by 1% (Liu and Xin, 2011).

According to CU regulations, practices resulting in unnecessary costs for the import or export of a commodity are considered as charges having effects equivalent to customs duties. The unnecessary fuel consumed by Turkish road carriers, or any additional costs that arise because of the prolongation of the transportation period, are paid by Turkish industrialists. Therefore, Turkish industrialists are faced with unfair competition and unfair trade conditions. In fact, this is not only Turkey's problem. This situation also has a negative effect on foreign investors in Turkey. Because more than 70% of

foreign investors are from the EU, one can conclude that the quotas also have negative effects on the international competitiveness of the EU economy.

Turkish authorities claim that Turkey's annual export loss because of the quotas is at least US$7 billion and that the quotas for goods shipped from Turkey are arguably one of the most important reasons that Turkey's exports to the EU cannot reach an adequate volume. Therefore, the aim of this research is to analyze the validity of the hypothesis that trade volume between Turkey and EU countries is negatively affected by quotas. This analysis has been conducted as an econometric study based on the gravity model. For this purpose, Turkey's exports to selected EU countries have been analyzed in a panel-data framework for the period from 2005 to 2012.

One of the important industries suffering from road-transport quotas is the textile sector. Because road transportation is faster than rail and sea and cheaper than air, trucking is the preferred means of transport for goods for which customer demand can be fickle and efficient response time is required. Turkey has been chosen as one of the largest suppliers of European apparel companies, particularly for its ability to provide short response times and low costs. The country's competitive advantage in the textile sector lies in the use of trucks to achieve short transportation times. Therefore, quotas on road transportation are expected to affect primarily Turkish textile exports to European countries. The textile sector therefore offers the opportunity to analyze the relationship between road-transport quotas and exports through a case study of the Turkish textile sector.

The second section provides a literature review of the use of gravity models in analyses of international trade. The third section provides a framework for the gravity model that is proposed to investigate the impact of quotas on international trade. The fourth section analyzes empirical results for Turkey's exports by road transportation and highlights the impact of quotas through estimated coefficients. The fifth section focuses on the textile sector as a case study, and finally conclusions and further suggestions are given.

2. Literature Survey of the Gravity Approach to Trade

The gravity model aims to analyze spatial interactions among different kinds of variables using the general idea of the theory of gravity in physics. The first application of this approach in the econometric domain was the seminal paper of Tinbergen (1962) on international trade relations. The first theoretical explanation for the gravity model, based on the properties of expenditure systems, was provided by Anderson (1979). Later studies to improve the theoretical basis of the model include Helpman and Krugman (1985), Bergstrand (1989), and Deardorff (1998). Moreover, the gravity model has been used quite successfully in several social science fields. Interested readers are referred to Sen and Smith's (1995) survey paper for various applications of the model.

Gravity equations have been used as a basic tool to model international trade for many years (Brun *et al*., 2002; Redding and Venables, 2004; Liu and Xin, 2011; Novy, 2013). According to the gravity model, the flow between any two points increases in direct proportion to the population and/or the economic activity level between these points and in inverse proportion to the distance between the points.

Generally, these models relate bilateral trade flows to country-specific characteristics of trading partners and analyze the impact of trade frictions such as distance, geography, free-trade

agreements, and border effects (Soloaga and Winters, 2001; Antonucci and Manzocchi, 2006; Jayasinghe and Sarker, 2008; Okubo, 2004; Baier and Bergstrand, 2007). The likely impact on trade of Turkey's potential EU membership has been analyzed by Antonucci and Manzocchi (2006) using a gravity model. Rose (2000) has analyzed the impact of the European Monetary Union on trade. Gil-Pareja *et al*. (2008) analyzed the effects of monetary agreements on trade flows, using a sample of 25 Organization for Economic Co-Operation and Development (OECD) countries. The study shows that all the monetary agreements considered have a statistically significant and economically important role in influencing trade. Egger and Larch (2011) also estimated a positive effect from both interim and European agreements on bilateral trade in a panel of 167 countries. Glick and Rose (2002) found an economically and statistically significant effect of currency unions on trade and showed that bilateral trade approximately doubles (halves) as two countries form (dissolve) a currency union.

Jacks *et al*. (2011) and Olper and Raimondi (2008a) showed the use of a particular transformation of the gravity model to infer the effect of trade costs. Jacks *et al*. (2011) used the gravity equation to find a unifying framework that accommodates a variety of explanations for international trade. They explored the long-run evolution of transaction and transportation costs associated with exchange of goods across national borders. Therefore, instead of estimating trade cost, they derive it from a gravity equation. Olper and Raimondi (2008a) explored market-access reciprocity in food trade among the United States, Canada, the European Union, and Japan using a bilateral trade equation. They estimated the border effect from a theory-consistent gravity model. These researchers explored whether and to what extent problems of market access asymmetry are effectively due to the existence of asymmetric trade policies.

Egger *et al*. (2011) analyzed the indirect effect of quotas through a general equilibrium response. They evaluated and quantified the role of preferential trade-agreement membership in trade using Poisson pseudo-maximum likelihood estimation with endogenous binary indicator variables.

Helpman *et al*. (2008) developed an estimation procedure to correct certain biases in the standard gravity estimation of trade flows. Their proposed model could decompose the impact on trade volumes of all trade-resistance measures into their intensive and extensive margin components using country-level data. This approach is especially important because in practice, a substantial proportion of trade adjustment takes place at the extensive margin, and it is not possible to obtain consistent firm-level data with export destinations for a large number of countries.

Anderson and Van Wincoop (2003) showed that the estimated gravity equations do not have a theoretical foundation. The estimation suffers from the omission of variables, the absence of which prevents the use of comparative statistics, although this is generally the purpose of estimating gravity equations. In response to this dilemma, these researchers developed a method to estimate a theoretical gravity equation in a consistent and efficient manner. Furthermore, they derived a general representation of bilateral aggregate nominal trade flow with one sector and N countries to conduct comparative statistical analysis. They argued that the traditional gravity equation is not correctly specified because it does not take into account multilateral resistance terms. They found that borders reduced bilateral national trade levels. As a solution, they proposed to augment the traditional gravity equation with exporter and importer fixed effects.

Raimondi and Olper (2011) used a gravity equation to estimate trade substitution elasticities. They simulated the trade effect of tariff elimination by dealing with uncertainty in the estimated values.

Their findings confirmed that these elasticities are sensitive to the estimation method, and that especially the Poisson pseudo-maximum-likelihood method significantly inflated their magnitude. The simulation results were critically dependent on the quality of the trade elasticity parameter estimates. They underlined that interpretation of log-linearized model parameters estimated by ordinary least squares as elasticity can be very misleading. They showed that the simulated trade flows obtained by the econometric approach were quite close to the evidence based on computable general equilibrium models. They suggested a two-step estimation procedure for this purpose.

Santos Silva and Tenreyno (2006) also underlined that under heteroscedasticity, the parameters of log-linearized models estimated by ordinary least squares lead to biased estimates of the true elasticities. Similarly to Raimondi and Opler (2011)'s research, Silva and Tenreynouse used Monte Carlo simulation to compare the performance of their estimator with that of ordinary least squares in a log-linear specification to show that in the presence of heteroscedasticity, the estimates obtained from the latter are severely biased. A related problem with the analogy between Newtonian gravity and trade is that the gravitational force can be very small, but is never zero. However, trade between several pairs of countries may be zero in a given period. The existence of zeroes creates an additional problem for using the log-linear form of the gravity equation. One solution is to drop the pairs with zero trade (t_{ij}=0). Some other studies, instead of dropping the zero trade terms, have estimated the model using t_{ij}+1 as the dependent variable. However, Santos Silva and Tenreyno (2006) claimed that these procedures lead to inconsistent estimators of the parameters of interest. These researchers argued that the gravity equation should be estimated in their multiplicative form and proposed the use of Poisson regression as a reasonable compromise. For these reasons, the Poisson-based pseudo-maximum likelihood technique was used in this study.

Novy (2013) derived a micro-founded gravity equation based on a trans-log demand system that accommodates flexible substitution patterns across goods. Because trans-log gravity generates an endogenous trade-cost elasticity, trade is more sensitive to trade costs if the exporting country provides only a small share of the destination country's imports.

Although many factors affect trade growth, the impact of road-transportation quotas is of primary interest in this research. Transport costs have been generally shown to have a negative impact on trade volumes (Evans and Harrigan, 2005; Anderson and Van Wincoop, 2004), and recent studies have suggested that improvements in transportation have a substantial impact on trade volume (Rietveld and Vickerman, 2004; Liu and Xin, 2011).

Most empirical studies in the gravity-model literature in the past decade have used a cross-sectional methodology. However, rather than using data averages over a certain period, a panel framework captures the relationships among the relevant variables over a longer period. Using panel data, it is also possible to understand country-specific effects and to interpret elasticity (Egger, 2000). However, when gravity models are based on panel data, it is necessary to decide whether a random-effect model (REM) or a fixed-effect model (FEM) should be used. Because trade relations between Turkey and specific EU countries are being analyzed, REM assumptions cannot hold in this setting. Therefore, the FEM was chosen, which is consistent with applications in related papers (Egger, 2000; Antonucci and Manzocchi, 2006).

3. Framework of the Proposed Model

This study aims to analyze the effects of quotas on Turkey's exports to EU countries. In this regard, gravity models have been developed to estimate Turkey's exports using road transportation. In addition, similar gravity models have been used to investigate Turkey's textile-sector exports.

The analysis was based on panel data and covers a total of 18 countries ($i = 1, \cdots, 18$) for the period between 2005 and 2012 ($t = 2005, \cdots, 2012$). Therefore, the data set consists of 144 entries for each variable in the panel. Turkey's European trade partners have been chosen from those countries which are on the transport routes frequently used by Turkish carriers and with which the trade volume is more than 1% of total Turkish exports. The selected countries are Austria, Belgium, Bulgaria, Croatia, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Romania, Serbia, Slovak Republic, Spain, Switzerland, UK, and Ukraine. All data used in the paper were obtained from the Turkish Statistical Institute (TSI, 2014).

Figure 1 summarizes the models estimated in this study; Table 1 defines the variables. In the first part, the effects of quotas and other factors on Turkey's total exports by road transport are investigated. In the second part, the effects of quotas and other factors on Turkey's textile exports are explored.

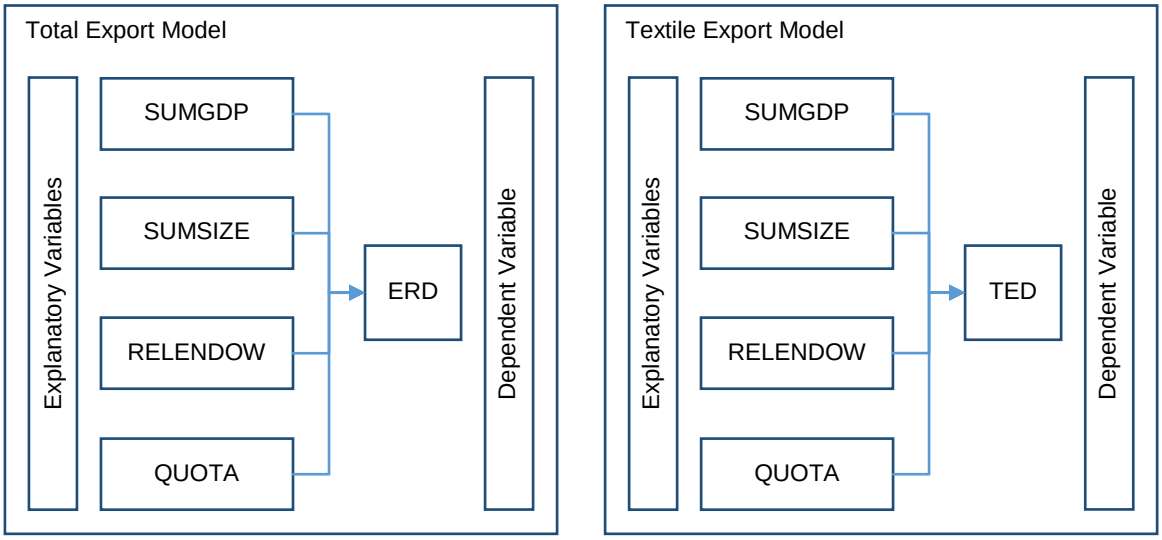

Figure 1. Models considered in this study.

Table 1. Definitions of variables

Variable	Definition
ERD_{it}	Turkey's exports by road transport to country i in year t (in US$)
$SUMGDP_{it}$	A measure of the size of the economies of both Turkey and country i in year t
$SIMSIZE_{it}$	A measure of size similarity between Turkey and country i in year t
$RELENDOW_{it}$	A measure of relative factor endowments between Turkey and country i in year t
$QUOTA_{it}$	The maximum number of Turkish trucks allowed by country i in year t
TED_{it}	Turkey's textile exports to country i in year t (in US$)

The dependent variables used in the empirical estimation are denoted as ERD_{it}. The explanatory variables, used in various specifications, are as follows (j denotes Turkey):

SUMGDP$_{it}$ measures the size of the economies of both the exporting and the importing country and is expected to have a positive effect. It is defined as:

$$SUMGDP_{it} = \ln(GDP_{it} + GDP_{jt}), \quad (1)$$

where GDP_{it} is the gross domestic product of country i in year t.

SIMSIZE$_{it}$ represents a measure of size similarity, which takes on values in the range $-\infty$ (perfect dissimilarity) to -0.69 (perfect similarity) and may have either a positive or a negative effect. The larger this measure, the more similar the two countries are in terms of GDP and the higher the share of intra-industry trade. If their exchanges are of an inter-industry nature, the coefficient should be negative (Antonucci and Manzocchi, 2006). It is defined as:

$$SIMSIZE_{it} = ln\left[1 - \left(\frac{GDP_{it}}{GDP_{it}+GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it}+GDP_{jt}}\right)^2\right]. \quad (2)$$

RELENDOW$_{it}$ measures relative factor endowments. The proxy used is the difference in capital stock per worker, as advocated by Wood (1994). The impact of factor endowments might be felt in either direction: a negative coefficient would point towards an intra-industry trade structure, whereas a positive coefficient would suggest that an inter-industry trade structure prevails (Antonucci and Manzocchi, 2006). It can be formulated as:

$$RELENDOW_{it} = \left(\ln\frac{CS_{it}}{POP_{it}} - \ln\frac{CS_{jt}}{POP_{jt}}\right), \quad (3)$$

where CS_{it} is the capital stock of country i in year t.

QUOTA$_{it}$ is the maximum number of Turkish trucks allowed by country *i* in year *t*. This variable includes only those trucks for which the final destination is country *i*. Therefore, the sum of single and multiple bilateral permits is considered. When *QUOTA*$_{it}$ is increased, the number of licenses allocated to Turkey by country i in year t is increased. Therefore, this variable should have a positive effect on the dependent variables in a coherent model. The *QUOTA*$_{it}$ variable is incorporated into the standard gravity model (without quota) by multiplying the standard gravity equation (before taking natural logarithms) by a fraction which is a function of the quota. In this way, only a fraction of the total export potential, which is represented by the standard gravity model, will be obtained. The fraction, which is a function of *QUOTA*$_{it}$, is $e^{-\frac{a}{QUOTA_{it}}}$ in this study. Note that this function is monotonically increasing in *QUOTA*$_{it}$ when $a > 0$ and that it always takes on values in the unit interval.

The basic formulation of the gravity model, obtained by taking natural logarithms, is as follows:

$$\text{Ln}\, ERD_{it} = \delta_i + \varphi_t + \delta_1 SUMGDP_{it} + \delta_2 SIMSIZE_{it} + \delta_3 RELENDOW_{it} + \delta_4 QUOTA_{it}^{-1} + ln\varepsilon''_{it}, \quad (4)$$

where φ_t and β_i are time and country dummies respectively. Balanced panel data were used, and the number of observations in each regression was 144 (18 trading partners and 8 years). In the literature, there is a long tradition of log-linearizing (as stated in (4)) and estimating the parameters of interest using these equations. The validity of this procedure depends critically on the assumption that the error terms, and hence $ln\varepsilon'_{it}\ and\ ln\varepsilon''_{it}$, are statistically independent of the regressors. Silva and Tenreyro (2006) found overwhelming evidence that the error terms in the usual log-linear

specification of the gravity equation are heteroscedastic, which violates the independence assumption, and suggested that this estimation method leads to inconsistent estimates of the elasticities of interest.

An important problem with the analogy between Newtonian gravity and trade is that the gravitational force can be very small, but is never zero. However, the trade between several pairs of countries may be absolutely zero because these pairs of countries did not trade at all in a given period. These zero observations will cause an additional problem in (4). That is why, in this study, both regressions have been estimated using the Poisson pseudo-maximum likelihood (PPML) estimator (for details of the method, see Siva and Tenreyro, 2006). Country dummy variables were added to the regression to monitor unobservable individual effects of different countries. These effects are represented by coefficients β_i and δ_i in the regression equations. However, because the data panel intended to extract information on the quota effect, the time-invariant fixed effect of the proposed equation may not have removed the potential time-series correlation bias. Therefore, to handle this potential source of bias, an analysis was performed including time dummies, as suggested by Olper and Raimondi (2008b) and Baldwin and Taglioni (2007). In fact, time-varying country dummies as suggested by Baldwin and Taglioni (2007) are not relevant to the present case because the number of dummies will be equal to the number of observations.

There are two different approaches to panel data regression: FEM and REM. It is well-known that FEM should be used when identifying the characteristics of trade flows between predetermined countries. Moreover, Antonucci and Manzocchi (2006) stated that FEM is a better choice for analyzing the export performance of Turkey to European Union countries. Therefore, this study has used the FEM approach and PPML for panel data regression.

3.1. Turkish exports by road transport

A fixed-effect panel data regression model, denoted as ERD, has been developed here to analyze the effect of quotas on Turkish exports by road transport. The outputs of the PPML fixed-effect model are given in Table 2~~Table 2~~. According to the results based on Equation 4, annual total export volume by road transport was significantly negatively affected by the quotas applied to Turkish road carriers. All coefficients were found to be significant for t=1.96.

Table 2. Outputs of the models for Turkish exports by road transportation.

	ERD
SUMGDP	**0.852** [3.139]
SIMSIZE	**-0.844** [-4.605]
RELENDOW	**0.250** [2.281]
$QUOTA^{-1}$	**-1247.532** [-2.799]
Pseudo R-squared	0.989

According to the results of the model, it can be seen that SUMGDP has a positive impact on exports. This finding is similar to that of Antonucci and Manzocchi (2006) and implies that Turkey tends to trade more with large economies. The RELENDOW and SIMSIZE variables are statistically significant in ERD. The signs of the coefficients of these variables are positive and negative respectively, indicating that exports by road transport are inter-industry in nature (Antonucci and Manzocchi, 2006).

Therefore, it can be concluded that road transportation is an important transportation mode in inter-industry trade between Turkey and European countries. Examples of materials in inter-industry trade include chemical raw materials, cereals, fruits, and vegetables.

Finally, $QUOTA^{-1}$ has a significant negative impact on exports by road transport. This finding shows that Turkey's road transportation is significantly negatively affected by the limited number of quotas. It is clear that when the number of quotas decreases, exports based on road transportation decrease significantly.

3.2. The quota effect on Turkey's exports by road transport

This section attempts to determine the true effect of quotas on Turkey's exports. Real export data are compared with estimated export data, assuming no quota on road transportation (so-called quota-free exports).

The first step was to investigate the effect of the quota on Turkey's exports by road transportation. For this purpose, the coefficients of the best-fit model were used to estimate quota-free exports by road transport. Using the coefficients given in Table 2~~Table 2~~, the ERD model can be formulated as follows:

$$\ln ERD_{it} = \delta_i + \varphi_t + 0.852SUMGDP_{it} - 0.844SIMSIZE_{it} + 0.250RELENDOW_{it} - 1247.532QUOTA_{it}^{-1}. \quad (5)$$

In this equation, the country-specific fixed factors δ_i are presented in Table 3. In the quota-free export scenario, all $QUOTA^{-1}$ values will be zero, and they will have no effect on exports by road transport. According to the results presented in Table 3, Turkey's expected export loss (to the countries under consideration) in 2005–2012 was about US$10.648 billion, or 5.5% of actual exports. The most important effect of the quotas was on exports to Spain, at US$3.5 billion.

Table 3. Turkey's total exports in 2005–2012 by road transport in US$

	δ_i	Actual Exports (billion US$)	Estimated Exports (billion US$)	Estimated quota-free exports (billion US$)	Difference (billion US$)
France	-4.390	15.945	15.937	16.279	0.342
Netherlands	-3.746	10.250	10.252	10.706	0.454
Germany	-3.388	56.567	56.577	57.026	0.449
Italy	-4.060	17.005	17.004	17.637	0.633
UK	-4.054	19.036	19.186	20.586	1.400
Greece	-3.738	7.589	7.592	7.946	0.354
Spain	-3.956	9.482	9.482	12.968	3.486
Belgium	-4.397	4.903	4.903	4.927	0.024
Austria	-4.469	4.079	4.079	4.372	0.293
Switzerland	-4.999	2.834	2.870	2.870	0.000
Poland	-3.556	8.086	8.186	8.186	0.000
Slovak Republic	-5.031	1.994	2.003	3.011	1.009
Hungary	-4.680	3.188	3.192	3.298	0.106
Romania	-2.921	15.875	16.074	16.074	0.000
Bulgaria	-3.890	11.089	11.232	11.696	0.464

Ukraine	-4.136	2.518	2.519	3.729	1.210
Croatia	-6.281	1.045	1.045	1.073	0.028
Serbia	-5.338	2.578	2.712	3.108	0.396
Grand Total		194.065	194.844	205.493	10.648

4. Empirical Results for the Textile Sector

4.1. Turkey's textile exports

The previous section showed that quotas have had a significant negative effect on Turkish exports by road transport. Because road transportation is faster than railway and sea transport and air freight is very expensive, road transportation is by far the best option for the Turkish textile sector, especially when exporting to EU countries. The main indicator of this characteristic of the Turkish textile sector is that 70% of all exported textile products were transported by road in 2012. This ratio increased to 82% for textile products exported to European countries.

In this section, it is hypothesized that road-transport quotas have a significant effect on Turkish textile sector exports, and this effect is analyzed using gravity models very similar to those used in Section 3. The basic formulation of the gravity model is as follows:

$$\mathrm{Ln}\, TED_{it} = \beta_i + \varphi_t + \beta_1 SUMGDP_{it} + \beta_2 SIMSIZE_{it} + \beta_3 RELENDOW_{it} + \beta_4 QUOTA_{it}^{-1} + \ln\varepsilon_{it}''', \quad (6)$$

where TED_{it} is total Turkish textile sector exports in U.S. dollars to country i in year t.

The regression was estimated using the PPML fixed-effect model, and Table 4 reports the results of the regression model in US dollars. From these results, although the coefficient of RELENDOW is not significant for $t = 1.96$, it is significant for $t = 1.64$ in the TED model. Taking a broad perspective, it can be concluded that there is strong evidence that the initial hypothesis is correct and that road-transport quotas significantly hinder the export performance of the Turkish textile sector.

Table 4. Output of the fixed-effect model for Turkish textile-sector exports

	TED
SUMGDP	**0.531 [2.097]**
SIMSIZE	**-0.241 [-1.991]**
RELENDOW	0.104 [1.688]
$QUOTA^{-1}$	**-933.530 [-2.500]**
Pseudo R-squared	0.990

Similarly to the ERD model, the positive impact of SUMGDP on textile exports implies that Turkey tends to trade more with large economies. The signs of the coefficients of RELENDOW and SIMSIZE are positive and negative respectively, indicating that textile exports are inter-industry in nature. Because Turkey is one of the largest suppliers of European apparel companies, this result is logical.

The Turkish textile sector is the third largest industrial sector in Turkey. In 2012, the textile sector represented approximately 16.73% of total Turkish exports. Moreover, Turkey is the eighth largest textile exporter in the world, with a 3.6% share according to 2010 data (BSTB, 2012). By combining these facts with the results of the gravity models analyzed in this section, it can be concluded that road-transport quotas have a relatively significant negative effect on total Turkish exports.

4.2. Adverse effects of transport quotas on Turkey's textile product exports

As mentioned in the previous subsection, textiles are one of the leading export sectors in Turkey. Therefore, it is important to show the adverse effects of transport quotas on Turkey's textile exports. In the previous subsection, the coefficients of the following equation were estimated:

$$\ln TED_{it} = \beta_i + \varphi_t + 0.531 - 0.241 SIMSIZE_{it} + 0.104 RELENDOW_{it} - 933.53 QUOTA_{it}^{-1}, \qquad (7)$$

where φ_t and β_i are time and country dummies respectively. β_i values found by the TED model are given in Table 5. According to the results in Table 5, Turkey's estimated export losses (to the countries under consideration) as a result of road-transport quotas in 2005–2012 were approximately US$5.65 billion, which is approximately 5% of actual textile exports. The most dramatic loss was related to textile exports of US$2.5 billion to Spain.

Table 5. Turkey's total textile exports in 2005–2012 (US$)

	β_i	Actual Exports (billion US$)	Estimated Exports (billion US$)	Estimated quota-free exports (billion US$)	Difference (billion US$)
France	5.254	9.987	9.987	10.145	0.159
Netherlands	5.575	7.910	7.910	8.164	0.254
Germany	6.287	32.082	32.082	32.272	0.190
Italy	5.461	10.755	10.755	11.049	0.293
UK	6.007	19.431	19.571	20.540	0.969
Greece	4.718	2.690	2.690	2.785	0.095
Spain	5.749	9.528	9.528	12.023	2.495
Belgium	4.847	3.569	3.569	3.582	0.013
Austria	4.060	1.489	1.489	1.568	0.079
Switzerland	3.690	1.156	1.167	1.167	0.000
Poland	4.936	3.235	3.265	3.265	0.000
Slovak Republic	3.217	0.462	0.462	0.627	0.165
Hungary	3.824	1.055	1.055	1.081	0.026
Romania	5.146	3.823	3.859	3.859	0.000
Bulgaria	4.713	2.750	2.779	2.864	0.085
Ukraine	4.928	2.041	2.041	2.755	0.714
Croatia	2.358	0.274	0.274	0.280	0.006
Serbia	3.723	0.971	0.971	1.078	0.107
Grand Total		113.206	113.452	119.101	5.650

5. Conclusions and Further Suggestions

Turkey acts as a link among the Mediterranean, Middle Eastern, Asian, Black Sea, and Caucasus regions (European Commission Report, 2009). However, the single most important trade link, which underpins Turkey's growth on the world trade scene, has been its privileged relationship with the EU. Nevertheless, although the EU remains Turkey's largest trading partner, trade volume between Turkey and the EU has decreased. Russia, China, the United States of America, and Iran were among Turkey's main trade partners in recent years.

The European Commission decided to conduct a study into the causes of this decline, which may involve the global financial crisis and the economic impact of the relative decline of the EU's share in Turkey's foreign trade volume, as well as other barriers such as quotas. This shows that the problem influences not only Turkey, but also EU countries. The problems faced by Turkey in this respect have been the subject of concern in EU countries since 2005. This difficulty of this situation is increased by the fact that Turkey is diversifying its trade patterns (ECWP, 2011). Turkey's investment level has also been negatively affected, and it must be kept in mind that this does not affect solely Turkish investors, but foreign investors as well, with 70% of these being EU-based.

This study addressed the question: "Do quotas on road transportation have a significant effect on Turkish exports to European countries?" For this purpose, fixed-effect gravity models were developed, and an analysis was conducted based on panel data covering 18 EU countries for 2005–2012. According to the results, quotas had a significantly negative effect on Turkish exports by road transport. The gravity model estimated that in the absence of quotas, Turkey's exports by road transportation to the selected European countries could have been increased by US$10.6 billion in the period under analysis.

It is interesting to underline that this value is not based solely on exports made by Turkish carriers, but includes all other foreign carriers as well. Serious differences in the treatment of Turkish haulers among the member states show that the EU has the obligation to coordinate national quotas to respect its treaty obligations under the EU-Turkey Customs Union and to avoid bottlenecks, unnecessarily long waiting times, or deviations of direct transport to the destination. If trade increases, the volume of quotas must be enhanced proportionally, even in advance if a further trade increase is expected for the following year.

On the other hand, this study cannot find robust evidence of a negative impact of quotas on total Turkish exports to the selected countries. This absence of effect indicates that Turkish companies have used other transportation modes whenever quota barriers are encountered. However, such an approach may produce a competitive disadvantage, especially for perishable and high-fashion textile products, due to the increase in the transportation period for sea and rail transportation. If air transportation is used to overcome this problem, the cost will increase dramatically and again will result in a competitive disadvantage.

In a further analysis, a negative effect of quotas on the Turkish textile sector in particular was found. It was estimated that Turkey lost US$5.65 billion of exports to the selected 18 countries in the period from 2005 to 2012.

Multilateral resistance has not been considered in this paper (Anderson and Van Wincoop, 2003) because the authors believe that it does not have a significant effect on the problem analyzed in this

study. The decision not to address multilateral resistance in this paper stems mainly from the fact that road-transportation quotas do not pose real barriers for trade between Turkey and EU countries. If all quotas have been used for a specific country, Turkish exporters start to use alternative routes, modes, or both which have a higher cost, but they do not try to export their products to another EU country. The main reason for this situation is that Turkish companies generally do not sell directly to final consumers or end users in the EU, but rather they are suppliers to certain EU companies. If there is demand, they must deliver their products. This situation increases the transportation costs of Turkish companies, which has a depressing effect on demand.

This paper is the first attempt to highlight the effect of quotas on international trade relations. The basic limitation of the paper is the small sample size because of the impossibility of obtaining quota data for other European countries. However, UND [Uluslararası Nakliyeciler Derneği – International Transporter's Association] is currently working to collect these data. Therefore, as a further suggestion, a similar methodology could be applied considering data not only for Turkey, but also for other countries subject to European transport quotas. This would increase the appropriateness of the gravity model, which normally requires the use of bilateral trade matrices that are square or close to square. Moreover, when the sample size is enlarged to take into account bilateral trade relations, it will be necessary to consider multilateral resistance, as suggested in Anderson and Van Wincoop (2003).

As another suggestion for further work, similar analyses can be conducted for other sectors that play dominant roles in Turkey's exports, such as the iron and steel and automotive sectors.

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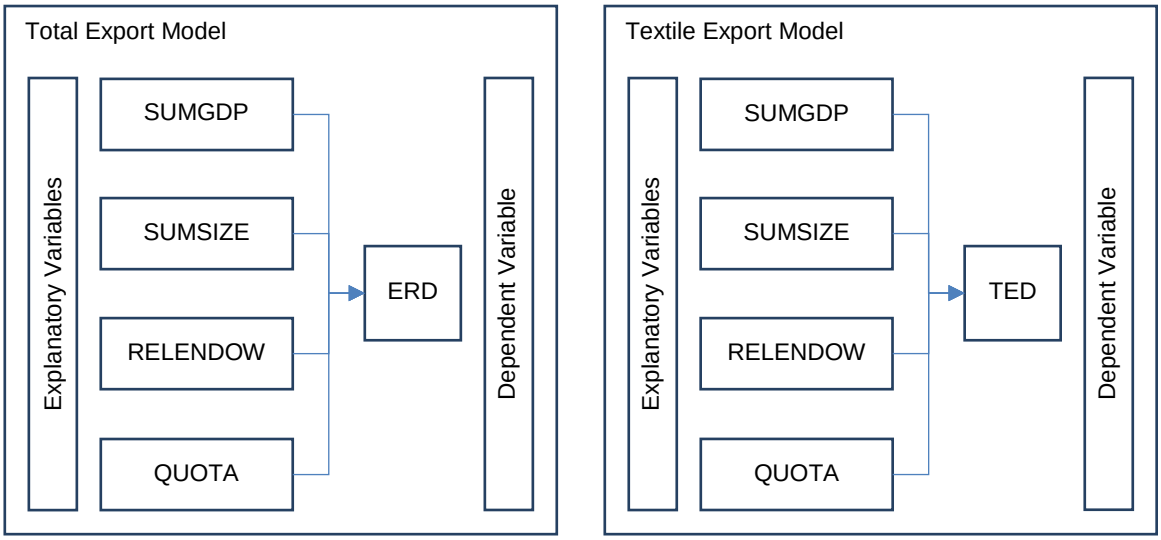
Figure


Total Export Model
Explanatory Variables
SUMGDP
SUMSIZE
RELENDOW
QUOTA
ERD
Dependent Variable
Textile Export Model
Explanatory Variables
SUMGDP
SUMSIZE
RELENDOW
QUOTA
TED
Dependent Variable