THE IMPACT OF INTERNATIONAL ENERGY PRICES ON WORLD TRADE: PANEL EVIDENCE OF GRAVITY MODELS FOR SELECTED COUNTRIES[1, 2]

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ABSTRACT The aim of this article is to examine the impacts of prices of energy and non-energy goods on world trade by including some variables that affect trade for selected countries within the framework of relative prices. The relevant literature confirms that the bilateral trade is theoretically analyzed by using the gravity models. The theoretical gravity models can be empirically applied by using the various panel regression techniques. In this study, three types of panel regression techniques are employed to define the effects of independent variables in the case of trade as the dependent variable. These are Stochastic Frontier, Random Effects, and Fixed Effects Filtered Estimator techniques. According to our panel regression findings, the price increases in the index of energy goods have negative effects on the exports, resulting in the terms of trade being against the countries in this case. Findings suggest that socio- economic policies preventing energy prices from rising need to be developed. Raising the supply to meet the increasing demand could be one of the major policies. Considering the other variables in the model, empirical evidence suggests that world trade volume can be increased not only by strengthening growth policies, ensuring competitiveness in the market, and providing effective logistics management but also by ensuring cultural cooperation, developing business partnerships among the similar income-level countries, and increasing and/or diversifying energy supply.

Keywords: *World trade, energy prices, gravity models of bilateral trade, panel random effects, fixed effects filtered and stochastic frontier estimation methods*
Jel codes: *F12, F14, Q40*

Scope: *Economics*
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[2] It is confirmed that the relevant ethical rules are followed in the study.

ULUSLARARASI ENERJİ FİYATLARININ DÜNYA TİCARETİ ÜZERİNE ETKİSİ: SEÇİLMİŞ ÜLKELER İÇİN ÇEKİM MODELLERİNİN PANEL BULGULARI

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ÖZ | Bu makalenin amacı, enerji fiyatları ile enerji dışı malların fiyatlarının, nispi fiyatlar çerçevesinde ve ticareti etkileyen diğer bazı değişkenler de ilave edilerek, dünya ticareti üzerindeki etkisini seçilmiş ülkeler için incelemektir. İlgili literatür, iki yönlü ticaretin çekim modelleri kullanılarak teorik olarak analiz edildiğini ortaya koymaktadır. Teorik çekim modeli analizi ampirik olarak çeşitli panel regresyon teknikleri ile uygulanabilmektedir. Araştırmada, bağımsız değişkenlerin bağımlı değişken olan ticaret üzerindeki etkisini belirlemede üç tür panel regresyon tekniği kullanılmıştır. Bunlar, stokastik sınır, rassal etkiler ve filtrelenen sabit etkiler tahmincisi teknikleridir. Elde edilen panel regresyon bulguları, enerji malları fiyat endeksindeki artışın ihracat üzerinde negatif etkide bulunduğunu, bu durumda da dış ticaret hadlerinin ilgili ülkelerin aleyhine olduğunu göstermektedir. Bulgular, enerji fiyatlarının yükselmesini engelleyecek sosyo-ekonomik politikalar geliştirilmesi gerektiğine işaret etmektedir. Artan talebi karşılamak için arzı arttırmak, temel politikalardan birisi olabilir. Modeldeki diğer değişkenler dikkate alındığında, elde edilen ampirik bulgular, büyüme yönlü politikaların arttırılması, piyasalarda rekabetçiliğin sağlanması ve etkili lojistik yönetiminin gerçekleştirilmesinin yanı sıra kültürel iş birliğinin sağlanması, benzer gelir seviyesindeki ülkelerin iş ortaklıklarının geliştirilmesi, enerji arzının arttırılması ve/veya çeşitlendirilmesi ile dünya ticaret hacminin artırılabileceğini göstermektedir.

Anahtar Kelimeler: *Dünya ticareti, enerji fiyatları, iki-yönlü ticaretin çekim modelleri, rassal etkiler, filtrelenen sabit etkiler ve stokastik sınır tahmin yöntemleri.*
JEL Kodu*: F12, F14, Q40*

Alan: *İktisat*
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1. INTRODUCTION

Since the beginning of the industrial revolution, energy has become increasingly important both as an input on production lines and for household use. A large part of the energy resources used are obtained from fossil fuels like oil, natural gas, and coal. Thus, the change in the prices of energy resources has resulted in the change in demand for these goods. It is obvious that the countries which demand energy goods are the countries that produce non- energy goods intensively. It is also observed that these countries export non-energy goods to countries exporting energy goods.

Energy products have gained importance since the middle of the 19th century. Energy goods are traded; the countries that produce non-energy goods need these energy products for their manufacturing industries, and the less developed or developing countries that export energy goods are seen as markets for their non-energy goods. This cycle has continued throughout the 20th century.

Under open economy conditions, surplus of a good is exported after domestic consumption, and if the product is not in sufficient quantities, it is imported. Energy goods are also traded. Four special cases emerge in the international or regional trade of energy products which are self-sufficient in energy; importing to reinforce its internal resources; exporting and finally, importing country without domestic resources. Energy goods are generally used as raw materials (or primary goods) rather than their intended use as final products. In the context of primary goods versus final goods, there are two directions in the world trade. While the direction of primary goods runs from south to north, there exits trade in final products from north to south, i.e. inter-industry trade. Therefore, the primary goods-based energy goods market is also related to the north-south trade issue in the trade literature. When the north-south direction of world trade and the sanction power of countries in the regulation of this type of trade are concerned, the country which consumes the primary product instead of producing it, becomes an effective party in this trade. The demand for energy goods is determined by the production and consumption capacities of countries that produce final products.

Since Alfred Marshall, foreign trade literature has been developed within the framework of bilateral demands of the countries. In the literature of energy economics, the effects of energy prices on production, consumption, and some internal macroeconomic variables (GDP, GDP Growth and etc.) are examined. However, the effect of energy prices on trade on a global scale has not been studied in detail. In this context, this article examines the effects of international energy prices on world trade. In specific, bilateral demand between energy-exporting countries and non-energy goods-exporting countries are taken in to account. Thus, the advantages and disadvantages arising from foreign trade are revealed, and the effects of changes in energy prices on international trade depending on price and income elasticities are also analyzed. In this study, the effect of energy prices and prices of non-energy goods on world trade within the framework of relative prices is examined for selected countries. In addition, some other variables that affect trade are also included in the analysis.

In this paper, the effect of the relative prices and other variables such as gross domestic products (GDP), populations, common language, contiguity, and common colonizer are theoretically modeled using the gravity models. Empirically, these parameters are analyzed by various panel regression methods, namely, Fixed Effect Filter, Stochastic Frontier, and Panel Random-effect estimations. The rest of the article is structured as follows: The following second chapter summarizes literature; the third chapter contains the theoretical background that reveals an empirically computable gravity model which derived from the theoretical gravity model, and the fourth chapter includes the data set. The fifth chapter gives the econometric methodology, while the sixth chapter presents empirical results. The last chapter gives a discussion of inferences from the findings, some conclusions and policy implications.

2. LITERATURE REVIEW

In the literature, there are very few studies exploring the relation between energy prices and bilateral trade, especially from the world trade perspective. On the other hand, the relevant literature confirms that existing studies are not based on relative price elasticity and do not examine its effects on world trade. In the literature, there are also studies including the dimension of time series with a single country regarding the relationship between the foreign trade and energy prices (generally oil prices). However, the existing literature examines the relationship between gross domestic product or other macroeconomic variables and energy prices from the current account balance perspective.

Some studies have included bilateral trade on a country basis and examined the relationship between energy prices and international trade on a country scale but not on a global scale. It is noteworthy that the energy prices of all fossil fuels are not considered in the analysis in the existing literature. Instead, it is only used the impact of oil prices on explaining trade. In terms of the relative price, the effect of energy goods' prices and non-energy goods' prices on trade has not been studied so far. In particular, the studies of Chen and Hsu (2013), Sato and Dechezleprete (2015), and Rafiq, Sgro, and Apergis (2016) do not take the prices of all energy products into account, but they are the closest to the subject. These studies generally consider the impact of oil prices on bilateral trade. They also do not separate countries as producers of energy goods and non-energy goods and examine the bilateral relations between them.

Chen and Hsu (2013) studied the effect of oil price volatility on bilateral trade for a data set consisting of 117 countries by converting the daily oil price series into an annual volatility data set. The effect of volatility in oil prices on bilateral trade was found negative. Sato and Dechezleprete (2015) created a data set with 16 years of observations in 62 manufacturing industry sectors in 42 countries. In the analysis, they analyzed the effect of price series created by the difference in industry-based real industrial energy prices of the two countries on bilateral trade. 10% increase in energy price differences in the sectors of the two countries increased imports by 0.2%. In their study for the period 1981-2013, Rafiq, Sgro, and Apergis (2016) found that the increase in petroleum prices positively affected the petroleum trade balance of petroleum-exporting countries. However, increases in petroleum prices negatively affected the trade balance of petroleum-importing countries. In this study, the trade balance was examined under the bilateral concept. The model also included positive and negative oil shocks.

In addition, studies that indirectly examine the relationship between energy price and world trade or examine some of relations between energy prices and other trade variables such as trade deficit or current account balance are included in Appendix 1.

In conclusion, there are some main issues that distinguish this study in hand from other studies which remarks its possible contributions to the existing literature. These are the following issues: There exits is no study, to our best knowledge, which includes the prices of energy goods and non-energy goods together in the form of relative prices. In the relevant empirical literature, only oil prices are considered as the price of energy goods. The price index of the energy goods used in this study is obtained by combining basic fossil fuels, natural gas, oil, and coal. However, the effect of the distance is considered as an indicator that expresses transportation costs like other gravity models in the existing literature. Furthermore, the Baltic Index, an alternative transportation cost indicator, is used simultaneously in the analysis. While the distance variable is time-invariant, the Baltic Index shows a structure that is time-varying. Thus, the effect of the transportation cost indicator in two different structures are measured. Finally, another point that distinguishes this study from others in the literature is the use of a technique based on the econometric method, that is, the fixed effect filter estimation method used in bilateral gravity models.

3. TRANSITION FROM THEORETICAL GRAVITY MODEL TO EMPIRICALLY COMPUTABLE ONE

In this study, the gravity theoretical model is employed. Gravity models are built on bilateral trade. Bilateral trade is defined as mutual trade between two countries. In other words, it is the whole of export movements from country A to country B, and vice versa. Analysis of measures promoting trade and investment between the two countries has become easier through bilateral analysis. In this context, by employing these measures, trade barriers such as customs tariffs, import quotas, and export restrictions, etc. between the two countries can be reduced. In addition, the effect of variables such as contiguity, distance, and common culture between the two countries can also be examined in bilateral trade as well. The bilateral trade analysis also allows the inclusion of income and price effects on trade between the two countries. Gravity models are also derived from the bilateral trade concept. They indicate that trade between the two countries essentially varies depending on their distance and economic sizes.

Assuming that the world markets operate by imperfect competition dynamics, and the structure of energy goods is particularly homogeneous, the theoretical and empirical models applied in this paper are the Krugman-type gravity models (like Bergstrand et.al., 2013) based on the assumptions of homogeneous firm and imperfect competition. While Allen and Arkolakis (2016) theoretically expresses the Krugman's gravity model, Bergstrand (1989) and Anderson and van Wincoop (2003) transform the theoretical gravity model to the empirical form based on monopolistic competition. These three studies are the basic reference sources used in creating the computable empirical gravity model of this study.

Krugman's theoretical gravity model (Equation 1) can be expressed as follows (Allen and Arkolakis, 2016: p.23-29):

$$X_{ij} = X_j P_j^{\sigma-1} \left(\frac{\sigma}{\sigma-1} \frac{\omega_i}{z_i} \tau_{ij} \right)^{1-\sigma} d\omega \Leftrightarrow$$

$$X_{ij} = \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} \tau_{ij}^{1-\sigma} \left(\frac{\omega_i}{z_i} \right)^{1-\sigma} N_i X_j P_j^{\sigma-1} \quad (1)$$

where X_{ij} is the export value from country i to country j, $\tau_{ij}^{1-\sigma}$ is the trade cost between two countries, z_i is the country i's common productivity in all firms, ω_i is the variety of goods in country i, N_i is the measure of firms producing in country i, X_j is the amount of imported goods in country j, which is the opposite country, $P_j^{\sigma-1}$ is the general level of prices (price index) in country j (in other words, it reflects the costs in the importing country), σ is the elasticity value, and $X_j P_j^{\sigma-1}$ this multiplication, in a sense, shows the income of country j.

In addition, Anderson and van Wincoop (2003:p. 174-175) reported a simple gravity equation obtained from the general equilibrium model under the assumption of constant substitution elasticity in the following equation 2:

$$T_{ij} = Y_i E_j \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \quad (2)$$

where T_{ij} is the trade value between country i and j, Y_i is the total output of country i, E_j is country j's expenditures, in other words, country j's income, t_{ij} is the trade costs between two countries, $\Pi_i and\ P_j$ are price indexes of country i and j.

In terms of this logic, consumers maximize their welfare by consuming the country's produced A and unproduced B goods with minimum amount, subjecting to budget constraints. The budget constraints depend not only on the amount of goods produced, but also on the well-regulated exchange rate and customs tax rate and the nominal income of the country. Technology is the same among firms; these firms use capital and labor as inputs. All nation has a constant capital and labor supplies. Given the constant flexibility of the transformation function, firms try to maximize their profits and sell some of their products to the external markets. This means companies manufacture with increasing returns to scale in the first phase and export to international markets with reduced returns to scale due to shipping costs in the second stage. The export function of the goods produced by the firms aiming at profit maximization is (see Starck, 2012:p. 14):

$$PX_{ij} = \alpha_0 Y_i^{\alpha_1} \left(\frac{K_i}{L_i}\right)^{\alpha_2} Y_j^{\alpha_3} \left(\frac{Y_j}{L_j}\right)^{\alpha_4} C_{ij}^{\alpha_5} T_{ij}^{\alpha_6} E_{ij}^{\alpha_7} P_i^{\alpha_8} P_j^{\alpha_9} U_{ij} \quad (3)$$

In Equation 3, the nominal export value PX_{ij} is based on the exporter's and importer's GDP (Y_i and Y_j), the capital-labour rate of country $i \left(\frac{K_i}{L_i}\right)$, the per capita income of the importing country $j \left(\frac{Y_j}{L_j}\right)$ and C_{ij} transportation costs and T_{ij} as tariff rates, E_{ij} is exchange rates, P_i and P_j are the exporting and importing country's prices, respectively. Bergstrand (1989) introduced a slightly more simplified version of Equation 3 with increasing returns to scale. Bergstrand (1989) carried out a study based on monopolistic competition and adapted to gravity modeling, considering the relationships with differentiated goods and economies of scale. Bergstrand's equation is:

$$PX_{ij} = \alpha_0 Y_i^{\alpha_1} \left(\frac{Y_i}{L_i}\right)^{\alpha_2} Y_j^{\alpha_3} \left(\frac{Y_j}{L_j}\right)^{\alpha_4} D_{ij}^{\alpha_5} A_{ij}^{\alpha_6} U_{ij} \quad (4)$$

where PX_{ij} shows the value of exports from country i to country j, Y_i and Y_j show countries' gross domestic products, L_i and L_j are countries' populations, and D_{ij} is the distance between countries. Other factors that may affect trade flow is Aij, and finally U_{ij} is the error term.

When equations 3 and 4 are compared, it is clear that the capital /labor rate variable for country i can be considered as the per capita income of country i, and transportation costs are used instead of the distance variable in Equation 4. Also, T_{ij} , E_{ij} , P_i and P_j variables in Equation 3 are used instead of the A_{ij} variable in Equation 4 (Starck, 2012:14). In this framework, the empirical model of the study in hand is created with the use of some assumptions. Considered assumptions for the empirical model created are goods A (energy goods) and B (non-energy goods) and single price (not P_i exporter and P_j importer) P_{world}. The template of the model created by considering the theoretical background is shown in Table 1.

Table 1: Transition from the Theoretical Model to the Empirical One

Theoretical Model Variable (Considered Krugman, Anderson and Van Wincopp, Bergstrand)	**Empirical Model Indicator**
X_{ij}	$lnEXPORT_{ij}$
The variables Y_i and Y_j appear hidden in the analysis of the Krugman model. Under the assumption that each firm produces one product, $\frac{\omega_i}{z_i}$ is the productivity per firm. When this value multiply with N_i (number of firms in the country) results in Y_i that is output of country i, in other words country i's income. In the opposite country, the variable $X_j P_j^{\sigma-1}$ gives Y_j.	$lnGDP_i$ and $lnGDP_j$
$\Pi_i and\ P_j$ terms are price indices in country i and country j, respectively.	lnP Here, the prices of non-energy goods and energy goods were taken by proportioning each other.
L_i and L_j	$lnPOP_i\ and\ lnPOP_j$
$(\frac{Y_i}{L_i}$ and $\frac{Y_j}{L_j})$	These are per capita income. In the study, the differences between per capita income variables were taken. The reason for this is that if $ln\ DGDPPC_{ij}$is close to each other, countries will trade more.
D_{ij} and even $\tau_{ij}^{1-\sigma}$	In terms of transportation costs

Theoretical Model Variable (Considered Krugman, Anderson and Van Wincopp, Bergstrand)	Empirical Model Indicator
	$lnDISTANCE_{ij}$ and $\ln BALTIC(t-1)$
$\tau_{ij}^{1-\sigma}$ and A_{ij}	All factors that make trade difficult or facilitating, which are called iceberg trade costs between the two countries, can be included. Common official and ethnic language, colonial connection, etc.

Source: Prepared by Authors.

In this context, the revised regression model is expressed as follows (equation 5):

$$\begin{aligned} lnEXPORT_{ij} = {} & a_0 + a_1 lnGDP_i + a_2 lnGDP_j + a_3 lnPOP_i + a_4 lnPOP_j \\ & + a_5 lnDİSTANCE_{ij} + a_6 lnP + a_7 \ln BALTIC(t-1) \\ & + a_8 ln\, DGDPPC_{ij} + a_9 CONTIGUITY_{ij} \\ & + a_{10}\ COMMON\ OFFICIAL\ LANGUAGE_{ij} \\ & + a_{11} COMMON\ ETHNIC\ LANGUAGE\ _{ij} \\ & + a_{12} COLONY_{ij} + a_{13} COMCOL\ _{ij} + a_{14} COL45_{ij} \\ & + error\ term \end{aligned} \tag{5}$$

4. ECONOMETRIC METHODOLOGY

The empirical model used here is based on the gravity model explained in the earlier section. As regards the empirical model, that is equation 5, variables are analyzed by utilizing three different methods, namely stochastic frontier, filtered fixed-effects, and panel random effects panel estimation methods, and the results are compared. Using three different methods enables us to see how consistent and robust the estimation results are.

4.1. Panel Random Effects Estimation Method

There are two different types of classical panel models, namely, fixed effect and random effect models. The main aim of the fixed effects panel data analysis is to compare groups (such as male/female), but not individuals. The fixed effects panel data analysis considers the connection among dependent variables and an independent variable in an entity. This entity can be a person, company, or country and affects common variables (Anna et.al., 2014:p. 233).

Unlike the fixed effects model, in the random effects model, it is assumed that there is a random variation between entities and unrelated to the independent variables in the model. The basic difference between the fixed effects model and the random effects model is that the neglected variables are not related to the independent variables in the random effects model. However, the neglected variables are concerned to the independent variables in the fixed effects model (Greene, 2008:p. 183).

The random effects model enables model parameters to vary from one entity to another. Hence it provides heterogeneity between individuals. If variations between entities have such effects on the dependent variable, the concept of random effects is used. Unlike the fixed effects model, the random effects model gives the errors between entities and within an entity (Wooldridge, 2016:p. 441-442).

One of the major features of panel data analysis is that it provides unobservable variables to be controlled and to account for the heterogeneity at the entity level. In the study, a particular country pair is selected as an entity. Initially, the Hausman test can be used to determine whether a fixed or random effect model would be appropriate for the data set. Our data set contains some time-invariant variables like distance and binary variables such as common language, common colonizer, and contiguity. For some individuals within the panel, these variables are unique and should be associated with other features. It is very possible that the error-terms will be associated with these time-invariant variables, which therefore provides a reason for choosing random effects (Kumar and Ahmed, 2015:p. 237).

4.2. Fixed-Effects Filtered Estimation Method

Identifying and predicting the effects of time-invariant variables such as race and gender effects that do not change over time is frequently the center of panel regression analysis. However, prediction methods such as fixed effects (FEs), which give highly coherent predictions of the coefficients of independent variables that time-varying, are not used for estimating time-invariant effects because the fixed effects estimation removes all time-invariant independent variables. As a consequence, the prediction of time-invariant effects, namely, how to infer effects that do not change over time without making a clear statement about the relationship among undetected individual effects and variables that change over time, posed a challenge to panel econometrics (Pesaran and Zhou, 2018:p. 1137).

Pesaran and Zhou (2018) reveal a static data panel model that allows for a random association between time variable covariates and individual effects and proposes a fixed-effect filtering (FEF) approach for predicting variable coefficients that do not change over time but vary between cross-sections. In this kind of panel model, N represents a large cross-sectional dimension while T consists of a small and a constant time dimension. The fixed effect filtering estimation method proposed by Pesaran and Zhou consists of two simple stages. In the first stage, fixed effect estimates are calculated for the coefficients of time varying variables and these predictions are employed to filters time varying effects. In the second stage, the error terms obtained from the first stage panel regression are averaged over time and used as a dependent variable in the cross-sectional least square regression containing the intercept and the time-invariant regressor vector. Based on the identifying hypothesis that time-invariant regressors are not associated with individual effects and a variety of other conditions of regularity, it is shown that the FEF predictor is unbiased and consistent for a finite T and as N → ∞. Pesaran and Zhou (2018) derived the FEF predictor's asymptotic distribution. They proposed a nonparametric covariance matrix predictor, which was consistent with the heteroscedasticity of the individual effects and worked decently in the existence of residual serial correlation (Pesaran and Zhou, 2018: p. 1138).

Considering the panel model, which contains both time-varying and time-invariant regressors:

$y_{it} = \alpha_i + z_i'\gamma + x_{it}'\beta + \varepsilon_{it}\ , i = 1,2, \dots \dots N; t = 1,2, \dots T$ where $\alpha_i = \alpha + \eta_i$ (6)

x_{it}' is a k×1 vector of time-varying variables, and z_i' is an mx1 vector of observed individual variables that vary only across the cross-sectional units, i. Intercalarily z_i' , the outcomes, y_{it} are also governed by unobserved individual-specific effects, α_i. The center of the analysis is on prediction and deduction including the elements of γ. Obviously, without any more limitations onα_i, γ cannot be determined even if β was known to the researcher (Pesaran and Zhou, 2018:p. 1139).

At this point, the FEF predictor should be figured out by using the following two-stage process: In stage one, by using model (6), figure out the fixed effects estimator of β, represented by $\hat{\beta}$, and the associated residuals $\hat{u}_{it}$ defined by

$$\hat{u}_{it} = y_{it} - \hat{\beta}' x_{it} \qquad (7)$$

In stage two, figure out the time averages of these residuals, $\bar{\hat{u}}_i = T^{-1}\Sigma_{t=1}^{T} \hat{u}_{it}$ and regress $\bar{\hat{u}}_i$ on z_i with an intercept to acquire $\hat{\gamma}FEF$, namely,

$$\hat{\gamma}FEF = \left[\sum_{i=1}^{N}(z_i - \bar{z})(z_i - \bar{z})'\right]^{-1} \sum_{i=1}^{N}(z_i - \bar{z})\left(\bar{\hat{u}}_i - \bar{\hat{u}}\right) \qquad (8)$$

and $\hat{\alpha}_{FEF} = \bar{\hat{u}} - \hat{\gamma}'FEF\ \bar{z}$, where $\bar{\hat{u}} = N^{-1}\sum_{i=1}^{N} \bar{\hat{u}}_i$. (Pesaran and Zhou, 2018:p. 1140).

This marks the end of the second stage.

4.3. Stochastic Frontier Estimation Method

When the performance of an economic unit is a matter of debate, the concepts of efficiency and productivity come to the forefront. The output-to-input ratio is productivity, and the ratio between potential and observed outputs (or inputs) is efficiency (Fried et.al., 2008:p.6). In spite of the idea that efficiency is as old as neo-classical economics, theoretical works started in 1951 with the studies of Koopmans and Debreu (Koopmans, 1951; Debreu,1951). However, first empirical work started with Farrell in 1957 (Farrell, 1957) on its own calculations. Technical efficiency calculation means comparing the current amounts of the input and output to their potential amounts. All in all, in any field where potential amounts and observed amounts differ, efficiency analysis can be applied. The study carried out in this direction, estimates the efficiency in international trade, based on the hypothesis that the actual trade volume and potential trade volume may differ.

Potential amounts need to be predicted because there are no observable amounts. To realize this prediction procedure and to measure the technical efficiency, some approaches were developed in the literature. The most accepted of these methods are the nonparametric data envelopment analysis and the parametric stochastic frontier analysis (Zhang et. al., 2013: p. 654-655). The Stochastic frontier analysis was proposed by Aigner et al. (1977) and Meeusen and van Den Broeck (1977), independent of each other. Unlike the previous models, there exists the term "random error". Therefore, deviations from the maximum product are not completely ascribed to inefficiency, so the error term here is separated into two pieces as the term ineffectiveness effects and the random error term (Stevenson,1980:p. 57).

Using panel data analysis, the stochastic frontier function can be expressed as follows:

$$\begin{gathered} y_{it} = \beta x_{it} + v_{it} - u_i \\ v_{it} \sim i.i.d. N(0, \sigma_v^2) \\ u_i \sim i.i.d. N^+(\mu, \sigma_v^2) \end{gathered} \tag{9}$$

where x denotes input, and y denotes output. In the frontier function, the error term is separated into two pieces. The initial one (v_{it}) is the random error term that is not under the control of the examined unit and provides that the frontier function is stochastic. The second (u_i) expresses the ineffectiveness effects. As can be understood from the subscript of the term u in the equation, the ineffectiveness effects of the model do not change over time (Aigner et. al., 1977: p. 24). Pitt and Lee (1981) and, Battese and Coelli (1988) are the examples of ineffectiveness models not changing with time. If the timespan taken in the calculation of the frontier function is long dated, the presumption that ineffectiveness does not change over time can lead to spurious findings. With time-varying type models, this rigid presumption has been removed. Instances of time-varying ineffectiveness models are Battese and Coelli (1995), Lee and Schmidt (1993), Battese and Coelli (1992), Kumbhakar (1990), and Cornwell et al. (1990). As previously stated, the calculation of technical effectiveness includes comparing the current input and output amounts with their potential amounts. Overall, an analysis of effectiveness can be applied in any field where potential amounts and actual amounts are different.

The stochastic frontier gravity equation can be defined as follows, as indicated by Kalirajan (2008):

$$X_{ij} = f(Z_i; \beta)\exp\,(v_i - u_i) \qquad (10)$$

where X_{ij} refers to the export of country i to country j, and Z_i refers to the determinants of potential trade. The stochastic frontier gravity model is typically calculated using the "maximum likelihood" method. When the model is expressed in logarithmic terms, the ratio of observed to potential trade gives the efficiency level [exp (- u_i)]:

$$\exp\,(-u_i) = \frac{X_{ij}}{f(Z_i;\beta)+\exp\,(v_i)} = \frac{Observed\ Trade}{Potential\ Trade} \qquad (11)$$

[exp (-ui)] is a number along 0 and 1. If the number is equal to 0, this means that the observed trade amount is equal to the potential trade amount, and there is no inefficiency. If this number is [0 < exp $(-u_i)$≤1], this indicates the presence of inefficiency. In this case, it means that some factors cause exports to remain below the potential level (Kalirajan, 2008:p. 1039). In this paper, the analysis is realized by employing Battase and Coelli's (1988) model, which is time-invariant, and Battase and Coelli (1995) model, which is time-varying.

5. DATA SET

The time span of the data consists of the period 2010-2016. The countries that make up the cross-sectional dimension in the study are divided into two groups. The first is the countries that export energy goods, and the second is the countries that export non-energy goods. In the period 2010-2016, countries whose exports consist of at least 60% or more of fossil fuels and its derivatives were selected as energy-selling countries. The selected 20 countries are Yemen, Venezuela, United Arab Emirates, Turkmenistan, Russia, Saudi Arabia, Republic of the Congo, Qatar, Oman, Nigeria, Libya, Kazakhstan, Kuwait, Brunei, Gabon, Iran, Iraq, Azerbaijan, Angola, and Algeria.

As for the countries exporting non-energy goods, the major economies of the world have been taken into consideration, especially in the export of manufacturing industry products. Selected countries realized approximately 90%

of the manufacturing industry product exports in the world in 2016. These are United States, United Kingdom, Turkey, Thailand, Switzerland, Sweden, Spain, South Korea, Poland, Netherlands, Mexico, Malaysia, Hong Kong, India, Indonesia, Ireland, Italy, Japan, China, Czech Republic, France, Germany, Australia, Austria, Belgium, Brazil, and Canada.

Since the analysis is on bilateral trade between the country selling non-energy goods and the country selling energy goods, there are 1080 trade directions. In the empirical model, the natural logarithms of variables other than binary variables are taken. The reason for choosing the natural logarithm is that it makes the series flatter, solving the heteroscedasticity problem, and interpreting the results in terms of elasticity. The description and the source of the variables used in the estimations are explained in the following.

In this study, the exports realized from the countries selling energy goods to the countries selling non-energy goods and the export realized in the opposite direction are examined. $lnEXPORT_{ij}$ data are in nominal dollars. In lines with zero trade, 1 is added to the nominal value of zero. This method is applied in gravity models. Data from World Bank, World Integrated Trade Solutions (WITS) and United Nations International Trade Statistics are used.

Gross Domestic Product (GDP) is an important data indicator for the economic powers and market sizes of the countries. Large GDP indicates more production and marketing for the exporter and economic power for the importer to purchase the goods. In theory, the expected signs are positive (Demir, 2019:p. 120). The data are expressed in nominal dollars. $lnGDP_i$ and $lnGDP_j$ are taken from the World Bank, World Development Indicators.

Whether the impact of the population on exports is positive or negative is a controversial issue. This impact depends on whether the absorption impact is greater than the scale impact directly associated with the population. Depend on Greene (2013), countries that have higher populations have more and broader range of productions, are more independent, and prefer to trade less than those with smaller populations. From another point of view, Yang and Martinez-Zarzoso (2014) reported that the population is negatively related to trade flows, as the large population will have a wider domestic market, rich resource allocation, and different outcomes, and is also less dependent on international specialization. In addition, they also noted that the population coefficient could be positive as a larger population in an importing country. This describes economies of scale and allows countries to trade more with international partners in a wide variety of goods. $lnPOP_i \, and \, lnPOP_j$ are taken from World Bank, World Development Indicators.

The distance variable ($lnDİSTANCE_{ij}$) is commonly referred to as trade friction (trade barrier). Therefore, the distance has a negative effect on trade flows from both heuristic and econometric viewpoints. The distance variable is a function of the spatial effect on trade flows. As the distance between the two countries increases, the cost of transportation increases and consequently the trade volume decreases. Thus, according to the theory, the expected sign is negative (Sumani, 2015: p. 53). The relevant data are obtained from CEPII (Centre d'Etudes Prospectives et d'Informations Internationales - Center for Prospective Studies and International Information).

The variable of gross domestic product per capita difference ($ln\,DGDPPC_{ij}$) is used to discover which countries fit the Heckscher-Ohlin or Linder hypotheses in world trade. The Heckscher-Ohlin hypothesis foresees that countries where per capita income rates are not same would trade more than countries with same levels. The Linder hypothesis, by contrast, suggests that countries with same per capita income rates should trade more with each other, as they will have same preferences for diversified goods. So, the Linder hypothesis is concerned with the negative impact of the per capita GDP difference between countries i and j on bilateral trade. A positive impact of this variable is related with the Heckscher-Ohlin hypothesis (Sumani, 2015: 53). GDP per capita variables are taken from World Bank, World Development Indicators. The absolute values of the differences of country i and j's GDP per capita variables are taken.

$CONTIGUITY_{ij}$ is the dummy variable added to the model as a common border measure. It implies that countries without common borders will bear more costs in trade. This variable is set as 1 for those who have common boundaries and 0 for those who do not. The data are obtained from CEPII.

The presence of a common language between countries reduces transaction costs during trade. In this case, there are two common-language dummy variables. The common official language variable indicates that the two countries use the same official language, while the common ethnic language variable is the language spoken by at least 9% of the population in both country i and country j (Mayer and Zignago, 2011:p. 12). COMMON OFFICIAL $LANGUAGE_{ij}$ and COMMON ETHNIC $LANGUAGE_{ij}$ data are obtained from CEPII.

It is obviously difficult to make a specific definition of a colonial relationship. Here, colonization is a very general concept that ruled the relationship between the two countries, regardless of their degree of growth, and contributed to the current state of their institutions for a long time (Mayer and Zignago, 2011:p. 12). COMCOL is a sign that the two trading countries had a common colonialism after 1945. The COLONY variable indicates that there was a colonial connection between the two countries in the past. COL45 indicates that there was a colonial relationship between the two countries after 1945. These data are also obtained from CEPII.

Cost differences between countries in foreign trade are undoubtedly one of the main reasons for foreign trade. Since countries do not have the same price advantage in the production of every good, they import goods that do not have price advantage. Therefore, price formation is important in foreign trade. What is meant by price formation in foreign trade is the formation of international relative prices. In other words, "balance" is the formation of terms of trade (Demir, 2019:p. 122). That's why in this framework, lnP is the variable that forms the basic argument of the study. This variable is added to the model by predicting the relative price variable (P_{world}), found by dividing the two indices, to give the barter price. The first of these indices is the Energy Price Index (EPI). This index is obtained by looking at the coal, oil, and natural gas export values of developing countries between 2002-2004. These values are based on fixed weighting Laspeyres indices of the data from the World Bank, Global Economy Monitor. These series are available from 1960 to present. This index, with a base value of 2010 = 100, has been chosen in terms of energy goods prices. The second index is the Non-Energy Goods Price Index (NEPI). It is the index obtained by looking at the export values of 34 products of developing countries, which are based on the constant weighting based Laspeyres indices of the data taken from the World Bank, Global Economic Monitor. These series are available from 1960 to present. This index, which has a base value of 2010 = 100, is selected in order to give non-energy goods prices. Thus, P = EPI / NEPI is a data that is formed as 1 in 2010.

The index, referred to as the Baltic Dry Index in the literature, is a measure of the shipping price of the main raw materials such as metals, grains and fossil fuels by sea. This index was created by the London Baltic Exchange based on daily assessments in the shipbrokers' panel. In addition to the distance factor stated as transportation costs, the basic reason for obtaining this index is to examine the effect of the change in transportation costs over time, even though the geographical distance factor has not changed over the years. The Baltic index variable is obtained by taking the closing value of that year. A delayed value is added to the empirical model because the costs of the previous year are included in the export value of any year. This data are obtained from the web page of Kitco (www. https://www.kitco.com/commentaries/2016-12-21/The-14-Year-Record-of-the-Baltic-Dry-Index.html).

6. EMPIRICAL FINDINGS

Empirical findings related to the study obtained by random effects, stochastic frontier, and fixed effect filtered estimation methods are given in Table 2.

Table 2: Comparative Panel Regression Estimation Results

Dependent Variables	**Random Effects**	**Stochastic Frontier Analysis Battase-Coelli (1988)**	**Stochastic Frontier Analysis Battase-Coelli (1995)**	**Fixed Effect Filtered Estimation**
Constant (a_0)	-34.26974* (2.409098)	-21.27551* (2.163573)	-27.22303* (1.31744)	--------------
$lnGDP_i$	1.675364* (0.0677464)	1.180706* (0.0708143)	1.180706* (0.0708143)	1.801606 * (0.2579459) t-value: 6.98
$lnGDP_j$	1.018883* (0.0677464)	0.9679818* (0.0548508)	0.9679818* (0.0548508)	0.943495 * (0.1848382) t-value: 5.10
$lnPOP_i$	-0.2836886* (0.0659222)	-0.1953826* (0.0559163)	-0.1953826* (0.0559163)	-1.170378 ** (0.6725445) t-value: -1.74
$lnPOP_j$	0.2433338* (0.0659222)	0.2194462* (0.0583534)	0.2194462* (0.0583534)	2.221958* (0.5450042) t-value: 4.08
$lnDISTANCE_{ij}$	-1.454534* (0.1231221)	-1.018775* (0.1205974)	-1.018775* (0.1205974)	-1.599759 * (0.2670403) t-value:- 5.99
lnP	-3.665815* (0.1342656)	-3.414778* (0.1321227)	-4.558542* (0.2045572)	-3.672662* (0.1917929) t-value: -19.15
$\ln BALTIC(t-1)$	-0.571338* (0.041869)	-0.6034138* (0.0420453)	-0.7669682* (0.0610107)	-0.5279338* (0.0339701) t-value: -15.54

$ln\ DGDPPC_{ij}$	-0.0883859* (0.0379097)	-0.1003383* (0.0358484)	-0.1607061* (0.0271357)	-0.028438 (0.0457542) t-value: - 0.62
$CONTIGUITY_{ij}$	0.4947797 (0.5904999)	0.4475561 (0.507605)	0.3201121 (0.2638846)	-0.5192702 (1.30884) t-value: - 0.40
$COMMON\ OFFICIAL\ LANGUAGE_{ij}$	-0.1731613 (0.5936326)	-0.3969789 (0.5366389)	-0.1661203 (0.2686025)	-0.5495505 (1.220326) t-value:-0.45
$COMMON\ ETHNIC\ LANGUAGE_{ij}$	0.4446814 (0.4949877)	0.322784 (0.4491613)	0.3775066** (0.2220182)	0.6982801 (1.069058) t-value: 0.65
$COLONY_{ij}$	0.7652988 (0.7334084)	0.5838432 (0.5506854)	0.8298744* (0.3321252)	0.5873516 (1.089948) t-value: 0.54
$COMCOL_{ij}$	2.025321* (0.3913951)	1.400664* (0.3233057)	1.778922* (0.1754524)	2.217859 * (0.9273259) t-value: 2.39
$COL45_{ij}$	0.3851858 (0.908389)	0.4045686 (0.7269412)	0.2082053 (0.4091852)	0.7017701 (1.54038) t-value: 0.46
Descriptive Statistics About Models				
OBSERVATION	7560	7560	7560	7560
F-Wald Statistics	3085.40	2546.11	7121.95	T-Statistics Critical Value at % 5 and % 10 levels are 1.96 and 1.65.
Prob>F	0.0000	0.0000	0.0000	
LOG-LIKELIHOOD	--------	-1.679e+04	-1.851e+04	

Values between parentheses are standard errors. * Significance level is 5%. ** Significance level is 10%.

Source: Calculated by authors using the STATA statistics program.

Consequently, considering the findings from the three econometric estimation methods; the gross domestic product and populations of both exporting and importing countries, price (P), distance, Baltic Dry Index and common colonizer variables are all statistically significant and have the same signs in all methods.

The GDP variable is both significant and positive for exporter and importer. The high GDP for the exporter means that the exporter countries are able to trade more, due to their comparative advantages. For the importer, having a high income means more imports.

The sign of the population of the exporter is negative, and the sign of the population of the importer is positive and significant. As mentioned earlier, there is no consensus in the literature regarding what the sign of the population would be. To have the negative sign of the exporting country's population means that the domestic market of the exporting country does not require internationalization due to its rich resource allocation. The population of the importing country has the positive sign; it means that imported products are effective in competing with domestic products. On the other hand, it indicates that the production level is inadequate due to the high domestic demand.

The estimation results suggest that the distance variable is negative and significant and therefore meet the theoretical expectation. Thus, transportation costs increase, and accordingly trade volume decreases.

The price variable P is the variable that forms the basic argument of our study. When the percentage change in the energy goods price index is more than the change in non-energy goods, the export elasticity is greater than 1 and negative. Accordingly, considering the elasticity relationship between energy and non-energy goods in the scale of the countries discussed, the reaction of exports to the percentage of change in energy goods prices is negative and more than one. The opposite is also true for the non-energy goods sector. In other words, a 1% increase in the relative price, expressed as P, would decrease the exports by 3.66% in Random Effect, 4.45% in Stochastic Frontier, and 3.67% in Fixed Effects Filtered Estimation Methods. As a result, the main hypothesis of the study, which suggests that the increase in energy prices will affect exports negatively, is confirmed. In this case, it can be interpreted that the terms of trade would be against the countries exporting non-energy goods.

The Baltic index is a measure of shipping prices. In this study, its effect on the trade is found to be negative and significant. Therefore, as global transportation costs increase, exports decrease.

The last important variable examined belongs to the common colony relationship. Results reveal that countries with common colonists have positive effects on trade.

In this context, policy suggestions for a total of eight variables are discussed in detail in the conclusion section of the article. However, as stated in the literature section, it should be noted that especially Chen and Hsu (2013), Sato and Dechezleprete (2015), and Rafiq, Sgro and Apergis (2016) are the closest studies to this subject. Therefore, it is important to compare the findings with the studies in the literature. Our empirical results in the work in hand, confirm Chen and Hsu (2013) in the sense that oil prices adversely affect the trade, the distance variable has negative while the GDP has positive signs. That is, Chen and Hsu (2013) find similar significant results in contiguity and common language, in a different way, insignificant results in population variables. Unlike our study, insignificant results are found in population variables, and significant results are found in contiguity and common languages.

Our study is compatible with the study of Sato and Dechezleprete (2015) in terms of GDP's positive sign, negative distance sign, insignificant contiguity and common official language, and the contraction effect of oil price increases on international trade. Rafiq, Sgro, and Apergis (2016) reveal that the increase in oil prices negatively affects the trade balance of oil-exporting countries. In this context, their results coincide with our study.

In summary, all studies reveal that price increases in energy goods affect trade negatively. In addition, the argument that the two major countries will trade more, becomes stronger with the result of positive GDP sign. The fact that the distance variable is negative and significant confirms the opinion that nearby countries trade more. Whether the common official language and contiguity variables are significant or not depends on the status of the data set. Therefore, the two main variables, namely GDP and distance, are very important in gravity model studies. In this study, these variables are also found to be significant and thus important.

7. CONCLUSION

Considering the results for all three estimation methods, namely Panel Random-Effects Estimation, Fixed Effects Filtered, and Stochastic Frontier Estimation Methods, the estimated coefficients of GDP_i, GDP_j, POP_i, POP_j, relative price (P), Baltic, distance, and common colonial (comcol) variables are all robust and consistent in terms of sign and significance.

In this context, it would be suitable to confirm that the countries need to focus on growth-oriented policies in order to increase their trade volume depending on their GDPs. Accordingly, high growth in the global economy causes an increase in international trade. Otherwise, trade may contract.

Our results suggest that the effect of the POP_i variable which indicates the population of the exporting country on trade is negative; while the effect of the POP_j variable which shows the population of the importing country on the trade is positive. Hence, the negative effect of the population variable for the exporter can be interpreted as the size of the domestic market and rich resource allocation.

The fact that the population variable of the importing country is positive enables imported goods to compete better with domestic goods and balances the foreign sales of domestic exporters. This result remarks economies of scale and encourages the country to make more trade with foreign trade partners in a wide variety of products. As a result, the problem arises as to what situation the policy proposal will be made for. According to all the methods used in this study and the findings of the econometric analyses, the effect of the importer's population variable on the trade is robustly greater and more significant as the regression coefficient than the effect of the exporter's population. Therefore, policy recommendations are comfortably made where the population of the importing country positively affects trade. In this framework, economies that consider the opportunities offered by economies of scale would provide a competitive advantage. Hence, countries require effective competition policies. In this context, efficiency should be increased; quality products should be developed with low prices and technological innovations should be made to ensure fair and effective competitive environments.

The common colonizer variable has a positive impact on exports and is significant. Although this variable is a fixed variable coming from the historical duration, it is important in terms of cultural affinity. In this context, countries with cultural ties in the past can continue their ties today and carry them to the next generations, which can increase the exports of countries. Beyond economic cooperation, it is also important that the increasing cultural convergence of countries will increase trade such as education, health, arts, and literature.

Considering both the time-varying Baltic index and the effect of the time-invariant distance variable, the increase in transportation costs negatively affects trade between countries. In this context, it is obvious that the implementation of effective logistics management methods will have significant improvement effects to produce effective policies reducing world transportation prices.

The relative increase in prices (EPI/NEPI) seems to negatively affect exports, which coincides with many studies in the literature. In this case, it is thought that the policies that can prevent the rise of energy prices, and the coordination of international economic policy, will positively affect the world trade volume. Thus, the artificial demand increase for fossil fuels created by consumers can be reduced. Therefore, clean energy subsidies that would encourage the use of alternative energy sources are recommended to be provided by the public sector to the system. In addition, it is important to create energy conservation awareness that will reduce the overuse of energy resources. Many actors in the economy have a duty to provide energy in a healthy and sustainable manner and to meet demand. At this point, it implies that it would be more beneficial for energy producers to invest in renewable energy sources in terms of sustainable ecological balance, since increasing fossil fuel supply causes negative environmental effects to meet the increasing demand.

As known, the transportation sector has the highest energy consumption, and fossil fuels are used in a significant part of this sector. Considering the energy consumption levels, the manufacturing industry is second, and as regards the domestic use in the third, the share of fossil fuels in these areas is considerably high. For this reason, the automotive sector, one of the main energy -consuming sectors, needs to develop hybrid vehicle technologies and even switch to the production of fully electric vehicles.

In addition, infrastructure and vehicle production for public transportation are suggested to be encouraged. It is also proposed that the manufacturing industry sector needs using substitute energy products as inputs in the production process instead of fossil fuels. It is obvious that increasing the use of solar panels and similar environmentally friendly technologies for self-contained domestic use can reduce the need for fossil fuels. At this point, increasing solar and wind power plants, which are included in the public energy production process, may decrease the demand for fossil fuels.

8. CONFLICT OF INTEREST STATEMENT

There is no conflict of interest between the authors.

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No funding or support was used in this study

10. AUTHOR CONTRIBUTIONS

MAD, UU: Idea and Design
MAD, UU: Theoretical Framework
MAD: Econometric Methodology
MAD: Data Collection and Processing
MAD: Data Analysis and Interpretation
MAD: Literature Review
MAD, UU: Writing of Article
MAD, UU: Interpretation of Findings
UU: Critical Review of Article

11. ETHICS COMMITTEE STATEMENT AND INTELLECTUAL PROPERTY COPYRIGHTS

Ethics committee principles were followed in the study. There has been no situation requiring permission within the framework of intellectual property and copyrights.

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Appendix1: Studies that Indirectly Examine the Relationship between Energy Price and World Trade

Researchers and Year of Research	**Sample**	**Method**	**Reason for Research**	**Main Finding**
Backus and Crucini (2000)	Developed 8 countries for the period 1955-1990.	Dynamic general equilibrium model	The effect of oil shocks on the general balance of the economy.	In terms of foreign trade, there is a negative relationship with oil prices outside of Canada.
Bridgman (2008)	United States of America – Canada water transportation data for the proxy of transportation costs 1960-2005 period.	Computable general equilibrium model	In this study, tariffs, energy prices, and the vertical specialization trade model in the energy-using transportation sector within the framework of these energy prices are examined.	They stated that oil shocks increase transportation costs and offset the falling tariff rates, so it is not necessary to change the price-import elasticity.
Welsch (2008)	In 4 European countries Germany, France, Italy, United Kingdom 15 goods groups. 1979-1990 period.	Armington elasticities and Johansen co-integration	The elasticity of goods as 60 country-commodity groups were calculated and modeled with time series. Here, it is aimed to find out which goods	It has been observed that elasticity is high in the machinery industry, but it is stated as a policy proposal that energy regulations affect these

			have superiority based on their elasticity values.	values in general.
Lutz and Meyer (2009)	Trade values of 25 goods and 1 service sector for a single country (Germany), GDP, Export Ratio, Disposable income, and the price index for 50 countries (Opec and Others) The simulations start in 2007 and make predictions for 2010 and 2020.	Extensive and disaggregated global GINFORS (global inter-industry forecasting System) model and the detailed INFORGE (inter-industry forecasting Germany) model for the German economy. These models are based on input-output analysis.	In this study, it was studied whether a permanent oil price increase has a stabilizing effect on international trade and the economy of an oil-importing country through an internal structural change on GDP.	From the perspective of Germany, it is seen that there is a shift from the consumer goods sector to the investment goods sector, and Germany's international competitive advantage has limited the negative impact of rising energy prices.
Kilian, Rebucci and Spatafora (2009)	Oil trade balance, non-oil trade balance, current account, capital gains, and changes in net foreign assets of the Oil Exporting Countries and the USA, Japan, Euro Area for the period 1970-2005.	Structural VAR (vector autoregressive) model	The aim of the study is to examine the effects of supply and demand shocks in global crude oil markets on external balances in the economy.	The effect of oil demand and supply shocks on the trade balance of oil-exporting and oil-importing countries also depends on the effect of the non-oil trade balance.
Abu- Bader and Abu-Qarn (2010)	Import/GDP and Export/GDP for the 1957-1993 period of 55 countries	Time Series (Vogelgang and Bai-Perron Structural Break Tests)	It has been stated that structural refractions in trade ratios occur with oil shocks rather than trade liberalization periods.	Most of the structural breaks in trade ratios in 55 countries occurred during the 1973/1974 and 1979/1980 oil shocks.
Huntington (2015)	Current account deficit as a dependent variable 91 countries for 1984-2009	Panel fixed-effect model.	A discussion has been made on how reducing oil import dependency can reduce a country's	Net oil exports create a current account surplus, while net oil imports do not

			trade deficit under certain conditions.	affect current account deficits.
Allegret, Mignon and Sallenave (2015)	GDP, equity price, current account balance, exchange rate, oil price, oil production value of 30 countries for the period 1980-2011	Global VAR model	To investigate the effects of oil price shocks and to examine their relationship with transmission channels on global imbalances.	Due to the nature of demand or supply shocks, the impact of oil price shocks on international imbalances is normal.
Timilsina (2015)	GDP sectoral trade for 27 sectors in 25 countries/regions The scenarios are implemented starting from 2012.	Computable general equilibrium model	Examine the impact of projected oil price increases on the global economy as well as specific regional/national economies.	Especially in terms of the effect of the study on international trade, it was seen that MENA increased its trade, high-income countries were not affected much, and their middle incomes were affected.
Abidin, Haseeb, Azam and Islam (2015)	Indonesia, Malaysia, Philippines, Singapore, Thailand for the period 2005-2013	Panel data evidence (Causality)	Causality between energy consumption and FDI and financial development and trade	There is bidirectional causality between trade and energy consumption.
Akman and Bozkurt (2016)	10 oil exporting countries and their main trading partners for the period 1950-2013	VAR	To investigate the indirect effect of oil prices on the trade of oil-exporting countries and their partners.	Imports of many oil-exporting countries are negatively affected by the indirect effect of oil prices.
Zhao, Li and Zhai (2016)	China and 6 gulf countries for the period 1994-2014	Panel GMM (general methods of moments) Model	It examines the effect of oil price volatility on China's trade with 6 Gulf countries.	Different types of oil price shocks have different effects on China-Gulf trade.

Szewerniak, Xu and Dall'erba (2016)	US States for 2002, 2007, and 2012	PPML (poisson pseudo-maximum-likelihood) panel Ordinary least squares panel	It is to examine the effect of diesel prices on the trade between the states of the USA.	The increase in diesel prices reduces the volume of trade.
Chan, Mandersson and Zhang (2017)	Energy and trade data for 43 countries and 10 manufacturing industry sectors for the period 1991-2012	Input-output PPML panel	The effect of energy costs in production on export performance examined.	Energy costs have a strong impact on exports.
Raheem (2017)	China, Germany, USA, India, Russia and Canada for the period January 1992 to June 2016	ARDL (Autoregressive distributed lag) Model NARDL (Non-linear ARDL) Model Bai-Perron structural break test	It is to examine the country-based effects of oil price changes on exports, imports and trade openness.	Exports of oil prices in Germany and China, which have high trade volumes in the long-term, the long-term imports of Russia and Canada, and the short-term imports of the USA and India asymmetrically affected.

Source: Prepared by Authors.