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THE POWER OF TRADE COSTS OVER INTERNATIONAL TRADE: CAUSALITY ANALYSIS IN FREQUENCY DOMAIN FOR TURKEY

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Abstract

The purpose of this paper is to find out the relation between foreign trade of Turkey and international trade costs (international commodity prices, transportation costs and exchange rate) by finding causality relations according to monthly time period. The data of our paper were taken from Central Bank of the Republic of Turkey (CBRT), United Nations Conference on Trade and Development (UNCTAD) and Bloomberg Markets database. The sample consists of 12 years in the period 2004:01 - 2015:12. We employ frequency domain Granger causality analysis that allows to short-run and long-run causality. The estimation of causality relation in frequency domain reveals that international trade costs could not be seen as causality indicator for international trade of Turkey except international commodity costs. Besides, causality relation between international commodity prices and import has been observed as of 4th month according to results. Therefore, the test results may draw new international trade strategies of Turkey.

Key Words: *Exchange Rate, International Commodity Index, International Trade, Transportation Cost.*

JEL Classification: *F14, F15, F19.*

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1. Introduction

International trade costs have close relationship with transaction and transportation costs. Intensification of economic transactions after Industrial Revolution has changed the perception towards trade costs. Sourdin and Pomfret (2012) believe that the reduction in trade costs provides trade facilitation which is an increasingly important for bilateral and regional trade agreements. According to Spulber (2007), international trade costs are called 'the four Ts': Transaction, Transportation, Tariff and non-Tariff and Time costs. Components of trade costs cover a wide range from transportation to language barriers of countries. That is, measurement of international trade costs varies among countries (Novy, 2009).

According to "2023 Turkey Export Strategy" the export share of country aims to reach 1.5% of global trade. Therefore, in this paper we use the dataset of global trade costs regarding transportation, input prices and exchange rates to find causality relation with international trade of Turkey. Econometric analysis of the study focuses on the real and nominal exchange rates, commodity prices and transportation costs. It is possible to add tariff rates to the analysis however free trade agreements and economic co-operation ties throughout the world has led to decrease the share of tariff rates on the trade costs. Besides, yearly computed tariff rates are not suitable for our monthly dataset. Instead of traditional Granger causality paper analyses the relation by decomposing Granger causality in the frequency domain. This econometric approach reveals the causality relation with respect to certain frequency (ω) rather than time. To the best of our knowledge, causality analysis from international trade costs to foreign trade of Turkey has not been studied via frequency domain. Results of the analysis will guide to decision makers regarding international trade policies of Turkey and provide opportunity to reach "2023 Turkey Export Strategy" targets Turkey by taking international trade costs.

The first section of the paper focuses on the literature about not only on Turkey but also global ones. In second section we introduce data and methodology of the study. Section three presents the empirical results of tests. In fourth section we conclude the paper with our findings.

1. REVIEW OF LITERATURE

Increasing trend of world population and development of countries require more intensified international trade ties. Although international costs of foreign trade are considered in the related literature individually, studies do not take into account collectively like our paper.

Initially, trade costs for a good affect world-based comparison of country in terms of comparative advantage over others and as a result of this transportation cost of international trade has been accepted as one of the most obvious cost for trade though trade theory neglects it (Deardorff, 2004). Sheppard (2012) mentions that 2008 global crisis had negative impacts on freight transportation all around the world and economies based on logistics experienced a particular kind of crisis. In addition to this transport costs of trade relate with many fields. Jong et. al. (2013) imply that full freight models cover from economic activities to assignment of vehicles in all supply chain structure. Krugman (1992) tries to explain intra-industry trade via imperfect competition with transportation costs. Also, study of Berthelon and Freund (2008) show that distance related trade costs have remained same for many sectors and high initial trade costs of goods, such as tariff and transportation, give more importance to distance sensibility.

Another cost for international trade is about input prices. A change in costs of inputs leads to shift the supply curve. Higher input prices will attract to produce less and lead to shift supply curve to the left (Begg et. al., 1994). Therefore, global commodity prices affect the international trade volume throughout the world. Sugden (2009) considers that international commodity prices volatility challenges economic management in Asia and Pacific and causes to high inflation and prices that threat growth. Slow growth is directly able to decrease the international trade volume of the country.

Thirdly, the relation of exchange rate and international trade has been seen as a popular topic by scientists for many years. Numerous studies regarding this topic have focused on this relation. Hooper and Kohlhagen

(1978), Cushman (1983), Grauwe (1988), Viaene and Vries (1992), Tenreyro (2007) are some of them who study regarding the impact of exchange rate volatility and risks over international trade. Moreover, Anderson and Wincoop (2004) define the exchange rate as one aspect of international trade costs.

However, academic studies on trade costs and international trade of Turkey literature generally discuss the impact of real exchange rate over trade of Turkey. Whereas Oz (2011) and Tapsin and Karabulut (2013) find out relation in their papers, Yildirim and Kesikoglu (2012) state that there was no relation between real exchange rate and international trade of Turkey. On the other hand, Kustepeli et. al. (2012) focus on effect of highway infrastructure investments over international trade of Turkey. The empirical results imply that there is no such a relation between two variables for the period of 1970 to 2005. Besides, Isik (2013) studies impact of international financial crisis on the international trade of Turkey. Author finds that global financial crisis affected trade of Turkey negatively due to high dependency regarding intermediate goods of Turkey's produced ones.

This paper takes these fundamental trade costs that never been studied together and examines the impact of trade costs over international trade of Turkey within a multidimensional perspective. The study aims to contribute not only providing theoretical infrastructure but also practical results to international trade literature.

2. DATA AND METHODOLOGY

We argue that the causality of trade costs over the international trade of Turkey via monthly declared datasets. To test the frequency domain Granger causality, we collect ten year interval monthly data (publication period of trade statistics of Turkey is monthly) between 2004:01 – 2015:12. Although the number of related study is limited, some papers discuss regarding to detect and measure international trade costs. The costs of international trade in the literature have certain dimensions including transportation, international commodity prices and exchange rates.

Golub and Tomasik (2008) estimate a new method for country specific transport costs which is based on direct measures of air, maritime and road transport costs by calculating as costs of goods per kilogram. Besides, Gaulier et. al. (2008) use a new method for transportation cost calculation via CIF/FOB ratio. Additionally, seaborne shipments carried four fifths of total world merchandise trade and two thirds of total belongs to dry cargo shipment (UNCTAD, 2015). Therefore, Baltic Dry Index (BDI) is included to causality test for international trade of Turkey. BDI was created by Baltic Exchange which was established in 1744 at negotiations between merchants and ships' captains for price of cargo sea transportation services. The Baltic Exchange is designed by the expectations of sea transportation brokers to determine price levels for a given line and goods to transport and time to delivery. BDI index is seen a reliable and independent source for cost of maritime transportation and volume of international trade operations (Oomen, 2012). Apergis and Payne (2013) mention that BDI is a significant component for the cost of trade and sensitive to demand changes for raw materials and global trade.

Besides, the raw materials that are compositions of commodities are initial part of production process. The data sets of international commodity price index are provided by United Nations Conference on Trade and Development (UNCTAD). The commodity price index has been calculated as of January 1960 by monthly. The data set covers all food (food and tropical beverages, vegetable oilseeds and oils), agricultural raw materials (cotton, linseed oil, tobacco, wool, woods and rubber) and minerals, ores and metals (phosphate, manganese, iron ore, aluminum, copper, zinc, gold, silver, crude petroleum and nickel).

Lastly, exchange rate is another discussable topic for international trade papers and literature. Effective exchange rates in terms of real and nominal (US Dollar - Turkish Lira) are obtained from Central Bank Data of Turkey. The calculation of real effective exchange rate differs from nominal effective exchange rate that shows weighted average value of Turkish Lira relative to currencies of major trade partners. Real effective exchange rate is computed prices in Turkey relative to prices of basic trade partners as geometric average including 36 countries (Central Bank of Turkey, 2014).

Our paper analyses the causality relation with trade figures of Turkey under frequency domain that provides frequency bands as it depends on time. Benhmad (2012) emphasizes that economic time series are usually analyzed time domain tests. Therefore it is the main motivation of using frequency domain analysis in our study. Initially we start to test the variables for unit roots in order to find suitable stationary levels of the datasets. In particular, the analysis of the variables is problematic due to data period that covers crisis years. Standard unit root tests possibly lead to misleading results due to number of datasets structural breaks. Rapid fluctuations of the series for a short period change the stationary levels of the variables. Therefore, the study employs the Kapetanios (2005) m-breaks unit root test which allows at most five unknown structural breaks of the series endogenously. Kapetanios (2005) unit root test was developed from Zivot and Andrews (1992) and Lumsdaine and Papell (1997) unit root tests. The following model (1) is the main result of Kapetanios (2005) m-breaks unit root test:

$$y_t = {}_0 + {}_1 t + y_{t-1} + \sum_{i=1}^{k} \gamma \Delta y_{t-i} + \sum_{i=1}^{m} \phi_i \, DU_{i,t} + \sum_{i=1}^{m} \psi \qquad (1)$$

The dummy variables DUi,t = 1 (t > T b,i) and DTi,t = 1 (t > T b,i) (t-T b,i) indicate structural break in the mean and trend. Also, Tb,i denotes the time of ith structural break and or 0 according to if argument of the function is true, indicator function takes 1 however otherwise it takes 0. The null hypothesis is H0 = ρ = 1, μ1 = 1 = 2 = …. = smax = ψ1 = ψ2 = …. = ψsmax = 0. The minimum t-statistic for all ρ up to m breaks minimize sum of squared residuals in the (1) equation estimation up to i structural breaks (Kapetanios, 2005).

We use Granger causality for revealing the relation between international trade costs and international trade of Turkey. Causal effect of one time series to another was formulated by Granger (1969, 1980) studies. Some papers such as Yildirim and Tastan (2012) demonstrate that the significance and direction of the Granger causality in time domain can change after integrating in frequency domain test (Aslanoglu and Deniz, 2012). Breitung and Candelon (2006) Granger causality test that is based on a new methodology by contributing to studies of Geweke (1982) and Hosoya (1991) takes into notice of these drawbacks. Test of Breitung and Candelon allows testing the causality over different frequencies in a VAR system (Bozoklu and Yilanci, 2013). Frequency domain demonstrates that how a variable changes other one over time. This technique provides more decisive interpretation of Granger causality with a decomposition of interdependence between two series by giving specific time period (Tiwari et. al., 2015).

Initially, let zt = [xt , yt] is a two-dimensional vector that is observed at t = 1, …… , T and zt has a finite-order VAR in the form of:

$$(L)z_t = \quad t, \qquad (2)$$

The Moving Average (MA) representation of system that is assumed as stationary is:

$$z_t = \phi(L) \; {}_t = \begin{bmatrix} \phi_{11}(L) & \phi_{12}(L) \\ \phi_{21}(L) & \phi_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_1 t \\ \varepsilon_2 t \end{bmatrix} = (L) \; {}_t = \begin{bmatrix} \psi_{11}(L) & \psi_{12}(L) \\ \psi_{21}(L) & \psi_{22}(L) \end{bmatrix} \begin{bmatrix} \eta_1 t \\ \eta_2 t \end{bmatrix}, \qquad (3)$$

where $\phi(L) = \phi(L)^{-1}$ and $\psi(L) = (L)G^{-1}$. G represents the lower matrix of Cholesky decomposition G G = $\sum^{-1}$, such that E(tt) = I and $_t = G\varepsilon_t$. Based on representation the spectral density of x_t can be written as:

$$f_x(\;) = \frac{1}{2\pi}\{| \; {}_{11}(e^{-i} \;)|^2 + | \; {}_{12}(e^{-i} \;)|^2\} \qquad (4)$$

In the stationary case, causality for Breitung and Candelon (2006) as in the following form:

$$M_{y \quad x}(\quad) = \log 1 + \frac{|\psi_{12}(e^{-i\omega})|^2}{|\psi_{11}(e^{-i\omega})|^2} \qquad (5)$$

If $(\psi_{12}(e\text{-}i\omega)) = 0$, it means that y does not cause x at frequency ω.

3. EMPIRICAL ANALYSIS

The study takes the each dataset separately to find out their relations with international trade of Turkey. Initially, unit root analyses of variables are required to make accurate forecasting. Application of least squares regressions on non-stationary variables is able to clear away spurious regression misleading estimation of relationship between variables (Mahadeva and Robinson, 2004). Absence of the unit root means stationary of data and fluctuations around a constant long-run mean and finite variance. Meanwhile, non-stationary series do not reject the random-walk hypothesis and shocks of past that have impact on current values (Granger and Swanson, 1997). Kapetanios m-break unit root test results are given at Table 1:

Table 1. Kapetanios Unit Root Test Results

Level	**BDI**	**Com.**	**Exp.**	**Imp.**	**Nom. Exc.**	**Real Exc.**
t- stat	5.49**	3.60	4.291	3.648	3.827	4.545
Break Dates	July 2008	July 2005	Sep 2008	Jan 2008	Dec 2004	April 2011
	1st Differences of Variables					
t- stat	-	5.686**	14.083***	12.412***	11.84***	9.958***
Break Dates	-	March 2008	May 2008	Jan 2009	March 2005	October 2005

*, ** and *** denote significance successively at the 0.1, 0.05 and 0.01 level.

Note: Com., Exp., Imp. and Nom. Exc. mean successively International Commodity Price Index, Export of Turkey, Import of Turkey and Nominal Exchange Rate.

Datasets of export and import are stationary at levels. However, BDI, Commodity Price Index nominal exchange rate and real effective exchange rate are stationary at first differences. Also, all variables have one break date that generally occurs in during 2008 global financial crisis. Break dates of BDI and international commodity price index may be seen as global pre-indicators for 2008 financial crisis. We also test the causality relationship between international trade costs - transportation, raw material and exchange costs - and international trade of Turkey both export and import in following figures at Table 2 by using Breitung and Candelon (2006) frequency domain causality test:

Table 2. Causality Test Results in Frequency Domain

		$0 < \omega < 0.5$	$0.5 < \omega < \pi$
International Costs	*Frequency*	*Higher than 12 Months*	*2 Months to 12 Months*
BDI	causes Export	No	No
	causes Import	No	No
Commodity Prices	causes Export	No	No
	causes Import	*Yes*	*Yes* (but no up to 4 months)
Real Exc. Rate	causes Export	No	No
	causes Import	No	No
Nominal Exc. Rate	causes Export	No	No
	causes Import	No	No

The critical value of χ2 distribution with 2 degrees of freedom for 5% is 5.99 which is drawn as horizontal dashed lines by representing the frequency (ω) □ (0, π). According to the test results, all variables except commodity prices have no causality over the international trade of Turkey. Null hypothesis is rejected for import or partially by commodity prices. The causality relation between international commodity prices and import of Turkey is observed as of 4 months. On the other hand, for short periods (until 4 months) the causality relation between international commodity prices and import has not been observed.

4. CONCLUSION REMARKS

The main target of this paper is to investigate causality link between international trade costs and international trade of Turkey as a developing country. Breitung and Candelon (2006) frequency domain approach demonstrates causality relations of series. Empirical test results indicate that there is no causality between transportation costs and exchange rates with international trade of Turkey in the period 2004:01 - 2015:12. Conversely, international commodity price index is Granger cause of Turkey's import for frequencies less than 1.7 that corresponds to 3.7 months and higher month-cycles. International commodity prices have capacity to affect the import of Turkey for short and long term periods in that term.

The trade share of raw materials -iron, steel, chemical products- of Turkey can be seen the reason of this causality relation. For next years, Turkey could shift the structure of export to more value added and technological goods to decrease the direct impacts of international commodity prices. According to Turkey country economic memorandum report by World Bank (2014), high-tech export capacity is low and this causes to lack of comparative advantage among other peers.

Additionally, Turkey international trade causality relation with other international cost variables has not been observed between 2004:01 and 2015:12. However, Oz (2011) states that the real exchange rate affects foreign trade balance via import as the result of Tapsin and Karabulut's (2013) study. Another study Yildirim and Kesikoglu (2012) find out that there was no relation between real exchange rate and international trade of Turkey. The study reveals that the causality from real and nominal exchange rates to import and export is not valid for trade of Turkey. It is possible to say that high import proportion in export products -the parts of vehicles other than railway, machineries and mechanical appliances, electrical machinery and equipment are common for the top five place of export and import- lead to remove causality effect of nominal and real effective exchange rate. Also, communiqué in 17/05/2011 official gazette about the inward process regime states that Turkey allows importing for export of automotive sector and textile up to 65%, for leather, cement and ceramic products up to 60%, for forestry products up to 70%. The high share of import and low-tech goods composition in export leads to be affected from international commodity prices. As a result, international trade costs could not be seen as causality indicator for international trade of Turkey except international commodity costs. The low share of Turkey in world trade is another key factor for frequency domain causality. The import share of Turkey is 1.3% whereas export is 0.8% in total world trade as of 2014. When trade share of Turkey increases, the causality relations might changes. Paper also demonstrates the BDI as global financial crisis indicator via break date (July 2008). Policy makers of Turkey can take into account these results before deciding to new strategies. International commodity prices directly impacts over import of Turkey in last decade. Nevertheless, future studies can focus on not only internal dynamics but also externals for international trade of Turkey because it is undeniable fact that the period of study covers a global financial crisis which affected all around the world.

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APPENDIX

Figure 1.

Causality Test in Frequency Domain: BDI ➔ Export

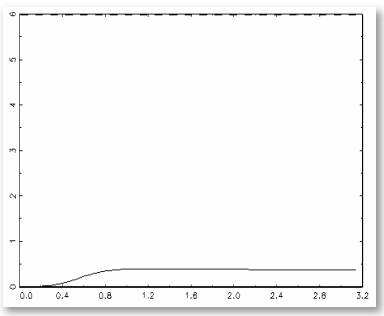

Figure 2.

Causality Test in Frequency Domain:
Commodity Prices ➔ Export

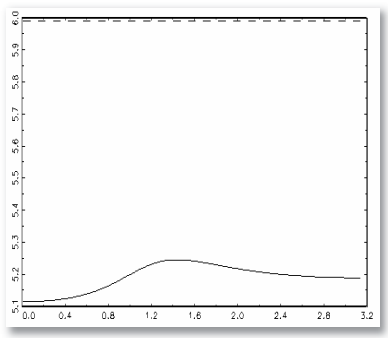

Figure 3.

Causality Test in Frequency Domain:

Real Exchange Rate ➔ Export

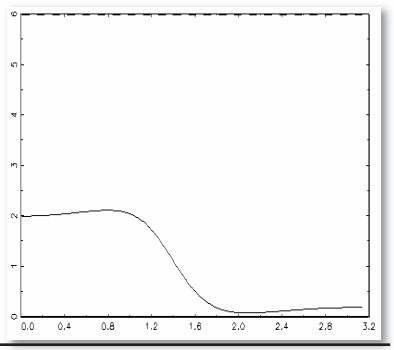

Figure 4.

Causality Test in Frequency Domain:

Nominal Exchange Rate ➔ Export

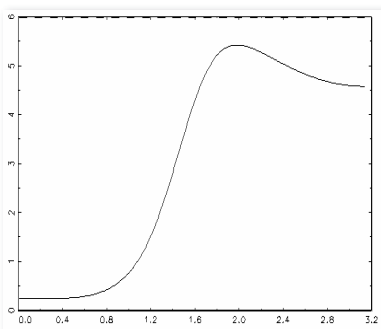

Figure 5.

Causality Test in Frequency Domain: BDI ➔ Import

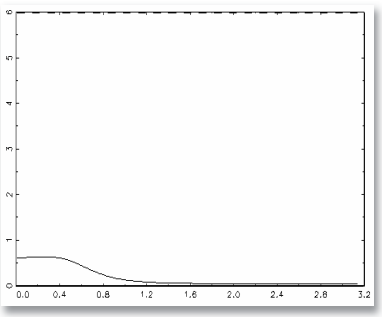

Figure 6.

Causality Test in Frequency Domain:

Commodity Prices ➔ Import

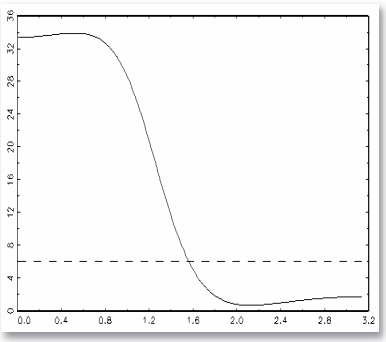

Figure 7.

Causality Test in Frequency Domain:

Real Exchange Rate ➔ Import

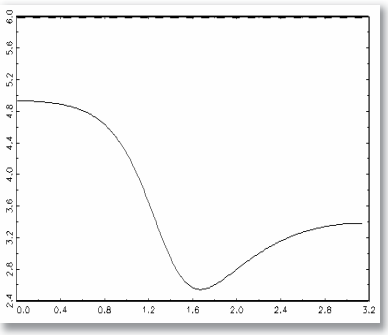

Figure 8.

Causality Test in Frequency Domain:

Nominal Exchange Rate ➔ Import