Testing for Symmetric and Asymmetric Causality between FDI and Foreign Trade in Turkey

Uğur Korkut Pata[1]
Harun Terzi[2]

In this paper, the relationship between FDI and foreign trade is investigated by symmetric; Sims (1972), Dolado-Lütkepohl (1996), Hacker-Hatemi (2006) and asymmetric; Hatemi-J (2012) causality analysis after the liberalization period 1983-2014 for the Turkish economy. The results of the empirical analysis show that unidirectional positive and statistically significant causality is going from total (goods and services) and only goods export, import and foreign trade (total import and export) to FDI. The conclusion is that findings point out to the existence of complementary relationship between the variables. Consequently, these results support that the government should encourage foreign trade to increase FDI inflows in Turkey.

Keywords: *FDI, Foreign Trade, Symmetric and Asymmetric Causality Tests, Turkey.*

JEL Classifications: F21, F14, C22.

[1] **Uğur Korkut Pata**, Res. Assist., Karadeniz Technical University Department of Economics, Trabzon/ Turkey, e-mail: korkutpata@ktu.edu.tr
[2] **Harun Terzi**, Prof. Dr., Karadeniz Technical University Department of Economics, Trabzon/ Turkey, e-mail: hterzi@ktu.edu.tr

1. Introduction

Globalization, which is assumed to raise social wealth and welfare, accelerates the exchange of goods and services between countries and provides a financial, political, and global integration. In the literature, foreign direct investments (FDIs) are major factor for less-developed and developing countries, especially complement to increase not only foreign trade but also level of national income, employment, economic growth, production, productivity, technology, competition and welfare. Countries prefer establishing new factories and maintaining continuity through FDIs rather than short-term capital inflows such as portfolio investments (e.g. stocks and bonds) (Seyidoğlu, 2015: 651). FDI affects countries' balance of payments and funds the countries with underdeveloped capital stock. Theoretically, trade restrictions (negatively) or trade liberalization (positively) can affect FDI. Foreign trade and FDI are the substitutes of each other for countries where customs tariffs and restrictions are effective (Liu, Wang, and Wei, 2001: 192). If an investor who will make an FDI in a country knows that some restrictive policies will be implemented in the country in future, he will be reluctant to invest in this country or even withdraw from it. The units deciding to make FDI with a quest of more profitable markets by opening to foreign countries can make their investments more comfortably in those countries where there are no restrictions or heavy taxation on export and import. Export subsidies and conveniences in the import of intermediate goods and raw materials are among the factors making things easier in the countries to which FDI inflow takes place.

The Theories; Absolute Advantage of Adam Smith and Comparative Advantage of David Ricardo, which defend that foreign trade is beneficial, do not include FDI in analyses by assuming that there is no capital mobility between the countries. Although Mundell's two-country and two-commodity, foreign trade model is one of the pioneering models explaining FDI, it remains incapable of explaining it

precisely as foreign portfolio investments are also contained in the model.
If there is a negative relationship between foreign trade and FDI, these two variables are the substitutes of each other; however, if there is a positive relationship between them, they are the complements of each other. Heckscher-Ohlin-Samuelson theory held that foreign trade will take place between the countries using factors in different intensities and finish when factor prices become equal in the end. It was assumed according to Heckscher-Ohlin theory in the first studies dealing with the relationship between FDI and foreign trade that there is a substitution relationship between FDI and foreign trade in the periods involving a lot of obstacles restricting trade. However, the studies carried out after Heckscher-Ohlin showed that there is a complementary relationship between FDI and foreign trade.
Contrary to the idea that the investments which are called export-based investments or vertical FDIs promote export through increased investment and funding as a complement of foreign trade, if the purpose of the vertical FDI coming to a country is to get into other markets by passing through heavy customs tariffs and leave the country, such investment may not promote export in the country (Sultan, 2013: 1). In vertical FDIs, investors seek a place where they can find raw materials and make production, mostly engage in global and regional sales. In horizontal FDIs, investors have a lot of buyers in the local market to whom they can sell their goods and only engage in sales in the country where they are settled. While vertical FDI serves as a complement of foreign trade by leading to export and import, horizontal FDI may not promote import and export by standing as the substitute of foreign trade because sales are domestic in it. According to another view, if FDI and foreign trade are the complements of each other, foreign trade will raise productivity in the country, and inflowing FDI will make firms more competitive. Local firms and multinational companies settled in a country can have more competitive export in the

course of time, and increased export leads to a rise in the FDI made in these firms. Similarly, incoming FDI can bring about a rise in export and import by improving the productivity of firms. As countries get into new markets by raising their export, import, and achieve increased productivity, decreased costs through division of labor and specialization, they can attract foreign direct investors that are seeking profitable markets for themselves. Thanks to exports, capital accumulation and technology transfer increase and firms make progress with learn by doing. As a result, foreign capital inflow accelerates. Turkey's export-oriented import that involves raw materials and intermediate goods as a large part of total import. Therefore, import and export can promote FDI inflow together.

Before the 1980s, Turkey was not a center of attraction for FDIs due to political instability and hyperinflation. FDI inflow into Turkey increased as the number of multinational companies rose across the world as a result of globalization as of the 1980s. After Turkey switched to export-oriented strategy from import-substitution strategy with the decisions made on 24 January 1980, drastic increases took place in Turkey's import and export. A recovery occurred in FDI in the early 2000s. With the "Foreign Direct Investment Law" no. 4875 entering into force on 17 June 2003, FDIs were re-defined. More subsidies and opportunities were introduced for FDI, and bureaucratic obstacles and restrictive tariffs were eliminated. The purpose of the law no. 4875 is to make up the deficiencies of the Law on Encouragement of Foreign Capital no. 6224 remaining in force from 18 January 1954 to 17 June 2003, expand the scope of FDIs, and reassure foreign investors at international standards, thereby increasing FDI inflows.

In 2014, approximately 2% increase took place in FDIs in developing countries. With such increase, the highest level of global FDI reached 681 billion dollars (UNCTAD, 2015: 3). Turkey, which had the highest FDI income in 2011 (i.e. 16 billion dollars), was one of the countries receiving most FDIs in Western Asia with an amount of 12.1 billion dollars in 2014 despite a 2% decrease in FDIs (UNCTAD, 2015: 54). Turkey's export of goods, import of goods, and total trade of goods were 157, 242 and 400 billion dollars in 2014 respectively. In the same year, the country's import of services 15, and export of services 53 billion dollars. Trade in services was quite low relative to trade in goods. The purpose of the present study is to investigate the relationship between foreign trade and FDIs within the scope of goods and services. To this end, analyses were made for the following relationships with six models: 1-) Export of goods (Export of goods and services) - FDI, 2-) Import of goods (Import of goods and services) - FDI, 3-) Total trade in goods (Total trade in goods and services) - FDI.

2. Empirical Literature on FDI and Foreign Trade

In this section, 20 studies are presented within the scope of the literature review. These studies analyze openness, only trade in goods, total trade, trade in services and goods, and the shares of these variables in GDP. Nine of these 20 studies have focused on Turkey.

Liu, Wang, and Wei (2001) performed an unrestricted VAR causality analysis of China for the period 1984-1998 by using panel data. They found that import increases FDI, FDI increases export and there is a complementary relationship between these variables. Alıcı and Ucal (2003) employed Toda-Yamamoto causality analysis and determined that there is no relationship between foreign trade and FDI for Turkey from the period 1987q1-2002q4. Pacheco-Lopez (2005) employed Johansen-Juselius cointegration and error correction model for Mexico from the period 1970-2000, identified a two-way causality relationship between import, export and FDI. Karagöz and Karagöz (2006) concluded that there is no causality relationship between FDI and export with the EG-cointegration from the period 1980-2002 for Turkey. Altıntaş (2009) detected that import increases FDI and FDI increases export through Johansen-Juselius cointegration and vector error correction model for Turkey from the period 1996q1-2007q2.

Temiz and Gökmen (2009) used Granger causality analysis, Johansen-Juselius cointegration and vector error correction model for Turkey over the period 1991m3-2008m11 and found that there is a positive one-way causality relationship from export to FDI. Wong and Tang (2009) carried out Toda-Yamamoto Granger causality test for Malaysia covering the period 1999q1-2006q3 and determined that there is a positive one-way causality relationship from import and export to FDI. Iqbal, Shaikh, and Shar (2010) employed Johansen-Juselius cointegration and vector error correction model for Pakistan over the period of 1988q1-2005q4, and identified a two-way causality relationship between FDI and export, a one-way causality relationship from import to FDI.

Pradhan (2010) used the least squares method for Pakistan from the period 1980-2007 and concluded that while there was no relationship between the two variables in the pre-globalization period 1980-1990, trade openness played an import role in promoting FDI in the post-globalization period 1991-2007 and the state must encourage trade liberalization. Anwar and Nguyen (2011) carried out a study for Vietnam in the period 1990-2007 by use of the gravity model and identified a complementary relationship between FDI, import and export.

Kiran (2011) conducted Dolado-Lütkepohl and Granger causality tests for Turkey from the period 1992q1-2008q4 and found that there is no causality relationship between the share of export in GDP and the share of FDI in GDP. Klasra (2011) used the ARDL bounds testing and error correction model for Turkey and Pakistan covering the period of 1975-2004 and detected a two-way causality relationship between export and FDI for Turkey, but identified no relationship between trade openness or export and FDI for Pakistan.

Tang and Wong (2011) employed unrestricted VAR, impulse response, and variance decomposition analyses for Cambodia from the period 1994q4-2006q4 and found that there is a one-way causality relationship from FDI to import and export of goods, from import of services to FDI, and from FDI to export of services.

Liagrovas and Skandalis (2012) utilized a panel data regression analysis for 36 developing countries from the period 1990-2008 and determined that trade liberalization measured based on eight different variables increases FDI in the long term.

Çetin and Seker (2013) carried out Toda-Yamamoto and Dolado-Lütkepohl Granger causality tests for eight developing countries from the period 1980-2009. At the end of the Toda-Yamamoto causality test, they detected a causality relationship from export to FDI in Turkey and Pakistan and from FDI to export in Mexico and Poland. According to results of the Dolado-Lütkepohl causality test, however, they identified a causality relationship from export to FDI in Pakistan and Thailand and from FDI to export in Poland.

Sharma and Kaur (2013) used Granger causality analysis for China and India from the period 1976-2002 and found a one-way causality relationship from FDI to export and import in China, and a two-way causality relationship between FDI and export and import in India. Sultan (2013) used Johansen-Juselius cointegration and vector error correction model for India from the period 1980-2010, determined a causality relationship from export to FDI in the long term. Cambazoğlu and Güneç (2014) employed Johansen-Juselius cointegration and vector error correction model for Turkey from the period 1980-2012 and found that there is a two-way causality relationship between import of services and FDI and a one-way relationship from export of services to FDI.

Guriş and Gözgör (2015) concluded that there is a causality relationship from trade openness to FDI with Granger causality test in the case of Turkey for the period of 1986-2010. Sinha, Bhar and Gole (2015) utilized Johansen-Juselius cointegration analysis for India over the period 1970-2013 and identified no relationship between FDI and foreign trade.

19 of 20 studies in the literature did not take the foreign trade separately as trade in goods and trade in services. Only Tang and Wong (2011) took them separately and dealt with the relationship between FDI and foreign trade. The above-mentioned 20 studies do not have any clear consensus on the direction of the causality relationship due to the differences in countries examined, periods focused on, and methods employed.

3. Dataset, Method, and Empirical Findings

The variables of the study covering the period 1983-2014 (i.e. import of goods [IMG], export of goods [EXG], total trade in goods [FTG], import of goods and services [IMGS], export of goods and services [EXGS], total trade in goods and services [FTGS], the foreign trade variables logarithmically included in the analysis, and foreign direct investment [FDI]) were made real through dollar deflator by 2010.

Table 1

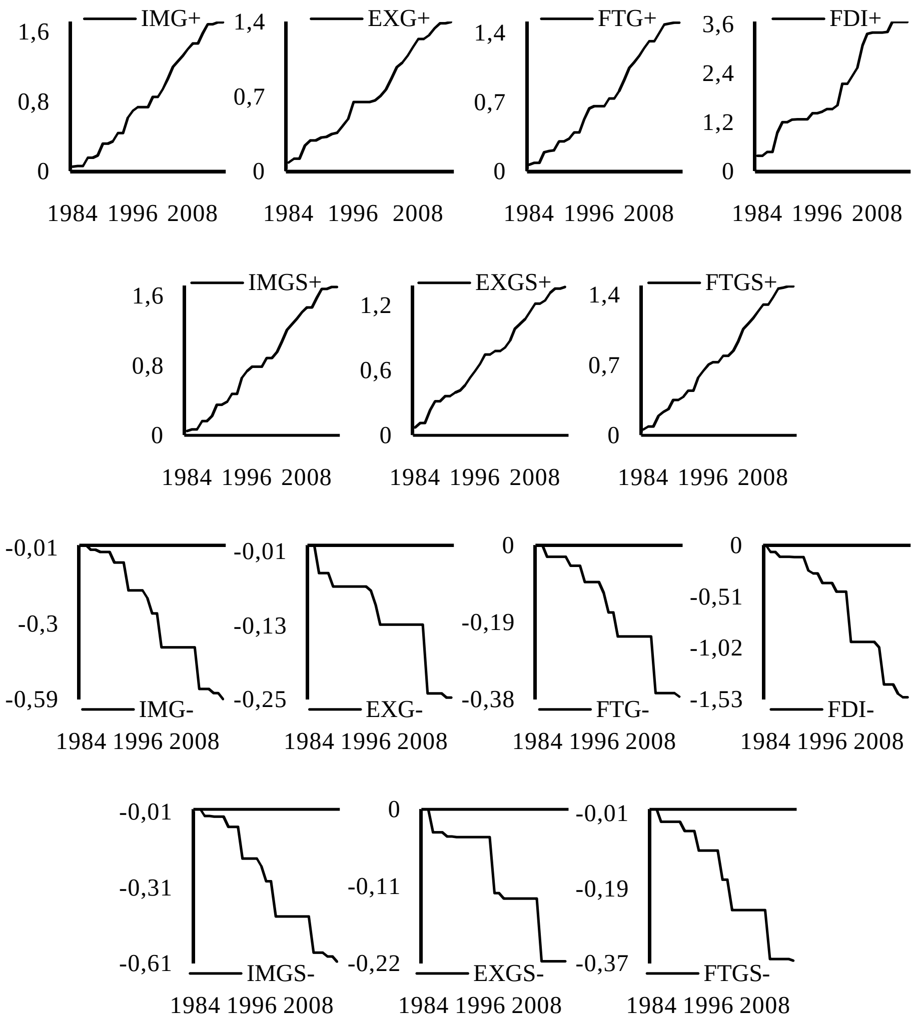
Pearson Correlation Matrix and Descriptive Statistics

Variables	EXGS	IMGS	FTGS	EXG	IMG	FTG	FDI
EXGS	1	0.99***	0.99***	0.99***	0.99***	0.99***	0.94***
IMGS	0.99***	1	0.99***	0.99***	0.99***		0.94***
FTGS	0.99***	0.99***	1	0.99***	0.99		0.94***
EXG	0.99***	0.99***	0.99***	1	0.99***		0.94***
IMG	0.99***	0.99***	0.99***	0.99***	1		0.94***
FTG	0.99***	0.99***	0.99***	0.99***	0.99***	0.99***	0.94***
FDI	0.94***	0.94***	0.94***	0.94***	0.94***	0.94***	1
Mean	10.78	10.85	11.12	10.64	10.80	11.03	9.28
Median	10.80	10.82	10.11	10.61	10.77	11.00	9.08
Skewness	-0.05	0.11	0.04	0.14	0.17	0.16	0.02
Kurtosis	1.77	1.76	1.76	1.65	1.70	1.68	2.05
Jarque-Bera	2.03	2.13	2.05	2.53	2.42	2.47	1.19
p-value	0.36	0.34	0.36	0.28	0.30	0.29	0.55

Note: Coefficients are significant at the (1%)*** level.

Figure 1

Positive and Negative Shocks of Variables



Descriptive statistics and Pearson correlation matrix in this study are used to describe the basic features of the data. The Pearson's correlation coefficient that is seen to be at least 0.94 and 0.99 in the Table 1 above indicates that there is a positive relationship between FDI and foreign trade variables, but this coefficient gives no precise information about the direction and the existence of the causality between the variables. The descriptive statistics of the variables presented in the table show that the series have a normal distribution.

It is seen from the Figure 1 above that the variables decomposed into positive and negative shocks have trends in the level values.

3.1. ADF and PP Unit Root Tests

In the Sims (1972) causality test, when the series contain unit root, the estimators of the model are not efficient and consistent. No unit root test is required for the three causality tests to be analyzed. Unit root tests are carried out with Augmented Dickey-Fuller (1981) (ADF) and Phillips-Perron (1988) (PP) tests, which are among pioneering unit root tests for the Sims (1972) causality analysis.

Table 2

ADF and PP Unit Root Tests Results

	ADF		PP	
Variable	C	C+T	C	C+T
EXGS	-0.96 (0)	-3.05 (0)	-1.11 (5)	-3.06 (3)
IMGS	-0.71 (0)	-3.40 (0)	-0.64 (1)	-3.41 (1)
FTGS	-0.74 (0)	-3.15 (0)	-0.72 (2)	-3.15 (0)
EXG	-0.56 (0)	-2.92 (1)	-0.52 (5)	-2.51 (2)
IMG	-0.61 (0)	-3.37 (0)	-0.61 (0)	-3.35 (2)
FTG	-0.54 (0)	-2.78 (0)	-0.49 (2)	-2.83 (1)
FDI	-1.68 (0)	-2.62 (0)	-1.69 (5)	-2.74 (2)
ΔEXGS	-5.80 (0)***	-5.73 (0)***	-6.25 (5)***	-6.20 (5)***
ΔIMGS	-6.92 (0)***	-6.80 (0)***	-7.15 (3)***	-7.01 (3)***
ΔFTGS	-6.40 (0)***	-6.30 (0)***	-6.50 (3)***	-6.38 (3)***
ΔEXG	-5.00 (0)***	-4.91 (0)***	-5.31 (7)***	-5.19 (7)***
ΔIMG	-7.13 (0)***	-7.01 (0)***	-7.34 (2)***	-7.20 (2)***
ΔFTG	-5.97 (0)***	-5.86 (0)***	-6.02 (2)***	-5.91 (2)***
ΔFDI	-5.80 (0)***	-5.71 (0)***	-6.08 (6)***	-6.00 (6)***

Note: Optimal lags are in parentheses selected by the AIC and SIC. ***: significant at 1% level.

As shown in the Table 2 above, clearly indicates that six foreign trade variables and FDI have a unit root (non-stationarity variables) in their levels, but after the first difference, the unit root is rejected at the 1% level, and these seven variables become stationary, I(1).

3.2. The Sims Causality Analysis

In the Sims (1972) causality test besides the Granger (1969) causality test, the future values of the independent variable are included in the analysis based on the lag length determined according to criteria such as AIC and SIC in addition to its past values. The Sims causality test differs from the Granger (1969) causality test in that the direction of the causality is tested from the dependent variable to the independent variable in the created model. The series determined at the end of the unit root tests I(1) were included in the analysis at the first difference.

$$FDI_t=\alpha_1+\sum_{i=1}^{i=m}\beta_i FDI_{t-i}+\sum_{i=1}^{i=n}\gamma_i FTGS_{t-i}+\sum_{i=1}^{i=p}\mu_i FTGS_{t+i}+e_{1t} \quad (1)$$

$$FTGS_t=\alpha_2+\sum_{i=1}^{i=m}\delta_i FTGS_{t-i}+\sum_{i=1}^{i=n}\theta_i FDI_{t-i}+\sum_{i=1}^{i=p}\emptyset_i FDI_{t+i}+e_{2t} \quad (2)$$

In the equation 1 and 2 respectively, H_0 hypotheses "FDI is not the Granger cause of FTGS" and "FTGS is not the Granger cause of FDI" are tested as $\mu_i=0$ and $\emptyset_i=0$, and alternative hypotheses are tested as $\mu i_i\neq0$ and $\emptyset_i\neq0$. When the H_0 hypothesis is rejected, a causality relationship is recognized from the dependent variable to the independent variable.

According to the result of the Sims causality test obtained at the 10% level of significance with optimal lag in the Table 3 bellow, there is a positive one-way causality from total trade in goods, total trade in goods and services, and import of goods, import of goods and services to FDI. The p-values of diagnostic tests for the validity of four models indicate that estimating equations provide accurate estimate of causal effect.

Table 3

Sims Causality Test Results

Model	F-statistic [p-value]	Causality and direction	Model	2(8)	3(9)
1-)EXGS=*f*(EXGS(-1), FDI(-1) FDI(1))	1.91 [0.17]	-	LM	0.13	0.14
2-)IMGS=*f*(IMGS(1), FDI(-1) FDI(1))	3.27 [0.08]	**IMGS→FDI (+0.12)***	BGP	0.27	0.47
3-)FTGS=*f*(FTGS(1), FDI(-1) FDI(1))	3.16 [0.09]	**FTGS→FDI (+0.09)***	JB	0.64	0.35
4-)FDI=*f*(FDI(1), EXGS(-1) EXGS(1))	0.14 [0.71]	-	Reset	0.68	0.98
5-)FDI=*f*(FDI(1), IMGS(-1) IMGS(1))	0.41 [0.53]	-	White	0.43	0.31
6-)FDI=*f*(FDI(1), FTGS(-1) FTGS(1))	0.25 [0.62]	-	Arch	0.70	0.91
7-)EXG=*f*(EXG(1), FDI(-1) FDI(1))	1.28 [0.27]	-	LM	0.12	0.30
8-)IMG=*f*(IMG(-1), FDI(-1) FDI(1))	3.36 [0.08]	**IMG→FDI (+0.12)***	BGP	0.31	0.41
9-)FTG=*f*(FTG(-1), FDI(-1) FDI(1))	3.37 [0.08]	**FTG→FDI (+0.10)***	JB	0.68	0.52
10-)FDI=*f*(FDI(-1), EXG(-1) EXG(1))	0.50 [0.48]	-	Reset	0.95	0.56
11-)FDI=*f*(FDI(1), IMG(-1) IMG(1))	0.27 [0.61]	-	White	0.41	0.45
12-)FDI=*f*(FDI(-1), FTG(-1) FTG(1))	0.58 [0.46]	-	Arch	0.89	0.71

Note: Optimal lags are selected by Akaike information criteria (AIC). *: significant at 10% level.

3.3. The Dolado-Lütkepohl Granger Causality Analysis

Series are included in Granger (1969), Sims (1972), and Hsiao (1981) causality analyses at the same level of integration, and information loss occurs in the tests carried out with the series identified I(1) or I(2) in the long term. In the Granger causality test based on the VAR model developed by Toda-Yamamoto (1995) in which long-term information loss is prevented through inclusion of the variables in analysis at their levels and no leading cointegration is required, d_{max}, which is the maximum integration degree of the variables, is added to the optimal lag length determined through information criteria such as AIC, SBC, HQ, and FPE to strengthen the significance of the model, and the modified Wald (MWald) test is performed in testing the causality. Dolado-Lütkepohl (1996) suggests adding a lag of +1 to the optimal lag length determined through information criteria to strengthen the significance of the model from any leading test application rather than adding d_{max}, which is the maximum integration degree of the variables, to the optimal lag length as in the TY-VAR analysis. The series are included in analysis at their levels regardless of their levels of stationarity, as in the TY-VAR analysis. The estimated VAR model is showed in the equation (3) and (4).

$$FDI_t = \alpha_{10} + \sum_{i=1}^{m+1} \alpha_{1(i+1)} FDI_{t-(i+1)} + \sum_{i=1}^{m+1} \alpha_{1(i+1)} EXG_{t-(i+1)} + u_{1t} \quad (3)$$

$$EXG_t = \alpha_{20} + \sum_{i=1}^{m+1} \alpha_{2(i+1)} EXG_{t-(i+1)} + \sum_{i=1}^{m+1} \alpha_{2(i+1)} FDI_{t-(i+1)} + u_{1t} \quad (4)$$

The expression of the DL-VAR model, in which the relationship between export of goods and FDI is illustrated and optimal lag lengths are determined to be 1 through information criteria such as LR, FPE, AIC, SBC, and HQ, in the matrix form (5) is as follows:

$$\begin{bmatrix} FDI_t \\ EXG_t \end{bmatrix} : \begin{bmatrix} \alpha_{10} \\ \alpha_{20} \end{bmatrix} + \begin{bmatrix} a_{11}^1 & a_{12}^1 \\ a_{21}^1 & a_{22}^1 \end{bmatrix} \begin{bmatrix} FDI_{t-1} \\ EXG_{t-1} \end{bmatrix} + \begin{bmatrix} a_{11}^2 & a_{12}^2 \\ a_{21}^2 & a_{22}^2 \end{bmatrix} \begin{bmatrix} FDI_{t-2} \\ EXG_{t-2} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (5)$$

The hypothesis "FDI is not the Granger cause of EXG" is tested with H_0: $a_{12}^1=0$, and the hypothesis "EXG is not the Granger cause of FDI" is tested with H_0: $a_{21}^1=0$. When both null hypotheses are rejected at the end of the MWald test, it is decided that there is a two-way causality relationship between the two variables.

Table 4

Dolado-Lütkepohl Granger Causality Test Results

Model	χ2- value	p-value	Causality and direction	m+1
1. FDI=*f*(EXGS) EXGS=*f*(FDI)	3.58 0.03	0.05** 0.86	**EXGS→FDI +(1.63)**** -	1+1=2
2. FDI=*f*(IMGS) IMGS=*f*(FDI)	6.75 1.00	0.01*** 0.32	**IMGS→FDI +(1.32)***** -	1+1=2
3. FDI=*f*(FTGS) FTGS=*f*(FDI)	6.50 0.40	0.01*** 0.53	**FTGS→FDI +(1.71)***** -	1+1=2
4. FDI=*f*(EXG) MX=*f*(FDI)	2.28 0.31	0.13 0.57	- -	1+1=2
5. FDI=*f*(IMG) IMG=*f*(FDI)	7.17 0.61	0.01*** 0.44	**IMG→FDI +(1.31)***** -	1+1=2
6. FDI=*f*(FTG) FTG=*f*(FDI)	6.29 0.47	0.01*** 0.49	**FTG→FDI +(1.54)***** -	1+1=2
Diagnostic Tests	LM	JB	AR Roots Max; Min	White
Model 1	<0.63	0.60	0.98; 0.18	0.15
Model 2	<0.64	0.67	0.97; 0.07	0.38
Model 3	<0.87	0.65	0.98; 0.17	0.32
Model 5	<0.62	0.74	0.98; 0.09	0.21
Model 6	<0.63	0.78	0.98; 0.14	0.21

Note: ( ): value of m lag. ***: and ** significant at 1% and 5% level respectively.

According to the Dolado-Lütkepohl Granger causality test results based on the bi-variate VAR model in the Table 4, there is a causality relationship from five foreign trade variables other than export of goods to FDI at a 1% level of significance. The diagnostic tests carried out for five models provide the requirements for the error terms of the models to be BLUE (there is no problem about normal distribution, autocorrelation, and heteroscedasticity), and the AR roots found to be less than 1 prove that the estimated five VAR models are stable.

3.4. The Hacker-Hatemi Causality Test

In the Hacker-Hatemi (2006) causality test, the autoregressive conditional heteroscedasticity (ARCH) test, which was developed by

Engle (1982), was carried out to see whether there was heteroscedasticity problem in the model. As asymptotic distribution can yield misleading results in the cases having few observations, analysis was made with the resampling-based bootstrap simulation developed by Bradley Efron (1979). Bootstrap simulation allows obtaining more reliable table critical values. For each simulation, representative data and bootstrapped error terms are produced in the OLS equation under the constraint of null hypothesis that there is no Granger causality. Hacker-Hatemi (2006) provide more robust results in bootstrap table with critical values than the asymptotic chi-square distribution for $d_{max}=1$ VAR(1), VAR(2) and $d_{max}=2$ VAR(2) models with some exceptions in VAR(1) models.

The most appropriate model can be established when the optimal lag length is determined through information criteria such as Hannan Quinn (HQ) and Schwarz-Bayesian (SIC) (Yılancı and Bozoklu, 2014: 215). As different results can be obtained from the models separately solved through these two information criteria, Hatemi-J (2003) developed Hatemi-J (HJC) information criterion involving these two information criteria.

$$HJC=\ln(|\widehat{\Omega}|+j\left(\frac{n^2\ln T+2n^2\ln(\ln T)}{2T}\right), j=0\ldots\ldots,k. \quad (6)$$

In the equation (6), $|\widehat{\Omega}|j$ indicates the variance-covariance matrix of the error terms of the VAR model estimated based on the lag length; n indicates the number of equations in the VAR model; and T indicates the number of observations. The Table 5 below presents the causality findings through comparison of the test statistic estimated in the Hacker-Hatemi (2006) causality test by adding a lag of +1 to the optimal lag length determined based on the HJC information criterion regardless of the integration degree of the variables as done by Yılancı and Bozoklu (2014) following the recommendation of Dolado-Lütkepohl (1996) with the bootstrapped table critical values.

Table 5

Hacker-Hatemi Causality Test Results

Model	Test Value	1%	5%	10%	Lags
IMGS→FDI	**6.75****	7.84	4.33	2.95	2
FTGS→FDI	**6.50****	7.96	4.31	2.97	2
EXGS→FDI	**3.58***	8.22	4.40	3.00	2
FDI→IMGS	1.00	7.92	4.33	2.93	2
FDI→FTGS	0.40	7.78	4.30	2.97	2
FDI→EXGS	0.03	8.05	4.42	2.91	2
IMG→FDI	**7.17****	7.82	4.30	2.93	2
FTG→FDI	**6.29****	7.68	4.24	2.97	2
EXG→FDI	2.82	8.04	4.25	2.94	2
FDI→IMG	0.61	7.84	4.33	2.94	2
FDI→FTG	0.47	7.99	4.41	2.96	2
FDI→EXG	0.32	8.10	4.39	3.03	2

Note: Optimal lags are selected by based on HJC. Number of bootstrap replication 10000.

3.5. Hatemi-J Asymmetric Causality Test

Granger and Newbold (1974), who improved the Granger (1969) causality test through Monte Carlo simulation, found that if the variables are not stationary, the results of the asymptotic distribution-based regression analysis can be deviant and exaggerated. In the Sims (1972) and Hsiao (1981) causality tests, just like in the Granger (1969) causality test, taking the difference of the series causes a long-term information loss in the results. Christopher Sims (1980) found that even if the variables are cointegrated, appropriate and statistically significant results can be obtained in the VAR model used for stationary values. Based on the VAR model, Toda and Yamamoto (1995) developed a Wald test that can be administered without considering the integration or cointegration characteristics of the variables. Dolado and Lütkepohl (1996) determined the Wald test of Toda-Yamamoto having an asymptotic distribution only for those variables which were stationary at their first differences. Hacker and Hatemi (2006) improved this test by using bootstrap simulation in order to obtain better results. In addition, they determined whether the TY-VAR analysis is sensitive to the ARCH effect and normality. In the Sims (1972), Dolado-Lütkepohl (DL) (1995), and Hacker-Hatemi (2006) symmetric causality analyses in the present study, the causality effects of the positive changes are considered to be the same as those of the negative changes. The responses given by individuals, firms, and decision-making units to the positive and negative shocks in the variables differ. In addition, they determined whether the TY-VAR analysis is sensitive to the ARCH effect and normality. In the Sims (1972), Dolado-Lütkepohl (DL) (1995), and Hacker-Hatemi (2006) symmetric causality analyses in the present study, the causality effects of the positive changes are considered to be the same as those of the negative changes. The responses given by individuals, firms, and decision-making units to the positive and negative shocks in the variables differ. Hatemi-J (2012) improved Granger and Yoon's (2002) asymmetric cointegration test for the Granger causality test.

$$FDI_t=FDI_{t-1}+\varepsilon_{1t}=FDI_{1,0}+\sum_{i=1}^{t}\varepsilon_{1i} \quad (7)$$

$$IMG_t=IMG_{t-1}+\varepsilon_{2t}=IMG_{2,0}+\sum_{i=1}^{t}\varepsilon_{2i} \quad (8)$$

In the equation (7) and (8), t= 1,2,3,4…..T, $FDI_{1,0}$ and $IMG_{2,0}$ are constant terms (initial values); and ε_{1i} and ε_{2i} are white noise stationary error terms. Positive and negative shocks are as follows: $\varepsilon_{1i}^{+}= \max(\varepsilon_{1i},0)$, $\varepsilon_{2i}^{+}=\max(\varepsilon_{2i},0)$; $\varepsilon_{1i}^{-}=\min(\varepsilon_{1i},0)$, and $\varepsilon_{2i}^{-}=\min(\varepsilon_{2i},0)$. As a whole, they can be expressed as $\varepsilon_{1i}=\varepsilon_{1i}^{+}+\varepsilon_{1i}^{-}$ and $\varepsilon_{2i}=\varepsilon_{2i}^{+}+\varepsilon_{2i}^{-}$. After the decomposition, the situation is as indicated in the equation (9) and (10).

$$FDI_t=FDI_{t-1}+\varepsilon_{1t}=FDI_{1,0}+\sum_{i=1}^{t}\varepsilon_{1_i}^{+}+\sum_{i=1}^{t}\varepsilon_{1_i}^{-} \quad (9)$$

$$EXG_t=EXG_{t-1}+\varepsilon_{1t}=EXG_{2,0}+\sum_{i=1}^{t}\varepsilon_{2_i}^{+}\sum_{i=1}^{t}\varepsilon_{2_i}^{-} \quad (10)$$

After the variables are decomposed into positive and negative shocks, the X=DZ+δ VAR model is estimated. The expressions in the equation are respectively as follows:

$X=(x_1^+, x_2^+, x_3^+ \ldots, x_T^+)(nxT)$ matrix,
$D=(\alpha, A_1, A_2, A_3 \ldots\ldots, A_k)(nx(1+nk))$ matrix;

$$Z_t=\begin{bmatrix} 1 \\ x_t^+ \\ x_{t-1}^+ \\ . \\ . \\ . \\ x_{t-k+1}^+ \end{bmatrix}\big((1+nk)x1\big)\text{matrix, } t=1,\ldots,T,$$

$Z=(Z_0, Z_1, Z_2 \ldots., Z_{T-1})((1+nkxT)$ matrix.
$\delta=(u_1^+, u_2^+, u_3^+ \ldots, u_T^+)(nxT)$ matrix. In this case, the main hypothesis $H_0=C\beta=0$ indicating that there is no Granger causality is tested with the Equation (11) below.

$$Wald=(C\beta)'\left[C\left((Z'Z)^{-1}\otimes S_u\right)C'\right]^{-1}(C\beta) \quad (11)$$

β=vec(D), vec indicates column accumulation operator. $\otimes$ represents the Kronecker product, and C is the indicator function matrix in kxn(1+nk) size involving constraints. With q showing the parameters in each VAR model, $S_u=\hat{\delta}_U'\hat{\delta}_U/(T-q)$ indicates the variance-covariance matrix calculated for the VAR model. After the estimation is made, the equation $X^*=\hat{D}Z+\delta^*$ is estimated through bootstrap simulation. δ^* refers to bootstrap error terms. Bootstrap simulation is repeated 10.000 times, and the Wald test is carried out at each repetition (Hatemi, 2012: 451). If the bootstrap obtained in the Wald test carried out at the last stage is greater than the table critical value, the null hypothesis is rejected, and it is accepted that there is an asymmetric causality. The asymmetric causality test through the bootstrap method can yield meaningful results even if there are ARCH effect and normal distribution problems in the model (Hatemi, 2012: 454).

Table 6

Hatemi-J Asymmetric Causality Test Results

Model	Test Value	1%	5%	10%	Lags
$IMGS^- \rightarrow FDI^-$	**7.38****	15.40	5.89	3.32	2
$IMGS^+ \rightarrow FDI^+$	**6.06****	8.39	4.51	3.02	2
$FDI^- \rightarrow IMGS^-$	0.02	10.02	4.50	2.92	2
$FDI^+ \rightarrow IMGS^+$	1.14	8.27	4.35	3.01	2
$EXGS^- \rightarrow FDI^-$	0.36	15.50	5.05	2.76	2
$EXGS^+ \rightarrow FDI^+$	**7.95****	8.43	4.43	3.04	2
$FDI^- \rightarrow EXGS^-$	0.47	14.84	4.98	2.80	2
$FDI^+ \rightarrow EXGS^+$	0.05	7.90	4.34	3.02	2
$FTGS^- \rightarrow FDI^-$	**7.46****	15.45	5.37	2.93	2
$FTGS^+ \rightarrow FDI^+$	**8.87*****	8.11	4.52	3.04	2
$FDI^- \rightarrow FTGS^-$	0.02	10.84	4.36	2.75	2
$FDI^+ \rightarrow FTGS^+$	0.69	8.04	4.30	2.96	2
$IMG^- \rightarrow FDI^-$	**7.70****	16.10	5.85	3.21	2
$IMG^+ \rightarrow FDI^+$	**8.56*****	8.41	4.47	3.04	2
$FDI^- \rightarrow IMG^-$	0.01	10.81	4.60	2.89	2
$FDI^+ \rightarrow IMG^+$	0.82	8.40	4.39	3.00	2
$EXG^- \rightarrow FDI^-$	0.00	14.03	5.06	2.82	2
$EXG^+ \rightarrow FDI^+$	**6.02****	8.12	4.49	3.05	2
$FDI^- \rightarrow EXG^-$	0.42	19.44	5.62	2.80	2
$FDI^+ \rightarrow EXG^+$	1.93	8.11	4.24	2.91	2
$FTG^- \rightarrow FDI^-$	**4.81***	17.00	5.46	2.73	2
$FTG^+ \rightarrow FDI^+$	**10.44*****	8.09	4.45	3.04	2
$FDI^- \rightarrow FTG^-$	0.17	13.46	4.53	2.75	2
$FDI^+ \rightarrow FTG^+$	1.45	7.69	4.41	2.95	2

Note: Optimal lags are selected by based on HJC. Number of bootstrap replication 10000.

According to the Table 6 above shows the results of the Hatemi-J (2012) asymmetric causality test, there is a causality between the positive shocks of total trade in goods and services and those of FDI; between the positive shocks of total trade in goods and those of FDI; and between the positive shocks of total import of goods and total import of goods and services and those of FDI. In addition, there is a causality between the negative shocks of total trade in goods and services and those of FDI; between the negative shocks of total trade in goods and those of FDI; and between the negative shocks of total import of goods and total import of goods and services and those of FDI. The Table 6 also indicates that while there is a causality from the positive shocks of export of goods and export of goods and services to only positive shocks of FDI, there is no causality between the negative shocks of these two variables. The findings confirm the results of the Sims (1972), Dolado-Lütkepohl (1996), and Hacker-Hatemi (2006) causality tests.

Table 7

Cusum and Cusum-sq Test Results

Model DL-VAR/ [Sims]	Cusum Test Value	p-value	Cusum-sq Test Value	p-value
IMGS-FDI	0.56 [0.50]	0.50 [0.65]	0.17 [0.09]	0.57 [1.00]
EXGS-FDI	0.49	0.67	0.22	0.29
FTGS-FDI	0.58 [0.54]	0.46 [0.56]	0.17 [0.14]	0.60 [0.76]
IMG-FDI	0.49 [0.62]	0.66 [0.37]	0.12 [0.22]	0.95 [0.30]
FTG-FDI	0.55 [0.25]	0.52 [0.58]	0.17 [0.22]	0.56 [0.30]

Note: [ ] Parentheses in the Cusum, Cusum-sq tests are the Sims causality test values.

Finally, for five models determined to have causality relationship in the Table 7 above, the null hypothesis indicating that there is no structural break in the Cusum and Cusum-sq tests of Brown, Durbin, and Evans (1975) was not rejected, and it was confirmed in the Sims and DL-VAR analyses that there is no structural break problem.

4. Conclusion

In the globalizing world, less-developed and developing countries make attempts to take more share from foreign trade. The most important sources of foreign trade that contribute to a country's development are stated to be export and FDI in the literature. Many countries implemented policies to attract the importance of foreign trade and FDIs for economic development.

At the end of the Sims (1972), Dolado-Lütkepohl (1996), Hacker-Hatemi (2006), and Hatemi-J (2012) causality tests that were carried out in the present study focusing on the 1983-2014 period following the liberalization decisions in Turkey, a positive causality was detected from import and export of goods, import and export of goods and services, and total trade to FDI. The findings were confirmed through decomposition of positive and negative shocks. According to the findings, the decisions made on 24 January 1980 have been effective in attracting foreign trade and FDI to the country. The government must maintain the policies encouraging foreign trade and provide productivity and efficiency growth in order to attract FDI. The findings prove that FDI is attracted to the country as the Turkish economy liberalizes, obstacles to import and export are eliminated, and incentives are provided. In the light of these findings, import and export growth must be ensured and foreign trade must be encouraged, thereby achieving an increase in FDI inflow to the country. Variables other than FDI can be more effective in increasing only trade in goods and total foreign trade. The finding indicating that there is positive causality from import, export, and total foreign trade to FDI shows that there is a complementary rather than substitution relationship between the two variables. Therefore, Turkey should have policy that is aimed at improving FDI growth through foreign trade.

References

Alıcı, A. A. and Ucal, M. Ş. (2003). Foreign direct investment, exports and output growth of Turkey: Causality analysis, *In European Trade Study Group (ETSG) fifth annual conference,* Madrid, pp.11-13.

Altıntaş, H. (2009). Türkiye'de doğrudan yabancı sermaye girişi ve dış ticaret arasındaki ilişkinin ekonometrik analizi: 1996-2007, *Ankara Üniversitesi SBF Dergisi*, 64(2), pp.1-30.

Anwar, S. and Nguyen, L. P. (2011). Foreign direct investment and trade: The case of Vietnam, *Research in International Business and Finance*, 25(1), pp.39-52.
Brown, R. L., Durbin, J. and Evans, J. M. (1975). Techniques for testing the constancy of regression relationships over time-with discussion, *Journal of Royal Statistical Society*, Series B, 37, pp.150-155.
Cambazoğlu, B. and Güneş, S. (2014). The relationship between foreign direct investment and trade: a case study for the Turkish service sector, *Economics, Management, and Financial Markets*, 9(4), pp.158-166.
Çetin, M. and Seker, F. (2013). Doğrudan yabancı yatırımlar ve ihracat ilişkisi: Gelişmekte olan ülkeler üzerine bir nedensellik analizi, *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*, 8(1), pp.121-142.
Dickey, D. A. and Fuller, W. A. (1981). Likelihood ratio statistics for an autoregressive time series with a unit root, *Econometrica*, 49(4), pp.1057-1072.
Dolado, J. J. and Lütkepohl, H. (1996). Making Wald tests work for cointegrated VAR systems. *Econometric Reviews*, 15(4), pp.369-386.
Efron, B. (1979). Bootstrap methods: another look at the jackknife, *Annals of Statistics*, 7(1), pp.1–26.
Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods, *Econometrica: Journal of the Econometric Society*, 37(3), pp.424-438.
Granger, C. W. and Newbold, P. (1974). Spurious regressions in econometrics, *Journal of Econometrics*, 2(2), pp.111-120.
Granger, C. W. and Yoon, G. (2002). Hidden cointegration. University of California, Working Paper 2002–02.
Güriş, S. and Gözgör, K. (2015). Trade openness and FDI inflows in Turkey, *Applied Econometrics and International Development,* 15(2), pp.53-62.
Hacker, R. S. and Hatemi-J, A. (2006). Tests for causality between integrated variables using asymptotic and bootstrap distributions: theory and application, *Applied Economics*, 38(13), pp.1489-1500.

Hatemi-J, A. (2012). Asymmetric causality tests with an application, *Empirical Economics*, 43(1), pp.447-456.
Hsiao, C. (1981). Autoregressive modelling and money-income causality detection, *Journal of Monetary Economics*, 7(1), pp.85-106.
Iqbal, M. S., Shaikh, F. M. and Shar, A. H. (2010). Causality relationship between foreign direct investment, trade and economic growth in Pakistan, *Asian Social Science*, 6(9), pp.82-89.
Karagöz, M. and Karagöz, K. (2006). Türk ekonomisinde ihracat ve doğrudan yabancı yatırım ilişkisi: Bir zaman serisi analizi, *AİBÜ-İİBF Ekonomik ve Sosyal Araştırmalar Dergisi*, 3(2), pp.117-126.
Kiran, B. (2011). Causal links between foreign direct investment and trade in Turkey, *International Journal of Economics and Finance*, 3(2), pp.150-158.
Klasra, M. A. (2011). Foreign direct investment, trade openness and economic growth in Pakistan and Turkey: An investigation using bounds test, *Quality & Quantity*, 45(1), pp.223-231.
Liargovas, P. G. and Skandalis, K. S. (2012). Foreign direct investment and trade openness: The case of developing economies, *Social Indicators Research*, 106(2), pp.323-331.
Liu, X., Wang, C. and Wei, Y. (2001). Causal links between foreign direct investment and trade in China, *China Economic Review*, 12(2), pp.190-202.
Pacheco-Lopez, P. (2005). Foreign direct investment, exports and imports in Mexico, *The World Economy*, 28(8), pp.1157-1172.
Phillips, P. C. and Perron, P. (1988). Testing for a unit root in time series regression, *Biometrika*, 75(2), pp.335-346.
Pradhan, R. P. (2010). Trade openness and foreign direct investment in India: The globalization experience, *IUP Journal of Applied Finance*, 16(3), pp.26-43.
Seyidoğlu, H. (2015). Uluslararası iktisat: Teori politika ve uygulama (20.Baskı), İstanbul: Güzem Can Yayınları.

Sharma, R. and Kaur, M. (2013). Causal links between foreign direct investments and trade: A comparative study of India and China, *Eurasian Journal of Business and Economics*, 6(11), pp.75-91.
Sims, C. A. (1972). Money, income, and causality, *The American economic review*, 62(4), pp.540-552.
Sims, C. A. (1980). Macroeconomics and reality, *Econometrica: Journal of the Econometric Society*, 48(1), pp.1-48.
Sinha, M., Bhar, M. and Gole, M. K. (2015). Foreign direct investment and international trade: An empirical exercise for India, *Suprayaga*, 5, pp.128-137.
Sultan, Z. A. (2013). A causal relationship between FDI inflows and export: The case of India, *Journal of Economics and Sustainable Development*, 4(2), pp.1-9.
Tang, T. C. and Wong, K. N. (2011). Foreign direct investment, merchandise and services trade in a transition economy: The case of Cambodia, *International Economic Journal*, 25(2), pp.251-267.
Temiz, D. and Gökmen, A. (2009). Foreign direct investment and export in Turkey: The period of 1991-2008, *EconAnadolu 2009: Anadolu International Conference in Economics*. Eskişehir: Turkey.
UNCTAD, (2015). World investment report 2015, *Reforming International Investment Governance*, Geneva.
Wong, K. N. and Tang, T. C. (2009). New evidence on the causal linkages between foreign direct investment, exports and imports in Malaysia, *ICFAI Journal of Applied Economics*, 8(1), pp.20-25.
Yilanci, V. and Bozoklu, S. (2014). Türk sermaye piyasasında fiyat ve işlem hacmi ilişkisi: Zamanla değişen asimetrik nedensellik analizi, *Ege Akademik Bakış*, 14(2), pp.211-220.