Montenegrin Journal of Economics

Relationship between Life Expectancy, Foreign Direct Investment and Trade Openness: Evidence from Turkey

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ARTICLE INFO

ABSTRACT

This is the first study in the single country studies that analyze the relationship between life expectancy, foreign direct investment and trade openness for Turkey for the period 1974 to 2017. The long run relationship between variables is analyzed by ARDL (Autoregressive Distributed Lag) model. Short run and long run causal relationships between variables are analyzed by VECM (Vector Error Correction) model. Nonlinear ARDL model is also used to analyze the non-linear relationships between the variables. Hypotheses, that are examined in this study, are impact of FINV net inflow and TOPEN on LEXP, unidirectional causality running from FINV net inflow and TOPEN to LEXP, asymmetric relationship between LEXP, FINV net inflow and TOPEN and asymmetric relationship between FINV net inflow and TOPEN in Turkey. According to the results in this study, long run relationship is found between the variables, and foreign direct investment affects significantly and positively life expectancy in the long run. No causal relationship from foreign direct investment and trade openness to life expectancy is found in the long run and in the short run. Trade openness does not significantly affect life expectancy in the long run. Nonlinear relationship between the variables is also not confirmed. Asymmetric relationship between trade openness and foreign direct investment is confirmed. While decrease in trade does not have a significant impact on foreign direct investment, increase in trade has a significant positive impact on foreign direct investment.

INTRODUCTION

The aim of this study is to analyze the relationship between life expectancy (LEXP), trade openness (TOPEN) and foreign direct investment (FINV) following the study of Alam, Raza, Shahbaz and Abbas (2016) for Pakistan. Alam, Raza, Shahbaz and Abbas confirmed that FINV and TOPEN had positive impact on LEXP and there was unidirectional causality running from FINV and TOPEN to LEXP in the short run in Pakistan for the period 1972 to 2013. Alam, Raza, Shahbaz and Abbas stated the study of Pakistan was the first study to examine the relationship between LEXP, TOPEN and FINV. There is a research gap in the literature for analyzing the relationships between LEXP, TOPEN and FINV, and TOPEN and FINV

for developing countries. The contribution of this study is that it is the first study that analyzes relationships between LEXP, TOPEN and FINV, and TOPEN and FINV for Turkey and it is also the first study that further investigates for nonlinear relationships between the variables besides linear relationships for Turkey which is a developing country.

LEXP in Turkey increased continuously from 54 to 77 for the period 1974 to 2017 (Figure 1). LEXP is expected to grow further in Turkey as LEXP is also expected to increase further worldwide. FINV started to increase by 1980s as the government of Turkey started to apply open market policy in Turkey (Figure 2). The government of Turkey still provides incentives for foreign companies to invest in Turkey in order to increase the overall FINV. TOPEN, which is indicated as the ratio of sum of import and exports to gross domestic product of Turkey, started to increase as the government of Turkey started to apply open market economy (Figure 3). Literature review is examined by the relationship between TOPEN and population health, the relationship between FINV and population health, the relationship between FINV and TOPEN and the relationship between FINV and sustainable development. This study investigated population health-FINV-TOPEN nexus and FINV-TOPEN nexus in Turkey.

Following hypotheses are examined in order to investigate the relationships between LEXP, TOPEN and FINV.

H1: There is significant and positive impact of FINV net inflow on LEXP in Turkey.
H2: There is significant and positive impact of TOPEN on LEXP in Turkey.
H3: There is unidirectional causality running from FINV net inflow to LEXP in Turkey.
H4: There is unidirectional causality running from TOPEN to LEXP in Turkey.
H5: There is asymmetric relationship between LEXP, FINV net inflow and TOPEN in Turkey.
H6: There is asymmetric relationship between FINV net inflow and TOPEN in Turkey.

Relationship between LEXP, FINV and TOPEN is examined by Augmented distributed lag (ARDL) model by Pesaran, Shin and Smith (2001) and symmetric cointegration is analyzed. After ARDL model application, nonlinear ARDL model by Shin, Yu and Greenwood-Nimmo (2014) is applied to investigate the asymmetric relationship between the variables. Since cointegration is found between the variables by ARDL model, VECM model is applied to investigate the long run and short run causality between the variables. Relationship between FINV and TOPEN is examined by ARDL model and symmetric cointegration is analyzed. After ARDL model application, nonlinear ARDL model is applied to investigate the asymmetric relationship between the variables.

In section 1, literature review is discussed. In section 2, methodology and data of this study are explained in detail. In section 3, results are discussed, and conclusion is in section 4.
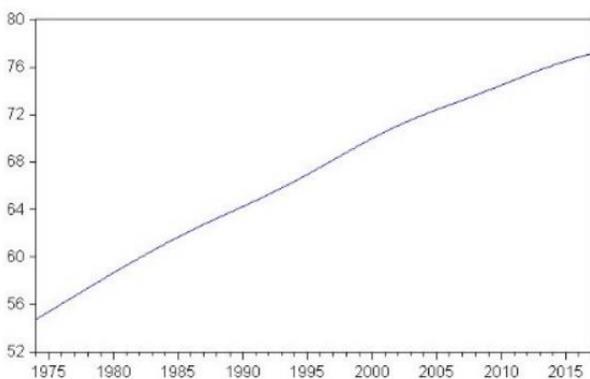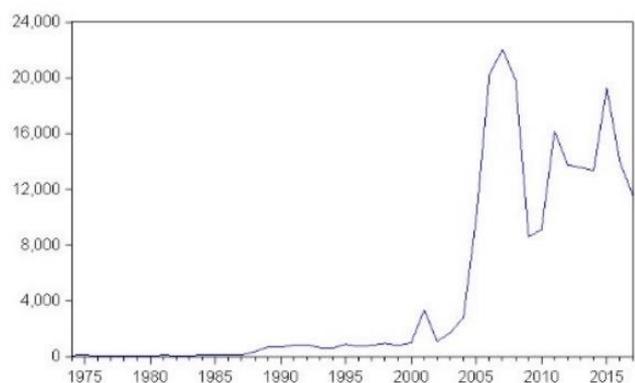

Figure 1. EXP in Turkey
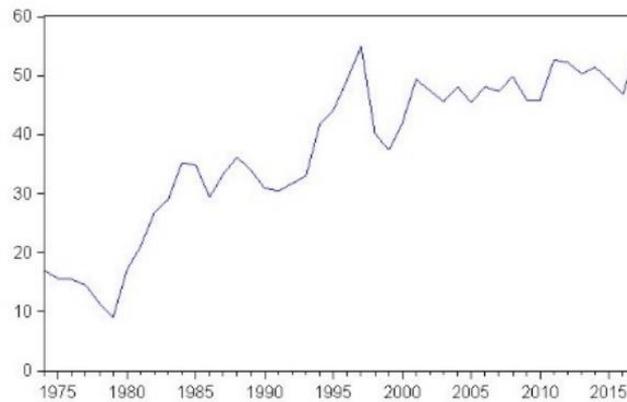

Figure 2. FINV in Turkey

Figure 3. TOPEN in Turkey

1. LITERATURE REVIEW

For the relationship between TOPEN and population health, Owen and Wu (2007) investigated the relationship between TOPEN and IM, LEXP of females and LEXP of males for a panel of 219 countries for the period 1960 to 1995. Owen and Wu found that TOPEN positively affected IM, LEXP of females and LEXP of males. Owen and Wu also found that TOPEN affected LEXP of females higher than LEXP of males in the poorest countries. Owen and Wu investigated the channels to explain positive relationship between TOPEN and health outcomes. Owen and Wu confirmed increased availability of vaccinations due to TOPEN affected positively health outcomes, but Owen and Wu did not find evidence for the import of pharmaceutical products to explain the positive relationship between TOPEN and health outcomes. Owen and Wu found that the real reason for the developing countries increase import of pharmaceutical products from developed countries was due to bad health outcomes rather than TOPEN. Herzer (2015) investigated the relationship between TOPEN and LEXP at birth by ARDL model for the period 1960 to 2011 for USA. Herzer found that TOPEN had a positive impact on LEXP. Herzer (2015) confirmed that there was a long-run causality running from TOPEN to LEXP. Stevens, Urbach and Wills (2013) and Owen and Wu (2007) confirmed that there was nonlinear relationship between health outcomes and TOPEN. Herzer (2014) investigated the effect of TOPEN on LEXP and IM for a panel of 74 countries for the period 1960 to 2010. Herzer found that the effect of TOPEN on health outcomes was higher in less developed and less regulated countries. Herzer found that there was bi-directional causality between TOPEN and LEXP. Herzer stated that there were six channels for the impact of TOPEN on health outcomes which are income, inequality, access, insecurity, pollution and aid. Ling, Ahmed, Muhamad, Shahbaz and

For the relationship between FINV and population health, Herzer and Nunnenkamp (2012) examined the long run effect of net FINV inflow on LEXP in developed countries for the period 1970 to 2009. Herzer and Nunnenkamp found that net FINV inflow had a significant and negative effect on LEXP in the long run for panel countries. Nagel, Herzer and Nunnenkamp (2015) examined the relationship between FINV and population health for a panel of 179 countries for the period 1980 to 2011. Nagel, Herzer and Nunnenkamp confirmed that there was a nonlinear relationship between FINV and health. Real stock of FINV had a a positive effect on IM rate for countries with low level of income and real stock of FINV had a significant and negative effect on IM rate for countries with high level income. Burns, Jones, Goryakin and Suhrcke (2017) investigated the relationship between FINV and overall health for 85 low and middle income countries for the period 1974 to 2012. Burns, Jones, Goryakin and Suhrcke found that FINV inflow positively affected LEXP and adult mortality, and FINV inflow had insignificant effect on IM rate under 5 and IM.

For the relationship between FINV and TOPEN, Alam, Raza, Shahbaz and Abbas (2016) investigated the impact of FINV and TOPEN on LEXP in Pakistan for the period between 1972 to 2013. Cointegration was discovered between the variables. The study concluded that FINV and TOPEN affected LEXP positively, and FINV and TOPEN caused LEXP in the short run. Idrees and Bakar (2019) investigated the impact of FINV on LEXP and IM rate under 5 for the period 1980 to 2017 in Pakistan. Idrees and Bakar found

long run relationship between the variables. Idrees and Bakar found that FINV, TOPEN and secondary school enrollment increased LEXP in the long run, and FINV, TOPEN and secondary school enrollment decreased IM rate under 5 in the long run in Pakistan. Government expenditure on health had insignificant impact on LEXP and IM rate under 5 in the long run in Pakistan.

For the relationship between FINV and sustainable development, Tvaronavičienė and Lankauskienė (2011) analyzed effect of FINV on sustainable development indicators and economic growth for a panel of 15 countries for the period 2000 to 2007, and 2000 to 2009. Tvaronavičienė and Lankauskienė found that effect of FINV on sustainable indicators were different for each time period. During the period 2000 to 2009, FINV inflows significantly improved sustainable development indicators of underdeveloped countries and effects of FINV inflows on economic growth were higher for underdeveloped and developing countries than for developed countries.

2. MATERIALS and METHODS

LEXP is life of expectancy at birth for Turkey. N is FINV net inflows in current$. TOPEN is sum of exports and imports of goods and services measured as share of GDP. The variables are used in log form in the analysis. The data for the variables is taken from World Bank's website. Time period for the analysis is from 1974 to 2017.

For the model, w_0, w_1, w_2 are coefficients for the examined variables and u_t is for error term.

$$\ln(LEXP)_t = w_0 + w_1 \ln(N)_t + w_2 \ln(TOPEN)_t + u_t \ (1)$$

$$\ln(N)_t = w_0 + w_1 \ln(TOPEN)_t + u_t \ (2)$$

ARDL model is specified as below.

$$\Delta LnK_t = J_0 + J_1 LnLEXP_{t-1} + J_2 LnN_{t-1} + J_3 LnTOPEN_{t-1} + \sum_{i=1}^{s} J_{4i} LnLEXP_{t-i} +$$

$$\sum_{i=0}^{h} J_{5i} LnN_{t-i} + \sum_{i=0}^{w} J_{6i} LnTOPEN_{t-i} + \mu_t \ (3)$$

μ_t is for white noise residuals. $J_1, J_2 \ and \ J_3$ are long run coefficients. $J_4, J_5 \ and \ J_6$ are short run coefficients.

Hypothesis of no cointegration is $H_0 = J_1 = J_2 = J_3 = 0$.

Hypothesis of cointegration is $H_1 = J_1 \neq J_2 \neq J_3 \neq 0$.

When cointegration is confirmed, short-run coefficients, long-run coefficients and error correction model of ARDL model are as below.

$$LnK_t = G_0 + \sum_{i=1}^{s} G_{1i} LnLEXP_{t-i} + \sum_{i=0}^{h} G_{2i} LnN_{t-i} + \sum_{i=0}^{w} G_{3i} LnTOPEN_{t-i} + \mu_t \ (4)$$

$$LnK_t = F_0 + \sum_{i=1}^{s} F_{1i} \Delta LnLEXP_{t-i} + \sum_{i=0}^{h} F_{2i} \Delta LnN_{t-i} + \sum_{i=0}^{w} F_{3i} \Delta LnTOPEN_{t-i} + \gamma ECT_{t-1} + \mu_t \ (5)$$

$$ECT_t = LnLEXP_t - \sum_{i=1}^{s} Z_{1i} \Delta LnLEXP_{t-i} - \sum_{i=0}^{h} Z_{2i} \Delta LnN_{t-i} - \sum_{i=0}^{w} Z_{3i} \Delta LnTOPEN_{t-i} \ (6)$$

Equation 4 is to determine the long-run coefficients of ARDL model and equation 5 is to determine the short-run coefficients of ARDL model. Error correction model is specified in equation 6.

VECM granger causality model is specified as below in equation 7.

$$\begin{bmatrix} \Delta LnLEXP_t \\ \Delta LnN_t \\ \Delta LnTOPEN_t \end{bmatrix} = \begin{bmatrix} R_1 \\ R_2 \\ R_3 \end{bmatrix} + \sum_{i=1}^{p} \begin{bmatrix} c11i & c12i & c13i \\ c21i & c22i & c23i \\ c31i & c32i & c33i \end{bmatrix} * \begin{bmatrix} \Delta LnLEXP_{t-i} \\ \Delta LnN_{t-i} \\ \Delta LnTOPEN_{t-i} \end{bmatrix} + \begin{bmatrix} W_1 \\ W_2 \\ W_3 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix} \ (7)$$

VEC Granger Causality/Block Exogeneity Wald Tests are applied to check long-run causal relationship between the variables. The coefficient of error correction term, γ, is also checked to verify long-run causal relationship between the variables. Wald tests are applied to analyze short-run causal relationship between the variables.

Nonlinear ARDL model is specified as below for LEXP, FINV and TOPEN nexus.

$$\Delta LnLEXP_t = M_0 + M_1 LnLEXP_{t-1} +$$
$$M_2 LnN^-_{t-1} + M_3 LnN^+_{t-1} + M_4 LnTOPEN^+_{t-1} + M_5 LnTOPEN^-_{t-1} +$$
$$\sum_{i=1}^{s} M_{6i} LnLEXP_{t-i} +$$
$$\sum_{i=0}^{h} M_{7i} LnN^+_{t-i} + \sum_{i=0}^{h} M_{8i} LnN^-_{t-i} +$$
$$\sum_{i=0}^{w} M_{9i} LnTOPEN^+_{t-i} + \sum_{i=0}^{w} M_{10i} LnTOPEN^-_{t-i} + \mu_t \quad (8)$$

μ_t is for white noise residuals. $M_1, M_2, M_3, M_4, and M_5$ are long run coefficients. $M_6, M_7, M_8, M_9, and M_{10}$ are short run coefficients.

Hypothesis of no cointegration is $H_0 = M_1 = M_2 = M_3 = M_4 = M_5 = 0$.

Hypothesis of cointegration is $H_1 = M_1 \neq M_2 \neq M_3 \neq M_4 \neq M_5 \neq 0$.

ARDL model is specified as below for equation 2.

$$\Delta LnN_t = J_0 + J_1 LnN_{t-1} + J_2 LnTOPEN_{t-1} + \sum_{i=1}^{s} J_{3i} LnN_{t-i} + \sum_{i=0}^{h} J_{4i} LnTOPEN_{t-i} + \mu_t \quad (9)$$

Nonlinear ARDL model is specified as below for FINV and TOPEN nexus.

$$\Delta LnN_t = M_0 + M_1 LnN_{t-1} + M_2 LnTOPEN^-_{t-1} + M_3 LnTOPEN^+_{t-1} + \sum_{i=1}^{s} M_{4i} LnN_{t-i} +$$
$$\sum_{i=0}^{w} M_{5i} LnTOPEN^+_{t-i} + \sum_{i=0}^{w} M_{6i} LnTOPEN^-_{t-i} + \mu_t \quad (10)$$

Zivot and Andrews (1992) unit root tests are applied to check unit root levels of the variables. Intercept and intercept and trend models are used to check unit root of the variables as suggested by Sen (2003). Results show that the variables are at the levels of combination of I(0) and I(1) (see Table 1). Structural breaks are taken into account as suggested by Perron (1990) for investigating unit root levels. Schwarz Information Criteria (SIC) and Akaike Information Criteria (AIC) are used to determine the maximum lag levels. Maximum lag values are entered into ARDL model and Nonlinear ARDL model, and the models choose lag values according to SIC criteria and AIC criteria (see Figure 4). Cusum (Stability Test I) and Cusum Squares (Stability Test II) tests are applied to investigate the stability of ARDL model as suggested by Brown, Durbin and Evans (1975) (see Figure 5 and Figure 6). Stability Test I is applied to investigate the stability of long-run coefficients as suggested by Pesaran and Pesaran (1997). The sign of the coefficient of error correction term is also checked to investigate the stability of long-run coefficients of ARDL model and Nonlinear ARDL model. Bayer and Hanck (2013) cointegration tests, which do not take into account the structural breaks in the model, are used to check the cointegration between the variables.

Break points, that are discovered in the unit root tests, are used in cointegration analysis and causality analysis by adding break dates to exogenous variables. Discovered break points are 1991, 2008 and 1986. Break date 2008 is the only break point that satisfies the stability tests for ARDL model. Pesaran, Shin and Smith (2001) introduced ARDL model for the cointegration between the variables which are at I(0) and I(1) levels. Results of ARDL model is compared with critical bounds values of Narayan (2005) to determine the cointegration. Unrestricted intercepts and no trends followed model of Pesaran, Shin and Smith (2001) is used in this study. 2008 is also used as break point for VECM Model to investigate the long-run and short-run causality between the variables. Wald tests are applied to check the short run causal relationships between the variables . Ramsey reset test, Breusch-pagan-godfrey test, arch test, white test, Breusch-godfrey serial correlation test and normality test are applied to check the stability of ARDL model.
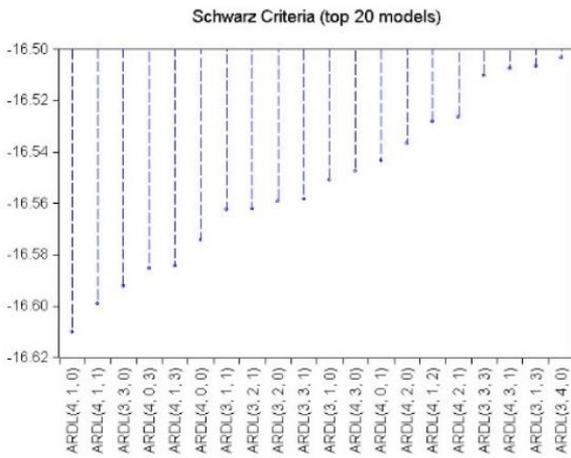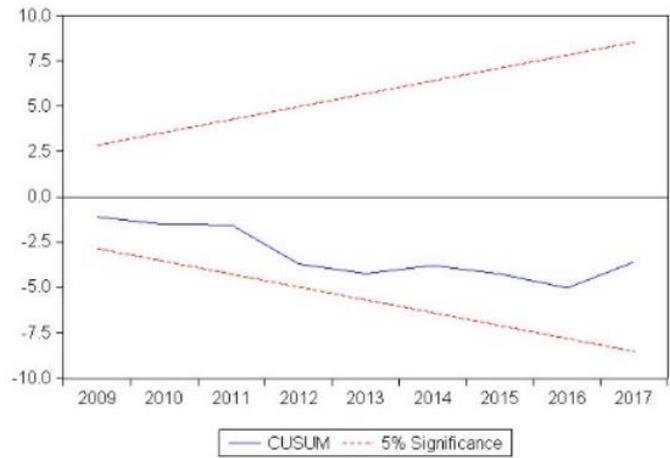
Figure 4. ARDL Model Graph for Turkey

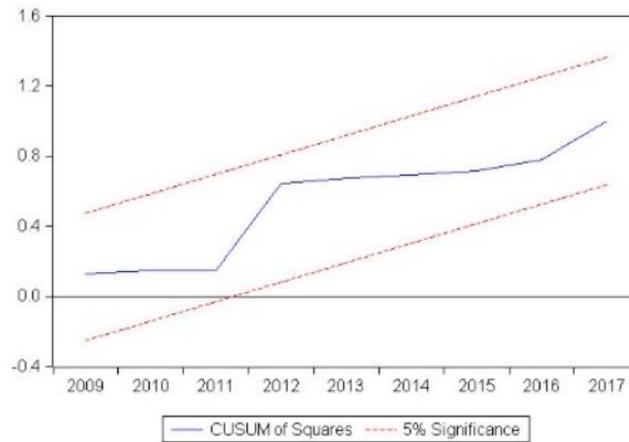**Figure 5.** Stability Test I for ARDL Model

Figure 6. Stability Test II for ARDL Model

For studies that use structural breaks in cointegration analysis and causality analysis, Alam et al. (2016) used structural break to check cointegration between FINV, TOPEN and LEXP for Pakistan for the period 1972 to 2013 by ARDL model and to check causal relationships between the variables by VECM model. Pala (2013) used structural break to check cointegration between crude oil price index and food price index by Johansen cointegration test and to check causal relationship between the variables by VECM model for the period 1990 to 2012. Malhotra and Kumari (2016) used structural breaks to check cointegration between gross domestic product, real exports, real imports, real gross capital formation and total labor force for China, Japan and South Korea for the period 1980 and 2012 by Johansen cointegration test. Malhotra and Kumari used structural breaks to investigate causal relationships between the variables by VECM model.

3. RESULTS

3.1 LEXP, FINV and TOPEN NEXUS

Variables are at I(1) levels according Zivot-Andrews unit root test results (see Table 1). Since variables are at I(1) levels, Bayer and Hanck (2013) combined cointegration tests are applied. According to Bayer and Hanck (2013) combined cointegration test results, there is cointegration between the variables since test statistics are higher than critical values (see Table 4). Bayer and Hanck (2013) cointegra-

tion tests do not take into account structural breaks so the results may change when the structural breaks are taken into account.

1991, 2008 and 1986 are the structural breaks in the model. 2008 is the break date that is used in ARDL and nonlinear ARDL models. ARDL model with a structural break is stable according to stability test results (see Table 2, Figure 5 and Figure 6). Cointegration between the variables is found according to F-statistics results (see Table 3). World economic crisis at 2008 has a negative and significant effect on LEXP in the short run and in the long run. FINV has a significant and positive effect on LEXP in the long run. Trade has negative but insignificant effect on LEXP in the long run. ARDL model only analyzes the symmetric relationship between the variables. Since ARDL model only analyzes the symmetric relationship between the variables, nonlinear ARDL model is applied to investigate the asymmetric relationship between the variables. FINV and trade are decomposed into positive and negative components, and the cointegration between the variables are investigated. According to nonlinear ARDL model, there is no cointegration between the variables. F-statistics is not significant at 5% level, coefficient of error correction term is negative but not significant at 5% level, and coefficients of positive and negative components of FINV and trade are not significant at 5% level (see Table 5). Nonlinear ARDL model is stable according to stability test (see Table 6 and Figure 7).
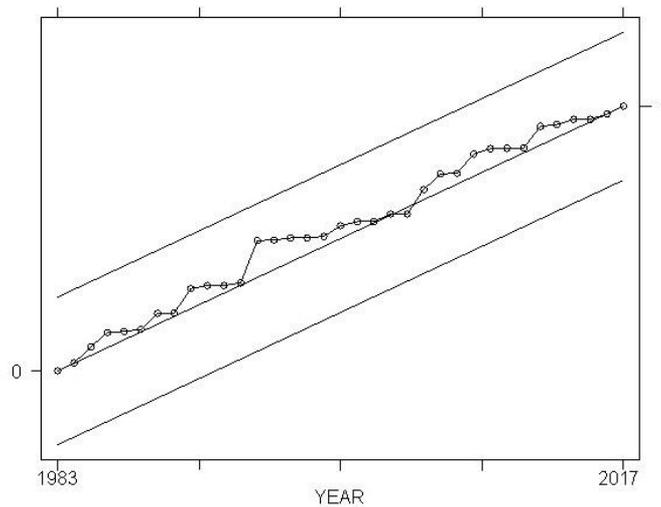

Figure 7. Stability Test II for Nonlinear ARDL Model

VECM model is established to check the causal relationships between the variables since cointegration between the variables is found by ARDL model. According to VECM model results, no causality is found from FINV to LEXP in the short run since wald statistics is 0.077270 with probability value of 0.9885. No causality is found from trade to LEXP in the short run since wald statistics is 1.109767 with probability value of 0.3749. Coefficient of error correction term is -0.000614 with probability of 0.7813 which states that there is no long run causality running from FINV and trade to LEXP.

3.2 FINV and TOPEN NEXUS

1991, 2008 and 1986 are the structural breaks in the model. 2008 is the break date that is used in ARDL and nonlinear ARDL models. ARDL model with a structural break is stable according to stability test results (see Table 7). According to ARDL model test results, symmetric cointegration does not exist between FINV and TOPEN (see Table 8). Nonlinear ARDL model is applied to examine the asymmetric relationship between the variables. Nonlinear ARDL model is stable according to stability test results (see Table 9, Figure 10 and Figure 11). According to Nonlinear ARDL model results and nonlinear ARDL multiplier graph, there is asymmetric relationship between the variables. (see Table 10 and Figure 12). Decreases in trade does not have a significant impact of FINV while increase in trade has a significant

and positive impact on FINV in Turkey. As trade increases, trade also impacts FINV positively. As trade decreases, trade impacts FINV positively but insignificantly. Akaike information criteria is used for the lag selection of models (see Figure 8 and Figure 9).
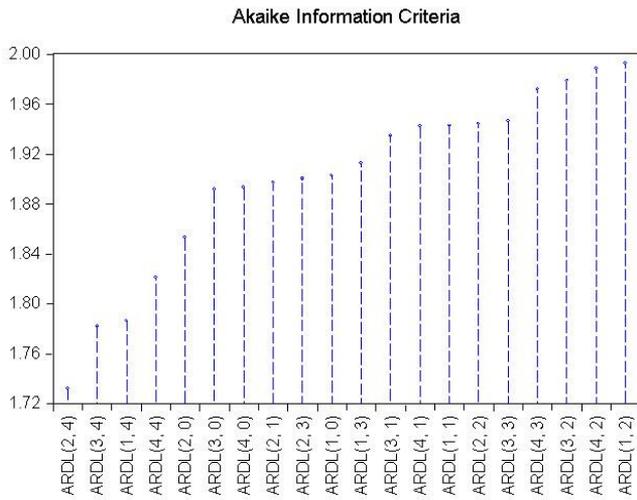

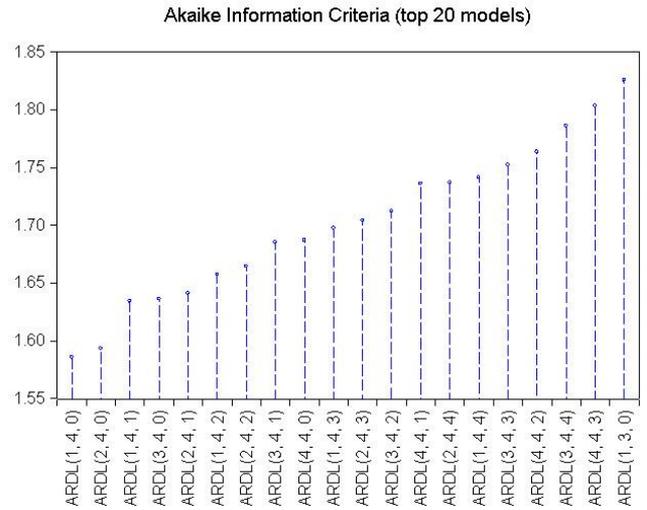**Figure 8.** ARDL Model Graph for Turkey

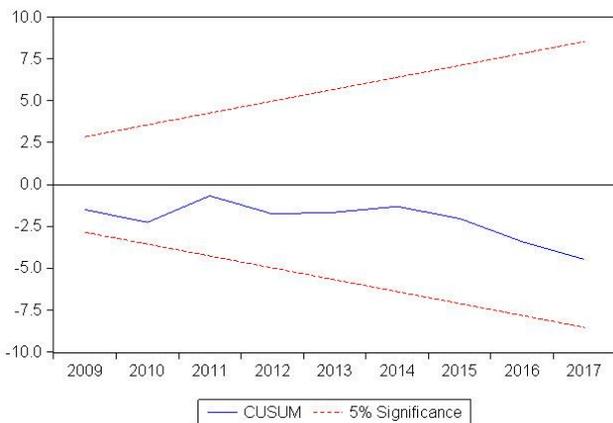**Figure 9.** Nonlinear ARDL Model Graph for Turkey

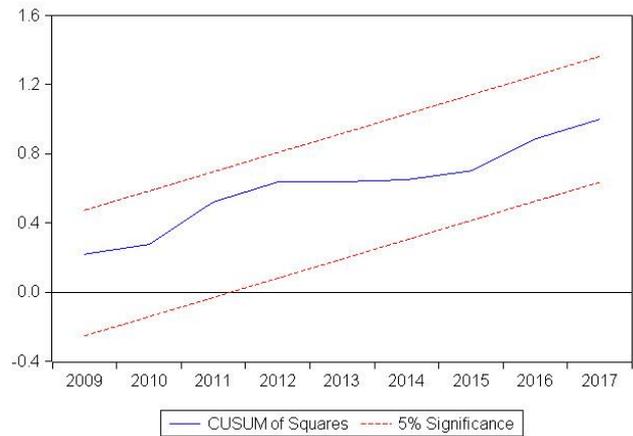**Figure 10.** Stability Test I for Nonlinear ARDL Model

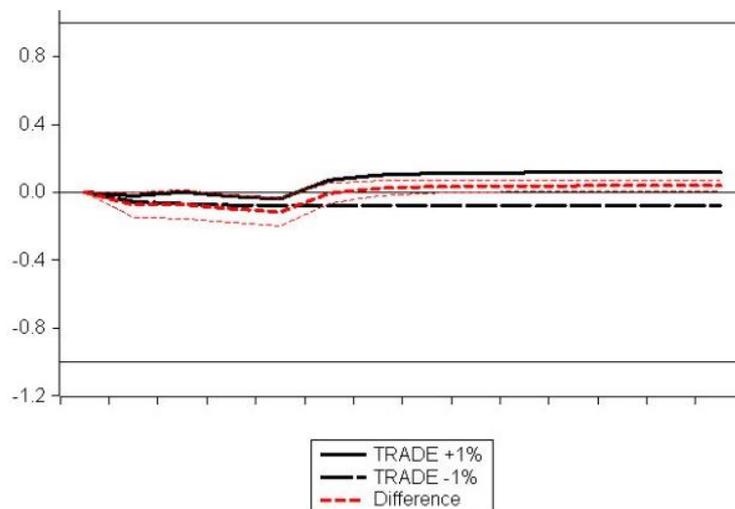**Figure 11.** Stability Test II for Nonlinear ARDL Model

Figure 12. Nonlinear ARDL Multiplier Graph

CONCLUSION

This study investigated the relationships between LEXP, FINV and trade for Turkey for the period 1974 to 2017. Main findings of this study are FINV has a significant and positive effect on LEXP in the long run and trade has a negative and insignificant effect on LEXP in the long run. No causal relationship is found from FINV and trade to LEXP both in the long run and in the short run. Nonlinear relationships between FINV, trade and LEXP are also analyzed by nonlinear ARDL model. No nonlinear relationship is confirmed between the variables.

This study also investigated the relationship between FINV and trade. Asymmetric relationship between trade and FINV is confirmed.

Hypothesis 2, 3, 4 and 5 are not confirmed in this study. Only hypothesis 1 and hypothesis 6 are confirmed for Turkey.

For similar studies in the literature, Herzer (2015) confirmed that TOPEN had a positive impact on LEXP and unidirectional causality running from TOPEN to LEXP in USA for the period 1960 to 2011. This study confirmed that TOPEN had insignificant impact on LEXP and no causality was found from TOPEN to LEXP in Turkey.

Stevens, Urbach and Wills (2013) and Owen and Wu (2007) confirmed asymmetric relationship between TOPEN and health outcomes. This study did not confirm cointegration between positive and negative components of TOPEN and LEXP in Turkey.

Nagel, Herzer and Nunnenkamp (2015) confirmed that there was a nonlinear relationship between FINV and health for a panel of 179 countries for the period 1980 to 2011. This study did not confirm nonlinear relationship between FINV and health for Turkey.

Herzer (2014) found that there was bi-directional causality between TOPEN and LEXP for a panel of 74 countries. This study did not confirm causality from TOPEN to LEXP in Turkey.

Ling, Ahmed, Muhamad, Shahbaz and Loganathan (2017) confirmed that there was unidirectional causality running from TOPEN to LEXP and TOPEN had positive impact on LEXP in the long run in Malaysia for the period 1960 to 2014. This study confirmed that TOPEN had negative and insignificant impact on LEXP in Turkey.

Herzer and Nunnenkamp (2012) found that net FINV inflow had a significant an negative effect on LEXP in the long-run for developed countries. This study confirmed that FINV had positive and significant impact on LEXP in Turkey in the long run.

Idrees and Bakar (2019) confirmed that FINV and TOPEN increased LEXP in Pakistan for the period 1980 to 2017. This study confirmed that FINV increased LEXP in Turkey in the long run.

Burns, Jones, Goryakin and Suhrcke (2017) confirmed that FINV inflow had a positive impact on LEXP for a panel of 85 low and middle income countries for the period 1974 to 2012. This study confimed that FINV had a positive impact on LEXP in Turkey in the long run.

Alam, Raza, Shahbaz and Abbas (2016) confirmed that FINV and TOPEN had positive impact on LEXP and there was unidirectional causality running from FINV and TOPEN to LEXP in the short run in Pakistan for the period 1972 to 2013. This study did not confirm unidirectional causality running from FINV and TOPEN to LEXP in Turkey.

Aizenman and Noy (2006) confirmed that TOPEN had positive impact on FINV net inflows for developing and industrialized countries. This study confirmed that positive component of TOPEN had a significant positive impact on FINV net inflow for Turkey.

The limitations of the study are the country of the study and the time period of the study. For future research directions, we recommend that new cointegration techniques that take into consideration structural breaks to be used such as Maki (2012) cointegration test and additional variables may be examined such as external debt.

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APPENDIX 1: TABLES

Table 1. Zivot-Andrews Unit Root Test Results

Intercept	*Level*			*First Difference*		
Variable	Break	t-statistic	Result	Break	t-statistic	Result
LOGLEXP	2009	-2.187293	Unit Root	1991	-11.99568*	Stationary
LOGN	1988	-4.557928	Unit Root	2008	-9.917501*	Stationary
LOGTOPEN	1982	-4.659954	Unit Root	1986	-4.990618**	Stationary
Intercept + Trend	Break	t-statistic	Result	Break	t-statistic	Result
LOGLEXP	2003	-3.210096	Unit Root	2009	-11.41233*	Stationary
LOGN	2005	-5.676246*	Stationary			
LOGTOPEN	1994	-4.528747	Unit Root	1994	-5.038003**	Stationary

* denotes 1% and ** denotes 5% significance.

Table 2. ARDL Model Stability Test Results

Break	2008		
Stability Test	F-stat	Prob.	JB
Normality	-	0.979011	0.042424
Breusch-Pagan-Godfrey	0.233810	0.9738	-
Arch	2.674062	0.0503	-
White	0.102982	0.9989	-
Ramsey	0.055242	0.8158	-
Correlation	1.261321	0.3094	-

Table 3. ARDL Bounds Test, Short Run and Long Run Results

		1%		
Bounds Test	F-Statistic	I0 Bound	I1 Bound	
	7.526679	5.15	6.36	
Short Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGLEXP(-1))	2.163363	0.136995	15.791520	0.0000
D(LOGLEXP(-2))	-1.542127	0.258897	-5.956533	0.0000
D(LOGLEXP(-3))	0.308682	0.137136	2.250918	0.0316
D(LOGN)	0.000003	0.000016	0.165178	0.8699
D(LOGTOPEN)	-0.000000	0.000002	-0.244823	0.8082

D(D2008)	-0.000111	0.000031	-3.528393	0.0013
CointEq(-1)	-0.001895	0.000614	-3.089216	0.0042
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGN	0.019973	0.008097	2.466693	0.0194
LOGTOPEN	-0.000213	0.000916	-0.232780	0.8175
D2008	-0.058466	0.023209	-2.519126	0.0171
C	4.101278	0.269035	15.244409	0.0000

Table 4. Bayer and Hanck Cointegration Test Results

Null Hypothesis: No Cointegration	Fisher Type Test Statistics	5% Critical Value	Result
EG-J	20.56657	10.895	Cointegration
EG-J-Ba-Bo	22.309949	21.106	Cointegration

*EG-J resembles Engle and Granger, and Johansen. Ba-Bo resembles Banerjee and Boswijk.

Table 5. Nonlinear ARDL Bounds Test, Short Run and Long Run Results

Variable	Long-run Effect (+)			Long-run Effect (-)		
	Coefficient	F-statistics	Prob.	Coefficient	F-statistics	Prob.
LOGN	0.016	0.9913	0.3300	-0.017	0.8743	0.360
LOGTOPEN	0.001	0.4346	0.517	-0.000	0.005836	0.940
	Long-run Asymmetry			Short-run Asymmetry		
		F-statistics	Prob.		F-statistics	Prob.
LOGN		0.002978	0.957		1.532	0.229
LOGTOPEN		0.1087	0.745		0.2978	0.591
	Coefficient	Standard Error	T-Statistics	Prob.		
Error Correction Term	-0.0034609	0.0024587	-1.41	0.173		
	5%	I0 Bound Value	I1 Bound Value			
F-Statistics	3.3283	3.79	4.85			

Table 6. Nonlinear ARDL Model Stability Test Results

Test	Statistics	Prob.
Portmanteau Test	22.02	0.2310
Heteroskedasticity Test	0.008866	0.9250
Ramsey Test	0.4735	0.7044
Normality Test	1.711	0.4251

Table 7. ARDL Model Stability Test Results

Break	2008		
Stability Test	F-stat	Prob.	JB
Normality	-	0.851693	0.321057
Breusch-Pagan-Godfrey	1.258161	0.3004	-
Arch	0.938914	0.4545	-
White	0.868324	0.5530	-
Ramsey	3.596643	0.0676	-
Correlation	1.416957	0.2552	-

Table 8. ARDL Bounds Test, Short Run and Long Run Results

		10%		
Bounds Test	F-Statistic	I0 Bound	I1 Bound	
	2.967398	4.04	4.78	

Table 9. Nonlinear ARDL Model Stability Test Results

Break	2008		
Stability Test	F-stat	Prob.	JB
Normality	-	0.333694	2.195059
Breusch-Pagan-Godfrey	1.608012	0.1643	-
Arch	0.394119	0.8112	-
White	0.497961	0.8479	-
Ramsey	2.988561	0.0945	-
Correlation	1.683593	0.1840	-

Table 10. Nonlinear ARDL Bounds Test, Short Run and Long Run Results

		1%		
Bounds Test	F-Statistic	I0 Bound	I1 Bound	
	7.250790	5.15	6.36	
Short Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGTOPEN_POS)	-0.022167	0.029452	-0.752648	0.4575
D(LOGTOPEN_POS(-1))	0.029237	0.043289	0.675405	0.5046
D(LOGTOPEN_POS(-2))	0.008440	0.042926	0.196616	0.8455
D(LOGTOPEN_POS(-3))	-0.114836	0.036072	-3.183540	0.0034
D(LOGTOPEN_NEG)	0.055895	0.028753	1.943998	0.0613
D(D2008)	-0.104610	0.274841	-0.380621	0.7062
CointEq(-1)	-0.707147	0.142633	-4.957804	0.0000
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGTOPEN_POS	0.117197	0.023341	5.020990	0.0000
LOGTOPEN_NEG	0.079043	0.039620	1.995035	0.0552
D2008	-0.147933	0.398102	-0.371595	0.7128
C	18.460380	0.397751	46.411911	0.0000