Examining the Causal Relationship between Exchange Rates, Foreign Investments and Inflation Rate: The Case of Turkey using data from January 2008 to December 2018

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Abstract

This study examines the relationships between exchange rates, foreign investments and inflation rate in Turkey using monthly data from 2008-2018. The vector autoregression (VAR) model is used to examine whether these three variables are correlated to each other. VAR results showed that Exchange Rates (ER) have a moderated impact on Foreign Investments (FI), where a percentage increase in Exchange Rates (ER) accounts for an increase of 27,58% on Foreign Investments (FI). Exchange Rates (ER) have a significant impact on Inflation Rates (IR), where a percentage increase in Exchange Rates (ER) is associated with an increase of 77,02% on Inflation Rate (IR). Pairwise Granger Causality test results' showed that Inflation Rate (IR) does not cause Foreign Investments (FI) and Foreign Investments (FI) does not cause Inflation Rate (IR); Exchange Rate (ER) does not cause Foreign Investments but Foreign Investments (FI) cause Exchange Rate (ER); Exchange Rates (ER) does not cause Inflation Rate (IR) and Inflation Rate (IR) does not cause Exchange Rates (ER).The result of impulse function shows that Foreign Investments (FI) and Inflation Rate (IR) responded positively to Exchange Rates (ER) in earlier periods and negatively in late periods.

Keywords*:* foreign investments; inflation rate; exchange rates, VAR; relationship;

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JEL: E2, E4, G0

1. Introduction

The exchange rate in developing and transition countries is one of the most critical macroeconomic variables. It influences inflation, exports, imports and economic activity (Edwards, 2006). Exchange rates are characterized as foreign currency per unit of domestic currency or domestic currency per unit of foreign currency. The exchange rate lets us express the cost or price of a product or service in a common currency (Krugman & Obstfeld, 2006). The nominal exchange rate is known as the value of a currency in relation to another currency. At the same time, the real exchange rate should be described in real term as the currency's value. Nonetheless, it is described in literature and textbooks as the relative price rates between two countries, rather than how much the currency can actually buy (Yang & Zeng, 2014).

Direct investment represents the purpose of gaining enduring interest by a resident entity of one economy (direct investor) in a business resident in another economy (direct investment firm), according to the IMF and OECD definitions (Duce & España, 2003). From a macroeconomic perspective, FDI is a specific form of cross-border capital flows from countries of origin to host countries, which are found in the balance of payments. Capital flows and stocks, income from investments, are the factor of interest (Denisia, 2010). The exchange rate and its impact on the inflation rate are been discussed in the financial literature. Inflation is the rate of increase in prices over a given period time. Inflation is usually a large indicator, such as overall price increases and rises in a country's cost of living. But for certain items, such as food, or for services, such as a haircut, it can also be measured more precisely. Inflation, whatever the context, is how much more costly the same collection of goods and/or services has become over a period of time, most usually one year (Oner, 2010).

This study aims to investigate the relationship between exchange rates, foreign investments and inflation rate in Turkey using a time-series data from January 2008 to December 2018.

2. Literature Review

Earlier studies have considered the relationship between exchange rate volatility and FDI and concluded that volatility could either discourage or encourage FDI, depending on the differences in the locations of production and sales. For example, if higher volatility discouraged exports, more attractive market service through FDI might result in a positive relationship between FDI and volatility (Cushman, 1985). Exchange rate volatility is widely considered to bear substantial significance to the economy, especially that of a small, open country (Crowley & Lee, 2003). Volatility of the exchange rate helps to increase the flow of foreign direct investment (Goldberg & Kolstad, 1995). It does matter for foreign direct investment, and hence for stable financing of growth in emerging countries, especially for those countries which are close to one main investing country (Benassy-Quere et al, 2001). Thus, exchange rate volatility can create facilities for multinational companies to locate production to lower-cost plants. High volatility increases the potential value of FDI and may encourage new investment (Sung & Lapan, 2000).

Froot & Stein (1991) presented a model where exchange rates were found to have a systematic effect on FDI. Amuedo-Dorantes & Pozo (2001), Kosteletou & Liargovas (2000), Blongien (1997), Dewenter (1995) displayed a strong correlation between weaker exchange rates and higher levels of foreign acquisitions in the United States. Kiyota & Urata (2004) in Japan; Osinubi & Amaghionyeodiwe (2009), Wafure & Nurudeen (2010) in Nigeria; and Ullah et al, (2012) in Pakistan presented same findings. Consequently, increases in the current real value of foreign exchange are associated with a reduction in foreign direct investment (Cushman, 1985; Cushman 1988). Exchange rate uncertainty was proved to harm the entry of new firms (Campa, 1993). Exchange rate uncertainty has a negative impact on a firm's outward FDI (Chen et al, 2006). Sharifi-Renani & Mirfatah (2012) found that volatility of exchange rate and world crude oil prices have a significant and negative impact on the flow of inward FDI in Iran. Some studies like the one of Chakrabarti & Scholnick (2002) have proved that average devaluation does not have a robust positive impact on FDI flows.

Baek & Okawa (2001) showed that an appreciation of the Japanese yen against the dollar and the Asian currencies significantly enhances Japanese foreign direct investment (FDI) in Asia. Later et al, (2011) estimated the impact of exchange rate movements on foreign direct investment (FDI)

flows from a developed to developing and emerging market economies, by utilizing the panel data of Japanese outward direct investment flows to nine dynamic Asian economies during 1987–2008. They also found that host country currency depreciation significantly increased Japanese FDI inflows. Wafure & Nurudeen (2010) investigated the determinants of foreign direct investments in Nigeria and they revealed that between other economic and political factors, the exchange rate is significant in explaining changes in FDI. A 1 percent depreciation in tge exchange rate causes FDI to increase by approximately 0,02. Omankhanlen (2011) too found that the foreign exchange rate has a major impact on the Nigerian economy's inflow of foreign investment. Similar results found Liargovas & Skandalis (2012) that apart from trade openness, there are other variables that have a positive influence on the life of FDI, such as political stability, exchange rate stability and market size (expressed by GDP).

As per relationship between exchange rates and inflation, Öniş & Özmucur (1990) proved a strong impact of exchange rate devaluation on domestic inflation in Turkey for the period of time from January 1981 to December 1987, as the "vicious circle" hypothesis states that, under a a floating exchange rate regime, an initial disruption (both domestic and foreign) may cause a cumulative inflation and exchange rate devaluation cycle through which the effect of the exchange rate is rapidly translated into domestic prices and costs and back to the exchange rate. Ahmad & Ali (1999) too revealed the impact period effects of temporary shock on the price level and exchange rate and argued that the continuation of shocks can produce a persistent but non-accelerating divergence between inflation rate and the rate of devaluation. For the given world prices, the inflation rate is equalized with the rate at which the exchange rate depreciates.

Kara & Nelson (2003) found a significant relationship between exchange rate changes and rates of change in prices of products labeled imported consumer goods, and some relation between CPI inflation and nominal exchange rate changes in the UK. The exchange rate in the UK is one vehicle for a relative price adjustment and resource allocation. Barlow (2005) found that purchasing power parity is held as the long-run relationship between the nominal exchange rate and price levels. Inflation appears to cause the rate of depreciation. Achsani et al, (2010) examined the relationship between inflation and real exchange using secondary annual data rates from some Asian and non-Asian regions and in Asian countries, and this relationship was found to be strong, but in the EU and North

America, there was found no such a relationship. The nominal exchange rate (also real exchange rate) depreciation affected the inflation and the inflation resulted in nominal exchange rate depreciation.

The stability of the inflation rate depends on the stability of the real exchange rate (Barbosa-Filho, 2006). Muço et al, (2004) argued that inflation associated with a change in the exchange rate, which in turn is affected by money growth would affect the trade balance. Ahn et al, (1998) studied the effects of inflation and exchange rate policy on direct investment flows to developing countries. They found that avoiding exchange rate overvaluation has a significant positive effect on direct investment inflows, but inflation does have a substantial negative effect on capital inflows. Öner (2019) examined the relationship between the nominal exchange rate and the inflation rates of the CPI and PPI with 132 monthly observations from January 2007 to December 2017 and found a single causality relation from the PPI inflation rate to the CPI inflation rate. Nominal exchange rate and the PPI inflation rates were not affected by other independent variables. Syzdykova (2016) investigated that the causality relationship between inflation and exchange rate in BRIC countries by using monthly data for January 2000-December 2017 period. As a result, it was found a long-term relationship between nominal exchange rates and inflation for all BRIC countries except China. However, the causality relationship between exchange rate and inflation in BRIC countries varied.

Türk (2016) also examined the relationship between exchange rate and inflation by using Vector Autoregressive (VAR) model. In his study, consumer price index (CPI), wholesale price index (WPI) and nominal exchange rate data set was used for the period of 1987-2013. According to the results of the analysis of the exchange rate, while the effect on inflation was found to be significant, the effect of inflation on exchange rate was meaningless. Güven & Uysal (2013) examined the effect of change in exchange rates on inflation. For this purpose, real time effective exchange rate and CPI data were analyzed with time series between 1983-2012. A two-way relationship was found between CPI and real effective exchange rate. The result of study of the Yılmaz (2016) supported increasing exchange rate policies to control inflation.

Gül & Ekinci (2006) investigated the causal relationship between inflation and nominal exchange empirically using monthly data in Turkey and according to the findings, there is a long-term relationship between nominal exchange rates and inflation. However, the causality relationship

between exchange rate and inflation is a one-way relationship to inflation. Terzi & Zengin (1996) examined the causality between exchange rate and inflation in Turkey by applying Granger Causality and Cointegration Analysis. They found that the factor affecting the value of TL against the dollar is the general level of domestic prices. Also there are a long term relationship between inflation and exchange rate.

3. Data and Methodology

The data used for this study is collected from the Central Bank of the Republic of Turkey and it covers a period from January 2008 to December 2018, including in total 131 observations. The Vector Autoregression (VAR) model was used to analyze data. Originally proposed by Sims (1980) VAR models have gained widespread use as an alternative to large-scale macro-econometric models in applied macroeconomic analysis (Bjørnland, 2000). The data were analysed using Eviews 10.

We have analyzed the relationship between foreign investment, inflation rate, and exchange rates. Foreign investment is a function of its own lagged values and the lagged values of the inflation rate and exchange rates. The inflation rate is a function of its own values and the lagged values of foreign investments and exchange rates. The exchange rate is a function of its own lagged values and the lagged values of foreign investments and inflation rate.

$$FI = a_1 + \sum_{i=1}^{k} \beta_i FI_{t-i} + \sum_{j=1}^{k} \phi_j IR_{t-j} + \sum_{m=1}^{k} \varphi_j ER_{t-m} + u_{1t} \qquad (1)$$

$$IR = a_2 + \sum_{i=1}^{k} \beta_i FI_{t-i} + \sum_{j=1}^{k} \phi_j IR_{t-j} + \sum_{m=1}^{k} \varphi_j ER_{t-m} + u_{2t} \quad (2)$$

$$ER = a_3 + \sum_{i=1}^{k} \beta_i FI_{t-i} + \sum_{j=1}^{k} \phi_j IR_{t-j} + \sum_{m=1}^{k} \varphi_j ER_{t-m} + u_{3t} \quad (3)$$

We have run the Augmented Dickey-Fuller (ADF) test to check for stationarity and the three variables were stationary at the first level of differentiation. To obtain the optimal lag number, we have first run the restricted VAR for each of the endogenous variables.

Table 1. Unit Root Test Based on Augmented Dickey-Fuller test and Lag Length Based on Akaike Information Criterion

	Level I(0)	**First Difference I(1)**	**Lag Length**
Foreign Investment	–2.40 (.14)	–10.11 (.00)	I(1) 1
Inflation Rate	–2.20 (.20)	–8.90 (.00)	I(1) 1
Exchange Rate	0.22 (.97)	–10.19 (.00)	I(1) 1

Table 2. Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	TraceStatistic	.05 Critical Value	Prob.**
None	.11	24.24	29.79	.19
At most 1	.05	8.24	15.49	.43
At most 2	.00	.89	3.84	.34
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**.05 Critical Value**	**Prob.****
None	.11	15.99	21.13	.22
At most 1	.05	7.35	14.26	.44
At most 2	.00	.89	3.84	.34

According to Akaike information criteria the optimal lag number is 1. In table 2 we have conducted the Johansen cointegration test to check whether the variables are cointegrated in the long term. We can see that trace statistics and maximum Eigen statistics are less than .05 critical value. This means that series are not cointegrated, that is, they do not exhibit a long-run relationship. We reject the null hypothesis, therefore, we will estimate the short-run model VAR.

Table 3. Vector Autoregression Estimates

	DLFI	DLIR	DLEXR
DLFI(-1)	.18	.18	-.16
	(.13)	(.14)	(.05)
	[1.33]	[1.31]	[-2.86]
DLIR(-1)	-.09	.23	-.00
	(.08)	(.08)	(.03)
	[-1.19]	[2.74]	[-.17]
DLEXR(-1)	.27	.77	-.19
	(.33)	(.34)	(.13)
	[.81]	[2.22]	[-1.42]
C	-.00	-.00	.013
	(.01)	(.01)	(.00)
	[-.36]	[-.35]	[3.18]
R-squared	.02	.09	.07
Adj. R-squared	.00	.07	.04

Sum sq. resids	1.56	1.64	.25
S.E. equation	.11	.11	.04
F-statistic	1.19	4.54	3.25
Log likelihood	103.90	100.77	223.50
Akaike AIC	-1.52	-1.47	-3.35
Schwarz SC	-1.43	-1.38	-3.26
Mean dependent	-.00	.00	.01
S.D. dependent	.11	.11	.04
Determinant resid covariance (dof adj.)		1.24	
Determinant resid covariance		1.13	
Log likelihood		490.05	
Akaike information criterion		-7.29	
Schwarz criterion		-7.03	
Number of coefficients		12	

Table 3 reports the outputs of VAR estimation including lag 1 for each variable in the model. Our VAR specification has three (k=3) endogenous variables, FI, IR and ER, the exogenous intercept C (d=1), and includes 1 lag (p=1). Thus, there are (kp + d = 4) regressors in each of the three equations in the VAR. Table 1 also displays additional information below the coefficient results. The first part of the additional output presents standard OLS regression summary statistics at the bottom of the column for the corresponding equation. The second part consists of summary statistics for the VAR system as a whole. These statistics include the determinant of the residual covariance, log-likelihood and associated information criteria, and the number of coefficients.

In Table 4, we have run the Granger Causality test. For the first part of Table 4, the null hypothesis states that the lagged coefficient of IR does not cause FI and the alternative hypothesis states that lagged coefficient casual effects on FI. Looking at the Chi-Square and probability values (p=.23>.05), we support the first hypothesis, that is, the lagged coefficient of IR does not cause FI. The same interpretation applies to the lagged coefficient of ER on FI. We can see that the probability value is .41>.05, therefore, we support the null hypothesis and the lagged coefficient of ER does not have a casual effect on FI in the short run.

Table 4. Granger Causality Test

Dependent variable: DLFI			
Excluded	**Chi-sq**	**df**	**Prob.**
DLIR	1.43	1	.23
DLEXR	.66	1	.41
All	2.06	2	.35
Dependent variable: DLIR			
Excluded	**Chi-sq**	**df**	**Prob.**
DLFI	1.71	1	.19
DLEXR	4.95	1	**.02**
All	5.37	2	.06
Dependent variable: DLEXR			
Excluded	**Chi-sq**	**df**	**Prob.**
DLFI	8.19	1	**.00**
DLIR	.02	1	.86
All	8.19	2	.01

In the second part of the table, the null hypothesis states that the lagged coefficients of FI and ER do not cause IR. We support the null hypothesis for the effect of FI on IR and there's no casual effect of FI on IR. But we reject the null hypothesis for the effect of ER on IR. The lagged coefficient of ER has a casual effect on IR in the short run. Probability value is .02. In the last part of the table, the null hypothesis is that the lagged coefficient of FI and IR does not have a causal impact on ER. The probability value for FI on ER is .00 and we reject the null hypothesis by stating that the lagged coefficient of FI has a casual impact on ER in the short run. The probability value for IR on ER is .86, hence, we cannot reject the null hypothesis, because the lagged coefficient of IR does not cause ER. But, FI and IR together have a causal impact on ER ($p=.01<.05$).

In the next step, we have performed the Wald Coefficient Test and Pairwise Granger Causality. To perform Wald Coefficients Test we have formulated each equation with its own coefficients as follows:

DLFI = C(1)*DLFI(-1) + C(2)*DLIR(-1) + C(3)*DLEXR(-1) + C(4)
DLIR = C(5)*DLFI(-1) + C(6)*DLIR(-1) + C(7)*DLEXR(-1) + C(8)
DLEXR = C(9)*DLFI(-1) + C(10)*DLIR(-1) + C(11)*DLEXR(-1) + C(12)

Table 5 reports coefficients, standard error, t-statistic and probability values. In the below part of the table, the equations of FI, IR, and ER are reported. The aim here is to check if whether coefficients have any causal effect on variables. For the equation of Foreign Investments (FI), we can see that the Inflation Rate (IR) takes the coefficient 2. If we check the probability value of this coefficient, we can see that the probability for coefficient 2 is .23. This value is not significant. We cannot reject the null hypothesis; therefore, this coefficient has no causal impact on FI. Furthermore, we can see that the Exchange Rate (ER) takes the coefficient 3. The probability value of this coefficient is .41. This value is not significant, and hence, we cannot reject the null hypothesis, this coefficient has no causal impact on FI.

For the equation of Inflation Rate (IR), Foreign Investments (FI) take the coefficient 5. The probability value of this coefficient is .19. This value is not significant, and therefore, we cannot reject the null hypothesis because this coefficient has no causal effect on IR. Exchange Rates (ER), in this equation, takes the coefficient 7. The probability value of this coefficient is .02. This means that exchange rates (ER) have a significant impact on the inflation rate (IR).

For the last equation, in Exchange Rates (ER), Foreign Investments (FI) take the coefficient 9. The probability value for this coefficient is .00. This coefficient is significant and shows that foreign investments (FI) have a causal effect on exchange rates (ER). The inflation rate (IR) takes coefficient 10. The probability value for this coefficient is .86 and we cannot reject the null hypothesis because this coefficient has no causal effect on the exchange rate (ER).

Finally, we performed the Granger causality test. In the first part of Table 6, Inflation Rate (IR) does not Granger cause Foreign Investments (FI) and Foreign Investments (FI) do not Granger

Table 5. Estimation of Equations using OLS

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C(1)	.18	.13	1.33	.18
C(2)	-.09	.08	-1.19	.23
C(3)	.27	.33	.81	.41
C(4)	-.00	.01	-.36	.71
C(5)	.18	.14	1.31	.19
C(6)	.23	.08	2.74	.00
C(7)	.77	.34	2.22	.02
C(8)	-.00	.01	-.35	.72
C(9)	-.16	.05	-2.86	.00
C(10)	-.00	.03	-.17	.86
C(11)	-.19	.13	-1.42	.15
C(12)	.01	.00	3.18	.00
Determinant residual covariance		1.13		
Equation: DLFI = C(1)*DLFI(-1) + C(2)*DLIR(-1) + C(3)*DLEXR(-1) + C(4)				
Observations: 131				
R-squared	.02	Mean dependent var		-.00
Adjusted R-squared	.00	S.D. dependent var		.11
S.E. of regression	.11	Sum squared resid		1.56
Durbin-Watson stat	1.91			
Equation: DLIR = C(5)*DLFI(-1) + C(6)*DLIR(-1) + C(7)*DLEXR(-1) + C(8)				
Observations: 131				
R-squared	.09	Mean dependent var		.00
Adjusted R-squared	.07	S.D. dependent var		.11
S.E. of regression	.11	Sum squared resid		1.64
Durbin-Watson stat	1.97			
Equation: DLEXR = C(9)*DLFI(-1) + C(10)*DLIR(-1) + C(11)*DLEXR(-1) + C(12)				
Observations: 131				
R-squared	.07	Mean dependent var		.01
Adjusted R-squared	.04	S.D. dependent var		.04
S.E. of regression	.04	Sum squared resid		.25
Durbin-Watson stat	1.96			

Table 6. Pairwise Granger Causality Test

Null Hypothesis:	**Obs**	**F-Statistic**	**Prob.**
DLIR does not Granger Cause DLFI	131	1.40	.23
DLFI does not Granger Cause DLIR		.41	.52
DLEXR does not Granger Cause DLFI	131	.62	.42
DLFI does not Granger Cause DLEXR		8.22	.00
DLEXR does not Granger Cause DLIR	131	3.64	.05
DLIR does not Granger Cause DLEXR		.00	.97

cause Inflation Rate (IR). Their probabilities values are .23 and .52, respectively. Hence, we cannot reject the null hypothesis, because these values are greater than .05. This shows that the relationship between these two variables is independent, both variables cannot cause one another.

In the second part of Table 6, Exchange Rates (ER) does not Granger cause Foreign Investments (FI). The probability value is .84 and therefore, we cannot reject the null hypothesis. Foreign Investments (FI) does not Granger cause Exchange Rates (ER), and this hypothesis is rejected because the probability value is significant (p=.00). This shows that Foreign Investments (FI) have an impact on Exchange Rates (ER).

In the last part of this table, Exchange Rates (ER) does not Granger cause Inflation Rate (IR). We cannot reject this hypothesis because the probability value is .05. But this value is very close to the confidence level of 5%. As we saw from the Granger Causality/Block Exogeneity Wald Test, this relationship was significant. Finally, we cannot reject the hypothesis of Inflation Rate (IR) does not Granger cause Exchange Rates (ER). The probability value is .97 and this is higher than .05.

In order, we have performed some diagnostics, starting with the autocorrelation LM test, normality test, and Heteroskedasticity test.

Table 7. Autocorrelation LM Test

Null hypothesis: No serial correlation at lag h and at lags 1 to h						
Lag	**LRE* stat**	**df**	**Prob.**	**Rao F-stat**	**df**	**Prob.**
1	7.73	9	.56	.86	(9, 297.1)	**.56**
*Edgeworth expansion corrected likelihood ratio statistic.						

Table 7 reports the results of the autocorrelation LM test. The probability value for lag 1 is .56. This value is higher than .05 and shows that our model does not suffer from serial autocorrelation.

Table 8 reports the results of VAR Residual Normality Tests. This test is evaluated in three segments: the test for skewness, the test for kurtosis and the test for Jarque-Bera.

Table 8. VAR Residual Normality Tests

Component	Jarque-Bera	df	Prob.	
1	24.33	2	.00	
2	34.34	2	.00	
3	416.12	2	.00	
Joint	474.80	6	.00	
*Approximate p-values do not account for coefficient estimation				

We checked only for Jarque-Bera test results as this test first computes the skewness and kurtosis measures of the OLS residuals. We have three components, Foreign Investments (FI), Inflation Rate (IR) and Exchange Rates (ER). The estimated joint JB statistic .00. The null hypothesis that the residuals are normally distributed is rejected.

Table 9. Heteroskedasticity Test

Joint test:					
Chi-sq	**df**	**Prob.**			
50.57	36	**.05**			
Individual components:					
Dependent	R-squared	F(6,124)	Prob.	Chi-sq(6)	Prob.
res1*res1	.09	2.11	.05	12.13	.05
res2*res2	.03	.70	.64	4.34	.62
res3*res3	.03	.70	.64	4.34	.62
res2*res1	.03	.81	.56	4.95	.54
res3*res1	.06	1.41	.21	8.41	.20
res3*res2	.03	.79	.57	4.87	.56

Table 9 reports the heteroskedasticity test. The probability value is .05 and this shows that there's no heteroskedasticity in our model.

Table 10 reports the output of Variance Decomposition. To interpret Variance Decomposition variables, we referred to the VAR estimation results from Table 3. Supposing that other variables are constant (ceteris paribus), from the VAR results we can see that Foreign Investments (FI) have a weak influence on itself.

The past realizations of Foreign Investments (FI) are associated with an 18,63% increase in Foreign Investments (FI). As per the Inflation Rate (R), we can see that it doesn't have any significant impact on Foreign Investments (FI). Exchange Rates (ER) have a moderated impact on Foreign Investments (FI), where a percentage increase in Exchange Rates accounts for an increase of 27,58%

Table 10. Variance Decomposition Variables

Variance Decomposition of DLFI:				
Period	S.E.	DLFI	DLIR	DLEXR
1	.11	100.00	.00	.00
2	.11	98.62	.90	.46
3	.11	98.39	1.10	.50
4	.11	98.38	1.10	.50
5	.11	98.38	1.10	.50
6	.11	98.38	1.10	.50
7	.11	98.38	1.10	.50
8	.11	98.38	1.10	.50
9	.11	98.38	1.10	.50
10	.11	98.38	1.10	.50
Variance Decomposition of DLIR:				
Period	S.E.	DLFI	DLIR	DLEXR
1	.11	0.79	99.20	0.00
2	.11	1.19	95.55	3.24
3	.11	1.65	95.08	3.26
4	.11	1.67	95.06	3.26
5	.11	1.67	95.06	3.26
6	.11	1.67	95.06	3.26
7	.11	1.67	95.06	3.26
8	.11	1.67	95.06	3.26
9	.11	1.67	95.06	3.26
10	.11	1.67	95.06	3.26

Variance Decomposition of DLEXR:				
Period	S.E.	DLFI	DLIR	DLEXR
1	.04	60.65	.15	39.19
2	.04	62.07	.18	37.74
3	.04	61.98	.32	37.68
4	.04	61.97	.33	37.69
5	.04	61.97	.33	37.69
6	.04	61.97	.33	37.69
7	.04	61.97	.33	37.69
8	.04	61.97	.33	37.69
9	.04	61.97	.33	37.69
10	.04	61.97	.33	37.69
Cholesky Ordering: DLFI DLIR DLEXR				

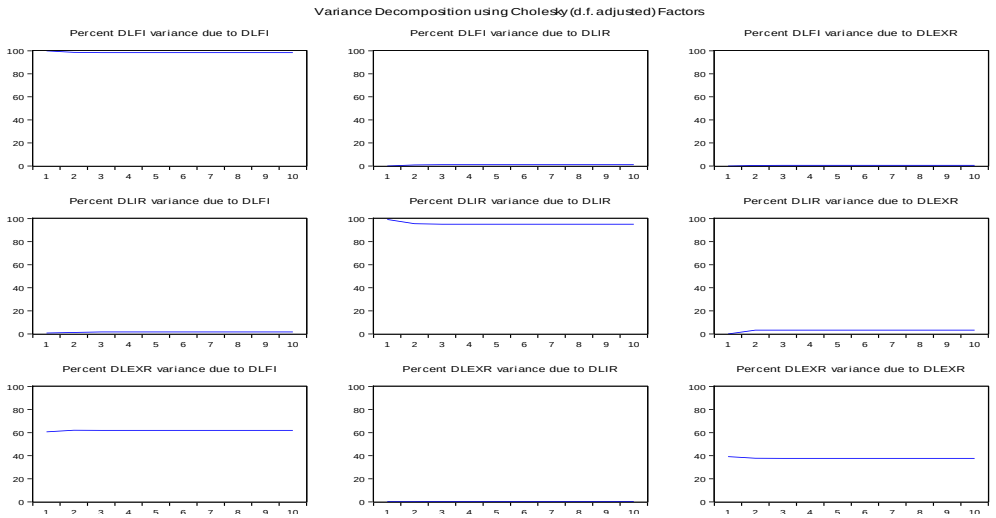
on Foreign Investments (FI) in ceteris paribus condition. In the second column, a percentage increase in Foreign Investments (FI) accounts for an increase of 18,76% in Inflation Rate (IR). The past realizations of Investment Rate (IR) are associated with a 23,24% increase in Inflation Rate (IR). It can be seen that Exchange Rates (ER) have a significant impact on Inflation Rate (IR). Where a percentage increase in Exchange Rates (ER) is associated with an increase of 77,02% in Inflation Rate (IR). In the third table, none of the variables have significant impacts on Exchange Rates (ER).

In the Variance Decomposition table, Variance Decomposition of Foreign Investments (FI), Inflation Rate (IR) and Exchange Rates (ER) are reported. Each of the rows of the table shows the percentage forecast error variance decomposition. We have chosen 10 periods to forecast for the future. In the first period, 100% of the forecast error variance in Foreign Investments (FI) it's explained by the variable itself, so other variables in the model do not have any strong influence on Foreign Investments (FI). We can say that these variables have a strong exogenous impact, that is, they do not influence Foreign Investments (FI). Same, in the following years, these variables do not influence Foreign Investments (FI), they exhibit strong exogeneity, that is, they have weak influence in predicting Foreign Investments (FI) in the future. As per Inflation Rate (IR) variance decomposition, there's the same flow as for Foreign Investments (FI). Inflation Rate (IR) strongly predicts itself from period 1 to period 10. The influence of the other two variables is not significant at all in the future

periods. Lastly, we can say that Exchange Rates (ER) do not strongly predict themselves in the future. But we can say that Foreign Investments (FI) influence strongly Exchange Rates (ER) for future periods accounting for around 61% forecast error variance. Unlike, Exchange Rates (ER) for the future values induces from 39 to 37%. So, Foreign Investments (FI) are strong influencers for Exchange Rates (ER) in predicting variation in Exchange Rates (ER). This is not true for Inflation Rate (IR), because Inflation Rate (IR) does not have any strong influence on Exchange Rates (ER).

Similar results have been obtained in a period of 5 years (60 months). After we checked the results and realized there are no significant differences between 10 months and 60 months, we didn't include here the table of this result. Variance decomposition results were also plotted visually in Figure 1.

Figure 1: Variance Decomposition

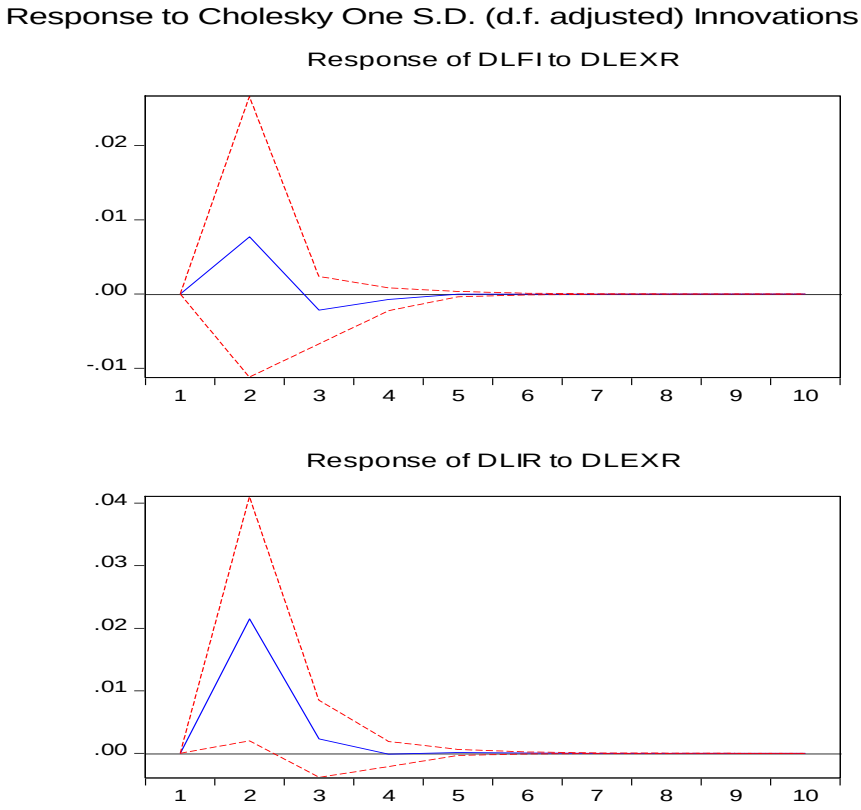


Since the individual coefficients in the estimated VAR models are often difficult to interpret, the practitioners of this technique often estimate the so-called impulse response function (IRF). The IRF traces out the response of the dependent variable in the VAR system to shocks in the error terms, such as u_1 and u_2 (Gujarati & Porter, 2009).

In Figure 2 we have plotted the responses of Foreign Investments (FI) and Inflation Rate (IR) to Exchange Rates (R) for ten periods. The first graph shows the response of FI to the ER. We can see that foreign investments (FI) increase from period 1 to 2. After period 2, foreign investments (FI) start declining and this decline becomes negative in period 3. After period 3 to 5 shock becomes zero and from period 5 to 10 there is no shock. Regarding the response of the inflation rate (IR) to exchange rates (ER), we can see that the inflation rate (IR) increases from period 1 to period 2. From period 2 to period 3 there is a fast decreasing and from period 3 to period 4 shock becomes zero and this continues up to the last period.

Figure 3 shows the reactions of three variable to each other and their self. In the first part, foreign investments (FI) to a shock in itself, inflation rate (IR) and exchange rates (ER) are given. Foreign Investments (FI) at the earlier periods show a declining positive response where after period 3 this decline becomes zero and there's no shock until period 10. Inflation Rate (IR) and Exchange Rates (ER) show similar responding to Foreign Investments (FI). They are both negative in the first periods and losing the shock after period 4 as they have become zero.

Figure 2: Responses of FI and IR to EX

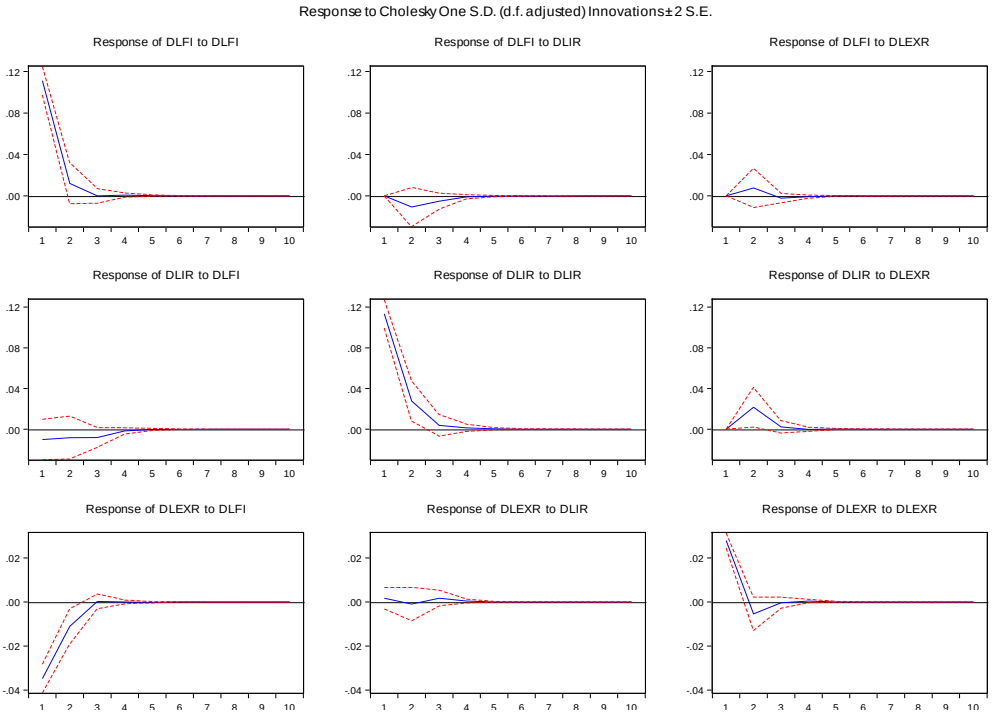


In the second case, foreign investments (FI) show firstly a negative decline response to the inflation rate (IR) and a negative increasing from period 2 to 3. After this period shock has become zero. Inflation rate (IR) firstly shows a rapid decrease from period 1 to 2 in the response to itself and then a continuing to decline from period 2 to 5 where the shock has finished. Exchange rates (ER) in response to the inflation rate (IR) show almost no shock and this shock has become zero after period 4.

Finally, foreign investments (FI) show a very small positive increasing from period 1 to 3 in response to exchange rates (ER), and from period 3 to period 4 decreases to zero. After period 4, there's no shock. Inflation rate (IR) in response to exchange rates (ER) shows a positive response from period 1 to 2, with decreasing from period 2 to 3 and with no shock from period 4 to 10. Exchange rates (ER) in response to itself shows a negative

decline from period 1 to 2, with a slight increase from period 2 to 3, where the shock is diminished to zero.

Figure 3: Multiple graphs for responses of FI, IR, and EX



4. Concluding Remarks

This study tried to examine the effect of exchange rates (ER) on foreign investments (FI) and inflation rates (IR) for Turkey during the period 2008-2018. These variables are analyzed using the Vector Autoregression (VAR) model. Using 1 lag for each variable three coefficients were obtained for each variable. VAR results showed that exchange rates have an almost significant impact on foreign investments. The percentage of increase in exchange rates accounted for an increase of 27,58% in foreign investments. On the other side, exchange rates had a significant influence on the inflation rate. The percentage of increase in exchange rates accounted for an increase of 77,02% on the inflation rate. According to the Granger causality test, foreign investments cause exchange rates and exchange rates cause

inflation rate at level .05. From Variance Decomposition results, it was revealed that foreign investments and inflation rate predict well their self but failed to predict each other and exchange rates in any period. Exchange rates failed to predict itself in the future but predicted good foreign investments and weakly inflation rates. The result of impulse function shows that Foreign Investments (FI) and Inflation Rate (IR) responded positively to Exchange Rates (ER) in earlier periods and negatively in late periods, where the shock finished after period 5.

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