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**THE NEXUS BETWEEN NOMINAL INTEREST RATE AND EXCHANGE RATE. THE  
CASE OF TURKEY (1987-2016)**

***NOMİNAL FAİZ ORANI VE DÖVÜZ KURU ORANI ARASINDAKİ İLİŞKİ. TÜRKİYE  
ÖRNEĞİ (1987-2016)***

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**ABSTRACT**

The study critically sifted the nexus between nominal interest rate and exchange rate and factors that determines the exchange rate fluctuations and its impact on the nominal interest rate in Turkey. The research employed a time series data spanning from 1987 to 2016. The key time series and econometric model adopted to obtain the set objectives were the Impulse Response Function (IRF), Variance Decomposition and Granger Causality test. The macroeconomic variables employed in the analysis were the nominal interest rate, exchange rate, broad money supply (M2), GDP deflator and inflation deflator. The results reveals that the impact of shocks is not totally consumed overtime. This means that the variables do not return to their equilibrium level after the occurrence of the error term. Thus an increase in nominal interest rate at the beginning period leads to the depreciation of the foreign currency, which hinders exports and leads to a decrease in domestic production. The decomposition of Choleski shows that the exchange rate contributes little in determining the interest rate on the Turkish domestic market. However, the Granger causality test indicates that broad money supply (M2) causes the interest rate. Meaning that any increase in interest rate leads to a decrease in money supply in circulation. In order to remedy the excessive depreciation of the Turkish currency, the monetary authorities must increase the interest rate in the very short term. This would attract foreign capital and reduce inflation through a reduction in the supply of money in the market.

**Keywords:** Impulse Response Function; Causality; Nominal Interest Rate; Exchange Rate

**ÖZET**

Çalışma, nominal faiz oranı ile döviz kuru arasındaki ilişkiyi ve döviz kurundaki dalgalanmaları belirleyen faktörleri ve bunun Türkiye'deki nominal faiz oranına etkisini incelemiştir. Araştırma, 1987'den 2016'ya kadar bir zaman serisi verisi kullanmıştır. Belirlenen hedefleri elde etmek için benimsenen anahtar zaman serileri ve ekonometrik model, Etki Tepki Fonksyonu (ETF), Varyans Ayırıştırma ve Granger Nedensellik testi idi. VAR modelinin analizinde kullanılan önemli makroekonomik değişkenler nominal faiz oranı, döviz kuru, geniş para arzı (M2), GSYİH deflatörü ve enflasyon deflatörü olmuştur. Sonuçlar, şokların etkisinin bütünüyle zaman tüketilmemesini gösterir. Bu, değişkenlerin hata oluştuktan sonra denge seviyesine dönmediği anlamına gelir. Böylece nominal faiz oranındaki artış yerel para biriminin değer kazanmasına yol açmakta, bu da yerli üretimde bir azalmaya yol açmaktadır.

Choloski'nin ayrışması, iç piyasadaki döviz kurlarının olduğunu göstermektedir. Bununla birlikte, Granger nedensellik testi, geniş para arzının (M2) faiz oranına neden olduğunu göstermektedir. Herhangi bir artışın dolaşımdaki para arzındaki azalmaya yol açtığı anlamına gelir. Araştırma, doğrudan yabancı yatırımları teşvik ederek güçlü para ve maliye politikalarının teşvik edilmesini önermektedir.

**Anathar kelmeler:** Etki tepki fonksyonu, Granger nedensellik, nominal Faiz oranı, döviz kuru oranı

**1. INTRODUCTION**

Domestic currency nose-diving and highfaluting nominal interest rate has been a subject of debate amongst many economists, investors both locally and foreign, students and even philanthropies over the years. It has become an albatross around the neck of many developing and emerging market

economies. Exchange rate and interest rate are a vital macroeconomic indicator of a country's economic growth and development. They are one of the critical deriving forces in an economy and if properly manage, can play a major role in the positive growth of a country. Exchange rate and interest rate are indeed a critical anchor to macroeconomic development in both emerging market economies and development or developing economies. Rising interest rate and exchange rate fluctuations can be a danger to a country's macroeconomic environment. For instance, highfalutin nominal exchange rate can creates a gloomy picture of an economy and even ruin the country's economic success. In the light of this, it is crucial for every economy that seeks to achieve resilient and sustain economy to take exchange rate regime and stable interest rate as a cornerstone. This will ensure buoyant economy vis-a-vis the stabilization of local currency, accelerate employment, declining inflation rate, stabilizing interbank rate, increase economic growth and enhance successful implementation of monetary policy regime.

### 1.1 Understanding of Exchange Rate

Exchange rate is the price of one currency expressed in terms of another currency. By this definition, two conventions were established namely E: price of home currency in terms of foreign currency and R: price of foreign currency in terms home currency.  $E = \frac{1}{R}$  (IMF, 2014:8-9). The study defines exchange rate as the nominal exchange rate that deals with the relative price of Turkish Lira (TL) to the United States dollars (\$US). That is how much TL one has to possess before he or she can get a dollar (TL/\$US). The domestic currency being Turkish Lira and the foreign currency being the United States dollars. In this study, the definition of exchange rate is solely limited to the nominal exchange rate. Going further, the term nominal exchange rate has taken on a largely amorphous meaning over the years, frequently being used to encapsulate intermediate arrangements, fixed arrangements and float arrangements. Intermediate arrangement deals with adjustable pegs, crawling pegs, basket pegs and target zones or bands. In case of adjustable pegs, this is where the central bank support the fixed exchange rate. In this case, rates are adjusted whenever it is perceived that they are in disequilibria. The most application was between 1945-1972 under the Bretton-Woods Agreements. Crawling pegs arises when monetary authorities intervene to achieve specific foreign exchange rate level often on a continuous basis. It is possible to declare official daily rates. Basket pegs occurs when foreign exchange are declared in terms of a basket of currencies, opposite to crawling pegs where the rates are determined separately for every single currency. Target zone or band; under this zone, there is a clear commitment that the monetary authority is ready to sell or buy whenever the rates fluctuate beyond or implied zones or bands. Snake-in-the-tunnel is the general structure of foreign exchange rate (Görmez and Yılmaz, 2008:272).

### 1.2 The Dynamics of Exchange Rate Regime

The exchange rate regime in turkey has undergone a series of remarkable changes. Historically, between 1980 -1996, the Turkish Economy adopted a fixed exchange rate regime and crawling peg exchange rate regime by liberalizing the foreign exchange market in 1984, currency substitution in 1985 and liberalization of capital movements in 1989 with 32 numbered decree. However, between 1989 -1993, the central bank of Turkey adopted a flexible exchange rate regime by allowing the market forces of demand and supply of foreign currency to determine its own prices in the Forex. Unfortunately, the country was hit by a serious economic crunch in 1994 immediately after adopting crawling band regime between 1994 -1996. Currency-peg regime was determined as the nominal anchor in the stabilization programme in 2000. From 2001 till today, the Turkish central bank continuous to use floating exchange rate regime. Is the floating exchange rate regime a bellicose bully to current woes of local currency depreciation in Turkey?

In a recent development, Turkey's economy has attracted a number of criticisms and chastisement for various reasons especially regarding the depreciation of the Turkish Lira (TRY) to other major foreign currencies in the global front. This issue created an incentive for people both in the formal and informal sector to speculate about the future of the dwindling TL and thereby further worsening the depreciation of the currency. From 2010 to 2018 the Turkish local currency is depreciated by

62.5% against the united state dollars that is from 1\$ to 1.50TL in 2010 to 1\$ now trading at 4.00TL in March 29, 2018. This is unprecedented in the economic history of Turkey. Colloquially, the research sought to establish the nexus between exchange rate and interest rate in Turkey. That is to examine whether the two variables are characterized by an action of forcefulness to influence other macroeconomic indicators in a positive or negative way.

## 2. THE REVIEW OF RELATED LETERATURE

Establishing the nexus between interest rate and exchange rate has been a subject of debate amongst many economists across the length and breadth of the globe. Some economic researchers perceived exchange rate fluctuations as a huge macroeconomic problem that is pernicious to a country's economic development. Recent studies dwelled on establishing the causes of exchange rate fluctuations or depreciation, rising interest rate, the essence of stable currency as well as suggesting policy measures to arrest its pestilent effect in an economy. One frequently quoted passage from the work of John Maynard Keynes is that "the best way to destroy the capitalist system [is] to debauch the currency." The passage, attributed to Vladimir Ilyich Lenin, appears in Keynes' book *The Economic Consequences of the Peace*, which became an international bestseller when it was published in 1919. (Lenin, 1920:143) asserted that, the best way to ruin a country is to debauch its currency. To Lenin, the economic success of a country depends on the resilient nature of its local currency. This means that when the domestic currency is subverted, the country has lost the moral ground in the fight for economic development and economic freedom. Strong monetary and fiscal reforms is a *sin qua non* since it helps the country to regain its economic dignity. The question the research ask is, are there empirical policy measures narrating the dynamic relationship between interest rate and exchange rate? (Mundell and Fleming 1962:369) in their economic model states that, an increase in interest rate is necessary to stabilise the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences. Mundell and Fleming hinted that, the rising interest rate is considered vital for three reasons. Firstly, it gives the information to the market about authorities' resolve not to allow the sharp exchange rate movement that the market expects given the state of the economy and thereby reduce the inflationary expectations and present the vicious cycle of inflation and exchange rate depreciation. Secondly, it increases the attractiveness of domestic financial assets as a result of which capital inflow takes place and thereby limiting the exchange rate depreciation. Lastly, it does not only reduces the level of domestic aggregate demand but also improves the balance of payment position by reducing the level of imports. (Mankiw, 2009:158) in his book entitled *macroeconomics* noted that, rising interest rate lowers the net capital outflow and national savings and thereby causing the exchange rate to appreciate in value against the domestic currency and the resultant effect is the decline in net export. Evidence from the East Asian currency crisis and the fiasco of rising interest rate policy to stabilise the exchange rate at its desirable level during 1997 to 1998 have doubted the credibility of Mundell-Fleming's argument of increasing rate to exchange rate.

Studies that placed much emphasis on the theories that determines exchange rate was not kept outside the bracket. There are several theories that determines the existence of exchange rate. These includes the Sticky Price Monetary Model (SPM), the Real Interest Rate Differential Model (RIRD), the Portfolio Balance Theory (PBT), Flexible Price Monetary Model (FPM) and the Purchasing Power Parity (PPP). (Branson and Kouri, 1976:280-304) asserted that, risk factors, current account, fiscal policy, authority's intervention in the foreign exchange market are the major determinants of exchange rates. This was done in line with the Portfolio Balance Model.

Further literature that dwells on the dynamic relationship between interest rate and exchange rate. (Sargent and Wallace, 1981:1-17) sifted the relationship between interest rate and exchange rate. To sargent and Wallace, a high interest rate policy may lead to a reduction in the demand for money and increase in price level because an increase interest rate implies an increase in government debt. As a result there will be exchange rate depreciation. Furman and Stiglitz (7) in 1998 also argued that an increase in interest rate may adversely affect the future export performance which would reduce the future flow of foreign exchange reserves and thereby, leads to depreciation of currency.

(Keminsky and Schumukler, 1998:1) examined the time series correlation between daily exchange rates and interest rate for five Asian countries that is Indonesia, Korea, Malaysia, the Philippines, Thailand, and China by using daily data during the second half of 1997. The result indicated that the signs of these correlations were not stable and concluded that the interest rate in those countries must be endogenous variables.

(Goldfajn and Baig, 1918) studied the linkage between interest rate and exchange rate for Asian countries from July 1997 to July 1998 using the VAR model based on Impulse response function. The result showed no evidence for the weakening impact of higher interest rate on exchange rate.

(Dash, 2012:25) examined the relationship between interest rate and exchange rate in India by using cointegration based on vector autoregression model during April 1993 to March 2003 and June 1995 to March 2003 and by using a theoretic vector autoregression model from June 1995 to March 2003. He employed three key variables like the call money rate, net intervention and expected inflation rate differential between India and the rest of the world. The results indicated a long-run relationship between interest rate and exchange rate. He further indicated that both call money rate and net intervention had negatively and significantly induced the exchange rate whereas the expected rate of inflation differential has not played significant role in the behaviour of exchange rate in India.

Dwelling on the exchange rate unpredictability, (Chen, 2006:208-224) critically examined the correlation between interest rate and exchange rates in the case of six developing countries. The empirical results indicated that an increase in nominal interest rate leads to a higher probability of switching to a regime with more volatile exchange rate.

A lots of studies on the relationship between interest rate and exchange rate in Turkey has generated a mixed reactions amongst economists. For instance, (Gümüş, 2002:14) studied the relationship between the nominal interest rate and nominal exchange rate using higher frequency (weekly) data set and employed a vector error correction model. The result found that raising interest rate had a significant long-term effect of depreciation of the nominal exchange rate.

(Aysoy & Kıpıcı, 2005: 39-71) sifted the impact of interest rates on exchange rate within a context of quarterly macro econometric model of Turkey. They concluded that interest rates has a transitory impact on the exchange rate in the sample period. (Ekinci & Özer, 2007:21-31) gave a comprehensive studies which indirectly investigated the relationship between interest rate and exchange rate. The study revealed one way causal relationship between interest rate and exchange rate. He concluded that interest rates affect the real and financial sector through exchange rate. On the contrary, (Kayhan, Bayat, & Uğur, 2013:227) investigated the causal relationship between interest rate and exchange rate. His evidence revealed no causal relationship between them. His evidence supported the earlier research conducted by Gul et al in 2007.

Finally, (Sarac and Karagoz 2016:195) examined the impact of short-term interest rate on exchange rate in Turkey in 2015 using a monthly data for the period of February 2003 to August 2015. They concluded that there is no evidence that higher interest rates causes a weakening of exchange rate by the frequency domain of Granger causality test.

### **3. DATA and METHODOLOGY**

This section describes the data used for the analysis of the relationship between the exchange rate and the interest rate in Turkey. It also describes the empirical method of the study.

#### **3.1 Data**

Analyze the impact of the interest rate on the exchange rate without taking into account other transmission channels that are, among other things, the inflation rate, the money supply, the GDP growth rate, the opening rate to the outside can produce biased results. For this reason, nominal exchange rate, nominal interest rate, GDP growth rate, money supply (M2) data are used to conduct the study. They come from the World Bank data base and cover the period 1987-2016.

### 3.2 Methodology

Several authors are interested in the analysis of the correlation between the exchange rate and the interest rate. On the other hand, these authors have adopted different approaches to determine this relation. In our case, it is question here, to use a VAR model and to determine the impact of the exchange rate on the interest rate through the functions of impulsive answers and the decomposition of the variance of the error. VAR model, which was expounded, by Sims (1980), Litterman (1979), and Doan (1984) has been used for testing empirically the interactions among real exchange rate (EXCH), interest rate (INTRA), GDP Deflator represented by GDPDF, and Money broad (M2). Contrary to the structural models, VAR technic gives more flexibility to the model for it does not require some restrictions beforehand. Moreover, this technic is highly beneficial to express the interactions between variables as a system (Zengin, 2000: 31). It is debated whether the variables within the VAR system should be stationary. The main argument against the difference extraction is that it causes information losses related to the co-movement in the data. The common opinion on this subject is that the variables in the system are obtained from a real data derivation procedure (Enders, 1995: 310- 311). In the light of this, the VAR is simply the best method to analyse time series data since it does not present ambiguous results. To determine the relationship between the macroeconomic variables, Sims (1980) proposes to use an unconstrained and dynamic statistical model like vector autoregressive model as an alternative to large macroeconometric models (Akan and Arslan, 2008:250). Empirically, consider the VAR model that contain a several variables. We can write like this:

$$Y_t = a_0 + a_1 Y_{t-1} + a_2 Y_{t-2} + \dots \dots a_p Y_{t-p} + u_t$$

$$\text{So, } Y_t = \begin{pmatrix} y_{1t} \\ \cdot \\ \cdot \\ y_{nt} \end{pmatrix} \quad a_0 = \begin{pmatrix} b_1^0 \\ \cdot \\ \cdot \\ b_n^0 \end{pmatrix} \quad a_p = \begin{pmatrix} b_{1p}^1 & b_{1p}^2 & \dots & b_{1p}^n \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ b_{np}^1 & b_{np}^2 & \dots & b_{np}^n \end{pmatrix} \quad u_t = \begin{pmatrix} u_{1t} \\ \cdot \\ \cdot \\ u_{nt} \end{pmatrix}$$

### 3.3 Data Analysis

In this section, we analysis the staionnarity of data and we test the VAR validity.

#### 3.3.1 Stationarity Test.

The analysis of the time series requires first to make sure of the stationarity of the variables. This saves us from having fallacious regressions. The stationarity of the series makes it possible to know the order of integration of the series that is to say how many times the variable must differentiated so that it is stationary. That's why it's important to do a number of preliminary tests to make sure the series is stationary.

Thus, there are several unit root tests such as the Dickey and Augmented Fuller test (ADF) and the Phillips Perron test (PP), but the most powerful and robust test is that of Dickey and Augmented Fuller (ADF). In this study, the ADF test used. A calculated statistic lower than the statistic read at the 5% threshold leads to the rejection H0. Thus, the results of the stationarity tests are summarized in Table 1 below.

**Table1:** Stationarity Test

variables	Level			First difference			Second difference		
	without trend and constant	Trend	Trend and constant	without trend and constant	Trend	Trend and constant	without trend and constant	Trend	Trend and constant
<sup>1</sup> INTRA	-1.96*** (-4.013)	-3.5806 (-2.253)	-3.0048 (-1.939)						
<sup>2</sup> EXCH	-1.9533 (1.518)	-3.5806 (-2.193)	-2.9718 (0.5298)	-1.9533** (-2.1615)	-3.5806 (-3.1252)	-2.9718 (-2.808)			
<sup>3</sup> M2	1.9533 (1.488)	3.5742** (-4.067)	-2.9718 (-0.313)						
<sup>4</sup> INFDEF	-1.955 (-1.149)	-3.6328 (-3.332)	-2.9862* (-0.969)	1.9533*** (-7.4597)	3.8575*** (-5.588)	2.9762 (-5.719)			
<sup>5</sup> GDPDF	-1.9533 (1.122)	-3.5806 (-1.949)	-2.9718 (0.9592)	-1.9533 (0.038)	-3.5806 (-2.190)	-2.918 (-1.249)	-5.694 (-1.954)	-5.719 (-3.587)	-5.8358 (-2.976)

Author's Computations, 2017

Examination of Table 1 shows that the series not integrated at the same level. Thus, the interest rate and the money supply (M2) are stationary in level. The exchange rate of the pound against the US dollar, the deflator of the inflation rate meanwhile are stationary in first difference. On the other hand, the GDP deflator is in secondary difference. Thus, the stationarity of the series at the same level excludes the risk of cointegration between the variables. This gives us the right to use a VAR model in the rest of this work.

### 3.3.2 VAR Model Analysis

In this section, we determine first, the optimal delay number to introduce into the model and after this, we examine the VAR model according the delay number. The optimal delay number to introduce into the model is obtained using the information criteria of AIC and BSC.

**Table2:** Selecting the optimal delay number

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-382.0646	NA	5867895.	29.77420	30.01614	29.84387
1	-312.8172	106.5344*	203515.6*	26.37056*	27.82221*	26.78858*
2	-291.4701	24.63138	343082.6	26.65154	29.31290	27.41792

Word Bank, 2017

With regards to Table 2 we see that the optimal delay number that minimizes the AIC and BSC criterion is one. Therefore, we have to do to a VAR (1).

According the result of optimal delay, it is a question of estimating the VAR (1) and of determining the impact of the exchange rate on the interest rate. After estimating the VAR (1) model through the impulse response functions, we determined the impact of a shock on the interest rate explanatory variables in Turkey. Thus, the estimation results of the VAR model (1) allow us to write each equation according to its own past values and the past values of others. In this study, which focuses on the analysis of the impact of the exchange rate on the interest rate, we will focus on the interest rate equation, which is written as follows:

<sup>1</sup> INTRA mean that the interest rate during the time,

<sup>2</sup> Exchange rate

<sup>3</sup> Money broad

<sup>4</sup> Inflation deflator

<sup>5</sup> GDP deflator

$$\text{INTRA} = 109.35^{***} + 0.366 * \text{INTRA}(-1)^{**} + 9.23 * \text{D}(\text{EXCH}(-1)) - 2.215 * \text{M2}(-1)^{***} - 0.086 * \text{D}(\text{infdef}(-1)) + 1.71 * \text{D2}(\text{GDPDF}(-1))$$

$$R^2 = 0.76; F = 13.5$$

According to the results of the VAR model estimate, F-statistic is 13.5, which is well above its threshold value of 5% (2.59). Which presages an overall significance of the parameters of the model. The value of  $R^2$  is also high and is equal to 76%, which means that 76% of the interest rate changes are explained by the variables of the model while the 14% are explained by variables that do not have been taken into account in this model. This allows us to accept our model.

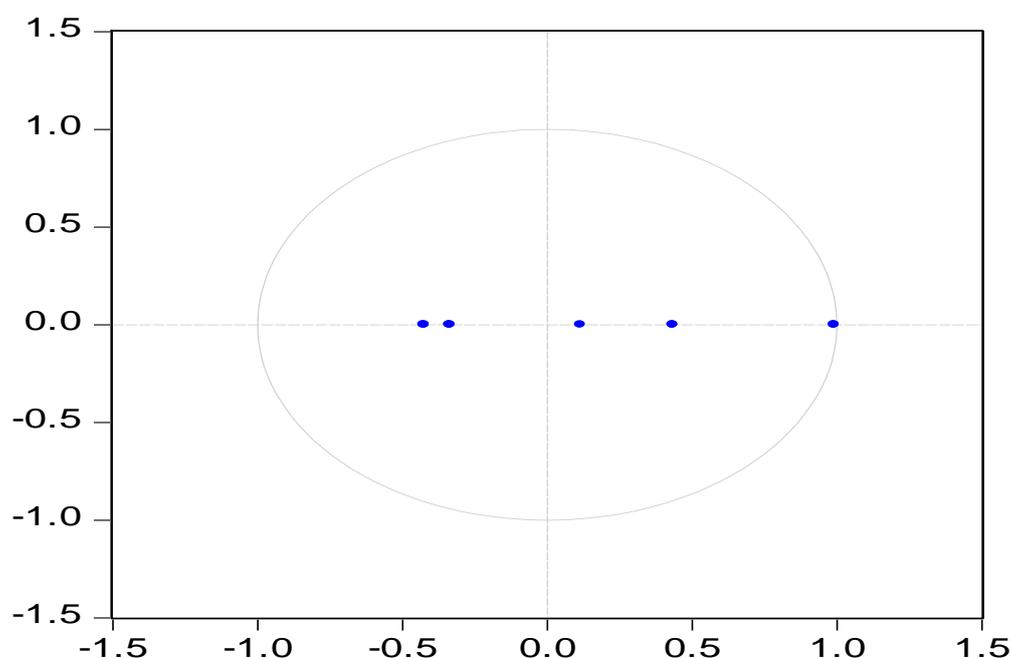
### 3.3.3 Validation test of the VAR Model

The validation test, is used to ensure the validation of the model used. To do this, it is imperative to do some tests. In our study, we will proceed to the stationarity test of the model, and the autocorrelation test of the errors.

#### 3.3.3.1 Stationarity test of the model

To test the stationarity of the model, we will use the inverse of the root of the characteristic polynomial. The model is stationary if the opposite all the roots are inside the unit circle.

#### Inverse Roots of AR Characteristic Polynomial



Referring to the above graph one realizes the inverse of all the roots of the polynomial are located inside the unit circle. This allows us to conclude the stationarity of the VAR (1) model.

#### 3.3.3.2 Autocorrelation error test

One of the conditions for validating a model is the lack of autocorrelation of errors. Therefore, before deciding on the validity of an econometric model, it is necessary to use an autocorrelation error test. In our case, we will use the LM-test Lagrange Multiplier test.

VAR Residual Serial Correlation LM Tests  
 Null Hypothesis: no serial correlation at lag order h  
 Date: 03/27/18 Time: 15:19  
 Sample: 1987 2016  
 Included observations: 27

Lags	LM-Stat	Prob
1	21.10520	0.6867

Probs from chi-square with 25 df.

By observing the results of the Lagrange Multiplier test, the showed that the probabilities are all greater than 5%. This means that the errors are not autocorrelated. This indicates that different tests performed on the VAR (1) model. Hence the results shows that the model is stationary and the errors are also non-autocorrelated. The errors are not autocorrelated. Therefore, our model can be retained for econometric purposes and can be interpreted.

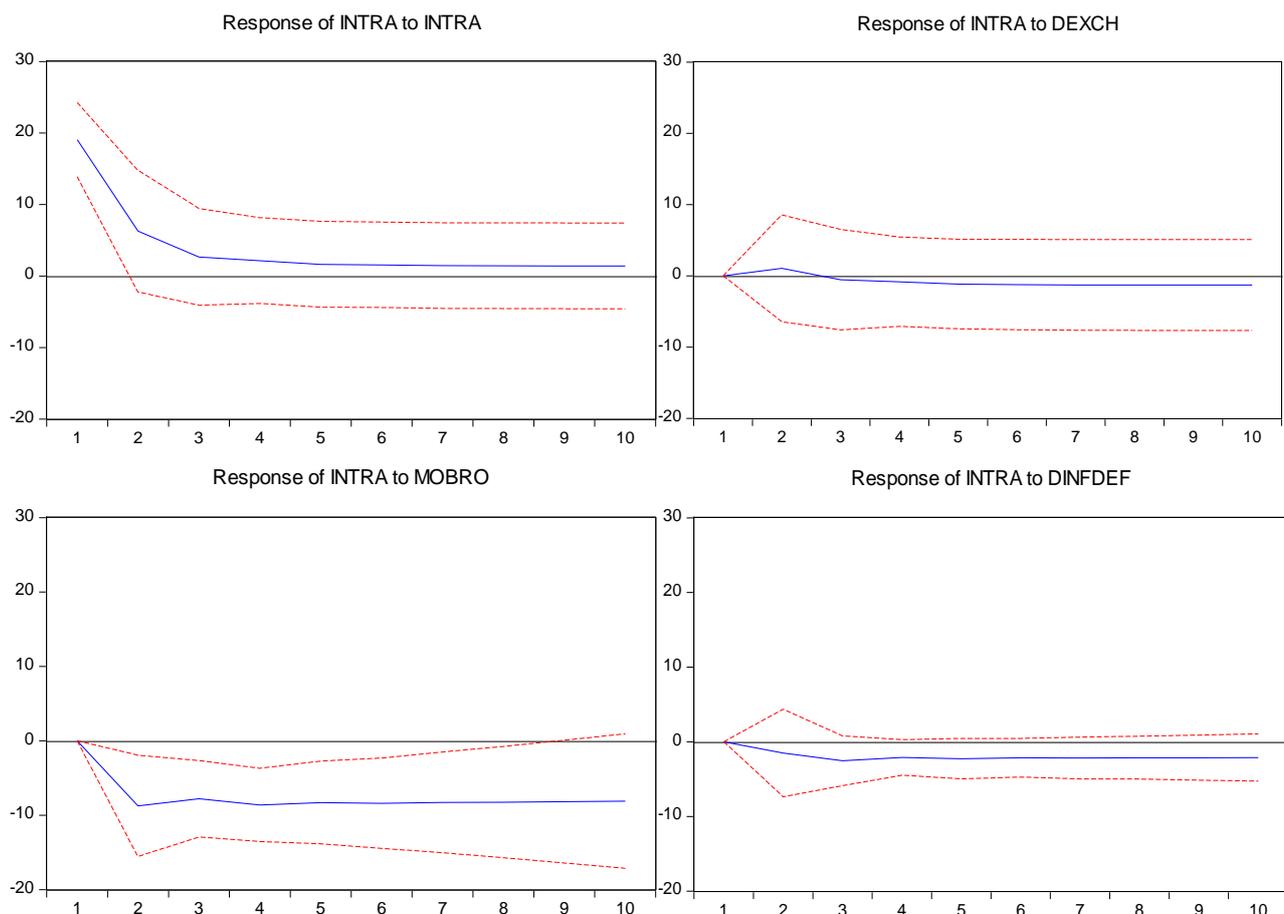
#### 4. RESULTS ESTIMATION

In this part of the study, we determined the impact of shocks on interest rate fluctuations by using the impulse response functions and the decomposition of the variance of the forecast error. In the last part of this study, we proceeded to the Granger causality test.

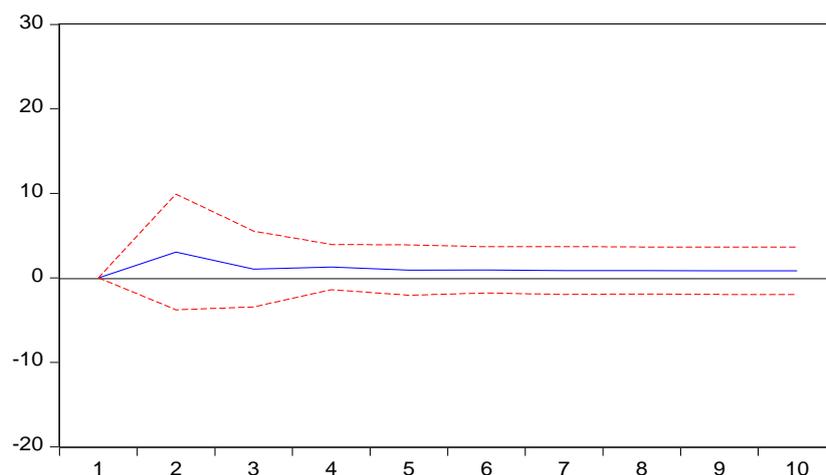
##### 4.1 Analysis of Impulsive Response Functions

The analysis of impulse responses is one of the main uses of VAR models. It is used to capture the relative impact of shocks on the dependent variable. Thus, the analysis of the transmission of the impact of a change in the shock on the exchange rate, the money supply in circulation, the inflation rate deflated, the gross domestic product deflated allows us to note a relative variation in the rate of interest at the beginning of the period but becomes constant in the long run.

The blue lines denote the interest rate response following a shock on the independent variables. These responses are represented over a 20 years horizon. The shocks are standardized to 1%, the vertical axis represents the percentage of the approximate variation of the interest rate following a 1% change in the exchange rate, the money supply, the inflation rate deflated and the rate of economic growth deflated.



Response of INTRA to D2GDPDF



The analysis of the results shows that the impact of shocks is not totally consumed over time. Which means that the variables do not return to their equilibrium level after the appearance of a shock on the error term. A shock on the exchange rate results in an alternating positive and negative change in the interest rate between the first and the fourth period before stabilizing.

These effects translate into periods of rising and falling interest rates. Thus, in the second period, we notice an increase in the interest rate of 1% due to a shock on the exchange rate. In a flexible exchange rate regime such as that of Turkey, an increase in the interest rate leads to an appreciation of the national currency, which hinders exports and leads to a decrease in domestic production to the detriment of imports. The opposite effect occurred in the third period with a fall in the interest rate of -1%. A decrease in the interest rate leads to a depreciation of the currency, which favors exports and domestic production. The consequence of such a policy is that the national currency becomes less attractive, leading capital flight to destinations in countries where return on capital is high. After the third period the interest rate becomes negative and stable.

However, a shock on the money supply (M2) causes a negative fluctuation of the interest rate. The application of the negative interest rate by the central bank on the excess reserves of commercial banks causes losses for commercial banks. For example, a negative interest rate on commercial bank deposits discourages banks from having excess reserves in the central bank. This policy allows the central bank to reduce the cost of loans granted by commercial banks to businesses and households and to facilitate the financing of the economy. A negative interest rate leads to lower loan costs, which favors the development of economic activities. For when the interest rate is negative, the money supply in circulation increases, which leads to a decrease in the interest rate of the loanable funds. This policy is effective in the short term, but its long-term effectiveness remains mixed.

The graph also shows that when a shock occurs on the deflated inflation rate, this leads to a negative fluctuation of the interest rate throughout the period. The effect of the shock does not fade throughout the period. In economic theory any increase in the interest rate causes a decrease in the rate of inflation through a decrease in the money supply in circulation. In other words, an improvement in the purchasing power of households, which corroborates with economic theory. The interest rate is an effective instrument of monetary policy.

Thus, when a shock occurs on the deflator of the gross domestic product, this is transmitted on the interest rate causing a positive fluctuation of the interest rate. Thus, the variable never finds its equilibrium after the shock. Indeed, an increase in the interest rate causes a narrowing of the money supply, and therefore of economic activity.

#### 4.2 Decomposition of Variance Method

In this part, the results of the analysis of the decomposition of the variance of the error are presented.

Variance Decomposition of INTRA:						
Period	S.E.	INTRA	DEXCH	M2	DINFDEF	D2GDPDF
1	20.09037	100.0000	0.000000	0.000000	0.000000	0.000000
2	23.75870	80.68359	0.264245	16.05761	2.696563	0.297993
3	26.06907	75.91377	2.528856	13.86259	7.312108	0.382671
4	29.19953	65.84660	4.610471	22.78374	6.018035	0.741159
5	31.52275	63.35601	4.203118	26.28828	5.292107	0.860480
6	32.74448	60.81633	4.149200	28.44811	5.579279	1.007081
7	34.27048	58.37099	4.045598	31.14897	5.504198	0.930249
8	35.76349	56.64335	3.903829	33.37570	5.190834	0.886295
9	37.02787	55.29666	3.682392	34.99233	5.199504	0.829110
10	38.16491	54.24593	3.537869	36.15434	5.271788	0.790068

Source: Authors Computation, 2017

An examination of Choleski's variance decomposition shows that over a one-year horizon, the variance of the forecast error in the interest rate is due to 100% of its own innovations. It is almost from the second period, the contribution of the other variables in the explanation of the interest rate increases. It is practically from the second period that the contribution of the other variables in the explanation of the interest rate increases. Thus, in the second period the contribution of the variance of the error is due to 80.68% of its own values, 0.26% of the exchange rate, 16% of the money supply in circulation, 2.70% of the inflation rate and 0.30% of the of gross domestic product deflated.

However, we note the persistence of shocks over time. That is, the variables do not return to their long-term equilibrium level. This result confirms those impulsive functions that predict the instability of the effects of shocks during the period. It is concluded that the exchange rate contributes little in determining the interest rate in Turkey.

### 4.3 Granger Causality Test

Granger Causality Test, the analysis of the Granger causality test allows us to determine the causal link between the dependent variable (interest rate) and the variables explained namely the exchange rate, the money supply, the interest rate, inflation and the deflator of gross domestic product. The result of the test is shown in the table below.

Table:

Pairwise Granger Causality Tests

Date: 03/25/18 Time: 20:55

Sample: 1987 2016

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
DEXCH does not Granger Cause INTRA	27	1.09669	0.3515
INTRA does not Granger Cause DEXCH		0.19662	0.8229
MOBRO does not Granger Cause INTRA	28	3.76437	0.0385
INTRA does not Granger Cause M2		0.53502	0.5928
DINFDEF does not Granger Cause INTRA	27	0.70169	0.5065
INTRA does not Granger Cause DINFDEF		0.13545	0.8740
D2GDPDF does not Granger Cause INTRA	26	0.37758	0.6901
INTRA does not Granger Cause D2GDPDF		0.14900	0.8625
MOBRO does not Granger Cause DEXCH	27	0.91109	0.4167
DEXCH does not Granger Cause M2		2.41819	0.1124

DINFDEF does not Granger Cause DEXCH	27	2.26164	0.1279
DEXCH does not Granger Cause DINFDEF		0.77846	0.4714
D2GDPDF does not Granger Cause DEXCH	26	3.14541	0.0638
DEXCH does not Granger Cause D2GDPDF		0.33691	0.7178
DINFDEF does not Granger Cause M2	27	1.34337	0.2815
MOBRO does not Granger Cause DINFDEF		0.34782	0.7100
D2GDPDF does not Granger Cause M2	26	0.59081	0.5628
MOBRO does not Granger Cause D2GDPDF		0.45434	0.6410
D2GDPDF does not Granger Cause DINFDEF	26	0.66725	0.5237
DINFDEF does not Granger Cause D2GDPDF		0.51671	0.6039

The result of the test is shown in the table above. The causality test makes it possible to determine the causal relationship between the explanatory variables and the explained variable above. Thus, the examination of the results showed that money supply (M2) causes the interest rate with a threshold of 5%. That is to say that any increase (respectively decrease) in the interest rate leads to a decrease (respectively increase) in the money supply in circulation. On the other hand, there is no causal relationship between the interest rate and other variables such as the gross domestic product deflated, the rate of inflation deflated, the bilateral exchange rate of the Turkish lira against the US dollar on the other hand at a critical threshold of 5%.

## 5. CONCLUSION

This study analyzes the impact of the exchange rate on Turkey's nominal interest rate between 1987-2016. Effective macroeconomic policies often use transmission channels for their purposes. However, it is noted that, these channels of transmission differ according to their degree of transmission of the policy. Thus, for a policy to reduce inflation, the interest rate channel plays a big role. The exchange rate influences the interest rate through other macroeconomic variables such as money supply, growth rate, and so on.

The study of the impact of the exchange rate on the interest rate was conducted using a four-variable VAR model including the nominal interest rate, the exchange rate, the GDP deflator, the deflator of the inflation (DINFL) and the money supply (M2). After estimating the VAR model, we find that the model is a VAR (1) which is globally significant, stationary and validated according to the different tests conducted.

The analysis of the results of the impulse functions shows that the impact of shocks is not totally consumed over time. This means that the variables do not return to their long-term equilibrium level after the occurrence of a shock on the error term. Thus, an increase in the nominal interest rate causes an appreciation of the Turkish local currency through the inflow of foreign capital. This has the effect of attracting foreign investors and also helps to fight against inflation as indicated by monetarists. On the other hand, it favors exports, decreases in local production, and domestic demand, which are major components of growth. The lowering of the interest rate leads to a depreciation of the Turkish local currency, which favors exports and encourages domestic production and encourages domestic demand. The consequence of such a policy is that the national currency becomes less attractive, leading capital flight to destinations in countries where return on capital is high. Traders buy currencies with a high interest rate and sell currencies with the lowest interest rates.

The decomposition of Choleski shows that the exchange rate contributes little in the determination of the interest rate on the Turkish market. However, the causality analysis shows that it is the M2 money supply that causes the interest rate. That is to say that any increase (respectively decrease) in the interest rate leads to a decrease (respectively an increase) in the money supply in circulation. There is no causal relationship between the interest rate and the exchange rate. The studies of Gul (2007)

supports results. It is concluded that the increase in the exchange rate does not significantly affect the nominal interest rate.

In order to remedy the excessive depreciation of the Turkish currency, the monetary authorities must increase the interest rate in the very short term. This would attract foreign capital (appreciation of the local currency) and reduce inflation through a reduction in the supply of money in the market. This policy has negative effects on exports and domestic demand. The research finally recommends that resilient fiscal and monetary policy reforms aim at improving private sector investment and economic growth should target reducing high inflation interest rate and encourage foreign direct investment.

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