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2008 GLOBAL KRİZİNDE TÜRKİYE'DE FAİZ ORANLARININ DÖVİZ KURLARINA ETKİLERİ

EFFECTS OF INTEREST RATES ON EXCHANGE RATES IN TURKEY DURING 2008 GLOBAL CRISIS

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ÖZ

Faiz oranları ile döviz kurlarının ilişkisi daima ilgi çeken bir konu olmuştur. Bu sebeple, bu çalışmada 1930 yıllarında gerçekleşen Büyük Buhran sonrasında en büyük ikinci kriz olan 2008 finansal krizi sırasında bu ilişki analiz edilmiştir. Analiz, yüksek faiz oranlarının döviz kurlarını düşürme etkisi olup olmadığını göstermeyi hedeflemektedir. Ekim 2008 ve Aralık 2009 tarihleri arasındaki haftalık veri ile ARDL Model uygulanmıştır. Analiz sonucunda faiz oranları ile döviz kurları arasında kısa vadeli bir ilişkiye rastlanmazken; uzun vadede, pozitif bir ilişki tespit edilmiştir. Bunun anlamı, yüksek faiz oranları uzun vadede döviz kurlarında artışa sebep olmaktadır.

Anahtar Kelimeler: Döviz Kuru, Faiz Oranı, Birim Kök Testleri, ARDL model

ABSTRACT

As the discussion on the relationship of interest rates and exchange rates is always a hot topic, this paper aims to analyze this relationship during 2008 financial crisis, which is the second global crisis after the Great Depression of 1930s, whether higher interest rates had the effect of defending exchange rates thus appreciating them. Applying an autoregressive distributed lag model (ARDL) to weekly data between October 2008 and December 2009, it can be concluded that there is no relationship in the short-run but there is a positive relationship in the long-run meaning that higher interest rates are associated with depreciation of exchange rates in the long-run in line with the revisionist view.

Keywords: Exchange Rate, Interest Rate, Unit Root Tests, ARDL model

1. GİRİŞ

There are two views regarding the relationship between interest rate and exchange rate. The traditional view underlines that increasing interest rates defend the exchange rates in crisis times. During extraordinary times, tight monetary policy can be a signal of currency defense by monetary authorities of a country thus restoring the confidence of the investor. As a result, capital flight can be avoided and even the country can attract capital inflows with higher interest rates. These factors support the currency and result in appreciation of the exchange rate.

However, some of the economists argue that raising interest rates during crises can lead to depreciation of the currency. High interest rates can worsen the financial position of the debtors increasing the risk of bankruptcies. Creditors and banking system can be affected adversely. This can lead to a credit crunch and the financial system can be affected adversely resulting in capital outflows thus exchange rate depreciation. This revisionist view is strongly supported by Furman and Stiglitz (1998).

There is a direct relationship between domestic and world inflation differential and domestic exchange rate. In other words, a higher domestic inflation results in high domestic exchange rate depreciation. This is so because an increase in domestic inflation as compared to world inflation would increase the domestic demand for foreign commodities and lowers the foreign demand for domestic commodities, which, in turn, would lead depreciation of domestic currency to maintain the exchange rate as per the purchasing power theory. Similarly a decrease in domestic inflation as compared to world inflation causes appreciation of domestic currency. Therefore, the higher the inflation differential between domestic and foreign countries, the higher will be the depreciation of domestic currency and vice versa (Dash, 2004).

This study aims to analyze the relationship between interest rates and exchange rates in Turkey during global financial crisis of 2008 using the methodology of Dekle, Hsiao and Wang (2002), Gümüş (2002) and Dash (2004). The results of the study will determine which view is supported in Turkey during this latest crisis.

The rest of the paper is organized as follows. The second section will encompass the literature review, the third section dataset and model; the fourth section the effects of the global financial crisis on Turkish economy, the fifth section econometric methodology and its findings and finally the concluding remarks respectively.

2. LITERATURE REVIEW

There are several articles published by Turkish and foreign academicians and researchers on the relationship between interest rates and foreign exchange rates. Some of them focus on this relationship only during crises while others study their long-term relationship excluding crisis periods.

Karaca (2005) studies the relationship between interest rates and exchange rates in the short-term, long-term and during floating exchange rate period with monthly data between January 1990 and July 2005. No statistically meaningful results are obtained to prove the relationship between short-term interest rate and exchange rate. Only during floating exchange rate period (March 2001-July 2005) a statistically meaningful positive relationship can be detected but this relationship is weak. Thus, the conclusion that an increase in short-term interest rates can depreciate the exchange rates can be deducted from the analysis.

Whereas Gümüş (2002) looks to the effects of the interest rate defense on exchange rate during the 1994 crisis in Turkey by studying weekly data from November 1993 to the end of June 1994. She finds that higher interest rates are associated with exchange rate depreciation in the long-run, supporting the revisionist view. Even though the impact effect of an interest rate increase is exchange rate appreciation, this effect is insignificant. Therefore, it can be said that interest rate defense has not been successful in appreciating the exchange rate in the 1994 Turkish crisis.

Dash (2004) analyzes this relationship with monthly data for two time periods namely, from April 1993 to March 2003 and from June 1995 to March 2003 because of the unavailability of data for some variables in the former time period in India. It was found that there has been a long-run relationship among variables. Both interest rate and net intervention by Central Bank have negatively and significantly influenced the exchange rate, whereas the expected rate of inflation differential between the India and world has not played significant role in the behavior of exchange rate in India. The interest rate and exchange rate were affecting each other. Finally, there is a strong case for an increase in interest rates to stabilize the value of rupee during the downward pressure in India.

In addition to country-specific studies, there were also cross-country studies that evaluate the effect of interest rates on exchange rates across many crises periods in different countries. Gould and Kamin (2000) work on weekly data for the five countries (Indonesia, Korea, Malaysia, the Philippines, and Thailand) most heavily affected by the Asian financial crisis. Credit spreads and stock prices make significant impacts on exchange rates during financial crises, but interest rates still are not estimated to have significant effects. They conclude that while monetary policy probably does make an important influence over exchange rates, this most likely takes place slowly, as central banks attempt to establish credibility. Their finding about credit spreads is consistent with their hypothesis that during financial crises, perceptions of country and credit risk become a major determinant of currency values.

Goldfajn and Gupta (1999) study monthly real exchange rate and real interest rate of 80 countries with currency crises between January 1980 and January 1998. Defining a successful recovery as one that occurs through a nominal appreciation rather than an increasing inflation, they compare the overall probability of success with the probability of success for the cases where monetary policy was tightened through higher interest rates. They find that except for the cases where both currency and banking crises are present, tight monetary policy increases the probability of success substantially (from 26% to 37%).

Dekle, Hsiao and Wang (2001) look to Korean weekly data including the Korean corporate bankruptcy rate as an additional variable from September 1997 to August 1998. The Korean experience supports the traditional view that raising the interest rate does appreciate the nominal exchange rate. Furthermore, they find that the corporate bankruptcy rate responds more to the exchange rate depreciation than to the interest rate increase. In short, they have not found evidence supporting the revisionist view that high interest rates result in rising corporate bankruptcies, capital outflows, and thus depreciating exchange rates. They (2002) also look for this relationship in Korea, Malaysia, and Thailand in a separate study. Their findings are supportive of the traditional view that raising interest rates appreciate the exchange rates but the impact is found to be small.

Furman and Stiglitz (1998) have examined the effect of an increase in interest rate, inflation, and many non-monetary factors on exchange rate for nine developing countries from 1992 to 1998. They argue that there are two important channels through which exchange rates are likely to be affected by the increase in interest rates. One of them is risk of default and another one is risk premium. Since the uncovered interest parity theory assumes no role for both these channels, the interest rate represents the promised return on domestic assets. However in a post crisis situation, high interest rate policy may decrease the probability of repayment and increase the risk premium on domestic assets because of its adverse effect on domestic economic activity by reducing the profitability of domestic firms and increasing the borrowing costs. Therefore an increase in interest rate may lead to exchange rate depreciation. This could be stronger when the financial position of firms and banks is fragile and the effect was more pronounced in low inflation country than in high inflation country.

Kraay (2000) studies the behavior of interest rates during a large number of successful speculative attacks (i.e. attacks that end in a sharp nominal devaluations) and failed speculative attacks (i.e. attacks that did not end in a devaluation) in a sample of 54 industrial and middle-income developing countries over the period 1975-1999 with monthly nominal exchange rates. Simple descriptive evidence provides no evidence of a significant positive or negative association between changes in interest rates and the outcome of speculative attacks. For 192 cases out of 313 speculative attacks, the exchange rate did not depreciate significantly.

Goldfajn and Baig (1998) study the linkage between real interest rate and real exchange rate for the Asian countries during July 1997 to July 1998 by using Vector Autoregression (VAR) based on the impulse response function from the daily interest rates and exchange rates. They have not found any strong conclusion regarding the relationship between interest rate and exchange rate.

Cho and West (2001) look to this relationship using weekly data during 1997-1998 exchange rate crises in Korea, Philippines and Thailand. As a result, they find that an exogenous increase in the interest rates lead to exchange rate appreciation in Korea and Philippines and to exchange rate depreciation in Thailand during the crisis period.

Agenor, McDermott and Ucer (1997) examine the links between fiscal policy, uncovered interest rate differentials, real exchange rate and capital inflows in Turkey since the late 1980s. They find out that an increase in interest rate differential leads to an appreciation of real exchange rate and this effect is significant.

Berument (2002) conducts an empirical analysis in Turkey. He suggests that tight monetary policy is associated with a decrease in income and prices and the appreciation of the currency in the short run. For prices and the exchange rate, the effect is permanent; but for income the effect is transitory.

Gül, Ekinci and Özer (2007) focus on the relationship between exchange rates and interest rates by using Granger causality test and cointegration test. The results underline that there is no cointegration relationship between exchange rates and interest rates but there is causality from nominal exchange rates to interest rates.

Sever and Mızrak (2007) also study the relationship between exchange rate, interest rate and inflation by applying VAR method. They conclude that changes in exchange rate have much effect on inflation and interest rate thus the stability of exchange rate is the determinant factor for the stability of inflation and interest rates.

Bal (2012) underlines that there is a long-term balance relationship between the foreign exchange rate and bank deposit interest rates, and the foreign exchange rate is also affected by the changes in wholesale price index and treasury bills and bonds.

Mamak Ekinci, Alhan and Ergör (2016) examine the relationship between exchange rates, interest rates and consumer price index (CPI) with non-parametric regression analysis by using monthly data between January 2010-October 2015. They find out that there is a statistically meaningful and positive relationship between dependent and independent variables. In other words, increases in inflation and exchange rates cause increases in interest rates.

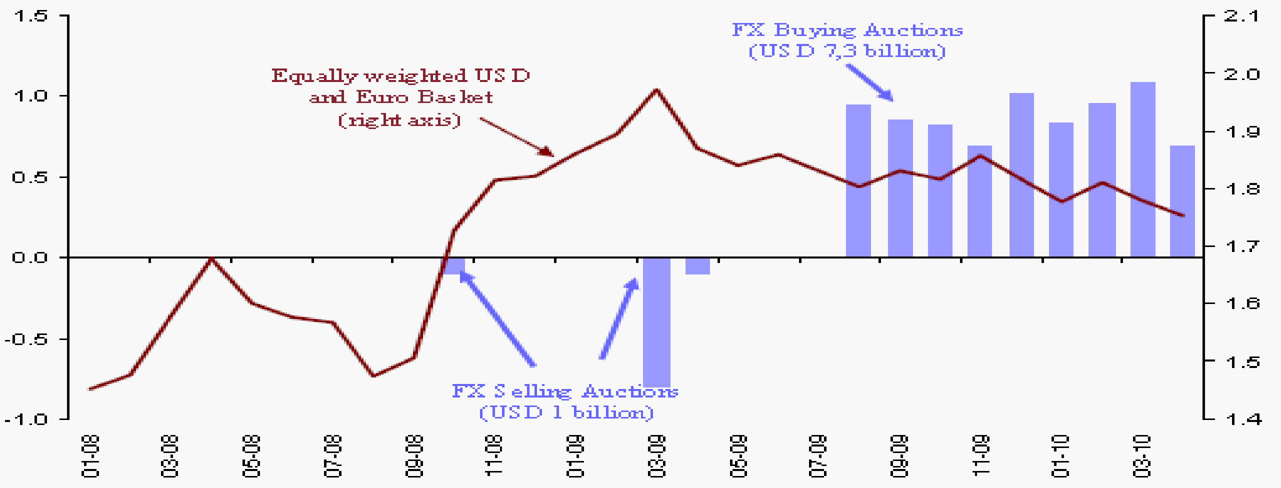
Erer and others (2016) analyze the effects of monetary policies by CBRT, FED and ECB (short-term (interbank) interest rate) on the consumer price index, the industrial production index and the real effective exchange rate under high and low inflation regimes. CBRT short-term interest rate affects both consumer price index and real exchange rate positively under low inflation regime but no effect is seen under high inflation regime. FED short-term interest rate is very significant for Turkey as it has a rising effect on exchange rate when FED increases its interest rate.

3. TURKISH ECONOMY DURING 2008 FINANCIAL CRISIS

The effects of the financial crisis were deepened in October 2008 in Turkey. Beginning from this month, Central Bank of the Republic Turkey (CBRT) gives information about its liquidity management strategy to the public on a continuous basis to prevent uncertainties in the financial system. Afterwards, announced measures for TL and Foreign Exchange (FX) markets were put into action gradually to overcome volatilities in a great extent (CBRT, 2010).

3.1. Measures taken in FX Market

i.FX buying auctions were suspended on October 2008 to enable banks to strengthen their FX liquidity positions during global crisis conditions. With positive expectations about global economy, they have been restarted on August 2009 to accumulate FX reserves in response to stronger risk appetite. Between August 2009 and 20 April 2010, CBRT has purchased USD 7.9 billion via FX buying auctions and injected TL 12 billion to the market as shown in Graph 1 and Table 1.



Graph 1: FX Buying and Selling Auctions against TRY and FX Basket (Jan 2008 – 20 Apr 2010)
Source: CBRT

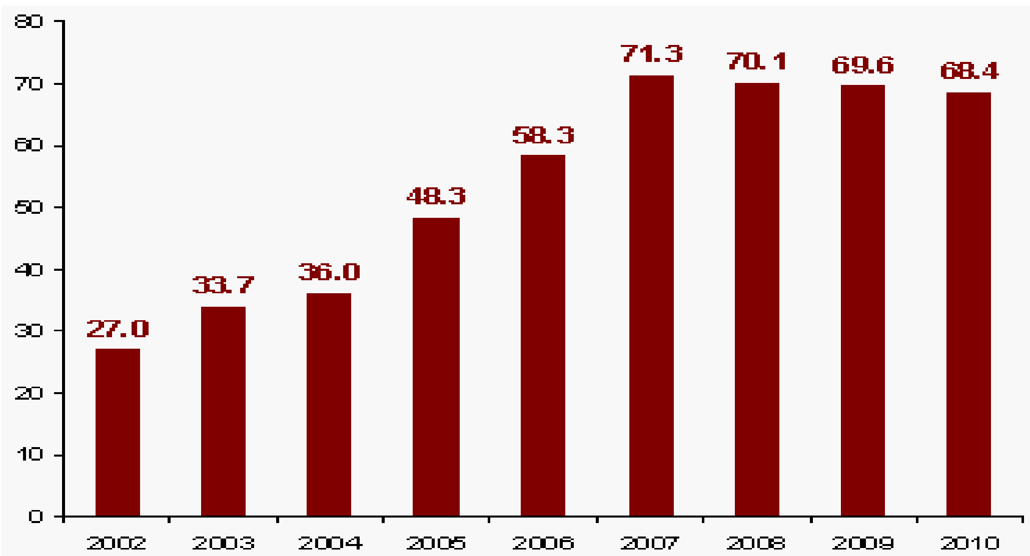
Table 1: CBRT FX Interventions and FX Auctions (Million USD)

Year	FX Buying Auctions	FX Selling Auctions	FX Buying Interventions	FX Selling Interventions	Total Net FX Purchases
2003	5652	-	4229	-	9881
2004	4104	-	1283	9	5378
2005	7442	-	14565	-	22007
2006	4296	1	5441	2105	6632
2007	9906	-	-	-	9906
2008	7584	100	-	-	7484
2009	4314	900	-	-	3414
2010*	3376	-	-	-	3376

Source: CBRT (*As of 15 April 2010)

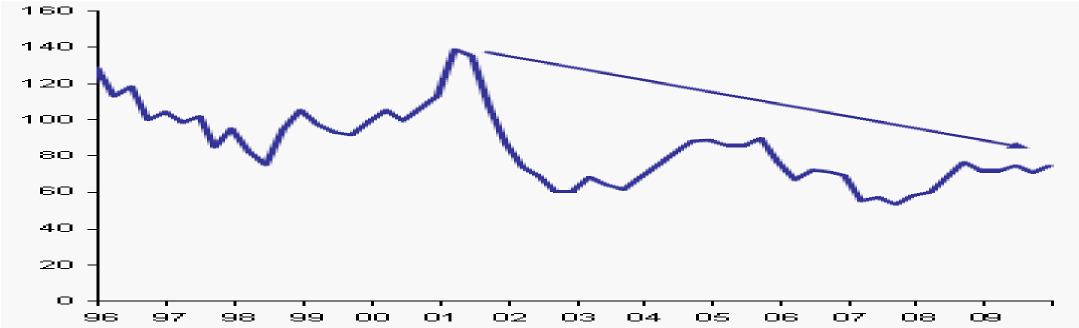
FX reserves of CBRT reached USD 68.4 billion as of April 2010 and are sufficient to cover the short-term foreign debt of the country as seen in Graph 2 and 3.

Graph 2: Central Bank FX Reserves by Year (2002 – Apr 2010, Billion USD)



Source: CBRT

Graph 3: Ratio of Short-term Foreign Debt to Central Bank FX Reserves (1996 – 2009 Q4, percent)



Source: Under secretariat of Treasury, CBRT

ii. On December 5, 2008, the reserve requirement ratio of FX deposits, which used to be 11%, was decreased to 9% to provide extra FX liquidity of USD 2.5 billion to the banking system. In addition, export discount credit limits were increased and their use by companies was widened via some arrangements.

iii. In February 2009, CBRT extended the maturity of foreign exchange deposits denominated in US dollar or Euro for banks in the FX Deposit Markets, and lending rate was reduced for transactions where the Central Bank is counterpart. Moreover, upon observing unhealthy pricing in the FX markets as a result of vanishing depth, 18 foreign exchange selling auctions were held between 10 March-2 April 2009 and USD 900 million was sold in total as seen in Table 1.

3.2. Measures taken in TL Market

i. To overcome the uncertainties in the markets:

a. In October and November 2008, the spread between borrowing interest rate and lending interest rate has been decreased from 3.5 % to 2.5 % to decrease potential volatility.

b. Excess funding has been started beginning from October 2008. At the end of the day, excess liquidity has been sterilized with additional transactions.

ii. To support credit markets:

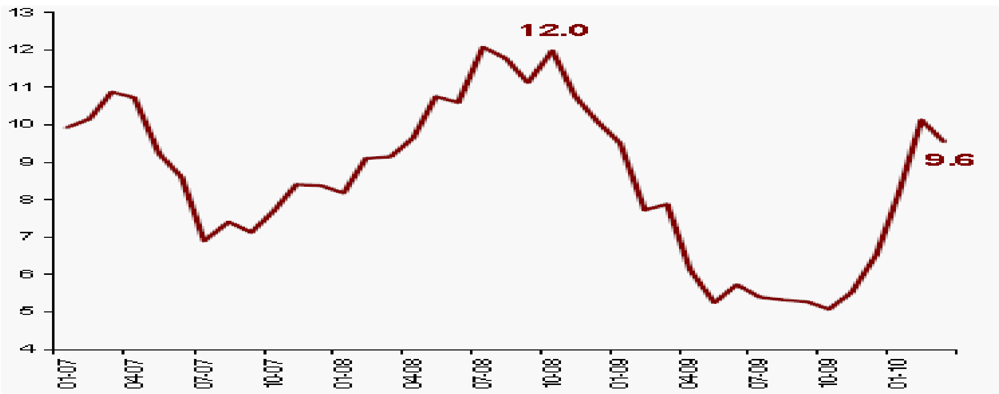
a. CBRT started to hold 3-month repo auctions as of June in order to support the smooth operation of the credit mechanism.

b. In October 2009, as it became evident that the liquidity shortage has been permanent, Turkish lira required reserve ratio was reduced from 6% to 5% in order to support the credit mechanism.

iii. Monetary policy decisions:

a. CBRT has foreseen that there will be dramatic declines in the inflation rate due to domestic demand thus economic activity contractions seen in Graph 4.

Graph 4: Consumer Inflation (Jan 2007 – Mar 2010, annual percentage change)



Source: TURKSTAT, CBRT

And the inflation rate remained below the announced target-consistent-path in September 2009. As a result, CBRT initiated policy rate cuts in November 2008 that were terminated in December 2009 due to stronger perceptions about recovery in economic activity. CBRT borrowing interest rate was decreased from 16.75 % to 6.5% as shown in Table 2.

Table 2: Monetary Policy Committee's Policy Rate Decisions in 2008 & 2010

Meeting Date	Policy Rate Decision (Percentage Point)	Policy Rate (Percent)
November 26, 2008	0,50	16,25
December 24, 2008	1,25	15,00
January 15, 2009	-2,00	13,00
February 19, 2009	-1,50	11,50
March 19, 2009	-1,00	10,50
April 16, 2009	-0,75	9,75
May 14, 2009	-0,50	9,25
June 16, 2009	-0,50	8,75
July 16, 2009	-0,50	8,25
August 18, 2009	-0,50	7,75
September 17, 2009	-0,50	7,25
October 15, 2009	-0,50	6,75
November 19, 2009	-0,25	6,50
December 17, 2009	No Change	6,50
January 14, 2010	No Change	6,50
February 16, 2010	No Change	6,50
March 18, 2010	No Change	6,50
April 13, 2010	No Change	6,50

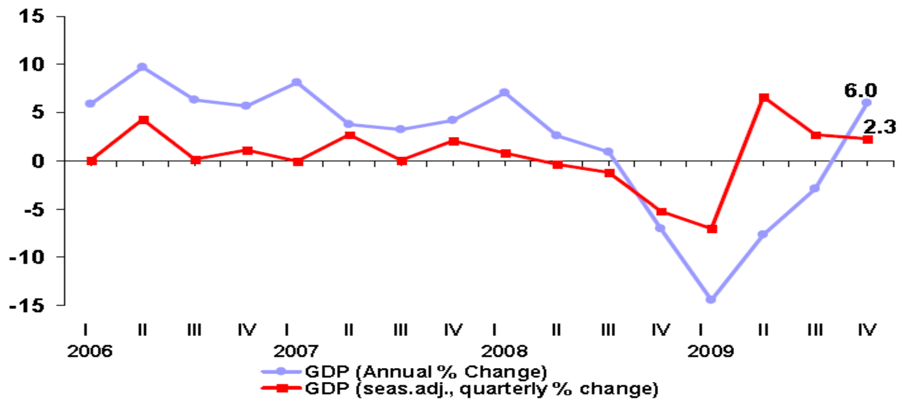
Source: CBRT

At a time when rising levels of public debt in advanced economies are expected to put upward pressure on global interest rates, CBRT's policy rates are the main determinant of market rates in Turkey indicating the improved effectiveness of monetary policy.

4. DATASET AND MODEL

In this paper, the period includes the first week of October 2008 and the last week of December 2009. The first week of October 2008 is taken as the first contraction in industrial production and GDP's contraction has been realized in the last quarter of 2008 as seen in Graph 5. This is accepted as the official beginning of deepening effects of global crisis in Turkey. Moreover, CBRT shows its monetary policy stance with the first policy interest rate cut in November 2008. Last week of December 2009 is taken as the effects of the financial crisis have softened with the return of economic growth in the last quarter of 2009 in the country.

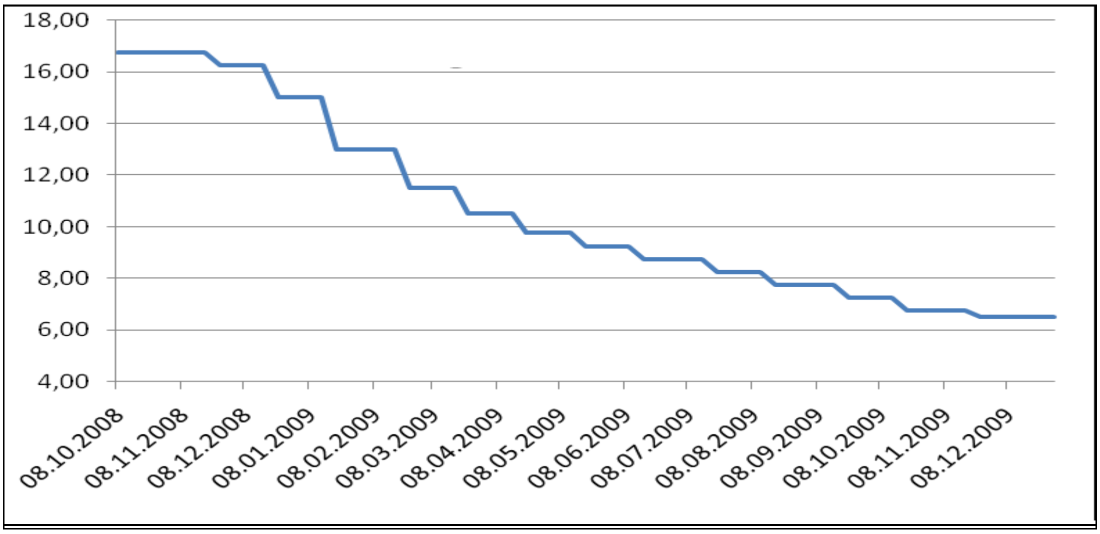
Graph 5: GDP



Source: CBRT

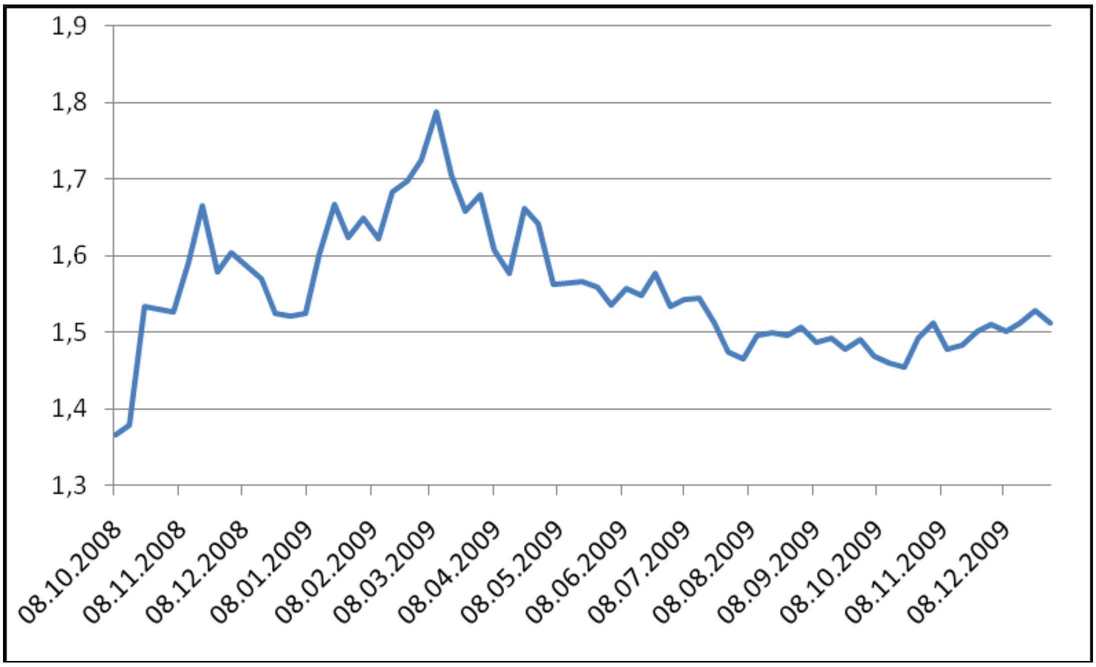
Graph 6 shows the development of interbank overnight interest rates and Table 3 shows the fluctuations in exchange rates between last quarter of 2008 and 2009.

Graph 6: Interbank Overnight Interest Rate



Source: CBRT

Table 3: Exchange Rate



Source: CBRT

Based on the theoretical and empirical literature of the relationship between interest rate and foreign exchange rate, the following model used in Dekle (2002), Gümüş (2002) and Dash (2004) is decided to be used in this study;

$Ln\ RATEt=a_0+a_1IRt+ a_2INDIFFt+Ut$

In the model, RATE represents USD dollar / TL Exchange rate, IR interbank overnight interest rate and INDIFF the difference between the consumer price indices of Turkey and the USA respectively. The data is obtained from online electronic database of CBRT and Bureau of Labor of Statistics of USA. Weekly data is used. a_0, a_1, a_2 are the parameters and Ut is the error term that will be estimated. According to Purchasing Power Parity Theorem, the parameter a_2 is expected to be positive. Taking into account the previous empirical studies, the parameter a_1 can be either positive or negative.

5. ECONOMETRIC METHODOLOGY AND RESULTS

To avoid spurious regression, Augmented Dickey-Fuller (ADF) unit root tests (using Akaike Information Criterion (AIC)) are conducted to investigate stationarity of time series. AIC determines the lag at which the time series become stationary. In this study, one lag corresponds to one week as the weekly data is used. The test statistics and critical values of ADF unit root tests are given in Table 4. According to the results, the test statistics of Ln RATE indicate the presence of unit root for without intercept and with intercept options for 1% significance level thus there is no stationarity. The results of INDIFF also indicate the presence of unit root for both 1% and 5% significance levels thus no stationarity. The test statistics of IR support that time series of IR are stationary at the level when there is no constant term (intercept) and at the level with 8 lags when there is a constant term but not a trend for both 1% and 5% significance levels and finally at the level with 8 lags when there is a constant term and a trend for 5% significance levels. Consequently, ln RATE and INDIFF become stationary when taking their first differences at 0 order of lags without and with intercept and trend respectively.

To check whether there is autocorrelation or not in the error terms of the mentioned time series, Breusch-Godfrey Serial Correlation LM test and Wald test are conducted. These tests control whether error terms produced by variables and the process are stationary ($\varepsilon_t \sim (0, \sigma^2_e)$). The results of LM test show that there is autocorrelation for ln RATE and INDIFF and it is necessary to take their first differences to ensure stationarity whereas no autocorrelation is detected for IR as it becomes stationary at the level. These results are parallel to the findings of unit root tests. Wald tests are conducted to check whether constant term and trend added, while conducting unit root tests, are statistically significant. If zero hypothesis is accepted, it is said that the time series are stochastic meaning that there is no deterministic constant term and trend. Wald tests of ln RATE, IR and INDIFF are conducted. As a result, the zero hypothesis is rejected for INDIFF and IR but not for ln RATE. This shows that ln RATE has drift (constant) and trend. Error terms produced by variables and the process are weakly stationary. In our study, some factors other than interest rate and inflation differential can have an effect on the exchange rate as it is a global crisis.

Table 4: Unit Root Tests with AIC

LEVEL

variables	order	intercept	ADF t statistic			MacKinnon critical value-%99			MacKinnon critical value-%95			Error
			no intercept	without trend	with trend	no intercept	without trend	with trend	no intercept	without trend	with trend	
ln rate	0		0.1577			-2.6028			-1.9462			with high error probability
ir	0		**-3.7216**			**-2.6028**			**-1.9462**			
indiff	0		1.8209			-2.6028			-1.9462			with high error probability
ln rate	0	yes		-2.8670	**-4.0101**		-3.5402	-4.1130		-2.9092	**-3.4840**	
ir	8	yes		**-5.6846**	**-3.6890**		**-3.5575**	-4.1373		**-2.9166**	**-3.4953**	with 3% of probability
indiff	0	yes		-0.7377	-1.6021		-3.5402	-4.1130		-2.9092	-3.4840	with high error probability

1st DIFFERENCE

variables	order	intercept	ADF t statistic			MacKinnon critical value-%99			MacKinnon critical value-%95			Error
			no intercept	without trend	with trend	no intercept	without trend	with trend	no intercept	without trend	with trend	
ln rate			**-8.17078**			**-2.603423**			**-1.946253**			
ir												
indiff	0		**-7.745967**			**-2.603423**			**-1.946253**			
ln rate	0	yes		**-8.1296**	**-8.2843**		**-3.5421**	**-4.1157**		**-2.9100**	**-3.4852**	
ir	0	yes										
indiff	0	yes		**-8.1421**	**-8.0827**		**-3.5421**	**-4.1157**		**-2.9100**	**-3.4852**	

Source: Eviews Workfile

In line with the findings, the time series of ln RATE and INDIFF are integrated at the level of I(1) while IR at the level of I(0). As the time series do not become stationary at the same level, it is impossible to use cointegration tests developed by Johensen (1988) or Engle-Granger(1987) to test if there is a cointegration relationship between variables of these time series. Instead, Granger causality tests are conducted to see if one variable has the causality for the other variable in the pair. These tests show the direction of the causality and the number of lags if there exist.

For one and two weeks lag, IR has causality for ln RATE but ln RATE does not have any cause on IR at 1% significance level. For two and three weeks lag, Ln RATE has a cause on inflation differential (INDIFF) at 1% significance level but also INDIFF has a cause on ln RATE at 5% significance level with one week lag. Their relationship is much more reciprocal.

As cointegration cannot be used, autoregressive distributed lag (ARDL) model is used to find out if there is a relationship between interest rate and exchange rate. The model used is as follows;

$$\text{Ln RATE}_t = a_0 \sum_{i=1}^{m} \ln \text{RATE}_{t-i} + a_1 \sum_{i=0}^{m} \text{IR}_{t-i} + a_2 \sum_{i=0}^{m} \text{INDIFF}_{t-i} + U_t$$

M denotes number of lags that has been decided according to AIC. Lag length has been determined according to a methodology proposed by Kamas and Joyce(1993)*. Maximum lag length can be taken as 52 as the data is weekly. The lag lengths where AIC is the smallest for the dependent variable (ln RATE) and independent variables (IR and INDIFF) are fixed for ARDL model. According to this rule, ARDL (1,12,6) model will be estimated. Estimation results of ARDL (1,12,6) model is given in Table 5.

Table 5: ARDL (1,12,6) Model Results

Variables	Coefficient	t statistic
ln rate (t-1)	0.802070	**13.920660**
ir(t-1)	0.003282	**3.445244**
ir(t-2)	0.003906	**3.804496**
ir(t-3)	0.002502	2.331339*
ir(t-4)	0.002691	2.369499*
ir(t-5)	0.002643	2.246514*
ir(t-6)	0.002314	1.918654**
ir(t-7)	0.002745	2.324771*
ir(t-8)	0.002890	2.320486*
ir(t-9)	0.003725	**2.914384**
ir(t-10)	0.004942	**3.718008**
ir(t-11)	0.006285	**4.200257**
ir(t-12)	0.008660	**5.230838**
indiff(t-1)	0.002538	**4.817161**
indiff(t-2)	0.002538	**4.784749**
indiff(t-3)	0.002603	**4.928748**
indiff(t-4)	0.002652	**4.893558**
indiff(t-5)	0.002664	**4.770804**
indiff(t-6)	0.002878	**5.236152**

* significant at 2,5% level

** significant at 5% level

t statistics in bold significant at 1% level

From this table, long-term coefficients of IR and INDIFF are calculated for ARDL (1,12,6) model.

* Karaca, O. (2005) Relationship between interest rate and foreign exchange rate: is decreasing interest rate increasing the exchange rates ? Turkish Economic Association Discussion Paper 2005/14 (www.tek.org.tr)

Table 6: Long-term Coefficients

Calculated Long-term coefficients[†]	
IR	0.235361
INDIFF	0.080195

To check whether there is autocorrelation in the error terms of the ARDL(1,12,6) model, Durbin-Watson test should be used. As it is an autoregressive model, Durbin-Watson *h* test should be conducted instead of Durbin-Watson *d* test because the computed *d* value in such models generally tends towards 2, which is the value of *d* expected in a truly random sequence. In other words, there is a built-in bias against discovering serial correlation. The test called as *h statistic* is as follows:

$H=(1-1/2\,d)\,(N/(1-N(var(a_0)))^{1/2}$

As the sample size is large (63 observations), *h* is normally distributed with zero mean and unit variance. From the normal distribution, it is known that

$Pr\,(-1.96 \leq h \leq 1.96) = 0.95$

That is, the probability of *h* lying between -1.96 and 1.96 is about 95%. Therefore the decision rule now is like this:

a. If h < 1.96 reject the null hypothesis that there is no positive first-order autocorrelation and

b. If h < - 1.96 reject the null hypothesis that there is no negative first-order autocorrelation, but

c. If h lies between -1.96 and 1.96 do not reject the null hypothesis that there is no first-order (positive or negative) autocorrelation[‡]

When the results of ARDL(1,12,6) model are put in the *h statistic* formula, it is found 0.37, which lies between -1.96 and 1.96. Thus I cannot reject the null hypothesis that there is no first-order (positive or negative) autocorrelation at the 5 % level for the mentioned ARDL model equation.

The findings in Table 5 show that ln RATE is effected by itself much more that IR and INDIFF affect it. When there is 1 unit increase in ln RATE, its effect is 0.80 increase in ln RATE. There exists a statistically significant positive relationship between ln RATE and IR and ln RATE and INDIFF but the magnitude of these relationships is small. Most of the cause is coming from IR at the end of 12 weeks and from INDIFF at the end of 6 weeks. Taking into account long-term coefficients calculated, it is found out that when there is 1 unit increase in IR, its effect is 0.235 increase in ln RATE and when there is 1 unit increase in INDIFF, its effect is 0.08 increase in ln RATE as shown in Table 6.

6. CONCLUSION

There are two views regarding the relationship between interest rate and exchange rate. The traditional view underlines that increasing interest rates defend the exchange rates in crisis times. However, some of the economists argue that raising interest rates during crises can lead to depreciation of the currency (revisionist view).

The literature underlines different findings on this subject. Dekle, Hsiao and Wang (2001), Agenor, McDermott and Ucer (1997) and Goldfajn and Gupta (1999) support the traditional view whereas Karaca (2005), Gümüş (2002), Dash (2004), Furman and Stiglitz (1998), Berument (2002), Gül, Ekinci and Özer (2007), Sever and Mızrak (2007), Bal (2012), Mamak Ekinci, Alhan and Ergör (2016) and Erer and others (2016) have analysis results supporting the revisionist view. Cho and

† The formula to calculate long-term coefficients are explained in the article of Orhan Karaca

‡ The features of h statistic are as follows:

1. It does not matter haw many independent variables or how many lagged values of dependent variable are included in the regression model. To compute h, it is necessary to consider only the variance of the coefficient of lagged dependent variable (ln RATE in our study).
2. The test is not applicable if N(var(a0)) exceeds 1. (0,51 in our study)
3. The test is meant for large samples (the study uses 63 observations)

West (2001) find both views for different countries. Gould and Kamin (2000), Kraay (2000) and Goldfajn and Baig (1998) underline that there is no significant relationship between interest rate and exchange rate.

In this paper, the relationship between exchange rate and interest rate has been analyzed during 2008 financial crisis in Turkey using an autoregressive distributed lag model. Estimation results show that the interest rate cannot be seen as a tool to affect exchange rates in the short-run and the exchange rate is affected more by the changes in itself. However, in the long-run, interest rate increases are associated with exchange rate depreciations, supporting the revisionist view. Therefore, it can be concluded that interest rate defense was not successful in appreciating the exchange rate in this latest global crisis in Turkey.

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APPENDIX

Table 7: Granger Causality Tests

Null Hypothesis:	Lag	F-statistic	Probability	Accept/Reject H_0 (1%)
Ln RATE does not Granger Cause IR	1	1.50049	0.22546	Accept
IR does not Granger Cause Ln RATE	**1**	**8.02993**	**0.00629**	**Reject**
Ln RATE does not Granger Cause IR	2	1.04074	0.35992	Accept
IR does not Granger Cause Ln RATE	**2**	**5.63947**	**0.00587**	**Reject**
Ln RATE does not Granger Cause IR	3	1.03625	0.38411	Accept
IR does not Granger Cause Ln RATE	3	1.60012	0.20031	Accept
Ln RATE does not Granger Cause IR	4	2.21956	0.08014	Accept
IR does not Granger Cause Ln RATE	4	1.12708	0.35440	Accept
Ln RATE does not Granger Cause INDIFF	1	0.53107	0.46904	Accept
INDIFF does not Granger Cause Ln RATE	**1**	**3.19144**	**0.07916**	**Reject at 5%**
Ln RATE does not Granger Cause INDIFF	**2**	**6.15144**	**0.00385**	**Reject**
INDIFF does not Granger Cause Ln RATE	2	2.47102	0.09367	Accept
Ln RATE does not Granger Cause INDIFF	**3**	**5.15129**	**0.00337**	**Reject**
INDIFF does not Granger Cause Ln RATE	3	0.58362	0.62838	Accept
Ln RATE does not Granger Cause INDIFF	4	0.82422	0.51599	Accept
INDIFF does not Granger Cause Ln RATE	4	0.66258	0.62092	Accept

Table 8: Determination of the ARDL Model

lrate	**constant**	**lrate (-1)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.80207	0.003256	0.001162				
t statistic		13.92066	3.383589	2.504141	0.770944	0.76318	-4.547915	2.20282
lrate		**lrate (-2)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.631124	0.006131	0.002171				
t statistic		9.386985	5.181961	3.97400	0.637843	0.625355	-4.172397	1.09481
lrate		**lrate (-3)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.566733	0.007278	0.002535				
t statistic		8.09149	5.584526	4.400319	0.585877	0.571346	-4.022017	0.671944
lrate		**lrate (-4)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.458834	0.009152	0.003157				
t statistic		5.903242	6.111618	4.891822	0.488294	0.470019	-3.794924	0.714568
lrate		**lrate (-5)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.430448	0.009993	0.003254				
t statistic		5.471689	6.341298	4.943151	0.476322	0.457279	-3.756319	0.57223
lrate		**lrate (-6)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.447793	0.009946	0.003097				
t statistic		5.840798	6.186752	4.796885	0.489154	0.470234	-3.794773	0.578984
lrate		**lrate (-7)**	**ir**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient		0.435785	0.010846	0.003037				
t statistic		5.744463	6.553124	4.713952	0.506776	0.488163	-3.811776	0.547627

lrate	**lrate (-1)**	**ir(-1)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.796301	0.003282	0.001198				
t statistic	13.7064	3.445244	2.581491	0.772305	0.764587	-4.553873	2.209779
lrate	**lrate (-1)**	**ir(-2)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.757434	0.003906	0.00142				
t statistic	12.13848	3.804496	2.974939	0.757998	0.749653	-4.575528	1.930091
lrate	**lrate (-1)**	**ir(-3)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.82813	0.002502	0.001041				
t statistic	12.77962	2.331339	2.200178	0.789387	0.781997	-4.698157	2.077946
lrate	**lrate (-1)**	**ir(-4)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.816961	0.002691	0.00110				
t statistic	12.03865	2.369499	2.27117	0.789777	0.782269	-4.684507	2.042323
lrate	**lrate (-1)**	**ir(-5)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.816478	0.002643	0.001098				
t statistic	11.74329	2.246514	2.259714	0.799378	0.792083	-4.715776	2.081133
lrate	**lrate (-1)**	**ir(-6)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.820644	0.002314	0.00111				
t statistic	11.60161	1.918654	2.292551	0.804662	0.797428	-4.756111	1.920675
lrate	**lrate (-1)**	**ir(-7)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.817002	0.002745	0.001057				
t statistic	11.74332	2.324771	2.241493	0.825085	0.818485	-4.848441	2.016046
lrate	**lrate (-1)**	**ir(-8)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.805779	0.00289	0.001115				
t statistic	11.08468	2.320486	2.314731	0.826588	0.819919	-4.844339	1.957764
lrate	**lrate (-1)**	**ir(-9)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.768433	0.003725	0.001269				
t statistic	10.37282	2.914384	2.641145	0.838139	0.831791	-4.893509	1.993567
lrate	**lrate (-1)**	**ir(-10)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.708566	0.004942	0.001543				
t statistic	9.302431	3.718008	3.234859	0.855922	0.850159	-4.992059	2.119475
lrate	**lrate (-1)**	**ir(-11)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.63459	0.006285	0.001906				
t statistic	7.505558	4.200257	3.776727	0.864295	0.858756	-5.034404	2.162706
lrate	**lrate (-1)**	**ir(-12)**	**indiff**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.505902	0.00866	0.002529				
t statistic	5.473943	5.230838	4.805148	0.882097	0.877185	-5.156484	1.978605

lrate	**lrate (-1)**	**ir(-12)**	**indiff(-1)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.509164	0.008526	0.002538				
t statistic	5.560819	5.223752	4.817161	0.882289	0.877384	-5.158108	1.936003
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-2)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.514461	0.008352	0.002538				
t statistic	5.647738	5.177225	4.784749	0.881772	0.876846	-5.153728	1.966886
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-3)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.509757	0.008298	0.002603				
t statistic	5.694501	5.274574	4.928748	0.88406	0.879229	-5.173266	1.948436
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-4)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.507058	0.008234	0.002652				
t statistic	5.594277	5.239531	4.893558	0.883503	0.878648	-5.168473	1.947369
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-5)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.510547	0.008081	0.002664				
t statistic	5.542389	5.128616	4.770804	0.881549	0.876614	-5.151847	2.009573
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-6)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.481555	0.008363	0.002878				
t statistic	5.367596	5.505783	5.236152	0.888863	0.884233	-5.215581	1.933641
sdt error	0.008048819						
lrate	**lrate (-1)**	**ir(-12)**	**indiff(-7)**	**R^2**	**Adjusted R^2**	**AIC**	**Durbin-Watson Statistic**
coefficient	0.469465	0.008429	0.002985				
t statistic	5.088558	5.501663	5.214987	0.888536	0.883892	-5.212644	1.915819