The Central Bank of Turkey's response to the global currency markets

Onur AKKAYA*, Mustafa ÖZER**, Özcan ÖZKAN***

Abstract

Previous studies have examined the monetary policy relationship among relatively similar size countries in terms of their economic development. It is also important to explore this relationship between developed countries and developing economies. Moreover, another important question which should be asked is whether the relationship exists among developed and developing economies and what would the size and sign of the coefficient be. Our contributions to existing literature sit on this line. To begin with, we test whether the Taylor rule exists in Turkey or not. First of all, we proved this relationship exists in Turkey. Then, this study concludes that developed countries have a greater impact on developing countries' monetary policies. Moreover, it is found that the effect of the European Central Bank's (ECB) on the monetary policy authority of the European Union related to interest rate over the foreign exchange rate is higher than the impact of the Federal Reserve Bank (FED).

Keywords: bank, monetary policy, interest rate, Turkish economy

Introduction

In February 2001, Turkey experienced the biggest economic crisis, also known as Black Wednesday. Then, in April 2001, structural reforms in accordance with the Strong Economy Transition Program (hereafter SETP), were implemented to address the consequences of the crisis. First, the exchange rate regime in Turkey transformed into floating from fixed exchange rate. One of the conditions of the floating exchange rate is to have a full independent central bank. Therefore, the Central Bank of the Republic of Turkey (hereafter CBRT) became independent from political institutions as the only actor in monetary policy applications. Moreover,

* Onur AKKAYA is Dr. at Kilis 7 Aralık University, Kilis, Turkey; e-mail: onurakkaya@kilis.edu.tr.

** Mustafa ÖZER is Dr. at Kilis 7 Aralık University, Kilis, Turkey; e-mail: mustafaozer@kilis.edu.tr.

*** Özcan ÖZKAN is PhD. Candidate at Kilis 7 Aralık University, Kilis, Turkey; e-mail: ozcanozkan@kilis.edu.tr.

Turkey used to experience high inflation problems since the onset of the crisis period. However, shortly after the structural reforms, inflation rates dropped to single digit levels. This story proposes that Taylor (1993)'s „the Great Inflation - Great Moderation rule" circumstance exists in Turkey. Having this in mind, when we look at the literature, we see that the policies implemented by central banks affect each other (Benati, 2010; Hirose, Kurozumi and Zandwedge, 2016; Korobilis, 2009; Korobilis, 2012). For example, Genberg (1981) stated that the intervention policies in a large country in terms of size of economy influence other countries' monetary and credit conditions, while the strongest effect was on the exchange rate. Kim and Roubini (2000) also discussed the conflicting reactions of German monetary policies to the different situations in the United States. For example, the paper suggests that an increase in the rate of the Federal Funds in the US have consequences on the German Central Bank's monetary policy. For instance, a higher interest rate in the United States tends to increase the interest rate in other countries. Moreover, Heinlein and Krolzig (2012) focused on „the delayed overshooting puzzle" impact of the USD/GBP exchange rate to an asymmetric monetary policy shock in the UK and the USA. Their results suggest evidence for delayed overshooting and violations of UIP (Uncovered Interest Rate Parity). In another study, Eleftheriou (2009) shows how Germany's interest rate rule is shaped by the monetary policy setting in the USA. Eleftheriou's (2017) study compares two strong central banks responses to each other when there is a monetary policy shock in one of them.

It is clear from the literature that, so far, current papers have investigated the monetary policy relationship among relatively similar size countries in terms of their economic and development level. Also, previous researches have focused on developed countries and neglected developing countries. Therefore, we wonder whether or not the correlation exists between monetary policy decisions of strong economies and relatively weak economies. Also, it is important to explore this relationship between developed and developing economies as it is also neglected in the previous papers. Also, another question which should be asked is whether the relationship exists among developing and developed economies, what would be the size and sign of the regression coefficients. Our contributions to existing literature sit on this line.

We choose Turkey as a developing country for the purpose of the research. The reasons for that are as follows; first of all, Turkey is world's 19th biggest economy (743.71 Billion U.S. dollars, Gross Domestic Product Value (GDP) in current prices) and also one of the members of the G20 (IMF, 2019). Turkey has also been in the process of entering the European Union (EU) for many years. As an official candidate to EU membership, Turkey's biggest trade partner is the European Union according to European Commission (2019). This study uses the European Union Central Bank and Federal Reserve Bank as developed countries monetary policy appliers. This is not an arbitrary choice as even the preliminary results from the Covariance Matrix show that the ECB, as the biggest trade partner of Turkey, is more dominant over the Central Bank of the Republic of Turkey both in terms of exchange rate and prices, in general, according to the preliminary results in Table 10 and Table 11. To begin with, we test whether or not the Taylor rule exists in Turkey. Then, after proving the rule exists in Turkey, we investigate how two relatively strong Central Banks' (the Federal Reserve Bank (hereafter FED) and the Central Banks of the European Union (hereafter ECB)) monetary policies[1] (i.e. short-term interest rates policies) affect the CBRT. CBRT is a relatively smaller central bank and Turkey is a relatively small developing country in terms of its economic activity and development level. By doing this, this paper fills a gap in the literature which has not been addressed before. The next section gives a brief background. Section 2 outlines the data and empirical strategy and presents the findings.

1. Background

Figure 1 plots the interest rate series calculated in annual terms for Turkey, the USA and the EU. Also, the inflation measure of Turkey is in annual terms. At the basis of the research, we investigate whether the CBRT responds to the developments in the US and EU economy. Before going into a deep discussion, it is important to mention that in this study, central banks considered having an ultimate goal to achieve long-term price stability. The important question is whether CBRT's monetary policies are determined by either interest rate rule as proposed by Taylor (1993) or by other domestic market conditions? This is an interesting and partially answered question.

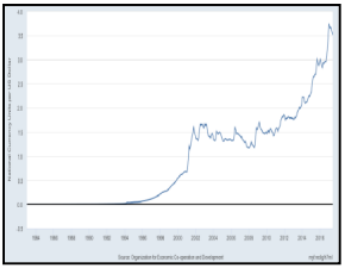
Before the establishment of the ECB, the Central Bank of the Germany was considered the strongest central bank of the EU and a relevant study analyzed whether the Central Bank of Germany was affected by the monetary policy decisions of the FED or not (Eleftheriou, 2017). This was a comparative analysis of two strong central banks. Starting from this point of view, we thought of another interesting question, which is whether FED or EU, the central banks of the larger markets, influence monetary policies of relatively smaller markets, such as Turkey, or not. The examination of this question, in a sense, is a contribution to the Eleftheriou's (2017) study.

To understand the study's time period, Figure 1 reports the interest rate, exchange rates and inflation rates of the USA, the EU, and Turkey. Also, Table. 1 shows the correlation coefficient of the interest rates and exchange rates of these countries. Between the 1980s-1990s, Turkey's economy experienced high inflation rates and was hit by severe economic crises in 1994, 1999 and 2000. One of the biggest economic crises, known as the Black Wednesday, occurred in 2001 in the Republic of Turkey. As a result of these crises, the Turkish Economy went through

[1] The ECB implements most of the EU monetary policies along with other important EU institutions such as the European Council, Parliament and Commission (Georgieva, 2011).

structural economic reforms which changed CBRT's legal status and brought it a complete independence from the governments with an ultimate goal of ensuring long term price stability. Also, the structural reforms turned the manageable or fixed exchange rate system into a floating exchange rate. The monetary policies of the CBRT devoted to great moderation in monetary policy in order to address great inflation rates following the 2001 crisis. This enabled us to implement Taylor (1993) rules for the relationship between the FED or ECB and the CBRT. Three separate analyses were performed after, before and for the whole periods of 2001, but long-term estimates were only made for the period after 2001 since VECM did not work for that time period.

Figure 1. Levels of time series



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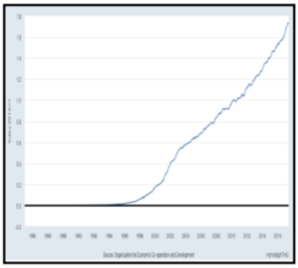
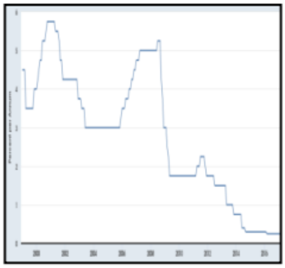
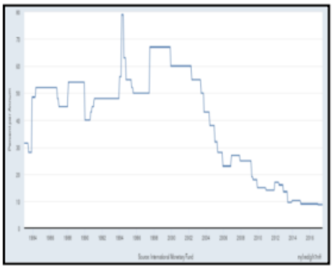


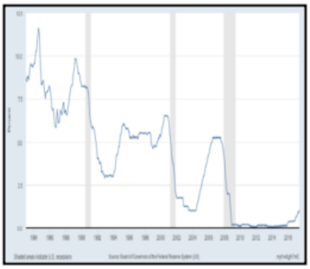
Exchange Rate (US/TL)



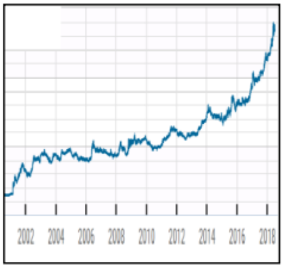
Interest Rate (EU)



Interest Rate (TR)



Interest Rate (US)



Exchange Rate (EU/TL)

Source: own representation

The negative correlation with US interest rate before 2001 in Table 1 was reversed after 2001. Similarly, the positive relationship with the exchange rate turns was negative after 2001. The negative sign of the correlation with exchange rate in Table.1 following the 2001 economic crisis in Turkey is also not surprising as higher interest rates mean more foreign currency inflow for the domestic market for Turkey, which subsequently drops the exchange rates. Also, the correlation coefficients are not surprising as the 2001 financial crisis resulted in the political independence of the CBRT and a floating exchange rate system as we discussed above. To be more specific, the CBRT has become more integrated with the world and seems to consider the monetary policy decisions of the FED and ECB.

Table 1. Correlation coefficients

	Rate of the CBT versus			
	($/TL)	(€/TL)	US Interest Rate(US_{IR})	EU Interest Rate (EU_{IR})
1983-2000	0.5424	-	-0.3392	-
2001-2017	-0.5476	-0.7649	0.4023	0.3467
1983-2017	-0.7587	-	0.6129	-

Source: own calculations

2. Data and empirical evidence

The time series data are operated monthly from 2001:04 to 2017:05. The Turkish short-term interest rate IR_t is evaluated by discount rate. The EU_{IR} is the interest rate of the European Union (average rate of 28-member countries). The Δp_t is the consumer price index. The US_{IR} is the effective federal funds rate in United States of America. The USD is the natural currency to US dollar exchange rate which is average of daily rates for Turkey. The EUR is EU euro exchange rate that is average of daily rates for Turkey. Consequently, we divided our data set into three different periods (shown in Table 1). Our main purpose was that the analyses be performed after 2001, before 2001, and for the whole period. But long-term estimates were only made for the data period after 2001 since VECM did not work.

In Table 2 the results of the Johansen's trace tests (Johansen, 1995) are shown. The five-dimension cointegration tests suggest a rank of one cointegrating relation between IR_t, USD, EUR andΔp_t.

Table 2. Rank of cointegration tests

Test Type	None No Intercept No Trend	None Intercept No Trend	Linear Intercept No Trend	Linear Intercept Trend	Quadratic Intercept Trend
Trace	3	3	3	1	1
Max-Eig	3	3	1	0	0

Selected (0.05 level*) Number of Cointegrating Relations by Model
*Critical values based on MacKinnon-Haug-Michelis (1999).
Source: own calculations

A Vector Error Correction (VECM) with l lags, t time and j cointegrating vectors is estimated of the form:

$$\Delta Y = \varphi \left[\frac{Y_{t-1}}{Trend_{t-1}}\right] + \sum_{j=1}^{k-l} \tau \Delta Y_{l-j} + \vartheta D_t + u_t$$

where $\varphi = \alpha\beta'$, Y is the vector with the endogenous variables, D_t contains the deterministic and u_t is white noise with zero mean and non-singular covariance matrix $\sum_u$. Furthermore, α includes the loading coefficients and β', the coefficients of the cointegration relationships. To identify β' the first part is set to be an identity matrix, i.e. $\beta' = \left[I_r : \beta'_{(M-r)}\right]$, where r is the cointegration rank, M is the number of the variables and $\beta'_{(M-r)}$ is a ((M-r) x r) matrix. The lag order k is chosen according to the information criteria while r by the cointegration tests.

Tables 3 and 4 describe the value of VECM coefficients. Our expectation is that the error correct mechanism (ECM) coefficient has a negative of sign and is statistically significant. If it has all of them, short-term dynamics equation and long-term equation has a strong relationship for this circumstance.

Table 3. Short-Term dynamics equation result for [Eq.1] in the period 2001:04 to 2017:05.

Variable	Coefficient	Std. Error	t-Statistic
ECM	***-0.013***	***0.005***	***-2.377***
d$EU_{IR_{-1}}$	-0.082	0.080	-1.020
dUSD_{-1}	0.514	1.624	0.316
d$\Delta p_{EU_{-1}}$	-0.200	0.120	-1.660
c	-0.325	0.105	-3.086

The lag orders according suggested by Schwarz Info Criterion
Source: own calculations

Table 4. Short-Term dynamics equation result for [Eq.2] in the period 2001:04 to 2017:05

Variable	Coefficient	Std. Error	t-Statistic
ECM	***-0.009***	***0.004***	***-2.157***
dIR_{-1}	-0.067	0.073	-0.925
dEUR_{-1}	-0.427	1.227	0.728
dΔp_{t-1}	-0.104	0.090	-1.150
c	-0.283	0.092	-3.064

The lag orders suggested by Schwarz Info Criterion
Source: own calculations

In the following pages, two different equations are estimated in empirical result according to Taylor (1993). Firstly, we analyzed the relationship between CBRT and FED. The reason for this is to measure the reaction of the CBRT as a small central bank to the monetary policies of the FED, (i.e. its interest rate decisions after the 2000s). Secondly, by the same reasoning, we investigated the CBRT and the ECB relationship. The assumption according to the Taylor (1993), is that the CBRT was affected by the central bank of the largest central banks[2].

The CBRT and the FED relationship

The [Eq.1] operated structure gives testing limitation on two different (long and short) run dynamics. The short-term normalized to 1 for the first turn to be:

$$\boldsymbol{IR_t} = 3.304\Delta \boldsymbol{p_t} + 32.793\boldsymbol{USD_t} - 0.405\boldsymbol{Trend_t}, \textbf{(Eq.1)}$$

$$\{0.706\} \qquad \{1.749\} \qquad \{0.026\}$$

$$(18.739) \qquad (4.677) \qquad (-15.425)$$

To investigate the stability situation for the [Eq.1], we use different kinds of diagnostic and stability tests. The results show that the [Eq.1] has stability for F-statistic, LR test and Breusch-Godfrey Serial Correlation LM Test and log likelihood ratio Table 6.

The [Eq.1] matches an interest rate rule suggesting a stricture of the policy position in the event of uphill inflation and a depreciating exchange rate. The inflation coefficient is statistically the same with Taylor's (1993), it passes over totality and is equivalent to (3.304/12=) 0.275 in annual terms. Besides, the coefficient of the USD exchange rate has the waited positive sign so that an increase, i.e. depreciation, causes an increase in the short-term interest rate.

In the [Eq.1], a negative one percentage point bias produces a rise by 8.2 base points in the policy rate in the after period. Therefore, a base point rising in monthly inflation causes a 3.304 base point rise in the interest rate. But owing to interest rate attempters, this deflection is corrected by rises of only 1.3 base points per period-like the loading coefficient highlight. It will hence take less than three months to return to target path Table 3.

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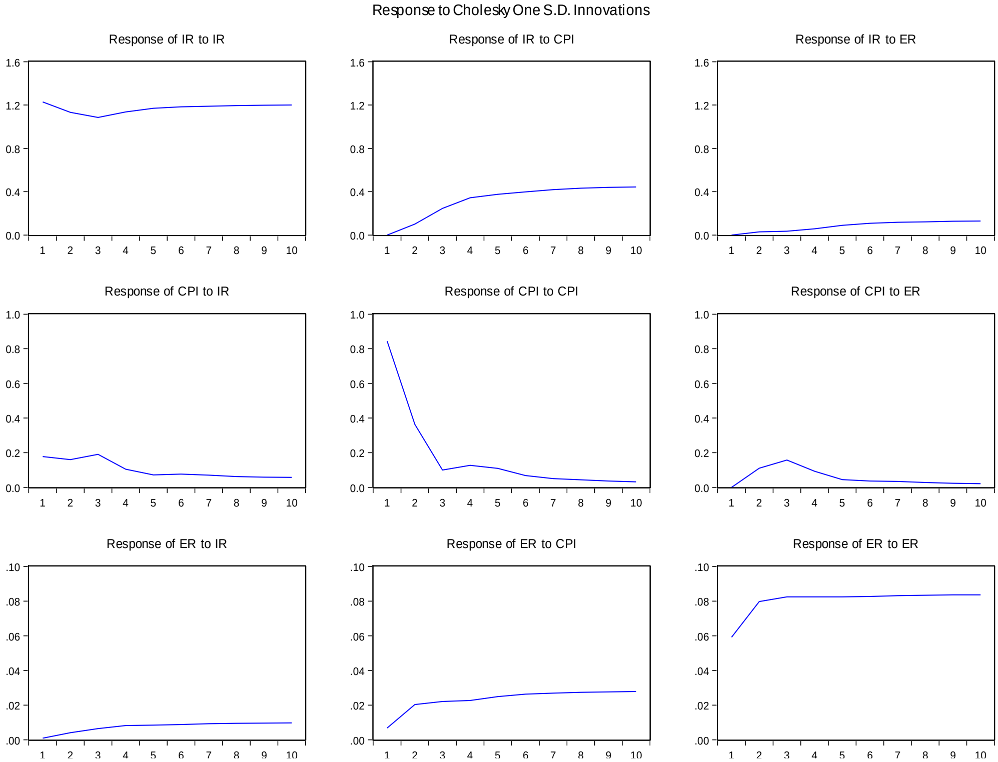
[2] In an unreported analysis, we investigated a similar relationship between the ECB and FED as the central bank of Germany was seen as the central bank of the EU countries before the Monetary Union. We were curious about whether similar coefficients would occur between the ECB and FED. This defines the relationship between these two strong central banks. The ECB has a smaller response against the FED's monetary decision compared to the response of the CBRT to the ECB and the FED. To conclude, the results are parallel to Eleftheriou's (2017) paper findings. This also indicates that the reported findings of the present paper are reliable.

The CBRT and the EC relationship

$$\boldsymbol{IR_t} = 2.440\Delta \boldsymbol{p_t} + 35.90\boldsymbol{EUR_t} + 0.58\,\boldsymbol{Trend_t}\,, \quad \textbf{[Eq.2]}$$
$$\{0.493\} \qquad \{1.198\} \qquad \{0.022\}$$
$$(4.951) \qquad (29.955) \qquad (-26.123)$$

To investigate the stability situation for the [Eq.2], we use different kinds of diagnostic and stability tests. The results show that the [Eq.2] has stability for F-statistic, LR test and Breusch-Godfrey Serial Correlation LM Test and log likelihood ratio [Table 7].

Figure 2. Impulse responses for the Equation-1

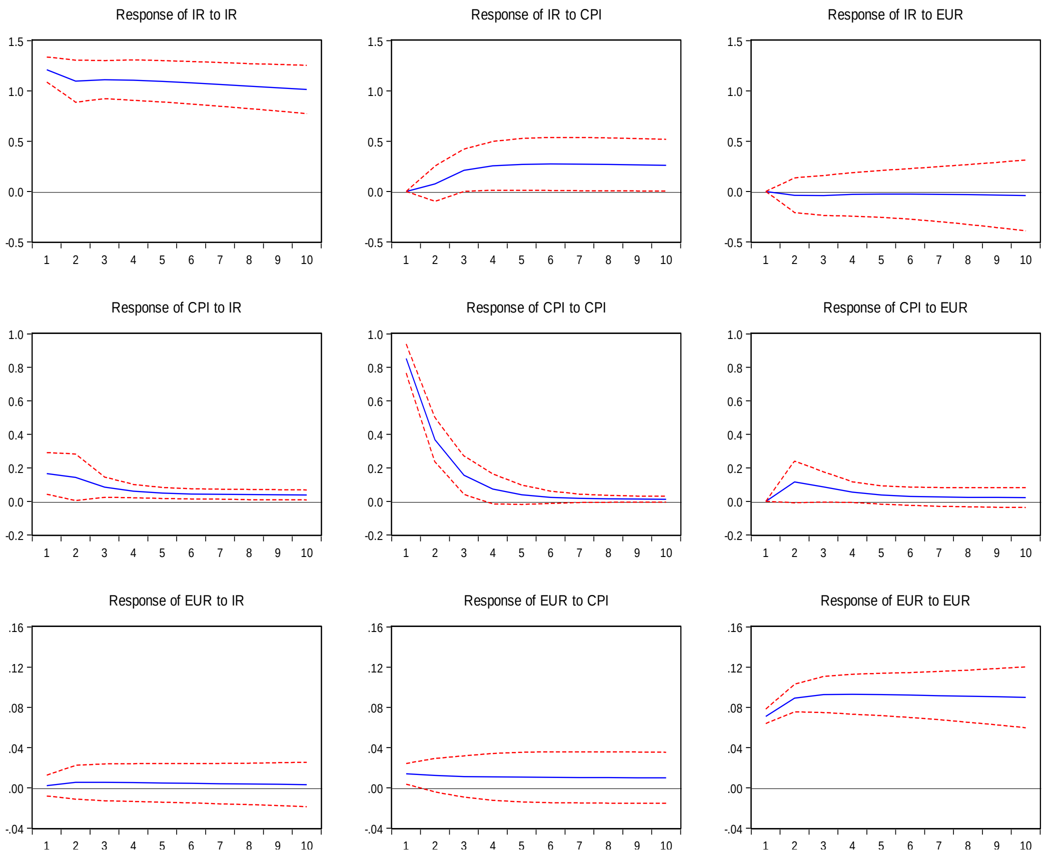


Source: own representation

[Eq.2] indicates the case of increasing inflation and a depreciating exchange rate. This situation is the same as [Eq.1]'s result and supports Taylor Rule for Turkish Economy. It overruns unity and is equivalent to (2.440/12=) 0.203 in annual terms. Intercalary, the EUR exchange rate coefficient has the anticipated positive sign so that an increase, i.e. depreciation, causes a rise in the short-term rate. So, we think about the short term and long term relation. It will hence take less than two months to return to target path Table 4. All in all, the CBRT has a very strong reaction to the FED and the ECB's monetary decisions as you can see in [Eq.1] and [Eq.2]. The unit root tests are presented in Table 5.

The impulse response Figure 2 and Figure 3 analysis shows the positive reaction of nominal interest rate to rising exchange rate and consumer price index. On the other hand, there is a horizontal reaction of the exchange rate to rising interest rate and consumer price index.

Figure 3. Impulse responses for the equation-2



Source: own representation

Additionally, Ramsey test was applied for robustness of the [Eq.1] and [Eq.2]. As a result of the test, [Eq.1] and [Eq.2] were found to be strong - Tables 8 and 9.

Overall, inflation coefficients $(\Delta \boldsymbol{p_t})$ are statistically significant in both equations - [Eq.1] and [Eq.2]. This validates the dominant effects of the ECB mentioned in the motivation part (see the covariance matrix) on the CBRT. According to the exchange rate relationship, the ECB is slightly more dominant than FED. It is not a surprise for Turkish economy since the EU is the biggest bilateral-trading partner for Turkey, which has been a candidate for the EU since 1964. On the other hand, we tested Taylor Rule's for Turkish economy.

Conclusions

FED is the strongest global financial actor and the EU is the biggest trade partner of Turkey. So far, recent papers have investigated the reaction of two relatively strong central banks' response to each other's monetary policy decisions. However, this paper examines how the CBRT (i.e. a relatively small central bank) monetary policy settings are bounded to the FED and the ECB's short/long-term interest rate decisions (i.e. two strong central banks) between 2001:04 and 2017:05. Overall, the CBRT closely observes the FED and ECB's monetary policy decisions. This means the results of this study are in line with Taylor's results (1993). However, a close examination of the results shows that the ECB is a more dominant player than the FED in terms of its effect on the interest rates over exchange rates. Therefore, we believe that this has important policy implications. This situation should be taken into consideration in the monetary policy. All in all, it can be said that after 2000, Turkey's economy experienced „the Great Inflation-Great Moderation" and has been affected by the FED/ECB's decisions/actions.

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Appendix

Table 5. Results of Unit Root Tests

Variable	Deterministic terms	Lag order	Test	Value of test stat.
IR_t	C	n(SIC)=14	ADF	-2.30
	c,t	n(SIC)=14	ADF	-1.32
		n(SIC)=14	ADF	-3.81(*)
Δp_t	C	n(SIC)=14	ADF	-4.78(*)
	c,t	n(SIC)=14	ADF	-3.83(*)
		n(SIC)=14	ADF	-3.89(*)
e_r	C	n(SIC)=14	ADF	1.48
	c,t	n(SIC)=14	ADF	-0,19
		n(SIC)=14	ADF	2.29
EU_{IR}	C	n(SIC)=14	ADF	-0.05
	c,t	n(SIC)=14	ADF	-1.98
		n(SIC)=14	ADF	2.11
US_{IR}	C	n(SIC)=14	ADF	-1.47
	c,t	n(SIC)=14	ADF	-1.57
		n(SIC)=14	ADF	-3.45(*)
ΔIR_t	C	n(SIC)=14	ADF	-14.45 (*)
	c,t	n(SIC)=14	ADF	-14.72 (*)
		n(SIC)=14	ADF	-13.82 (*)
Δe_r	C	n(SIC)=14	ADF	-10.82 (*)
	c,t	n(SIC)=14	ADF	-11,11 (*)
		n(SIC)=14	ADF	-10.58 (*)
EU_{IR}	C	n(SIC)=14	ADF	-10.83 (*)
	c,t	n(SIC)=14	ADF	-10.84 (*)
		n(SIC)=14	ADF	-10.49 (*)
US_{IR}	c	n(SIC)=14	ADF	-6.37(*)
	c,t	n(SIC)=14	ADF	-6.34(*)
		n(SIC)=14	ADF	-6.38(*)

*n(SIC) indicate the lag orders suggested by Schwarz Info Criterion respectively, when the maximum lag order equals 14. ADF denotes the Augmented Dickey-Fuller test and (*) indicates that the null hypothesis of a unit root is rejected at the 10%, 5% and 1% levels respectively.

Table 6. Diagnostic and Stability Tests Results for [Eq.1] in the Period 2001:04 to 2017:05

t-statistic	**3.349393**	**183**	**0.000**
F-statistic	11.21843	(1, 183)	0.000
Likelihood ratio	11.12600	1	0.000
	F-Test Summary		
	Sum of Sq.	**df**	**Mean Squares**
Test SSR	1456.287	1	1456.287
Restricted SSR	25211.88	184	137.0211
Unrestricted SSR	23755.59	183	129.8120
	LR Test Summary		
	Value	**df**	
Restricted LogL	-723.8620	184	
Unrestricted LogL	-718.2990	183	
	Breusch-Godfrey Serial Correlation LM Test		
F-statistic	636.4970	Prob. F(2,182)	0.000
Obs*R-squared	161.8072	Prob. Chi-Square(2)	0.000

Table 7. Diagnostic and Stability Tests Results for [Eq.2] in the Period 2001:04 to 2017:05

t-statistic	**2.50679**	**190**	**0.000**
F-statistic	12.7043	(1, 190)	0.000
Likelihood ratio	13.0449	1	0.000
	F-Test Summary		
	Sum of Sq.	**df**	**Mean Squares**
Test SSR	155.2454	1	155.2454
Restricted SSR	13146.86	191	68.83173
Unrestricted SSR	12991.62	190	68.37692
	LR Test Summary		
	Value	**df**	
Restricted LogL	-684.2338	191	
Unrestricted LogL	-683.0816	190	
	Breusch-Godfrey Serial Correlation LM Test		
F-statistic	299.9613	Prob. F(2,189)	0.0000
Obs*R-squared	146.4629	Prob. Chi-Square(2)	0.0000

Table 8. RESET Tests Result for [Eq.1] in the Period 2001:04 to 2017:05.

	Value	**df**	**Probability**
t-statistic	3.670603	185	0.0003
F-statistic	13.47333	(1, 185)	0.0003
Likelihood ratio	13.28649	1	0.0003
	F-test Summary		
	Sum of Sq.	df	Mean Squares
Test SSR	1684.595	1	1684.595
Restricted SSR	24815.49	186	133.4166
Unrestricted SSR	23130.89	185	125.0318
	LR test Summary		
	Value	df	
Restricted LogL	-729.1009	186	
Unrestricted LogL	-722.4576	185	

Table 9. RESET Tests for [Eq.2] in the Period 2001:04 to 2017:05.

	Value	df	Probability
F-statistic	22.74923	(3, 188)	0.0000
Likelihood ratio	60.08229	3	0.0000
	F-test Summary		
	Sum of Sq.	df	Mean Squares
Test SSR	3501.467	3	1167.156
Restricted SSR	13146.86	191	68.83173
Unrestricted SSR	9645.393	188	51.30528
	LR test Summary		
	Value	df	
Restricted LogL	-684.2338	191	
Unrestricted LogL	-654.1927	188	

Table 10. [Equ.1] Covariance Matrix for the period 2001:04 to 2017:05.

	IR_t	e_r	Δp_t
IR_t	1	-0.543	-0.483
e_r	-0.543	1	-0.120
Δp_t	0.483	-0.120	1

Table 11. [Equ.2] Covariance Matrix for the period 2001:04 to 2017:05.

	IR_t	e_r	Δp_t
IR_t	1	-8.072	10.291
e_r	-8.072	1	-0.228
Δp_t	10.291	-0.228	1