Does Fed Funds Target Interest Rate Lead Bank of England's Bank Rate and European Central Bank's Key Interest Rate?

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Does Fed Funds Target Interest Rate Lead Bank of England's Bank Rate and European Central Bank's Key Interest Rate?

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Abstract

It has been a long debate whether Fed Funds target interest rate (FFTR) has significant explanatory power on interest rates in other countries. In this paper, we analyze the effects of FFTR on Bank of England (BOE) bank rate and European Central Bank (ECB) key interest rate employing-the rather new and trustworthy technique of-Bounds testing developed by Pesaran (2001). Our empirical results are consistent with a priori expectations as BOE and ECB interest rates are highly dependent on FFTR. This finding can be interpreted as a clear signal of how globally tight-knit the world currencies have been. Moreover, it emphasizes the importance of US dollar as the world currency and rather serves as an argument against alternative global currency propositions.

Keywords: Interest Rates, Monetary Policy, Bounds Testing.

JEL Classification: C29, E4, E43, F42.

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1. INTRODUCTION

Price stability is generally the priority of the Central Banks. The monetary policies are directed towards achieving the inflation targeting. In a closed economy, the monetary policies are regarding the behavior of the domestic market. When the economy becomes open, the circumstances taking place out of borders, become an issue for the domestic economy. Monetary policies may, therefore, include the effects of the developments occuring in the foreign markets. In fact, it became more than just the open economies. The world economy gets integrated, globalized. Thereby, as a matter of fact, the outside world becomes highly influential on the domestic economies. The concern of this paper is on the interest rates. Thus, analyzing the effect of the foreign interest rates on the domestic interest rate makes sense in the way that it is a subtopic of the developments that globalization creates.

If the interest rates in the foreign country increase and become higher than the domestic interest rates, the capital flows will direct to the foreign country and outflows depreciate the domestic currency which increase the competetiveness in the global arena. Increasing exports make the domestic economy direct its domestic resources outside world and moreover, decreasing imports blocks the domestic consumption resources. This process comes up with inflation for the domestic economy. Since the priority of the Central Banks is to manage the price stability, the domestic Central Bank will carry out an increase in the domestic interest rates in an attempt to decline inflation. The reverse of this process is also possible starting with a decline in the foreign interest rates. Thereby, we see that under open economy, Central Banks may lose their monetary policy as an economic tool, or to put it differently, the Central Banks have their monetary policies as no longer independent and taking direction towards the developments in the foreign markets. Above is the general mechanism of how the domestic interest rates are effected by the foreign interest rates. However, what is realized is much more complicated than this process as with the globalization. There may be many different mechanisms depending on the features of the countries.

There is an ongoing debate whether the Federal Reserve (FED) is leading in the interest rate. The developments occuring in the world make us frequently consider that FED is preceding in changes in the interest rates. There is also a huge literature in this issue proning to the leading of FED interest rates. Under this topic, we choose European Central Bank (ECB) interest rates as the dependent variable, getting inspiration from Taylor (2009) NBER working paper. In this study, we try to see the influence on ECB interest rates choosing FED interest rates as the exogeneous variable in accordance with what we frequently observe looking at the newspapers. ECB interest rates are the common interest rates for the European Monetary Union (EMU) which began in January 1999, that makes up 10 years. Thus, EMU is a young union and ECB is a young Central Bank. However, if compare to FED, ECB may be seen as a much weaker Central Bank. Since reaching the targets in the monetary policies requires credible Central Banks, the confidence to the Central Banks is highly crucial. Since ECB is a new one, it may take time to make people feel trust to ECB. To make a comparison, we also want to see the effect of FED interest rates on a European Union member but EMU non member country. Accordingly, we employed the old and trustworthy Bank of England (BOE). Thus, the aim of this paper is to analyze whether FED interest rates have effect on ECB and BOE interest rates.

In this study, differently from the literature on this topic, we employed the ARDL cointegration technique, Bounds testing of Pesaran et al.(2001). The technique is way more applicable one and gives more sensible results than what has been used until Bounds testing. Also, we employed a newer and therefore a longer data span which is considered to bring out more confident results.

The study is organized as follows. In Section 2, we present the ongoing literature about the effect of FED monetary policies on ECB and BOE monetary policies. Next, we mention about the possible transmission mechanism that creates this dependence of Central Banks. In Section 4, we explain the econometric technique we employ in the study in details. Afterwards comes the empirical findings and lastly the concluding remarks.

2. LITERATURE SURVEY

There is a huge literature analyzing the dependence of monetary policies on foreign Central Banks. FED is the most analyzed Central Bank that is considered to have impact on the domestic interest rate policies. Accordingly, we only take into account the studies that are directed to the relationship between FED, BOE and ECB interest rates. Also, most of these analyses put this relationship into the Taylor rule that is how the optimal domestic interest rates are obtained. Since we only focus on the interest rates of these Central Banks and put the other variables such as; unemployment, inflation, output gap, etc. out of topic in this study, we will not mention about the Taylor rule mentality in these studies and mention only the findings for the relationship between FED, BOE and ECB interest rates in the literature survey.

Monticini and Vaciago (2005) working paper analyze the reactions of the markets to the decisions of other countries' Central Banks. They analyzed how domestic interest rates are influenced by foreign Central Banks' monetary decisions basing the mentality to globalization. They used daily data within the period of January 1999 to October 2005 and employed OLS technique. They first analyzed the influence of expected and unexpected changes in the target interest rate, where future rates are employed to separate these two- on one-day response to monetary policy decisions, i.e., change in the realized interest rates, domestically. Secondly, they analyzed the influence of surprise made by domestic and foreign Central Banks' announcements on one-day response to, again, monetary policy decisions, i.e., change in the realized interest rates, domestically. They directed their study on ECB, FED and BOE whether these Central Banks are influenced by each other's monetary announcements along with domestic monetary announcements. What they found is that ECB is influenced by FED's monetary announcements and BOE is only marginally affected by FED's monetary announcements. Ullrich (2003) analyzed Taylor rule mentality whether it can be used to understand the relationship between FED and ECB. Reaction function -Taylor rule- employed 1999-2002 monthly data as the case of after Euro area and 1995-1999 monthly data as the case of before Euro area. It is found that FED is not taking a significant place in the Taylor rule function before Euro but it is reversed after Euro. TSLS is used for the analysis. Breuss (2002) analyzed Taylor reaction function for ECB and found that it reacted to FED with a changing time lag within the period of 1999-2001. Belke and Gros (2005) using daily and weekly data within the period of 1989-2003, analyzed the relationship between FED and ECB interest rates employing Granger causality test. They found that ECB is affected by FED and that in longer data span analysis FED is also influenced by ECB. They also test 2000-2001 years for structural break and what they found is that after that period the relationship between the two Central Banks yield much longer lags. Gerlach, Schnabel (2000) employing GMM(Generalized Method of Moments) for the period of 1990-1998 for EMU-11 countries analyzed Taylor rule using the variables; interest rate, output gap, future inflation rate, lagged inflation, money growth, Fed funds rate, real euro/$ rate, where Fed funds rate is found to be a significant variable on ECB interest rate. Clarida, Gali and Gertler (1998) analyzed several

Central Banks' reaction functions. UK, Italy and France are chosen to see the effect of Bundesbank and Germany, Japan are selected to see the effect of Fed funds rate, within the reaction functions. It is crucial that the paper is written before the establishment of Euro. Holding output gap and inflation rate as fixed, Fed funds rate is found to have a small but significant effect on Bundesbank interest rate for the monthly period of 1979-2003. Ehrmann and Fratzscher (2003) analyzed the interdependence between US and Germany for 1993-2003 period spliting into Pre-EMU and Post-EMU, and the interdependence between US and Euro area for 1999-2003 period, using many variables such as; interest rates, CPI, industrial production, unemployment rate, etc. Employing weighted least squares method, they find that the monetary interdependence of Euro area on US macroeconomic variables is getting stronger after the establishment of EMU and explain this in the way that US and EU markets are getting more integrated in real economy.

3. TRANSMISSION MECHANISM

As the world is getting economically, socially and politically integrated, any effect in the outside markets has the capability of influencing the domestic markets. The same situation is also taking place in the policy tools. Either monetary or fiscal policies, the tools for the regulation of domestic markets are becoming the concern of the foreign markets. This study accordingly analyzes the dependence of monetary policies taking Fed interest rate as the focus of determinant. The selection of Fed as the determinant is not random but is based on the observations of the developments since FED is frequently considered to be preceding in the monetary policy side. The study take ECB and BOE interest rates as endogeneous to see the effect of FED interest rate on them.

It is important to see the possible transmission mechanisms that explain this interdependence. Let's say that there is an increase in the interest rate of a foreign country. In an open economy, this increase will appreciate the foreign currency and accordingly depreciate the domestic currency against the foreign one. In the trade arena, this depreciation will provide competetiveness for the domestic economy and through the increase in the exports and the decrease in the imports, the domestic markets will be left with less product to be consumed and accordingly the inflation will be triggered upwards. The domestic Central Bank, since its main mission is to maintain the price stability, will need to increase the interest rate in accordance with the foreign Central Bank. What we see in this mechanism is that the domestic monetary policy needs to keep up with the foreign Central Bank. However, this case is sensible when the trade with the foreign country -especially the export to the foreign country- is constituting a crucial part in the total trade volume –or basically the export volume- of the domestic economy. As it is mentioned in the European Commission website EU and USA have the largest bilateral trade relationship in the world, the “exchange rate to inflation” mechanism we mentioned above is quite meaningful.

There may also ve several other mechanisms explaining monetary policy interdependence. If the domestic economy has the policy of maintaining exchange rate stability, the monetary policy, as a matter of fact, will be copied from the foreign economies. If the economy aims to keep the short term capital portfolios inside, then the increase in the interest rates of foreign economies will be compensated by the domestic economy. Monticini and Vaciago (2005) mention about the low transaction costs, due to the high financial integration, as creating an ameliorating effect for the movement of capital. Thereby, the monetary policies applied by the foreign Central Banks will have high influence in the domestic monetary policies. Thus, integrated markets or more comprehensively globalization is the starting point of the interdependence among the markets, including the monetary markets.

4. METHODOLOGY

We decided to apply Pesaran et al. (2001) “Bounds Testing” procedure to analyze the relationship between FED - ECB and FED - BOE interest rate. In the Bounds Testing, the number of integrated order, in other words, whether the variables are I(0) or I(1) will not bring any additional produre. However, we check the variables to be sure that none of them are I(2) via Augmented Dickey Fuller and Phillips Perron unit root tests. Afterwards, the two conditional ECMs are constructed:

$$\Delta ECB_t = c_0 + \alpha_1 ECB_{t-1} + \alpha_2 FED_{t-1} + \sum_{i=1}^{p} \beta_i \Delta ECB_{t-i} + \sum_{j=0}^{q} \delta_j \Delta FED_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta BOE_t = c_1 + \gamma_1 BOE_{t-1} + \gamma_2 FED_{t-1} + \sum_{k=1}^{c} \theta_i \Delta BOE_{t-i} + \sum_{l=0}^{d} \varpi_j \Delta FED_{t-j} + \vartheta_t \quad (2)$$

The model is greatly depending on the lag selections. Accordingly, Pesaran et al. (2001) highlights that the number lags must be high enough to overcome the serial correlation problem, but low enough to prevent overparameterization problem. Thus there must be a balance between them.

When the conditional ECM is constructed, the residuals must be checked for serial correlation. Accordingly, we used Breusch-Godfrey Serial Correlation LM test which has the null of no serial correlation. Thus, the model must fail to reject the null hypothesis since we use the OLS technique. For the lag selection, AIC or SIC can be used to choose the best model. Accordingly, we checked the SIC for the lag selection.

For a long run relationship, the conditional ECM has to certify two conditions. First of all, the lagged level coefficients must be jointly significant, that is; $H_0 : \alpha_1 = \alpha_2 = 0$ for (1) , $H_0 : \gamma_1 = \gamma_2 = 0$ for (2) must be rejected. Secondly, the lagged level coefficient of the dependent variable, that is; $H_0 : \alpha_1 = 0$ for (1) , $H_0 : \gamma_1 = 0$ for (2) must be rejected. The critical F statistics for the joint case and the critical t statistics for the single case are given in Pesaran et al. (2001). There are two critical values for the both cases according to the integrated order of the variables, whether they are I(0), I(1) or a mixture of both. First critical value is the lower bound of I(0) and the second is the upper bound of I(1). For cointegration, the calculated F and t statistics must be over the upper bound critical values. If the calculated statistics are between the two critical values, then we say that the result is inconclusive. When the critical upper bounds are exceeded, we say that there is a long run relationship without looking at the variables whether they are I(0) or I(1). After ensuring the existence of the cointegration, we pass on to the level effects and the short run dynamic adjustments. Accordingly, the here comes the standard method. Firstly, ARDL(p,q) will be modeled;

$$y_t = c + \sum_{i=1}^{p} \lambda_i y_{t-i} + \sum_{j=0}^{q} \eta_j x_{t-j} + \varepsilon_t \tag{3}$$

For a long run solution:

$$y^* = y_t = y_{t-1} = y_{t-2} = \dots = y_{t-p} \tag{4}$$

$$x^* = x_t = x_{t-1} = x_{t-2} = ... = x_{t-q} \tag{5}$$

Thus, $$y^* = \frac{c}{1-\Sigma\lambda_i} + \frac{\Sigma\eta_i}{1-\Sigma\lambda_i} \tag{6}$$

or, put it differently,

$$y^* = \phi_0 + \phi_1 x^* \tag{7}$$

In other words, after specifying the lag orders of the ARDL model, the long run coefficients are obtained. Secondly, the equilibrium error (e) is obtained from the long run model:

$$e_t = y_t^* - \phi_0 - \phi_1 x_t^* \tag{8}$$

Lastly, the Error Correction Model (ECM) is constructed with general to specific approach, in other words, eliminating the insignificant values to be parsimonious. Also, the one lagged value of the equilibrium error is included instead of lagged values of the level coefficients:

$$\Delta y_t = \mathrm{c} + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{j=0}^{q-1} \eta_j \Delta x_{t-j} - \pi \hat{e}_{t-1} + \varepsilon_t \tag{9}$$

where π is the error correction coefficient and shows how quickly the model comes to equilibrium.

5. EMPIRICAL FINDINGS

5.1. DATA

One of the main tools for monetary policy of the Central Bank is the short term interest rates. Thereby we employed short term interest rates for USA (FED, hereafter), Euro zone (ECB, hereafter) and UK (BOE, hereafter). The data are obtained from OECD. For analysis between BOE and FED, monthly short term term interest rates within the period of 1991 January to

2008 December are used. For the analysis between ECB and FED, monthly short term interest rates within the period of 1999 January to 2008 December are used.

5.2. UNIT ROOT TESTS

This study employs Bound testing method which does not require the variables to be I(1) or I(0). Either integrated of order 1 or order 0, i.e., stationary, can be used for the analysis without any extra procedure. Accordingly, we test the variables to ensure that none of the variables are I(2). Table 1 shows the Augmented Dickey Fuller (1979, 1981) and Phillips Perron (1988) unit root tests results in levels. FED interest rates variables both for the period of 1991-2008 and 1999-2008 show that there is unit root, since the null hypothesis of unit root in Augmented Dickey Fuller (ADF, hereafter) and Phillips Perron (PP, hereafter) tests are failed to reject for constant and constant-trend cases. ECB interest rates are also found to be unit root. BOE interest rates reject the null of unit root in the both unit root tests. Thus, FED (1991-2008), FED (1999-2008) and ECB interest rates are I(1) but BOE interest rates are found to be I(0).

5.3. BOUNDS TESTING

None of the variables are found to be integrated of oreder 2. Thus, we can continue the Bounds testing method. Since neither variables seem to be trended, we used only the intercept case in all models. For BOE-FED analysis, the max lag length is selected as 18 and for ECB-FED, the max lag length is selected as 9 due to the existence of a much shorter data span. Since the model is very dependent to the number of lags used, the SIC is checked to obtain the best model, as the lowest SIC is to be selected. Also, the important assumption of the Bounds testing is that the residuals should not be serially correlated. Therefore, the model is checked for serial correlation. For BOE-FED analysis, the model with 18 lag (the max lag) is selected as the best model, for ECB-FED, the model with 9 lag (the max lag) is selected as the best model since these lags are what the serial correlation test and SIC bring out.

In Table 2, we have the bounds tests for the existence of a level relationship for BOE-FED and ECB-FED model. Using Pesaran (2001) asymptotic critical values, we see that both F and t statistics are significant, since the test statistics exceed the upper bound critical values. Put it differently, the lagged level coefficient of the dependent variables for both models are significant which is tested by t test. Also, both lagged level coefficients for both models are jointly significant which is tested by F or Wald test. Thus, we reject the null hypothesis of no cointegration for both models. In other words, we find that there is a long run relationship between BOE interest rates and FED interest rates. The same case is obtained for the relationship between ECB interest rates and FED interest rates. Since we obtained a long run relationship for both models, we can continue the estimation the long run coefficients from ARDL and analyze short run dynamic adjustments.

5.4. ARDL ESTIMATION AND LONG RUN COEFFICIENTS

In order to estimate the long run coefficients, we estimate an ARDL model. For BOE-FED model with maximum lag of 18, ARDL(18,17) is selected using SIC. For ECB-FED model with maximum lag of 9, ARDL(8,8) is selected using SIC. For ARDL(18,17), the long run regression for BOE-FED model and for ARDL(8,8), the long run regression for ECB-FED model is given in Table 3. We see that FED is positively and significantly affecting BOE with a rate of 0.52. Also, ECB is positively and significantly affected by FED with a lower rate of 0.49. We see that effect of FED on BOE is slightly but higher than it is on ECB. As we mentioned in the transmission mechanism section, there is a mechanism directing from exchange rate to inflation. We also mentioned that if the export to the foreign country within the total export is crucial, the transmission mechanism gets meaningful. Looking at the 2007 data from Eurostat website, we see that USA is the largest export market for UK with a value of 45,558,949,882 Euro. It is 193,851,571,848 Euro for Euro zone. But there are many countries in the Euro zone which do not have USA as the largest export market. Thus, within the Euro zone the weight of USA as the export market is lower if compared to UK. Thereby we can say that the transmission mechanism we mention is more effective for BOE model. The magnitude of the long run coefficients is very sensible under this mentality.

5.5. SHORT RUN DYNAMIC ADJUSTMENTS

The short run dynamic coefficients that is related with the long run estimation regression given in Table 4 for BOE - FED model and in Table 5 for ECB-FED model. For both model, we see that the Error Correction term (ECM, hereafter) is negative and significant. This finding also strengthens the evidence of a cointegration relationship for both models since the disequilibriums in the short run -due to shocks- are leading to the equilibrium in the long run. The ECM coefficient shows the speed of adjustment to the long run equilibrium. ECM coefficient for BOE - FED model is -0.135269 which means that each period there is 13% adjustment to the long run equilibrium. Also, ECM coefficient for ECB-FED model is -0.272888 which which means that each period there is 27% adjustment to the long run equilibrium. This means that ECB is slightly less influenced from FED, compared to BOE, but the disequilibriums from this long run relationship is taking shorter time period. We can attribute this to the weakness of ECB in independent monetary policies. BOE is incomparable with ECB since it is older and more trustworthy, or credible. Therefore, even if it is highly affected by FED, it can resist this dependency more than ECB can do.

6. CONCLUDING REMARKS

This study aims to investigate the effect of USA interest rate on UK and Euro zone(EMU) interest rate since FED is highly considered to be a determinant in the other countries' monetary policies. There is a vast literature analyzing the relationship between these variables. However, we analyze this topic employing a rather new and trustworthy technique of Pesaran (2001) bounds testing. Also, we posit a differentiated perspective. The emprirical findings showed that there is a long run relationship between ECB-FED and BOE-FED with a higher magnitude in BOE-FED model. We attribute this to the priority in export partnership since USA is the largest export market for UK but it is not totally the case for Euro zone. The mentality is such that, any movement in the FED interest rate affect the value of the domestic (UK, EMU) currency and through the external trade, it cause a differentiation in the price level and accordingly the interest rates. The selection of FED interest rates is not a random selection in this and other studies. FED interest rate has a different position in the global arena. A crucial percentage of the world trade is being done by the US dollar. This emerges a dependence or increases the dependence of monetary policies on USA monetary policies. Employing the ECB interest rates and BOE interest rates, we tried to see this dependence. BOE interest rates are found be affected by a higher degree and ECB interest rates are found to be less resistant. As EMU is a 10 year of monetary union and accordingly, ECB is a young Central Bank, this low resistancy gains significance.

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Table 1: ADF and PP Unit Root Tests

	ADF		PP	
Variable	constant	constant and trend	constant	constant and trend
FED(1991-2008)	-2.168783 (0.2185)	-2.164944 (0.5062)	-2.245446 (0.1910)	-2.236638 (0.4664)
FED (1999-2008)	-1.630387 (0.4640)	-1.617599 (0.7804)	-1.680134 (0.4387)	-1.669337 (0.7588)
ECB (1999-2008)	-2.555135 (0.1056)	-2.572972 (0.2935)	-1.959867 (0.3042)	-1.965895 (0.6135)
BOE (1991-2008)	-3.127995 (0.0261)	-3.622700 (0.0303)	-4.312158 (0.0005)	-4.655622 (0.0011)

For ADF unit root test, max lag length is selected as 18 and Schwarz Information Criterion (SIC) is used for the automatic lag selection. For PP unit root test, Newey-West Bandwidth is selected for the automatic bandwidth selection.

Table 2: Bounds tests for the existence of a level relationship

Analysis	**F test (Wald Test)**	**t test**	**Serial Correlation LM test (probability)**	
			LM(1)	**LM(3)**
BOE-FED	13.96016 F(2, 157)	-5.265333	0.059526	0.196751
ECB-FED	8.065696 F(2, 88)	-3.414446	0.666177	0.395222

Critical values, for F test, in 5% for intercept and no trend case is 4.94, for lower bound and 5.73, for upper bound (k=1), where k is the number of regressor. Critical values are obtained from Pesaran et al.(2001, p.300). Critical values for t statistic, in 5% for intercept and no trend case is -2.86 for lower bound and -3.22 for upper bound. Critical values are obtained from Pesaran et al.(2001, p.303).

Table 3: Long Run Coefficients from ARDL model

BOE = 3.117143 + 0.524695* FED (0.149750)
ECB = 1.455947 + 0.492072* FED (0.107753)

The values in brackets are the standard errors.

Table 4: Error correction representation for the ARDL(18,17) model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UK(-1))	-0.172405	0.072723	-2.370707	0.0189
D(UK(-2))	0.009592	0.075073	0.127771	0.8985
D(UK(-3))	0.037381	0.073444	0.508971	0.6115
D(UK(-4))	0.116248	0.073375	1.584289	0.1151
D(UK(-5))	0.127130	0.072754	1.747401	0.0825
D(UK(-6))	0.071839	0.065954	1.089222	0.2777
D(UK(-7))	-0.102135	0.065983	-1.547895	0.1236
D(UK(-8))	-0.095637	0.068016	-1.406093	0.1616
D(UK(-9))	0.020621	0.067750	0.304364	0.7612
D(UK(-10))	-0.062564	0.065388	-0.956802	0.3401
D(UK(-11))	-0.224554	0.066289	-3.387484	0.0009
D(UK(-12))	0.404768	0.067762	5.973423	0.0000
D(UK(-13))	0.021222	0.073590	0.288374	0.7734
D(UK(-14))	0.019961	0.071224	0.280260	0.7796
D(UK(-15))	-0.057986	0.064170	-0.903624	0.3675
D(UK(-16))	-0.145378	0.062711	-2.318210	0.0217
D(UK(-17))	-0.189969	0.061142	-3.107008	0.0022
D(US)	0.203835	0.072365	2.816754	0.0055
D(US(-1))	0.056341	0.075199	0.749225	0.4548
D(US(-2))	0.016567	0.076422	0.216787	0.8286
D(US(-3))	-0.091159	0.077534	-1.175722	0.2414
D(US(-4))	-0.155916	0.077167	-2.020501	0.0450
D(US(-5))	-0.063116	0.079103	-0.797897	0.4261
D(US(-6))	0.017809	0.078469	0.226959	0.8207
D(US(-7))	0.072084	0.077867	0.925726	0.3560
D(US(-8))	0.077941	0.076843	1.014289	0.3120
D(US(-9))	-0.101548	0.077208	-1.315258	0.1903
D(US(-10))	0.136456	0.080808	1.688644	0.0932
D(US(-11))	0.093388	0.082688	1.129408	0.2604
D(US(-12))	-0.162758	0.083725	-1.943962	0.0536
D(US(-13))	-0.002933	0.085164	-0.034441	0.9726
D(US(-14))	0.167707	0.088103	1.903537	0.0587
D(US(-15))	0.115934	0.088589	1.308676	0.1925
D(US(-16))	-0.191616	0.088472	-2.165849	0.0318
ECM(-1)	-0.135269	0.029618	-4.567161	0.0000
C	2.21E-05	0.029544	0.000748	0.9994

R-squared 0.669763

Adjusted R-squared 0.598416

$ECM_t = BOE_t - 3.117143 - 0.524695*USA_t$

Table 5: Error correction representation for the ARDL(8,8) model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO (-1))	-0.390499	0.090545	-4.312778	0.0000
D(EURO (-2))	-0.130334	0.094407	-1.380562	0.1707
D(EURO (-3))	0.153983	0.096231	1.600143	0.1129
D(EURO (-4))	0.147614	0.101857	1.449233	0.1506
D(EURO (-5))	0.163916	0.103213	1.588139	0.1156
D(EURO (-6))	0.421876	0.098581	4.279495	0.0000
D(EURO (-7))	0.237962	0.088305	2.694778	0.0083
D(US)	0.171057	0.054950	3.112970	0.0024
D(US(-1))	0.168549	0.061239	2.752307	0.0071
D(US(-2))	-0.062754	0.064174	-0.977865	0.3306
D(US(-3))	-0.132919	0.070333	-1.889869	0.0618
D(US(-4))	-0.294761	0.073060	-4.034508	0.0001
D(US(-5))	-0.373232	0.080495	-4.636714	0.0000
D(US(-6))	-0.291150	0.082894	-3.512300	0.0007
D(US(-7))	-0.189857	0.076970	-2.466648	0.0154
ECM(-1)	-0.272888	0.048057	-5.678412	0.0000
C	4.27E-06	0.029686	0.000144	0.9999

R-squared 0.560368
Adjusted R-squared 0.486325
$ECM_t = ECB_t - 1.455947 - 0.492072*FED_t$