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AUTHORS	Sadullah Çelik Pınar Deniz
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Sadullah Çelik (Turkey), Pınar Deniz (Turkey)

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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 et al. (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.

Introduction

It is well known that price stability has been the priority of Central Banks in recent decades. Hence, monetary policy has been operated via short-term interest rates to achieve inflation targeting. In a closed economy, it is easier to operate monetary policy as the behavior of the domestic market is the key ingredient. However, global open economies of today face all kinds of externalities either in the form of changes or shocks in foreign markets as the behavior of the rest of the world becomes highly influential on domestic economies. The concern of this paper is the short-term interest rates. We analyze the effects of the foreign interest rates on domestic interest rate which has been a subtopic of the developments that globalization has created.

If foreign interest rate increases to levels higher than domestic interest rate, capital will flow to foreign country and the outflow will depreciate the domestic currency, thereby increasing domestic competitiveness in the global arena. Increasing exports means more domestic resources are sent to the rest of the world and moreover, decreasing imports means domestic consumption resources will decline. This process could create inflation for the domestic economy through the depreciation in domestic currency. Since the priority of the Central Banks is to sustain and preserve price stability, the home country Central Bank needs to increase interest rates in an attempt to combat inflation. Hence, in an open economy, Central Bank may lose its control over monetary policy, or, monetary policy is no longer independent and will be shaped through the developments in foreign markets. So, the significant point of this analysis becomes any kind of change in foreign (or domestic) interest rates.

There is an ongoing debate whether the Federal Reserve (FED) is leading in short-term interest rates. The developments in the global economy frequently lead us to consider whether FED is preceding in changes in interest rates. Motivated by Taylor (2009), our analysis focuses on the influence of FED interest rates on ECB interest rates. ECB interest rates are the common interest rates for the European Monetary Union (EMU) which began in January 1999. Thus, EMU is a young union and ECB is a young Central Bank. However, if we compare it to FED, ECB may be seen as a much weaker Central Bank in terms of policy action. Since hitting the targets for monetary policy requires credible Central Banks, the confidence to Central Banks is highly crucial. Since ECB is rather new, it may take some time before economic agents trust ECB and act accordingly. For the sake of comparison, we also would like to observe the effects of FED interest rates on a European Union member but non-EMU member. Accordingly, we choose the old and trustworthy Bank of England (BOE). Thus, the ultimate aim of this paper is to analyze whether FED interest rates have any corresponding effects on ECB and BOE interest rates.

The originality of our study consists in employing the autoregressive distributed lag model (ARDL) cointegration technique through Bounds testing of Pesaran et al. (2001). The technique is more applicable and gives more sensible results than the conventional cointegration tests. Moreover, we employ a longer data span to attain robust results.

This study is organized as follows. In Section 1, we present the ongoing literature about the effect of FED monetary policy actions on ECB and BOE monetary policy actions. Next, we briefly underline the possible transmission mechanism that creates the dependence of Central Banks. In Section 3, we explain the econometric technique employed. Section 4 includes the empirical findings and the last section has the concluding remarks.

1. Literature survey

There is a vast literature analyzing the dependence of monetary policy actions on foreign Central Banks. FED is the most analyzed Central Bank that is considered to have an impact on other Central Bank interest rate decisions. Accordingly, we only take into account the studies that are focused on the relationship between FED, BOE and ECB interest rates[1].

Monticini and Vaciago (2005) analyze the reactions of the markets to the decisions of other countries' Central Banks. They examine how domestic interest rates are influenced by foreign Central Banks' monetary decisions depending on globalization. They use daily data for the period of January 1999 to October 2005 and employ OLS technique. First, the study investigates the influence of expected and unexpected changes in the target interest rate[2], on one-day response to monetary policy decisions, i.e. the change in realized domestic interest rates. Then, they analyze the influence of surprise made by domestic and foreign Central Banks' announcements on one-day response to, again, monetary policy decisions. The study covers ECB, FED and BOE and whether these Central Banks are influenced by each other's monetary policy announcements along with domestic monetary policy announcements. Their findings show that ECB is influenced by FED's monetary announcements and BOE is only marginally affected by FED's monetary announcements. Another study by Ullrich (2003) explores whether Taylor rule can be used to understand the relationship between FED and ECB. Reaction function, i.e. Taylor rule, employs monthly data from 1999 to 2002 as Euro era and monthly data from 1995 to 1999 as the case for pre-Euro era. The empirical findings demonstrate that FED is not following a Taylor rule type function before Euro but this evidence is rejected for the Euro era. Moreover, Breuss (2002) investigates Taylor reaction function for ECB and shows that it reacted to FED policy actions with a changing time lag within the period of 1999-2001. On the other hand, Belke and Gros (2005), using daily and weekly data within the period of 1989-2003, search for the relationship between FED and ECB interest rates employing Granger causality test. Their important conclusion is that ECB is affected by FED and that in longer data span analysis FED is also influenced by ECB. They also test the period of 2000-2001 for the possibility of a structural break and show that after that period the relationship between the two Central Banks yield much longer lags. In another study, Gerlach and Schnabel (2000) employing Generalized Method of Moments for the period of 1990-1998 for EMU-11 countries analyze Taylor rule through variables, interest rates, output gap, future inflation rate, lagged inflation, money growth, Fed Funds Rate, real euro/$ rate. Their significant finding points to Fed funds rate's effect on ECB interest rate. Rather different from the others, Clarida, Gali and Gertler (1998) investigate several Central Banks' reaction functions. Taking 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 period of 1979-2003 in monthly data. Finally, Ehrmann and Fratzscher (2003) examine the interdependence between US and Germany for the period of 1993-2003, splitting it into Pre-EMU and Post-EMU, and the interdependence between US and Euro area for the period of 1999-2003, using many variables such as interest rates, consumer price index, industrial production, unemployment rate, etc. Employing weighted least squares method, they find that the monetary interdependence of Euro area on US macroeconomic variables gains strength after the establishment of EMU. They attribute this finding to the process of more integration between the US and EU markets not only in financial terms but also in real economy.

2. Transmission mechanism

As the world is getting more and more economically, socially and politically integrated, any effect in foreign markets has the capability of influencing the domestic market. The same argument turns out to be valid for monetary policy tools. Moreover, the tools used to provide smooth functioning of domestic markets are under scrutiny from foreign participants due to global capital flows. This study accordingly analyzes the dependence of monetary policy taking into account the Fed interest rate as the focus of determinant. The selection of Fed 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 ECB and BOE interest rates are taken as the endogenous variables to observe the effects of FED interest rate changes on them.

It is important to briefly explain the possible transmission mechanism that sheds light on this interdependence. Let's say that there is an increase in foreign interest rates. In an open economy scenario, the foreign currency will appreciate. In the trade arena,

[1] Most of the studies examine this relationship through the Taylor rule. Since we only focus on the interest rates of these Central Banks and exclude other variables such as unemployment, inflation, output gap, we will not discuss the Taylor rule mentality in these studies and state only their findings for the relationship between FED, BOE and ECB interest rates.

[2] They employ future rates to separate the influence of expected and unexpected changes in the target interest rate.

this depreciation will provide competitiveness for the domestic economy. Through the increase in exports and the decrease in imports, the domestic market will offer less output for the consumption of domestic economic agents and scarcity will trigger inflation upwards. The domestic Central Bank, since its main mission is to maintain the price stability, will need to increase the domestic interest rates. This mechanism shows that domestic monetary policy needs to keep up with foreign one. However, this case is especially important when trade with foreign country – especially the exports to the foreign country – constitutes a crucial part in total trade volume – or basically the export volume – of the domestic economy.

There may also be several other mechanisms explaining monetary policy interdependence. If the domestic Central bank has the mission of maintaining a stable exchange rate, the monetary policy, as a matter of fact, will be imported and depend on foreign monetary policy actions. If the economy aims to keep the short-term capital flows, then the increase in foreign interest rates needs to be compensated by the domestic interest rates. Monticini and Vaciago (2005) mention the low transaction costs, due to the high financial integration, as the factor creating an ameliorating effect for the movement of capital. Thus, integrated markets or more comprehensively globalization is one of main reasons for interdependence among the markets, including the money market as well as the financial markets.

3. Methodology

We decided to apply Pesaran et al. (2001) "Bounds Testing" procedure to analyze the relationship between FED-ECB and FED-BOE interest rates. In Bounds testing, the integration order, in other words, whether the variables are I(0) or I(1), does not add any additional procedure to the empirical analysis. However, we still 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 error correction models (ECM) are constructed[1]:

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

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

For a long-run relationship, the conditional ECM has to certify two conditions[2]. 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[3].

Second, 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[4]. After ensuring the existence of the cointegration, one can go on to carry out the analysis of level effects and the short-run dynamic adjustments. The standard method used is as follows. First, ARDL (p, q) is modeled as:

$$y_t = c + \sum_{i=1}^{p} \lambda_i y_{t-i} + \sum_{j=1}^{q} \eta_j x_{t-j} + \varepsilon_t . \quad (3)$$

For a long-run solution:

$$y^* = y_t = y_{t-1} = y_{t-2} = ... = y_{t-p} . \quad (4)$$

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

Thus, $y^* = \dfrac{c}{1-\sum \lambda_i} + \dfrac{\sum \eta_i}{1-\sum \lambda_i}$, (6)

or, $y^* = \phi_0 + \phi_1 x^*$. (7)

Hence, after specifying the lag order of the ARDL model, the long-run coefficients are obtained. Second, the equilibrium error is obtained from the long-run model as:

$$e_t = y_t^* - \phi_0 - \phi_1 x . \quad (8)$$

Finally, the ECM is constructed with general to specific approach. Moreover, the first lag of the equilibrium error is included instead of the lagged values of the level coefficients as:

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[1] The model and the empirical results depend on the lag selection. Accordingly, Pesaran et al. (2001) highlight that the number of lags must be high enough to overcome the serial correlation problem, but low enough to prevent overparameterization problem.

[2] When the conditional ECM is constructed, the residuals must be checked for serial correlation. Hence, we use Breusch-Godfrey Serial Correlation LM test which has the null or 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.

[3] The critical F-statistics for the joint case and the critical t-statistics for the single case are given in Pesaran et al. (2001).

[4] There are two critical values for the both cases, according to the integration order of the variables, whether they are I(0), I(1) or a mixture of both. The first critical value is the lower bound of I(0) and the second one 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 the result is inconclusive. When the critical upper bounds are exceeded, there is a long-run relationship without considering whether the variables are I(0) or I(1).

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

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

4. Empirical findings

4.1. Data. One of the main tools for monetary policy of a Central Bank is the short-term interest rates. Thereby, we employ the short-term interest rates for the USA (hence, FED funds target rate), Euro zone (hence, ECB key rate) and the UK (hence, BOE Bank rate). The data is obtained from OECD and for FED and BOE, we use the period from January 1991 to December 2008, and for FED and ECB, we use the period from January 1999 to December 2008.

4.2. Unit root tests. Although Bound testing does not require the variables to be I(1) or I(0), we still test to ensure that none of them are I(2). Table 1 shows the Augmented Dickey Fuller (ADF) (1979, 1981) and Phillips-Perron (PP) (1988) unit root test results. FED interest rates for both periods show a unit root, as well as ECB. However, for BOE interest rates we reject the null of unit root in the both cases. Thus, FED and ECB interest rates are I(1) but BOE interest rates are I(0).

Table 1. ADF and PP unit root tests

	ADF		PP	
Variable	Constant	Constant and trend	Constant	Constant and trend
FED (1991-2008)	-2.168 (0.219)	-2.165 (0.506)	-2.245 (0.191)	-2.237 (0.466)
FED (1999-2008)	-1.630 (0.464)	-1.618 (0.780)	-1.680 (0.439)	-1.669 (0.759)
ECB (1999-2008)	-2.555 (0.106)	-2.573 (0.294)	-1.960 (0.304)	-1.966 (0.613)
BOE (1991-2008)	-3.128* (0.026)	-3.623* (0.030)	-4.312** (0.001)	-4.656** (0.001)

Notes: (*, **) denotes significance at 5% and 1% levels, respectively. 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.

4.3. Bounds testing. As the unit root tests show that there is no I(2) variable we move on and apply Bounds testing method[1]. For BOE-FED analysis, the maximum lag length is selected as 18 and for ECB-FED the maximum lag length is selected as 9 due to the existence of a much shorter data span[2].

Table 2 displays the results of bounds tests for the existence of a level relationship for BOE-FED and ECB-FED models. Both F- and t-statistics are significant so we reject the null hypothesis of no cointegration for both models, showing the existence of a long-run relationship between BOE interest rates and FED interest rates. A similar conclusion is obtained for the relationship between ECB interest rates and FED interest rates.

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

Analysis	F-test (Wald test)	t-test	$\chi^2(1)$	$\chi^2(3)$
BOE-FED	13.960 F(2, 157)	-5.265	0.060	0.197
ECB-FED	8.065 F(2, 88)	-3.414	0.666	0.395

Notes: Critical values for F-test at 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 regressors. Critical values are obtained from Pesaran et al. (2001, p. 300). Critical values for t-test at 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). $\chi^2(1)$ and $\chi^2(3)$ tests are the serial correlation LM test results for 1 and 3 lags.

4.4. ARDL estimation and long-run coefficients. In order to estimate the long-run coefficients, we estimate an ARDL model. For BOE-FED, ARDL (18, 17) is selected and for ECB-FED, ARDL (8, 8) is selected. The long-run regressions for both BOE-FED model and ECB-FED model are in Table 3.

Table 3. Long-run coefficients from ARDL model

BOE = 3.117 + 0.525* FED (0.149750)
ECB = 1.456 + 0.492* FED (0.107753)

Notes: The values in parentheses are the standard errors.

FED is positively and significantly affecting BOE with a rate of 0.52 and ECB with a slightly lower rate of 0.49. 2007 data from Eurostat website shows that USA is the largest export market for United Kingdom (UK) with a value of 46 billion Euros. This amount is 194 billion Euros for the Euro zone. But there are many countries in the Euro zone which do not have USA as their largest export market. Thus, within the Euro zone the weight of USA as the export market is lower compared to UK. Thereby, the transmission mechanism is more effective for UK and the magnitude of the long-run coefficients is very sensitive as our results demonstrate.

4.5. Short-run dynamic adjustments. The short-run dynamic coefficients for the long-run estimation regressions are given in Table 4 for BOE-FED model and in Table 5 for ECB-FED model. For both models, the ECM is negative and significant. This finding strengthens the evidence

[1] Since none of the variables seem to display a trend, we use only the intercept case in all models.
[2] We use the same number of maximum lags throughout and choose the number of lags according to SIC.

for a cointegration relationship since the disequilibrium in the short run – due to shocks – turns out to be equilibrium in the long run. ECM coefficient shows that each period for BOE-FED model there is 13% adjustment and for ECB-FED model 27% adjustment to the long-run equilibrium. This means that ECB is less influenced by FED compared to BOE, but the disequilibrium from this long-run relationship exists for a shorter period. This result can be attributed to the weakness of ECB in terms of an independent monetary policy. BOE is incomparable with ECB since it is older, more trustworthy and probably more credible. Therefore, even if it is highly affected by FED, it can resist this dependency more than ECB.

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	0.670			
Adjusted R-squared	0.598			
$ECM_t = BOE_t - 3.117 - 0.525*USA_t$				

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	0.560			
Adjusted R-squared	0.486			
$ECM_t = ECB_t - 1.456 - 0.492*FED_t$				

Concluding remarks

This study aims to investigate the effect of USA interest rates on UK and Euro zone interest rates as FED is considered to be the dominant monetary policy maker in the world. There is a vast literature analyzing the relationship between these variables. However, our study examines this topic employing a rather new and trustworthy technique developed by Pesaran (2001). Moreover, we posit a differentiated perspective.

Our empirical findings show that there is a long-run relationship between ECB and FED and BOE and FED, but we obtain a higher magnitude for BOE-FED model. We attribute this to the priority in export partnership since USA is the largest export market for UK but this is not the case for Euro zone. Any movement in FED interest rates affects the value of the domestic currency (UK, EMU) and through trade it causes a change in the domestic price level and, thus, the level of interest rates.

The selection of FED interest rate is not random in previous studies or the current study. FED interest rate has a unique position in the global arena as a substantial percentage of the world trade is carried through US dollar. This mechanism creates a dependence on US dollar and also increases the dependence of monetary policy of an economy on the USA monetary policy. Employing the ECB interest rates and BOE interest rates, we try to observe and measure this relationship. Our empirical findings show that BOE interest rates are affected by a higher magnitude and ECB interest rates are found to be less resistant. As EMU reaches a milestone of 10 years as a monetary union, with ECB still a young Central Bank, this rather low resistance is significant to underline.

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