

Are Europe's Interest Rates led by FED Announcements?

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Abstract

This paper investigates the degree and nature of economic and monetary policy relations among the United States, the Euro area, and Great Britain. Using daily interest rates, we estimate the impact of monetary policy announcements of a Central Bank on its domestic market and in what measure those announcements are able to influence other financial markets. In particular, we analyse the effect of the FED, ECB, and BoE monetary policy announcements on European markets. We find that Europe's interest rates have a relevant response to FED announcements.

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1 Introduction

The main instrument of monetary policy is the setting of central bank rates, which can either follow a “reaction function” – Taylor rule - or be decided on a discretionary basis. In both cases it is very important how the central bank announces its policy.

In the 1990’s numerous studies analysed the transmission mechanisms of monetary policy, focusing particularly on the reaction of market interest rates to the decisions and, more generally, to the monetary policy announcements of central banks.

In our opinion, knowing how markets respond to monetary policy announcements is of extreme importance for both financial operators and monetary authorities: operators want to know how monetary policy will affect their decisions, and the central bank wishes to know how its decision on interest rates is transmitted to the market and how much autonomy to determine rates it actually enjoys.

It is interesting, with the increased globalisation of financial markets, to look also at how domestic interest rates are influenced by the monetary policy announcements of a foreign central bank.

The aim of this study is to examine how the announcements of a central bank are reflected on its domestic market and to what extent they are able to influence the financial markets of other countries. We analyse the effects of the FED’s, the ECB’s, and the BoE’s monetary policy announcements on their own and other markets, using future rates to separate expected from unexpected policy decisions. In accordance with the efficient markets hypothesis, we show that the response of domestic interest rates to the surprise component of monetary policy is stronger than the expected component of policy action, but we also find that Europe’s interest rates respond significantly to FED announcements. This amounts to a temporary loss of monetary sovereignty for Europe’s central banks.

More generally, this finding can be used to improve the effectiveness of

monetary policy: it is in fact essential for a central bank to take account of the capacity of others to communicate and of the leadership effects this has, if it wishes to conserve its sovereignty over its own yield curves at all times.

2 Transmission channel

What are the channels through which monetary policy announcements by the central bank of one country can cause changes on the domestic market of another country? Generally speaking there are three main channels. The first depends on the regime in which the monetary policy is set. Some central banks do in fact set themselves the target of stabilizing a relationship in which one of the two variables involved is controlled by a foreign central bank. This occurs for example when monetary policy seeks to stabilize the exchange rate. In this case, monetary policy is determined by an exogenous variable controlled by a foreign central bank. When that foreign central bank announces a change in its monetary policy, this change also is transmitted to the other monetary market.

The second channel is connected with the growing integration of financial markets and the relative spillover effects. An announcement by one central bank can in fact create arbitrage phenomena which tend to be eliminated by movements of capital. Since the transaction costs of transferring capital from one market to another are low in integrated financial markets, an announcement by a foreign central bank will generate capital flows which will have an impact on its domestic financial markets.

Finally, the third channel is connected with the publishing of macroeconomic data. A monetary policy announcement by a central bank may reveal important economic information concerning another country. Consider, for example, an economic outlook which contains explicit references to the economic conditions of other economies or in any case useful information for forecasting the economic performance of other countries.

3 A review of earlier studies

An early paper assessing market reactions to monetary policy actions is that of Cook and Hahn (1989), who examined the one-day response of bond rates to changes in the target Fed Funds rate from 1974 through 1979. Cook and Hahn begin by compiling a record of the changes in the Federal Reserve's target over this period. They examine both the records of the Federal Reserve Bank of New York (which implemented the changes) and the reports of the changes in *The Wall Street Journal*. As Cook and Hahn describe it, the actual Federal funds rate moves closely with the Federal Reserve's target. Moreover it is highly improbable that the Federal Reserve was changing the target in response to factors that would have moved the funds rate even in the absence of the policy changes, i.e. it is unlikely that in the absence of the Federal Reserve's actions the Federal funds rate would have moved by discrete amounts. Their procedure was to regress the change in the bill, note, and bond rates on the change in the Fed's target funds rate for a sample consisting of 75 days during which the Fed had changed the funds rate target. They find that the response to the target rate increases is positive and significant at all maturities, but noticeably smaller at the long end of the yield curve. In addition, Cook and Hahn examine the relationship between changes in interest rates and future changes in the target, but they find little evidence that the target rate changes were anticipated.

In contrast with this research, Roley and Sellon (1995), using Cook and Hahn's eventstudy approach to the 1987-1995 period, find a statistically insignificant response of bond rates to changes in the target funds rate. Later on, more sophisticated econometric procedures were used. Edelberg and Marshall (1996), using a VAR (Vector Autoregressive) model to study monetary policy, found a large response of bill rates to policy shocks, and a small response of bond rates.

In 2001, Kuttner used the Federal Funds rate futures to separate expected from unexpected changes in the Federal Funds target rate. Examin-

ing the impact of monetary policy on bill, note, and bond yields, the author showed that the response of interest rates to expected changes is insignificant, while the response to unexpected change is statistically significant and relevant to explain the impact of monetary policy changes. These results support the hypothesis of rational expectations of economic agents.

Perez-Quiros and J. Sicilia (2002) examined the predictability of the monetary policy of the ECB and analysed the impact of monetary policy decisions on the yield curve, using daily data. As regards predictability, their evidence suggested that markets have not been surprised by monetary policy decisions of the ECB, i.e. markets have been able to predict the Governing Council's decisions on key ECB interest rates fairly accurately. As regards transmission of the unexpected component of monetary policy decisions to the yield curve, they provide evidence that meetings smooth out the impact of the monetary policy shocks (daily changes in short-term interest rates) which have been generated outside meeting days.

Ross (2002) looking at the relations between monetary policy announcements and the market's reaction, makes a comparative analysis on the market's ability to understand the ECB's, FED's, and BoE's decisions. In this work it appears that the market is able to anticipate correctly the FED's and the BoE's decisions. With regard to the ECB, the market has difficulty to anticipate changes in the interest rate. The author thinks that this may be explained by the larger number of meetings, which are a source of confusion.

Various studies on money markets in the literature consider the importance of foreign announcements to domestic markets. Kim, Kortian and Sheen(2000) look at the Australian financial market. They find that American macroeconomic news affects Australian interest rates.

In another study Gravelle and Moessner (2001) demonstrate that Canadian interest rates are more affected by news on the United States economy than by that on the Canadian economy.

At the end, Ehrmann and Fratzscher (2002) analyse interdependence

between the Euro area and the US area in the period 1993-2002¹. In particular, they examine how the release of macroeconomic news from the Euro area and US area can influence domestic interest rates and interest rates of the other area. The authors find some spillover effects from the USA into the Euro area, noting that we are in the presence of an increasing interdependence between these two areas. This interdependence appears very similar to what we shall call dependence.

3.1 Expectations using futures

The measurement of market expectations constitutes an important aspect of our analysis. It is well known that the measurement of expectations of future monetary policy decisions is rather complex. A broad ranging literature has grown in recent years on the use of asset prices to measure expectations.

In particular, Kuttner (2001) and Faust, Swanson and Wright (2001) use the current month Federal Funds futures contract to measure the expectations on the Federal Funds rate. Other authors like Bomfim (2003) and Poole and Rasche (2000) use the month-ahead Federal Funds futures contract.

In 2002 Gurkaynak, Sack, and Swanson looked at the optimal market-based measures of monetary policy expectations for up to five months. Their predictive power for the future Federal Funds rate is the highest. In particular, a very simple measure of the unexpected component of monetary policy decisions consists of the difference between the appropriate futures price on the day before the announcement and on the announcement day. Following this line, as described in Kuttner (2001), a monetary policy surprise can be measured by the changes in the “spot month” futures rate calculated on the relevant successive days. This measure is subject to a scaling factor, $\frac{m}{m-t}$, used to adjust the measure to the days of effective change. Analytically we

¹They use data from Bundesbank for the period 1993-1998.

have:

$$\Delta r_t^u = \frac{m}{m-t}(f_{s,t}^0 - f_{s,t-1}^0) \quad (1)$$

where, r_t^u is the surprise generated by unexpected changes to the interest rates, $f_{s,t}^0$ is the spot month future rate the day t of the month s and m is the number of days in a month².

Once we have a surprise generated by monetary policy decisions we can measure market's expectations in this way:

$$\Delta r_t^e = \Delta r_t - \Delta r_t^u. \quad (2)$$

Where Δr_t^e is the expected monetary policy decision while Δr_t is the change in the interest rate operated by the monetary policy authority. In this work we use a slightly different approach. In fact, we use the futures contract with expiration one month ahead; so our approach is quite similar to Bomfim (2003). With this correction from Kuttner (2001) we compute the unexpected component of monetary policy decisions using (1) without the scaling factor. The criteria we use to measure expected monetary policy decisions remains the same (2).

3.2 Measuring the announcement impact

This section explains the model we have estimated to measure the impact of monetary policy decisions. Basically we use the model described by Cook and Hahn (1989) with the improvements of Kuttner (2001). This analysis consists of an OLS regression³ where the dependent variable is a one-day response⁴ of interest rates, and the independent variable is the change in the

² $\frac{m}{m-t}$ it is the scaling factor.

³Poole, Rasche, Thornton (2002) underline that the use of the OLS method of estimation could give distorted results. The distortion is due to the different ways in which markets process new information. They nevertheless also affirm that the differences between estimates made using the OLS method and those made using the "errors in variable" method are generally very small.

⁴In actual fact the change is calculated between the rate on the day of the announcement and the rate on the following day.

Fed Funds target. Kuttner (2001) uses Cook and Hahn’s model adjusted for expectations. Specifically, using the futures contract as mentioned above, Kuttner splits the change in target into expected and unexpected monetary components. We estimate the following equation:

$$\Delta R_t = \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^u + \varepsilon_t \quad (3)$$

where R is the yield of the rate examined, β is the response to expected and unexpected changes to the target.

Like Kuttner, ΔR is computed as the one-day response to monetary policy decision. In this way we can outline market’s adjustment after monetary policy decisions. The coefficient β_2 give us the possibility to measure the surprise component. This measure is very useful to understand if the market believes that it is important news while β_1 “expected response” represents the information already known by operators. This econometric exercise permits us to gain indications on the ability of a Central Bank to control its yield curve, and to analyse the behaviour of non-domestic markets in relation to announcements of another Central Bank. We expect a value of α very close to zero, a value of β_1 statistically not significant and close to zero, and a β_2 statistically significant and close to one. These theoretical results are obtained from the rational expectation model which postulates market response only to new information.

4 The sample for the money market analysis

The time series of the interest rates examined are Euribor one month, and one year; LIBOR one month and one year. The model examines interest rate variations between the announcement day and the next day. The exogenous variables are the Central Bank’s changes in monetary policy, measured by variations in the key interest rates directly determined by the Central Banks, for their respective money markets: Main Refinancing Operations (MRO) for Euro-zone, and repo for UK market. To measure market expec-

tations, we use data from the futures markets, in particular, the one month Euribor, and the three-month futures on GBP (Great Britain Pound), both with expiration one month ahead. The analysis covers the period between 1st January 1999 and 31st December 2003. During this period we have outlined the monetary policy meetings of the three Central Banks. It is important to note that we consider all meetings and not only those followed by a monetary policy change. This is justified by the fact that every meeting gives information that helps operators to form their expectations, influencing the trend of interest rates. In the period analysed the ECB had a greater number of meetings than the FED and the BoE (Table 1), the ECB had 95 meetings, the FED 40, and the BoE 60⁵.

Decision	FED		ECB		BoE	
	N. Meeting	%	N. Meeting	%	N. Meeting	%
Maintained	24	60.00%	80	84.21%	43	71.67%
Change						
0.50%	1	2.50%	2	2.11%	0	0.00%
0.25%	5	12.50%	5	5.26%	5	8.33%
-0.25%	4	10.00%	3	3.16%	10	16.67%
-0.50%	6	15.00%	5	5.26%	2	3.33%
Total of Meeting	40		95		60	

Table 1: Number of meetings and decisions

In short, the youngest of the three Banks had more meetings than the others. We have to remember that the ECB had two meetings per month. It left its interest rates unchanged in 84.2% of those meetings, raised them by a half point in 2.1% and by a quarter of a point (percent) in 5.3% of meetings. It reduced them by a quarter of a point and by half a point respectively in 5.3% and 3.2% of the meetings.

The Federal Reserve left its interest rates unchanged in 60% of its meetings, raised them by half a point and by a quarter-point respectively in 2.5% and 12.5% of its meetings, and reduced them by a quarter-point and

⁵For the FED we use unscheduled meetings as well.

half-point respectively in 10% and 15% of its meetings. The Bank of England left its interest rates unchanged in 71.7% of its meetings, raised them by a quarter-point in 8.3% and it reduced them by a quarter-point and a half-point respectively in 16.7% and 3.3% of its meetings.

5 The results

The main econometric results are reported in Table 2. The first important point to be observed is the general statistical appearance of the estimated parameters, which confirms the adequacy of the empirical model. The intercept and expected response are approximately equal to zero or are statistically insignificant. By contrast analysing unexpected response, we can observe how the Euro-zone money market immediately responds to “monetary policy surprises” announced by the ECB, and its interest rates react to the ECB’s monetary policy decisions. In particular, we can see how short term interest rates reflect almost entirely the variation announced (the coefficient of unexpected response is close to one), while the longer money market interest rates (one year) respond much less.

The 1-day response of interest rates to changes in the MRO						
	Response					
	Intercept	Expected	Unexpected	Adj R ²	DW	F-Stat
Euribor 1 month	0.005	0.069	0.952	0.692	1.763	105.622
<i>t stat</i>	1.311	2.281	13.826			
Euribor 12 month	0.009	0.014	0.777	0.573	2.169	63.536
<i>t stat</i>	2.32	0.479	11.051			
LIBOR 1 month	-0.006	0.031	0.738	0.392	1.88	31.03
<i>t stat</i>	-1.55	1.1	7.84			
LIBOR 12 month	-0.001	0.017	1.023	0.66	1.86	91.71
<i>t stat</i>	-0.468	0.747	13.334			

Table 2: The Response of Interest Rates to ECB's decisions.

The 1-day response of interest rates to changes in the Fed funds target						
	Intercept	Response Expected	Response Unexpected	Adj R ²	DW	F-Stat
Euribor 1 month	-0.005	0.012	0.799	0.653	2.34	37.732
<i>t stat</i>	-2.132	0.875	6.342			
Euribor 12 month	-0.003	0.013	0.855	0.41	2.138	14.603
<i>t stat</i>	-0.707	0.562	3.933			
LIBOR 1 month	-0.003	0.027	0.283	0.104	2.27	3.277
<i>t stat</i>	-0.799	1.383	2.417			
LIBOR 12 month	0.004	0.04	0.373	0.125	2.33	3.800
<i>t stat</i>	0.701	1.651	2.531			

Table 3: The Response of Interest Rates to FED's decisions.

With regard to the relations between the ECB's decisions and the British money market there are interesting results. The adjusted R-square is high, and β_2 close to one; furthermore, differently from what happens in the Euro-zone money market, these results are confirmed also for longer money market interest rates. A good explanation could be derived from the fact that the ECB's meetings and the BoE's meetings are often on the same days. From 2002 to 2003, 23 ECB's meetings, 17 happened on the same days as those of the BoE, and 11 meetings were followed by the same decisions⁶.

Now consider the Federal Reserve. From Table 3 we see the response to the FED's announcement in the Euro-zone, and British money markets. The model which describes Euro-zone interest rates' reaction to the FED's announcements appears statistically significant, with an intercept and an "expected response" close to zero, an unexpected response close to one and an R-squared also very good.

The same thing cannot be said of the British market. The British rates do react to FED announcements but to a much lesser extent.

⁶Clearly this coincidence in the dates affects the estimates made. It must nevertheless be underlined that in the 11 meetings in which the ECB and the BoE took the same decision, this always coincided with leaving interest rates unchanged. On the contrary, in the other 6 meetings, rates were changed, but always by a different amount.

Concerning possible spillover effects from FED to other markets, Euro-zone interest rates do indeed react to the FED announcements, but not apparently British ones. The result suggests that the Europe-zone money market takes into account decisions made by the FED, and is ready to adjust its yield curve fully only after the FED's monetary policy decisions⁷. A greater level of independency seems to characterize the British money market.

Table 4 shows the impact of the BoE.

The 1-day response of interest rates to changes in the repo rate						
	Response					
	Intercept	Expected	Unexpected	Adj R ²	DW	F-Stat
Euribor 1 month	0.005	0.059	0.943	0.465	2.161	26.669
<i>t stat</i>	0.877	1.545	7.266			
Euribor 12 month	0.006	0.007	0.83	0.495	1.789	29.957
<i>t stat</i>	1.398	0.242	7.715			
LIBOR 1 month	-0.009	0.204	0.976	0.691	1.798	67.068
<i>t stat</i>	-1.477	4.531	11.08			
LIBOR 12 month	0.003	0.006	1.105	0.825	1.706	140.113
<i>t stat</i>	0.757	0.194	16.663			

Table 4: The Response of Interest Rates to BoE's decisions.

Here too the significance of the estimated model is confirmed. The Bank of England seems able to control yields curve at least up to a maturity of one year. However in contrast with the other Central Banks, the influence of the BoE's decisions is stronger on the LIBOR 1 year than on the LIBOR 1 month rate. Of course, it is possible to explain this by recalling that the BoE does not use a specific target for the shorter interest rates, preferring to focus on the longer one. Euro-zone interest rates appear sensitive to the BoE's monetary policy decisions. Both Euribor one-month and one-year

⁷Confirmation of this is given by 40 FED meetings followed by as many as 29 ECB meetings with changes in the same direction: the ECB left rates unchanged 20 times and changed them 9 times.

interest rates show a ready response to the unexpected monetary policy change. Again the coincidence of BoE and ECB's meetings may be relevant.

6 The interest-rate response on the bond market

Having examined the response of monetary markets to the monetary policy announcements of the three central banks under study here, we will now focus on an analysis of the longer term markets, those of bonds. As is known, the rates that are set in those markets constitute indicators used by many economic operators in their decision making.

The purpose of this section is to study the effects of FED monetary policy on bond markets in the euro area and in Great Britain in order to see whether those markets are in some way dependent on FED announcements.

An econometric analysis is therefore conducted to investigate the effects of FED, BoE and ECB announcements on British and Euro-zone financial markets. It would seem plausible to expect each bank to control the time structure of its own rates and therefore Euro-zone and British market rates should respond principally to the announcements of the ECB and the BoE respectively and only marginally to FED announcements.

The results of the analysis are given in tables 5, 6 and 7. Table 5 shows the response of interest rates to ECB changes in MRO's on British and Euro-zone markets, while table 6 gives the response to BoE changes in repos on these markets and finally table 7 shows the response to FED changes in the federal fund target on the same markets.

The first thing to note is that the results are significant. Here too, as with the analysis of money markets, we can conclude that the empirical model employed is adequate because the intercept and expected response coefficients are approximately equal to zero. This confirms that interest rates only respond to new elements in the monetary policy announcements.

Examination of table 5 shows that the unexpected response to 2 and 3 year rates in the euro area is statistically significant. This coefficient becomes rapidly less significant with longer term maturity dates, which leads to the conclusion that the ECB has a degree of influence on the time structure of its rates up to maturities of 3 years.

The same analysis of table 6 shows that the BoE also effectively controls the time structure of its interest rates up to maturities of 3 years and here too the unexpected response coefficient is fairly substantial, especially for 2 and 3 year rates.

If we now look at table 7, which shows the role of FED announcements on the Euro-zone and British markets, we see rather interesting results. Interest rates on the Euro-zone market react perfectly to FED announcements. The unexpected response coefficient for 2 and 3 year rates is approximately equal to 1. This coefficient decreases slightly for 5 to 7 year maturity rates, but still continues to be significant up to 10 years.

Similarly if we observe that rates on British markets respond strongly to FED intervention, with an unexpected response coefficient of 0.9 for the two year rate, of 0.77 for the 3 year rate and an in any case significant response up to 5 years.

The results that emerged from this comparative analysis are therefore extremely interesting. While it is true that the ECB and the BoE control the time structure of their own rates fairly significantly up to 3 years, it is also true that the FED not only controls the same rates up to almost 10 years, but these rates seem to respond more strongly to FED announcements than they do to those of the other Central Banks.

7 Conclusion

The study shows that BoE, and ECB are able to control their own monetary markets in a significant manner. However, when we shifted our attention to bond markets, we found that for long term bonds in particular, the British

and Euro-zone markets are very sensitive to FED decisions. Not only do the rates respond to FED announcements, but FED decisions actually have a greater impact than that produced by the central banks in question⁸.

The reasons for this FED leadership⁹ are certainly multiple and not always easy to identify. One initial reason could, however, be connected with market size. The American market is decidedly larger than the Euro-zone and British markets in terms of volumes traded. It would therefore be plausible to expect that financial operators have a greater interest in and take more account of events on that market.

A second factor that may explain FED leadership could be closely linked with the communication strategies¹⁰ adopted by central banks. When a central bank makes a monetary policy change, it officially announces its decisions to the market. The methods adopted by the central bank for making the communication are very important because they help shape the expectations of market operators.

As is known, in recent years central banks have tended to implement policies by transparently manifesting their intentions in advance to some degree. This transparency helps increase the ability of operators to understand the decisions of the monetary authority, which improves the effectiveness of the monetary decision. Jansen e de Haan (2004) claim that ECB

⁸With regard to the United States, Kuttner found that the FED has good control over its own market in both the short and long term. For the sake of thorough investigation we also analysed the reactions of United States' rates to ECB and BoE announcements. Put briefly, no significant response by the United States' market to ECB and BoE monetary policies was found. This allows us to exclude the hypothesis that rational agents give equal consideration to all central banks in a global economy.

⁹This also confirms the findings of Breuss F. (2002) who found a causal relationship between the FED's monetary decisions and those of the ECB. Accordingly, the ECB follows those of the FED with a lag of 4-6 months.

¹⁰The fact that the FED today is discussing the adoption of targets (Wang, J., 2005), when Greenspan retires, seems to underline the importance of the reputation and communicative skills of the current FED chairman.

statements were rather contradictory in this respect in its first few years¹¹. While its statements on interest rates have become more consistent in recent years, its statements on growth and inflation are still ambiguous.

A third element, strictly connected with the previous one, is the reputation of the bank itself. This reputation is a direct function of the central bank's ability to pursue the monetary policy objectives that it sets itself. Financial operators could therefore place their trust in the good reputation of the FED, while they are still unable to judge the ability of the ECB. The ECB is in fact too young for operators to be able to express an opinion on its ability to achieve the monetary policy objectives it sets itself, especially in the long term.

While the ECB's reputation is young, the same cannot be said of the BoE, which is the oldest central bank in the world. Looking at the results, the BoE does not seem to be subject to FED leadership: the BoE, at least as far as the British monetary market is concerned, demonstrates that it knows how to adjust its rates, which are not very sensitive to FED announcements.

Finally, the Euro-zone and British financial markets are in a situation which will not become final for a few years to come. While on the one hand financial integration in the EMU area is not yet complete, on the other hand Great Britain has not yet decided to enter the EMU. It is possible, in such a context, that operators are more interested in basing their decisions on the FED which operates on a decidedly more stable market.

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¹¹See also Padoa-Schioppa 2004 on ECB communication problems.

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The 1-day response of interest rates to changes in the MRO						
Maturity EMU	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	0.007	-0.016	0.653	0.249	2.189	16.591
<i>t stat</i>	1.105	-0.329	5.733			
3 year	0.009	-0.036	0.543	0.168	2.134	10.494
<i>t stat</i>	1.31	-0.693	4.581			
5 year	0.002	-0.07	0.434	0.122	1.974	7.566
<i>t stat</i>	0.435	-1.399	3.800			
7 year	-0.009	-0.035	0.212	0.025	2.155	2.230
<i>t stat</i>	-1.628	-0.776	2.059			
10 year	-0.001	-0.075	0.205	0.051	1.879	3.562
<i>t stat</i>	-0.267	-1.828	2.201			
15 year	0.002	-0.098	0.207	0.066	2.226	4.338
<i>t stat</i>	0.364	-2.323	2.144			
20 year	-0.013	-0.021	0.018	-0.018	2.28	0.140
<i>t stat</i>	-2.404	-0.517	0.194			
30 year	-0.012	-0.071	0.054	0.013	1.758	1.640
<i>t stat</i>	-2.251	-1.781	0.590			
Maturity UK	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	0	0.004	0.895	0.509	1.927	49.796
<i>t stat</i>	0.016	0.170	9.751			
3 year	0.0076	0.009	0.754	0.319	2.040	23.090
<i>t stat</i>	1.450	0.285	6.674			
5 year	0.006	0.012	0.654	0.289	2.076	20.135
<i>t stat</i>	1.385	0.382	6.253			
7 year	0.008	0.019	0.56	0.203	2.122	13.010
<i>t stat</i>	1.571	0.591	5.067			
10 year	0.008	0.011	0.431	0.106	2.049	6.584
<i>t stat</i>	1.455	0.326	3.592			
15 year	0.005	0.001	0.346	0.079	1.997	5.083
<i>t stat</i>	1.034	0.034	3.111			
20 year	0.004	0.004	0.288	0.053	1.877	3.679
<i>t stat</i>	0.830	0.130	2.667			
30 year	0.002	0.003	0.234	0.028	1.852	2.389
<i>t stat</i>	0.558	0.096	2.147			

Table 5: The Response of Interest Rates to ECB's Decisions.

The 1-day response of interest rates to changes in the repo rate						
Maturity EMU	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	0.008	-0.012	0.668	0.179	1.972	7.463
<i>t stat</i>	1.073	-0.248	3.800			
3 year	0.008	-0.040	0.514	0.137	1.98	5.690
<i>t stat</i>	1.086	-0.855	3.155			
5 year	0.003	-0.061	0.442	0.108	2.103	4.596
<i>t stat</i>	0.399	-1.245	2.615			
7 year	0.003	-0.065	0.393	0.051	1.967	2.578
<i>t stat</i>	0.714	-1.065	1.879			
10 year	-0.001	-0.054	0.209	0.026	2.018	1.789
<i>t stat</i>	-0.177	-1.191	1.333			
15 year	0.002	0.014	0.451	0.091	1.985	3.960
<i>t stat</i>	0.365	0.307	2.814			
20 year	-0.0009	-0.081	-0.043	0.017	1.967	1.539
<i>t stat</i>	-0.135	-1.752	-0.271			
30 year	-0.007	-0.113	0.102	0.078	1.957	3.500
<i>t stat</i>	-1.11	-2.480	0.651			
Maturity UK	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	-0.0002	-0.04	0.705	0.579	1.899	41.706
<i>t stat</i>	-0.048	-0.994	8.920			
3 year	0.006	-0.066	0.574	0.383	1.936	19.341
<i>t stat</i>	0.865	-1.332	5.898			
5 year	0.004	-0.101	0.436	0.343	1.690	16.418
<i>t stat</i>	0.745	-2.264	4.992			
7 year	0.004	-0.117	0.304	0.229	1.676	9.800
<i>t stat</i>	0.732	-2.522	3.351			
10 year	0.006	-0.126	0.2	0.136	1.690	5.645
<i>t stat</i>	0.887	-2.470	2.000			
15 year	0.006	-0.105	0.163	0.097	1.617	4.160
<i>t stat</i>	0.897	-2.140	1.690			
20 year	0.005	-0.103	0.145	0.087	1.658	3.830
<i>t stat</i>	0.843	-2.129	1.534			
30 year	0.005	-0.104	0.13	0.082	1.657	3.660
<i>t stat</i>	0.773	-2.166	1.380			

Table 6: The Response of Interest Rates to BoE's Decisions.

The 1-day response of interest rates to changes in the Fed funds target						
Maturity EMU	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	-0.003	0.01	1.034	0.284	2.390	8.752
<i>t stat</i>	-0.463	0.277	3.15			
3 year	-0.004	-0.006	1.021	0.243	2.035	7.273
<i>t stat</i>	-0.667	-0.182	3.139			
5 year	-0.0002	-0.007	0.856	0.124	2.140	3.775
<i>t stat</i>	-0.03	-0.188	2.293			
7 year	0.007	0.02	0.977	0.222	1.969	6.591
<i>t stat</i>	0.966	0.469	2.577			
10 year	-0.001	0.013	0.521	0.074	1.880	2.566
<i>t stat</i>	-0.24	0.353	1.564			
15 year	0.009	-0.024	0.267	-0.032	1.210	0.378
<i>t stat</i>	1.367	-0.68	0.84			
20 year	0.006	0.038	0.121	-0.013	2.180	0.743
<i>t stat</i>	0.724	0.773	0.28			
30 year	-0.0002	0.012	0.299	0.032	2.110	1.660
<i>t stat</i>	-0.04	0.426	1.15			
Maturity UK	Response			Adj R ²	DW	F-Stat
	Intercept	Expected	Unexpected			
2 year	0.012	0.044	0.902	0.318	2.150	10.132
<i>t stat</i>	1.537	1.327	4.490			
3 year	0.014	0.055	0.766	0.195	2.180	5.739
<i>t stat</i>	1.498	1.453	3.314			
5 year	0.011	0.058	0.600	0.110	1.940	3.437
<i>t stat</i>	1.143	1.442	2.465			
7 year	0.013	0.072	0.296	0.039	2.140	1.790
<i>t stat</i>	1.306	1.717	1.172			
10 year	0.014	0.082	0.143	0.0398	2.150	1.809
<i>t stat</i>	1.299	1.899	0.547			
15 year	0.012	0.074	0.096	0.025	2.230	1.509
<i>t stat</i>	1.165	1.737	0.377			
20 year	0.011	0.069	0.048	0.017	2.300	1.342
<i>t stat</i>	1.083	1.626	0.188			
30 year	0.01	0.062	0.072	0.004	2.399	1.088
<i>t stat</i>	0.955	1.474	0.286			

Table 7: The Response of Interest Rates to FED's Decisions.