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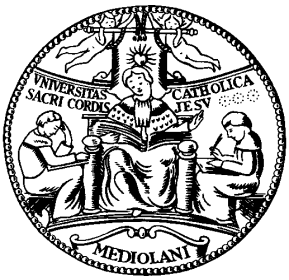

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Abstract

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 both on their own market, and on the others.

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1 Introduction

In today's global world how many central banks are there? The question is not rhetorical because one of the prime areas in which markets tend toward global unification is that of liquid financial flows, and one would expect to find a corresponding tendency towards unification of monetary authorities. Indeed, anyone who works in financial markets is aware that some Central Banks are more important than others and therefore their behaviour can be more significant.

The hypothesis that we want to verify is simple: in the last five years, the activity of a new Central Bank - the ECB for the twelve countries - has not been enough to establish a corresponding monetary sovereignty. By sovereignty we mean the ability of a Central Bank to determine its own interest rate, and at the same time to influence its yield curve for all maturities.

In the European Monetary Union, the entire preparatory period has been employed to recover equilibrium in macroeconomic conditions, i.e. compliance with the five parameters established in the Maastricht Treaty, which were necessary to give stability to the value of the new currency. In short, reduction of the budget deficit and of public debt, lowering of both the inflation rate and interest rates, and exchange rate stability were necessary conditions for initiating the new Central Bank and its monetary policy. In our opinion not enough attention has been paid to the necessary financial market integration. On the contrary each country has maintained its respective money and capital markets; so the integration of each country and the adoption of the same rules and procedures for all the financial markets has not been realized. Paradoxical result - reinforced by the fact that the financial liberalization process has not been limited to countries of the Monetary Union - was a monetary integration that cannot be identified by the globalization process of financial markets.

On the other hand, how market interest rates respond to Central Bank actions is a topic of great interest to financial market participants and poli-

cymakers alike. Operators want to know how monetary policy can condition their choice, and the Central Bank is interested in knowing how its decision on interest rates is transmitted to the market and how much autonomy to determine rates it actually enjoys.

In the recent years, many studies[1] have concentrated on monetary policy transmission mechanisms, and they have outlined two main aspects. The first is that the Monetary Authority by its decisions controls substantially the first part of the yield curve, while its control over the longer maturities is fair less.

The second aspect is that the modern Central Bank tipically conducts a transparent monetary policy, endeavouring to signal its intention to the market in advance, so that operators can adequately adjust their decisions. This approach is closely associated with the rational expectation hypothesis. Another related, two-way connection between monetary policy announcements and money market behaviour is the appearance of derivative instruments reflecting the expectations of operators.

The aim of this study is to examine how announcements of a Central Bank are reflected on its domestic market and in what measure they are able to influence other financial markets. In particular, we analyse the effects of the FED's, ECB's, and BoE's monetary policy announcements on their own market, and in the others. In this analysis we consider the yield curve up to 12 months (money market) and beyond (financial market). This analysis seeks to verify the particular market characteristics on which these three Central Banks work, and show their connections: is there an ordering and a particular dependent relationship? Alternatively, are we in a global market where the operators are continuously looking at every Central Bank? In the past few years, every Central Bank made investments on reputation and credibility - and effectively, the yield curve is, more than the past few years, under the Central Bank's control. The question is, are these gains on sovereignty extended to the European Central Bank, or the

[1] See Lange, J., Sack, B., Whitesell, W., 2003.

incomplete integration on which the ECB works has for instance reduced that effectiveness?

2 Transmission channel

One important issue that has been given little attention in the literature so far is the relevance of news spillovers across markets. In principle, there are three channels through which foreign announcements may affect domestic markets. First, foreign news may be relevant for domestic monetary policy authorities, as when it affects "external" variables such as the exchange rate. A tightening of monetary policy abroad, for instance, may force domestic authorities to adjust their own monetary policy stance in order to maintain their exchange rate target. In short, foreign announcements may be important for domestic monetary policy via this direct channel of targeting of external variables.

The second way is related to the integration of global financial markets and arbitrage margins. Changes in monetary policy in one country will affect other monetary and financial markets via capital flows and the elimination of arbitrage possibilities.

The third way is related to real variables. In fact, foreign announcements may reveal important information about domestic macroeconomic conditions. For example, an economic announcement may give information about conditions on another monetary area, and so help to predict future moves of monetary policy of that Central Bank. The literature contains studies on money market interdependence. For example, Gravelle and Moessner (2001) find that Canadian interest rates are strongly influenced by US macroeconomic news and much less by Canadian ones. They interpret these findings as reflecting the close integration between Canada and the US, but also as revealing some market uncertainty about the reaction function of Canadian monetary policy. Kim and Sheen (2000) show similar results for Australian interest rates, which are found to be strongly affected

by US news, in particular at the short end of the yield curve. Ehrmann and Fratzscher (2002) analyse the interdependence between the Euro area and the US. They find evidence of close interdependence between the Euro and the US area. That interdependence, as we shall argue, is better labelled dependence because there is evidence for spillover asymmetric effects caused by the FED's monetary policy announcements.

3 A review of earlier studies

An early paper assessing market reactions to monetary policy actions is that of Cook and Hahn[2] (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.

[2]See Cook, T., Hahn, T., 1989.

In contrast with this research, Roley and Sellon[3] (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 [4](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[5] used the Federal Funds rate futures to separate expected from unexpected changes in the Federal Funds target rate. Examining 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) [6], 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.

Ehrmann and Fratzscher[7] analyse interdependence between the Euro area and the US area in the period 1993-2002[8]. In particular, they examine

[3]Roley, V.V., Sellon, G.H., 1995.

[4]Edelberg, W., Marshall, D., 1996.

[5]Kuttner, K.N., 2001.

[6]Perez-Quiros, G., Sicilia, J., 2002.

[7]Ehrmann, M., Fratzscher, M., 2002.

[8]They use data from Bundesbank for the period 1993-1998.

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.

Ross (2002)[9], 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 anticipating 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.

3.1 Expectations using futures

Measures of monetary policy expectations are an important element of many empirical papers in the macroeconomics and finance literature. Lately, a strand of literature has focused on measuring policy expectations from asset prices. In this context, market interest rates have been used to parse out the unexpected component of policy decisions, communally referred to as monetary policy shocks. An important issue is the choice of the correct asset to be used in measuring expectations. In the literature a lot of studies which try to measure Federal Funds rate expectations. Kuttner (2001) and Faust, Swanson and Wright (2001) use the current month Federal Funds futures contract; Bomfin (2002) and Poole and Rasche (2000) use the month-ahead Federal Funds futures contract; Cochrane and Piazzessi (2002) use the one-month Eurodollar deposit rate, Ellingsen and Soderstrom (1999) the three-month eurodollar futures rate. In 2002 Gurkaynak, Sack, and

[9] Ross, K., 2002.

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 higher. 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. Analitically we have:

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

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 nember of days in a month[10].

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

$$\Delta r_t^e = \Delta r_t - \Delta r_t^u. \tag{2}$$

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[11]. In this way we gain a measure less sensitive to monetary policy decisions, but more importantly because this contract is the most traded. This approach is quite similar to Bomfin (2001). 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 decision remains the same (1).

[10] $\frac{m}{m-t}$ it is the scaling factor.

[11] In particular, see Gürkaynak, R. S., Sack, B., Swanson, E., 2002.

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 regression where the dependent variable is a one-day response of interest rates, and the independent variable is the change in the 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:

$$\Delta R_t = \alpha + \beta_1 \Delta r_t^e + \beta_2 \Delta r_t^u + \varepsilon_t \tag{3}$$

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; USD LIBOR 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 repo for European and UK market, Federal Funds target for US market. To measure market expectations, we use data from the futures markets, in particular, the one month and one year, Euribor, the one-month and one year Federal Funds futures, and the three-month futures on GBP (Great Britain Pound). 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 60[12].

Decision	**FED**		**ECB**		**BoE**	
	N. Meeting	**%**	**N. Meeting**	**%**	**N. Meeting**	**%**
Mantained	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

[12]For FED we use unscheduled meeting as well.

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 meeting, and reduced them by a quarter-point and 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 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 theoretical model. The intercept and expected response are approximately equal to zero, and are statistically insignificant. By contrast analysing unexpected response, we can observe how the European 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						
	Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
Euribor 1 month	0.005	0.069	0.952	0.692	1.763	105.622
t stat	*1.311*	*2.281*	*13.826*			
Euribor 12 month	0.009	0.014	0.777	0.573	2.169	63.536
t stat	*2.32*	*0.479*	*11.051*			
US LIBOR 1 month	-0.002	0.084	0.299	0.215	2.34	13.736
t stat	*-0.643*	*3.734*	*4.552*			
US LIBOR 12 month	0.004	0.022	0.306	0.09	2.42	5.65
t stat	*0.924*	*0.714*	*3.356*			
LIBOR 1 month	-0.006	0.031	0.738	0.392	1.88	31.03
t stat	*-1.55*	*1.1*	*7.84*			
LIBOR 12 month	-0.001	0.017	1.023	0.66	1.86	91.71
t stat	*-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
t stat	*-2.132*	*0.875*	*6.342*			
Euribor 12 month	-0.003	0.013	0.855	0.41	2.138	14.603
t stat	*-0.707*	*0.562*	*3.933*			
US LIBOR 1 month	-0.002	0.005	1.01	0.785	1.739	72.44
t stat	*-0.706*	*0.273*	*11.849*			
US LIBOR 12 month	-0.006	0.0625	0.752	0.371	2.38	12.505
t stat	*-0.739*	*1.676*	*4.399*			
LIBOR 1 month	-0.003	0.027	0.283	0.104	2.27	3.277
t stat	*-0.799*	*1.383*	*2.417*			
LIBOR 12 month	0.004	0.04	0.373	0.125	2.33	3.800
t stat	*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 American money market there seems to be irrelevant impact on US interest rates, because the model shows a low R square, and a β_2 close to zero. Finally, we look at the British money market. This market gives interesting results.

The adjusted R-square is high, and β_2 close to one; furthermore, differently from what happens in the European 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 decisions

Now consider the Federal Reserve. From Table 3 we see the response to the FED's announcement in the European, British, and American money markets.

The model which describes American 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. FED control is naturally stronger in relation to short-term interest rates. Concerning possible spillover effects from FED to other markets, European interest rates do indeed react to the FED announcements, but not apparently British ones. The result suggests that the European 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 decisions. 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						
	Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
Euribor 1 month	0.005	0.059	0.943	0.465	2.161	26.669
t stat	*0.877*	*1.545*	*7.266*			
Euribor 12 month	0.006	0.007	0.83	0.495	1.789	29.957
t stat	*1.398*	*0.242*	*7.715*			
US LIBOR 1 month	-0.002	0.067	1.237	0.342	2.254	16.400
t stat	*-0.718*	*2.639*	*5.64*			
US LIBOR 12 month	0.005	0.016	1.799	0.414	1.649	21.856
t stat	*1.196*	*0.507*	*6.44*			
LIBOR 1 month	-0.009	0.204	0.976	0.691	1.798	67.068
t stat	*-1.477*	*4.531*	*11.08*			
LIBOR 12 month	0.003	0.006	1.105	0.825	1.706	140.113
t stat	*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. European interest rates appear sensitive to the BoE's monetary policy decisions. Both Euribor one-month and one-year interest rates show a ready response to the unexpected monetary policy change. Again the coincidence of BoE and ECB's meetings may be relevant. Differently from what we outlined about the ECB, the American money market also seems to respond to decisions taken by the BoE. US one-month and one-year rates show a desproportionate reaction to the BoE's decisions. This behaviour could be explained by the fact that the American money market considers the BoE's decisions a proxy for future FED's decisions. It is natural in fact that , given its historical reputation, the BoE be thought of as a kind of early warning signaller for global monetary policy decisions.

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 was therefore conducted to investigate the effects of FED, BoE and ECB announcements on British and European financial markets. It would seem plausible to expect each bank to control the time structure of its own rates and therefore European 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 European 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 theoretical model employed is adequate because the intercept and expected response coefficients are approximately equal to zero and statistically not significant. 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 European and British markets, we see rather interesting results. Interest rates on the European 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 showed that each of the three central banks investigated is able to control its own monetary market in a significant manner. However, when we shifted our attention to bond markets, we saw that for long term bonds in particular, the British and European 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 question.

The reasons for this FED leadership 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 European and British markets in terms of volumes traded. It would therefore be plausible to expect that financial operators have a greater interest and take more account of events on that market.

A second element which could explain this leadership by the FED is strictly connected with 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 monetary policy objectives it sets itself, especially in the long term.

Finally, the European 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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The 1-day response of interest rates to changes in the MRO							
Maturity EU		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		0.007	-0.016	0.653	0.249	2.189	16.591
	t stat	*1.105*	*-0.329*	*5.733*			
3 year		0.009	-0.036	0.543	0.168	2.134	10.494
	t stat	*1.31*	*-0.693*	*4.581*			
5 year		0.002	-0.07	0.434	0.122	1.974	7.566
	t stat	*0.435*	*-1.399*	*3.800*			
7 year		-0.009	-0.035	0.212	0.025	2.155	2.230
	t stat	*-1.628*	*-0.776*	*2.059*			
10 year		-0.001	-0.075	0.205	0.051	1.879	3.562
	t stat	*-0.267*	*-1.828*	*2.201*			
15 year		0.002	-0.098	0.207	0.066	2.226	4.338
	t stat	*0.364*	*-2.323*	*2.144*			
20 year		-0.013	-0.021	0.018	-0.018	2.28	0.140
	t stat	*-2.404*	*-0.517*	*0.194*			
30 year		-0.012	-0.071	0.054	0.013	1.758	1.640
	t stat	*-2.251*	*-1.781*	*0.590*			
Maturity UK		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		0	0.004	0.895	0.509	1.927	49.796
	t stat	*0.016*	*0.170*	*9.751*			
3 year		0.0076	0.009	0.754	0.319	2.040	23.090
	t stat	*1.450*	*0.285*	*6.674*			
5 year		0.006	0.012	0.654	0.289	2.076	20.135
	t stat	*1.385*	*0.382*	*6.253*			
7 year		0.008	0.019	0.56	0.203	2.122	13.010
	t stat	*1.571*	*0.591*	*5.067*			
10 year		0.008	0.011	0.431	0.106	2.049	6.584
	t stat	*1.455*	*0.326*	*3.592*			
15 year		0.005	0.001	0.346	0.079	1.997	5.083
	t stat	*1.034*	*0.034*	*3.111*			
20 year		0.004	0.004	0.288	0.053	1.877	3.679
	t stat	*0.830*	*0.130*	*2.667*			
30 year		0.002	0.003	0.234	0.028	1.852	2.389
	t stat	*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 EU		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		0.008	-0.012	0.668	0.179	1.972	7.463
	t stat	*1.073*	*-0.248*	*3.800*			
3 year		0.008	-0.040	0.514	0.137	1.98	5.690
	t stat	*1.086*	*-0.855*	*3.155*			
5 year		0.003	-0.061	0.442	0.108	2.103	4.596
	t stat	*0.399*	*-1.245*	*2.615*			
7 year		0.003	-0.065	0.393	0.051	1.967	2.578
	t stat	*0.714*	*-1.065*	*1.879*			
10 year		-0.001	-0.054	0.209	0.026	2.018	1.789
	t stat	*-0.177*	*-1.191*	*1.333*			
15 year		0.002	0.014	0.451	0.091	1.985	3.960
	t stat	*0.365*	*0.307*	*2.814*			
20 year		-0.0009	-0.081	-0.043	0.017	1.967	1.539
	t stat	*-0.135*	*-1.752*	*-0.271*			
30 year		-0.007	-0.113	0.102	0.078	1.957	3.500
	t stat	*-1.11*	*-2.480*	*0.651*			
Maturity UK		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		-0.0002	-0.04	0.705	0.579	1.899	41.706
	t stat	*-0.048*	*-0.994*	*8.920*			
3 year		0.006	-0.066	0.574	0.383	1.936	19.341
	t stat	*0.865*	*-1.332*	*5.898*			
5 year		0.004	-0.101	0.436	0.343	1.690	16.418
	t stat	*0.745*	*-2.264*	*4.992*			
7 year		0.004	-0.117	0.304	0.229	1.676	9.800
	t stat	*0.732*	*-2.522*	*3.351*			
10 year		0.006	-0.126	0.2	0.136	1.690	5.645
	t stat	*0.887*	*-2.470*	*2.000*			
15 year		0.006	-0.105	0.163	0.097	1.617	4.160
	t stat	*0.897*	*-2.140*	*1.690*			
20 year		0.005	-0.103	0.145	0.087	1.658	3.830
	t stat	*0.843*	*-2.129*	*1.534*			
30 year		0.005	-0.104	0.13	0.082	1.657	3.660
	t stat	*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 EU		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		-0.003	0.01	1.034	0.284	2.390	8.752
	t stat	*-0.463*	*0.277*	*3.15*			
3 year		-0.004	-0.006	1.021	0.243	2.035	7.273
	t stat	*-0.667*	*-0.182*	*3.139*			
5 year		-0.0002	-0.007	0.856	0.124	2.140	3.775
	t stat	*-0.03*	*-0.188*	*2.293*			
7 year		0.007	0.02	0.977	0.222	1.969	6.591
	t stat	*0.966*	*0.469*	*2.577*			
10 year		-0.001	0.013	0.521	0.074	1.880	2.566
	t stat	*-0.24*	*0.353*	*1.564*			
15 year		0.009	-0.024	0.267	-0.032	1.210	0.378
	t stat	*1.367*	*-0.68*	*0.84*			
20 year		0.006	0.038	0.121	-0.013	2.180	0.743
	t stat	*0.724*	*0.773*	*0.28*			
30 year		-0.0002	0.012	0.299	0.032	2.110	1.660
	t stat	*-0.04*	*0.426*	*1.15*			
Maturity UK		Intercept	Response Expected	Response Unexpected	Adj R^2	DW	F-Stat
2 year		0.012	0.044	0.902	0.318	2.150	10.132
	t stat	*1.537*	*1.327*	*4.490*			
3 year		0.014	0.055	0.766	0.195	2.180	5.739
	t stat	*1.498*	*1.453*	*3.314*			
5 year		0.011	0.058	0.600	0.110	1.940	3.437
	t stat	*1.143*	*1.442*	*2.465*			
7 year		0.013	0.072	0.296	0.039	2.140	1.790
	t stat	*1.306*	*1.717*	*1.172*			
10 year		0.014	0.082	0.143	0.0398	2.150	1.809
	t stat	*1.299*	*1.899*	*0.547*			
15 year		0.012	0.074	0.096	0.025	2.230	1.509
	t stat	*1.165*	*1.737*	*0.377*			
20 year		0.011	0.069	0.048	0.017	2.300	1.342
	t stat	*1.083*	*1.626*	*0.188*			
30 year		0.01	0.062	0.072	0.004	2.399	1.088
	t stat	*0.955*	*1.474*	*0.286*			

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

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