The Impact of Discount Rate Changes on Market Interest Rates:  
Evidence from Three European Countries and Japan

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Abstract

This paper examines the impact of official discount rate (ODR) changes on market interest rates of four countries (Germany, France, Japan and the U.K) during the period from 1980 through 1997. The overall results indicate that short-term rates are more responsive than long-term rates for all countries. The magnitude of the changes is country specific. Market rate responses are lower for Germany and Japan, which have fewer changes in ODR. These results are consistent with expectations that there is less uncertainty under such regimes. Consistent with the pace of regulatory reforms, the results of ODR changes are strongest in UK and weakest in Japan. When monetary policy is changed or reversed, interest rate responses are shown to be larger for countries with frequent changes in discount rates.

Keywords: Monetary Policy, Discount Rates, Interest Rates

JEL classification: E42; G14
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1. Introduction

Financial communities in most countries pay considerable attention to changes in discount rates administered by central banks. In the U.S., the event is newsworthy enough for the financial press to provide regular coverage of the Federal Reserve Board's (Fed's) Open Market Committee meetings, which among other monetary policy issues, decides on discount rate changes. Such attention implies that changes in official discount rates (ODRs) carry information of relevance to market participants, particularly on the future course of interest rates. Under the expectations theory of the term structure of interest rates, any revised forecast of interest rates affects both short-term and long-term market interest rates as they adjust towards a new equilibrium term structure.

Several studies have documented the effects of ODR changes on market interest rates in the U.S. (Cook and Hahn, 1988, Roley and Sellon, 1998a, Roley and Troll, 1984, Smirlock and Yawitz, 1985, Thornton 1982, 1994, 1998). Most studies distinguish between two types of changes: technical and non-technical. Technical changes are defined as corrections by the central bank to align discount rates with current market rates. Non-technical changes are defined as adjustments by the central bank to discount rates in response to new information on the future course of economic activity. Prior

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1 Studies have also looked at the effects of monetary policy changes on other markets such as exchange rates (Bosner-Neal, et. al, 1998; Batten and Thornton, 1984) and GDP (Christiano et. al., 1996).
studies show that the technical changes generally do not have a significant impact on market interest rates in contrast to non-technical changes.\textsuperscript{2}

Interest rate responses to new ODR information, broadly defined as announcement effects, depend on the market's perception of the effectiveness of the change. This in turn is affected by several factors, including whether the change is expected to be permanent and whether appropriate fiscal and macroeconomic policies are in place to support the change. It is also affected by the sophistication and ability of market participants to assess the information embedded in the announcements. Since it is difficult to model the various factors affecting expectations, most studies attempt to identify one or two relevant factors. For example, Roley and Sellon (1998a) model market responses as a function of two factors, expectations of market participants on whether regulators respond in a systematic manner to persistent economic shocks or alternatively, in a discretionary manner. They document that market responses change as Fed acts in a less discretionary manner. Other studies find the choice of monetary targets as an important factor (Roley and Troll, 1984; Smirlock and Yawitz, 1985.\textsuperscript{3,4}

This paper analyzes the announcement effects of ODR changes on market interest rates of four countries: Germany, France, the United Kingdom (U.K.) and Japan.

\textsuperscript{2} Prior studies that have addressed the technical/non-technical dichotomy include (e.g., Roley and Troll (1984), Smirlock and Yawitz (1985), Thornton (1986, 1998), Cook and Hahn (1988), Hakkio and Pearce (1992), and Dueker (1994)).

\textsuperscript{3} Although Cook and Hahn (1988) find market rates responsive during the pre-1979 period, Wagster (1993) has shown that this discrepancy can be explained by the inclusion of data from the 1973-74 period in Cook and Hahn’s study.

\textsuperscript{4} Another factor to influence market responses is the direct effect of discount rate changes. Direct effects occur when an ODR change causes an imbalance between supply and demand for borrowed reserves. These effects are therefore invariant to whether or not discount rates changes have informational content. Most studies have shown that direct effects are insignificant ((Thornton (1998), Neumann and Weidmann (1996))).
Institutional differences among the countries and a changing financial environment allow us to draw inferences about three factors that affect market expectations and the informational content of ODR announcements. We present these three factors in three separate sections.

The first section compares market responses between countries that make frequent and infrequent changes to their ODRs. Financial markets are likely to perceive infrequent ODR changes as permanent. In our sample, Germany and Japan have few ODR changes. A comparison of their responses to ODR changes with France and the U.K., which have more frequent ODR changes, allows us to infer whether the perceived permanent changes result in different market responses.

The second sections examines market responses before, and after financial markets are deregulated in Europe and Japan. Information-gathering activities should increase in efficiency and sophistication in a deregulated environment. Since market responses are affected by the availability of information, we expect the informational content in ODR announcements to decrease in the post-deregulated period.

The third section compares the market responses to reversals in ODR changes. A priori, we expect the changes during reversal to be larger than others because it signals a clear change in policy. However, the responses are likely to be larger in countries with frequent changes in discount rates because they generate greater uncertainty on the future course of interest rates.

The topic of this paper is of particular relevance in the current environment since the European Central Bank (ECB) sets interest rates for the 12 participating countries in
the euro zone. In May 2004, 10 more countries joined the European Union.\textsuperscript{5} While these new members will immediately enjoy the trade and other benefits of EU membership, they must meet certain criteria before they can qualify for full participation in the euro. One of the criteria for entering into EMU is the convergence of long-term interest-rates.\textsuperscript{6} There has been considerable debate among policymakers for an appropriate governance process to achieve sustainable convergence for economic and monetary union in the euro zone countries. The permanent executive group of the ECB favors extreme independence and has set inflation targeting as a major goal. Most finance ministers of the participating countries prefer broader objectives including employment and exchange rate stability. The effects of ODR announcements in countries with different regulatory structures and their impact on market interest rates will be a valuable input in their decisions.

Research on this topic for countries outside the U.S. is limited to a few individual countries. Neumann and Weidmann (NW, 1996) and Hardy (1996) examine the effects of Lombard and discount rate changes on German overnight rates.\textsuperscript{7} NW (1996) find that unanticipated announcement effects are significant for the 1979-95 period. Hardy (1996) shows that changes to market interest rates are significant, for both anticipated and

\textsuperscript{5} Germany, France, the Netherlands, Italy, Spain, Portugal, Belgium, Ireland, Luxembourg, Austria, Greece, and Finland are the 12 participating countries in the euro zone. The countries that joined the EU in May 1, 2004 are the former Eastern bloc countries: Hungary, Poland, the Czech Republic, Slovakia, Slovenia, Estonia, Latvia, Lithuania, and Cyprus. Denmark, Sweden, and Great Britain are expected to join at a later stage.

\textsuperscript{6} Under the Maastricht Treaty, ECB requires that the EMU applicants’ long-term interest rates must not be more than 2 percentage points higher than the average of the three lowest interest rates in the EU.

\textsuperscript{7} The discount rate is the rate charged by the Bundesbank for loans to commercial banks and the Lombard rate is the rate charged between banks, equivalent to U.S. federal fund rates.
unanticipated announcements, for overnight, 3- and 6-month rates but insignificant for the 12-month rates. Dale (1993) finds similar results for the U.K. markets. We also find that announcement effects are significant for short-term rates but insignificant for longer-term rates. By comparing the responses, we also are able to infer the relevance of several factors that affect the informational content of ODR announcements that cannot be captured in individual country studies. The choice of countries is limited to four to keep the scope of the paper manageable.

Section 2 discusses the estimation procedure of announcement effects and the various responses expected from a comparative analysis. The data is described in Section 3 followed by the methodology and results in Section 4. Section 5 concludes.
2. Effects of ODR Announcements on Market Rates

2.1 Announcement, Anticipatory and Learning Effects

We use a standard event study methodology to capture the announcement effects of ODR changes, with two differences.\(^8\) One, we do not distinguish a priori between technical and non-technical changes. There are several reasons for this omission. First, it is not clear from the literature that technical changes contain no information. Second, it is difficult to predict technical changes as shown by several papers using different statistical methods (NW, 1996, and Thornton, 1998). This is because central banks always have a choice of whether or not to make technical changes. They also have some leeway on the timing of the announcement and the magnitude of the change.\(^9\) Should they align the ODRs to the current level of interest rates or to the rates expected to prevail in the future?

These options make it difficult for markets to predict when and whether a technical change will be announced. Instead, we will infer from the results ex-post whether the changes were technical. Third, Roley and Sellon (1998b) find that markets respond to non-announcements of the Fed, i.e. even on days when the Fed meets and no discount rate changes are announced. Unlike the Fed, none of the four central banks in

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\(^8\)Other studies have attempted to capture the impact of interest rate shocks on market interest rates by comparing forward and realized rates, under the assumption of rational expectations (Mankiew and Miron, 1986; Fama and Bliss, 1987; and Campbell and Shiller, 1991). One limitation of using this time-series approach is that the speed of the transmission of monetary policy changes cannot be captured (Dale, 1993). Another is the inability to incorporate the arrival of new information during the interim period, making the assumption of an orthogonal error term unrealistic. Event studies provide a cleaner picture of the speed of transmission of interest rate shocks to the term structure because of its immediate impact.

\(^9\)Thornton (1994) recognizes the timing issue as a reason for the unanticipated component in technical changes. He cites as evidence the erratic actions of the Fed who have changed rates when the spread between the discount and fed fund rates have been low, and left them unchanged when the spread has been over 300 basis points.
our sample provides explanations for ODR changes, making it difficult to obtain a clean sample.

The second difference from the standard methodology is that we use several time intervals to capture the announcement effects. The immediate impact of the announcement, defined as announcement day effects, is captured on days -1, +1 and from -1 to +1. We include day +1 to rule out the possibility of any news reaching market participants late. The anticipatory effects of the announcement are captured by estimating market responses up to one week, -7 to 0 (approximately 5 business days) prior to the announcement. Anticipating the possible actions of the monetary authorities (Fed watching) is now an integral job function for most investment analysts and portfolio managers. Considerable speculation and adjustments to debt and stock portfolios take place prior to the scheduled meetings of regulators.

We also estimate announcement effects one week after the ODR change to capture any delayed responses. If no official explanations are provided, market participants have to determine whether the changes are technical or non-technical and whether they are permanent or temporary. Responses may lag if markets require time to determine the relevant information in each announcement, defined as learning effects. Thus, the announcement effects of ODR changes is separated into three components, announcement day effects (-1 to +1), anticipatory effects (-7 to 0) and learning effects (0 to +7).

In general, it is assumed that short-term rates will change in size with ODR change. If expectations hypothesis determines the term structure of interest rates, announcement effects of short- and long-term rates should also be similar. However, as
pointed out by Thornton (1998), the size of long-term rate changes is more likely to be influenced by market’s interpretation of ODR changes. If ODR changes are viewed as short-term macroeconomic adjustments, long-term rates may respond only marginally. If the market also revises expectation on inflation, long-term rates may vary differently.

We next specify the responses expected from ODR changes from this group of countries. In particular, we examine a) whether responses differ from countries that change frequently to those that do not; b) whether responses are different post 1990 when financial markets were liberalized; and c) whether responses differ during reversals or a change in monetary policy.

2.2 Effects of Frequent ODR Changes

We first examine whether the announcement effects are related to the frequency of ODR changes. In most countries, regulators have the ability to influence interest rates by purchasing and selling securities. Alternatively, they can refrain from open market operations altogether. In practice, most regulators pursue a middle path. They set benchmark rates close to the desired levels and intervene as necessary to sustain them.

Two of the countries, Germany and Japan, have very few ODR announcements, as shown in Table 1. The low number of changes in Japan reflects the use of quantity adjustments by the Bank of Japan, such as credit availability and ceilings, rather than price, to adjust monetary imbalances (Shigehara, 1990). Germany has few changes because it relies on open market operations to control economic activity, mainly through the repo market (Neumann and Weidmann, 1996).

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10 They can also affect market rates indirectly by changing reserve requirements, deposit insurance premiums and minimum capital levels.
In contrast, France and the U.K. have more frequent ODR changes. Apart from their preferences to use interest rates to manage macro activity, their commitment to exchange rate stability, as members of the Exchange Rate Mechanism (ERM), requires them to adjust interest rates often. Both France and the U.K. experienced several periods of downward pressures on their currencies during the sample period. In 1992, the U.K. dropped out of the ERM. This resulted in fewer ODR changes, 30 in the second period compared to 35 in the first period. In contrast, France continued to change frequently in the post 1990 period.

We specify the expected market responses for each country based partially on the model described in Roley and Sellon (1998a). For countries that do not rely on ODR changes to affect monetary policy, markets are likely to interpret infrequent announcements as permanent changes. The extent of the change will depend on whether they are technical or non-technical changes. If they are non-technical changes, then changes to short-term market rates should equal to ODR changes. If they are purely technical changes, then changes to short-term market rates should be minimal. Changes to long-term rates may be higher or lower depending on inflationary expectations. If ODR changes are far and apart, then the inflationary expectations are easier to forecast and long-term rates are also likely to be more responsive to ODR changes.

For countries that make frequent changes, markets are likely to perceive the announcements to be persistent. If further announcements are anticipated, market responses will depend on the uncertainty associated with future changes. The

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11Roley and Sellon's (1998a) model is somewhat different in that interest rate responses depend on whether market participants perceive the Fed to partially or fully offset any economic shock.
uncertainties include both the timing of the future changes and the size of the changes. Markets may respond in several ways. If the uncertainty is high, most of the responses will take place around the announcement dates. Alternatively, they may attempt to compensate for the uncertainty by raising rates close to the expected change and then revise them upwards or downwards on further announcements. This will result in partial adjustments around announcement dates. Responses to long-term rates are less predictable since long-term inflationary expectations may be harder to model in a country where ODRs are changed frequently.

2.3 Deregulatory Effects

We next examine whether deregulation of financial services is a factor affecting market responses. The post-1990 years include a period of rapid liberalization of the financial services industry in Europe and Japan. The signing of the Maastricht Treaty in 1989 paved the way for the formation of the Euro and hastened the passage of several directives encouraging cross-border financial services.\textsuperscript{12} Laws have been enacted to improve open disclosure of financial statements, encourage stricter corporate governance rules and strengthen enforcement of legal financial contracts. Among the four countries, the U.K. was the earliest to reform followed by Germany and France. Although slower to implement, the proposed reforms in Japan are similar to those adopted in Europe and the U.S.

\textsuperscript{12}Some of the directives include the Third Life and Non-Life Directives enabling insurance firms to engage in cross-border acquisitions, effective July 1994. The Second Banking Co-ordination Directive established a single license for all banks to operate within the EU, effective July 1994. Finally, the Investment Service Directive set common regulations for securities firms in the EU, effective January 1996.
The combination of regulatory changes and technological improvements in the delivery of financial services has significantly reduced barriers to trading and increased the free flow of information. The availability of information is an important factor affecting market responses. If market participants are able to acquire the same information as regulators, neither technical nor non-technical changes should result in significant announcement effects. Most ODR changes will be anticipated and incorporated in the prices prior to the announcement. The overall informational content of ODR announcements is therefore expected to be lower in the post-deregulated environment and announcement affects smaller.

The changing importance of ODR announcements has been observed in the U.S. by Roley and Sellon (1998a). They find market responses in the U.S. during 1987 through 1995 period are lower than the 1974-79 periods. They cite a better ability by the market to predict ODR changes because policy changes are less discretionary in the second period.

We separate our sample into two periods, 1980-89 and 1990-97. As in Neumann and Weidmann (1996), 1990 is chosen as the cutoff year to represent the beginning of the post Maastricht period of deregulation in Europe. We expect market responses to be lower in the post-1990 period for all countries. Between countries, we expect the reduction to be lowest for the U.K. because of their earlier implementation of reforms. Germany and France began their reforms earnestly in 1994 and we expect some reduction
in responses. We expect few changes in Japan because of the delay and uncertainty associated with the ability of their government to implement reforms successfully.\textsuperscript{13}

2.4 Reversals in ODR changes

We next test whether the announcement effects differ when there is reversal in policy.\textsuperscript{14} Since changes are generally persistent in one direction, a reversal is usually a clear indication of change in monetary policy. Responses to such a change should be larger if the markets are unable to predict the change in monetary policy, usually in countries with frequent changes. If the responses are not significant, it may be for two reasons, the changes are technical or that markets have correctly anticipated the changes. Thornton (1998) finds reversal of fed funds rate resulted in larger changes, although he has a limited sample of 3 events.

3. Data

The data for this study are obtained from several sources and are listed in Appendix-A. Daily ODRs are obtained from several sources; the BIS for Germany, DataStream for France, Bank of Japan for Japan, and Bank of England for the U.K.\textsuperscript{15} Changes in ODRs are calculated as the log difference of rates between the announcement date and the prior day. The number of ODR announcements varies by country, as shown in Table 1. Germany and Japan had the fewest ODR changes with 34 and 26, respectively. Lack of data further reduced the usable events to 19 for Japan. The UK and

\textsuperscript{13} Although termed “Big Bang” under Japan’s financial liberalization initiative, which started in mid-1990s, Japan’s financial reforms were implemented fully in 2004.

\textsuperscript{14} A separate test to determine whether responses are different for negative and positive ODR changes showed no significant differences.

\textsuperscript{15} Although the Bank for International Settlements (BIS) reports ODR rates for nearly all countries, most of them are month-end rates.
France had the highest with 104 and 106, respectively. However, to ensure a clean sample, we eliminated all ODR changes that had overlapping events of +/- 7 days, i.e. a minimum gap of 14 days was maintained between any two successive changes. This reduced the final sample to 65 events for the UK and 76 for France. Table 1 also shows the number of announcements in the two sub-periods 1980-89 and 1990-97, between ODR increases and decreases, and reversals for the entire period. The reversal for France and UK are 17 and 15, respectively. The reversals for German and Japan are only 5 and 2, respectively, making it difficult to interpret the results.

Table 1 about here

Daily interest rates are available for all countries from the BIS, which collects data from individual countries and classifies them in broad categories. Since debt instruments vary by country, a single category may contain a wide selection of rates. For example, the category of 3-month money market rates, HEEA, includes rates for commercial deposits, call-money deposits, inter-bank deposits, commercial bills and banker’s acceptances. In spite of this broad inclusion, it is difficult to find a common rate for all maturities. For example, there is no equivalent 3-month loan rate under the category HEEA for France. Instead a 3-month French treasury rate is substituted from the category HEPA. Similar judgements are made for a few other securities. Appendix A provides a list of the individual rates selected for each country.

To consider the impact on the full term structure of interest rates, we examine five market interest rates:

1D = Overnight rates.

3M = 3-month money market rates.
1Y = One-year bond rates.
5Y = Five-year bond rates.
10Y = 10-year bond rates.

Changes in interest rates are calculated as the log differences of rates between the relevant intervals. Daily and continuous data for all five rates are available only for Germany and France. Data for Japan are limited to overnight, 3-month and 10-year rates. Data for the U.K. are available only for overnight, 5-year and 10-year rates.

4. Methodology and Results

We first discuss the methodology to estimate announcement effects. Next we report the announcement day, anticipatory and learning effects for all four countries. We then examine the effects of deregulation and reversals.

4.1 Methodology

We regress changes in several market interest rates on ODR changes using heteroskedastic-consistent covariance matrix estimators (HCCM) proposed by Long and Ervin (2000). The popularly used White’s (1980) HCCM estimators are justified asymptotically but for small samples McKinnon and White (1985) had proposed three alternative estimators, H1, H2 and H3. Using Monte Carlo simulations, Long and Ervin (2000) show that one of the estimators, HC3, works the best for samples below 250.\(^{16}\)

\[^{16}\text{The estimators differ in how the squared residuals of OLS regressions are used in estimating the HCCM. HC3 uses the squared residuals as follows: } (X'X)^{-1}X'\text{diag}(e_i^2/1-h_{ii})X(X'X)^{-1} \text{ where } h_{ii}=x_i'(X'X)^{-1}x_i' \text{ and } e_i = \text{standard OLS residuals (see McKinnon and White (1985) and Long and Ervin (2000) for details).}\]
In addition, they show the loss of power in using HC3 even when heteroskedasticity is not present is minimal.

The dependent variable is the log change in market interest rates of various intervals regressed against the log change in ODR.\(^\text{17}\)

\[
\Delta M_{t-n, t+m} = \alpha + \beta \Delta (ODR_{t-1, t}) + \varepsilon_t
\]  

(1)

where,

\[
\Delta M_{t-n, t+m} \quad \text{= Log change in market interest rates from day } t-n \text{ to } t+m.
\]

\[
\Delta (ODR_{t-1, t}) \quad \text{= Log change in official discount rates from day } t-1 \text{ to day } t.
\]

\[
\varepsilon_t \quad \text{= error term}
\]

n, m \quad = 0, 1, \text{ and } 7 \text{ except } n=m=0.

t \quad = \text{date of announcement defined as day } 0.

To reduce the reporting of the various regressions, we present results for only six intervals in Table 2. Market responses of ODR announcements on days -1, +1 and -1 to +1 capture the announcement day effects. Market responses prior to the announcement date, i.e. from days -7 to 0 capture the anticipatory effects and from days 0 to +7 capture the learning effects. Market responses one week prior to and after the announcement day (days -7 to +7) capture the total effects.

\(^{17}\) Changes in ODR and market rates are used, instead of levels, because the error terms are likely to have unit roots.
4.2 Results

4.2.1 Announcement, Anticipatory and Learning Effects

Table 2 shows the changes in market yields of overnight, 3-month, 1-year, 5-year and the 10-year rates for the full 1980-97 period. Announcement day effects, -1 to +1, for overnight interest rates are positive and statistically significant for Germany, UK and Japan. For Germany, the positive announcement day effects extend to the 3-month and 1-year rates. In France the results are mixed with insignificant responses for the 1-day and 3-month rates, positive and significant for the 1-year rate but negative for the 5 and 10-year rates. The one-day rate responses (-1 to +1) for Germany and Japan are 0.58 and 0.67 respectively. These results suggest that the market responses for Germany and Japan, which have few ODR changes, are either anticipated or the event represents a partial technical alignment by the central bank.

When examined together with anticipatory and learning effects (-7 to +7), the overall responses for 1-day rates for Germany and Japan are approximately half the ODR change (0.49 and 63, respectively). This indicates that the changes in 1-day rates in Germany and Japan, although infrequent, are partially anticipated. Since the change is not close to unity, especially for overnight rates, it also suggests that part of the ODR changes may be technical.

In the case of UK, which has frequent changes, the coefficient for 1-day rates is close to unity (0.99). When the anticipatory effects are included, the coefficient marginally increases to 1.06. This supports the hypothesis that announcements in countries with frequent changes are expected to be persistent and the resulting uncertainty is resolved during a short period surrounding the event dates.
In the case of France, with exception of few positive changes in 1-year rates, there are no statistically positive changes for any of the other four market rates. Instead, there are few negative changes scattered through the events, day –7 for overnight and 3-month rates, day +7 for 1-year rates and day –1 for 10-year rates. A careful examination of the data shows that the rates are somewhat volatile prior to and during the event period. This indicates that the changes are more technical in nature. Central banks are more inclined to follow the market since the announcement itself does not appear to elicit strong responses.

[Table 2A and 2B about here]

Finally, for all three countries that elicited significant responses, the changes are the largest for 1-day rates and decrease as the maturity increases. Cook and Hahn (1989), Dale (1993) and Thornton (1982) all find similar results, i.e. changes are significant for short-term but not for long-term rates. The lack of response of long-term rates has also been observed in time-series studies (Shiller, Campbell, and Schoenholtz, 1983; and Mankiew and Miron, 1986). Recent research attempts to explain this discrepancy as a result of expected shocks in the interim period, such as federal funds targeting (Rudebusch, 1995) or expected changes in federal funds targeting (Balduzzi et al (1998)). That is, market behavior is still rational even if long-term rates are not responsive because participants are uncertain about future interest rate shocks. Cook and Hahn (1989) and Dale (1993) also find yield changes of short-term rates to be of near equal magnitude. Our results show no evidence of such parallel shift in rates with the exception of UK.
Examining the anticipatory effects in isolation (day -7), it appears that market rates of the countries are responsive prior to announcement changes. In contrast, the learning effects (+7) effects (+7) appear to be insignificant for Germany, while they are significant for UK for 1-day and 3-month rates, respectively. This reinforces the result that for countries with infrequent changes, the markets seem to respond prior to the announcement date. For countries with more changes it appears that the responses continue through day +7, reflecting the uncertainty in the market in such environments.

Overall, the results for Germany, UK and Japan show that short-term rates are more responsive than long-term rates and the most of the announcement are partially anticipated. In the case of France, the changes are technical in nature.

4.2.2 Deregulatory Effects

The second set of tests examines the effects of deregulation on the informational content of ODR announcements. If markets participants have greater access to information, as would be expected in a deregulated environment, the informational content of ODR announcements is expected to be lower. The announcement effects between the two sub-periods, 1980-89 and 1990-97 are compared by testing equation (1) with a dummy variable POST set to one when the event occurs in the 1990-97 period. That is,

$$\Delta M_{t-n, t+m} = \alpha + \beta_1 \Delta (ODR_{t,t-1}) + \beta_2 (ODR_{t,t-1}) \ast POST_t + \beta_3 \text{REVERSAL}_t + \epsilon_t \quad (2)$$

where, POST = 1 if the observation lies in the post-1990 (second) period. The third variable REVERSAL is explained in the next section.

The coefficient $\beta_2$ is tested for the same set of intervals. For all countries, the reduction will be larger for countries that are further along the implementation process.
The magnitude of the changes will depend on the nature of the impact. If markets are likely to anticipate ODR announcements more effectively in a deregulated environment, then the $\beta_2$ coefficient will be negative during the anticipatory period. Alternatively, if ODR announcements play a decreasing role in a deregulated environment, the $\beta_2$ coefficient will be negative during the announcement period (-1 to +1). $\beta_2$ will be positive only if the deregulated environment increased uncertainty in the markets.

[Table 3A and 3B about here]

The estimates of the dummy variable, $\beta_2$, of equation (2) are reported in Table 3A and 3B. The results for Germany show that there is a lower response (-0.42) in the post 1990 period for the one-day rate during the announcement period (-1 to +1). This suggests that the deregulatory environment has reduced the impact of ODR announcements on market rates.

In contrast, the coefficients for Japan are positive for the one-day and three-month rates during the announcement period. The results are consistent with the slow pace of reforms, which appears to have increased uncertainties in the markets. In the UK, the responses are mostly negative for both 1-day and 5-year rates, supporting the decreasing importance of ODR information in the second period. The decrease in uncertainty is clearly in line with the Bank of England’s strong push to deregulate the financial markets much more aggressively than continental Europe. Finally in the case of France, we note that the market responses during the post 1990 period for all rates are not statistically significant with the exception of one positive change for the 10-year rate. These results add evidence that ODR changes in France are more technical. Thus, the deregulated environment in France has not produced any change to the market responses.
We conclude that overall results shed some light on the effective implementation of the deregulatory process. It is clear that the deregulatory environment seemed to have had biggest impact on UK rates, which had implemented reforms far ahead of the other countries. At the other extreme, the impact was lowest for Japan in the post 1990 period reflecting the slow or non-existent implementation of reforms. Between Germany and France, where implementation was still under way, the impact on Germany is larger. For France, the non-responses associated with the ODR changes confirm the earlier conclusions that ODR changes are more technical in nature.

4.2.3. Market Responses to ODR Reversals

The final set of tests examines the announcement effects for reversals. Reversals should provide a much clearer picture of the impact of ODR announcements as long as they are not fully anticipated. Unfortunately, as in most studies, it is difficult to obtain a large dataset for reversals. We use the same equation (2) for estimating the reversal variable, REVERSAL

\[
\Delta M_{t-n, t+m} = \alpha + \beta_1 \Delta (ODR_{t-1}) + \beta_2 (ODR_{t-1}) \ast \text{POST}_t + \beta_3 \text{REVERSAL} + \epsilon_t \quad (2)
\]

where, \( \beta_3 \) if the ODR is a reversal, defined as a change in the direction of monetary policy. Thus, if \( \beta_3 \) is positive, it implies that a fall in ODR leads to a greater fall in market rates if the ODR change is a reversal. Similarly, if ODR increases, the increase in market rate is greater if the ODR increase is a reversal.

[Table 4A and 4B about here]

The results show that reversals have the largest impact on countries that make frequent changes. The signs are positive for the one-day and three-month rates for France (-7 to +7 days) and for all three rates for the UK at different intervals. These are
consistent with expectations that countries with frequent changes are associated with greater uncertainty and reversals generate larger responses. In the case of France, this provides the first evidence that that all ODR changes may not be technical because markets appear unable to anticipate reversals. The changes are larger than non-reversals during the announcement and post-announcement periods. The results for countries with infrequent changes are mixed. The coefficients for Germany are negative for four of the five rates. It supports earlier evidence that the permanent changes in Germany are partially anticipated and partially technical and reversals are predicted or anticipated with more accuracy. In Japan, the results are all insignificant. Unfortunately, both results have to be interpreted with care because of the small sample size. Overall, we conclude that reversals are larger for countries with frequent changes that generate higher uncertainty on the future course of ODR changes.
5. Conclusions

This paper examines the effects of official discount rate (ODR) changes on market interest rates of four countries, Germany, France, Japan and the U.K., during the 1980-97 period. Changes in ODR announcements are newsworthy events that are closely watched by market participants. If an announcement provides new information on the future course of interest rates, the term structure of interest rates adjusts towards a new equilibrium. The overall results show that short-term rates are more responsive than long-term rates to ODR announcement dates. This is consistent with the results of other studies. In addition, several of the market changes occur prior to the announcement date, indicating that the changes are anticipated. Some market responses occur after the announcement date, but are smaller in magnitude. In the case of France, the changes are insignificant indicating that ODR changes are more technical in nature.

We also compare responses between countries that have frequent and infrequent changes. If announcements are infrequent, markets likely to perceive the changes to be permanent. The results indicate that for Germany and Japan with fewer changes, the magnitude of the responses is close to half the ODR changes. This suggests that changes are partially technical and anticipated. In contrast, the changes to UK are close to unity. This is consistent with expectations that persistent changes are likely to result in greater uncertainty for market participants on the future course of events. Hence, most of the uncertainty is resolved during the period immediately surrounding the announcement.

We next examine whether the liberalization of the financial services in Europe and Japan reduces the informational value of ODR announcements. We choose 1990 as the cutoff point because the signing of the 1989 Maastricht Treaty marks a turning point
for financial consolidation in Europe. We associate financial market deregulation with increasing sophistication by market participants to obtain information, reducing the informational content of ODR announcements. We conclude that overall that the results shed light on the effective implementation of the deregulatory process. It made the biggest impact for UK rates, which had implemented reforms far ahead of the other countries. At the other extreme, the impact was lowest for Japan in the post 1990 period reflecting the slow or non-existent implementation of reforms. Between Germany and France, where implementation was still under way, the impact on Germany is larger. In the case of France, the non-responses confirm the earlier conclusions that ODR changes are more technical in nature.

Finally, we examine the impact on market rates when there is a change in monetary policy. A reversal takes place when an ODR change is in the opposite direction of previous changes. Thornton (1998) finds reversal of fed funds rate resulted in larger changes. Our results indicate that reversals are larger for France and UK, countries with persistent changes and higher uncertainty on future changes. In contrast, the results are negative for Germany and insignificant for France, suggesting that countries with fewer changes have less impact. However, the results have to be interpreted with care because of the small sample size for Germany and Japan.

We outline below some of the limitations of this research. First, as in most international studies, it is difficult to obtain clean and reliable data for comparison across countries because of varying institutional, legal and regulatory constraints dealing with financial market data. In our case, the limited number of ODR changes constrained our efforts to sub-divide the sample any further. One approach to solving this problem is to
increase the number of countries in the sample. An increased sample also allows for multiple cutoff points to test the effects of deregulation. On the other hand, it also makes our task difficult while providing meaningful comparisons among the various countries because of their unique political and social structures. Second, it is possible that other news may affect market interest rates, especially when estimating responses over longer intervals. One approach to alleviate this problem is to scrutinize for news in each country on days prior to the announcement. However, publicly available financial news for Europe and Japan, with the exception of recent years, is limited to the English language Financial Times and Wall Street Journal. These two sources may not reflect the true information available to market participants during the sample period. However, our results are likely to be less sensitive to this problem because several of the coefficients are statistically significant on announcement day.
Acknowledgements

The views expressed are those of the authors and do not necessarily reflect those of World Bank. The authors thank Andrew Hayes for the use of the SAS program to estimate the HC3 heteroskedastic-consistent covariance matrices. The authors would like to thank Oliver Schnusenberg (the discussant at the 2004 FMA meeting) for providing useful comments and Manish Shah for research assistance. The authors remain responsible for any errors or omissions.
Appendix A

The data on official discount rates was pieced together from several sources. Daily data on market interest rates were all obtained from the Bank for International Settlements. We list below the market interest rates selected and the sources.

<table>
<thead>
<tr>
<th>Official Discount Rates (See Table 1 for additional details)</th>
</tr>
</thead>
</table>
| Germany | Lombard rate of Bundesbank.  
Source: BIS database. |
| France  | Intervention Rate  
Source: DataStream. |
| U.K.    | Official Discount Rate  
Source: Bank of England web page: www.bankofengland.co.uk |
| Japan   | Discount rate of Commercial bills and interest rates on loans secured by government bonds.  
Source: Bank of Japan web page: www.boj.or.jp. |

<table>
<thead>
<tr>
<th>Market Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEBA etc. refers to the classification used in the BIS Database. 02, 14 refers to the specific rate selected from the above classifications</td>
</tr>
<tr>
<td>Germany</td>
</tr>
</tbody>
</table>
| HEBA (02): Money Market interest rates on day to day money based on daily quotations reported by Frankfurt banks. These rates are not fixed or quoted officially.  
HEEA (02): Money Market interest rates on 3-month loans based on daily quotations reported by Frankfurt banks. These rates are not fixed or quoted officially.  
HGLA (14): Secondary market yield on 1-year Federal public bonds  
HGLA (22): Secondary market yields of 5-year Federal public bonds  
HGLA (32): Secondary market yield on 10-year Federal public bonds |
| France |
| HEBA (02): Money Market interest rates on day-to-day loans. Aggregate private bills Taux Pratiques sur Le Marche Monetaire (pensions Entre Banques) Effects  
HESA (12): Money Market interest rates on 12 month, (remaining maturity) T-bills, Market Yield |
**U.K.**

*HEBA (04)*: Money Market interest rates on Call Money. Short-term call money rates of selected U.K. retail banks

*HGLA (22)*: Secondary market yield on Short-dated (5 Years) government stocks

*HGHA (32)*: Secondary market yield on 10-year (Benchmark) government bonds

**Japan**

*HEBA (04)*: Uncollateralized and overnight Call money rates

*HEGA (02)*: Money Market interest rate on 3-month Certificates of deposit

*HGCA (02)*: secondary market yield on 10-year interest-bearing government bonds.
References


Table 1: Number of Official Discount Rate Changes in the Sample


<table>
<thead>
<tr>
<th></th>
<th>Total Sample</th>
<th>1st period</th>
<th>2nd period</th>
<th>Positive/ Negative Changes</th>
<th>Reversals</th>
</tr>
</thead>
<tbody>
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<td>16</td>
<td>14/20</td>
<td>5</td>
</tr>
<tr>
<td>France²</td>
<td>76</td>
<td>27</td>
<td>49</td>
<td>21/55</td>
<td>17</td>
</tr>
<tr>
<td>UKP³</td>
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<td>35</td>
<td>30</td>
<td>30/35</td>
<td>15</td>
</tr>
<tr>
<td>Japan⁴</td>
<td>19</td>
<td>8</td>
<td>11</td>
<td>5/14</td>
<td>2</td>
</tr>
</tbody>
</table>

¹ Lombard Rate (Source: Bank for International Settlements)
² Intervention Rate (Source: DataStream)
³ Official Rate (Source: Bank of England (BOE), Minimum Dealing Rate). As its Official Rate, The BOE used the Minimum Lending Rate till 1981, the Minimum Dealer Rate till 1997 and thereafter the Repo Rate
⁴ Discount Rate of Commercial Bills and Interest Rate on Loans Secured by Government Bonds (Source: Bank of Japan)

Start and End dates:

- Germany: February 29, 1980 - April 19, 1996
- Japan: February 19, 1980 - September 8, 1995
### TABLE 2A: Response of Market Interest Rates to Changes in Official Discount Rates (ODR)

Sample period 1980-97 (See Table 1 for exact dates).
1D = Day-to-Day Rates. 3M = 3 Month Rates. 1Y = 1Year Rates. 5Y = 5 Year Rates.
10Y = 10 Year Rates.

<table>
<thead>
<tr>
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<th></th>
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<tr>
<td></td>
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<td>5Y</td>
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<td></td>
<td>1D</td>
<td>3M</td>
<td>1Y</td>
<td>5Y</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>76</td>
<td>43</td>
<td>29</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
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<td>0.31***</td>
<td>0.29***</td>
<td>0.08***</td>
<td>0.03</td>
<td>-0.01</td>
<td>-0.11</td>
<td>0.30*</td>
<td>-0.05</td>
<td>-0.04</td>
</tr>
<tr>
<td></td>
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<td>(4.70)</td>
<td>(6.07)</td>
<td>(3.66)</td>
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<td>(-0.61)</td>
<td>(2.02)</td>
<td>(-1.52)</td>
<td>(-1.09)</td>
</tr>
<tr>
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<td>0.15*</td>
<td>0.10**</td>
<td>0.03**</td>
<td>0.01</td>
<td>-0.01</td>
<td>-0.10</td>
<td>0.10**</td>
<td>-0.02**</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
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<td>(2.01)</td>
<td>(3.56)</td>
<td>(2.57)</td>
<td>(1.11)</td>
<td>(-0.57)</td>
<td>(-1.29)</td>
<td>(2.62)</td>
<td>(-2.90)</td>
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<td>0.04**</td>
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<td>0.02</td>
<td>0.01</td>
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<td>-0.08</td>
<td>0.03</td>
<td>-0.01</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
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<td>(2.30)</td>
<td>(1.48)</td>
<td>(0.86)</td>
<td>(0.62)</td>
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<td>(-0.64)</td>
<td>(0.69)</td>
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</tr>
<tr>
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<td>0.05</td>
<td>0.05</td>
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<td>0.02</td>
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<td>-0.03</td>
<td>-0.01</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td>(1.06)</td>
<td>(1.90)</td>
<td>(1.09)</td>
<td>(0.64)</td>
<td>(-1.01)</td>
<td>(-0.88)</td>
<td>(-0.18)</td>
<td>(-0.51)</td>
<td>(0.37)</td>
</tr>
<tr>
<td><strong>-1 to +1</strong></td>
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<td>0.18***</td>
<td>0.16***</td>
<td>0.05*</td>
<td>0.02</td>
<td>-0.09</td>
<td>-0.18</td>
<td>0.13**</td>
<td>-0.03**</td>
<td>-0.03*</td>
</tr>
<tr>
<td></td>
<td>(5.08)</td>
<td>(2.75)</td>
<td>(2.86)</td>
<td>(1.77)</td>
<td>(0.99)</td>
<td>(-0.76)</td>
<td>(-1.10)</td>
<td>(2.53)</td>
<td>(-2.67)</td>
<td>(-1.92)</td>
</tr>
<tr>
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<td>0.49***</td>
<td>0.36***</td>
<td>0.43***</td>
<td>0.13**</td>
<td>0.053</td>
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<td>-0.24</td>
<td>0.27</td>
<td>-0.06**</td>
<td>-0.03</td>
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<tr>
<td></td>
<td>(2.78)</td>
<td>(6.88)</td>
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<td>(1.33)</td>
<td>(-0.95)</td>
<td>(-0.82)</td>
<td>(0.94)</td>
<td>(-2.26)</td>
<td>(-0.75)</td>
</tr>
</tbody>
</table>

**Note:** N = number of observations where the dummy = 1 for reversals out of total observations used in the regressions. Numbers in parentheses are t-statistics. ***,**, * significant at the 1%, 5%, 10% respectively.
TABLE 2B: Response of Market Interest Rates to Changes in Official Discount Rates (ODR)

Sample period 1980-97 (See Table 1 for exact dates).
1D = Day-to-Day Rates. 3M = 3 Month Rates. 5Y = 5 Year Rates.
10Y = 10 Year Rates.

<table>
<thead>
<tr>
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</tr>
</thead>
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<tr>
<td></td>
<td>1D</td>
</tr>
<tr>
<td>Type</td>
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</tr>
<tr>
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</tr>
<tr>
<td>-7</td>
<td>0.56***</td>
</tr>
<tr>
<td></td>
<td>(3.60)</td>
</tr>
<tr>
<td>-1</td>
<td>0.68***</td>
</tr>
<tr>
<td></td>
<td>(3.89)</td>
</tr>
<tr>
<td>+1</td>
<td>0.32**</td>
</tr>
<tr>
<td></td>
<td>(2.41)</td>
</tr>
<tr>
<td>+7</td>
<td>0.50***</td>
</tr>
<tr>
<td></td>
<td>(3.58)</td>
</tr>
<tr>
<td>-1 to +1</td>
<td>0.99***</td>
</tr>
<tr>
<td></td>
<td>(5.96)</td>
</tr>
<tr>
<td>-7 to +7</td>
<td>1.06***</td>
</tr>
<tr>
<td></td>
<td>(7.98)</td>
</tr>
</tbody>
</table>

Note: N = number of observations where the dummy =1 for reversals out of total observations used in the regressions. Number in parentheses are t-statistics. ***,**,*, significant at the 1%,5%, 10% respectively.
### TABLE 3A: Coefficients of the Second Period (1990-97) Dummy of Market Response to Official Discount Rates Changes

Sample Period 1980-97. Dummy=1 for all events occurring in the second sample period, 1990-97 (See Table 1 for exact dates).
Results pertain to $\gamma$ coefficient as specified in Equation 2.  1D = Day-to Day Rates.  3M = 3 Month Rates.  1Y = 1 Year Rates.  5Y = 5 Year Rates.  10Y = 10 Year Rates.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1D</td>
<td>3M</td>
</tr>
<tr>
<td>N1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-7</td>
<td>0.04 (-0.12)</td>
<td>-0.06 (-0.45)</td>
</tr>
<tr>
<td>-1</td>
<td>-0.24 (-1.37)</td>
<td>-0.04 (-0.31)</td>
</tr>
<tr>
<td>+1</td>
<td>-0.18* (-1.71)</td>
<td>-0.02 (-0.67)</td>
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<tr>
<td>+7</td>
<td>-0.12 (-0.46)</td>
<td>-0.003 (-0.03)</td>
</tr>
<tr>
<td>-1 to +1</td>
<td>-0.42** (-2.42)</td>
<td>-0.07 (-0.60)</td>
</tr>
<tr>
<td>-7 to +7</td>
<td>-0.10 (-0.27)</td>
<td>-0.10 (-0.74)</td>
</tr>
</tbody>
</table>

**Note:** N1 = number of observations over total observations where the dummy =1 for the second sample period. Numbers in parentheses are t-statistics. ***,**, * significant at the 1%, 5%, 10% respectively.
TABLE 3B: Response of Market Interest Rates to Changes in Official Discount Rates (ODR)

Sample period 1980-97 (See Table 1 for exact dates).
Result pertains to $\gamma$ coefficient as specified in Equation 2. 1D = Day-to Day Rates.
3M = 3 Month Rates. 5Y = 5 Year Rates.
10Y = 10 Year Rates.

<table>
<thead>
<tr>
<th>United Kingdom</th>
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<tbody>
<tr>
<td>1D 5Y 10Y</td>
<td>1D 3M 10Y</td>
</tr>
<tr>
<td>Type HEBA HGLA HGHA</td>
<td>HEBA HEGA HGGA</td>
</tr>
<tr>
<td>N1</td>
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<tr>
<td>-7</td>
<td>-0.06 0.02 --</td>
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<tr>
<td></td>
<td>(-0.17) (0.11)</td>
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<tr>
<td>-1</td>
<td>0.31 -0.02 --</td>
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<td>(0.60) (-0.19)</td>
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<td>-0.56* -0.08* --</td>
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<td>+7</td>
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<td>(0.20) (-1.27)</td>
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<td>-1 to +1</td>
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<tr>
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<td>(-0.67) (-0.79)</td>
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<tr>
<td>-7 to +7</td>
<td>-0.08 -0.08 --</td>
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<tr>
<td></td>
<td>(-0.20) (-0.41)</td>
</tr>
</tbody>
</table>

Note: N1 = number of observations where the dummy =1 for reversals out of total observations used in the regressions. Numbers in parentheses are t-statistics. ***,**, * significant at the 1%, 5%, 10 % respectively.
## TABLE 4A: Coefficients of the Second Period (1990-97) Dummy of Market Response to Official Discount Rates Changes

Sample Period 1980-97. Dummy=1 for all events occurring in the second sample period, 1990-97 (See Table 1 for exact dates).

Result pertain to \( \gamma \) coefficient as specified in Equation 2.1 1D = Day-to Day Rates. 3M = 3 Month Rates. 1Y = 1 Year Rates. 5Y = 5 Year Rates.

<table>
<thead>
<tr>
<th>Type</th>
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<th>5Y</th>
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<th>3M</th>
<th>1Y</th>
<th>5Y</th>
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<tr>
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<td>5/34</td>
<td>5/28</td>
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<td>5/28</td>
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<td>7/29</td>
<td>7/35</td>
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<tr>
<td>-7</td>
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</tr>
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<td>-0.03</td>
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<td>0.001</td>
<td>0.003(^{**})</td>
<td>0.01(^{*})</td>
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<td>0.01</td>
<td>0.003</td>
<td>0.000</td>
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<td>0.004</td>
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<td>0.03</td>
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<td>0.003</td>
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<td>(-0.11)</td>
<td>(0.94)</td>
<td>(0.80)</td>
</tr>
<tr>
<td>-7 to +7</td>
<td>-0.04</td>
<td>0.009</td>
<td>0.002</td>
<td>-0.001</td>
<td>-0.0001</td>
<td>0.03(^{*})</td>
<td>0.07(^{*})</td>
<td>0.02</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(-0.98)</td>
<td>(0.84)</td>
<td>(0.16)</td>
<td>(-0.13)</td>
<td>(-0.06)</td>
<td>(1.79)</td>
<td>(1.84)</td>
<td>(0.78)</td>
<td>(0.29)</td>
<td>(0.20)</td>
</tr>
</tbody>
</table>

Note: N2 = number of observations where the dummy =1 for reversals out of total observations used in the regressions. Number in parentheses are t-statistics. ***,**, * significant at the 1%, 5%, 10 % respectively.
### TABLE 4B: Response of Market Interest Rates to Changes in Official Discount Rates (ODR)

Sample period 1980-97 (See Table 1 for exact dates).

1D = Day-to-Day Rates. 3M = 3 Month Rates. 5Y = 5 Year Rates.
10Y = 10 Year Rates.

<table>
<thead>
<tr>
<th>United Kingdom</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>HEBA</td>
</tr>
<tr>
<td><strong>N2</strong></td>
<td>15/65</td>
</tr>
<tr>
<td><strong>-7</strong></td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
</tr>
<tr>
<td><strong>-1</strong></td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(-0.45)</td>
</tr>
<tr>
<td><strong>+1</strong></td>
<td>0.02</td>
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<tr>
<td></td>
<td>(0.10)</td>
</tr>
<tr>
<td><strong>+7</strong></td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.57)</td>
</tr>
<tr>
<td><strong>-1 to +1</strong></td>
<td>-0.01</td>
</tr>
<tr>
<td></td>
<td>(-0.40)</td>
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<tr>
<td><strong>-7 to +7</strong></td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
</tr>
</tbody>
</table>

**Note:** N2 = number of observations where the dummy = 1 for reversals out of total observations used in the regressions. Numbers in parentheses are t-statistics. ***,**, * significant at the 1%, 5%, 10% respectively.