Do Financial Markets Learn from ECB Monetary Policy?

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Abstract

This article examines the magnitude of stock market reactions around European Central Bank (ECB) monetary policy announcements. Since the introduction of ECB, the declining absolute abnormal returns have been compatible with stock market learning from ECB monetary policy making. The Eurozone financial markets extract information from the ECB announcements and consider the information before making investing decisions. Furthermore, the credibility of ECB has been increasing over time.

JEL Classification: E52, E58, G14
Keywords: Monetary Policy, CAR, Learning

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1 Introduction

According to recent research, central bank credibility plays a key role in the modern literature on monetary policy. In the Eurozone, maintaining price stability is the primary objective of the European Central Bank (ECB), and its greater credibility can help the ECB holds down low rates of inflation. This investigation also examines how the credibility of the ECB has changed since its creation, in the eyes of financial markets.

According to the semi-strong efficient markets hypothesis, stock prices reflect all publicly available information. The release of a monetary policy decision conveys information to stock markets (Pearce and Roley, 1983; Funke and Matsuda, 2006), such that Eurozone financial markets should react to ECB monetary policy announcements. However, the ECB also seeks credibility as part of its strategy and financial markets aim to understand any signals about the directions of interest rate developments. We therefore test empirically whether investors learn how evaluate ECB monetary policy by observing their actions. "Learning" in this context means that the Eurozone financial markets extract information from the ECB announcements and consider the information in subsequent investing decisions. Central banks have gradually been releasing more information pertinent to monetary policymaking (Geraats, 2009), and this form of transparency has influenced monetary policy significantly, especially through improved explanations of monetary policy decisions. The predictability of Eurozone stock markets, therefore offers an indicator of consistency in communication about monetary policy and the effectiveness of monetary policy implementation.

We examine the impact of ECB monetary policy announcements to estimate the dispersion in stock market reactions to monetary policy announcements and the determinants of that impact. We consider an event period starting with the creation of the ECB the recent financial crisis. Although we recognize that monetary policy surprises occur in settings other than central bank meetings, such as in speeches given by members of central banks, these events are heterogeneous and generally wider in focus. Moreover, the ECB's communication about the monetary analysis does not determine its actions, especially ECB interest rate decisions (Berger et al., 2011). We accordingly concentrate on stock market reactions surrounding ECB monetary policy decisions and define a monetary policy announcement as the release of the main refinancing operations rate (MRO) by the Governing Council of the ECB. We focus on these reactions because the MRO is the main instrument under control of Eurozone monetary policy makers.

Despite rich literature regarding the wealth channels of monetary policy, surprisingly little large-sample research examines the learning effects in relation to ECB monetary policy. From this innovative approach, we therefore derive several key results. First, we find that the Eurozone stock market reactions to ECB MRO announcements decrease over time, which implies that the ECB's monetary policy decisions are becoming more and more predictable. These results are consistent with a learning hypothesis and suggest an enhancement of ECB credibility. Second, macroeconomic variables also affect the learning effect: During good business conditions, the Eurozone stock markets are more likely to overestimate bad news, whereas they focus on learning good news during bad times. Third, we reveal that inflation hinders the ability of stock markets to predict ECB monetary policy. We argue that a high level of prices may trigger uncertainty and nervousness among investors. Fourth, we observe that ECB governance also influences the learning effect. Fifth, in robustness tests, we demonstrate that the learning effect is consistent with the definition of learning, the choice of control variables, the potential outliers, the status quo, the event period, and the stock market sample.

The rest of this article is organized as follows: In Section 2, we provide a brief review of literature related to the impact of central banks on stock prices. In Section 3, we describe our data and present the methodology. In Section 4, we discuss the empirical results, then present robustness tests in Section 5. Finally, we summarize our main conclusions in Section 6.

2 Literature Review

According to rich literature on monetary policy transmission, a change of the target rate affects the real economy (Bernanke and Blinder, 1992), through interest and wealth channels. The most direct and immediate impact of monetary policy decisions is on the financial markets (Bernanke and Kuttner, 2005). Many of the most important empirical studies related to the impact of monetary policy on stock markets empirically address how the impact of monetary policy announcements affect stock prices. Such studies typically find an inverse relationship between stock prices and the target rate determined by central banks. For the 1977-1982 period for example, Pearce and Roley (1983) investigate U.S. stock market responses to weekly monetary announcements and find that an unexpected increase in the announced money supply lowers stock prices, whereas an unexpected decrease reduces stock prices.

From September 1977 to October 1982, Pearce and Roley (1985) also examine daily reactions of U.S. stock prices to announcements about a broad set of macroeconomics news; in this study, their results again suggest that stock prices affect unexpected monetary policy news. From January 1967 to December 1990, Thorbecke (1997) observes that an expansionary U.S. monetary policy increased ex-post U.S. stock returns by increasing expected cash flows or decreasing the discount factors. For the era between June 1989 and December 2002, Bernanke and Kuttner (2005) reveal that on average, a hypothetical, unanticipated 25-basis point decrease in the Federal funds rate target would have been associated with an approximately 1% increase in U.S. stock indexes. Bomfim (2003) also indicates that for each basis point increase in the expected average daily values of a funds rate in the following month, daily stock market returns fall by 0.04 percentage points. Over January 1994 to November 2001, Rigobon and Sack (2004) find that an unanticipated 25-basis point increase in the U.S. short-term interest rate resulted in a 1.7% decline in the S&P index. Also using intraday data during 1990-2004, Gurkaynak et al. (2005) further find that, on average, a surprise 25-basis point tightening in the Federal funds rate leads to an approximately 1% significant fall in the S&P500. Using intraday data, Rosa (2011) observes that stock markets tend to incorporate Federal Open Market Committee (FOMC) monetary surprises within 40 minutes of their from the announcement.

In the Eurozone, the results are more mixed though. Angeloni and Ehrmann (2003) analyze the effects of ECB monetary surprises on domestic stock market indexes and discover that the impact of a monetary tightening is negative in all Eurozone countries except Ireland. Bohl et al. (2008) also find a negative and significant relationship between ECB monetary policy surprises and European stock market returns. However, Bredin et al. (2009) indicate that unexpected changes in German/Euro monetary policy have no impact on the aggregate German stock market returns.

We argue that the mixed results arising from studies in the Eurozone could be explained by learning about ECB monetary policy by investors. Previous investigations that study different periods or markets underline learning differences across time or samples. The credibility aim of the ECB implies that financial markets should be able to learn from its policy. To assess the credibility of the ECB, we consider how investors dynamically adjust their behavior in response to announcements in ECB signals. We hypothesize that the Eurozone absolute cumulative abnormal returns around MRO announcements decrease over time. Stock markets

thus learn through feedback received from ECB communication, because the ECB monetary announcements provide signals that financial markets can use to update their beliefs about future monetary policy. We suggest that declining absolute abnormal returns across time are consistent with ECB credibility in monetary policy making.

3 Empirical Method

To test our hypothesis, we employ an event study. Therefore we begin by describing our data, before we present our methodology.

3.1 Sample

We collect all ECB announcements around MRO during ECB Council of Governors meetings from January 1, 1999, to December 31, 2008, using the event dates listed on the ECB website. Our sample covers 157 events. As Table 1 reveals, in terms of the frequency of ECB monetary policy announcements, we observe 27 changes in MRO, including 16 increases and 11 decreases.

3.2 Method

3.2.1 Market Reactions to ECB MRO Announcements

We focus on stock markets because they are among the most liquid asset markets in the Eurozone. We use daily stock market index prices from Datastream and investigate the Eurozone aggregate stock market index, the DJEurostoxx50 Index. We calculate the returns as: $R_{i,t} = ln(\frac{P_{i,t}}{P_{i,t-1}})$, where $P_{i,t}$ is the price of index i on day t.

We then calculate the abnormal returns using an event study methodology introduced by Fama et al. (1969). Abnormal returns can be estimated with three different models: the constant mean returns model, the market model, or the adjusted return risk market. The measure of abnormal returns is robust to the choice of model (Brown and Warner, 1985). Because of our focus is on index returns, we select the mean constant returns model to estimate the abnormal component of returns of the stock market index i at date t:

$$AR_{i,t} = R_{i,t} - \overline{R}_{i,t}, \tag{1}$$

with

$$\overline{R}_{i,t} = \frac{1}{201} \sum_{t=-220}^{-20} R_{i,t}, \tag{2}$$

where $AR_{i,t}$ is the abnormal return of the stock market index i at day t, $R_{i,t}$ reveals the observed return of the stock market index i at day t, and $\overline{R}_{i,t}$ indicates the average returns of index i over the estimation period. To avoid contamination, we use an estimation period that spans 220 days to 20 days before the announcement date.[1] We calculate the cross-sectional average abnormal return:

$$AR_t = \frac{1}{n} \sum_{i=1}^{n} AR_{i,t}, \tag{3}$$

where n indicates the number of announcements in our sample. Then, we calculate the cumulative abnormal returns (CAR) by summing the average abnormal returns over the five trading days surrounding the announcement dates [-4 days; +0 day]:

$$CAR = \sum_{t=-4}^{0} AR_t. \tag{4}$$

This window of five trading days controls for possible news leaks, allows investors time to gather additional information, and avoids overlapping events.

3.2.2 Learning Effect

To test the learning effect, we regress the following equation:

$$|CAR_{i,t}| = \alpha_0 + \alpha_1 Time_{i,t} + \beta Control_{i,t} + \epsilon_{i,t}, \tag{5}$$

where *Time* measures the calendar time elapsed during the sample period, expressed in days. For example, Time=6 for ECB MRO announced on January 6, 1999. We estimate the dispersion in stock market returns around ECB MRO events over time and for a set of control variables related to ECB governance, macroeconomic conditions, and the expected component of MRO announcements. The prediction about α_1 is specific to the learning hypothesis; therefore, we hypothesize a negative relationship between *Time* and $|CAR_{i,t}|$.

[1] Our results are robust to the length of the estimation period.

3.2.3 Control Variables

We include variables to control for economic conditions, exchange rate, inflation, interest rates, governance, and monetary policy announcements surprises, in line with prior literature. News conveys clear information about growth expectations. We expect that the investor's behavior changes with business conditions; as Veronesi (1999) shows, stock markets overreact to bad news in good times and underreact to good news in bad times. When business conditions are strong, bad news increases the discount over expected cash flows, which reflects an attempt to bear the risk of higher uncertainty. Good news in bad times tends to increase expected cash flows, but it also increases the discount investors demand to hold the asset. To capture this effect, we include an interactive term between GDP growth (*GDP Growth*) and the change in the MRO variables (ΔMRO).

We also include the Euro-US Dollar exchange rate (*EUR-USD*) in the regression. We expect a positive relationship between the exchange rate variable and the absolute stock market reactions. A high EUR/DOLL exchange rate reduces uncertainty around the intervention of ECB because it diminished the risk of importing inflation into the Eurozone and lowers the probability of the ECB's intervention.

Inflation news increases investor uncertainty though. Knif et al. (2008) find that negative CPI and PPI shocks are associated with higher stock returns. Moreover, since its inception, the ECB has included inflation targeting in its monetary policy strategy. Low and stable inflation promotes financial market stability. Therefore, lower inflation should exert a calming effect on stock market volatility. We use HICP (*Inflation*) to control for inflation.

We also use the long-term interest rate (*LT Interest Rates*), because the sign of long-term interest rate reactions should be determined by changes in expected inflation.

Before 2002, the ECB instituted its current policy of announcing changes in the funds rate target twice per month. Therefore, market participants generally grew more aware of policy actions after this time. We identify the monetary policy decisions resulting from ECB MRO announcement before 2002 with a dummy variable that equals 1 if the announcements is before 2002 ([*1999−2001*]), and 0 otherwise.

We distinguish expected from unexpected components of monetary policy announcements (Bernanke and Kuttner, 2005; Gurkaynak et al., 2005; Wongswan, 2009) by defining the unexpected component of MRO announcements according to the difference between the consensus prediction by European ECB watchers, released in the financial press just before the ECB

Board of Governors' meetings, and the decisions of the ECB (Bohl et al., 2008). We obtain European analysts' expectations from research published in *Financial Times*, *Les Echos*, and *La Tribune*, using Factiva.[2] Our estimate of unexpected ECB monetary announcement further includes the degree of surprise. Specifically, the degree of unexpected ECB MRO (*Surprise by Length*) indicates the difference between the degree of the change in the ECB MRO and that expected by analysts. On April 4, 1999 for example, the ECB lowered the MRO from 3.00% to 2.50%, whereas the market expected a decrease of 25 basis points. We therefore identify an unexpected ECB monetary policy announcement in degree. In Appendix A, we provide the occurrence matrix of the degree of unexpected changes in ECB MRO.

4 Empirical Results

In Table 2, we summarize the descriptive statistics descriptive for our variables. The mean abnormal stock market reaction to the ECB MRO announcement is close to 0. However, absolute cumulative abnormal returns are larger; specifically, $|CAR|$ is 2.48% on average. Furthermore, the distribution of *Time* reflects the study period, from 6 to 3625 days since the beginning of the ECB. Moreover, we observe that most of the announcements occur during good economic conditions, estimated by the GDP growth in the Eurozone. The ECB sets its policy interest rate to keep inflation at 2%, on average, in the medium term. It is not surprising then that we find 2.12% Eurozone inflation over our entire sample. We observe that 31% of the observations are concentrated in the first years in which the ECB announced changes in the funds rate target twice per month. We also provide the sign of unexpected changes in ECB MRO, which indicates only 11 unexpected ECB monetary policy announcements according to the sign. That is, the ECB monetary policy decisions appear well anticipated by analysts.

With the ECB monetary announcements, we carried out an event study to assess the absolute cumulative abnormal returns of the Eurozone stock markets. Our methodology achieves the key results that appear in Table 3. First, the absolute cumulative abnormal returns for Eurozone stock markets significatively diminish over time. The ECB's communication policy seems to be successful, in terms of ECB monetary predictability and credibility. The incorporation of changes in the ECB's MRO into Eurozone stock prices happens increasingly quickly. We argue that these data imply the ECB has successfully communicated

[2]Factiva is a database that offers world-wide press content.

its monetary policy, especially in the recent years, consistent with Rosa and Verga's (2007) findings. Moreover, certain economic variables and governance characteristic affect learning. The evidence is consistent with the interpretations we offer subsequently.

Second, we observe a significant and negative relationship between the change in MRO and the absolute cumulative abnormal returns, which is evidence of a period of high uncertainty during the monetary policy accommodation. Furthermore, our results are consistent with Veronesi (1999). The interactive term between GDP growth (*GDP Growth*) and the change in the MRO variables (ΔMRO) is positive and significant. Financial markets tend to overreact to an increase in ECB MRO during good economic conditions. We also observe a negative relationship between the magnitude of abnormal stock returns and the change in MRO, such that investors calm when the ECB increases MRO.

Third, we examine the link between the absolute cumulative abnormal returns and inflation. A high level of inflation increases the nervousness of investors and reduces the learning effect. Fourth, regarding the governance of ECB, we find that in the 1999-2001 period, when there were biweekly meetings, the magnitude stock reactions declined. We argue that this governance likely worked to enhance the consistency of ECB communication and therefore investors' ability to understand ECB monetary policy. Fifth, we find evidence of an impact of the exchange rate, long-term rates, and the unexpected component of news on the learning effect.

5 Robustness Checks

This section contains the results from robustness tests we performed on our model. The variables of our initial model were constructed using the most pertinent calculation methods in the monetary policy literature. However, other variables could have been used to test the hypotheses. We also perform sensitivity tests on the extreme values of the dependent variable. In Tables 4 and 5, we provide the results of these tests of robustness.

First, we check the robustness of our results to the definition of the independent variable. The variable *Time (count)* is a count variable that measures the chronological order of MRO announcements during the sample period. For example, Time=1 for ECB MRO decisions announced on January 6, 1999. Jansen (2010) also argues that communication varies across chairs of the ECB. Although Wim Duisenberg was the first President of the ECB, from July 1, 1998, until October 30, 2003, Rosa and Verga (2007) find no difference in the tones of

Duisenberg's and Trichet's communications. The management of a central bank is one of the most prestigious positions of economic responsibility (Diouf and Pépin, 2010). Therefore to test whether the chairmanship of Duisenberg influenced the learning effect, we include a dummy variable (*Duisenberg*) that takes a value of 1 if the chair is Wim Duisenberg or 0 if the chair was held by Jean-Claude Trichet at the time. Following McQueen and Roley (1993), we define economic states using an alternative economic variable. We also use the seasonally adjusted monthly industrial production index (*Industrial Production*) to define economic states. To explain the economic rationale for the observed market response to policy surprises, we must assess how those policy surprises affect expectations of abnormal returns. Therefore, we also estimate whether an unexpected ECB monetary announcement includes the sign of the surprise (*Surprise by Sign*). The sign of the unexpected ECB MRO reflects the difference between the sign of the change in the ECB MRO and that expected by the analysts. The level of the MRO also could have an impact on the learning effect, so we replace the variable *LT interest rates* with the level of MRO (*MRO*).

Second, we check for the effect of outliers on our model. The dates September 13, 2001, September 17, 2001, and October 11, 2001, are excluded from the analysis, because the September 11 terrorist attacks in that year created exogenous shocks unrelated to monetary policy actions. Third, we perform the regression only during the status quo. This alternative regression only includes a sample of ECB MRO announcements associated with no change in the funds rate. Fourth, we report the regression results when the dependent variable in the regressions is the absolute CAR experienced by the investors over two different event windows. The longer event window, from -5 days before to the announcement date, should more fully capture any information about ECB communication revealed in the period. In the shorter window, measured from 3 days before to the announcement date, the narrower abnormal return measurement should reduce the possibility of confounding events. Finally, we study the learning hypothesis among the domestic Eurozone stock markets with the highest capitalizations: namely, the BEL20 Index (Belgium), the Performance DAX30 Index (Germany), the IBEX35 Index (Spain), the CAC40 Index (France), the Milan MIB30 Index (Italy), the AEX Index (the Netherlands), and the OMX Helsinki Index (Finland).

In the robustness tests, time still predicts the dispersion in the abnormal stock market reactions around the ECB MRO announcements. This evidence is consistent with the learning hypothesis. In particular, unexpected changes in ECB monetary policy affect aggregate

Eurozone stock markets during the status quo. In the disaggregated results for individual financial markets, we observe that learning only exists in the largest stock markets (Performance DAX30 Index, IBEX35 Index, and CAC40 Index); the strongest effect occurs in the French stock markets.

6 Conclusion

The reaction of stock prices to monetary policy announcements is an extremely valuable source of information. Investors can observe how markets react to decisions and thus gain a better understanding of central banks and their actions. Our framework is based on conjecture about learning in Eurozone stock markets, through observations of by observing ECB monetary policy information. We show that financial markets seem to learn from the ECB according to its monetary policy decisions. Investors extract information from the MRO announcement and apply that information to their investing decisions. In the sample of ECB MRO announcements since its creation, the Eurozone absolute cumulative abnormal returns has decreased in time. This evidence favors the learning hypothesis. Thus, we suggest that ECB had become increasingly more and more credible, according to stock markets.

An interesting topic for further research would be to expand our announcements sample to other information released by the ECB, such as monthly press conferences. Another extension might determine the informational content contained in the stock prices of monetary policy news, especially compared with other forms of economic news.

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Table 1: Distribution of the Change in ECB Main Refinancing Operations Rates Announcements

This table presents the annual frequency of the change in ECB main refinancing operations rates announcements between 1999 and 2008.

Year	-0.75	-0.5	-0.25	0	0.25	0.5	Total
1999	0	1	0	22	0	1	24
2000	0	0	0	18	5	1	24
2001	0	2	2	20	0	0	24
2002	0	1	0	11	0	0	12
2003	0	1	1	10	0	0	12
2004	0	0	0	12	0	0	12
2005	0	0	0	11	1	0	12
2006	0	0	0	7	5	0	12
2007	0	0	0	10	2	0	12
2008	1	2	0	9	1	0	13
Total	1	7	3	130	14	2	157

Table 2: Summary Statistics for Stock Market, ECB, and Economic Environment Characteristics

This table presents descriptive statistics of the variables related to stock markets, ECB, and economic environment. The sample consists of 157 ECB monetary policy announcements made between January 1, 1999, and December 31, 2008. Variable definitions are provided in Appendix B.

Variable	Mean	St-Dev.	Min.	Q1	Med.	Q3	Max.
CAR	0.33	3.23	-11.18	-1.46	0.46	2.15	8.45
|CAR|	2.48	2.09	0.00	0.98	1.93	3.44	11.18
Time	1533.17	1092.28	6	580	1280	2470	3625
GDP Growth	2.27	1.29	-2.1	1.6	2.2	2.9	4.9
EUR-USD	0.93	0.15	0.64	0.80	0.93	1.07	1.18
Inflation	2.12	0.62	0.8	1.9	2.1	2.4	4
LT Interest Rates	4.56	0.65	3.14	4.1	4.48	5.18	5.7
[1999-2001]	0.31	0.46	0	0	0	1	1
Surprise by Sign	0.02	0.26	-1	0	0	0	1

Table 3: Explaining the absolute cumulative abnormal returns with time: OLS regression

This table presents the results of OLS regressions explaining the absolute cumulative abnormal returns. The sample consists of 157 ECB monetary policy announcements made between January 1, 1999, and December 31, 2008. Variable definitions are provided in Appendix B. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	$\lvert CAR \rvert$
Intercept	5.67^{**}
Time	-0.99^{***}
GDP Growth	-0.12
ΔMRO	-4.25^{***}
ΔMRO*GDP Growth	0.93^{**}
EUR$-$USD	-0.65
Inflation	0.73^{**}
LT Interest Rates	0.64
[1999$-$2001]	-1.27^{*}
Surprise by Sign	0.65
Adjusted R^2	18.55%

Table 4: Explaining the absolute cumulative abnormal returns with time: OLS Robustness Tests

This table presents the results of OLS alternative regressions explaining the absolute cumulative abnormal returns. The outliers excluded from the regressions correspond to the three observations implying in the 09-11 events. The sample consists of 157 ECB monetary policy announcements made between January 1, 1999, and December 31, 2008. Variable definitions are provided in Appendix B. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Time (count)	Duisenberg	Industrial Production	Surprise by Length	MRO	Statu Quo	Without 09-11 Outliers	CAR(-5;0)	CAR(-3;0)
Intercept	3.62	3.46^{*}	5.40^{**}	5.69^{**}	6.01^{***}	3.75^{*}	5.84^{***}	4.89^{**}	6.72^{***}
Time	.	-0.69^{***}	-0.97^{***}	-0.99^{***}	-0.97^{***}	-0.61^{**}	-0.94^{***}	-0.77^{***}	-1.17^{***}
Time (count)	-0.03^{**}	.	.	.	.	.	.	.	.
GDP Growth	−0.23	-0.28^{*}	.	−0.11	−0.05	-0.31^{*}	−0.15	−0.19	−0.03
Industrial Production	.	.	−0.11	.	.	.	.	.	.
ΔMRO	-4.16^{***}	-3.80^{***}	-2.44^{*}	-4.26^{***}	-4.42^{***}	.	-3.93^{***}	-2.71^{**}	-3.74^{***}
ΔMRO*GDP Growth	0.88^{*}	0.65	.	0.96^{**}	1.03^{**}	.	0.93^{**}	1.06^{**}	0.98^{**}
ΔMRO*Industrial Production	.	.	0.67	.	.	.	.	.	.
EUR-USD	−2.52	0.71	−0.47	−0.55	1.23	−0.15	−0.97	−0.01	−1.96
Inflation	0.67^{*}	0.72^{*}	0.73^{**}	0.72^{*}	1.03^{**}	0.41	0.76^{**}	0.56	0.46
MRO	.	.	.	.	−0.07	.	.	.	.
LT Interest Rates	0.48	0.45	0.59	0.64	.	0.54	0.56	0.39	1.16^{***}
[1999−2001]	−0.92	.	-1.31^{**}	-1.32^{*}	−0.88	−0.24	−0.97	−0.76	-2.30^{***}
Duisenberg	.	−0.36	.	.	.	.	.	.	.
Surprise by Sign	0.66	0.76	0.61	.	0.64	2.70^{***}	0.88	0.88	0.89
Surprise by Length	.	.	.	0.26	.	.	.	.	.
Adjusted R^2	15.01%	16.82%	16.52%	17.98%	17.19%	21.42%	17.29%	13.45%	16.67%
N	157	157	157	157	157	130	154	157	157

Table 5: Explaining the absolute cumulative abnormal returns with time: OLS regression by Index

This table presents the results of OLS regressions explaining the absolute cumulative abnormal returns. The sample consists of 157 ECB monetary policy announcements made between January 1, 1999, and December 31, 2008. Variable definitions are provided in Appendix B. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	Belgium	Germany	Spain	France	Italy	The Netherlands	Finland
Intercept	0.63	3.65	3.57	5.85^{**}	−0.29	7.08^{***}	0.33
Time	−0.15	-0.69^{**}	-0.87^{***}	-1.05^{***}	−0.44	−0.03	−0.32
GDP Growth	−0.24	-0.30^{*}	−0.01	−0.20	−0.18	−0.21	-0.33^{*}
ΔMRO	-4.27^{***}	-3.42^{**}	-4.13^{**}	-3.65^{***}	-3.95^{***}	-5.83^{***}	−0.74
ΔMRO*GDP Growth	1.99^{***}	0.74	0.62	1.12^{**}	1.27^{***}	1.46^{***}	0.05
EUR-USD	-3.09^{*}	0.10	0.47	−0.93	−0.11	-8.85^{***}	1.50
Inflation	−0.09	0.44	0.16	0.44	0.14	1.25^{***}	0.55^{*}
LT Interest Rates	1.30^{***}	0.76	0.94^{**}	0.98^{**}	1.29^{***}	0.04	0.86
[1999−2001]	−0.20	−0.70	-2.02^{***}	-1.59^{**}	−1.28	1.84^{*}	0.26
Surprise by Sign	−0.43	0.12	0.13	0.29	−0.37	0.27	1.13
Adjusted R^2	16.45%	12.79%	16.72%	16.08%	19.54%	30.06%	17.03%

Appendices

Appendix A: Sign of Unexpected Changes in ECB Main Refinancing Operations Rates Announcements Matrix

This table presents the frequency of unexpected signs of the ECB main refinancing operations rates announcements. We present the expected sign of the change in the ECB main refinancing operation rates just prior to the monetary policy announcement in the columns and the sign of the change in the ECB main refinancing operation rates in the rows.

		Expected Sign of Change		
		Downward	Status Quo	Upward
Sign of Change	Downward	[gray]0.88	3	0
	Status Quo	4	[gray]0.8125	1
	Upward	0	3	[gray]0.813

Appendix B: Variables Descriptions

Type	**Variables**	**Description**	**Source**
Stock Market Reaction	Cumulative abnormal returns (*CAR*) (%)	Cumulative abnormal returns of DJ Eurostoxx50 index around ECB MRO announcement	Authors
Learning	*Time* (Days)	Calendar time elapsed during the sample period expressed in days	ECB
	Time (count)	Count measuring the chronological order of MRO announcements	ECB
Business Conditions	*GDP Growth* (%)	Quarterly change in gross domestic product, which is a measure of the economic activity, defined as the value of all goods and services produced, less the value of any goods or services used in their creation	Eurostat
	Industrial Production (%)	Monthly changes in the volume of output on a monthly basis for Euro area	Eurostat
Exchange Rate	*EUR-USD* (Dollar)	Bilateral exchange rate for the EURO vs. U.S. Dollar	Datastream
Inflation	*Inflation* (%)	HICPs are economic indicators constructed to measure the changes over time in the prices of and services acquired by households	Eurostat
Interest Rates	*MRO* (%)	ECB Main Refinancing Operations rate	ECB
	LT Interest Rates (%)	EMU convergence criterion bond yields on a monthly basis for Euro area	Eurostat
Governance	[*1999−2001*] (Dummy)	1 if the change in MRO was announced between 1999 and 2001, and 0 otherwise	ECB
	Duisenberg (Dummy)	1 if the chairman of ECB is W. Duisenberg, and 0 otherwise	ECB
Surprises	*Surprise by Sign* (multinomial)	The unexpected component of MRO announcements, defined according to the sign of difference between European ECB watchers' consensus, released in the financial press just before the ECB Board of Governors' meetings, and the decisions of the ECB	Authors
	Surprise by Length (multinomial)	The unexpected component of MRO announcements, defined according to the length of difference between European ECB watchers consensus, released in the financial press just before the ECB Board of Governors' meetings, and the decisions of the ECB	Authors