Received: 16 September 2021 | Accepted: 29 November 2021

DOI: 10.1111/manc.12393

ORIGINAL ARTICLE

The Manchester School WILEY

Is the ECB's conventional monetary policy state-dependent? An event study approach

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Abstract

We investigate the impact of ECB conventional (CMP) on national banking indices of 10 Eurozone countries and a Eurozone-wide banking index using the event study technique. We find that announcements of unexpected increases in interest rates benefit French, German, Greek and Italian banks when interest rates are low, while in other periods, the effect is muted. A plausible explanation is that bank profits are squeezed when interest rates are low because banks are reluctant to push deposit rates to zero. Our results are robust to potentially confounding events related to unconventional monetary policy announcements, volatility clustering and volatility expectations.

KEYWORDS

banking, conventional monetary policy, ECB, interest rate

JEL CLASSIFICATION

G01; G14; G18; E44; E52

1 | INTRODUCTION

The ECB, like other central banks around the world, has implemented both conventional (CMP) and unconventional monetary policy (UMP) measures to address financial crises (Eser & Schwaab, 2016; Rodnyansky & Darmouni, 2017). CMP measures influence economic activity primarily via changes

in interest rates, while UMP influence directly banks' balance sheets (Bernoth et al., 2016). Relying on a variety of monetary policy measures is essential because of Tinbergen's Law: if a central bank has N policy targets, it needs at least N policy instruments (Joyce et al., 2012).

In this paper, we address the following research questions: Which Eurozone banking systems are more sensitive to CMP announcements of the ECB? Is there any state-dependence in the bank stock return to CMP announcements?

We investigate the impact of CMP on banks because they play an important role in the monetary policy transmission channel. Two strands of literature emphasize the relationship between bank performance and CMP: a first strand focuses on the relationship between monetary policy shocks and bank profitability through the income and balance sheet channel (Alessandri & Nelson, 2015)[1]; a second strand examines the relationship between bank stock return and monetary policy (Akella & Greenbaum, 1992; Lumpkin & O'Brien, 1997). In line with this second strand of literature, we investigate the impact of CMP announcements on the Eurozone banking system using an event study methodology.

Investigating the impact of CMP on Eurozone banks is especially important because there is a feedback effect between sovereign and bank risk (Acharya et al., 2014; Acharya & Steffen, 2015; Fratzscher & Rieth, 2019), and therefore, the impact of monetary policy on banks is crucial to understand the overall impact on the real economy.

In this paper, we follow the approach developed by Kuttner (2001) and corrected by Thornton (2014) to estimate the impact of CMP announcements on Eurozone banking systems.[2] A second critical innovation is that we allow for UMP announcements in the estimation of the bank return to CMP announcements, eliminating the possibility to conflate the effects of these two types of policy.

Our period of investigation goes from 1 January 1999 to 14 September 2015, which is longer than that of papers focusing on the impact of CMP or UMP measures during the crisis (Eser & Schwaab, 2016; Fratzscher & Rieth, 2019). Therefore, our analysis covers both the financial crisis of 2007–2009 and the Eurozone crisis as well as the pre-crisis period. We define the US sub-prime crisis as the period from 1 July 2007 to 30 September 2009,[3] and the European sovereign debt crisis as the period from 1 October 2009 to 14 September 2015.[4]

We also investigate the impact of CMP announcements separately for the first phase of European sovereign debt crisis (1 October 2009 to 31 October 2011), and the second phase of European sovereign debt crisis (1 November 2011 to 14 September 2015). The cut-off date for the two stages of the Eurozone crisis reflects a clear switch in the monetary policy stance of the ECB: the interest rate cut (from 1.5% to 1.25%) in November 2011 kicked off a series of consecutive interest rate cuts until the end of the sample period (when it reached 0.05%).[5]

[1]Recent theoretical work suggests that expansive monetary policy may cause an increase in credit risk (Allen & Gale, 2000, 2004; Allen & Rogoff, 2011; Diamond & Rajan, 2012). Jiménez et al. (2014) confirms this hypothesis empirically.

[2]Kuttner's methodology has been employed in empirical studies about monetary policy in the United States, among others: Bernanke and Kuttner (2005); Ehrmann and Fratzscher (2004).

[3]For the definition of the beginning and the end of the US sub-prime crisis, we have followed the indications of the Business Cycle Dating Committee of the National Bureau of Economic Research (NBER). Since macroeconomic data return to the levels before the crisis in the last quarter of 2009, we consider September 2009 as end date, rather than June 2009.

[4]The Eurozone crisis erupted in late 2009 (Lane, 2012) and was characterized by high government structural deficits and accelerating government debt levels. During the Eurozone crisis, several Eurozone member states (Greece, Portugal, Ireland and Spain) were unable to repay or refinance their government debt or to bail out banks in distress without the assistance of third parties such as the ECB or the International Monetary Fund (IMF) (Ritzen, 2017). In August 2015, the last bailout for Greece was announced.

[5]https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html.

To isolate the effect of CMP when the interest rates are low, we exclude from our analysis the period after September 2015 because we want to eliminate the possibility of co-founding effect due to the quantitative easing (QE).[6]

We contribute to two strands of literature: the literature on the impact of government actions during crises on banks (Altavilla et al., 2018; Fiordelisi & Galloppo, 2018; Fiordelisi & Ricci, 2016; Fiordelisi et al., 2014; Ricci, 2015) and the literature on the effect of low-interest rates on banks' behaviour (Heider et al., 2019; Landi et al., 2020). Unlike this literature, we focus on the impact of unexpected changes in target interest rates when evaluating CMP actions. Moreover, we consider the impact on the national banking systems of these countries, because we are interested in the systemic impact of monetary policy, rather than the microeconomic impact.

We show that the impact of unexpected increases in target interest rates (positive surprises) tends to be either insignificant or positive. This result is at odds with Bernanke and Kuttner (2005). They find that unexpected increases of target rates have a negative impact on stock market returns (they did not consider only bank stocks) on target rate announcement days. Since in our robustness checks, we also control for the impact of CMP on broader stock market returns, it is unlikely that this finding is driven simply by the fact that we are considering European markets, rather than the American one. Our results also differ from those reported by English et al. (2018). They find that unanticipated increases in the level of interest rates are negatively correlated with bank stock return in the United States in the period from 1992 to 2007. However, they do not consider the period of low interest rates.

In particular, we show that for some countries (France, Germany, Greece and Italy), positive surprises generate a positive stock return in the second phase of the Eurozone crisis (after October 2011), when interest rates are low, while for other periods the results tend to be insignificant. A plausible cause of this finding is that banks may benefit from higher interest rates when interest rates are low in these countries. Recent literature supports the view that banks are reluctant to pass negative rates to depositors, and as a result, their profits are squeezed (Heider et al., 2019). Thus, an unexpected increase in interest rates is good news when interest rates are close to zero or negative, and the interest margin is squeezed. Finally, our findings suggest that CMP by ECB affects the Eurozone bank system only during the period of low-interest rate.

In the rest of the paper, we proceed as follows. Section 2 introduces the institutional background and testable predictions. Section 3 explains our econometric strategy. Section 4 describes the data. Section 5 reports our main results and robustness checks. Section 6 concludes.

2 | INSTITUTIONAL BACKGROUND AND HYPOTHESES

2.1 | Institutional background

We define decisions on target interest rates for the Main Refinancing Operations (MRO) as CMP. Until 2001, the ECB's board of directors met twice a month, while from 2002 onwards once a month. The ECB cut interest rates mainly from 2007 to 2014, due to the US sub-prime

[6]The QE affects banks' profitability in three ways: (1) increase the bond prices improving the banks' balance sheets; (2) reduces the term spread yield reducing the banks' net interest income, and (3) improve the economic outlook improving banks to find new lending opportunities (Demertzis & Wolff, 2016).

crisis and the Eurozone crisis. We consider as UMP measures: rules about collateral eligibility (denoted with COLL); liquidity provision at longer maturities (LTRO, TLTRO); Covered Bond Purchase Programs (CBPP1, CBPP2, CBPP3), Outright Monetary Transactions (OMT); and ABS and Public Sector Purchase Programme (ABSPP, PSPP). We do not consider liquidity provision measures (such as currency swaps), because the ECB does not consider them as UMP measures.[7] In Table 1, Panel A, we list CMP announcements from 1999 to 2015, while in Panel B, we list the 20 UMP announcements. We report separately, the statistics for interest rate cuts (IR_CUT), increases (IR_INCR) and no change (IR_UNC). The number of CMP events is 231. In Table 2, we summarize the key features of announcements related to UMP measures.

2.2 | Hypotheses

We develop testable predictions for how European bank stock returns respond to CMP shocks.

2.2.1 | Impact of CMP measures on bank stock returns

Policymakers acknowledge that the stock market is an important conduit of monetary policy. Fluctuations in stock prices may affect the cost of capital of firms and their ability to raise new capital and invest (Ehrmann & Fratzscher, 2004; Fama & French, 1988). The stock market can also affect consumption and economic growth Lettau and Ludvigson (2001).

Expansionary policy interventions should elicit a positive stock market response because they improve the future dividend streams, reduce the discount rate, and increase the equity market premium (Bernanke & Gertler, 1995; Gertler & Bernanke, 1989). Using the event-study methodology, Bernanke and Kuttner (2005) show that unexpected increases in the target interest rate decrease stock market return on announcement days.

Following this literature, our first hypothesis seeks to determine the impact of unexpected changes in interest rates on bank stock returns. In banks, an increase in the target rate can have either a positive or a negative impact on bank profitability, depending on two factors. On the one hand, there is the non-interest income effect and, on the other hand, there is the interest income effect (Borio et al., 2017).

The non-interest income effect is related to the impact of a change in the discount factor on the value of banks' security portfolios and on the future income from fees and commissions. In particular, an increase (decrease) in the discount factor generates a decrease (increase) in the overall market value of the banks' security portfolios and a decrease (increase) in the present value of the future streams of fees and commissions.

A recent paper by English et al. (2018) finds that unanticipated increases in the level of interest rates decrease bank stock returns in the United States. This finding is consistent with those provided by Bernanke and Kuttner (2005).

Following these considerations, our first hypothesis is as follows:

[7] https://www.ecb.europa.eu/press/key/date/2017/html/ecb.sp170912.en.html.

TABLE 1 Monetary policy announcements

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Panel A—CMP announcements																		
IR_Unc	18	18	20	11	10	12	11	7	9	9	8	12	8	11	10	10	6	190
IR_Incr	1	6	0	0	0	0	1	5	2	1	0	0	2	0	0	0	0	18
IR_Cut	1	0	4	1	2	0	0	0	1	3	4	0	2	1	2	2	0	23
Total	20	24	24	12	12	12	12	12	12	13	12	12	12	12	12	12	6	231
Panel B—UMP announcements																		
Announcements	0	0	0	0	0	0	0	0	0	1	2	0	2	5	1	5	4	20
COLL	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	4
LTRO	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	3
TLTRO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
CBPP	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	2	1	7
OMT	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
ABSPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	7
PSPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Multiple Ann.	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0	1	2	7
No multiple Ann.	0	0	0	0	0	0	0	0	0	0	1	0	1	4	1	4	2	13

Notes: This table reports annual statistics about ECB monetary policy announcements during the period: January 1999–September 2015. Panel A reports statistics for CMP announcements. IR_CUT denotes interest rate cuts; IR_INCR indicates interest rate increases; IR_UNC indicates stable interest rates. Panel B reports statistics for UMP announcements. COLL indicates announcements related to the ECB collateral eligibility framework; LTRO stands for Long-Term Refinancing Operations; CBPP relates to announcements about the Covered Bond Purchase Programme; OMT indicates Outright Monetary Transactions; ABSPP stands for Asset-Backed Securities programme; PSPP indicates Public Sector Purchase interventions; and QE indicates Quantitative Easing measures. *Source*: ECB Press releases, https://www.ecb.europa.eu/press/pr/date/2017/html/index.en.html.

TABLE 2 UMP events

Event date	Short description	Abbreviation
October 15, 2008	Measures to further expand the collateral framework and enhance the provision of liquidity	COLL, LTRO
May 07, 2009	Longer-term refinancing operations and Covered Purchase Programme	LTRO1, CBPP
June 04, 2009	Purchase programme for covered bonds	CBPP1
October 06, 2011	ECB announces details of refinancing operations from October 2011 to 10 July 2012 - ECB announces new covered bond purchase programme	LTRO2, CBPP2
November 03, 2011	ECB announces details of its new covered bond purchase programme (CBPP2)	CBPP2.1
February 09, 2012	ECB's Governing Council approves eligibility criteria for additional credit claims	COLL1
June 22, 2012	ECB takes further measures to increase collateral availability for counterparts	COLL2
July 26, 2012	Draghi's London Speech: "Whatever it takes"	OMT
August 27, 2012	ECB announces Outright Monetary Transaction	OMT1
September 06, 2012	Technical features of Outright Monetary Transactions	OMT2, COLL3
June 18, 2013	ECB reviews its risk control framework allowing for a new treatment of asset-backed securities	ABSPP
June 03, 2014	ECB announces Target-Longer-term refinancing operations	TLTRO
September 04, 2014	ECB modifies loan-level reporting requirements for some asset-backed securities	ABSPP1
October 02, 2014	ECB announces operational details of asset-backed securities and covered bond purchase programmes	ABSPP2, CBPP3
October 15, 2014	ECB announces details on the implementation of the third covered bond purchase programme	CBPP3.1
November 19, 2014	ECB announces details on the implementation of the asset purchase program-backed securitizations	ABSPP3
January 22, 2015	ECB announces expanded asset purchase programme	ABSPP4, CBPP3
March 04, 2015	ECB announces details on the public sector purchase programme	PSPP
March 18, 2015	ECB announces criteria for the purchase of guaranteed mezzanine tranches of ABS under the ABSPP	ABSPP5
September 03, 2015	ECB announces to increase the upper limit for buying sovereign European securities	ABSPP6, PSPP

Source: ECB Press releases. https://www.ecb.europa.eu/press/pr/date/2017/html/index.en.html.

- **H1: Discount Factor Channel Hypothesis.** Unexpected increases in interest rates (positive surprises) have a *negative impact* on the stock returns of Eurozone banks on target announcement days.

If the demand for loans is more elastic to interest rates than the demand for deposits, as in Klein–Monti model (Klein, 1971; Monti, 1972), then the increase in the policy rate has a positive effect on

the net interest income.[8] Therefore, the interest income effect is likely to result in a positive relationship between interest rates and stock return. The interest income effect can also offset, at least partly, the non-interest income effect: English et al. (2018) find that the negative bank stock return to positive surprises is smaller for banks with large maturity mismatches (that is, banks for which the interest income effect is stronger).

It is an empirical question whether the non-interest income effect is stronger than the interest income effect in Eurozone banks, and for this reason, we formulate an alternative hypothesis to *H1*: provided that the non-interest income effect is weaker than the interest income effect, there should be a positive stock return to ECB announcements related to unexpected positive changes in interest rates (positive surprises).

- **H2: Interest Rate Channel Hypothesis.** Unexpected increases in interest rates (positive surprises) have a *positive impact* on the stock returns of Eurozone banks on target announcement days.

It is important to emphasize that *H1* and *H2* need not be mutually exclusive because there may be state-dependence in the stock return. In particular, the positive impact of positive surprises could be limited to periods of low-interest rates, when the average net interest income is low (Heider et al., 2019). It is equally important to highlight that we do not use the proxy for the impact of CMP using only dummies that take the value one on announcement days and zero otherwise. Instead, we interact these dummies with unexpected changes in interest rates on announcement days, because we want to reduce the probability that we are capturing the effect of other events on bank stock returns.

- **H3: Low Interest Rate Hypothesis.** Unexpected increases in interest rates (positive surprises) have a positive impact on the stock returns of Eurozone banks on target announcement days *during periods of low-interest rates*.

The target interest rate dropped from 3.25% in November 2008 (sub-prime crisis) to 1.50% in July 2011 (first stage of the Eurozone crisis), and from November 2011 (second stage of the Eurozone crisis) to the end of our sample period it kept dropping until it reached 0.05% (in September 2014). For this reason, *H3* is consistent with a positive impact of positive surprises for CMP announcements in the second stage of the Eurozone crisis.

To test these hypotheses, we estimate the stock market reaction to CMP announcements for 11 banking indices: a bank index for the whole Eurozone area (Euro Stoxx Banks) and 10 national banking indices: Austria DS Banks (Austria), FTSE Belgium Banks (Belgium), EuroNext Cac Banks (France), DAX XETRA Banks (Germany), FTSE Athex Banks (Greece), ISEQ Financial (Ireland), FTSE Italy Banks (Italy), Netherlands DS Banks (the Netherlands), Portugal DS Banks (Portugal), FTSE Spain Banks (Spain). Moreover, we construct three separate dummies for the US sub-prime crisis period and the two stages of the Eurozone crisis to understand whether there is state-dependence in the market reaction to CMP measures.

[8]Other factors that play a role are: inertia in prices, reflecting some oligopolistic power of the banking system, and accounting practices based on the incurred loss model. For a review, see Freixas and Rochet (2008).

3 | ECONOMETRIC METHODOLOGY

The existing literature has employed two methods to study the effects of monetary shocks on the stock market: vector autoregression (VAR) models and 'event studies'. While the VAR methodology allows studying the effects of monetary policy shocks on key variables such as prices, output and employment (Burriel & Galesi, 2018; Thorbecke, 1997), time aggregation of data at low frequencies (e.g. monthly or quarterly) generally produces simultaneity in economic data, even if there is unidirectional causality at very high frequencies (Fawley & Neely, 2014; Thornton, 2003).

Moreover, it is unlikely that asset price changes within the meeting day influence monetary policy decisions. On the contrary, asset price movement before monetary policy decisions possibly influenced such decisions. Both simultaneity issues and the omission of relevant variables that affect asset prices leaves one highly uncertain about the consequence of monetary policy shocks on monthly variables. The seminal paper of Kuttner (2001) allows extracting monetary policy surprises from the interest rate target changes. Then, it is easy to determine the effects of monetary policy surprises on asset prices, which inform about the transmission of all monetary policies. For these reasons, many studies identify the effects of high-frequency (daily, hourly) monetary shocks on asset prices using an event-study methodology (Altavilla et al., 2019; Bernanke & Kuttner, 2005; Ehrmann & Fratzscher, 2004). The assumption is that monetary policy does not respond to asset price changes within the day. Hence causality goes from monetary policy to asset prices, and financial markets' reaction to monetary policy can be examined through the event-study methodology (Altavilla et al., 2019).

Since our main objective in this paper is to identify monetary policy shocks in the Eurozone banking sector, we adopt an event-study approach.

3.1 | Estimating the price reaction to CMP

The efficient markets hypothesis implies that, because financial markets are forward-looking, only the unexpected portion of CMP measures should influence asset prices, and it should do so very quickly. Therefore, we follow the approach introduced by Kuttner (2001)[9] and estimate the expected component and the unexpected component of changes in interest rates, similar to Bernanke and Kuttner (2005), who estimate the impact of monetary policy actions on US stock market returns. In our analysis, we allow for joint-response bias (Thornton, 2014), and we make further adjustments to accommodate the nature of our data (because we use Eurozone banking indices, rather than US stock market indices).[10]

[9]Kuttner (2001) used the federal funds' futures rate change on days when the funds' rate target was changed as a proxy for the unexpected target change.

[10]In our regressions, we consider both event-days and non-event days because Thornton (2014) shows that discarding non-event days from the analysis can result in joint-response bias, and the estimated stock market reaction overstates the effect of monetary policy events. Using only observations for which there are CMP announcements assumes that interest rates respond only to monetary policy actions on announcement days, while they react to the news every day. Thus, omitting non-event days can lead to wrong inferences. For this reason, we consider both event-days and non-event days when we run the regressions. Furthermore, when we use only the 231 CMP event-days for our analysis, similar to Bernanke and Kuttner (2005), the results change substantially, suggesting that using Thornton's method is not trivial. The results for these estimations are available upon request.

Our baseline specification is based on the following OLS regression with heteroscedasticity and autocorrelation consistent (HAC) standard errors[11]:

$$\begin{aligned} Return_t = \alpha_0 + \beta_1 Return_{t-1} + \beta_2 \Delta i_t^u + \beta_3 S\_ECB + \beta_4 S\_Crisis + \beta_5 S\_FE + \beta_6 S\_SE + \\ \beta_7 E\_ECB * ECBAnnouncement + \beta_8 ECBAnnouncement + \beta_9 Crisis + \\ \beta_{10} First\_Sovereign\_Crisis + \beta_{11} Second\_Sovereign\_Crisis + \\ \beta_{12} UMP\_Crisis + \beta_{13} UMP\_FSC + \beta_{14} UMP\_SSC + \mu_t \end{aligned} \tag{1}$$

where:

$S\_ECB = \Delta i_t^u * ECBAnnouncement$;
$S\_Crisis = \Delta i_t^u * ECBAnnouncement * Crisis$;
$S\_FE = \Delta i_t^u * ECBAnnouncement * First\_Sovereign\_Crisis$;
$S\_SE = \Delta i_t^u * ECBAnnouncement * Second\_Sovereign\_Crisis$.

In the equations above, $Return_t$ is the daily return of any of European banking indices chosen. We use the Euro Stoxx Bank price index as a proxy for the European banking system. We also consider ten national banking indices for the same countries examined by Eser and Schwaab (2016) and Fratzscher and Rieth (2019): Austria, Belgium, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

The unexpected interest rate changes (surprises), denoted Δi_t^u, are defined as the changes in the implied 3-month Euribor rate, t, relative to the previous day, $t-1$. i.e.: $\Delta i_t^u = (f.Euribor_{m,t} - f.Euribor_{m,t-1})$; where $f.Euribor_{m,t}$ represents the futures rate at day t (Monticini et al., 2011).[12] We use continuous 3-month Euribor futures rates because Bernoth et al. (2004) show that these rates are a reliable predictor for the ECB's policy rates.[13]

Following Kuttner (2001); Bernanke and Kuttner (2005); Thornton (2014), we define the expected changes in interest rate *E_ECB* as the actual changes minus the surprise: $E\_ECB = \Delta R - \Delta i_t^u$, where *E_ECB* represents the expected component of target changes and ΔR is the actual target rate change on the announcement day. *ECBAnnouncement* is a dummy variable that takes value 1 when the ECB announced a conventional policy (interest rate target).

We also add additional control variables to account that our results could be driven by the financial turmoil experienced after the US subprime crisis. The variables *Crisis*, *First_Sovereign_Crisis* and *Second_Sovereign_Crisis* are indicator variables capturing the effect of entire phases of the crisis. The variables take the value of one during the following periods (zero otherwise): *Crisis* from 1 July 2007 to 30 September 2009, *First_Sovereign_Crisis* from 1 October 2009 to 31 October 2011 and *Second_Sovereign_Crisis* from 1 November 2011 to 14 September 2015.

[11]We select the order of the AR model using Akaike's information criterion (AIC). We choose the first lag for which is minimised the value of the AIC. Consistent with Müller (2014), we use the HAC standard error that fit well for a stationary AR(1) model, as in our case.

[12]Bernanke and Kuttner (2005) adjust the futures Fed funds rate by the number of days of the month affected by the change in the reference rate. Since the contract's settlement price is based on the monthly average Fed funds rate, the change in the implied futures rate must be scaled up by a factor related to the number of days in the month affected by the change. In our case, using continuous futures contracts renders the adjustment made by Bernanke and Kuttner (2005) unnecessary.

[13]In the literature about the US banking system, Fed funds futures are employed. Fed funds futures offer three advantages (Kuttner, 2001): (i) Futures require no model; (ii) futures data are not revised, and so there is no 'data vintage' problem; and (iii) futures do not entail an errors-in-variables problem.

3.1.1 | Testing H1–H3

To test *H1* and *H2*, we estimate the stock market reaction to unexpected changes in interest rates on CMP announcements days. Since we are interested in the impact of unexpected changes in interest rates on the stock market reaction, we need to consider the sum of the coefficients on Δi_t^u and *S_ECB* ($\beta_2 + \beta_3$). If this value is negative (positive) and statistically significant, then *H1* (*H2*) is valid. Finally, since interest rates in the Eurozone reached very low levels in the second stage of the Eurozone crisis, *H3* is consistent with a positive and statistically significant sum of the coefficients β_2, β_3 and β_6.[14]

We also control for the UMP to avoid that those policies drive our results. Specifically, the variables *UMP_Crisis*, *UMP_FSC* and *UMP_SSC* are indicator variables capturing the effect of unconventional measures during the sub-prime crisis, the first stage of the Eurozone crisis and the second stage of the Eurozone crisis, respectively. These variables take the value of one when the ECB announces an unconventional policy and zero otherwise. We identify 19 announcements that relate to UMP measures.[15]

The empirical literature documents that volatility persistence affects stock returns Chou (1988); Lamoureux and Lastrapes (1990) since our dependent variable is an equity index return, volatility persistence could affect our main results. To allow for substantial changes in volatility over the sample period, likely to have occurred mainly after 2007, we also employ an AR (1)-GARCH (1,1) model (Bollerslev, 1986; Engle, 1982):

$$\begin{aligned} Return_t = {} & \alpha_0 + \beta_1 Return_{t-1} + \beta_2 \Delta i_t^u + \beta_3 S\_ECB + \beta_4 S\_Crisis + \beta_5 S\_FE + \beta_6 S\_SE \\ & + \beta_7 E\_ECB * ECBAnnouncement + \beta_8 ECBAnnouncement + \beta_9 Crisis \\ & + \beta_{10} First\_Sovereign\_Crisis \\ & + \beta_{11} Second\_Sovereign\_Crisis + \beta_{12} UMP\_Crisis + \beta_{13} UMP\_FSC + \beta_{14} UMP\_SSC + \mu_t \end{aligned} \tag{2}$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \tag{3}$$

where σ_{t-1}^2 represents the first lag of conditional volatility and μ_{t-1}^2 is the first lag of the squared innovations.

4 | DATA

In this section, we describe our data and we show descriptive statistics. Our data set covers the period from January 1999 to September 2015 and comprises monetary policy indicators (both unexpected and expected components), returns for the Eurozone bank index (Euro Stoxx Bank) and for country-specific banking-sector indices, and dummy variables to capture the effect of ECB announcements related to CMP and UMP.

Table 3 presents descriptive statistics for the absolute value of expected (*E_ECB*) and unexpected changes (*S_ECB*; *S_Crisis*; *S_FE*; *S_SE*) in interest rates. Panel A reports the

[14]The variable *S_ECB* represents the average impact of conventional policy measures throughout the sample, while *S_Crisis*, *S_FE* and *S_SE* capture the impact of CMP during the three different phases of the crisis.

[15]There are three announcements for LTRO, 1 for TLTRO; 4 for COLL; 7 for CBPP; 3 for OMT; 7 for ABSPP; and 2 for PSPP. Of these 20 announcement days, 7 have more than one press release related to UMP measures.

TABLE 3 Descriptive statistics

Variable	N	Mean	*SD*	Min	Max
Panel A—Non-event days excluded					
S_ECB	231	−0.15368	0.0535289	−3	2.7
E_ECB	231	−1.18831	0.1677661	−7	7.25
S_Crisis	31	−0.37097	0.0784428	−3	1.25
S_FE	25	−0.36	0.0533955	−1.7	0.9
S_SE	44	0.09091	0.0242149	−0.4	0.85
Panel B—Non-event days included					
Δi^u	4356	0.07461	0.0361151	−4	8.45
S_ECB	4356	−0.00815	0.0123063	−3	2.7
E_ECB	4356	−0.06302	0.0064853	−7	7.25
S_Crisis	4356	−0.00356	0.0039732	−3	1.25
S_FE	4356	−0.00207	0.0024079	−1.7	0.9
S_SE	4356	0.000918	0.0386463	−0.4	0.85
Panel C—Banking indices returns					
	Total sample (January 1999–September 2015)				**sub-prime crisis (June 2007—September 2009)**
Variable	*N*	**Mean**	*SD*	**Max%**	**Min%**	**N**	**Mean**	*SD*	**Max%**	**Min%**
Eurozone	4356	−1.543	1.885	17.763	−10.829	651	−11.60706	2.724591	14.1356	−10.8291
Austria	4356	1.782	2.004	14.322	−13.532	651	−12.31969	3.338633	14.32265	−13.53208
Belgium	4356	−2.691	2.593	19.457	−27.184	651	−23.33854	4.251591	19.45721	−27.1842
Spain	4356	−1.207	1.969	19.808	−12.095	651	−4.38675	2.595438	12.35374	−12.09556
France	4356	1.028	2.211	19.243	−14.758	651	−10.77413	3.338779	17.99896	−12.7851
Germany	4356	−1.8296	2.305	18.713	−17.743	651	−15.29325	3.836608	18.71309	−17.74322
Greece	4356	−11.429	3.428	25.559	−35.559	651	−15.09917	3.03724	12.2802	−10.61679
Ireland	4356	−6.67	3.266	24.94	−67.517	651	−41.08531	6.462624	24.9479	−67.51775
Italy	4356	−2.837	2.138	16.87	−13.386	651	−11.91788	2.726476	11.53796	−11.24083
Netherlands	4356	−6.653	2.88	15.116	−129.914	651	−42.01423	6114761	15.11634	−12.99141
Portugal	4356	−6.474	1.896	16.638	−12.605	651	−18.60042	1.959429	90.89281	−10.09637
	First period Sov.debt crisis (October 2009–October 2011)					**Second period Sov. debt crisis (November 2011–September 2015)**				
Eurozone	543	−14.131	2.453	17.764	−9.291	1010	2.266	1.925	8.18	−9.185
Austria	543	−11.028	2.347	12.89	−8.875	1010	1.622	1.966	9.008	−10.445
Belgium	543	−19.81	3.143	19.209	−10.766	1010	11.539	2.664	13.044	−13.969
Spain	543	−11.007	2.441	19.809	−8.917	1010	−0.762	1.844	9.854	−8.964
France	543	−13.052	2.991	19.244	−12.146	1010	6.446	2.114	9.656	−14.758
Germany	543	−9.967	2.468	14.429	−8.928	1010	−0.08	1.994	9.004	−8.726
Greece	543	−44.464	3.937	25.559	−18.455	1010	−25.025	5.539	23.849	−35.56
Ireland	543	-51.199	4.416	18.93	−20.604	1010	10.829	2.485	13.004	−10.5
Italy	543	−17.865	2.743	16.871	−10.945	1010	4.875	2.542	11.202	−13.386
Netherlands	543	−9.036	1.441	5.928	−8.795	1010	−1.096	1.846	11.766	−9.649
Portugal	543	−26.147	2.17	12.788	−7.056	1010	−8.648	2.994	16.638	−12.605

Notes: Monetary policy variables and banking indices returns. In the Panels, we report the number of observations, mean, standard deviation (*SD*), min and max. Panel A reports the statistics considering only event days. Panel B consider all the observations available during our sample period. The data reported are in basis points. In Panel C, we consider the following indices: Euro Stoxx Banks index (Eurozone), Austria DS Banks (Austria), FTSE Belgium Banks (Belgium), EuroNext Cac Banks (France), DAX XETRA Banks (Germany),FTSE Athex Banks (Greece), ISEQ financial (Ireland), FTSE Italy Banks (Italy), Netherlands DS Banks (the Netherlands), Portugal DS Banks (Portugal), FTSE Spain Banks (Spain). The statistics are reported in basis points, apart from min and max, which are reported in percentage points.

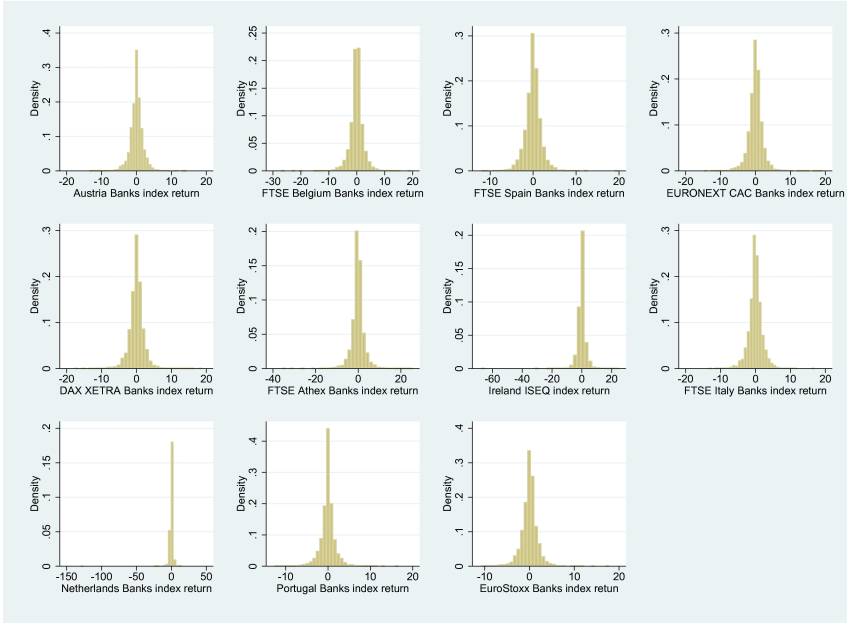

FIGURE 1 Histogram of European banking indices returns (January 1999–September 2015) [Colour figure can be viewed at wileyonlinelibrary.com]

statistics for event-days only, while Panel B reports the statistics for both event days and non-event days. The mean expected change is −1.18 basis points (bp), and the standard deviation is 0.16 bp, while the unexpected mean change is −0.15 bp (standard deviation 0.053 bp). During the Great Recession, the unexpected mean change (*S_Crisis*) tends to be larger in absolute value (−0.37 bp), and the same phenomenon occurs during the first phase of the sovereign debt crisis (*S_FE*), for which the unexpected mean change is −0.36 bp. Finally, during the second phase of the sovereign debt crisis, the unexpected mean change (*S_SE*) is positive (0.09 bp).

Table 3, Panel C, reports descriptive statistics for the returns of the 11 bank indices. As reported in Figure 1, the returns of the bank indices for Ireland and the Netherlands exhibit a highly negatively skewed distribution, suggesting that crashes are more likely than for a normal distribution. For this reason, in the subsequent econometric analysis, we run robustness tests based on asymmetric GARCH models.

The mean return for the Euro Stoxx bank index is −1.5 bp for the whole sample period and −11.60 bp during the Great Recession. The standard deviation of returns increases from 1.88 bp to 2.72, consistent with the view that, during the crisis, greater instability leads to higher stock market volatility. During the first phase of the sovereign debt crisis, the average return drops further, to −14.13 bp, but the standard deviation also decreases (2.45 bp). The negative performance of the Euro Stoxx bank index turns to positive during the second phase of the sovereign debt crisis when the mean return is 2.2 bp, and its standard deviation decreases further (1.92 bp). These statistics suggest that negative shocks in interest rates occur in periods when there are also declines in the returns of European bank stocks and vice versa for positive shocks.

5 | RESULTS

This section focuses on the impact of CMP on the 11 bank indices. We start from our main results, based on OLS regressions, and then we run robustness checks to ensure that our results are not sensitive to the choice of the econometric model chosen.[16]

5.1 | Main results

Results in Table 4 show that the coefficients on Δi^u are negative and statistically significant for all indices, suggesting that an unexpected interest rate increase decreases bank stock returns.

The coefficient on *S_ECB* is positive and statistically significant for the Euro Stoxx bank index, but the sum of the coefficients β_2 and β_3 is not. The same applies to the results for the national indices. Therefore, *H2* is not supported by our results.[17]

The coefficients on *S_Crisis* are insignificant at the 5% level for all indices. The coefficients on *S_FE* are also insignificant, apart from one case: for Greece, the coefficient is negative and significant in Table 4. Finally, although the coefficients on *S_SE* are positive for all countries, they are significant at the 5% level only for France, Germany, Greece and Italy.

Notably, the sum of the coefficients β_2, β_3 and β_4, and β_2, β_3 and β_5 are statistically insignificant, suggesting that the negative impact of positive surprises in interest rates becomes insignificant on target rate announcement days during the US subprime and first EU sovereign debt crisis. However, the sum of the coefficients β_2, β_3 and β_6 is positive and significant for the Euro Stoxx bank index, as well as for the national banking indices of France, Germany, Greece and Italy during the low-interest rate period. For these countries, *H3* is supported.

These results are consistent with the view that the positive impact of CMP could be limited to periods of low-interest rates (Heider et al., 2019) and for banks with large maturity transformations (English et al., 2018). In line with the fact that the Euro Stoxx bank index is composed mainly by commercial banks that provide traditional banking services.

5.2 | Robustness checks

Table 5 Panel A contains tests based on placebo CMP events, in line with Bruno et al. (2018). The purpose of these tests is to understand whether our results are driven by an upward or downward short-term trend in bank returns before and after the events, for example, because of anticipation effects or post-announcement drift effects. The placebo events are three and five trading days before and after each CMP announcement. In the table, we show the results for the Euro Stoxx bank index (Eurozone). In the first section of Panel A, we consider placebo events three days before the actual events related to CMP measures, and we denote these new variables as *S_ECB3b*, *S_Crisis3b*, *S_FE3b* and *S_SE3b*. In the second section of Panel A, we consider placebo events 5 days before the actual announcements (*S_ECB5b*, *S_Crisis5b*, *S_FE5b* and *S_SE5b*). In the third and fourth section of Panel A, we consider the

[16]We tested for multicollinearity among the explanatory and control variables by calculating the variance inflation factors (VIFs). The mean VIF is equal to 1.22.

[17]The coefficients on *S_ECB* are positive and significant a the 5% level, apart from those for the bank indices for Austria, Greece, the Netherlands and Spain, for which the results are significant at the 10% level or insignificant.

TABLE 4 Market reaction to ECB's CMP announcements

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Δi^u	−9.035***	−5.702***	−8.929***	−10.487***	−12.431***	−4.295***	−8.386***	−7.583***	−7.524***	−2.420**	−8.632***
	(1.423)	(1.516)	(1.921)	(1.635)	(1.858)	(1.577)	(2.343)	(1.477)	(2.162)	(1.055)	(1.421)
S_ECB	10.454***	5.881	12.735**	10.640**	14.293***	6.078	17.278***	9.428**	9.098*	3.588**	9.642**
	(3.932)	(3.823)	(5.715)	(4.745)	(5.212)	(3.874)	(6.088)	(3.976)	(4.798)	(1.802)	(4.362)
S_Crisis	−6.047	−14.284	−0.227	−4.228	−8.352	−4.683	−9.303	−5.222	1.699	−9.103	−5.190
	(8.325)	(11.143)	(9.530)	(9.673)	(11.816)	(7.225)	(15.265)	(7.186)	(9.970)	(5.863)	(8.764)
S_FE	−3.438	2.263	1.300	−6.064	−3.178	−20.544*	1.032	−3.347	−0.947	4.084	−0.760
	(9.852)	(8.227)	(11.815)	(9.127)	(8.649)	(10.741)	(10.333)	(14.578)	(6.619)	(7.021)	(11.051)
S_SE	33.304**	19.546*	23.345	48.984***	37.821***	68.868***	11.155	52.198**	12.930	29.439	13.833
	(14.634)	(10.101)	(16.945)	(15.261)	(13.390)	(24.869)	(15.516)	(22.328)	(10.318)	(23.448)	(13.949)
E_ECB	2.411**	0.506	3.175	1.856	3.711**	1.689	6.315**	3.269***	1.844*	0.320	1.966
	(1.197)	(1.509)	(2.172)	(1.472)	(1.730)	(1.348)	(2.510)	(1.243)	(1.097)	(0.622)	(1.203)
ECBAnnouncement	−0.011	0.044	0.158	0.048	−0.008	0.205	0.135	−0.158	0.064	0.198*	−0.004
	(0.128)	(0.133)	(0.194)	(0.143)	(0.149)	(0.188)	(0.188)	(0.151)	(0.142)	(0.116)	(0.146)
UMP_Crisis	−2.831	−4.005	−0.352	−3.701**	−3.456	−5.770***	−0.336	−2.566	0.534	0.733	−2.061
	(2.038)	(4.098)	(5.272)	(1.572)	(4.097)	(1.623)	(2.437)	(1.944)	(1.153)	(2.093)	(1.745)
UMP_FSC	3.356***	0.517	4.345***	5.855***	2.106**	−2.356**	4.112***	3.892***	−0.201	0.232	2.615**
	(1.003)	(0.877)	(1.257)	(0.920)	(0.846)	(1.094)	(1.120)	(1.498)	(0.604)	(0.745)	(1.113)
UMP_SSC	1.062	0.550	1.027	1.353	1.104	−0.286	0.862	0.856	0.239	−0.018	1.081
	(0.867)	(0.603)	(0.962)	(0.884)	(0.767)	(1.236)	(0.845)	(1.046)	(0.651)	(0.842)	(0.879)
Crisis	−0.043	−0.128	−0.115	−0.052	−0.045	−0.061	−0.196	−0.028	−0.389	−0.176**	0.015
	(0.113)	(0.138)	(0.174)	(0.140)	(0.157)	(0.125)	(0.261)	(0.115)	(0.276)	(0.083)	(0.111)
First_Sovereign_Crisis	−0.168	−0.187*	−0.189	−0.189	−0.133	−0.430**	−0.478**	−0.184	−0.104	−0.257***	−0.134
	(0.108)	(0.104)	(0.138)	(0.130)	(0.111)	(0.174)	(0.192)	(0.121)	(0.073)	(0.095)	(0.110)
Second_Sovereign_Crisis	0.006	−0.060	0.113	0.018	−0.012	−0.235	0.090	0.058	−0.008	−0.093	−0.020
	(0.066)	(0.068)	(0.091)	(0.073)	(0.073)	(0.176)	(0.084)	(0.086)	(0.070)	(0.096)	(0.067)

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
_cons	0.016	0.074**	−0.015	0.038	0.018	0.008	0.007	−0.002	0.004	0.008	0.011
	(0.028)	(0.029)	(0.035)	(0.032)	(0.037)	(0.038)	(0.030)	(0.032)	(0.039)	(0.020)	(0.035)
F-test	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)
$\beta 2+\beta 3$	0.15	0.00	0.50	0.00	0.15	0.25	2.47	0.25	0.14	0.65	0.06
$\beta 2+\beta 3+\beta 4$	0.35	1.71	0.13	0.19	0.35	0.21	0.00	0.25	0.14	1.81	0.27
$\beta 2+\beta 3+\beta 5$	0.05	0.09	0.20	0.48	0.03	3.17*	0.95	0.01	0.01	0.58	0.00
$\beta 2+\beta 3+\beta 6$	5.64**	3.51*	2.46	10.30***	8.55***	8.20***	1.48	5.80**	2.04	1.69	1.18
N	4355	4355	4355	4355	4355	4355	4355	4355	4355	4355	4355
R^2	0.038	0.020	0.033	0.038	0.045	0.017	0.036	0.025	0.012	0.017	0.027
AIC	17,736	18,359	20,541	19,119	19,463	23,039	22,537	18,888	21,548	17,884	18,162
BIC	17,825	18,448	20,630	19,209	19,552	23,128	22,627	18,977	21,637	17,973	18,251
Log Likelihood	−8854	−9165	−10,256	−9546	−9717	−11,505	−11,255	−9430	−10,760	−8928	−9067

Notes: This table reports the results of OLS regressions based on Equation (1). The sum of coefficients is estimated using the *F*-test. All regressions are estimated with HAC standard errors (reported in parentheses).

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 5 Robustness checks

		S_ECB3b	S_Crisis3b	S_FE3b	S_SE3b
Panel A—Placebo analysis for CMP on the event day					
	Eurozone	−1.388	0.913	0.659	−16.957
		(2.060)	(2.805)	(6.754)	(13.178)
Controls		Yes	Yes	Yes	Yes
N		4355	4355	4355	4355
		S_ECB5b	**S_Crisis5b**	**S_FE5b**	**S_SE5b**
	Eurozone	0.433	−0.790	−2.639	−4.527
		(1.556)	(2.536)	(6.902)	(9.044)
Controls		Yes	Yes	Yes	Yes
N		4355	4355	4355	4355
		S_ECB3a	**S_Crisis3a**	**S_FE3a**	**S_SE3a**
	Eurozone	**2.542***	**−22.441****	2.806	−9.833
		(1.524)	(9.686)	(22.329)	(11.638)
Controls		Yes	Yes	Yes	Yes
N		4355	4355	4355	4355
		S_ECB5a	**S_Crisis5a**	**S_FE5a**	**S_SE5a**
	Eurozone	1.574	**−13.840***	−8.335	−14.060
		(1.391)	(7.996)	(18.126)	(10.027)
Controls		Yes	Yes	Yes	Yes
N		4355	4355	4355	4355

Panel B—Market adjusted returns (MAR)

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
S_ECB	1.448	−1.243	0.267	3.173	1.391	0.781	1.711	0.869	1.744	−1.471	−0.067
	(1.776)	(2.206)	(2.154)	(2.617)	(2.428)	(2.916)	(2.394)	(2.565)	(2.286)	(2.041)	(1.954)
S_Crisis	4.847	0.567	6.147	5.918	5.708*	3.146	2.535	5.869	−8.735	2.225	8.171
	(4.143)	(5.590)	(7.862)	(5.760)	(3.175)	(4.906)	(6.145)	(3.721)	(7.522)	(4.354)	(5.032)

TABLE 5 Continued

		S_ECB3b	S_Crisis3b	S_FE3b	S_SE3b						
S_FE	0.449	6.752	11.195	−4.385	4.063	−15.662	16.684	1.505	17.938	10.555	5.474
	(7.882)	(4.345)	(8.644)	(6.989)	(3.422)	(15.841)	(18.023)	(12.096)	(11.163)	(8.548)	(8.969)
S_SE	39.135***	23.140*	32.992**	47.792***	42.278***	68.708***	19.342	51.600***	32.090	4.574	24.599**
	(11.980)	(13.482)	(13.108)	(10.699)	(11.487)	(22.982)	(22.446)	(19.395)	(20.746)	(21.910)	(11.505)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)
$\beta 2+\beta 3$	0.29	0.00	0.14	0.02	0.52	0.22	0.01	0.12	0.67	0.07	1.44
$\beta 2+\beta 3+\beta 4$	1.02	0.01	0.51	1.05	2.33	1.02	0.22	2.62	0.99	0.48	1.54
$\beta 2+\beta 3+\beta 5$	0.00	2.57	1.51	0.49	0.63	0.84	0.89	0.00	3.17*	1.77	0.13
$\beta 2+\beta 3+\beta 6$	10.21***	2.94*	6.05**	19.88***	12.71***	9.28***	0.75	6.85***	2.71*	0.05	3.82*
N	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356
AIC	13291	16087	16298	15187	15316	19709	17943	13773	16074	15422	14553
BIC	13400	16196	16406	15295	15424	19817	18052	13882	16183	15530	14662
Log Likelihood	−6629	−8027	−8132	−7576	−7641	−9837	−8955	−6870	−8020	−7694	−7260
Panel C—Controlling for market expectations (VIX)											
	Eurozone	**Austria**	**Belgium**	**France**	**Germany**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
S_ECB	4.006*	1.475	1.569	5.248*	4.109	3.339	4.598	2.760	3.514	1.199	2.280
	(2.241)	(2.053)	(2.104)	(2.973)	(2.773)	(2.738)	(2.867)	(2.959)	(3.060)	(1.307)	(2.620)
S_Crisis	2.928	−1.617	4.077	4.915	3.171	−0.813	0.181	3.419	−11.030	−4.330	6.830
	(4.669)	(6.148)	(7.645)	(6.048)	(3.978)	(5.265)	(7.429)	(4.464)	(8.068)	(4.516)	(4.392)
S_FE	−0.078	2.910	8.251	−5.383	1.558	−15.841	4.929	−0.387	5.420	6.500	5.250
	(7.487)	(5.046)	(9.233)	(8.097)	(4.780)	(13.917)	(17.905)	(11.128)	(8.490)	(7.456)	(8.761)
S_SE	36.780***	23.750*	33.276**	44.439***	42.099***	67.586***	23.224	51.361**	−7.883	6.007	26.363**
	(14.218)	(14.075)	(14.472)	(12.590)	(13.264)	(22.597)	(21.440)	(21.929)	(62.520)	(24.175)	(12.913)
VIX	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)
$\beta 2+\beta 3$	0.00	0.00	0.17	0.01	0.07	0.02	0.04	0.09	0.54	0.07	0.60

Continues

TABLE 5 Continued

		S_ECB3b	S_Crisis3b	S_FE3b	S_SE3b						
$\beta 2+\beta 3+\beta 4$	0.45	0.07	0.19	0.68	0.52	0.01	0.01	0.46	1.37	0.83	1.54
$\beta 2+\beta 3+\beta 5$	0.00	0.36	0.67	0.52	0.04	1.26	0.09	0.01	0.83	0.86	0.15
$\beta 2+\beta 3+\beta 6$	6.68***	2.85*	5.01**	12.3***	9.75***	9.00***	1.20	5.31**	0.01	0.07	3.58*
N	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356
AIC	15118	16518	17145	16454	16734	20005	18381	16468	16554	14882	16010
BIC	15233	16633	17260	16568	16849	20119	18496	16583	16669	14996	16124
Log Likelihood	−7541	−8241	−8555	−8209	−8349	−9984	−9173	−8216	−8259	−7423	−7987

Notes: Panel A reports the results of regressions based on Equations (2) and (3), where the variables capturing CMP announcements are replaced by variables capturing placebo announcements. The placebo announcements occur three and five trading days before and after the actual CMP announcements. Panel B reports the results from regressions based on Equations (2) and (3), where the dependent variable is market-adjusted returns, using the MSCI Europe as a proxy for the market portfolio. Panel C reports the results of regressions based on Equations (2) and (3), augmented with a variable capturing market expectations about volatility (VIX returns). The sum of coefficients is estimated using the F-test. All regressions are estimated with robust standard errors (reported in parentheses).

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 6 Market reaction to CMP announcements (GARCH models)

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Δi^u	−4.269***	−1.560**	−2.988***	−5.478***	−5.349***	−3.579***	−4.577***	−4.074***	−1.886*	−1.042**	−4.897***
	(0.790)	(0.788)	(0.950)	(1.243)	(0.913)	(1.177)	(1.012)	(0.946)	(1.062)	(0.456)	(0.834)
S_ECB	4.292*	1.529	1.631	5.402*	3.628	3.458	5.006*	3.096	2.856	1.604	3.296
	(2.365)	(2.076)	(2.169)	(3.041)	(2.915)	(2.829)	(3.029)	(3.045)	(3.091)	(1.503)	(2.819)
S_Crisis	−1.671	−3.808	3.326	0.471	−0.293	−1.054	−0.698	0.965	−12.036	−5.351	2.404
	(6.675)	(7.343)	(8.063)	(7.562)	(5.946)	(4.906)	(7.585)	(5.015)	(8.379)	(4.490)	(6.684)
S_FE	−6.239	−0.876	1.799	−11.959	−2.391	−15.637	−0.248	−2.766	2.051	4.827	−2.384
	(7.867)	(6.314)	(10.396)	(8.697)	(5.965)	(12.179)	(18.287)	(10.836)	(7.494)	(7.398)	(8.991)
S_SE	36.975**	18.870	28.260*	44.515***	38.344***	64.831***	21.077	49.379**	42.630	4.277	25.179*
	(14.786)	(14.148)	(16.350)	(12.956)	(12.248)	(23.661)	(22.150)	(22.631)	(28.726)	(24.708)	(13.961)
E_ECB	0.275	−0.354	0.327	−0.153	−0.082	0.804	1.739	0.918	0.570	0.192	0.057
	(0.662)	(0.875)	(0.816)	(0.911)	(0.945)	(0.765)	(1.058)	(0.810)	(0.796)	(0.321)	(0.855)
ECBAnnouncement	0.077	0.028	0.015	0.117	0.125	0.215*	−0.019	−0.024	0.030	0.003	0.083
	(0.087)	(0.098)	(0.095)	(0.114)	(0.116)	(0.122)	(0.106)	(0.105)	(0.098)	(0.060)	(0.099)
UMP_Crisis	−1.143	−1.472	2.666	−1.880	−0.038	−5.058***	0.221	−0.801	−0.801	0.980	−0.549
	(0.927)	(1.947)	(3.038)	(1.155)	(1.498)	(1.532)	(1.965)	(1.316)	(0.573)	(1.320)	(0.649)
UMP_FSC	3.062***	0.295	4.978***	5.419***	2.203***	−2.420*	3.291	3.727***	0.316	0.485	2.243**
	(0.824)	(0.705)	(1.118)	(0.910)	(0.611)	(1.294)	(2.353)	(1.131)	(0.902)	(0.792)	(0.940)
UMP_SSC	0.076	0.175	−0.394	0.021	0.170	−0.888	0.692	0.053	0.280	0.749	0.040
	(0.942)	(0.777)	(0.812)	(0.946)	(0.801)	(1.742)	(1.085)	(1.006)	(0.683)	(1.547)	(1.037)
Crisis	−0.102	−0.130	−0.296**	−0.119	−0.195	−0.029	−0.264	−0.131	−0.145	−0.154	−0.024
	(0.100)	(0.141)	(0.139)	(0.126)	(0.143)	(0.120)	(0.207)	(0.104)	(0.109)	(0.102)	(0.086)
First_Sovereign_Crisis	−0.128	−0.116	−0.073	−0.088	−0.097	−0.132	−0.378	−0.143	−0.185***	−0.171	−0.098
	(0.103)	(0.092)	(0.167)	(0.115)	(0.095)	(0.274)	(0.300)	(0.115)	(0.059)	(0.106)	(0.113)
Second_Sovereign_Crisis	0.003	−0.053	0.079	0.027	−0.069	−0.255	0.069	0.052	−0.044	−0.036	−0.017
	(0.068)	(0.078)	(0.078)	(0.063)	(0.065)	(0.175)	(0.102)	(0.085)	(0.067)	(0.125)	(0.064)
_cons	0.055***	0.099***	0.059***	0.057**	0.057**	0.041	0.058**	0.043**	0.055**	0.059***	0.052**
	(0.019)	(0.024)	(0.022)	(0.024)	(0.026)	(0.033)	(0.025)	(0.022)	(0.021)	(0.019)	(0.022)
ARCH											
ARCH											
L.arch	0.094***	0.082***	0.117***	0.090***	0.094***	0.059***	0.059***	0.073***	0.114***	0.100***	0.100***
	(0.013)	(0.019)	(0.019)	(0.015)	(0.015)	(0.016)	(0.022)	(0.012)	(0.019)	(0.033)	(0.014)
L.garch	0.906***	0.918***	0.883***	0.910***	0.906***	0.941***	0.941***	0.927***	0.886***	0.900***	0.900***
	(0.013)	(0.019)	(0.019)	(0.015)	(0.015)	(0.016)	(0.022)	(0.012)	(0.019)	(0.033)	(0.014)
_cons	0.016***	0.023**	0.024***	0.022***	0.028***	0.017**	0.009	0.010**	0.034***	0.012*	0.023***
	(0.005)	(0.010)	(0.008)	(0.008)	(0.009)	(0.008)	(0.007)	(0.004)	(0.010)	(0.006)	(0.007)
F-test	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)
$\beta_2+\beta_3$	0.00	0.00	0.48	0.00	0.38	0.00	0.02	0.11	0.11	0.17	0.35
$\beta_2+\beta_3+\beta_4$	0.07	0.28	0.06	0.00	0.13	0.07	0.00	0.00	1.95	1.24	0.02
$\beta_2+\beta_3+\beta_5$	0.66	0.02	0.00	2.05	0.52	1.71	0.00	0.13	0.18	0.55	0.21
$\beta_2+\beta_3+\beta_6$	6.24**	1.76	2.70	11.75***	8.77***	7.46***	0.92	4.59**	2.36	0.04	2.84*
N	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356
AIC	15811	16756	17546	17007	17345	20089	18553	16920	16820	15007	16605
BIC	15919	16865	17655	17115	17453	20197	18662	17028	16928	15116	16714
Log Likelihood	−7888	−8361	−8756	−8486	−8655	−10027	−9260	−8443	−8393	−7487	−8286

Notes: This table reports the results of AR(1)-GARCH(1,1) regressions based on Equations (2) and (3). The sum of coefficients is estimated using the *F*-test. All regressions are estimated with robust standard errors (reported in parentheses).

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.

TABLE 7 Market reaction to CMP announcements (AR (1)-GJR-GARCH (1,1) models)

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Δi^u	−3.997***	−1.490**	−2.766***	−5.203***	−5.068***	−3.259***	−4.496***	−3.815***	−1.610	−1.041**	−4.534***
	(0.734)	(0.717)	(0.777)	(0.937)	(0.825)	(1.185)	(0.984)	(0.825)	(0.984)	(0.449)	(0.777)
S_ECB	3.951*	1.593	1.438	4.802	3.896	3.299	5.102*	4.109	2.380	1.670	2.943
	(2.227)	(1.924)	(1.979)	(3.265)	(2.745)	(2.739)	(2.835)	(3.014)	(3.225)	(1.256)	(2.829)
S_Crisis	−1.764	−4.124	0.037	−0.054	−0.837	−1.375	−0.799	0.038	−8.849	−4.406	2.434
	(5.757)	(7.834)	(4.834)	(7.587)	(6.346)	(4.526)	(7.098)	(4.772)	(7.891)	(4.264)	(5.699)
S_FE	−4.595	−0.675	4.320	−9.369	−2.448	−16.144	0.298	−2.436	2.679	5.109	−1.742
	(6.319)	(5.453)	(9.734)	(6.997)	(5.215)	(11.753)	(16.037)	(8.651)	(7.675)	(7.612)	(7.637)
S_SE	30.113*	16.033	29.324*	40.582***	37.039***	61.179***	17.504	42.872*	1.828	−2.895	21.342
	(16.106)	(13.738)	(15.608)	(14.734)	(13.621)	(23.190)	(22.003)	(24.589)	(69.772)	(26.042)	(13.498)
E_ECB	0.388	−0.521	0.396	0.039	0.122	0.788	1.627*	1.369*	0.626	0.271	0.132
	(0.622)	(0.816)	(0.697)	(1.027)	(0.857)	(0.707)	(0.947)	(0.822)	(0.915)	(0.310)	(0.874)
ECBAnnouncement	0.077	0.034	−0.014	0.055	0.132	0.206*	−0.039	−0.019	0.011	0.007	0.054
	(0.087)	(0.096)	(0.091)	(0.112)	(0.113)	(0.120)	(0.105)	(0.105)	(0.099)	(0.057)	(0.095)
UMP_Crisis	−1.334	−1.559	2.555	−2.266*	−0.164	−5.047***	0.270	−0.834	−0.620	1.042	−0.631
	(0.839)	(2.263)	(3.546)	(1.199)	(1.485)	(1.408)	(2.218)	(1.800)	(0.463)	(1.509)	(0.682)
UMP_FSC	3.145***	0.277	5.218***	5.700***	2.228***	−2.428**	3.421	3.833***	0.546	0.511	2.326***
	(0.654)	(0.638)	(1.048)	(0.750)	(0.547)	(1.237)	(2.115)	(0.881)	(0.908)	(0.805)	(0.791)
UMP_SSC	0.198	0.358	−0.454	0.143	0.190	−0.631	0.734	−0.110	−0.117	0.540	0.229
	(0.810)	(0.652)	(0.756)	(0.837)	(0.804)	(1.444)	(1.004)	(0.974)	(0.994)	(1.449)	(0.769)
Crisis	−0.002	−0.026	−0.140	0.029	−0.079	−0.006	−0.183	−0.065	−0.042	−0.139	0.023
	(0.071)	(0.134)	(0.109)	(0.098)	(0.121)	(0.109)	(0.176)	(0.081)	(0.106)	(0.091)	(0.061)
First_Sovereign_Crisis	−0.037	−0.089	−0.042	−0.027	−0.048	−0.116	−0.331	−0.102	−0.143**	−0.151	−0.040
	(0.074)	(0.085)	(0.126)	(0.084)	(0.092)	(0.242)	(0.268)	(0.087)	(0.059)	(0.093)	(0.080)
Second_Sovereign_Crisis	0.114**	0.014	0.140**	0.059	−0.028	−0.180	0.113	0.100	−0.009	0.051	0.067
	(0.057)	(0.083)	(0.070)	(0.051)	(0.064)	(0.160)	(0.116)	(0.073)	(0.076)	(0.140)	(0.053)
_cons	−0.016	0.056**	0.002	−0.002	0.000	−0.001	0.027	0.002	−0.005	0.031*	−0.022
	(0.021)	(0.027)	(0.023)	(0.025)	(0.028)	(0.036)	(0.027)	(0.023)	(0.029)	(0.018)	(0.023)
ARMA											
L.ar	0.040***	0.041**	0.045***	0.025	0.031*	0.096***	0.073***	0.014	−0.048*	0.084***	0.015
	(0.015)	(0.017)	(0.017)	(0.016)	(0.016)	(0.017)	(0.019)	(0.016)	(0.029)	(0.017)	(0.016)
ARCH											
L.arch	0.129***	0.107***	0.146***	0.113***	0.115***	0.080***	0.084***	0.104***	0.169***	0.147***	0.141***
	(0.017)	(0.022)	(0.024)	(0.016)	(0.017)	(0.022)	(0.031)	(0.017)	(0.019)	(0.044)	(0.021)
L.tarch	−0.125***	−0.072***	−0.114***	−0.106***	−0.077***	−0.039**	−0.045**	−0.082***	−0.113***	−0.088***	−0.136***
	(0.016)	(0.017)	(0.017)	(0.015)	(0.014)	(0.016)	(0.018)	(0.016)	(0.030)	(0.024)	(0.020)
L.garch	0.928***	0.920***	0.911***	0.934***	0.918***	0.942***	0.941***	0.935***	0.892***	0.902***	0.921***
	(0.010)	(0.018)	(0.016)	(0.010)	(0.014)	(0.016)	(0.022)	(0.011)	(0.016)	(0.031)	(0.013)
_cons	0.017***	0.034***	0.018***	0.025***	0.030***	0.012	0.008	0.012***	0.033**	0.011**	0.025***
	(0.004)	(0.011)	(0.006)	(0.007)	(0.009)	(0.010)	(0.006)	(0.004)	(0.015)	(0.005)	(0.007)
F-test	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)	*F*(1,4340)
$\beta_2+\beta_3$	0.00	0.00	0.54	0.02	0.20	0.00	0.05	0.01	0.07	0.32	0.34
$\beta_2+\beta_3+\beta_4$	0.11	0.27	0.08	0.00	0.11	0.11	0.00	0.01	1.20	0.83	0.03
$\beta_2+\beta_3+\beta_5$	0.58	0.01	0.10	2.21	0.55	1.92	0.00	0.07	0.22	0.58	0.20
$\beta_2+\beta_3+\beta_6$	3.47*	1.38	3.22*	7.39***	6.87***	6.97***	0.66	3.09*	0.00	0.01	2.13

TABLE 7 Continued

	Eurozone	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
N	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356	4356
R_2											
AIC	15,663	16,710	17,464	16,895	17,292	20,064	18,521	16,842	16,746	14,941	16,456
BIC	15,784	16,831	17,585	17,016	17,413	20,185	18,642	16,963	16,867	15,063	16,577
Log Likelihood	−7812	−8336	−8713	−8428	−8627	−10013	−9242	−8402	−8354	−7452	−8209

Notes: This table reports the results of AR (1)-GJR-GARCH(1,1). The sum of coefficients is estimated using the *F*-test. All regressions are estimated with robust standard errors (reported in parentheses).

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

corresponding variables for days after the announcements: *S_ECB3a*, *S_Crisis3a*, *S_FE3a* and *S_SE3a* (for 3 days after the announcements); and *S_ECB5a*, *S_Crisis5a*, *S_FE5a* and *S_SE5a* (for 5 days after the announcements).

All coefficients related to the placebo events remain insignificant at the 5% level, except for the one on *SE_Crisis3a* (negative and significant). However, the coefficient on *SE_Crisis* is insignificant in our main results, and thus our main inferences remain intact. These results suggest the absence of anticipation effects and alleviate the concern that the significance of the results reported in the previous section is due to short-run trends in the bank stock returns.

We also examine the robustness of our results to the model employed to estimate the stock market reaction to monetary policy interventions. To this end, we replace the dependent variable (returns of the bank indices) with market-adjusted returns (MAR, MacKinlay, 1997), using the MSCI Europe as a proxy for the market portfolio. The results reported in Panel B of Table 5 show that, even after adjusting for market-wide fluctuations in stock returns, our main findings remain substantially the same.

It may be argued that using the MAR allows for the impact of current stock market conditions, but fails to consider the effect of market expectations concerning volatility. Bekaert et al. (2013) suggest that the VIX, the market option-based proxy for implied volatility, correlates with monetary policy variables. For this reason, in additional robustness checks, we include among our regressors the VIX index.[18] Our main results are reiterated, as shown in Panel C of Table 5.

Furthermore, we complete our series of robustness checks by using GARCH models. Table 6 reiterates the estimation by using an AR(1)-GARCH(1,1) model, as per equations (2) and (3). The results substantially reiterate those reported in Table 4: the coefficients on *S_SE* are positive for all countries, but they are significant at the 5% level only for France, Germany, Greece and Italy, as well as for the Eurozone banking index. The sum of the coefficients β_2, β_3 and β_6 is positive and significant for these indices.

Finally, as said in the data sections, some of the banking indices in our sample exhibit a high degree of non-normality. Simple GARCH models are unable to capture the impact of asymmetric shocks. Among others, French et al. (1987), Engle and Ng (1993) and Glosten et al. (1993) considered the asymmetric effect of return on stocks. The GJR-GARCH model (Glosten et al., 1993) allows evaluating the impact of both good and bad news on asset price volatility. For this reason, we repeat our estimations using GJR-GARCH models (Glosten et al., 1993), which allow for the

[18]Since the VIX index is available only for a few countries in our data set, and we use the VIX for Eurozone countries, VSTOXX.

leverage effect. The results are reported in Table 7. They are similar to those already reported previously.

6 | CONCLUSIONS

In this paper, we examine the effects of CMP actions by the ECB on Eurozone banking indices using an 'event study approach'. Our findings provide support for the existence of state dependence for CMP measures during period of low-interest rate, whereby an increase in the ECB target interest rate has a positive impact on banks' profitability.

Our findings support the view that when interest rates are low, banks' profits suffer, and unexpected increases in interest rates can lead to a positive return for bank stocks. These findings are significant because they are at variance with the results reported by Bernanke and Kuttner (2005) and English et al. (2018). The former paper focuses on US non-financial stocks, while the latter investigates banking stocks. Bernanke and Kuttner (2005) find that unexpected increases of target interest rates have a negative impact on stock market returns (they did not consider only bank stocks) on target rate announcement days. English et al. (2018) finds that unanticipated increases in interest rates are negatively correlated with bank stock returns in the United States from 1992 to 2007. The most likely reason for the discrepancy between our results and those reported by Bernanke and Kuttner (2005) and English et al. (2018) is that banks may benefit from higher interest rates when interest rates are low. Recent literature supports the view that banks are reluctant to pass negative rates to depositors, and as a result, their profits are squeezed (Heider et al., 2019). Therefore, an unexpected increase in the target ECB rate is likely to improve bank profits.

To conclude, similar to other event studies, such as Aït-Sahalia et al. (2012) and Bruno et al. (2018), we need to be cautious in interpreting our findings. First, the results for the CMP announcements on bank indices focus on a very short time window, and may not be indicative of the long-term consequences of the CMP measures. Second, our methodology can only allow for the impact of CMP on listed banks, because for unlisted banks, stock price information is unavailable.

ACKNOWLEDGMENTS

Open Access Funding provided by Universita degli Studi di Bologna within the CRUI-CARE Agreement.

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How to cite this article: Perdichizzi, S., Cotugno, M., & Torluccio, G. (2022). Is the ECB's conventional monetary policy state-dependent? An event study approach. *The Manchester School*, 90, 213–236. https://doi.org/10.1111/manc.12393