



Article

# Eurozone Stock Market Reaction to Monetary Policy Interventions and Other Covariates

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**Abstract:** The joint effect of the global economic and sovereign debt crisis forced the European Central Bank (ECB) to apply conventional and non-standard expansionary monetary policy interventions in order to stabilize eurozone economies. We conducted a panel regression econometric analysis to study the influence of euro area monetary authority policy interventions, along with two main macroeconomic variables and a sentiment indicator, on market equity returns of eurozone countries for the period January 2007 to December 2017. Our findings suggest that conventional and non-standard monetary policy innovations had a positive lagged impact on equity returns of euro area monetary markets. More specifically, interest rate cuts evenly influenced market indices while non-conventional actions mainly affected core eurozone countries that were less affected by the crisis. We also document a strong negative relationship between inflation rates and market returns. In addition, the sentiment indicator produces positive effects on returns because it contains information that is not incorporated into other macro variables.

**Keywords:** monetary policy; Central Bank; financial crisis; panel data



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## 1. Introduction

The financial turmoil and the sharp deterioration of the macroeconomic environment in 2008 caused significant shocks to markets and global economies. At the beginning of the economic crisis, there was great uncertainty about the financial health of globally significant financial institutions (GSIFIs), which led to intense pressure in interbank markets and a possible collapse in financial activity. In 2010, there were market expectations regarding a possible Greek sovereign default, because Greek government bond yields reached unsustainable levels with a risk of “infection” in Spain, Italy, Ireland, and Portugal. The impending sovereign debt crisis forced peripheral eurozone countries to apply for economic adjustment programs in order to receive financial support. With no access to money and capital markets, Greece launched three programs (lasting from May 2010 to August 2018) to refinance public debt, recapitalize banks, and cover budget deficits. In April 2011, the Portuguese government requested financial assistance to finance its budget and recapitalize the banks. In July 2012, Spain also requested financial support to restructure the country's banking system. Further, the Italian banking sector was hit hard during the second phase of the crisis. In addition, Ireland and Cyprus, two more peripheral countries, asked for loan packages.<sup>1</sup> Reacting to the global economic and debt crisis, the monetary authority of the euro area implemented both conventional and non-standard monetary policy measures (presented in Section 2) to strengthen lending to the business sector, support financial activity, and support the eurozone countries facing sovereign debt difficulties.

This study explores the influence of the ECB's expansionary monetary policy on equity returns of eurozone countries using the panel regression econometric method. Several previous studies surveyed the influence of monetary policy mainly on euro area capital markets (see, among others, [Fratzscher et al. 2014](#); [Haitsma et al. 2016](#); [Hau and Lai 2016](#); [Pacocco et al. 2019](#); [Chebbi 2019](#)). Considering previous research ([Fama and Schwert 1977](#); [Fama 1981, 1990](#); [Schwert 1990](#); [Baker and Stein 2004](#); [Stambaugh et al. 2011](#)), we also study (along with monetary interventions) whether two main macroeconomic factors, inflation and industrial production, and a sentiment indicator could affect market returns.

Our sample consists of eight eurozone countries and covers the period from January 2007 to December 2017. The analysis period covers the first phase of the crisis (global economic crisis), the second phase (sovereign debt crisis), and the third phase (post debt crisis). We also group our country sample into two sub-samples, core euro area countries and peripheral countries, in order to investigate whether stock markets react heterogeneously to expansionary monetary policy innovations and other covariates. As we have previously noted, peripheral eurozone countries faced sovereign debt difficulties and were more affected by the economic crisis, while core countries were less influenced.

We address herein the research questions (RQs) analyzed within the framework of this study:

RQ 1: Do eurozone markets react to ECB's expansionary monetary policy interventions?

RQ 2: Do inflation and output affect the returns of eurozone equity markets?

RQ 3: What impact does a sentiment indicator have on the performance of eurozone stock markets?

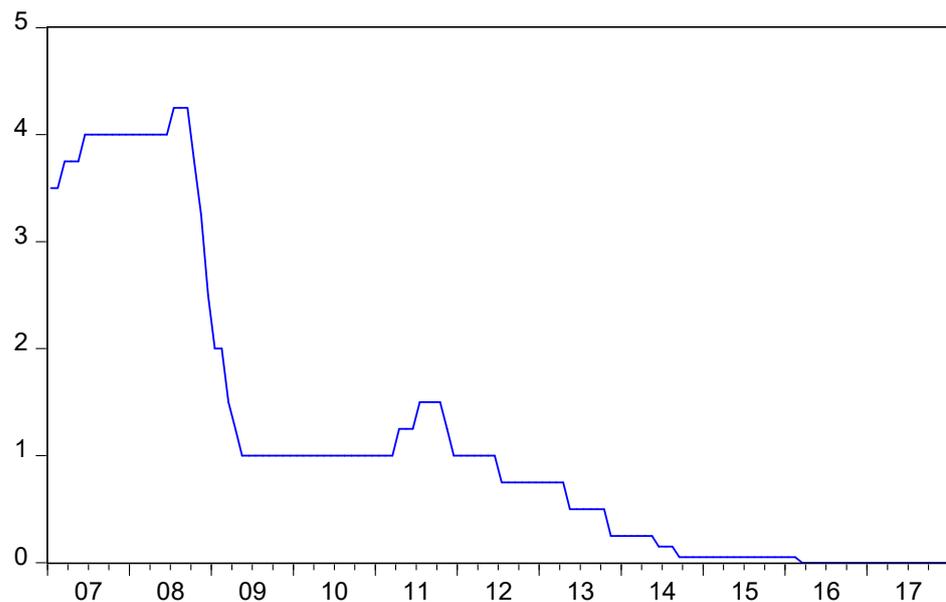
RQ 4: Is there a heterogeneous reaction to expansionary monetary policy innovations and to other covariates between core and peripheral eurozone countries?

Our study contributes to the literature by analyzing a wide set of monetary, macroeconomic, and sentiment variables that influence eurozone stock returns during and after a crisis period and helps to better understand how markets function. We also present a comparison between core and peripheral eurozone equity market reactions to expansionary monetary policy innovations and other covariates, and we perform a comprehensive analysis to determine the significance of each variable. Our results are useful for both decision-makers and investors, in order to determine their financial strategies.

The rest of this study is structured as follows. First, in Section 2, we briefly present the ECB's monetary policy measures. In Section 3, we examine previous studies that provide evidence on the impact of the ECB's exceptional monetary policy on bond yields and equity returns. In Section 4, we seek to underscore the main transmission channels of monetary policy that influence equity returns. In Section 5, we describe the empirical approach used to analyze the influence of monetary policies along with main macroeconomic variables and a sentiment indicator on equity markets, as well as the data and methodology used to address the research questions. Finally, in Sections 6 and 7, we describe the results of this study and the conclusions of the analysis.

## 2. ECB's Monetary Interventions

Responding to the global economic and sovereign debt crisis, the ECB announced and implemented conventional and non-conventional monetary policy measures to improve bank funding conditions, strengthen lending to the business sector, and support financial activity. More specifically, from the beginning of the financial crisis, the ECB rapidly reduced its key interest rates to the zero bound level. As shown in Figure 1, since the last quarter of 2008, the ECB decreased the rate of main refinancing operations from 4.25 to 1%, which then remained flat until April 2011, and after a small increase, it decreased to zero level.

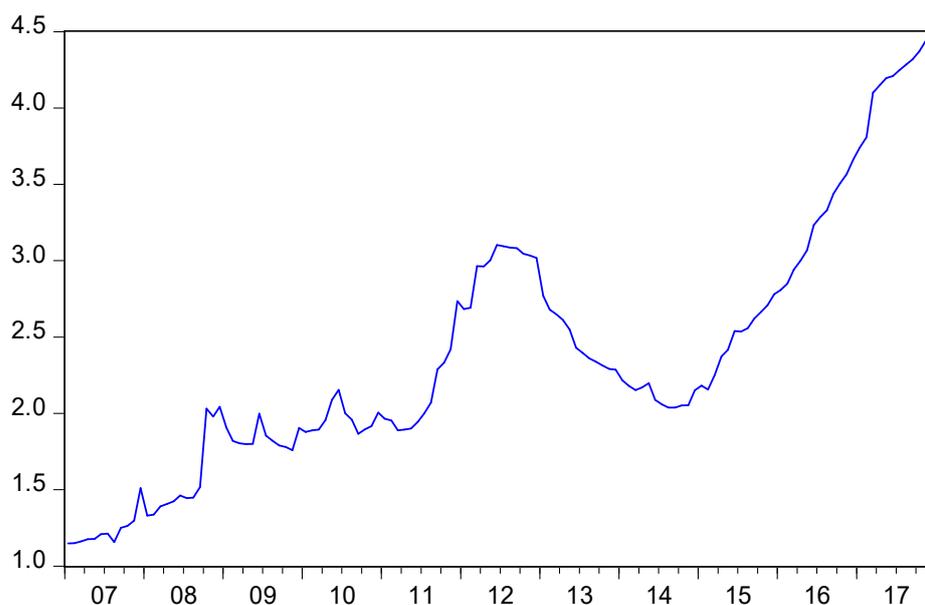


**Figure 1.** ECB's interest rate of main refinancing operations, in percentages per annum. Source: ECB statistical data warehouse.

Also, the ECB introduced non-conventional monetary measures in order to reinforce the funding of banks and face the tension in interbank markets.<sup>2</sup> Among other measures (e.g., full allotment fixed interest rate procedure for unlimited liquidity provision, maturity expansion of longer-term refinancing operations, extension of accepted collateral in refinancing operations, currency swap agreements with the US Fed), the ECB launched purchases of euro area covered bank bonds.

In the so-called sovereign debt crisis (second phase of the crisis), in an attempt to overcome market dysfunctions regarding the transition of monetary policy and to support euro area countries that faced sovereign debt difficulties, the ECB established the Securities Market Programme (SMP). Under the SMP, the ECB intruded in the secondary markets and bought public debt bonds, and at the end of the program, the ECB held a portfolio of EUR 218 billion, which was allocated among countries with sovereign debt problems (EUR 33.9 billion for Greece, EUR 14.2 billion for Ireland, EUR 44.3 billion for Spain, EUR 102.8 billion for Italy, and EUR 22.8 billion for Portugal).<sup>3</sup> Also, the ECB activated a complementary covered bond purchase program (CBPP2) in November 2011 and carried out two three-year very long-term refinancing operations (VLTROs). On 6 September 2012, the ECB introduced Outright Monetary Transactions (OMT) in order to intervene in the secondary bond markets. There were no quantitative limits on the size of OMT, but the program was not activated. In addition, from 2013 the ECB gave forward guidance for its future monetary policy intentions.

In the third phase of the crisis, starting in June 2014, the ECB launched a credit easing program (CEP), intended to strengthen the transition mechanism of monetary policy. The CEP included two targeted longer-term refinancing operations (TLTROs) of up to four years' duration, designed to supply funding to euro area banking institutions and the expanded asset purchase program (APP), which includes the acquisition of private and public sector securities from secondary markets.<sup>4</sup> Asset purchases under the APP were conducted until December 2018. [Boeckx et al. \(2017\)](#), [Moder \(2019\)](#), and [Fiorelli and Meliciani \(2019\)](#) used total assets of the eurosystem's balance sheet as a proxy for non-standard monetary measures. As shown in [Figure 2](#), unconventional monetary policy operations resulted in a serious expansion of the ECB's balance sheet from 1.1 trillion at the beginning of 2007 to 4.5 trillion at the end of 2017.



**Figure 2.** ECB's total balance sheet assets. Source: ECB statistical data warehouse.

### 3. Literature Review of Monetary Policy

Regarding research on monetary policy, several previous studies surveyed the influence of monetary policy mainly on US capital markets.<sup>5</sup> In the 1990s, many published papers used the vector autoregressive (VAR) approach. [Patelis \(1997\)](#), studying the US stock market from 1964 to 1992, provided evidence that monetary policy variables can determine future stock returns, but they cannot fully absorb the estimated return forecasting ability. [Thorbecke \(1997\)](#), applying VAR analysis, found that expansionary monetary policy raises equity returns. [Jensen and Mercer \(2002\)](#) reexamined the three-factor model, which contains market beta, market value, and book-to-market factors, as well as the monetary sector. They concluded that the stringency of monetary policy significantly influences the relationship between equity returns and the three variables. [Ehrmann and Fratzscher \(2004\)](#) concluded that for the period from February 1992 to January 2003, industry and individual stocks responded in a profoundly different way to the Fed's policy announcements. [Ridogon and Sack \(2004\)](#) studied the response of securities to monetary policy shifts and suggested using the identification through heteroscedasticity approach to overcome endogeneity issues. [Bernanke and Kuttner \(2005\)](#), applying event study methodology, documented a strong and statistically significant response of the US stock markets to monetary policy actions from May 1989 through December 2002. They also found that responses to unexpected monetary policy news tend to vary across industries.

Several research papers have considered the influence of the ECB's exceptional monetary policy on bond yields. [Trebesch and Zettelmeyer \(2014\)](#) showed that under the SMP, Greek bond yields substantially decreased. [Falagiarda and Reitz \(2015\)](#) concluded that from 2008 to 2012, announcements about SMP reduced the government bond spread of four distressed euro countries, while OMT announcements had an impact on only two of them. [Kilponen et al. \(2015\)](#) reported that the ECB's news about SMP and OMT reduced the 10-year bond spreads of seven European countries. [Altavilla et al. \(2016\)](#) reported that the ECB's announcements of outright monetary operations decreased the two-year sovereign bond yields of Italy and Spain by about 200 basis points. [Jäger and Grigoriadis \(2017\)](#) concluded that by increasing the magnitude of its balance sheet, the ECB successfully affected bond yield spreads, but heterogeneously, with a more significant effect on distressed countries.

Recent surveys have explored the impact of ECB's monetary policy decisions on equity markets. [Bohl et al. \(2008\)](#) reported that European financial markets negatively responded to the unexpected conventional part of ECB's decisions, while ECB successfully

communicated its policy. [Bredin et al. \(2009\)](#) pointed out that the VAR approach used in the late 1990s served as a panacea for the endogeneity problems. Using an event study approach similar to [Bermanke and Kuttner \(2005\)](#), they found that for the period May 1989 to May 2004, unexpected shocks to German and euro area monetary policies did not influence DAX and sectoral indices. [Rogers et al. \(2014\)](#) examined the impact of non-standard monetary measures of the Federal Reserve (Fed), ECB, Bank of England (BoE), and Bank of Japan (BoJ) on rates of exchange, stock returns, and bond yields. To measure monetary policy innovations introduced by the ECB, using the change in the spread between Italian and German 10-year government bond yields. Many other researchers also followed this approach. They reported that the ECB's announcement of a non-conventional monetary policy had a positive and statistically significant effect on stock returns during the crisis period.

[Fratzscher et al. \(2014\)](#) evaluated the impact of the ECB's unconventional measures (SMP, OMT, VLTROs) on various asset returns from 2007 to 2012 and ended up showing positive results. [Haitsma et al. \(2016\)](#) tested the response of equity markets to the traditional and non-conventional monetary policies of the ECB from 1999 to 2015. They used the difference between the daily futures spot rate and proxy standard policy surprises and the change in the daily difference between German and Italian 10-year bond yields as a proxy for the unconventional surprises. They reported that unexpected non-conventional measures, more than conventional policies, affected the EURO STOXX 50 index. [Georgiadis and Gräß \(2016\)](#) found that the announcement of APP had global spillover, enhancing equity prices worldwide. [Hau and Lai \(2016\)](#) showed that expansive euro area monetary policy was related to a switch from money markets toward equity markets. [Fausch and Sigonius \(2018\)](#), focusing on the German market, observed a significant equity response to unexpected policy interventions when the real interest rates were negative. [Pacitto et al. \(2019\)](#) applied a joint event study and panel fixed effects regression analysis to explore whether European monetary union (EMU) equity markets reacted to traditional and unconventional ECB policy innovations from April 1999 to June 2016. They concluded that conventional policies heterogeneously affected financial markets, while unconventional measures exerted homogeneous pressure on all markets. [Fiorelli and Meliciani \(2019\)](#), using structural vector autoregressive (SVAR) and factor augmented vector autoregressive (FAVAR) models, showed that conventional and unconventional monetary policies had mutual relations and one cannot be substituted for the other; instead, the ECB should combine them to stabilize the eurozone's real economy. [Chebbi \(2019\)](#), using three measures of non-standard monetary policy, event study methodology, and an exponential general autoregressive conditional heteroskedastic (E-GARCH) base model of conditional volatility, concluded that for 2009 to 2015, the effect of non-standard monetary policy on stock returns of core and distressed countries was statistically significant and positive.

In addition, a few recent studies evaluated the influence of the ECB's monetary policy on equity returns of banking institutions. [Fiordelisi et al. \(2014\)](#), considering systematically important global financial institutions and using event study methodology and a five-year sampling period (June 2007 to June 2012), concluded that announcements of unconventional monetary policy measures generated a positive reaction in GSIFIs returns. [Ricci \(2015\)](#), applying a panel regression procedure along with an event study, found that for the period from June 2007 to June 2013, large European banks were more susceptible to unconventional interventions than to traditional ones and that the crisis stage influenced each kind of crisis intervention. [Fiordelisi and Ricci \(2016\)](#) used a detailed set of 1322 global monetary, financial sector, and bailout policy interventions along with a fixed econometric effect panel model. They showed that stock returns for systematically important international banks were affected by monetary policy interventions, but not those for non-financial companies. [Fiordelisi and Galloppo \(2018\)](#) also applied event study and panel regression methodology to analyze the reactions to fiscal and monetary announcements in 12 worldwide stock markets from June 2007 to June 2012. The results showed that expansionary monetary measures positively affected market and banking indices.

#### 4. Transmission Channels of Monetary Policy

This section evaluates the main transmission channels of monetary policy that can influence the equity returns investigated in our research.<sup>6</sup>

First, we analyzed the interest rate channel of conventional policy, which affects equity prices by influencing the present value of future net cash flows. According to [Bernanke and Kuttner \(2005\)](#), interest rate cuts reduce the risk-free rate used as a discount factor and reduce the equity risk premium while enhancing expected cash flows. [Tobin \(1978\)](#) argued that a contractionary policy decreases the present value of future flows and therefore reduces equity prices. Further, interest rate cuts reduce the cost of banks' refinancing operations, increase liquidity, enhance credit expansion, strengthen bank revenues, and boost asset prices.

Second, the literature proposes the confidence channel. By taking immediate action when sovereign bond yields of peripheral countries reached unsustainable levels, the ECB, via asset purchasing programs (SMP, OMT, and PSPP), helped the markets to calm down. As a consequence, risk premia of stressed euro area countries were reduced and confidence was restored. Thus, there was an expectation that increased capital inflows in those countries would positively influence equity prices.

Third, the ECB could influence equity prices via the portfolio rebalancing channel (see [Fratzscher et al. 2014](#)). Specifically, when the ECB purchases government bonds issued by euro area countries, their yields decrease. With lower yields, investors who hold them are encouraged to sell them and rebalance their portfolios by reinvesting in other securities such as bonds or equity.

Fourth, the direct pass-through and bank lending channels could also affect bank equity prices. TLTROs, the main instrument of these channels, are designed to provide long-term liquidity to banks, substitute market funding, and reduce their funding costs, thus decreasing bank liquidity risk. Further, through TLTROs, euro area banks have an incentive to expand lending by increasing loans to non-financial firms and households. Such credit expansion, along with the decreased liquidity risk, is expected to boost equity prices by decreasing risk premiums.

Fifth, from 2013, ECB has given forward guidance (known as the signaling channel), as it officially declared that key interest rates were anticipated to remain low for an extended period. This signaling channel affects investors' expectations about the forecasted path of interest rates. The signaling channel of low-interest rates reduces uncertainty and volatility in the market, which is very important for investment. Consequently, the risk premium spread across riskier assets, such as stocks, decreased, resulting in equity price recovery.

Monetary policy transmission channels are not substitutes, and they can work alongside one another. In [Figure 3](#), we show how expansionary monetary policy measures (interest rate cuts, liquidity provision, and monetary easing) can influence asset prices via the main transmission channels. In addition, changes in asset prices can trigger the ECB's reaction, as in the case of the sovereign debt crisis when Greek government bond yields reached unsustainable levels with a possibility of contamination in Italy, Ireland, Portugal, and Spain. During this period, the ECB established the SMP to help markets calm down by buying public debt bonds from the five stressed countries (GIIPS). Thus, we recognize a cyclical framework operating between monetary interventions and asset prices.

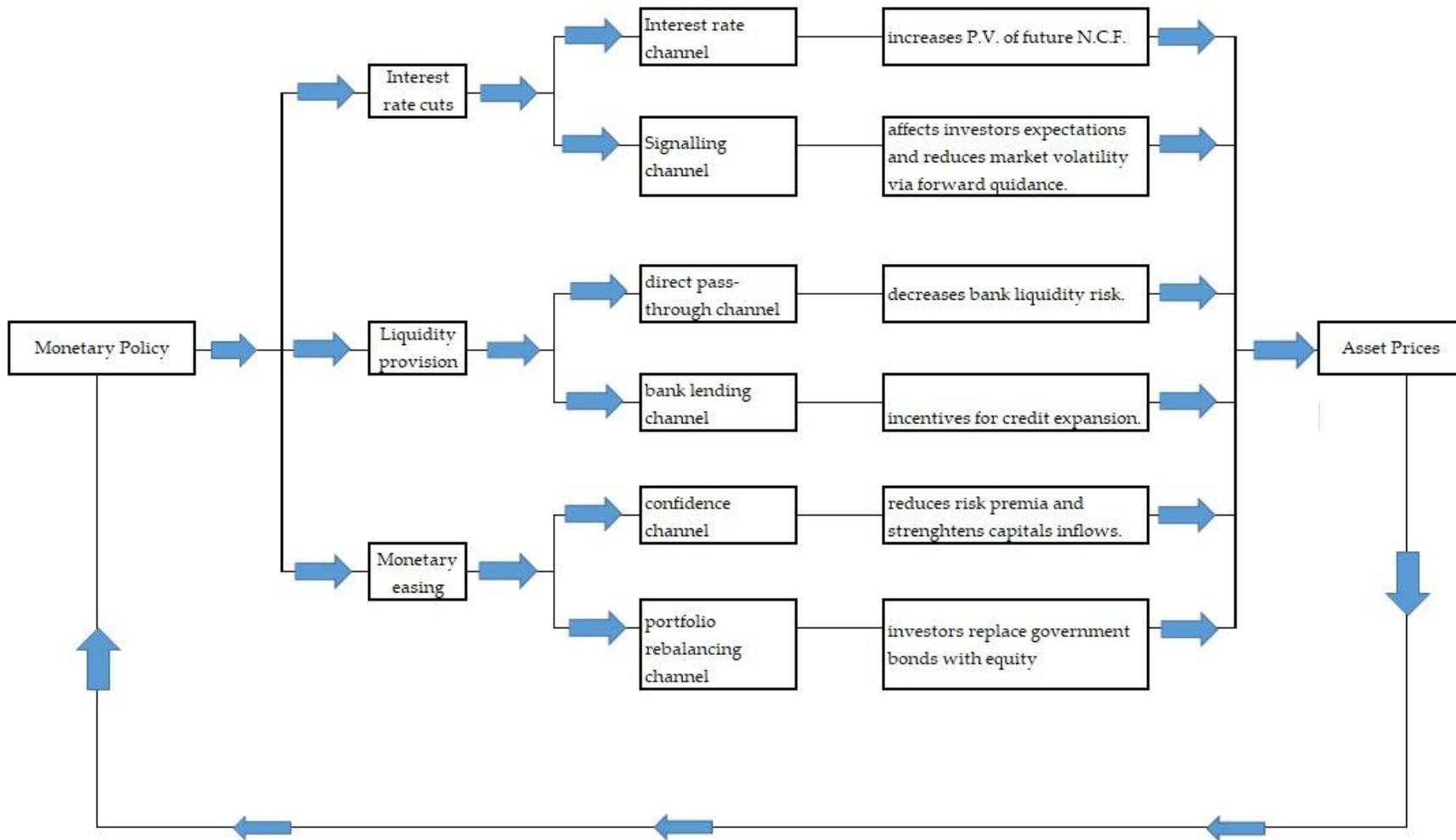


Figure 3. Cyclical effect framework (CEF) for figuring out the effect of ECB's monetary policy interventions on asset prices, and vice versa.

## 5. Empirical Approach

In this part, we present the data and regression approach used in this research.

### 5.1. Data

Our study analyzes whether expansionary monetary interventions introduced by the ECB, along with two main macroeconomic factors and a sentiment indicator, affected market equity returns of eight eurozone countries for the period January 2007 to December 2017. Our sampling period covers the first phase of the crisis (global financial crisis), the second phase (sovereign debt crisis), and the third phase (post debt crisis). We also grouped our country sample into two sub-samples, core countries (Belgium, France, Germany, and the Netherlands) and peripheral countries (Italy, Spain, Portugal, and Greece) to investigate whether stock markets reacted heterogeneously to expansionary monetary policy innovations and other covariates.

#### 5.1.1. Dependent Variable

This paper employs monthly data of closing equity market prices of eight eurozone markets, in core and peripheral countries: CAC 40, DAX 30, BEL 20, AEX, ASE Comp, FTSE MIB, PSI 20, and IBEX 30. Monthly returns (RET) from each index are calculated as the first differences of log prices:

$$R_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1})$$

Table 1 presents the indices used in this study and the corresponding countries, and Table A1 presents descriptive statistics on returns. We note negative mean monthly returns for peripheral markets and greater volatility. According to panel unit root tests, RET is a stationary variable.

**Table 1.** Market indices.

Stock Index	Country
BEL 20	Belgium
CAC 40	France
DAX 30	Germany
ASE Comp.	Greece
FTSE MIB	Italy
AEX	Netherlands
PSI 20	Portugal
IBEX 30	Spain

#### 5.1.2. Independent Variables

We considered the following independent variables:

**Interest rate cuts (IRC):** To capture the results of conventional expansionary monetary policy measures on returns, we constructed a dummy variable that takes a value of 1 in the month when the ECB decreased the policy rate and 0 otherwise. As a proxy for the policy rate, we used the main rate of refinancing operations (MRO). During our sampling period, ECB decreased MRO 15 times (see Table A2 in Appendix A).

**Unconventional monetary policy interventions (UNC)** is a dummy variable that takes a value of 1 in the month of a non-standard policy intervention and 0 otherwise. This variable captures the effect of the ECB's unconventional policy announcements on stock indices. Unconventional innovations include monetary easing and liquidity provision announcements. Monetary easing comprises the ECB's purchases of public bonds (Securities Market Programme, Outright Monetary Transactions, and Public Sector Purchase Programme) and corporate bonds from banks or non-financial institutions (i.e., first, second and third Covered Bond Purchase Programme, Corporate Sector Purchase Programme, and Asset-Backed Securities Purchase Programme). Liquidity provision measures include full

allotment fixed-rate procedure for refinancing operations, supplementary, very longer-term, and targeted refinancing operations (SLTROs, VLTROs, and TLTROs I and II). Intervention announcements were collected from press conferences, press releases, critical speeches, and [Martins et al. \(2019\)](#) (see Table A3 in Appendix A). Cross-checking with previous research was also carried out ([Rogers et al. 2014](#); [Falagiarda et al. 2015](#); [Haitsma et al. 2016](#)).

The industrial production index (IPI) was seasonally adjusted as a proxy for output because data for GDP are available in quarter values. According to the literature, there is a positive relationship between output growth and equity returns ([Schwert 1990](#); [Fama 1990](#); [Choi et al. 1999](#); [Mauro 2003](#)). To ensure stationarity, we used monthly percentage change through the first differences of logs. Data processing revealed negative means for peripheral countries.

The inflation rate (INFL) is measured as the 12-month percentage change of the Harmonized Index of Consumer Prices (HICP). For the Fisher-ADF and [Im et al. \(2003\)](#) panel unit root tests, the variable is stationary. Regarding inflation rate and returns, some studies suggest a negative relation ([Fama and Schwert 1977](#); [Fama 1981](#); [Bakshi and Chen 1996](#)) while others find a positive relationship ([Graham 1996](#); [Choudry 2001](#)). Descriptive statistics for inflation rates are presented in Table A4. All eight countries have a positive mean, with an overall value of 1.48%.

The economic sentiment indicator (ESI) is used as a proxy for sentiment. The ESI is constructed by the European Commission as a monthly survey result weighted average from five sectors (40% industry, 30% services, 20% consumption, 5% retail trade, 5% construction). Previous studies documented that sentiment indices reflect information that is not already incorporated in other macro variables ([Carroll et al. 1994](#); [Barsky and Sims 2012](#)). Financial researchers have also demonstrated that sentiment indicators affect stock prices (see, among others, [Fisher and Statman 2003](#); [Brown and Cliff 2004](#); [Baker and Stein 2004](#); [Lemmon and Portniaguina 2006](#); [Stambaugh et al. 2011](#); [Dahmene et al. 2021](#)). To avoid non-stationarity issues, we used the monthly first difference of ESI.

Table 2 presents the descriptive statistics of variables from January 2007 to December 2017 for the full sample of eight eurozone countries. The data sources are as follows: DataStream for equity market prices, Eurostat for HICP and IPI, and European Commission for ESI and other indicators.

**Table 2.** Descriptive statistics for the full sample.

Variable	Mean	Median	Max	Min	Std. Dev.
RET	−0.002413	0.004244	0.198539	−0.326730	0.062535
IPI	−0.000645	0.000932	0.110244	−0.096355	0.021470
INFL	0.014865	0.014340	0.058927	−0.028560	0.014386
ESI	0.000758	0.100	8.100	−10.800	2.411.091

RET, equity market returns; IPI, monthly percentage growth of industrial production; INFL, inflation rate as annual percentage change of HICP; ESI, monthly first difference of economic sentiment indicator.

## 5.2. Methodology

In order to study the influence of the ECB's expansionary monetary policy as well as main macroeconomic factors and a sentiment indicator on eurozone market returns (RET), we conducted a panel data regression analysis. More specifically, we created two dummy variables that capture the announcements of expansionary monetary policy innovations introduced by the ECB, interest rate cuts (IRC) for conventional and unconventional monetary policy interventions (UNC) for non-standard measures.

According to the literature ([Fama and Schwert 1977](#); [Fama 1981, 1990](#); [Schwert 1990](#)), macroeconomic factors determine equity returns, so we used two main macroeconomic variables, inflation rate (INFL) and monthly percentage change of the industrial production index (IPI), as a proxy for output. A sentiment indicator (ESI) was also used (in monthly first differences) because previous studies ([Fisher and Statman 2003](#); [Stambaugh et al. 2011](#))

documented that sentiment contains information that is not already incorporated in other macro variables.

The model introduced in our empirical work is as follows:

$$R_{i,t} = \beta_0 + \beta_1 RC_L + \beta_2 UNC_L + \beta_3 INFL_{i,t} + \beta_4 IPI_{i,t} + \beta_5 ESI_{i,t} + \delta_i + \varepsilon_{i,t}$$

Market returns,  $R_{i,t}$ , are considered as the dependent variable, and  $IRC_t$  and  $UNC_t$ , the two dummy variables capturing announcements of traditional and nonconventional expansionary monetary policy measures, respectively (same for all countries), inflation rate (INFL), monthly percentage change of industrial production index (IPI), and monthly first difference of economic sentiment indicator (ESI) are the independent variables;  $\delta_i$  indicates cross-country specific effects and  $\varepsilon_{i,t}$  is the error term. We checked pairwise cross-correlations between explanatory variables, and we found relatively low correlations so there is no multicollinearity.<sup>7</sup>

We employed data from January 2007 to December 2017 (132 monthly observations) and our sample consisted of eight eurozone countries (periods  $t = 1, \dots, 132$ ; cross sections  $i = 1, \dots, 8$ ).  $L = 0, -1, -2, \dots$  denotes lags.<sup>8</sup> The model was estimated with panel data regression analysis in order to reduce bias in coefficient estimators. Further, it takes into account cross-sectional heterogeneity (Wooldridge 2010).<sup>9</sup> We distinguish between core countries (France, Belgium, Netherlands, and Germany) and peripheral countries (Italy, Spain, Greece, and Portugal) to count whether stock markets of stressed and non-stressed countries reacted heterogeneously to the ECB's expansionary monetary policy innovations and other covariates. Compared with core countries, peripheral countries were more influenced by the economic crisis.

## 6. Results

Tables 3–5 report our empirical findings for the full sample and the core and peripheral countries, respectively, regarding the research questions set out in the introduction and more specifically the response of eurozone equity to expansionary monetary policy interventions launched by the euro area monetary authority to two main macroeconomic variables and a sentiment indicator. Hausman's test gives evidence in favor of random effects against fixed effects for the full country sample, core and peripheral countries, but the differences in coefficient estimators between these two models are not statistically significant. The Breusch–Pagan LM test provides evidence for cross-sectional correlation in residuals. The likelihood ratio test rejects the hypothesis of panel cross-sectional homoskedasticity for the full sample and peripheral countries. Beck and Katz (1995) proved that the combination of OLS with panel-corrected standard errors (PCSEs) allows for more accurate estimation compared to GLS in the presence of panel error structures (cross-sectional heteroskedasticity and cross-sectional correlation in residuals). So, particular emphasis should be placed on the OLS with panel-corrected standard error model estimation.

First, interest rate cut announcements by the eurozone monetary authority have a positive and statistically significant impact on equity market returns. The impact takes effect two months after the announcement. In linear panel regressions with  $IRC(-2)$  as an independent variable, coefficients of  $IRC$  are statistically significant, but with different levels for the entire country sample, the core countries, and the peripheral countries. Results are stronger for core countries. Further, estimated coefficients show rather stable values in multivariate regressions. So, announcements of conventional expansionary monetary policy measures seem to affect market reactions. Interest rate cuts increase the present value of future net cash flows by decreasing equity risk premium, which, in turn, leads to higher stock prices. It takes about two months for equity prices to reflect new risk premiums as investors need time to adjust their financial strategy. In addition, the reduction in the official interest rates affects money market rates, deposit rates, and other short-term interest rates. Low interest rates make riskier securities more attractive as agents search for higher returns.

**Table 3.** Results for full sample of eight countries.

Independent Variables	Dependent Variable RET							
	Panel OLS		Random Effects		Fixed Effects		Panel OLS with PCSEs	
	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error
C	0.001111	0.003098	0.001111	0.003098	0.001400	0.003111	0.001111	0.003335
IPI	0.080181	0.088117	0.080181	0.088115	0.066169	0.088316	0.080181	0.096750
INFL	−0.475166 *	0.136316	−0.475166 *	0.136313	−0.493096 *	0.137454	−0.475166 *	0.155883
IRC(−2)	0.016715 *	0.005997	0.016715 *	0.005997	0.016487 *	0.005999	0.016715 *	0.006027
UNC(−2)	0.006144	0.004465	0.006144	0.004465	0.006118	0.004465	0.006144	0.004462
ESI	0.006674 *	0.000812	0.006674 *	0.000812	0.006669 *	0.000812	0.006674 *	0.000799
R squared	10.45%		10.45%		11.07%		10.45%	
Hausman test RE/FE	6.518							
LM test for no cross-sectional dependence	1793.05 *							
LR test for cross-sectional heteroskedasticity	125.14 *							

Note: Table reports equity reaction of eight eurozone markets to ECB’s expansionary monetary policy announcements, two main macroeconomic variables, and sentiment indicator. Monthly market return is dependent variable of panel regression. We use two dummy variables: IRC, which specifies announcements for interest rate cuts, and UNC, which specifies announcements for non-traditional monetary policy innovations. Remaining independent variables are: monthly percentage change of Industrial Production Index (IPI), inflation rate (INFL), and monthly first difference of economic sentiment indicator (ESI). IRC(−2), UNC(−2) denote two months lagged dummy variables. \* indicate statistical significance at 1% level.

**Table 4.** Results for Core Countries.

Independent Variables	Dependent Variable RET							
	Panel OLS		Random Effects		Fixed Effects		Panel OLS with PCSEs	
	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error
C	0.006153	0.004016	0.006153	0.004024	0.006442	0.004080	0.006153	0.003991
IPI	0.182698	0.103476	0.182698 ***	0.103682	0.179951 ***	0.103751	0.182698 ***	0.101367
INFL	−0.582786 *	0.195515	−0.582786 *	0.195904	−0.600562 *	0.200300	−0.582786 *	0.190955
IRC(−2)	0.013870 **	0.006818	0.013870 **	0.006831	0.013752 **	0.006836	0.013870 **	0.006817
UNC(−2)	0.009806 ***	0.005087	0.009806 ***	0.005097	0.009784 ***	0.005097	0.009806 ***	0.005087
ESI	0.006827 *	0.000942	0.006827 *	0.000943	0.006794 *	0.000945	0.006827 *	0.000915
R squared	16.92		16.92		17.07		16.92	
Hausman test RE/FE	0.918							
LM test for no cross-sectional dependence	489.09 *							
LR test for cross-sectional heteroskedasticity	6.61							

Note: Same variables used as in Table 3. \*, \*\*, \*\*\* indicate statistical significance at 1%, 5% and 10% level, respectively.

Table 5. Results for peripheral countries.

Independent Variables	Dependent Variable RET							
	Panel OLS		Random Effects		Fixed Effects		Panel OLS with PCSEs	
	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error
C	−0.002543	0.004740	−0.002543	0.004747	−0.002430	0.004750	−0.002543	0.004938
IPI	−0.035462	0.141639	−0.035462	0.141863	−0.040430	0.141950	−0.035462	0.159566
INFL	−0.456559 **	0.192437	−0.456559 **	0.192742	−0.464099 **	0.192991	−0.456559 **	0.211265
IRC(−2)	0.019174 ***	0.009866	0.019174 ***	0.009882	0.019093 ***	0.009882	0.019174 ***	0.009937
UNC(−2)	0.001584	0.007364	0.001584	0.007376	0.001570	0.007376	0.001584	0.007348
ESI	0.006348 *	0.001326	0.006348 *	0.001328	0.006348 *	0.001328	0.006348 *	0.001296
R squared	7.55		7.55		7.80		7.55	
Hausman test RE/FE			0.00					
LM test for no cross-sectional dependence	386.04 *							
LR test for cross-sectional heteroskedasticity	49.19 *							

Note: Same variables used as in Table 3. \*, \*\*, \*\*\* indicate statistical significance at 1%, 5% and 10% level, respectively.

We previously noticed that from the last quarter of 2008 until May 2009, the ECB decreased the rate of main refinancing operations from 4.25% to 1% to overcome the first phase of the crisis, but the margins for further reduction were restricted as the MRO rate was near the zero lower bound level. For this reason, the ECB introduced non-standard measures. Regarding the announcements of these interventions, our results display country heterogeneity.

For the core country sample, unconventional expansionary monetary policy interventions positively and statistically significantly affect market returns at a 10% level with a delay of two months. While core equity markets exhibit a positive significant response, peripheral stock markets seem not to react, as the UNC coefficient has a positive sign but is not statistically significant.<sup>10</sup> So, peripheral countries reacted less to non-standard monetary policy measures.<sup>11</sup> During the sovereign debt crisis, three peripheral countries in our sample (Greece, Portugal, and Spain) faced economic difficulties, received financial support, and were forced to apply economic adjustment programs in cooperation with the International Monetary Fund (IMF), European Commission (EC), and European Central Bank (ECB). Those programs increased investors' uncertainty and decreased expectations about unconventional monetary policy measures. Also, market participants knew that banks in peripheral countries could not efficiently transmit central bank support to the real economy because of financial fragility, higher rates of non-performing loans, and lower capitalization rates. In addition, for a long time, Greek government bonds were ineligible as collateral in the ECB's liquidity transactions, as were Portuguese bonds for a shorter time. Besides this, due to low credit rating, Greek public and private securities were not eligible for expanded Asset Purchase Program operations, while Portuguese securities had limited participation.

Overall, our findings indicate that the ECB's non-traditional expansionary interventions produced a positive and statistically significant impact on eurozone core countries that were less influenced by the economic crisis. Core countries participated more in unconventional operations because of their higher credit rating. By purchasing bonds from high-rating countries, ECB reduced their availability to private investors, while bond prices increased and yields declined. Investors were encouraged to rebalance their portfolios by investing in other securities such as equity. Also, through liquidity operations, the ECB gives incentives to euro area banks to expand lending by increasing loans to non-financial

firms and households. The credit expansion, along with the decreased liquidity risk, boosts equity prices by decreasing risk premiums. Banks in highly rated countries participated more in liquidity operations and expanded credit. Banks in weaker peripheral economies faced the risk of collapse and decreased credit (Martins et al. 2019). For the lagged impact, we should take into account that bank lending channels take about two months to operate because banks have a bureaucratic process and need time to evaluate the financial situation of the candidate borrower. In addition, investors need time to evaluate the ECB's announcements and rebalance their portfolios. Moreover, we recall that there was a time delay between the announcement and the implementation of monetary measures. For example, CBPP3 was announced on 4 September 2014, but operations launched on 20 October 2014.

We have to point out that, for policymakers, conventional and unconventional measures are supplementary, not substitutes, and could jointly stabilize financial markets in turbulent periods. Conventional interventions, accompanied by non-standard measures, reduce banks' funding costs, decrease liquidity risk, reduce asset risk premia, increase collateral value, enhance credit expansion, restore market confidence, increase capital inflows, strengthen revenues, and boost asset prices.

Regarding the inflation rate and returns, we find a statistically significant negative relationship in the full country sample and core and peripheral countries. Previous research supports our findings (Bakshi and Chen 1996; Fama 1981; Fama and Schwert 1977). The coefficient estimates range from  $-0.42$  for peripheral countries (with an average inflation rate of 1.45%) to  $-0.65$  for core countries (with average inflation of 1.52%). High inflation impacts investment strategy because it increases the cost of inputs, reduces consumer purchasing power, decreases firms' revenues and profits, reduces fixed incomes, and is associated with economic deceleration, higher borrowing rates, and risk premiums.

We also document a marginally positive statistically significant effect of monthly percentage change of industrial production on market returns at the 10% level for the core country sample, in agreement with previous research (Fama 1990; Choi et al. 1999; Mauro 2003). On average, core countries present a positive monthly rate of change for IPI, while peripheral countries exhibit a negative rate.

Finally, we examined the relationships between sentiment indicator and current month eurozone equity return. We found a statistically significant and positive impact at the 1% level for the full country sample and the two sub-samples. In multivariate panel regressions with all independent variables, coefficient estimates range from 0.51 for peripheral countries to 0.59 for core countries. Our results are in line with those of (Fisher and Statman 2003; Jansen and Nahius 2003; Brown and Cliff 2004; Stambaugh et al. 2011). According to Ho and Hung (2012), ESI reflects the trust of firms and consumers in each EU country regarding the economy and its prospects. We can suppose that firms and consumers feel optimistic about the future prospects of the economy and their own welfare conditions. In that case, they are more willing to consume, produce, and invest so security markets should incorporate such economic operations.

#### *Robustness Tests*

The economic sentiment indicator (ESI) was constructed by the European Commission as a weighted average of monthly survey results from indicators of five sectors: 40% industry, 30% services, 20% consumption, 5% retail trade, and 5% construction. These indicators are concerned with production, business climate and demand evolution, the economic and financial situation, business activity, and employment, respectively. The ESI is likely to be influenced by contemporaneous equity market returns leading to a potential endogeneity problem. More specifically, because some questions included in indicators are related to the financial situation of businesses and households, market returns could probably influence ESI.

For this reason, we re-estimated our equation using instrumental variables regression. The two-stage least squares (TSLS) method is a special case of instrumental variables used by researchers to reduce estimation bias. The instruments used in our specification include:

a constant  $C$ ,  $IRC(-2)$ ,  $UNC(-2)$ ,  $IPI$ ,  $INFL$  (as defined above), and the monthly first difference of the industrial confidence indicator ( $INDU$ ). The cross-correlation between the monthly first difference of  $INDU$  and of  $ESI$  is 0.79 for the full country sample. We choose  $INDU$  as an instrumental variable because the weight of the industrial confidence indicator on the  $ESI$  is the highest (40%) among all indicators. Also, our estimation procedure satisfies order and rank conditions. Table 6 reports our empirical results.

**Table 6.** Results using TSLS with PCSEs.

Dependent Variable RET						
Instrument Specification: C IPI INFL IRC(-2) UNC(-2) INDU						
Independent Variables	Full Country Sample		Core Countries		Peripheral Countries	
	Coeff.	Std.Error	Coeff.	Std.Error	Coeff.	Std.Error
C	0.000226	0.003390	0.006426	0.004027	-0.003745	0.005021
IPI	0.071168	0.097086	0.193015 ***	0.100187	-0.046648	0.159609
INFL	-0.423797 *	0.159545	-0.608979 *	0.194946	-0.394386 ***	0.216272
IRC(-2)	0.017358 *	0.006034	0.013941 **	0.006748	0.020075 **	0.009959
UNC(-2)	0.006247	0.004470	0.009759 ***	0.005023	0.002079	0.007379
ESI	0.007769 *	0.001099	0.006875 *	0.001145	0.008080 *	0.001835
R squared	10.29		17.92		7.24	

Note: Table presents estimation results using two-stage least squares (TSLS) method. Same variables used as in Table 3.  $INDU$ , monthly first difference of industrial confidence indicator. \*, \*\*, \*\*\* indicate statistical significance at 1%, 5% and 10% level, respectively.

Our findings are consistent with the instrumental variables approach. With the two-stage least squares panel regression method,  $ESI$  has a positive and statistically significant effect on equity market returns at the 1% level for the full sample and the two sub-samples. Comparing this with the results shown in Section 6, the respective coefficients of other independent variables remain statistically significant with similar magnitudes.

## 7. Conclusions

The global financial system was under unprecedented pressure at the beginning of the economic crisis. There was great uncertainty about the financial health of globally significant financial institutions that led to a collapse in financial activity. The impending sovereign debt crisis forced peripheral eurozone countries to apply for economic adjustment programs to receive financial support.

During the financial crisis, the euro area monetary authority launched an extensive set of standard and non-conventional policy interventions in order to reduce uncertainty and risk in the markets. Our study explored the impact of these measures on market returns of eight eurozone countries for the period January 2007 to December 2017 along with two main macroeconomic variables and a sentiment indicator. In order to investigate whether stock markets react heterogeneously to expansionary monetary policy innovations and other covariates, we divided the sample into two sub-samples, core and peripheral countries.

Our results indicate that interest rate cuts significantly affect equity returns for core and peripheral markets. So, investors appreciated the conventional expansionary monetary policy interventions and ECB's intense efforts to overcome the first stage of the financial crisis by reducing its main refinancing rate to a lower bound. Low official interest rates affect short-term interest rates and make equity more attractive as agents are searching for higher returns. Besides this, the ECB's official intention to maintain key interest rates at a deficient level for an anticipated period reduced uncertainty and volatility in the market and positively affected investors' expectations.

We also documented that ECB's non-conventional expansionary interventions had a positive and statistically significant lagged impact on core eurozone markets that were less influenced by the economic crisis. Peripheral countries were forced to apply economic

adjustment programs that increased investors' uncertainty during and after the sovereign debt crisis, boosted capital outflows from these markets and decreased expectations about unconventional monetary policy measures. On the other hand, equity markets of core countries were influenced by unconventional interventions via the portfolio rebalancing and bank lending channels.

Concerning inflation rates and returns, in a sampling period of low inflation, we found a statistically significant negative relationship for the full country sample, core, and peripheral countries. Our results are in line with those of [Fama and Schwert \(1977\)](#), [Fama \(1981\)](#), and [Bakshi and Chen \(1996\)](#). High inflation impacts investment strategy because it is associated with economic deceleration and higher borrowing rates. During our sampling period, the inflation rate moved at low to moderate levels, with an average value of 1.48%, below but close to 2%, which is the main objective of the euro area monetary authority.

Finally, we documented evidence that the economic sentiment indicator introduced by the European Commission had a strongly positive statistically significant effect on eurozone stock markets, in agreement with previous research (see [Stambaugh et al. 2011](#); [Brown and Cliff 2004](#); [Jansen and Nahius 2003](#); [Fisher and Statman 2003](#)). ESI reflects the expectations of EU firms and consumers about the economy and its prospects. If prospects are promising, firms and consumers are more willing to consume, produce, and invest. Security markets should incorporate such economic operations.

We recognize some limitations in our study, as we did not consider spillover effects from conventional and non-standard monetary policy measures introduced by other central banks (Fed, BoE) during our sample period. We also did not examine effects from fiscal policy interventions that could affect market returns or the predictive ability of other macroeconomic variables such as exchange rate and trade balance. These could constitute interesting topics for future research.

Despite the limitations, our results are useful both for policy-makers and investors, because they should consider a broad set of monetary measures and macroeconomic and sentiment variables that could affect financial markets.

Regarding monetary policy, during the first phase of the financial crisis, ECB managed to calm and support euro area markets by reducing the MRO near to the zero lower bound level. On the other hand, the effect of non-standard monetary policy innovations is not uniform across euro area equity markets. Core equity markets seem to be more affected by unconventional measures than peripheral countries. By taking into account these effects, policy-makers could design more effective monetary policy measures. In addition, investors build their strategies with the goal of increasing returns. Our findings shed light on the effects of standard and non-standard policies, along with two main macroeconomic variables and a sentiment indicator, on equity returns.

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## Appendix A

**Table A1.** Descriptive statistics for monthly returns by country.

Country	Mean	Median	Max	Min	Std. Dev.
Belgium	−0.000744	0.004634	0.110650	−0.240879	0.049945
France	−0.000320	0.002259	0.118287	−0.145225	0.049831
Germany	0.005091	0.010683	0.154968	−0.213096	0.055215
Greece	−0.011196	−0.003996	0.198539	−0.326730	0.097612
Italy	−0.004847	−0.003831	0.188966	−0.178007	0.063794
Netherlands	0.000718	0.010110	0.105922	−0.219583	0.053387
Portugal	−0.005541	−0.003481	0.100720	−0.233478	0.057707
Spain	−0.002595	0.002270	0.153789	−0.219408	0.060079
All	−0.002413	0.004244	0.198539	−0.326730	0.062535

**Table A2.** MRO rate reduction announcement dates.

Date	MRO Rate Change
8 October 2008	−0.5
6 November 2008	−0.5
4 December 2008	−0.75
15 January 2009	−0.5
5 March 2009	−0.5
2 April 2009	−0.25
7 May 2009	−0.25
3 November 2011	−0.25
8 December 2011	−0.25
5 July 2012	−0.25
2 May 2013	−0.25
7 November 2013	−0.25
5 June 2014	−0.1
4 September 2014	−0.1
10 March 2016	−0.05

Note: The IRC dummy variable takes the value of one (=1) in the month in which ECB announced the reduction of the policy rate and zero otherwise (15 months). Source: ECB's press conferences and press releases.

**Table A3.** Announcement dates of ECB's non-standard measures.

Date	Description
22 August 2007	Supplementary LTROs
28 March 2008	6 month Supplementary LTROs
7 May 2009	One year LTROs and purchases of covered bonds
4 June 2009	Details for CBPP1
3 December 2009	LTROs enhancement
4 March 2010	LTROs enhancement
10 May 2010	SMP and other liquidity measures
3 March 2011	Fixed-rate full allotment procedure for MROs and LTROs
4 August 2011	6-month Supplementary LTROs at fixed rate full allotment procedure and other measures
6 October 2011	CBPP2 and 12-month Supplementary LTROs launched
8 December 2011	Two 3-year LTROs and other measures
9 February 2012	Approval of National credit claims criteria
26 July 2012	Draghi's speech "whatever it takes"
2 August 2012	Outright open market transactions (OMT)
6 September 2012	Details for OMT
22 March 2013	Collateral rule amendments
5 June 2014	Targeted LTROs launched and other measures
3 July 2014	Details for first series of T-LTROs

**Table A3.** *Cont.*

Date	Description
4 September 2014	CBPP3 and ABSPP
22 January 2015	Expanded Asset Purchase Programme (APP) and other measures
5 March 2015	Public Sector Purchase Programme details
23 September 2015	ECB adjusts purchase process in ABSPP
9 November 2015	ECB increases the PSPP share limit
3 December 2015	Extension of APP until the end of March 2017.
10 March 2016	ECB's decision to increase monthly purchases under APP, to launch second series of Targeted LTROs and Corporate Sector PP
21 April 2016	Details for CSPP
3 May 2016	Legal acts for the second series of T-LTROs
2 June 2016	The Eurosystem will start making purchases under CSPP
8 December 2016	ECB's decision to continue net asset purchases at a monthly pace of €60 billion until the end of December 2017, starting from April 2017.
26 October 2017	ECB's decision to continue net asset purchases at a monthly pace of €30 billion until the end of September 2018, starting from January 2018

Note: The UNC dummy variable takes the value of one (=1) in the month in which ECB announced a non-standard expansionary policy measure and zero otherwise (30 months). Source: ECB's press conferences, press releases, and key speeches; Cross-checking with previous research was also carried out (Rogers et al. 2014; Falagiarda et al. 2015; Haitma et al. 2016; Martins et al. 2019).

**Table A4.** Descriptive statistics for inflation rate by country.

Country	Mean	Median	Max	Min	Std. Dev.
Belgium	0.019080	0.018373	0.058927	-0.017293	0.014168
France	0.012979	0.011884	0.040416	-0.007963	0.010429
Germany	0.014695	0.015350	0.033784	-0.006501	0.009544
Greece	0.013880	0.010462	0.056552	-0.028560	0.021675
Italy	0.015477	0.014078	0.042529	-0.005076	0.012854
Netherlands	0.014092	0.014117	0.033742	-0.006702	0.010678
Portugal	0.013530	0.010743	0.040464	-0.017872	0.014122
Spain	0.015184	0.018326	0.053256	-0.014574	0.017094
All	0.014865	0.014340	0.058927	-0.028560	0.014386

## Notes

- <sup>1</sup> For more information about financial assistance to eurozone peripheral countries, see <https://www.esm.europa.eu/>, accessed on 3 December 2021.
- <sup>2</sup> For more details about the ECB's non-standard monetary policy measures in response to the financial and sovereign debt crisis see Cour-Thiman and Winkler (2013).
- <sup>3</sup> See Falagiarda and Reitz (2015) for details on the ECB's securities holdings under the SMP.
- <sup>4</sup> For details about APP, see European Central Bank (2015, 2019), Economic Bulletin, issue 7, 2015 and issue 2, 2019.
- <sup>5</sup> See Sellin (2001) for a comprehensive literature review on how monetary policy affects stock prices.
- <sup>6</sup> See Mishkin (2001) for a complete presentation of transition channels.
- <sup>7</sup> The higher cross-correlation, in absolute value, was 0.2633, between inflation rate and first difference of the economic sentiment indicator.
- <sup>8</sup> For example,  $L = -2$  means two periods (months) lagged.
- <sup>9</sup> Many researchers used the same econometrical approach to study this topic (see among others, Fiordelisi and Ricci 2016; Fiordelisi and Galloppo 2018; Pacocco et al. 2019; Fatas et al. 2021).
- <sup>10</sup> The dummy variable UNC is displayed with two lags,  $UNC(-2)$  in models for the full country sample, and peripheral countries only in comparison with the corresponding models for core countries.
- <sup>11</sup> See Boeckx et al. (2017) for the effectiveness of ECB's balance sheet policies.

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