Assessing the sources of heterogeneity in eurozone response to unconventional monetary policy

Eli Agba, Hamza Bennani, Jean-Yves Gnabo

Assessing the Sources of Heterogeneity in Eurozone Response to Unconventional Monetary Policy

Komlan Eli Agba[a,*], Hamza Bennani[b], Jean-Yves Gnabo[a,c]

[a] *CeReFiM, University of Namur, Namur, Belgium*
[b] *LEMNA, University of Nantes, Nantes, France*
[c] *EconomiX, Paris-Nanterre University, Nanterre, France*

Abstract

In this paper, we aim at explaining a specific type of heterogeneity in the euro area pertaining to the diverging responses of countries and sectors to the European Central Bank's Unconventional Monetary Policy. Equipped with stock markets indices of 17 sectors for each euro area country, we first preform an event-study analysis to assess the reaction of the markets. Next, we regress the responses on a set of country-specific drivers. Our main findings show that variables related to the nature of banking industry (e.g. cost-to-income, return on assets), macroeconomic environment (e.g. gross debt) and macroprudential policy all contribute to observe diverging responses to ECB's monetary policies. While some sectors and countries responded more negatively than positively to the policies, the Unconventional Monetary Policy impacts the markets positively on average. A policy implication is that the heterogeneous response calls for domestic structural reforms that should target the discrepancies in the banking and the macroeconomic environments across euro area countries.

Keywords: Event-study, Ordered probit, Heterogeneity, Cross-sector/Cross-country, UMP

JEL classification: E52, E58, G14

*Corresponding author: Rempart de la Vierge, 8, 5000 Namur, Belgium; +32 487 753 146

Email addresses: komlan.agba@unamur.be (Komlan Eli Agba), hamza.bennani@univ-nantes.fr (Hamza Bennani), jean-yves.gnabo@unamur.be (Jean-Yves Gnabo)

1 Introduction

"[the] ECB faced severe impairments to the transmission of monetary policy across the euro area, with marked heterogeneity from country to country" (Draghi, 2014)

"[...] if we want to avoid overburdening monetary policy, then policymakers need to act more forcefully to reduce the major sources of euro area heterogeneity, that is, we need a better economic policy framework" (Cœuré, 2019)

The statements above by Mario Draghi and Benoît Cœuré, President (2011-2019) and Executive Board member (2012-2019) of the European Central Bank (ECB), respectively, emphasise three important issues related to the sustainability of the currency union: heterogeneity in the euro area, its implication for responses to monetary policy, and corrective policy actions to address this heterogeneity.[1] Indeed, more than twenty years after the introduction of the single currency, convergence among the member states is still a concern. As an illustration, inflation differentials among euro area members are persistent, while the magnitude of the business and financial cycles is still widening (Franks et al., 2018). Hence, cross-border financial integration, the ECB's "monetary dominance" mantra, and the anchoring of inflation expectations may not be sufficient to sustain the monetary policy transmission mechanism in the euro area in case of idiosyncratic shocks. This observation is particularly true with the advent of the Global Financial Crisis (GFC) (Oman, 2019), which revealed the inefficiency of conventional monetary tools to respond adequately to such a crisis (Salachas et al., 2018).[2] This might have been due, in part, to the banking sector in the euro area which is fragmented across member states. This fragmentation has impaired the uniform transmission of the single monetary policy, visible through the large cross-country dispersion in bank lending growth following the GFC (Ciccarelli et al., 2013; Grandi, 2019). This shows that differences in the structure of euro area economies can give rise to asymmetries in the transmission of a common monetary policy and

[1] See, for example, Mandler et al. (2021) for a selected literature on heterogeneity in euro area monetary policy transmission

[2] The GFC, and later the sovereign debt crisis, led to a destabilising dispersion in interest rates and, ultimately, in real and nominal economic indicators.

thus, shed some doubt on its effectiveness.

Hence, there is a need to understand the sources of the heterogeneous countries' reactions, which is crucial in order to address them with appropriate corrective policies. Against this background, we first aim to document the level of heterogeneity among the responses of sectors of euro area countries to Unconventional Monetary Policy (UMP) measures implemented by the ECB. In a second step, we aim to explain these heterogeneous responses with several country and sector characteristics.

The issue of heterogeneity among euro area economies and its implication for monetary policy revived in the academic literature in the aftermath of the European sovereign debt crisis. Altavilla et al. (2020) focuses on this issue by looking mostly at the banking sector. They show that the heterogeneity of pass-through of monetary policy changes on lending rates depends on some bank-level variables such as the capital ratio, the exposure to sovereign debt, and the percentage of non-performing loans. Ricci (2015) investigates the impact of ECB monetary policy announcements on the stock price of large European banks. She finds that some variables characterising the banking sector (e.g. capitalisation, liquidity, and risk) are strong determinants of the reaction to policy announcements. However, focusing only on the banking sector gives a partial view of the effect of the monetary policy and neglects the responses of other sectors. Following this line of thought, Georgiadis (2015) examine the domestic transmission of euro area monetary policy shocks using a mixed cross-section GVAR model over the time period from 1999Q1 to 2009Q4. He finds that asymmetries in the transmission of monetary policy within the euro area are driven by a number of key country-specific structural characteristics. Haitsma et al. (2016) study heterogeneity at the sectoral level using Euro STOXX 50 Index components. They find contrasting responses among sectors, with durable goods sectors responding more than non-durable sectors. They explain their results by various firm characteristics, but for the unconventional surprises, these characteristics capture none or only little of the heterogeneity in the sectors' reactions. Nevertheless, this approach implicitly assumes that all components of a given aggregate sector have homogeneous behaviour towards the policies. In other words,

it assumes, for instance, that the utilities sector's reaction in Spain is similar to the one in Germany or in the Netherlands.[3] Finally, Pacicco et al. (2019), by focusing on cross-country heterogeneity, assess the markets reactions to ECB's conventional and unconventional policies, and then analyse the possible determinants of the reactions. However, they limit their study to aggregate cross-country reactions by using national equity indices. This approach probably sets aside some cross-sector reactions to the policies. The sectors' responses could therefore neither be explored with the aggregate country data nor help identify the extent to which industry composition influences cross-country heterogeneity. As the authors acknowledge themselves, the diverse composition of the indices can be a driver of the heterogeneity in the reactions.

As a result, even though the literature clearly identified that the ECB's UMP had heterogeneous effects on sectors or countries at the aggregate level, the effects at the disaggregated level, that is, in each country's different sectors, are less explored. Disentangling between the cross-sector and the cross-country reactions will help to account for the heterogeneity that characterises the aggregate sectoral or country indices. This study aims to fill this gap on the heterogeneous responses to UMP by considering country-based as well as sector-based heterogeneity, and using a large set of determinants related to the banking industry, macroeconomic environment and macroprudential regulation to explain why euro area countries responded differently to the ECB's UMP. Specifically, we are interested in the reaction of various sectors inside each country (e.g. the bank sector in Italy, consumer durables sector in Germany, utilities sector in Spain), rather than the broad picture captured when working with aggregate country indices (e.g. CAC40, DAX30, IBEX35), or aggregate sector indices (e.g. Euro STOXX Banks, Euro STOXX Utilities). Therefore, we can formulate the resulting research question as follows: how do the individual sectors' stock markets of euro area countries react to the ECB's unconventional policies, and what can explain the heterogeneous reactions?

We exploit disaggregated market data at the sectoral level for each country to provide an accu-

[3] Another possible drawback is that the aggregate sector index will reflect mostly the dominant component's reaction.

rate assessment of the impact of the unconventional policies on the different sectors. A set of key ECB's UMP programmes are at the heart of this analysis: Securities Markets Programme (SMP), Outright Monetary Transaction (OMT) and Very-/Targeted-Longer Term Refinancing Operations (V/TLTRO). These asset purchase programmes and liquidity-providing operations were by far among the most important actions taken by the ECB to tackle the two mounting euro area crises (see Krishnamurthy et al. (2017); Fratzscher et al. (2016)). From this assessment, we are able to identify the heterogeneity in the sectors' responses. Next, we aim to uncover the determinants of this heterogeneity by exploring the role of the banking system, as well as macroeconomic and regulatory indicators. Our empirical strategy is thus based on two steps. First, we estimate the markets impacts of ECB's announcements using an event-study methodology. From this event-study, we retain only the Cumulative Abnormal Returns (CARs) that are significant to the policies to explain the heterogeneity. As a second step, we rely on an ordered probit model to characterise the determinants of the heterogeneity. In doing so, we extend and complement the literature by differentiating between the components (sectors or countries) that contributed positively or negatively to the overall reactions, and by empirically documenting the relationship between the positive or negative reactions and the macro-level variables above.

We report the following main findings. We show that euro area countries and their sectors did not react uniformly to the ECB's UMP. As an illustration, Italian and Spanish stocks responded the most positively to the announcements. The most effective announcement that pushed markets up is the extension of the SMP to Italy and Spain. The European banking sector led the total reactions from all sectors to the non-standard policies, followed by the Utilities, Retail trade and Communications sectors. Some sectors responded more negatively to the policies, but overall, the impact of these policies was significantly positive. Regarding the determinants of these heterogeneous reactions, our main findings point to evidence that an increase in certain variables characterising the banking industry (e.g. cost-to-income, return on assets (ROA)), the macroeconomic environment (e.g. gross debt) leads to an increase in the probability of a positive response. The opposite effect, that is, a decrease in the probability of a positive reaction,

happens with a rise in some other variables, like e.g. bank concentration, or primary balance. A policy implication of these findings is that the country-specific characteristics that explain the asymmetric responses to monetary policy changes require domestic structural reforms. These reforms could help having homogeneous reactions to ECB monetary policy across euro area countries.

In the remainder of the article, we describe the data in section 2. In section 3, we lay out the empirical strategy. We present our results in section 4 and some sensitivity analyses in section 5. Section 6 concludes.

2 Data

We consider the 11 largest euro area countries in this study: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), Finland (FI), France (FR), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL) and Portugal (PT). For each country, we collect the daily closing prices of 17 sectors, upon availability.[4] The data are provided by FactSet database and MacroBond database. Figure 1 shows the cumulative market capitalisation of each sector expressed in percentage.[5] It shows the relative size of each sector in the euro area, which is dominated by Bank, Health technology and Consumer non-durables as the top three.

Following the literature (Krishnamurthy et al., 2017; Fratzscher et al., 2016), we focus on some key dates that represent the ECB's UMP during the GFC and the sovereign debt crisis (Table 1). These ECB's policies are the SMP, the OMT, the VLTRO, and the TLTRO.[6]

Given the multiple objectives of those unconventional policies[7], there are several transmis-

[4]Based on FactSet's Revere Business Industry Classification System (RBICS), 19 sectors are defined, but we did not have data for the Energy Minerals and Health Services sectors. Those two sectors are thus absent from the study. Moreover, because monetary policy transmission operates mainly via banks, we did not include the Financial sector as a whole, but only the Bank sub-sector. Data for this latter follow the FTSE's Industry Classification Benchmark (ICB) definition.

[5]Data are those from the Eurotop Sectors equity indices, as defined by the FTSE. Because those sectors are defined following the ICB scheme, we perform a matching of the sectors according to the RBICS scheme first. The Distribution Services sector is missing from this figure, but is part of the study.

[6]Krishnamurthy et al. (2017) provide an excellent description of those policies.

[7]To address the malfunctioning of securities markets and restore an appropriate monetary policy transmission mechanism, to contain the redenomination risk growing among market participants with fears of a euro breakup, and to address the severe liquidity concerns in the money markets

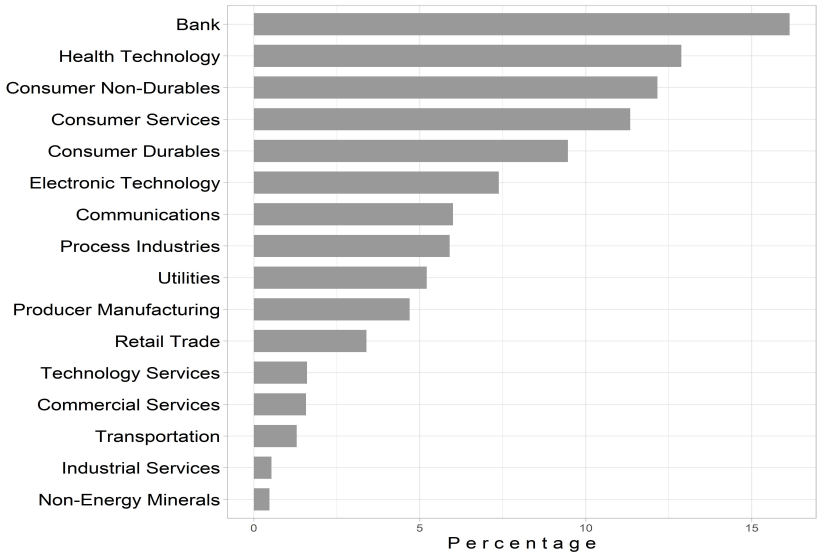

Figure 1: Cumulative market capitalisation (2010-2016)

Note: Each horizontal bar represents the share of the sector's market capitalisation in the cumulative daily market capitalisation over January 2010 - December 2016 of all the 17 sectors

Table 1: The ECB's Unconventional Monetary Policy

Date	Policy description
10 May 2010	*Securities Markets Programme (SMP) announcement*
4 August 2011	*SMP covers Spain and Italy*
1 December 2011	*Draghi's speech to the European Parliament*
8 December 2011	*Two 3-year LTROs (VLTROs) announcement*
26 July 2012	*Draghi's "Whatever it takes" London speech*
2 August 2012	*Outright Monetary Transactions (OMT) press conference*
6 September 2012	*OMT details released*
5 June 2014	*First round of TLTROs announcement*
10 March 2016	*Second round of TLTROs announcement*

Note: Dates of announcement related to ECB's Unconventional Monetary Policy

sion channels through which they can affect stock markets.[8] Through the *confidence channel*, market participants should perceive these announcements as a commitment to restore a proper transmission mechanism of monetary policy. Another channel that should be at work with the liquidity-providing operations is the *bank credit risk channel*: with easy conditions and (unlimited) access to liquidity for banks, market participants should consider that the credit risk is reduced, and that firms and households may have access to funding again with less constraints. As a result, Bank equity prices and other sectors' equity prices should show a positive impact.

[8]The SMP and OMT policies targeted the bond markets, but we expect their announcements to produce effects beyond the targeted markets.

Notwithstanding the suspected heterogeneity, we expect that the effect of these policies across countries and sectors is subject to some macroeconomic, regulations, financial and banking conditions. Hence, we aim to explain the cross-country and cross-sector response patterns with the banking industry infrastructure, financial markets characteristics, fiscal policy and macroprudential policy indicators.

Accordingly, we collect data on banks' cost-to-income ratio and ROA (after tax), as well as bank concentration (compiled in the World Bank's Global Financial Development Database by Cihak et al. (2012)). Additionally, banking data on credit risk, market risk and tier 1 ratio are gathered from the ECB's Consolidated Banking Data and Banking Structural Financial Indicators. Fiscal indicators (primary balance and gross debt (expressed as a percentage of GDP)) come from the International Monetary Fund's Fiscal Monitor database, and the macroprudential policy index (MPI) is computed by Cerutti et al. (2017). Table 2 gives the definition of those variables.

Table 2: Variables definition

Variable	Definition	Source
	Banking sector characteristics	
Bank Cost to Income Ratio (in %)	Operating expenses of a bank as a share of sum of net-interest revenue and other operating income	Cihak, Demirguc-Kunt, Feyen and Levine (2012)
Bank Return on Assets (After Tax) (in %)	Commercial banks' after-tax net income to yearly averaged total assets	Cihak, Demirguc-Kunt, Feyen and Levine (2012)
Bank Concentration (in %)	Assets of three largest commercial banks as a share of total commercial banking assets	Cihak, Demirguc-Kunt, Feyen and Levine (2012)
Credit Risk (in %)	The risk of loss due to default by a borrower, computed as credit risk / total risk exposure amount, and following the standardised approach (use of external ratings)	ECB (Consolidated Banking data and Banking Structural Financial Indicators database)
Tier 1 Ratio (in %)	Core tier 1 capital (equity capital and disclosed reserves) / total risk exposure amount	ECB (Consolidated Banking data and Banking Structural Financial Indicators database)
	Financial system characteristics	
Market Risk (in %)	The risk of losses in on- and off-balance sheet positions arising from adverse movements in market prices. Computed as risk exposure amount for position, foreign exchange and commodities risks (under standardised approach) / total risk exposure amount	ECB (Consolidated Banking data and Banking Structural Financial Indicators database)
	Fiscal and Regulation indicators	
Primary Balance (in %)	Overall balance excluding net interest payment (interest expenditure minus interest revenue)	IMF (Fiscal Monitor database)
Gross Debt (in %)	General Government Gross Debt	IMF (Fiscal Monitor database)
Macroprudential Index (in unit)	Sum of the scores on policies aimed at borrowers' leverage and financial positions, and at financial institutions' assets or liabilities	Cerutti, Claessens and Laeven (2017)

3 Empirical strategy

We rely on an event-study approach to measure the markets' responses to the ECB's UMP. We describe its implementation in subsection 3.1. After this step, we run a panel regression with the objective to explain the results from the event-study analysis. Subsection 3.2 presents the model for this regression.

3.1 Event-study description

Among the estimation methods to obtain predicted returns, we favour the standard market model.[9] The intuition behind this model is the following: we can obtain the fraction of the return of a stock that reacts to a particular event as the forecast error from the observed returns and the predicted returns. While the former are readily available, we must estimate the latter.

We begin by computing the daily log-returns of the stock prices to estimate the model: $R^j_{i,t} = ln\left(P^j_{i,t}/P^j_{i,t-1}\right)$, where $P^j_{i,t}$ is the closing price of the stock of sector i at day t in country j. With the computed returns, we estimate the following market model using an OLS regression:

$$R^{j,\tau'}_{i,t} = \alpha^j_i + \beta^j_i R^{\tau'}_{m,t} + \varepsilon^j_{i,t}; \tag{1}$$

with $R_{m,t}$ the daily return of the markets and $E[\varepsilon_{i,t}] = 0$, $Var[\varepsilon_{i,t}] = \sigma^2_{\varepsilon_i}$. We estimate Equation (1) for each country and each sector over the estimation window τ', which ranges from 271 days to 20 days (252 days) before the event. We thus generate the abnormal returns due to the UMP event on date t:

$$AR^{j,\tau}_i = R^{j,\tau}_i - \widehat{\alpha}^j_i - \widehat{\beta}^j_i R^{\tau}_m; \tag{2}$$

τ represents the event window (5-day window), ranging from one day before the event to three days after the event for each announcement. Next, we obtain the CARs by summing up the

[9] Financial econometric models, of which this is one, look principally on the impact of a policy on financial markets returns, and usually rely on the event-study framework to measure the impact via the abnormal returns the policy generated. This approach is better for capturing the immediate, short-term impact of the policy. Our choice of this methodology is logical given the objectives of our study.

ARs: $CAR_i^{j,\tau} = \sum_{\tau} AR_i^{j,\tau}$. To close the event-study, we perform a Student test on the CARs to obtain their significance: $T_i = CAR_i / \tau\widehat{\sigma}_{\varepsilon_i}$, with $\widehat{\sigma}^2_{\varepsilon_i} = \left(1/(N-d)\right) \sum_{\tau'} AR^2{}_{\tau',i}$, where N is the number of observations in the estimation window τ' and d the degrees of freedom of Equation (2) estimated over τ'. The T statistic above has a Student distribution with $N-2$ degrees of freedom.

We represent the markets, R_m, by the FTSE Europe All Cap index.[10] For the purpose of inference, we need sufficient data in the estimation window. However, some stock prices were missing or frozen (same price level) for certain periods. We choose to discard those data using the following filtering rules: there should be less than 10% continuous zero returns (the number amounts to 25 returns) in the estimation window, and no more than one zero return in the event window.[11] Otherwise, we do not perform the event-study. This event-study approach may suffer from small bias, but outperforms Rigobon and Sack (2004)'s heteroscedasticity-based estimator.[12] The endogeneity concern between monetary policy and stock price reactions in this context is also of less importance since we use daily data.

3.2 Regression analysis

With the steps described above, for each event, we compute the CARs by sector and country and obtain their statistical significance. To explain the heterogeneous responses of euro area countries to UMP, we transform these CARs into discrete variables taking -1 for negative and significant coefficients at the 5% level, 1 for positive and significant coefficients at 5% level, and 0 for non-significant coefficients at the 5% level. This methodology does not reflect the simple amplitude of the responses, but rather its significance to UMP. Using a panel data approach, we investigate the role of different variables as plausible determinants of the heterogeneous

[10] We think a good index that represents the markets should be as unaffected as possible by ECB's interventions, while representing accurately the countries under study. We compare the returns of the MSCI index, STOXX index and FTSE index. Data for the MSCI are incomplete for this study and the FTSE index showed one of the weakest reactions towards the policies.

[11] For purpose of space, the descriptive statistics are displayed in the appendix.

[12] Rigobon and Sack (2004) measure the markets reactions through the increase in the variance of policy shocks, while the variance of other shocks remains constant. However, according to Rosa (2011), the OLS approach tends to outperform in an expected squared error sense the heteroscedasticity-based estimator for both small and large sample sizes.

responses. We rely on the existing literature to select the most relevant variables. In particular, we focus on some banking sector characteristics, financial system variables, and fiscal and regulatory indicators:

$$Response_{i,t} = f\Big(\beta_1 BANK_t;\ \beta_2 FINANCIAL_t;\ \beta_3 FISC_t\Big); \tag{3}$$

where the explained variable $Response_{i,t}$ is the ordinal variable coded as $-1 < 0 < +1$ and indicating whether the CAR of sector i is significant (whether positively or negatively) or not to event during t. $BANK_t$ is a matrix of banking sector characteristics, $FINANCIAL_t$ a matrix of financial system characteristics and $FISC_t$ a matrix of fiscal and macroprudential indicators. $f()$ is a nonlinear link function. We estimate the model at the quarterly frequency.

We briefly recall the framework for ordered response models (Wooldridge, 2010) and apply it to our case of 3 ordered responses. Let y^* be a latent variable defined by

$$y^* = \mathrm{x}\beta + \mathrm{e}; \quad \mathrm{e} \mid \mathrm{x} \sim \mathcal{N}(0,1)$$

and $\alpha_1 < \alpha_2$ be two unknown cut points such that

$$\begin{cases} y = -1 & \text{if } y^* \leq \alpha_1 \\ y = 0 & \text{if } \alpha_1 < y^* \leq \alpha_2 \\ y = 1 & \text{if } y^* > \alpha_2 \end{cases}$$

The conditional distribution of $y \mid \mathrm{x}$ is

$$\begin{cases} P(y=-1 \mid \mathrm{x}) & = P(\mathrm{e} \leq \alpha_1 - \mathrm{x}\beta \mid \mathrm{x}) = \Phi(\alpha_1 - \mathrm{x}\beta) \\ P(y=0 \mid \mathrm{x}) & = P(\alpha_1 - \mathrm{x}\beta < \mathrm{e} \leq \alpha_2 - \mathrm{x}\beta \mid \mathrm{x}) = \Phi(\alpha_2 - \mathrm{x}\beta) - \Phi(\alpha_1 - \mathrm{x}\beta) \\ P(y=1 \mid \mathrm{x}) & = P(\mathrm{e} > \alpha_2 - \mathrm{x}\beta \mid \mathrm{x}) = 1 - \Phi(\alpha_2 - \mathrm{x}\beta) \end{cases}$$

where Φ is the c.d.f. of a normal distribution.

We estimate α and β by maximum likelihood, the log-likelihood function being the following for each i:

$$\begin{aligned}\mathscr{L}_i(\alpha,\beta) = & 1_{[y_i=-1]} \log[\Phi(\alpha_1 - \mathrm{x}_i\beta)] \\ & + 1_{[y_i=0]} \log[\Phi(\alpha_2 - \mathrm{x}_i\beta) - \Phi(\alpha_1 - \mathrm{x}_i\beta)] \\ & + 1_{[y_i=1]} \log[1 - \Phi(\alpha_2 - \mathrm{x}_i\beta)]\end{aligned}$$

Given that Φ represents the c.d.f. of a normal distribution, $f()$ is thus an ordered probit model. Because of the nonlinear form of Equation (3), we cannot interpret the estimated coefficients $\widehat{\beta}$ directly and instead discuss their signs and statistical significance. We also apply the Huber-White correction for heteroscedasticity and correlation to obtain robust variance-covariance matrix estimates. We obtain the results by sector with observations from the 11 countries over the 9 events, and the results by country with observations from the 17 sectors over the 9 events, but they are subject to some missing data.

4 Results

We discuss the results obtained from the estimation of the models presented in sections 3.1 and 3.2 in the following subsections.

4.1 Significance of announcements

We examine the significant reactions following the policy announcements at the 5% level. When considering the set of 9 announcements related to UMP, we find that sectors in Spain and Italy responded (positively) the most to the ECB's policies (Table 3). These results are not surprising given that some of the policies targeted mainly these two distressed countries (e.g. announcement of 4 August 2011). We also observe that the peripheral eurozone countries (Spain, Italy, Ireland, Greece, Portugal) responded to the policies more than did the core countries.

A detailed analysis of the reactions by type (whether positive or negative) shows that Finland, Austria and Germany displayed more negative reactions than positive ones (Figure 2). Interestingly, this is a feature only shared by the core countries. Moreover, the extension of the SMP to Italy and Spain, and the introduction of the three-year LTRO are the announcements to which those core countries reacted altogether negatively.[13]

Table 3: Significant reactions by country

Total reaction		Positive and negative reactions			
Country	Significant reactions (in %)	Country	Positive	Country	Negative
Spain	13.29	Spain	11.19	Finland	7.19
Finland	11.11	Italy	7.19	Greece	4.67
Italy	9.80	Portugal	5.38	Austria	4.63
Greece	9.35	France	5.23	Ireland	4.21
Ireland	8.42	Greece	4.67	Germany	3.92
Portugal	7.53	Ireland	4.21	Italy	2.61
France	6.54	Belgium	4.20	Portugal	2.15
Austria	6.48	Finland	3.92	Spain	2.10
Belgium	6.29	Austria	1.85	Belgium	2.10
Germany	4.58	Netherlands	1.56	France	1.31
Netherlands	2.34	Germany	0.65	Netherlands	0.78

Note: The left panel shows the total (negative and positive) reaction of sectors aggregated by country. The right panel shows the detailed (negative or positive) reaction.

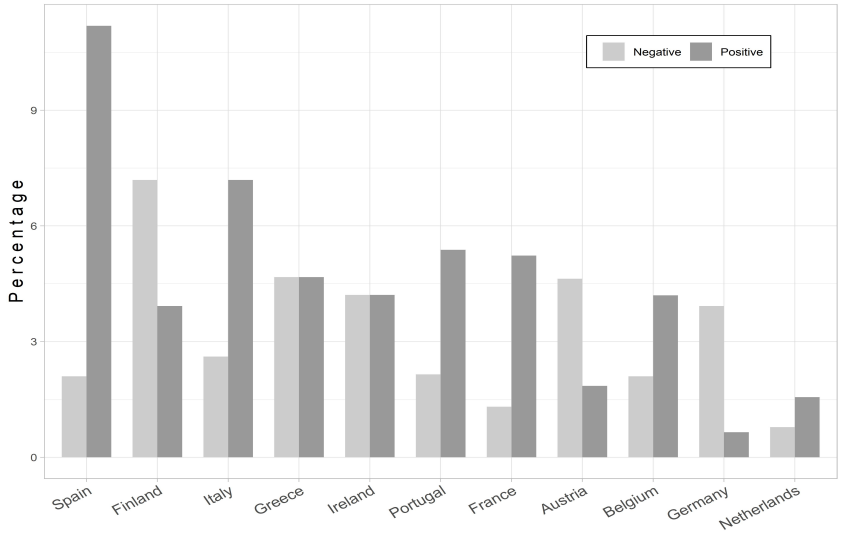

Figure 2: Significant reactions to policy announcements by country across all sectors

Note: The figure shows the negative (light grey) or positive (dark grey) reaction by country across their sectors.

By looking specifically at each policy (Table 4), some interesting facts stand out. Tthe announcement of the extension of the SMP to Italy and Spain yielded the largest reaction. The second-largest announcement is the introduction of the three-year LTRO. Even though the mar-

[13]The detailed results are available upon request.

kets had a hint about this announcement a week before (on 1 December 2011), the weak reaction following that hint shows that the markets were actually very cautious or were expecting it. We also observe that M. Draghi's "Whatever it takes" speech and the official launch of the OMT triggered significant markets reactions. The first announcement related to SMP induced a non-negligible significant reaction from the sectors, while the first four-year maturity TLTRO produced weak reactions.

This broad picture can hide some interesting details. Zooming in on the type of reactions (Table 4 and Figure 3), we observe that for the announcement of 04 August 2011 (SMP extension), the negative reactions account for almost half of the positive reactions. It is particularly striking that the large significant reactions to the three-year LTRO policy announcement (VLTRO) were actually near entirely negative.

Table 4: Significant reactions by policy

Total reactions

Policy	Significant reactions (in %)
SMP-extension	24.07
VLTRO	12.58
OMT-whatever_it_takes	8.33
OMT	7.64
SMP	6.06
TLTRO2	3.82
OMT-press_conf	3.21
VLTRO-hint	2.55
TLTRO1	1.88

Positive and negative reactions

Policy	Positive	Policy	Negative
SMP-extension	16.67	VLTRO	11.95
OMT	7.64	SMP-extension	7.41
OMT-whatever_it_takes	7.05	SMP	4.24
TLTRO2	3.18	OMT-press_conf	1.92
TLTRO1	1.88	OMT-whatever_it_takes	1.28
SMP	1.82	VLTRO-hint	1.27
OMT-press_conf	1.28	TLTRO2	0.64
VLTRO-hint	1.27	OMT	0.00
VLTRO	0.63	TLTRO1	0.00

Note: The tables show the total reaction (left panel) and positive/negative reaction (right panel) of sectors aggregated by policy.
SMP = *SMP announcement (10 May 2010)*; SMP-extension = *SMP extension to Spain and Italy (4 August 2011)*; VLTRO-hint = *A hint on VLTROs (1 December 2011)*; VLTRO = *VLTROs announcement (8 December 2011)*; OMT-whatever_it_takes = *OMT 'Whatever it takes' speech (26 July 2012)*; OMT-press_conf = *OMT press conference (2 August 2012)*; OMT = *OMT officially launched (6 September 2012)*; TLTRO1 = *First round of TLTROs announcement (5 June 2014)*; TLTRO2 = *Second round of TLTROs announcement (10 March 2016)*

Indeed, there seemed to be a huge deception from the markets, where many sectors reacted negatively to that announcement. The markets were already expecting either an extension of the SMP or a three-year LTRO following M. Draghi's speech to the European Parliament on the 1 December 2011, according to the Financial Times ("*Draghi hints at eurozone aid plan*").[14] Additionally, the Financial Times ("*On the ECB's most significant non-standard measure*") highlighted that the announcement of the two rounds of VLTRO a few hours earlier was not

[14] Atkins, R., & Carnegy, H. (2011). Draghi hints at eurozone aid plan. *Financial Times*, 01 December.

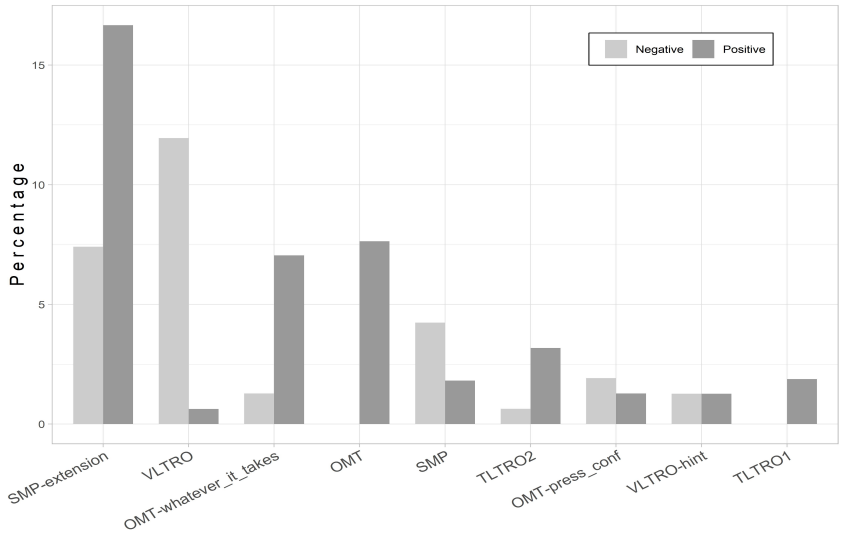

Figure 3: Significant reactions to policy announcements across all countries and sectors

Note: The figure shows the negative (light grey) or positive (dark grey) reaction by policy across countries and sectors.

a surprise for the markets.[15] The massive negative reactions can thus reflect the fact that the markets were expecting more than what was announced. The press conference of 2 August 2012 detailing the implementation of the OMT and the SMP announcement of 10 May 2010 are the other policies which created more negative than positive markets reactions. For the latter, the large negative reactions probably showed that it sparked an atmosphere of mistrust among market participants. A possible explanation is that some market participants interpreted this announcement as a confirmation of the distressed state of the peripheral countries. However, its extension to Italy and Spain seemed to have reassured the markets.

Finally, across the 11 countries over the 9 events, the results by sector (Table 5 and Figure 4) confirm that the banking sector had the most significant reaction to the policies.

There is a mix of countries where the banking sector reacted positively to at least one announcement (Spain, Italy, Portugal, Greece, Belgium, Germany, and Finland), but the negative reaction came once again from core countries (Austria and Finland).[16] The Utilities, Retail Trade and Communications sectors were also very sensitive to the announcements. The countries where most of the positive reaction comes from are very similar to previously. On the contrary, mainly the services sectors reacted the least to the announcements (e.g. Distribution

[15] Kaminska, I. (2011). On the ECB's most significant nonstandard measure. *Financial Times*, 08 December.
[16] The specific results are available in the appendix.

Table 5: Significant reactions by sector

Total reactions

Sector	Significant reactions (in %)
Bank	17.44
Utilities	13.58
Retail Trade	11.11
Communications	10.00
Transportation	9.09
Health Technology	8.75
Electronic Technology	8.33
Non-Energy Minerals	7.78
Producer Manufacturing	7.78
Process Industries	6.38
Industrial Services	5.56
Technology Services	5.56
Consumer Non-Durables	4.49
Commercial Services	4.44
Consumer Services	4.35
Distribution Services	4.35
Consumer Durables	3.12

Positive and negative reactions

Sector	Positive	Sector	Negative
Bank	13.95	Utilities	6.17
Communications	7.78	Retail Trade	6.17
Utilities	7.41	Health Technology	5.00
Non-Energy Minerals	5.56	Commercial Services	4.44
Producer Manufacturing	5.56	Electronic Technology	4.17
Transportation	5.05	Transportation	4.04
Retail Trade	4.94	Bank	3.49
Industrial Services	4.44	Process Industries	3.19
Electronic Technology	4.17	Distribution Services	2.90
Technology Services	4.17	Consumer Non-Durables	2.25
Health Technology	3.75	Communications	2.22
Process Industries	3.19	Non-Energy Minerals	2.22
Consumer Non-Durables	2.25	Producer Manufacturing	2.22
Consumer Services	2.17	Consumer Services	2.17
Consumer Durables	1.56	Consumer Durables	1.56
Distribution Services	1.45	Technology Services	1.39
Commercial Services	0.00	Industrial Services	1.11

Note: The tables show the total reaction (left panel) and positive/negative reaction (right panel) by sector.

Services, Consumer Services, Commercial Services). The weak response from the Consumer Durables sector suggests the interest rate channel of monetary policy was not completely effective, since this sector relies mostly on interest rates, and as such, should react strongly like the banking sector.

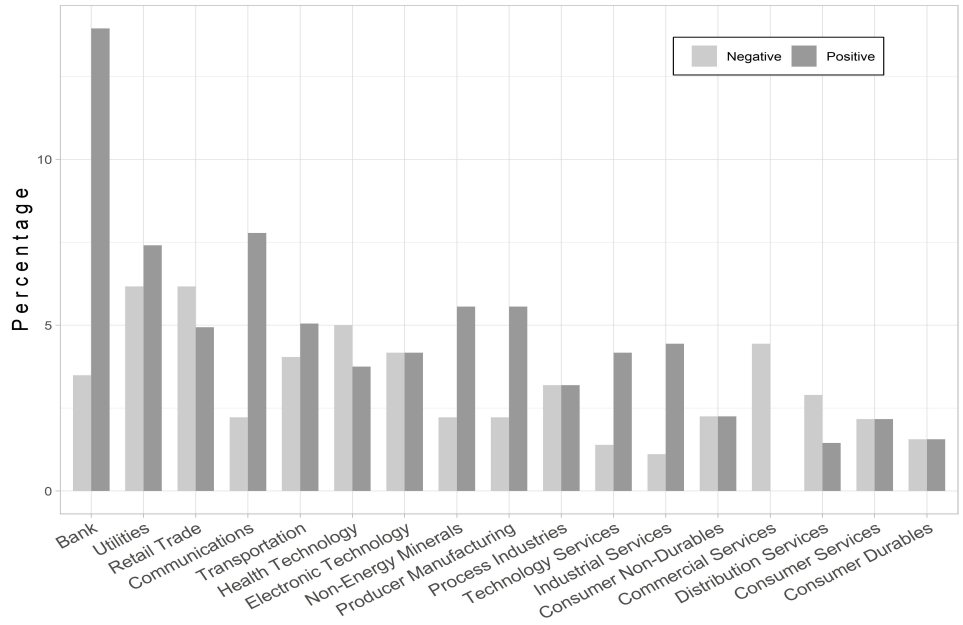

Figure 4: Significant reactions to policy announcements by sector across all countries

Note: The figure shows the negative (light grey) or positive (dark grey) reaction by sector.

Overall, we observe a large heterogeneity in the sectors' responses: some reacted more positively, but few sectors showed more negative reactions to the policies. We also show that UMP

affected the banking and non-banking sectors, albeit to different degrees. It is then interesting to assess the determinants of such heterogeneity in reactions to ECB's announcements. The next section discusses our results from the regression analysis of Equation (3), both at the sector level and the country level.

4.2 Determinants of the heterogeneous responses

Markets reactions to the ECB's UMP are subject, among other things, to investors' expectations about the state of the economy. Given the objectives of these expansionary measures (decrease the yields on bonds, ease the liquidity concerns in the money market), market participants could interpret them as a commitment by the central bank to restore economic conditions, on the one hand. Expecting a beneficial outcome of the policies, investors' confidence is naturally boosted, producing a positive response to them. On the other hand, for some investors, these measures revealed only that the implied country or sector is weak and may not recover from the crisis without assistance. To prevent further losses, they would prefer to retreat from the markets, which translates into a negative response. Our results capture the dominant effect of these two types of decisions from investors for a given state of country/sector characteristics. In this part, we aim to explore the difference in the reactions of investors to the unconventional policies across European countries and sectors.

Table 6 presents the results across sectors of Equation (3). We recall that in the (ordered) probit model framework, we cannot directly interpret the marginal impact of the regressors by looking at the coefficient. Nevertheless, even though the estimated model is not the latent one, the estimated coefficients will reflect the sign and the significance of the true or underlying coefficients. That is, if the estimated coefficient is positive and statistically significant, then the true or underlying coefficient will also be positive and statistically significant (Train, 2009). The sign of the coefficient will furthermore give the direction of change in the probability of the highest outcome (a positive reaction in our case). For example, a positive coefficient will signal an increase in the probability of a positive reaction to the announcements. Inversely, a negative coefficient means that it decreases the probability of the highest category and increases the one of the lowest category (a negative reaction).

Table 6: Ordered probit model estimation results at sector-level

Variables	Bank	Health Technology	Consumer Non-Durables	Consumer Services	Consumer Durables	Electronic Technology	Communic-ations	Process Industries
Banks Cost to Income Ratio	0.0129	0.0414**	0.0247	0.0621***	0.7351***	-0.0316	-0.0107	0.0319
Banks Return on Assets (After Tax)	0.1726	1.9462***	0.0409	0.1128*	4.83***	-0.0832	-0.1326	0.1242
Banks Concentration	-0.0247	-0.046	0.0222	0.0017	0.087**	-0.0321	-0.0061	-0.0233
Credit Risk	0.0321**	-0.011	-0.0165*	0	-0.1022***	0.0199*	-0.0066	0.0021
Tier 1 Ratio	0.0923	-0.128	0.0093	0.0269	2.2841***	0.3009***	-0.0503	-0.0111
Market Risk	1.0351*	0.8367	-0.1951	-0.6826	-18.5727***	-0.7254*	0.1281	-1.5114***
Primary Balance (% of GDP)	-0.2201	-0.9954***	-0.2255	-0.209	-9.8344***	-0.4938	0.0576	-0.4058*
Gross Debt (% of GDP)	0.0037	0.0166	-0.0012	0.0103	0.2978***	0.0016	-0.012	0.0099
MacroPrudential Index	-0.2235	-0.3951*	0.1652	-0.2474	-2.5251***	-0.3172**	0.3277	0.0772
Cut1 (Negative | Absent)	0.0794	-3.7824	0.4713	2.1558	78.7101	-2.6072	-4.5657	-1.385
Cut2 (Absent | Positive)	3.3536	1.3429	4.9557	6.883	113.663	1.5627	-0.7968	3.0364
N	86	80	89	92	64	72	90	94
R^2	0.169	0.352	0.131	0.168	0.838	0.223	0.133	0.208
DEV	84.3	41.22	34	33.03	3.82	41.16	61.46	44.14
L.R.	10.31	15.82	4.18	5.42	16.75	8.47	6.59	8.8
pval	(0.33)	(0.07)	(0.9)	(0.8)	(0.05)	(0.49)	(0.68)	(0.46)

Variables	Utilities	Producer Manufacturing	Retail Trade	Technology† Services	Commercial‡ Services	Transpor-tation	Industrial Services	Non-Energy Minerals	Distribution Services
Banks Cost to Income Ratio	-0.0677***	-0.0175	-0.006	0.0674	0.3357*	-0.0049	0.0078	-0.0058	-1.5521***
Banks Return on Assets (After Tax)	0.1893	0.0084	0.4861***	-0.5809	2.8861*	0.124	0.084	-0.1592	-10.8305***
Banks Concentration	-0.0173	-0.0098	-0.0061	-0.1785*	0.6749**	-0.0602***	-0.0097	-0.0396**	-1.2537***
Credit Risk	0.0029	0.0101	-0.006	0.0394	-0.1821**	0.0277**	0.0459***	-0.0074	-0.4908***
Tier 1 Ratio	-0.188**	-0.0134	0.2224*	-0.4752	-0.762**	0.044	0.0497	-0.0728	-3.0048***
Market Risk	-0.1946	0.7419	0.2141	-7.8646***	-12.4586**	-1.1922*	-0.5076	-0.812*	2.1019***
Primary Balance (% of GDP)	0.2829	0.057	-1.206***	0.7059	-7.8339*	0.2604	-0.7024**	0.2753	22.5485***
Gross Debt (% of GDP)	0.0115	0	0.0368***	-0.0516	0.1861*	-0.0113	-0.0034	-0.012	-0.3014***
MacroPrudential Index	0.5405	-0.0171	-0.0479	0.5538	2.0513***	-0.2234*	0.0442	-0.2381	-3.9517***
Cut1 (Negative | Absent)	-7.5811	-3.3248	3.2395	-28.7692		-7.2099	-0.5418	-8.7336	-319.1687
Cut2 (Absent | Positive)	-3.5201	0.4818	7.6964	-13.4912		-3.0109	4.644	-4.8372	-270.2399
Intercept					-61.2191				
N	81	90	81	72	90	99	90	90	69
R^2	0.316	0.072	0.378	0.376	0.473	0.241	0.262	0.111	1
DEV	61.66	54.48	49.14	24.03	18.71	59.45	34.08	52.72	0
L.R.	17.85	3.1	19.74	11.37	14.02	13.24	9.55	4.85	28.5
pval	(0.04)	(0.96)	(0.02)	(0.25)	(0.12)	(0.15)	(0.39)	(0.85)	(0)

Note: The dependent variable is the ordered reaction of sectors. The explanatory variables are Banks Cost to Income Ratio, Banks Return on Assets, Banks Concentration, Credit Risk, Tier 1 Ratio, Market Risk, Primary Balance, Gross Debt, and MPI. Cut1 and Cut2 are the estimated cut points.

***N**: number of observations, **R**^{2}: Nagelkerke R^2 index, **DEV**: deviance (-2x log likelihood of the fitted model), **L.R.**: model likelihood ratio χ^2 statistic, p-value of the L.R. test in brackets()*

******, ** and * indicate significance at the 1%, 5% and 10% levels, respectively***

† An ordered logistic estimation is performed instead to achieve the convergence of the model.

‡ A binary model is fitted because the dependent variable has only two outcomes.

We find that a higher cost-to-income among banks leads to a significant increase in the probability of a positive response from many sectors (like the Health technology or Consumer services sectors), everything else being equal. In contrast, few sectors display a significant negative coefficient, which implies in this case that a higher cost-to-income is likely to prompt a decrease in their probability of a positive response. In the same vein, a higher bank ROA is associated with a significant increase in the probability of a positive response from multiple sectors. Only the Distribution services sector records a negative significant coefficient for increasing ROA. The bank concentration variable predicts mostly a decrease in the probability of a positive reaction from the sectors. Higher credit risk leads to an increasing probability of a positive reaction among 4 sectors, and to a decreasing probability of a positive reaction among 4 other sectors. With respect to a stronger tier 1 ratio, an equal number of sectors show an increasing probability of a positive response on the one hand, and a decreasing probability of a positive reaction on the other hand. Finally, increasing market risk predicts a decreasing response (i.e. a drop in the likelihood of a positive reaction) from numerous sectors. Turning to the fiscal variables, we show that healthy government's primary balance leads to a decline in the probability of positive response from most sectors. With increasing gross debt, the odds of a positive reaction is increasing among multiple sectors. Lastly, with respect to a higher MPI, several sectors show a decrease in the probability of a positive response.

Overall, our results indicate that among the 17 sectors, with increasing cost-to-income, sectors show mostly an increasing probability of a positive reaction. The same observation holds for increasing ROA and gross debt. For increasing levels of concentration, primary balance, and MPI, various sectors show a decreasing likelihood of a positive response. However, the evidence is mixed for increasing credit risk and tier 1 ratio.

With respect to some of our predictors, we can discuss in what follows some rationales at play. We argue that bank profitability is a positive driver of sectors' responses to the policies. While there is a nonlinear effect between the central bank interest rate and bank ROA, our results show that monetary policy easing during the unconventional periods leads market par-

ticipants holding stocks from various sectors to believe that the accommodative policies should not erode bank profitability.[17] In this regard, our finding complements the results by Altavilla et al. (2018). While yielding a mixed result, we also argue that credit risk is (potentially) a positive determinant of an increasing probability of a positive reaction. Although this seems to contradict the classic view of the bank credit risk channel, our interpretation of this result is that some market participants interpreted the high credit risk as an emergency call to the central bank to intervene and rescue the banking sector, thus leading to an increase in the demand for bank equities.[18] Another strong result we find is that high concentration in the banking sector compresses the likelihood of a positive reaction from market participants to the UMP. When there is too much concentration in the banking sector, the sector has less competition and less efficiency (IJtsma et al., 2017) and can jeopardize the policy transmission to the other sectors. Lastly, we claim that a high primary balance drives down the prospect of observing a positive reaction, while high gross debt does the opposite. A deteriorating government budget (low primary balance) or increasing debt level, equivalent to a distressed country, signals to market participants that the ECB would provide liquidity to the country, most likely through the SMP and OMT, but also through the LTROs with the banks' purchases of government bonds. We thus complement some of the results in Krishnamurthy et al. (2017).

The last table (7) presents the results of Equation (3) across countries. Without discussing these results at the same detailed level, we observe that the previous findings still hold. There is, in addition, clear-cut evidence that higher credit risk leads to an increase in the probability of a positive reaction among euro area countries. The only conflictual result is regarding an

[17] Some prior studies find a positive correlation between the central bank interest rate level and banks' profitability. For instance, Borio et al. (2017) show that short-term rates and bank ROA have a positive relationship; that is, monetary policy tightening increases bank profitability because its positive impact on the net interest income component dominates the negative impact on loan loss provisions and non-interest income. Altavilla et al. (2018), in contrast, find that monetary policy easing (during the ECB's standard and non-standard policy periods) is not associated with lower bank profits. In any case, Creel et al. (2016) found that the pass-through from the ECB rate to interest rates has been effective.

[18] The relationship between monetary policy and the bank risk channel is not unique and linear. Accommodative monetary policy can lead to overall lower loan spreads (charging riskier borrowers with lower loan spreads), which translates into less risk (Matthys et al., 2020; Paligorova and Santos, 2017; Andreeva and García-Posada, 2021). Conversely, monetary policy expansion can also increase banks leverage and risk as the reinforcing links between liquidity and risk-taking may drive banks' appetite for risk (Angeloni et al., 2015; Borio and Zhu, 2012)

increase in the macroprudential index: the country-by-country analysis shows an increase in the probability of a positive reaction, while from the sector point of view, the balance is in favour of the opposite effect.

Table 7: Ordered probit model estimation results at country-level

Variables	Spain	Greece	Ireland	Italy	Portugal
Banks Cost to Income Ratio	0.0591***	-0.0674**	-0.0327	0.009	0.188***
Banks Return on Assets (After Tax)	0.3018**	-0.2163	-0.0348	0.1309	2.3411***
Banks Concentration	0.0346	-0.0224	-0.0187	-0.0122	0.1768***
Credit Risk	0.0238**	-0.0231**	0.0314*	-0.006	0.0147
Tier 1 Ratio	0.0875	0.083	-0.033	-0.0251	-0.0041
Market Risk	-0.2172	-0.4498	0.4872	0.4577	1.7519
Primary Balance (% of GDP)	-1.4326***	0.7735	0.5619	-0.2466	-7.9479***
Gross Debt (% of GDP)	0.0134	0.0051	-0.0155	0.0017	0.1371***
MacroPrudential Index	-0.0631	-0.152	-0.3094	-0.0855	0.8906***
Cut1 (Negative | Absent)	7.3969	-8.3244	-7.0602	-2.5242	37.7697
Cut2 (Absent | Positive)	11.9738	-3.9182	-2.7501	0.8455	48.289
N	127	93	83	135	82
R^2	0.205	0.221	0.182	0.073	0.592
DEV	52	49	41.53	107.55	31.66
L.R.	10.56	10.23	6.96	5.73	31.35
pval	(0.31)	(0.33)	(0.64)	(0.77)	(0)

Variables	Austria	Belgium	Germany	Finland	France	Netherlands
Banks Cost to Income Ratio	-0.0062	0.0214	-0.026	-0.0011	0.0138	-0.0206
Banks Return on Assets (After Tax)	0.089	0.4566***	-0.0148	0.1314	0.2699**	-0.1448
Banks Concentration	-0.0523***	-0.0187	-0.0297	-0.057**	0.0216	-0.022
Credit Risk	0.0432**	0.026**	0.0055	0.0041	0.0093	-0.0435***
Tier 1 Ratio	-0.103	-0.1396	-0.0251	0	0.0894	0.0135
Market Risk	0.5004	-2.2283***	-0.4484	-0.5606	-0.0416	0.5471
Primary Balance (% of GDP)	-0.4077	-1.4684***	0.3942	-0.1833	-0.0651	-0.7762*
Gross Debt (% of GDP)	-0.0077	0.0354***	-0.0078	-0.0038	0.0146*	0.0221*
MacroPrudential Index	-0.0652	0.4791*	0.0402	-0.1695	0.1306	0.2555
Cut1 (Negative | Absent)	-7.2589	-0.3179	-6.6263	-6.865	3.4301	-4.673
Cut2 (Absent | Positive)	-2.1	6.3858	-3.0093	-2.9012	7.2313	1.2002
N	96	127	136	136	136	113
R^2	0.341	0.416	0.079	0.233	0.116	0.332
DEV	44.31	45.56	92.21	85.68	86.49	39.2
L.R.	16.79	24.75	5.6	18.02	8.18	15.34
pval	(0.05)	(0)	(0.78)	(0.03)	(0.52)	(0.08)

Note: The dependent variable is the ordered reaction of sectors. The explanatory variables are Banks Cost to Income Ratio, Banks Return on Assets, Banks Concentration, Credit Risk, Tier 1 Ratio, Market Risk, Primary Balance, Gross Debt, and MPI. Cut1 and Cut2 are the estimated cut points.

***N**: number of observations, **R^2**: Nagelkerke R^2 index, **DEV**: deviance (-2x log likelihood of the fitted model), **L.R.**: model likelihood ratio χ^2 statistic, p-value of the L.R. test in brackets()*

******, ** and * indicate significance at the 1%, 5% and 10% levels, respectively***

Despite the heterogeneous behaviour of sectors and countries that our predictors captured, we provide the rationale behind the dominant behaviour among market participants toward the ECB's unconventional policies. Our results thus should not be viewed as characterising the unique behaviour of market participants, but rather as expressing their most common reactions during the unconventional times.

Furthermore, we also use sector-level (the banking sector) and macro-level variables together to assess the heterogeneous responses. That way, we uncover the impact of the heterogeneous characteristics among countries on the sectors' reactions. For instance, we found that on average, a sector is likely to have the odds of a positive reaction decreased when the country has a healthy primary balance. We believe this result that links sectors' reactions to a country characteristic cannot be uncovered in a straightforward way in an aggregate data setup. This is another highlight of the added-value of using the disaggregated sectors data to assess the sources of the heterogeneity in the reactions to ECB's UMP.

5 Sensitivity analyses

In this section, we perform various sensitivity analyses to check the robustness of our results.[19]

Additional ECB's announcements. We introduce in this part several other expansionary policies by the ECB, in addition to the 3 that we considered. They are the first Covered Bond Purchase Programme (CBPP1, announced on 07 May 2009), the second CBPP (CBPP2, on 06 October 2011), the third CBPP, announced on the same day with the Asset Backed-Securities Purchase Programme (CBPP3 and ABSPP on 04 September 2014), and the Expanded Asset Purchase Programme (EAPP on 22 January 2015). These additional expansionary policies do not distort significantly our previous results.

Estimation with CARs values. In this last exercise, we implement two alternative OLS regressions of (3). In the first one, we do not transform the dependent variable into ordinal values, thus keeping the original CARs values for the estimation. In the second one, the dependent variable is obtained by keeping the values of the CARs that are significant (at the 5% level), and the non significant CARs are set to 0. The regression results, in contrast with the ordered probit model, show very little significant coefficients. This confirms the advantage of focusing mainly on the significance of the announcements rather than their simple amplitude.

[19] For purpose of space, the figures and tables are available in the appendix.

6 Conclusion

In light of the implemented ECB's unconventional policies in response to the GFC and euro area sovereign debt crisis, there has been a buoyant literature on the asymmetric impact and effectiveness of these policies. While the literature on the determinants of their effectiveness focused on the cross-country or cross-sector responses to the UMPs at an aggregated level, this study contributes to the literature by using disaggregated data for each sector, and by combining the heterogeneous responses at both the country and sectoral level and analysing its determinants.

Proceeding in a two-step approach, we first confirm that markets reacted heterogeneously to ECB's announcements of the SMP, OMT and V/TLTRO. Second, we uncover the main determinants of these heterogeneous responses by considering some banking system, financial, and fiscal and regulatory indicators. Our main findings reveal that some banking sector conditions, macroeconomic and macroprudential indicators are drivers of the heterogeneous reactions across sectors and across countries. We clearly show that with increasing cost-to-income, ROA (variables related to the banking sector), and gross debt (macroeconomic variable), the probability of a positive response by many sectors is increasing. We observe the opposite behaviour, that is, a decrease in the probability of a positive reaction, for increasing bank concentration and primary balance.

From these findings, a policy implication we derive is that domestic structural reforms of the country-specific characteristics could help having more homogeneous responses to ECB policy across euro area countries, and in turn, better guarantee the effectiveness of the common monetary policy.

Acknowlegdements

The authors would like to thank Mark P. Taylor (the Editor) and an anonymous referee for their valuable comments and discussions. We also gratefully acknowledge many helpful comments and discussions from Maximilian Horst and Ilias Kostarakos. Finally, we thank the

participants of the "37th International Symposium on Money, Banking and Finance", the "69th Annual Meeting of the French Economic Association", and the "25th International Conference on Macroeconomic Analysis and International Finance".

References

Altavilla, C., Boucinha, M., Peydró, J.L., 2018. Monetary policy and bank profitability in a low interest rate environment. Economic Policy 33, 531–586. doi:10.1093/epolic/eiy013.

Altavilla, C., Canova, F., Ciccarelli, M., 2020. Mending the broken link: Heterogeneous bank lending rates and monetary policy pass-through. Journal of Monetary Economics 110, 81–98. doi:10.1016/j.jmoneco.2019.01.001.

Andreeva, D.C., García-Posada, M., 2021. The impact of the ECB's targeted long-term refinancing operations on banks' lending policies: The role of competition. Journal of Banking & Finance 122, 105992. doi:10.1016/j.jbankfin.2020.105992.

Angeloni, I., Faia, E., Duca, M.L., 2015. Monetary policy and risk taking. Journal of Economic Dynamics and Control 52, 285–307. doi:10.1016/j.jedc.2014.12.001.

Borio, C., Gambacorta, L., Hofmann, B., 2017. The influence of monetary policy on bank profitability. International Finance 20, 48–63. doi:10.1111/infi.12104.

Borio, C., Zhu, H., 2012. Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism? Journal of Financial Stability 8, 236–251. doi:10.1016/j.jfs.2011.12.003.

Cerutti, E., Claessens, S., Laeven, L., 2017. The use and effectiveness of macroprudential policies: New evidence. Journal of Financial Stability 28, 203–224. doi:10.1016/j.jfs.2015.10.004.

Ciccarelli, M., Maddaloni, A., Peydró, J.L., 2013. Heterogeneous transmission mechanism: monetary policy and financial fragility in the eurozone. Economic Policy 28, 459–512. doi:10.1111/1468-0327.12015.

Cihak, M., Demirguc-Kunt, A., Feyen, E., Levine, R., 2012. Benchmarking financial systems around the world, in: Global Financial Development Report 2013. The World Bank, pp. 15–43. doi:10.1596/9780821395035_ch01.

Cœuré, B., 2019. Heterogeneity and the ecb's monetary policy. Speech at the Banque de France Symposium & 34th SUERF Colloquium on the occasion of the 20th anniversary of the euro on "The Euro Area: Staying the Course through Uncertainties", Paris, 29 March 2019 .

Creel, J., Hubert, P., Viennot, M., 2016. The effect of ECB monetary policies on interest rates and volumes. Applied Economics 48, 4477–4501. doi:10.1080/00036846.2016.1158923.

Draghi, M., 2014. Monetary policy communication in turbulent times, in: Speech at the Conference De Nederlandsche Bank.

Franks, J., Barkbu, B., Blavy, R., Oman, W., Schoelermann, H., 2018. Economic convergence in the euro area: Coming together or drifting apart? IMF Working Papers 18, 1. doi:10.5089/9781484338490.001.

Fratzscher, M., Duca, M.L., Straub, R., 2016. ECB unconventional monetary policy: Market impact and international spillovers. IMF Economic Review 64, 36–74. doi:10.1057/imfer.2016.5.

Georgiadis, G., 2015. Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model. European Economic Review 75, 195–215. doi:10.1016/j.euroecorev.2014.12.007.

Grandi, P., 2019. Sovereign stress and heterogeneous monetary transmission to bank lending in the euro area. European Economic Review 119, 251–273. doi:10.1016/j.euroecorev.2019.07.011.

Haitsma, R., Unalmis, D., de Haan, J., 2016. The impact of the ECB's conventional and unconventional monetary policies on stock markets. Journal of Macroeconomics 48, 101–116. doi:10.1016/j.jmacro.2016.04.

IJtsma, P., Spierdijk, L., Shaffer, S., 2017. The concentration–stability controversy in banking: New evidence from the EU-25. Journal of Financial Stability 33, 273–284. doi:10.1016/j.jfs.2017.06.003.

Krishnamurthy, A., Nagel, S., Vissing-Jorgensen, A., 2017. ECB policies involving government bond purchases: Impact and channels. Review of Finance 22, 1–44. doi:10.1093/rof/rfx053.

Mandler, M., Scharnagl, M., Volz, U., 2021. Heterogeneity in euro area monetary policy transmission: Results from a large multicountry BVAR model. Journal of Money, Credit and Banking doi:10.1111/jmcb.12859.

Matthys, T., Meuleman, E., Vennet, R.V., 2020. Unconventional monetary policy and bank risk taking. Journal of International Money and Finance 109, 102233. doi:10.1016/j.jimonfin.2020.102233.

Oman, W., 2019. The Synchronization of Business Cycles and Financial Cycles in the Euro Area. International Journal of Central Banking 15, 327–362.

Pacicco, F., Vena, L., Venegoni, A., 2019. Market reactions to ECB policy innovations: A cross-country analysis. Journal of International Money and Finance 91, 126–137. doi:10.1016/j.jimonfin.2018.11.006.

Paligorova, T., Santos, J.A., 2017. Monetary policy and bank risk-taking: Evidence from the corporate loan market. Journal of Financial Intermediation 30, 35–49. doi:10.1016/j.jfi.2016.11.003.

Ricci, O., 2015. The impact of monetary policy announcements on the stock price of large European banks during the financial crisis. Journal of Banking & Finance 52, 245–255. doi:10.1016/j.jbankfin.2014.0.

Rigobon, R., Sack, B., 2004. The impact of monetary policy on asset prices. Journal of Monetary Economics 51, 1553–1575. doi:10.1016/j.jmoneco.2004.02.004.

Rosa, C., 2011. The validity of the event-study approach: Evidence from the impact of the fed's monetary policy on us and foreign asset prices. Economica 78, 429–439.

Salachas, E., Laopodis, N.T., Kouretas, G.P., 2018. Assessing monetary policies in the euro-zone, u.s., u.k. and japan: new evidence from the post-crisis period. Applied Economics 50, 6481–6500. doi:10.1080/00036846.2018.1486026.

Train, K.E., 2009. Discrete Choice Methods with Simulation. Cambridge University Press. doi:10.1017/cbo9780511805271.

Wooldridge, J.M., 2010. Econometric analysis of cross section and panel data. Mit Press .