Euro-area monetary policy, bank resilience and bank competition.

E. C. Mamatzakis[1] C. Staikouras[2] & C. Triantopoulos[3]

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Abstract

We study the impact of ECB's monetary policy (UMPs) on bank resilience and competition. Our sample includes all euro-area member states and employs ECB monetary policy tools both in terms of conventional and unconventional monetary policy, though the focus is on unconventional policy. We also employ bank specific data like Z-score and Boone indicator. Our identification includes a plethora of panel regression analysis. The general specification opts for maximum likelihood estimation while we provide robustness analysis. We also control for endogeneity issues, using 2SLS estimations. The results suggest that UMP enhances bank soundness overall for the euro-area, though there is variability across countries, for countries in the periphery. It appears that German banks benefit the most from UMPs in terms of improving their financial stability. The results unveil the necessity to separately examine Germany and different groups of member countries so that the variability in the impact of UMPs can be observable. Policy recommendations include the warning of potential moral hazard problems and the role of national regulators in supporting ECB's monetary policy decisions, especially in terms of dissimilarities between countries.

JEL classifications: G21, E52, E43.

Keywords: Unconventional monetary policies; ECB; Asset Purchases; Bank stability; Risk.

[1] Department of Management, Birkbeck College, University of London, Malet Street WC1E 7HX, UK; Corresponding author, e-mail: e.mamatzakis@bbk.ac.uk. [2] Department of Accounting and Finance, Athens University of Economics and Business, Athens, Greece, Greece. E-mail: cstaik@aueb.gr. [3] Centre of Planning and Economic Research, 11, Amerikis str., 106 72 Athens, Greece. E-mail: ctrianto@kepe.gr.

1. INTRODUCTION

The emergence of unconventional monetary policies (UMPs) has shed light on a new era of monetary policy tools for central banking. Started as quantitative easing in Japan to tackle economic stagnation and combat deflation in March 2001, UMPs have nowadays been present in various forms. Large-scale asset purchase programs, another name for quantitative easing, implemented by the Federal Reserve Bank, Bank of Japan and the Bank of England, has increasingly attracted research interests on its effectiveness, transmission mechanism, and international spill over (Bauer, Neely, 2014; D'Amico et al., 2012; Gagnon et al., 2011; Krishnamurthy). The European Central Bank (ECB) has implemented a plethora of unconventional monetary policies such as the Longer-Term Refinancing Operations (LTROs), Fixed-Rate Full Allotment (FRFA), the Securities Market Program (SMP, and Asset Purchase Programs (APPs). In addition, the ECB has applied new collateral rules and reserves requirement, as well as outright monetary transactions.

In this study, we focus on exploring the impact of ECB's UMPs on bank stability. The motivation stems from the existence of a countervailing effects of monetary easing on bank risk-taking (Buch, Eickmeier, Prieto, 2014). The risk-taking channel transmission mechanism of monetary policy explains the incentives of bank managers in engaging more risks (Altunbas, Gambacortab, Marques-Ibanezc, 2014; Gambacorta, 2009). Low interest rates induce the "search for yield" (Rajan, 2005) from bank managers to offset the low returns received from standard contracts. Central banks conduct UMPs when the traditional monetary policy tools lose their power in stimulating the economy and ensuring price stability. Asset purchase programs, in theory, affect the economy through several channels such as the portfolio rebalancing, liquidity, and signalling (Cour-Thimann, Winkler, 2012; D'Amico et al., 2012; Sahuc, 2016).

Besides, the literature on the microeconomic impact of UMPs is rather limited, not only on European banking but also on US banking (Mamatzakis and Bermpei 2016) and elsewhere (see Mamatzakis, et al. 2016 for Japan). This paper builds of previous literature and contributes in several ways: first, it sheds light into the impact of ECB's UMPs on bank resilience and competition. Second, the paper provides a robustness analysis to test whether the main results hold for bank across difference countries within the euro-area. Third, the paper considers measurement issues of UMP by employing several proxies of UMP.

The rest of the paper is organised as follows. Section 2 introduces the data and methodology. Section 3 discusses the results. Section 4 concludes and offers some policy recommendations.

2. THE DATA SET

We select all countries of the euro-area to build a sample of bank specific data. To this end, the sample includes nineteen euro-area countries for the period 2007-2019. The bank-specific variables come from the data base Bankscope and are from bank balance sheets of annual frequency. All bank specific data are in thousand USD. There are 25,928 observations of 3,748 banks specialised as commercial, investment, savings, and real estate banks. Table 1 describes the summary statistics of our data.

For UMP, and to consider measurement issues, we employ various measures. First, we employ the Asset Purchases Programmes (APP) and the Longer-Term Refinancing Operations (LTRO).[2] To this end, our measure follows Bluwstein and Canova (2016).

[2] This measure includes all the amounts of different asset purchase programmes (APPs), since 2009, reported as a total figure under the Securities Held for Monetary Policy Purposes in the ECB's annual balance sheets and the Longer-Term Refinancing Operations also available from the ECB's annual balance sheets). LTROs had fixed rate tender procedures with full allotment and a maturity of three years. APPs include the Securities Market Program (SMP, effective from 05/2010 to 09/2012), the Covered Bond Purchase Programs 1 and 2 (CBPP 1, CBPP 2), and the current Asset Purchase Program. CBPP 1 was in effect from 06/2009 to 06/2010, while the second one was carried out between 11/2011 and 10/2012. The Asset Purchase Program was in operation from 2014 to 2017. This consists of all purchases of the public and private sector securities to address the issue of

Table 1. Main Variables of our Identification

Variable	Obs	Mean	S.D.	Min	Max
lnZ-score	25,928	1.8379	0.9164	0.0000	5.6529
Boone	25,928	-0.2045	0.0323	-0.2843	-0.1576
Ln(APP&LTRO)	25,928	20.6489	0.4450	19.7584	21.2964
Ln(ECB assets)	25,928	21.8153	0.1784	21.4841	22.1103
Ln(Excess reserves)	25,928	16.4268	2.4161	13.7934	20.1167
MR	25,928	1.2354	1.1974	0.0500	4.0000
MLF	25,928	1.8759	1.3458	0.3000	5.0000
DF	25,928	0.6237	1.0547	-0.3000	3.0000
Size	25,928	13.9240	1.8887	6.0798	21.9074
Asset diversification	25,928	0.2314	0.1572	0.0000	0.9990
Liquidity ratio	25,928	0.1785	0.1726	0.0000	1.0000
Revenue diversification	25,928	0.2014	0.2834	-21.0620	0.9999
Cost to income ratio	25,928	0.8078	0.8688	0.0128	105.8750
GDP growth	25,928	0.6180	2.8244	-14.8142	11.0870

Notes: Z-score measures bank resilience; APP&LTRO the amount of asset purchases under the Securities Markets Programme, Covered Bond Purchase Programmes (1 and 2), Asset Purchase Programme, and Longer-Term Refinancing Operations; MR is the main refinancing rate; MLF is Marginal Lending Facility rate; DF is Deposit Facility rate; Size is *ln*(total assets); asset diversification is securities/assets; liquidity is liquid assets/total assets, revenue diversification is non-interest incomes/total operating income; GDP growth (%).

In a cross-country study of UMPs, Gambacorta et al. (2014) use the central bank assets to represent the UMP instrument. As Lyonnet, Werner (2012) argue, central banks can use both sides of the balance sheet to exert the impact of asset purchases. While the asset side provides an alternative source for private financial intermediation through outright purchase of credit products, the liability side captures a cushion for funding liquidity risk. Following the literature, we include two additional proxies for UMP, namely the ECB's assets and excess reserves, available from the ECB Statistical Data Warehouse. Excess reserves are the total excess reserves of credit institutions subject to minimum reserve requirement in the euro area. As our bank-specific variables are in thousand USD, we use the EUR/USD exchange rate from

prolonged low inflation and provide credit to the real economy. The breakdown of the expanded APPs includes the CBPP 3 (since 20/10/2014), Asset-backed Securities Purchase Program (ABSPP, started 21/11/2014), Public Sector Purchase Program (PSPP, started 09/03/2015), and Corporate Sector Purchase Program (CSPP, since 08/06/2016). The securities covered by the PSPP are: i) nominal and inflation-linked central government bonds, ii) bonds issued by recognised agencies, regional and local governments, international organisations, and multilateral development banks located in the euro area.

Bankscope to convert the UMP data from million EUR to thousand USD when we use them in our analysis. Cour-Thimann, Winkler (2012) emphasise that ECB's non-standard measures complement key interest rate decisions rather than acting as a substitute. To account for conventional monetary policies (CMPs), we use the marginal lending facility (MLF) rate, the deposit facility rate (DF), and the main refinancing rate (MR). These variables are available from the ECB's website.

Z-score is our dependent variable representing bank stability, computed as $Z_{it} = \left(ROA_{it} + Capital\ ratio_{it}\right) / \sigma ROA_{it}$. This is defined as the number of standard deviations below the mean of return on assets that would result in insolvency by evaporating capital (Beck, De Jonghe, Schepens, 2013). We use the time-varying Boone indicator as a measure of bank competition. The method to obtain this measure is provided in the next section. In addition, we include bank specific variables like asset and revenue diversification, size, and liquidity. Size is measured by the natural logarithm of total assets. Revenue diversification captures the ratio of non-interest income to total operating income (Anginer, et al., 2014; Beck et al., 2013), while the assets diversification is the ratio of securities to assets (Zhang et al., 2013), and lastly liquidity is liquid assets to total assets (Jeon, Olivero, Wu, 2011). GDP growth is included to reflect the influence of macroeconomic environment (Jiménez, Lopez, Saurina, 2013). Data for GDP growth are available from World Bank database and IMF Statistics.

The Boone indicator is the coefficient of log marginal cost (profit elasticity) in the following function (Boone, 2008; Boone, Van Ours, Van Der Wiel, 2007). To obtain yearly Boone indicator, we follow (Mamatzakis et al., 2016; Schaeck, Cihák, 2014; Van Leuvensteijn et al., 2011) that estimate a bank profit equation to measure bank marginal cost.

2.2. The main identification of the impact of UMP

We employ different regression methods in our analysis to ensure the robustness of our results. In general, the regression model takes the following form:

$$\ln Zscore_{i,t} = f\left(Boone_{i,t}, X_{i,t}, UMP_{i,t}, CMP_{i,t}\right) + \varepsilon_{i,t} \quad (5)$$

where X is a vector of bank-specific variables and GDP growth. UMP and CMP are the proxies of unconventional monetary policy and conventional monetary policy. We respectively include three proxies of UMPs and three proxies of CMPs in the model. We start with the simple maximum likelihood regression. We then use the generalised least squares regression, accounting for heteroscedasticity. To address endogeneity, we employ the instrumental variable (IV/2SLS) regression. This endogeneity concern arises from the possible relationship between competition and UMP/CMP, UMP and CMP, and UMP/CMP and GDP growth. UMPs and CMPs tend to accompany each other. UMPs are implemented when policy rates are usually close to zero and CMPs are ineffective in boosting the economy and/or combating deflation. GDP growth is undoubtedly among the indicators for the success of UMPs. However, there may be some delay for the effectiveness of UMPs to be conveyed through GDP growth, as well as a mutual relation between the two indicated through the impact of GDP growth on subsequent implementations of UMPs. In fact, the macroeconomic literature usually considers these two variables as endogenous covariates in a panel Vector Autoregression framework (Ciccarelli et al., 2013; Gambacorta et al., 2014). Although these variables do not enter the regression model in lags, we cannot rule out their potential relationship. Besides, it is necessary to control for the impact of macroeconomic conditions (whereby GDP growth is a popular proxy) on bank risk. Therefore, we must take endogeneity into account.

3. RESULTS

3.1. Identifying the impact of UMP on bank risk

Table 2 reports the main findings of the general model in terms of identification. Results show that there is no strong evidence for a significant impact of APP&LTRO on bank resilience, using maximum likelihood. For ECB's total assets and excess reserves, we find a significant relationship between these proxies of UMPs and bank stability. Nevertheless, there are conflicting results. An increase in ECB's total assets is reported to lead to a decrease in bank stability, while ECB's excess reserves are found to positively affect bank stability. At this point, the results indicate that the countervailing effects of UMPs on bank risk may be at play. The CMP variables, as represented by policy rates, show a positive impact on bank stability. Hence, lower interest rates increase bank risk, as explained in the risk-taking channel of monetary policy transmission (Altunbas et al., 2014; Gambacorta, 2009).

There is a significant impact of competition, consistent across model specifications. The coefficients of the Boone indicator are positive and statistically significant at the 1% level. The results are interpreted as the higher the Boone indicator (which is translated into lower competition), the higher the bank stability. Put differently, competition would be detrimental for European banks in terms of increasing their risk. This finding is in line with the *competition-fragility* hypothesis (Fu et al., 2014; Liu, Wilson, 2013). This hypothesis proposes that banks are induced to attempt more risk under intense competition due to foreseeing the potential profit forgone as a consequence of heightened competition (Allen, Gale, 2004; Keeley, 1990). Other arguments supporting this view relate to asymmetric information, liquidity constraints, and compensation incentives. The nature of banking business adheres to informational asymmetries. The problems associated with asymmetric information are adverse selection and moral hazard, which could be magnified under tough competition. The reason is that in this context, asymmetric information would dampen risk management practices through, for

example, screening and monitoring. This in turn raises credit risk (Allen, Gale, 2004; Boot, Greenbaum, 1993).

Table 2: The impact of UMP on bank resilience

Variables	1	2	3	4	5	6	7	8	9
Boone	0.2731+	0.2282+	0.3830+	0.3057+	0.2145+	0.4604+	0.3900+	0.3071+	0.4657+
	(0.078)	(0.071)	(0.072)	(0.088)	(0.079)	(0.070)	(0.084)	(0.076)	(0.070)
Size	-0.0030	-0.0023	-0.0042	-0.0029	-0.0019	-0.0054	-0.0033	-0.0024	-0.0049
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Liq.ratio	-0.2834+	-0.2861+	-0.2827+	-0.2843+	-0.2866+	-0.2826+	-0.2841+	-0.2863+	-0.2835+
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
AsssetDiv	-0.1932+	-0.1964+	-0.1914+	-0.1908+	-0.1948+	-0.1905+	-0.1914+	-0.1946+	-0.1910+
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
RevDiv	0.0363+	0.0355+	0.0367+	0.0366+	0.0357+	0.0368+	0.0365+	0.0358+	0.0366+
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
CosttoInc	-0.0223+	-0.0224+	-0.0222+	-0.0222+	-0.0224+	-0.0222+	-0.0222+	-0.0224+	-0.0222+
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
GDPg	0.4788+	0.5209+	0.6196+	0.7345+	0.8107+	0.9603+	0.5621+	0.6009+	0.7565+
	(0.087)	(0.083)	(0.102)	(0.083)	(0.084)	(0.088)	(0.087)	(0.086)	(0.098)
MLFrate	0.0307+	0.0295+	0.0247+						
	(0.004)	(0.004)	(0.005)						
DFrate				0.0122+	0.0069*	0.0004			
				(0.004)	(0.004)	(0.004)			
MRrate							0.0271+	0.0234+	0.0150+
							(0.004)	(0.004)	(0.005)
APP&LTRO	-0.0102			-0.0074			-0.0017		
	(0.007)			(0.008)			(0.007)		
ECBTA		-0.0531+			-0.0555+			-0.0399+	
		(0.014)			(0.015)			(0.014)	
ECBER			0.0036*			0.0107+			0.0072+
			(0.002)			(0.002)			(0.002)
C	2.4407+	3.3707+	2.2477+	2.4831+	3.5152+	2.2862+	2.3316+	3.1447+	2.2789+
	(0.256)	(0.362)	(0.22)	(0.264)	(0.390)	(0.220)	(0.260)	(0.375)	(0.220)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	25928	25928	25928	25928	25928	25928	25928	25928	25928

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

Banks may also hesitate to lend to each other in a less concentrated market. Allen, Gale (2000) explain this behaviour through the contagion in the interbank market. Under perfect competition, banks are small price takers whose failure would be considered insignificant to

the market. Hence, in equilibrium, it is assumed that there is no contagion and thus no need to provide liquidity to temporarily illiquid banks. Regarding compensation incentives, the higher likelihood that bank managers forfeiting their bonuses due to the higher potential loss of market share and profit, along with the principal-agent problem, could serve as a catalyst for higher risk-taking.

Turning to bank-specific variables, liquidity ratio, asset diversification, cost to income ratio are found to have a negative relation with Z-score. It appears that the more liquid assets relative to total assets that banks hold do not help banks financially heathier. A potential explanation is that holding liquid assets could reduce bank profits. The construction of Z-score involves profits (ROA). Lower profits, ceteris paribus, lead to lower Z-score. The rationale for lower profits given greater proportion of liquid assets is that they tend to generate low expected returns compared to less liquid assets. This is the trade-off between liquidity and profitability (Rose, Hudgins, 2006)**.** Holding more liquid assets can reduce liquidity risk, however, could be at the expense of potential profit forgone on other assets that might be acquired. In a similar vein, Tabak, Fazio, Cajueiro (2012) report that banks with more liquidity appear farther from the stability frontier. In an attempt to explain for this finding, Tabak et al. (2012) argue that liquidity could reduce profits, which consequently censor the buffer to withstand a crisis. The greater extent of asset diversification is also unbeneficial for bank stability. This finding implies that larger percentage of investment securities (relative to total assets) would make banks riskier, indirectly indicating that lending activities would be safer for banking business.

In terms of the impact of revenue diversification, an increase in this ratio is reported to enhance bank stability.

Table 3 displays the results from the generalised least squares regression. All three proxies of UMPs reveal a positive and statistically significant impact on bank soundness (columns 3, 4,

6, 7, 9). In this regard, greater amount of asset purchases and LTROs contribute to the stability of European banking. Higher MLF, DF, and MR rates are also significant in improving bank stability. The point of view that low interest rates induce greater risk-taking through either the search for yield or changing banks' risk perceptions (Altunbas et al., 2014; Buch et al., 2014; Gambacorta, 2009; Rajan, 2005) is supported. On the contrary, the claim that UMP implementation facilitates borrowers' conditions, raising banks' income and risk buffer (Borio, Zhu, 2012; Buch et al., 2014) is backed in these findings.

Table 3: Generalised least squares results for the whole sample

Variables	1	2	3	4	5	6	7	8	9
Boone	0.5660+	0.5035+	0.6004+	0.6575+	0.5602+	0.6514+	0.7170+	0.6240+	0.6626+
	(0.091)	(0.083)	(0.083)	(0.103)	(0.093)	(0.081)	(0.097)	(0.089)	(0.081)
Size	-0.0049+	-0.0049+	-0.0049+	-0.0048+	-0.0048+	-0.0048+	-0.0049+	-0.0048+	-0.0049+
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LiqRatio	-0.2178+	-0.2179+	-0.2175+	-0.2200+	-0.2199+	-0.2170+	-0.2190+	-0.2190+	-0.2177+
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
AsssetDiv	-0.1494+	-0.1500+	-0.1488+	-0.1484+	-0.1494+	-0.1487+	-0.1485+	-0.1492+	-0.1485+
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
RevDiv	-0.0914+	-0.0921+	-0.0913+	-0.0888+	-0.0892+	-0.0888+	-0.0906+	-0.0910+	-0.0904+
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
CostInc	-0.1509+	-0.1509+	-0.1515+	-0.1508+	-0.1507+	-0.1512+	-0.1511+	-0.1511+	-0.1516+
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
GDPg	0.2829+	0.2383**	0.4840+	0.5462+	0.4909+	0.8198+	0.3626+	0.2868+	0.6438+
	(0.097)	(0.094)	(0.116)	(0.093)	(0.095)	(0.098)	(0.097)	(0.097)	(0.111)
MLFrate	0.0354+	0.0350+	0.0186+						
	(0.004)	(0.004)	(0.625)						
DFrate				0.0183+	0.0157+	-0.0063			
				(0.005)	(0.005)	(0.005)			
MRrate							0.0331+	0.0313+	0.0072
							(0.005)	(0.005)	(0.006)
APP&LTRO	0.0117			0.0198**			0.0229+		
	(0.008)			(0.009)			(0.008)		
ECBTA		0.0042			0.0167			0.0251	
		(0.016)			(0.018)			(0.017)	
ECBER			0.0082+			0.0148+			0.0119+
			(0.002)			(0.002)			(0.002)
C	1.9717+	2.1087+	2.1783+	1.9248+	1.9538+	2.1893+	1.8122+	1.7221+	2.1948+
	(0.164)	(0.341)	(0.058)	(0.182)	(0.387)	(0.058)	(0.174)	(0.364)	(0.058)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
N	25928	25928	25928	25928	25928	25928	25928	25928	25928

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

Like the results reported in Table 2, there is a positive relationship between the Boone indicator and bank soundness, strongly significant across models. GDP growth is also a major factor affecting bank stability. The negative impact of higher liquidity ratio, greater proportion of securities relative to assets, and higher cost to income ratio is confirmed in all model specifications. The results with revenue diversification, interestingly, unlike those in Table 2, reveal that the greater extent of non-interest income relative to total operating income would lessen bank stability. Similar relationship is reported in Lepetit et al. (2008), Liu, Wilson (2013) and Beck et al. (2013). For a sample of European banks between 1996 and 2002, Lepetit et al. (2008) show that banks engaging in non-interest income activities are associated with higher risk and insolvency risk in comparison with banks whose loan supply is the main business line. For Japanese banks, Liu, Wilson (2013) find that more diversified banks are riskier than their counterparts are. Using an international sample, Beck et al. (2013) report that non-interest revenue share negatively affects bank soundness. In Table 3, the impact of bank size on bank soundness is also statistically significant. The larger the bank, the greater the overall bank risk. The models yield a consistent but rather small magnitude of the effect of bank size on bank stability, approximately at 0.0049. This finding is interesting in the sense that *too-big-to-fail* banks or Global Systemically Important Financial Institutions in the Eurozone could carry more risks than their smaller peers. De Nicolo (2000), Laeven, Levine (2009) and Fu et al. (2014) also find that large banks are associated with greater risk or the probability of failure. The complexity of large banks could make it more difficult for supervisors to monitor their banking activities (Beck, Demirgüç-Kunt, Levine, 2006). Decreasing transparency, complicated financial instruments and innovations, and sophisticated organisational structure as banks expand could hinder effective management, thus, raising risks (Cetorelli et al., 2007).

3.2. Controlling for endogeneity

Endogeneity could be an issue, and as result Table 4 presents results using the 2SLS estimation. It is evident that UMPs augment bank stability. With APPs and LTROs, the impact of UMP is reported at around 0.06 (0.0655; 0.0555; and 0.0609 in columns 1; 4; 7 respectively). When the log of ECB's total assets is used, UMPs reportedly have a greater influence on Z-score (0.1478; 0.1199; and 0.1342 in columns 2; 5; 8 respectively).

Table 4: 2SLS regression results for all euro-area member states

Variables	1	2	3	4	5	6	7	8	9
Boone	0.4525+	0.3197+	0.6354**	0.4317+	0.3075+	0.2508**	0.4449+	0.3142+	0.4814**
	(0.096)	(0.081)	(0.256)	(0.107)	(0.088)	(0.099)	(0.101)	(0.084)	(0.228)
Size	-0.0085	-0.0086	-0.0024	-0.0102	-0.0102	-0.0108	-0.0092	-0.0093	-0.0046
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
LiqRatio	-0.3025+	-0.2976+	-0.3432+	-0.3066+	-0.3033+	-0.2988+	-0.3044+	-0.3004+	-0.3396+
	(0.059)	(0.059)	(0.061)	(0.059)	(0.060)	(0.059)	(0.059)	(0.059)	(0.060)
AsssetDiv	-0.3028+	-0.2965+	-0.2417+	-0.2991+	-0.2937+	-0.3217+	-0.3011+	-0.2952+	-0.2630+
	(0.064)	(0.064)	(0.063)	(0.065)	(0.065)	(0.064)	(0.064)	(0.065)	(0.069)
RevDiv	0.0156	0.0176	0.0315	0.0172	0.0191	0.0118	0.0164	0.0184	0.0272
	(0.034)	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
CostInc	-0.0384	-0.0377	-0.0345	-0.0382	-0.0376	-0.0397	-0.0383	-0.0377	-0.036
	(0.045)	(0.045)	(0.046)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.046)
GDPg	0.6492+	0.4295+	-0.2035**	0.2926+	0.0565	0.0835	0.4762+	0.2439**	-0.4810+
	(0.151)	(0.138)	(0.093)	(0.107)	(0.102)	(0.079)	(0.125)	(0.115)	(0.172)
MLFrate	0.003	0.0018	0.0410+						
	(0.005)	(0.005)	(0.012)						
DFrate				0.0041	0.0027	-0.0015			
				(0.006)	(0.006)	(0.005)			
MRrate							0.0034	0.0021	0.0301*
							(0.005)	(0.005)	(0.016)
APP&LTRO	0.0655+			0.0555+			0.0609+		
	(0.011)			(0.011)			(0.011)		
ECBTA		0.1478+			0.1199+			0.1342+	
		(0.026)			(0.025)			(0.025)	
ECBER			0.0114+			0.0033*			0.0075
			(0.003)			(0.002)			(0.005)
C	0.8265**	-1.0712*	1.8821+	1.0578+	-0.4393	2.1320+	0.9328**	-0.7639	1.9871+
	(0.377)	(0.596)	(0.342)	(0.371)	(0.577)	(0.336)	(0.378)	(0.594)	(0.336)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.233	0.223	0.141	0.122	0.214	0.125	0.115	0.132	0.132
N	25,928	25,928	25,928	25,928	25,928	25,928	25,928	25,928	25,928

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

Among the three proxies of UMPs, the last one, excess reserves, shows the smallest magnitude of the impact (0.0144 and 0.0033 in columns 3 and 6). Policy rates, as previously reported in Tables 2 and 3, are positively related to bank stability. Overall, UMPs increase bank stability, while low interest rates do the opposite. The impacts of competition, liquidity, and asset diversification on bank soundness are like those reported in Tables 2 and 3. Better economic environment indicated by higher GDP growth also boosts bank stability in most models (except in columns 3 and 9).

3.2. Sensitivity analysis: Results for selected countries

The previous section produces estimation results for the full sample with a general insight that UMPs bring along financial soundness for European banking systems, whereas lower interest rates induce greater risk-taking. As Eichler, Hielscher (2012) argue, ECB implements a monetary policy for all nations in the EMU, thus, is unable to stabilise every member countries at all times. As institutional heterogeneity exists, we conjecture that ECB's UMPs may also affect member countries differently. To this end, we focus on the euro-area in the periphery that include the following countries: Cyprus, Italy, Ireland, Portugal, Slovenia, and Spain. Those countries have high nonperforming loan ratio reported in European Banking Authority's report in July 2016. Greece has undergone a sovereign crisis like other countries in this group. We exclude Greece from this group because for the current APPs, especially the PSPP, ECB does not purchase assets from Greece. For robustness check, we also analyse the impact of UMPs on bank risk of two sub-groups, namely GIIPS (Greece, Italy, Ireland, Portugal, Spain) and FGLN (France, Germany, Luxembourg, the Netherlands). GIIPS are the vulnerable EMU member countries due to the sovereign crisis (Eichler, Hielscher, 2012), while FGLN are the tranquil members (Reichlin, 2014).

We continue with the 2SLS regression for this sub-sample analysis. Tables 5 and 6 show the results for groups 1 and 2 respectively.

Table 5: 2SLS Estimations for the Group: Cyprus, Italy, Ireland, Portugal, Slovenia, and Spain.

Variables	1	2	3	4	5	6	7	8	9
Boone	-0.9761+	-0.8721+	-1.8675+	0.1125	0.0576	-0.9875+	-0.3154	-0.2934	-1.9402+
	(0.271)	(0.221)	(0.527)	(0.305)	(0.243)	(0.258)	(0.291)	(0.233)	(0.651)
Size	-0.0303	-0.0286	-0.0302	-0.0401	-0.0411	-0.0504	-0.0349	-0.0345	-0.0308
	(0.052)	(0.053)	(0.053)	(0.053)	(0.053)	(0.054)	(0.052)	(0.053)	(0.054)
LiqRatio	0.0295	0.0189	-0.0634	-0.1139	-0.111	-0.1361	-0.0244	-0.026	-0.1202
	(0.114)	(0.117)	(0.116)	(0.112)	(0.113)	(0.110)	(0.113)	(0.115)	(0.117)
AsssetDiv	0.177	0.1692	0.2061	-0.0249	-0.0204	0.0328	0.1127	0.111	0.1359
	(0.119)	(0.121)	(0.171)	(0.115)	(0.118)	(0.109)	(0.117)	(0.120)	(0.126)
RevDiv	-0.3587**	-0.3596**	-0.3718**	-0.3391**	-0.3386**	-0.3650**	-0.3525**	-0.3527**	-0.3726**
	(0.147)	(0.147)	(0.152)	(0.144)	(0.144)	(0.152)	(0.146)	(0.146)	(0.156)
CostInc	-0.6057+	-0.6058+	-0.6146+	-0.5773+	-0.5771+	-0.6023+	-0.5964+	-0.5964+	-0.6110+
	(0.145)	(0.146)	(0.151)	(0.142)	(0.142)	(0.151)	(0.145)	(0.145)	(0.153)
GDPg	-0.0868	0.0636	-1.8214+	-0.4114	-0.5107*	-1.9286+	-0.3831	-0.347	-2.3312+
	(0.445)	(0.383)	(0.337)	(0.321)	(0.269)	(0.243)	(0.375)	(0.311)	(0.542)
MLFrate	0.1529+	0.1537+	0.0719**						
	(0.014)	(0.013)	(0.029)						
DFrate				0.1968+	0.1963+	0.1086+			
				(0.017)	(0.017)	(0.012)			
MRrate							0.1700+	0.1702+	0.0618
							(0.015)	(0.015)	(0.047)
APP&LTRO	-0.0453			0.0207			-0.0088		
	(0.032)			(0.032)			(0.032)		
ECBTA		-0.0996			0.0415			-0.0184	
		(0.071)			(0.063)			(0.068)	
ECBER			-0.0381+			-0.0253+			-0.0424+
			(0.007)			(0.005)			(0.015)
C	2.6055+	3.8442**	2.2317+	1.7982*	1.3207	2.5902+	2.1369**	2.3574	2.3629+
	(0.968)	(1.634)	(0.813)	(0.972)	(1.518)	(0.810)	(0.976)	(1.589)	(0.813)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.376	0.312	0.323	0.332	0.321	0.322	0.322	0.322	0.322
N	6221	6221	6221	6221	6221	6221	6221	6221	6221

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

Table 6: 2SLS Estimations for the remaining countries.

Variables	1	2	3	4	5	6	7	8	9
Boone	0.8090+	0.6748+	1.8893+	0.4114+	0.3276+	0.5894+	0.5812+	0.4754+	0.6407+
	(0.092)	(0.078)	(0.290)	(0.101)	(0.085)	(0.100)	(0.096)	(0.080)	(0.228)
Size	-0.0231	-0.0219	-0.0134	-0.0128	-0.012	-0.0191	-0.0198	-0.0189	-0.0149
	(0.026)	(0.026)	(0.027)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
LiqRatio	-0.1895+	-0.1899+	-0.2975+	-0.2087+	-0.2094+	-0.1903+	-0.1964+	-0.1970+	-0.2213+
	(0.066)	(0.066)	(0.074)	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)
AsssetDiv	-0.0868	-0.0845	-0.0502	-0.1293*	-0.1287*	-0.1146	-0.0999	-0.0985	-0.0825
	(0.077)	(0.076)	(0.078)	(0.078)	(0.078)	(0.079)	(0.077)	(0.077)	(0.082)
RevDiv	0.1035**	0.1077**	0.1635+	0.1181+	0.1211+	0.1106**	0.1092**	0.1127**	0.1342+
	(0.047)	(0.047)	(0.044)	(0.045)	(0.045)	(0.046)	(0.046)	(0.046)	(0.043)
CostInc	0.0019	0.0032	0.0175	0.0057	0.0066	0.0038	0.0034	0.0044	0.0089
	(0.028)	(0.028)	(0.030)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.029)
GDPg	0.9878+	0.7524+	0.2563+	0.5891+	0.4235+	0.5344+	0.8084+	0.6114+	-0.2446
	(0.146)	(0.136)	(0.089)	(0.106)	(0.104)	(0.078)	(0.122)	(0.114)	(0.171)
MLFrate	-0.0418+	-0.0430+	0.0440+						
	(0.005)	(0.005)	(0.013)						
DFrate				-0.0559+	-0.0567+	-0.0445+			
				(0.006)	(0.006)	(0.006)			
MRrate							-0.0471+	-0.0480+	-0.0256
							(0.005)	(0.005)	(0.016)
APP&LTRO	0.0704+			0.0404+			0.0528+		
	(0.011)			(0.012)			(0.012)		
ECBTA		0.1599+			0.0889+			0.1180+	
		(0.026)			(0.026)			(0.026)	
ECBER			0.0267+			0.0072+			0.0063
			(0.004)			(0.002)			(0.005)
C	1.1626+	-0.9145	2.1312+	1.5227+	0.3899	2.3618+	1.4155+	-0.1001	2.3302+
	(0.390)	(0.604)	(0.370)	(0.387)	(0.601)	(0.358)	(0.392)	(0.610)	(0.357)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.143	0.141	0.142	0.143	0.142	0.142	0.143	0.143	0.141
N	17872	17872	17872	17872	17872	17872	17872	17872	17872

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

The most insightful result is the difference in the impact of both UMPs and CMPs. For group 1 that includes Cyprus, Italy, Ireland, Portugal, Slovenia, and Spain, we find a negative association between UMPs and bank stability (Table 5, columns 3, 6, 9). There is a positive relationship between CMPs and bank stability (Table 5, columns 1-8). These results denote that low interest rates and the implementation of UMP increase bank risk. For the remaining countries, the contrary is reported. Columns 1-8 of Table 6 reveal that UMPs positively affect bank stability. In most specifications, low interest rates positive affects bank stability. It could

be the case that countries in group 1 have not received a sufficiently large amount of support as most public sector asset purchases conducted by the ECB is mainly directed to countries in group 2. Note that in this study, we are interested in the microeconomic impact of UMPs rather than the inflation target expected to achieve through UMP implementation. Extra support from the ECB could be desirable, probably augmented APP holdings, to facilitate financial stability alongside the objectives of UMPs. It is noteworthy that there may be a risk of the "insurance effect" (Altunbas et al., 2014) from increasing APP holdings, consequently leading to greater bank risk taking. Therefore, this strategy should be applied with caution. Second, we cannot rule out the possibility that banks in vulnerable countries anticipate a rescue of the ECB during economic recession, in turn taking advantage of that.

Like monetary policy, competition influences bank stability differently in two groups. It is evident in Table 5 that the *competition-stability* hypothesis is at play for banks in group 1, while the *competition-fragility* hypothesis is supported for banks in group 2 (consistently in all models of Table 6). Note that GDP growth would lower bank stability in the periphery of the euro-area. The contrary is reported for group 2. There is also some variation in the relationship between revenue diversification and bank risk. Banks in Cyprus, Italy, Ireland, Portugal, Slovenia, and Spain appear to experience greater risk (see Table 5, all models) compared to banks in other countries (see Table 6, all models).

Given that Germany dominates the sample as it is the country with most banks and received the largest cumulative monthly net purchases from the PSPP (EUR 368,084 million as in April 2017), we, therefore, proceed by estimating the 2SLS regression for Germany. Tables 7 and 8 report the results for these regression results for Germany and the group of euro-area excluding Germany respectively.

Table 7: 2SLS regression results for Germany.

Variables	1	2	3	4	5	6	7	8	9
Boone	0.7133+	0.6118+	0.8908+	0.3363+	0.2806+	0.3180+	0.4990+	0.4225+	0.6435+
	(0.099)	(0.088)	(0.095)	(0.103)	(0.093)	(0.083)	(0.097)	(0.087)	(0.087)
Size	-0.0765*	-0.0729*	-0.0541	-0.056	-0.054	-0.0576	-0.0696*	-0.0669*	-0.0686*
	(0.041)	(0.041)	(0.041)	(0.039)	(0.039)	(0.040)	(0.041)	(0.040)	(0.041)
LiqRatio	-0.0489	-0.057	-0.1029	-0.086	-0.0913	-0.0645	-0.0628	-0.0695	-0.0613
	(0.095)	(0.094)	(0.097)	(0.094)	(0.094)	(0.094)	(0.094)	(0.094)	(0.096)
AsssetDiv	0.0131	0.0087	0.0011	-0.0508	-0.0535	-0.0369	-0.0074	-0.011	0.0022
	(0.092)	(0.091)	(0.094)	(0.092)	(0.092)	(0.095)	(0.092)	(0.091)	(0.094)
RevDiv	0.1564	0.1686	0.3130**	0.2548*	0.2670*	0.2159	0.1964	0.2094	0.2262
	(0.140)	(0.140)	(0.149)	(0.139)	(0.139)	(0.140)	(0.140)	(0.140)	(0.145)
CostInc	-0.4838+	-0.4811+	-0.5176+	-0.4846+	-0.4852+	-0.4855+	-0.4868+	-0.4863+	-0.5048+
	(0.151)	(0.150)	(0.157)	(0.146)	(0.146)	(0.147)	(0.150)	(0.149)	(0.155)
GDPg	0.4117**	0.2212	0.0721	0.2267*	0.098	0.2200**	0.3309**	0.1722	0.1284
	(0.163)	(0.150)	(0.085)	(0.116)	(0.107)	(0.088)	(0.137)	(0.126)	(0.089)
MLFrate	-0.0408+	-0.0411+	-0.0244+						
	(0.006)	(0.006)	(0.007)						
DFrate				-0.0520+	-0.0520+	-0.0495+			
				(0.008)	(0.008)	(0.006)			
MRrate							-0.0449+	-0.0450+	-0.0331+
							(0.007)	(0.007)	(0.006)
APP&LTRO	0.0621+			0.0340+			0.0463+		
	(0.009)			(0.008)			(0.009)		
ECBTA		0.1413+			0.0755+			0.1040+	
		(0.021)			(0.019)			(0.019)	
ECBER			0.0044*			0.0036**			0.0059+
			(0.002)			(0.002)			(0.002)
C	2.5912+	0.7214	3.5250+	2.7776+	1.7942**	3.4418+	2.7624+	1.3979*	3.6379+
	(0.632)	(0.739)	(0.597)	(0.602)	(0.704)	(0.584)	(0.622)	(0.723)	(0.597)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.221	0.223	0.223	0.223	0.221	0.221	0.221	0.223	0.221
N	9328	9328	9328	9328	9328	9328	9328	9328	9328

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

As in Table 6, the UMP enhances bank resilience for German banks. Low policy interest rates and UMPs facilitate bank soundness. This finding is confirmed across model specifications in Table 7. In detail, there is a negative and statistically significant relationship (at the 1% level) between different interest rates and banks stability. The positive impact of UMPs on bank stability is also robust. The magnitude of the coefficient estimates is not too far away from those reported in Table 6. The impacts of competition, GDP growth and revenue diversification are in line with findings of Table 6. Besides, larger bank size and higher cost to income ratio

reduce bank stability. Schaeck, Cihák (2014) also report a negative relation between bank size and Z-score for a sample of European banks during 1995-2005.

Table 8: 2SLS regression results excluding Germany.

Variables	1	2	3	4	5	6	7	8	9
Boone	-0.8779	-0.8246+	-0.0324	0.1646	-0.7379+	0.0506	0.0839	0.5198	-0.3521
	(0.535)	(0.272)	(0.222)	(0.305)	(0.286)	(0.796)	(0.323)	(0.391)	(0.265)
size	0.0113	0.0174	0.0037	0.0013	0.011	0.0002	0.0011	-0.0088	0.0054
	(0.038)	(0.037)	(0.037)	(0.037)	(0.036)	(0.038)	(0.038)	(0.036)	(0.037)
LiqRatio	-0.1659*	-0.1829*	-0.1781*	-0.1936**	-0.1856**	-0.1831*	-0.1709*	-0.1788*	-0.1805*
	(0.094)	(0.096)	(0.095)	(0.095)	(0.094)	(0.095)	(0.093)	(0.094)	(0.094)
AsssetDiv	-0.2588**	-0.2901**	-0.2483*	-0.2454*	-0.2795**	-0.2434*	-0.2324*	-0.2202*	-0.2560**
	(0.131)	(0.131)	(0.130)	(0.130)	(0.128)	(0.132)	(0.132)	(0.128)	(0.130)
RevDiv	0.2090+	0.2016+	0.2105+	0.2091+	0.1981+	0.2085+	0.2225+	0.2073+	0.2075+
	(0.047)	(0.047)	(0.048)	(0.047)	(0.045)	(0.046)	(0.050)	(0.046)	(0.047)
CostInc	0.0377*	0.0354*	0.0386*	0.0383*	0.0346	0.0380*	0.0421*	0.0380*	0.0376*
	(0.021)	(0.021)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)	(0.021)
GDPg	-0.0215	0.7590**	0.3726	0.8993**	0.8650+	0.5630*	-0.1782	0.5279	0.491
	(0.469)	(0.359)	(0.346)	(0.379)	(0.318)	(0.331)	(0.517)	(0.343)	(0.341)
MLFrate	-0.0441+	-0.0418+	-0.0380+						
	(0.012)	(0.009)	(0.013)						
DFrate				-0.0253*	-0.0518+	-0.033			
				(0.014)	(0.011)	(0.028)			
MRrate							-0.0224*	-0.0239**	-0.0504+
							(0.013)	(0.010)	(0.015)
APP&LTRO	-0.1054			0.0018			-0.0183		
	(0.067)			(0.049)			(0.055)		
ECBTA		-0.3185+			-0.1918+			0.1118	
		(0.068)			(0.047)			(0.082)	
ECBER			-0.0061			-0.0004			-0.0086
			(0.005)			(0.010)			(0.005)
C	3.3812+	8.0778+	1.5753+	1.4678	5.3784+	1.5051+	1.8722*	-0.7067	1.5161+
	(1.218)	(1.400)	(0.533)	(0.962)	(1.076)	(0.548)	(1.090)	(1.792)	(0.531)
Chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R^2	0.144	0.141	0.141	0.143	0.143	0.143	0.143	0.144	0.144
N	5423	5423	5423	5423	5423	5423	5423	5423	5423

Notes: Authors' estimations. *,**,+: significance at the 10%, 5%, 1% levels.

Removing Germany from the sample, we find that the impact of CMPs on bank stability remains negative, signifying that lower interest rates reduce overall bank risk. UMPs, however, turn out negative in their relationship with bank stability. This is confirmed in columns 2 and 5 of Table 8. In this regard, for the remaining banks in group 2, monetary easing to the extent of low interest rates rather than additional asset purchases is preferable to accompany greater

stability for the banking systems. This could imply that CMPs work better than UMPs in bringing a financially heathier banking system. Different from Tables 6-7, Table 8 shows evidence for a presence of the *competition-stability* hypothesis. In addition, inefficient banks about higher cost to income ratio are found to benefit from lower bank risk. This finding could be related to the *risk-averse management* hypothesis denoting that bank may appear inefficient in the short-run due to extra caution taken by risk-averse managers (Koutsomanoli-Filippaki, Mamatzakis, 2009; Mamatzakis et al., 2016). Operating costs can be higher because of prudent credit screening, collateral evaluation, and proper monitoring ex-post in their loan issuance procedure. Notwithstanding, these robust risk management practices yield lower credit risk and overall bank risk in return. Regarding other control variables, we find similar results as reported in Table 6. To this end, the results affirm the necessity to investigate the UMPs-risk linkage for Germany on its own.

4. CONCLUSION

In this study for European banks in the Eurozone, we find that UMPs enhance bank resilience, though there is variability across countries. In addition, it is worth noting to the ECB as well as national regulators that the potential moral hazard problems may prevail. Banks may foresee an extended period of monetary easing, UMP implementation, and the implicit guarantee of support from the ECB, thus increasing their risk-taking. Our results also emphasise the need to consider Germany on its own due to its important role in the EMU, the size of the banking industry, and the dominant amount of asset purchases from ECB. It appears that German banks benefit the most from UMPs in terms of improving their financial stability.

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