



Bank-specific capital requirements: Short and long-run determinants

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ABSTRACT

This paper studies the determinants of the Pillar 2 capital requirements (P2R) of banks directly supervised by the ECB between 2016 and 2021. Drawing on the ECB's Supervisory Review and Evaluation Process (SREP) to identify the list of potential drivers of P2R, we estimate the impact on P2R by employing a method that separates long-run from short-run determinants. Our results suggest that in (i) the long-run, the P2R is mostly driven by credit risk, funding risk, and governance, whereas (ii) profitability and market risk seem to be the main short-run determinants of P2R. Furthermore, we find evidence that suggests the supervisor incorporates proportionality in the P2R decisions. Effectively, our sensitivity analyses show considerable differences in the long-run determinants of P2R according to the level of capital, size, and access to market funding of supervised entities.

1. Introduction

The 'Pillar 2 capital requirements' (P2R) are bank-specific capital requirements that vary cross-sectionally and over time, contrasting with Pillar 1 requirements which are the same for all banks every year. In the case of banks under the 'Single Supervisory Mechanism' (SSM), the P2R is determined annually as the output of the 'Supervisory Review and Evaluation Process' (SREP) (EBA, 2022).

The P2R decision is relevant in several ways. First, the magnitude of the P2R (sample mean: 2.13%) is significant compared to Pillar 1 requirements (8.00%). Second, the P2R has been found to negatively impact the supply of credit to the economy (Aiyar et al., 2014). Third, evidence suggests that banks react to increases in P2R by adjusting their asset-composition and risk exposure (De Jonghe et al., 2020). Thirdly, increased capital requirements can deteriorate banks' probability of default, via effects on competition and borrowers' riskiness (Hakenes and Schnabel, 2011). Finally, the P2R is complemented by macroprudential capital requirements, which have been shown to bear implications in the risk profile of banks (Mayordomo and Rodriguez-Moreno, 2021).

In this context, it is surprising that no study has yet analyzed the determinants of P2R. Such gap seems particularly interesting given that as an output of the SREP, the P2R reflects the judgement of the supervisor regarding a wide variety of risk drivers, including the business model and profitability, risks to capital (credit risk, market risk, operational risk, and funding risk), and governance and risk management. Furthermore, we note that some risk drivers may be stickier than others in the short-run, potentially restricting the speed and cost at which a bank may adjust its risk profile. For instance, one may hypothesize that a bank may take a relatively long time to

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adjust its credit risk profile (Jiangli and Pritsker, 2008) or corporate governance quality (Andriş et al., 2018). On the other hand, one cannot completely exclude the possibility that actions by bank managers may produce significant changes to some of the risk drivers in the short run (Kaparakis et al., 1994).

Hence, the diversity of potential drivers of P2R and the ambiguity as to whether their effects may be seen in the short or long-run, leads us to the following research question: what are the short and long-run determinants of the P2R?

To address this question, we focus on the list of banks directly supervised by the ECB, as these banks are more prone to disclose P2R information, despite not being mandatory. Furthermore, we draw on the ECB's Supervisory Review and Evaluation Process (SREP) to identify the list of potential drivers of P2R, namely (i) business model and profitability, (ii) risks to capital, and (iii) liquidity and funding risk. Importantly, we follow a strand of the literature (Afonso et al., 2011; Mergaerts and Vennet, 2016) and employ the Mundlak estimator (Mundlak, 1978), which allows us, under the same regression, to estimate the between (long-run) and within (short-run) determinants of P2R.

2. Data and methodology

Our study focuses on European banks centrally supervised by the ECB (2016–2021). The P2R data is obtained from the ECB's Banking Supervision website¹ (2019–2021) and hand-collected from banks' annual reports (2016–2018). While the disclosure of P2R is not mandatory, our sample represents 80.31% of total P2R decisions (526/655) and covers 121 banks. The financial data is from Moody's Bank Focus database and, where missing, complemented by annual reports. We use Factiva to search for banks' media coverage related to 'Litigation Actions and Corporate Crime'. The corporate governance data is from Datastream/Eikon and annual reports.

Table 1 shows the descriptive statistics. The average P2R is 2.13%, ranging from 1.32% to 3.00%. Also, untabulated results show that the average P2R has slightly increased over time (2016: 2.09%, 2019: 2.15%, 2021: 2.22%). Importantly for our methodology, the descriptive statistics indicate that for all P2R determinants the between variation is greater than the within variation. This means that the differences across banks are greater than changes within banks over the sample period.

Bearing these results in mind, we follow a strand of empirical literature in finance (Afonso et al., 2011; Mergaerts and Vander Vennet, 2016) which equates the between dimension of the panel data to long-run effects and the within dimension to short-run effects, by drawing on panel data econometrics.² According to Baltagi and Griffin (1984) the problem of 'dynamic misspecification' leads to structural differences in the performance of the between and within estimators in estimating long-term effects. Namely, the authors find that "the within estimator offers a good estimator of the short run effects but can severely underestimate the long-run response" (Baltagi and Griffin, 1984: p.644), whereas the between estimator does better at estimating the long-run effects. As such, relating our descriptive statistics to the abovementioned econometrical approach leads us to conjecture that the P2R seems to be mainly driven by long-term determinants. However, given the relevance of P2R for banks, we also wish to study the short-run determinants of P2R.

To study the long-run (between) and short-run (within) determinants of P2R, we estimate the Mundlak regression (Mundlak, 1978) using random effects (RE). Econometrical and conceptual arguments back such choice. As stated by Afonso et al. (2011), it is sound to use the RE estimator over the fixed effects estimator (FE), if one can convincingly prove the absence of correlation between the unit-specific error (α_i) and the time variant (X_{it}) and time-invariant (Z_i) regressors, i.e., $E(\alpha_i|X_{it}, Z_i) = 0$. However, it is reasonable to assume that, in our setting, the bank-specific error (α_i) is likely to be correlated with the regressors (X_{it}, Z_i). For instance, the risk culture of the bank may be only partially observable, and hence drive both α_i and X_{it}, Z_i . Hence, as referred by Afonso et al. (2011), the question becomes how to rescue the RE estimator when $E(\alpha_i|X_{it}, Z_i) \neq 0$. The Mundlak estimator (Mundlak, 1978) provides a solution for this problem by explicitly modeling $E(\alpha_i|X_{it}, Z_i)$ as the linear combination of the mean values of X_{it} over the sample period (\bar{X}_i) and using the RE estimator (Afonso et al., 2011; Mergaerts and Vander Vennet, 2016). In other words, the Mundlak estimator explicitly models the unit-specific error.

Our baseline model is the following:

$$Y_{it} = \alpha_0 + \beta\bar{X}_i + \gamma(X_{it-1} - \bar{X}_i) + \delta_j + \varphi_t + \varepsilon_{it} \quad (1)$$

wherein Y_{it} is the P2R of bank i for year t . \bar{X}_i is a matrix of bank-specific mean values for the sample period of the independent variables used to proxy for the SREP elements: (i) 'profitability risk', we use ROA, (ii) 'risks to capital', we employ the NPL ratio (credit risk), the share of total assets in the trading book (market risk), and the count of Factiva news related to 'Legal Action/Corporate Crime' (LACC) divided by the natural log of total assets (operational risk), and (iii) 'funding risks', we use short-term wholesale funding to total funding. The $(X_{it-1} - \bar{X}_i)$ represents the demeaned independent variables, wherein the lagged variables are used to mitigate endogeneity concerns. Furthermore, we control for unobserved time-invariant confounders at the country-level (δ_j) and time-variant shocks over the sample period (φ_t). The coefficients β and γ correspond to the between (long-run) and within (short-run) parameters, and are

¹ The P2R of banks directly supervised by the ECB, between 2019 and 2021, can be accessed in the following link: <https://www.bankingsupervision.europa.eu/banking/srep/html/p2r.en.html>.

² For intuition, consider the following explanation for the between/long-run and within/short-run nexus provided by Kuh's seminal paper (1959): "(...) cross sections typically will reflect long run adjustments whereas annual time series will tend to reflect shorter run. Because disequilibrium among firms tends to be synchronized in response to common market forces and the business cycle, many disequilibrium effects wash out ... so that the higher cross section slope estimates can be interpreted as long run coefficients." (pp.207-208).

Table 1
Descriptive statistics.

	Obs.	Mean	Standard deviation		B/W	Min	Max
			Between	Within			
P2R	526	2.13	0.55	0.16	3.44	1.32	3.00
ROA	526	0.37	0.35	0.19	1.84	-0.27	1.06
NPL ratio	526	5.23	4.37	2.01	2.01	0.50	16.30
Trading book	526	6.60	5.85	1.77	3.31	0.27	18.66
LACC news	526	22.15	34.95	21.90	1.60	0.00	136.40
Wholesale funding	526	14.30	9.52	3.88	2.45	1.55	34.74
Board size	526	14.62	4.03	1.29	3.12	9.00	22.00
Board non-executives	526	74.72	13.68	4.48	3.05	50.00	95.65
Board gender diversity	526	26.61	9.85	5.26	1.87	9.09	42.86
Total assets	526	18.09	1.37	0.15	9.13	15.60	20.20

Notes: P2R represents the bank-specific capital requirements (%). ROA is the net income divided by average total assets (%). NPL ratio is the ratio of non-performing loans per gross loan to customers (%). Trading book is defined as the share of total assets at fair value (%). LACC news is the total number of Factiva news labelled as 'Legal Action/Corporate Crime' per natural log of total assets. Wholesale funding is total short-term wholesale funding divided by total funding (%). Board size is the count of board members. Board non-executives is the share of non-executives sitting on the board (%). Board gender diversity is the share of females sitting on the board (%). Total assets are the natural log of total assets. All variables are winsorized at the 1% and 99% levels.

reported separately in the results table. An important aspect of the Mundlak approach (Mundlak, 1978) is to ensure that the between effects are significant, and hence we report the results of the test for joint significance of β in each regression. Additionally, we report the results of the Hausman test (Hausman, 1978), which checks whether the within effects (γ) estimated in our model using the random effects estimator, are significantly different from those that would be obtained using the fixed effects estimator. Finally, the inclusion of both between and within effects in our model and country and year dummies may raise model overfitting concerns (Harrel, 2001). In this regard, our regressions meet the commonly used $n/p > 10$ (12.2) threshold.

3. Results

Table 2 shows the results for the determinants of P2R. Columns (1) and (2) display the between and within effects, respectively, which we interpret as the long and short-run determinants of P2R, following the literature (Mergaerts and Vennet, 2016). Additionally, the table shows the results regarding (i) the joint significance of the between effects, (ii) the absence of a systematic difference in the coefficients of the within panel of our model – column (2) – *vis-à-vis* those that would be obtained in a standard fixed effects model (Hausman test), and (iii) the relatively high R-square of our model, particularly for the between dimension.

Focusing on column (1) of Table 2, in the long-run we find that the P2R is primarily driven by credit risk and size and, to a lesser extent, by other risks to capital (operational risk and funding risk) and governance. Regarding credit risk, our estimates show that banks with a one (between) standard deviation higher NPL ratio (+4.37 p.p.) are expected to be charged with a +0.29 p.p. higher P2R, which represents 13.6% of the P2R mean (2.13%). Such an increase is economically significant and suggests that supervisors have used the P2R to push banks to reduce credit risk, in line with the supervisory priorities (ECB, 2016). Additionally, we find that larger banks seem to benefit from a significant P2R discount – all else constant, a bank which is one (between) standard deviation larger (total assets: € 282.7 billion) than the mean bank in our sample (total assets: € 71.8 billion), benefits from a -0.27 p.p. lower P2R (12.8% of P2R mean). Such P2R discount to larger banks may reflect the supervisor's assessment of larger banks' risk management practices as superior to smaller banks, for instance, due to the presence of economies of scale (Beccalli et al., 2015); or, alternatively, it could reflect a 'P2R leniency' by the supervisor towards larger banks, due to the existence of additional size-specific capital requirements (i.e., systemically important institutions capital buffer).

Concerning other risks to capital, we find that the supervisor charges a P2R penalty to banks that show a higher reputational risk (i.e., banks with higher media coverage related to legal actions or corporate crime) and greater reliance on short-term wholesale funding – which seems coherent with the lower reliability of short-term wholesale funding under turbulent times (Huang and Ratnovski, 2011). Finally, consistent with the notion that governance has attracted the attention of bank supervisors since the aftermath of global financial crisis (Fratzscher et al., 2016; Vallascas et al., 2017), our results show that the P2R is relatively lower, in the long-run, for banks that have a higher share of non-executives in the board.

Regarding column (2) of Table 2, in the short-run we find that the P2R is chiefly driven by profitability and asset composition. More specifically, we find that short-run increases in ROA significantly reduce the P2R, whereas increases in the share of assets at fair value held by banks induce a P2R increase. Both aspects align with supervisors' priority for bank profitability and sustainability (Marques and Alves, 2021).

Next, given the SSM's concern with ensuring proportionality in supervisory decisions (EBA, 2015), we test whether the long-run P2R determinants obtained in our baseline results differ when considering banks with different levels of capital, size, and access to

Table 2
Determinants of P2R: baseline regression.

	Baseline model	
	Between (1)	Within (2)
ROA	-0.185	-0.103**
NPL ratio	0.066***	0.010
Trading book	0.008	0.011*
LACC news	0.003*	0.000
Wholesale funding	0.008*	0.003
Board size	-0.016	0.010
Board non-executives	-0.006*	-0.001
Board gender diversity	-0.005	0.001
Total assets	-0.199***	-0.119
Observations	526	
Banks	121	
R-square (overall)	0.613	
R-square (between)	0.673	
R-square (within)	0.117	
Between effects	88.70***	
Hausman test	8.48 (0.863)	

Notes: The model is estimated using the Mundlak estimator (Mundlak, 1978) with country and year fixed effects and White-robust standard errors. The dependent variable is the P2R. Columns (1) and (2) represent the between and within parameters, respectively, which equate to the long and short-term effects. ***, ** and * indicate significance at 1%, 5% and 10%, respectively. We also perform the test for the joint significance of the between effects. The null hypothesis of the Hausman test is that RE estimation is consistent, therefore, preferable to fixed effects. The p-value is reported in brackets.

market funding. Namely, we re-run the baseline model, including the interaction between each P2R determinant and a dummy Z, which identifies, respectively: (i) banks in the bottom quartile of total capital ratio, (ii) banks in the top quartile of size, and (iii) listed banks. The results are in Table 3.³

For the level of capital, the results presented in column (2) suggest that supervisors attribute particular relevance to profitability and funding issues when setting the P2R of banks with higher insolvency risk. Regarding profitability, the results indicate that less capitalized banks that record a higher ROA are awarded a significantly lower P2R – specifically, a + 0.25 p.p. higher ROA (one between standard deviation among less capitalized banks) is estimated to induce a -0.28 p.p. lower P2R (which represents 12.7% of the mean P2R of less capitalized banks). Additionally, we may observe that the ‘P2R penalty’, induced by short-term wholesale funding shown in the baseline model, is only significant for less capitalized banks. Both results suggest that bank supervisors use the P2R decision to persuade banks with higher insolvency risk to adopt profitable and sustainable business models, hence promoting the internal generation of capital (Enria, 2021).

Regarding bank size, column (3) results indicate that bank supervisors place special weight on profitability issues for larger banks. Such a result seems in line with the existence of supervisory expectations regarding the potential for larger banks to become more profitable and sustainable, for instance, via economies of scale – an expectation which is implicit in the ongoing supervisory debate on the merits of cross-border bank mergers and acquisitions (Figueiras et al., 2021). Moreover, we note a significant difference in the P2R treatment of larger banks’ reputational, funding, and governance issues *vis-à-vis* their smaller peers. Effectively, we find that LACC news and short-term wholesale funding only significantly increase the P2R for smaller banks. In our view, both factors may be driven by the same supervisory concern: in general, smaller banks may be less prepared to manage and absorb sudden reputational and funding shocks than larger banks. For governance, we find that the share of non-executive directors only significantly reduces the P2R of smaller banks – which may be explained by a relative lag of smaller banks in implementing reforms to governance at the board-level, when compared to larger banks (Nguyen, 2022).

Finally, several P2R determinants seem to be specific to whether a bank is listed or not. First, our results suggest that supervisors are only comfortable in rewarding more profitable banks with a lower P2R in the case of listed banks – which could reflect the supervisors’ concern that unlisted banks (even those that are profitable) are bound to face added difficulties in raising new capital in case of future need when compared to their listed peers. Second, we find that the impact of credit risk on P2R is significantly dampened for listed banks, which is likely related to the greater possibilities of such banks in terms of credit risk securitization (Casu et al., 2011). Similarly, we find that the supervisor seems to have a differential treatment for listed and non-listed banks concerning the size of the trading book: while it imposes a P2R discount for listed banks, it requires additional P2R for non-listed banks. Such a result indicates that the supervisor equates listed banks with superior abilities to manage the market risk implicit in a sizable trading book (Wong et al., 2003). Next, our findings suggest that the P2R of listed banks is significantly more impacted by LACC news, which seems in line with the anticipation, by the supervisor, of the potential for the stock market to act as an amplifier of noisy public signals (Huang and

³ For brevity reasons, and given the relevance of the long-term effects in our baseline results, we focus exclusively on the long-term (between) determinants of P2R. For easiness of comparability, we include the baseline results in column (1).

Table 3
Determinants of P2R: sensitivity analysis.

	Baseline model (1)	Z: less capitalized (2)	Z: largest banks (3)	Z: listed banks (4)
ROA	-0.185	-0.060	-0.067	0.137
ROA*Z		-1.054**	-1.065***	-0.652***
NPL ratio	0.066***	0.061***	0.075***	0.097***
NPL ratio*Z		-0.036	-0.001	-0.061***
Trading book	0.008	0.007	0.005	0.020**
Trading book*Z		0.009	-0.003	-0.040***
LACC news	0.003*	0.003*	0.007**	-0.004
LACC news*Z		-0.002	-0.007*	0.008**
Wholesale funding	0.008*	0.006	0.009**	0.005
Wholesale funding*Z		0.019*	-0.014**	-0.002
Board size	-0.016	-0.011	-0.027*	-0.023*
Board size*Z		0.022	0.019	0.045***
Board non-executives	-0.006*	-0.004	-0.006*	-0.007*
Board non-executives*Z		-0.006	0.011*	0.005
Board gender diversity	-0.005	-0.002	-0.003	-0.002
Board gender diversity*Z		0.011	-0.001	-0.013*
Observations	526	526	526	526
Banks (Z)	121	121 (30)	121 (30)	121 (45)
R-square (overall)	0.613	0.657	0.687	0.671
R-square (between)	0.673	0.706	0.736	0.736
R-square (within)	0.118	0.117	0.117	0.117
Between effects	88.70***	106.26***	126.72***	211.21***
Hausman test	8.48 (0.863)	9.13 (0.822)	10.01 (0.761)	5.57 (0.976)

Notes: The models are estimated using the Mundlak estimator (Mundlak, 1978) with country and year fixed effects and White-robust standard errors. The dependent variable is the P2R. Only the between parameters are presented. In column (1), we repeat the Table 1 coefficients. In columns (2) to (5), we present models with interaction terms (Z), which vary according to the estimated model (as identified at the top of each column). Specifically, in column (2), 'Less capitalized' the Z represents a dummy with value 1 if the bank is in the lowest quartile of the total capital ratio in our sample; in column (3), 'Largest banks' the Z represents a dummy with value 1 if the bank is in the highest quartile of bank size; in column (4), the Z represents dummies for listed banks. ***, ** and * indicate significance at 1%, 5% and 10%, respectively. We also perform the test for the joint significance of the between effects. The null hypothesis of the Hausman test is that RE estimation is consistent, therefore, preferable to fixed effects. The p-value is reported in brackets.

Ratnovski, 2011). Finally, we also uncover several governance-related differential P2R determinants: on the one hand, we find that board size and the share of non-executive board members are significant determinants of P2R of unlisted banks; on the other hand, the gender diversity of the board is related to a lower P2R for listed banks (Owen and Temesvary, 2018; Fan et al., 2019) – which may be equated with a supervisory judgement on the different maturity stages of board governance of listed and unlisted banks.

Table 4 shows our robustness checks. First, we re-estimate the baseline model using the between and within estimators, respectively. This analysis shows consistency in the results *vis-à-vis* the Mundlak estimator, while also providing evidence of the superiority of our baseline approach, as given by the higher R^2 in our baseline regressions. Second, we re-estimate the baseline model changing the regressors related to business model and profitability (Net interest margin) and credit risk (Loan loss reserves to total assets). Third, and final, we exclude the 2021 P2R decision as this reflects the 2020 year-end financial statements of banks, which already reflect the impact of Covid. All the robustness checks confirm the signs and significance of the baseline regressions.

4. Conclusions

Our results suggest that the bank-specific capital requirements (P2R) of European banks directly supervised by the ECB (2016–2021) differ significantly in the long and short-run: while in the long-run the P2R is mostly attributed to credit risk, funding risk and governance factors, in the short run the P2R is determined mostly by profitability and market risk issues. Moreover, our results show considerable differences in the long-run determinants of P2R according to the level of capital, size, and access to market funding. Such findings are expected to contribute to bank managers' knowledge of the short and long-run drivers of (costly) capital requirements and provide evidence of proportionality in the supervisor's approach. Two avenues for future research are envisioned: (i) the extension of the analysis of P2R determinants to Less Significant Institutions (LSIs), which are supervised by Euro Area national supervisors, in particular regarding the potential existence of differences in the P2R determinants between LSIs and SIs, and (ii) the extension of the literature on the consequences of the P2R decision, namely in what concerns bank competition.

CRedit authorship contribution statement

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Table 4
Robustness checks.

	Between estimator (1)	Within estimator (2)	Alternative regressors (3)	Pre-covid period (4)
ROA	-0.107	-0.104**		-0.168
Net interest margin			-0.017	
NPL ratio	0.076***	0.010		0.069***
Loan loss reserves			0.185***	
Trading book	0.009	0.012**	0.010	0.012
LACC news	0.003*	0.000	0.003*	0.003
Wholesale funding	0.010**	0.003	0.009**	0.009*
Board size	-0.017	0.010	-0.009	-0.019
Board non-executives	-0.007*	-0.001	-0.008**	-0.007*
Board gender diversity	-0.004	0.001	-0.005	-0.003
Total assets	-0.208***	0.128	-0.195***	-0.196***
Observations	526	526	526	416
Banks (Z)	121	121	121	116
R-square (overall)	0.358	0.028	0.558	0.627
R-square (between)	0.687	0.045	0.634	0.661
R-square (within)	0.011	0.118	0.104	0.135
Between effects			70.37***	70.37***
Hausman test			9.06 (0.827)	1.39 (1.000)

Notes: In columns (1) and (2) we re-estimate the baseline model using the between and within estimators, respectively. In column (3) we re-estimate the baseline model changing the regressors related to business model and profitability (Net interest margin is calculated as Net interest income divided by total assets) and credit risk (Loan loss reserves divided by total assets). In column (4) we exclude P2R decisions that report to post-Covid financial statements (namely, we exclude the 2021 P2R, as these decisions were made using 2020 year end data, i.e., data which reflects the Covid pandemic period). For brevity reasons, we only report the between dimension in regressions (3) and (4). ***, ** and * indicate significance at 1%, 5% and 10%, respectively. We perform the test for the joint significance of the between effects. The null hypothesis of the Hausman test is that RE estimation is consistent, therefore, preferable to fixed effects. The p-value is reported in brackets.

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