Credit Portfolio Modelling and its Effect on Capital Requirements

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Relevance of credit portfolio models

- Credit risk management in banks has become ever more advanced in recent times: rating systems, credit derivatives and credit portfolio models (CPM)
- According to Bangia et al. (2002) not suprising that the financial industry more heavily applies CPM, given increased availability of credit risk transfer instruments
- The crisis revealed that banks relied heavily on portfolio models, induced many of them to overlook signs of trouble (Rodgers, 2011; Hatzius, 2008)
- Overreliance on models and fundamental failures of the risk control system lead bankers in a false sense of security (Lang and Jagtiani, 2010)

The regulator's recommendation

- BCBS (1999) acknowledges that CPM can generate more accurate evaluations of capital adequacy
- However, according to BCBS (2009) caution should be exercised when determining the capital requirement

Purposes of CPM implementation

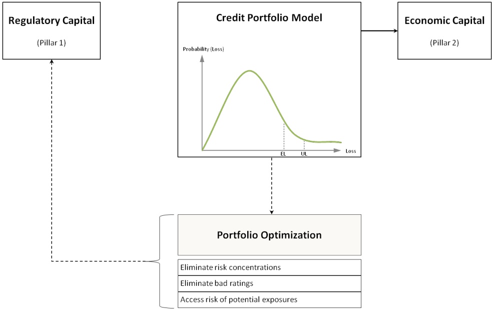
- Calculate economic capital
- Break down aggregate risk distribution of their portfolio, gain knowledge on credit risk distribution of each element, identify credit risk concentrations in portfolio
- Analyze porfolio changes that are caused by underlying macroeconomic factors that do not translate in the respective rating of the exposure

CPM regulation in Pillar II of the Basel II framework

- Pillar II designed to evaluate the risk assessment procedures of banks by focusing on the extent to which industry best practices are embedded in the strategic decisions of banks
- Pillar II guidelines are to enable the regulator to evaluate the adequacy of internal risk management and capital decision processes
- CPM to match credit risk of loan portfolio to a bank's specific risk appetite (which must be covered by capital)

Credit portfolio management

- Basel II rating based approach (Pillar I) eliminated frictions on individual exposure level
- Diversification incentives of banks remain on portfolio level (Jackson and Perraudin, 2000)



Objective

- In view of anticipated regulatory changes it is important to understand whether CPM-adopters determine their capital requirement in a manner that systematically differs from non-CPM-adopters
- Do banks that employ credit portfolio models adapt their capital requirement? In other words, we investigate whether decisions on total risk-based capital are channeled through CPM

Results

- Level total risk-based capital differs one year post the implementation and throughout the period
- Changes in total risk-based capital significantly differ for adopters and non-adopters one year post the implementation
- Minimum regulatory capital is not determined from the output of credit portfolio models, banks nevertheless use the information to adapt their total risk-based capital
- Banks seem to show more caution in interpreting value-at-risk models to set capital requirements

Related literature

Banks determine their target capital: Shrieves und Dahl, 1992; Diamond et al., 2000

- The buffer exceeds the regulatory minimum (capital buffer theory) (Ayuso et al., 2004; Barrios and Blanco, 2003; Milne and Walley, 2001)
- Risk weighted assets, regulatory pressure, size serve as determinants (see for example Shim, 2010; Repullo, 2004; Rime, 1998; Ediz et al.,1998)

Duellmann (2006): Business sector concentration can substantially increase economic capital

- BCB (2004): Credit risk concentration was cited in nine out of 13 bank failures in mature economies
- The Joint Forum (2008): Most banks manage credit risk concentration through the use of internal risk limits

Contribution to the literature

- Study expands prior work in analyzing whether banks that adopt CPM significantly and systematically differ from banks that have not implemented CPM with regard to total risk-based capital
- Our study explores whether CPMs serve as a determinant to banks to assess their capital

Outline

For our analysis we merged three data sets

- Survey data: 438 savings banks contacted in 2009; 279 completed questionnaires (response rate over 60%); 249 used for analysis
- Banks' balance sheet and income statement data on a detailed level, unique dataset provided by the German Savings Banks Association
- Regional economic data provided by the Statistical States Offices

To achieve comparability we set up a laboratory environment

- Same regulatory environment and common business model
- Same cost of accessing risk management tools
- Business only within regional defined areas
- Economically independent institutions

Sample Overview - Usage of CPM

- Sample Period: 2003-2006
- Exclude effects that are attributed to the recent financial crisis
- Survey question 1: “How intensively does your bank use the credit portfolio model ”CreditPortfolioView (CPV)” to analyze credit portfolio risk?”
- Survey question 2: “How intensively does your bank use other credit portfolio models to analyze credit portfolio risk?”

	Frequent use	**Occasional Use**	**No Use**
CPM (CPV)	87	51	111
CPM (other than CPV)	20	41	188
Employment of two Models	7	6	75

Comparison of means: statistically significant differences

	mean/sd	mean/sd	Difference	p-values
Panel A: Regulatory Ratios: 2003-2006				
Tier 1 (Level)	0.0821	0.0846	0.0025**	0.0477
	(0.0007)	(0.0010)		
Panel B: Regulatory Ratios: 2003				
Tier 1 & 2 (Change)	0.0036	0.0019	-0.0017**	0.0469
	(0.0004)	(0.0008)		
Tier 1 (Change)	0.0020	0.0014	-0.0010*	0.0868
	(0.0003)	(0.0005)		

OLS level estimation

Variable	Tier 1 & 2 (Level) 2003	Tier 1 & 2 (Level) 2003-2006
CPM	0.0045**	0.0040**
	(0.0021)	(0.0020)

OLS change estimation

Variable	Tier 1 & 2 (Change) 2003	Tier 1 & 2 (Change) 2003-2006
CPM	0.0009	0.0019**
	(0.0006)	(0.0010)

Identification strategy: average treatment effect

Banks' employment of CPM is unlikely to be exogeneous

- Need to recognize potential selection
- Need to determine what would have occured if CPM-users had not employed the model

$$ATT = E(\Delta y^1_{i,t+1}|CPM = 1) - E(\Delta y^0_{i,t+1}|CPM = 1)$$

- $E(\Delta y^1_{i,t+1}|CPM = 1)$ represents the expected value of the change in total risk-based capital of bank i at time $t + 1$: identified CPM-users' observed average effect
- $E(\Delta y^0_{i,t+1}|CPM = 1)$ represents the hypothetical effect of these banks on the total risk-based capital at time $t + 1$ if they had not initially employed these models: unobservability of this effect central problem of causal inference (Holland, 1986)
- There exists no direct estiamte of the counterfactual mean in non-experimental studies

Identification strategy: quasi-experiments

- Quasi-experiment to identify causal effect

$$ATT = E(\Delta y^1_{i,t+1}|CPM = 1, X_{i,t-1}) - E(\Delta y^0_{i,t+1}|CPM = 0, X_{i,t-1})$$

- $E(\Delta y^1_{i,t+1}|CPM = 1, X_{i,t-1})$ is the mean change in the total risk-based capital ratios of the banks in time $t + 1$ after employing credit portfolio models at time t, $E(\Delta y^0_{i,t+1}|CPM = 0, X_{i,t-1})$ for the control group
- $X_{i,t-1}$ is a vector that contains the observable covariates that select banks into using credit portfolio models or that may influence the capital decisions of the banks

- Propensity matching (Rosenbaum and Rubin, 1983) to reduce selection and match heterogeneous banks
- Average treatment effect becomes:

$$ATT = E(\Delta y^1_{i,t+1}|CPM = 1,\ p(X_{i,t-1})) - E(\Delta y^0_{i,t+1}|CPM = 0,\ p(X_{i,t-1}))$$

Identification strategy: empirical model

$$CPM_{it} = beta_0 + \beta_1 Risk_{it-1} + \beta_2 TA_{it-1} + \beta_3 MERG_{it-1} + \beta_4 East_{it} + \beta_5 REG_{it-1} +$$

$$\beta_6 EQU_{it-1} + \beta_7 NPL_{it-1} + \beta_8 CORP_{it-1} + \beta_9 DL_{it-1} + \beta_{10} ROA_{it-1} + \sum_{j=1}^{J} \gamma_j x_{ji,t-1} + \epsilon_i$$

- CPM_{it} = Credit portfolio model
- EQU_{it-1} = Balance sheet equity, to represent a bank's capacity to absorb losses: one component of regulatory capital, amount of Tier 2 capital bounded by balance sheet equity
- $\sum_{j=1}^{J} \gamma_j x_{ji}$ = Sector concentration, Competition, GDP

Robustness

- To alleviate multicollinearity concerns: tested different model specifications
- Examination of variance inflation factors: values below 10 (Neter, 1985)

Results: total risk-based capital (level)

Nearest neighbor matching

	2003		**2003-2006**	
	Panel A: Nearest Neighbor Matching ($NN = 1$, caliper 1, replacement)			
BS 300	0.00593	1.95	0.00687	2.76
	(0.00304)		(0.00249)	
	Panel B: Nearest Neighbor Matching ($NN = 3$, caliper 1, replacement)			
BS 300	0.00479	2.09	0.00596	2.51
	(0.00229)		(0.00237)	

Kernel matching

	2003		**2003-2006**	
	Panel C: Kernel Matching (Gaussian normal) $bandwith = 0.06$			
BS 300	0.00593	2.25	0.00740	3.54
	(0.00264)		(0.00209)	
	Panel D: Kernel Matching (Gaussian normal) $bandwith = 0.4$			
BS 300	0.00593	2.08	0.00740	2.95
	(0.00285)		(0.00251)	
	Panel E: Kernel Matching (Gaussian normal) $bandwith = 0.7$			
BS 300	0.00593	2.25	0.00740	3.08
	(0.00264)		(0.00240)	

Results: total risk-based capital (change)

Nearest neighbor matching

	2003		2003-2006	
	Panel A: Nearest Neighbor Matching ($NN = 1$, caliper 1, replacement)			
BS 300	0.00272	2.03	0.00189	0.97
	(0.00134)		(0.00210)	
	Panel B: Nearest Neighbor Matching ($NN = 3$, caliper 1, replacement)			
BS 300	0.00260	2.23	0.00296	1.07
	(0.00117)		(0.00276)	

Kernel matching

	2003		2003-2006	
	Panel C: Kernel Matching (Gaussian normal) $bandwith = 0.06$			
BS 300	0.00264	2.09	0.00252	1.28
	(0.00126)		(0.00197)	
	Panel D: Kernel Matching (Gaussian normal) $bandwith = 0.4$			
BS 300	0.00264	2.08	0.00252	1.25
	(0.00127)		(0.00201)	
	Panel E: Kernel Matching (Gaussian normal) $bandwith = 0.7$			
BS 300	0.00264	1.68	0.00252	1.22
	(0.00157)		(0.00205)	

Economic significance: is the effect noteworthy?

- Coefficients approximately range around 0.5%
- The economic significance of these coefficients is noteworthy when compared with the average levels of capital, which are approximately 11%

External validity: can the results be generalized?

- During last 20 years banks throughout the world have extensively used credit risk instruments, whereas others have not (Cebenoyan and Strahan, 2004)
- Banks in our sample adjust capital upwards and therefore seem to act upon economic judgement rather than regulatory pressure
- Channel effect of CPM can be generalized; however, the direction and magnitude of the effect may be unique driven by particular business model of individual bank