Basel Committee
on Banking Supervision

BIS

Bank capital and balance sheet management during times of distress: international evidence

Samuel Da Rocha Lopes, Daniel Foos, Aaron Janowski, Stefan W Schmitz, Mariana Tomova and Julieta Yung

Agenda

- Introduction
- Literature review
- Methodological approach
- Estimating banks' target capital-asset ratios with a partial adjustment model
- What determines management action on capital? (Single-equation approach)
- The endogeneity of management action on capital and RWA growth (simultaneous-equations approach)
- Summary and conclusions

- Backup Slides

Introduction

Motivation

- Empirical literature on the relationship between bank capital regulation/constraints and bank asset growth yields inconclusive results. Results depend on assumption:

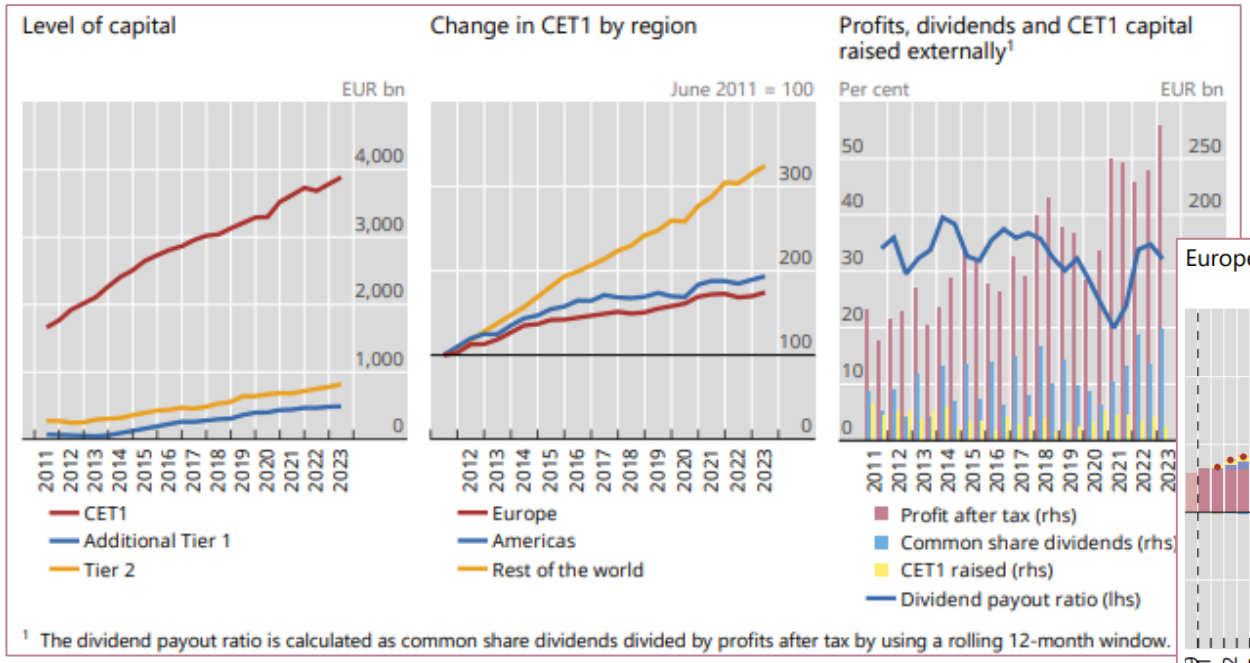
Capital endogenous (Opportunity cost approach) – lower social costs

Capital exogenous (Quantity-based approach) – higher social costs

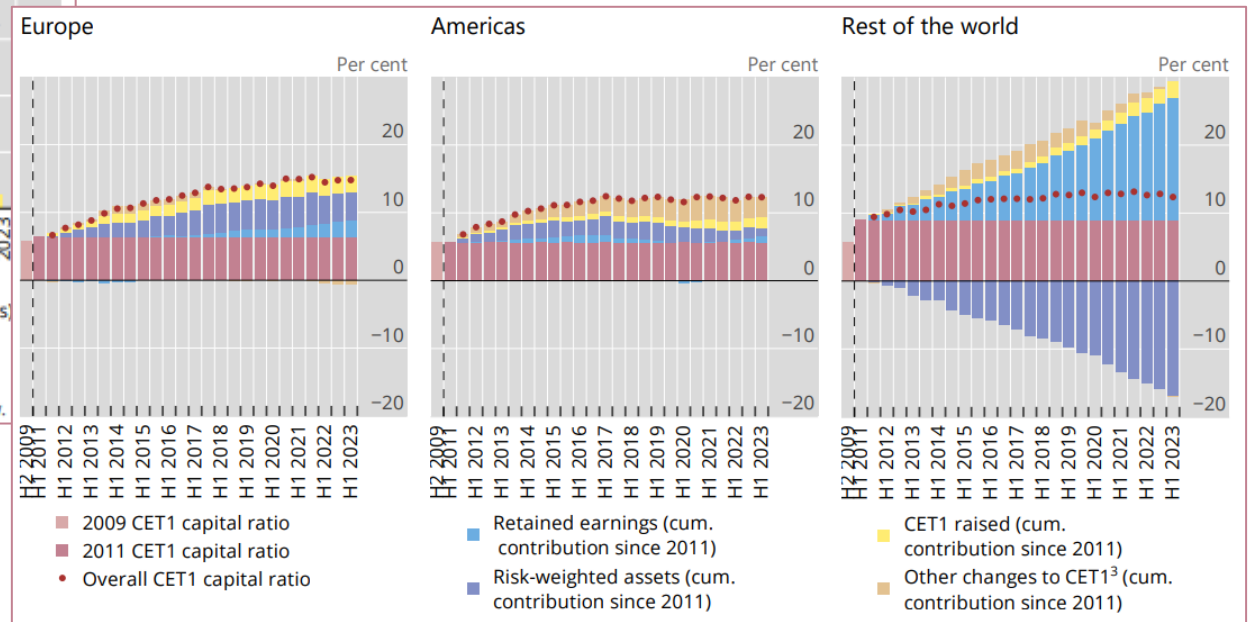
$$\Delta LoanSpread \leq \Delta WACC \geq \Delta CapitalConstraint \times \frac{\left(RoE_{target} - (1 - tax) \times \left[r_{DLT,MM} \times s_{LT} + r_{DST,MM} \times (1 - s_{LT})\right]\right)}{(1 - tax)}$$

$$\Delta LogAssets_{s,i,t} = f(CapitalConstraint_{i,t-1}, BankControls_{i,t}, MacroControls_t, \varepsilon_t)$$

Motivation: CET1 capital increased from 2011 to 2023 driven by payout policies, CET1 issuances, and unexplained "other" changes in CET1



[1] The dividend payout ratio is calculated as common share dividends divided by profits after tax by using a rolling 12-month window.



[1] The graph shows the fully phased-in initial Basel III framework for the data points up to and including the end of 2018 and the actual framework in place at the reporting date for all data points thereafter. [2] Except the ratio for H2 2009, which is based on the different sample of the Committee's comprehensive Quantitative Impact Study and therefore not fully comparable. [3] Other changes include changes in regulatory adjustments to CET1 capital and any other changes in CET1 capital between two reporting dates that are not reported separately.

Source: BCBS (2024): Basel III Monitoring Report.

Research questions

We examine the composition of banks' assets and liabilities. Specifically, we consider the general research question *How do banks manage their capital and what effects does this have on their their asset and liability structure?* More specifically:

- Do banks that plan to grow their balance sheets raise capital to achieve that growth objective (capital is endogenous) in the short run? Or is banks' balance sheet growth constrained in the short run by a given capitalization (capital exogenous)?
- How do banks manage their balance sheets to adjust their CET1 ratios towards their estimated targets in the short run?
- How can the short-run endogeneity of capital be captured in a tractable, econometric model of bank balance sheet management?
- What relevant lessons can be learnt from the literature on bank capital management and balance-sheet management?

➢ Potential implications for policy, supervisors, and for ex-post impact assessments

Literature review

Bringing together three strands of literatures shows capital is endogenous also in the short-run under distress

- Supervisory requirements regarding banks' capital management
  - Supervisors require banks to manage capital in an active, forward-looking manner under business as usual and under stress and to have capital plans in place that contain management action for capital under stress.
- Banks' capital management in practice
  - Banks are broadly compliant with these requirements.
  - Banks' adjustment to deviations from capital plans under stress takes place via a broad set of options, with changes of capital contributing most to the adjustment.
- Empirics of bank capital management
  - Banks actively adjust capital by capital increases, retained earnings and several other measures (such as asset sales, risk weight optimization, NPL reduction & other management actions on capital) also under stress.

- Our methodological approach builds on these findings

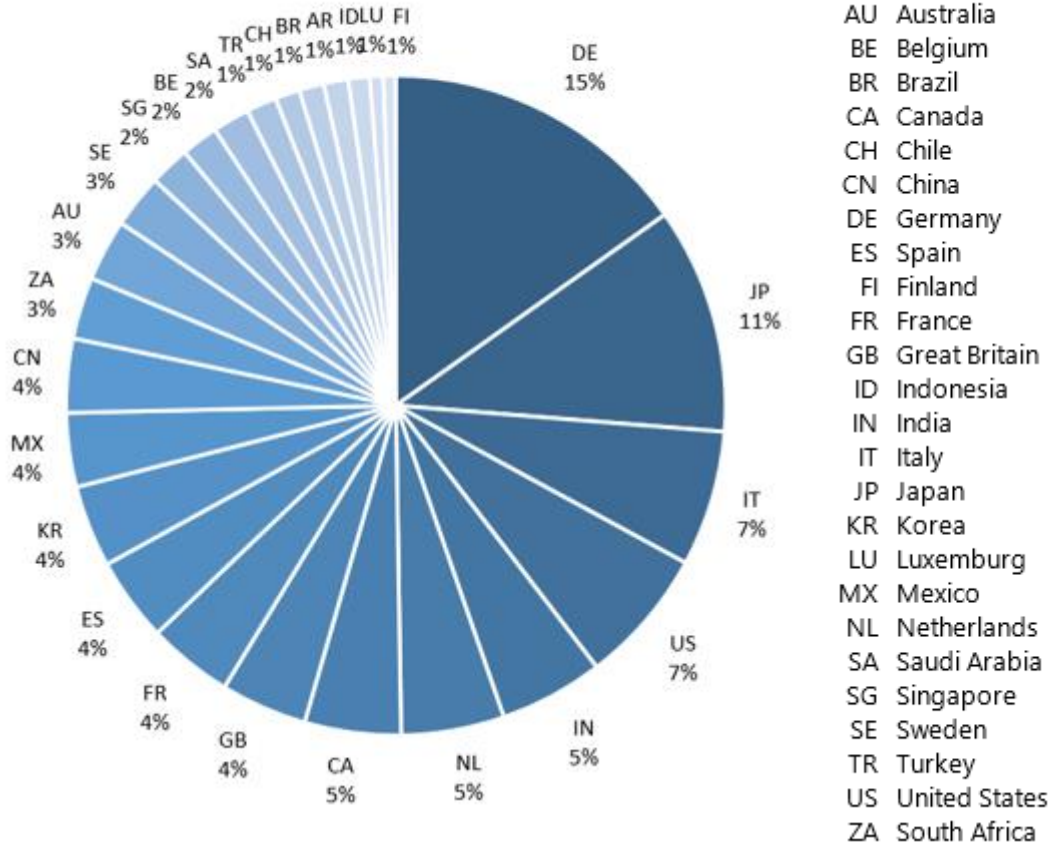
Methodological approach

Hypotheses and general methodological approach

- **Hypotheses**
  - (1) Active adjustment of banks' CET1 capital in the current period *t* by management, also under distress in period *t*;
  - (2) Higher asset growth by banks that want/can growth their assets more in period *t*
  - (3) Higher CET1 capital growth by banks that are more capital constrained at the beginning of period *t*
- **Methodological approach**
  - (1) Estimate banks' CET1 constraints in each period
    - using a partial adjustment model of bank internal target capital ratios
    - based on unique QIS data set
    - taking into account the current national capital definitions and the full implementation definition
  - (2) Employ these estimates in testing the three hypotheses
    - using a model of simultaneous equations for capital and balance sheet items
    - taking into account internal capital targets and Management Action on Capital

Sample composition and descriptive statistics

- Source: Quantitative Impact Study (https://www.bis.org/bcbs/qis/)
- Semi-annual data, 2014-2019
- 1,644 observations from 172 banks
  - Geographical coverage: 27 jurisdictions
  - Business model: 62% retail/commercial banking, 33% investment banking
  - Legal form: 84% joint stock companies (40% of them with publicly traded equity)
- Winsorise outliers, remove banks < 3 yrs of consecutive reporting, interpolate missing observations



Sample composition of global banks in the sample

Estimating banks' target capital-asset ratios with a partial adjustment model

The partial adjustment model - Overview

1. **We estimate banks' target capital-asset ratios with a partial adjustment model**
   - Approach based on Berger et al. (2008), De Jonghe and Oztekin (2015), de-Ramon et al. (2022)
   - Targets are based on
     - bank-specific characteristics (proxies for size, liquidity, profits, model complexity, impact)
     - country-specific characteristics (real GDP, inflation)
     - anticipation of Basel III changes to capital requirements [specific contribution of this project]
   - Use system GMM for estimation (Blundell and Bond, 1998)
     - Control for financial conditions, small-sample and finite-sample bias, time fixed-effects, test for overidentification and serial correlation in residuals
     - Test for robustness of sample-selection choices and different model variants

2. **We calculate deviations of reported capital ratios from target ratios using our estimates**

Partial adjustment model - setup

- The evolution of a bank's capital ratio over time is a dynamic process
  - depending on the management's target variable k*
  - influenced by other bank-specific factors (idiosyncratic shocks to banks' capital as strategies chosen by banks' management) and
  - time-specific factors (eg changes in the regulatory and supervisory environment, macroeconomic factors).
- We apply a partial adjustment model to map this process econometrically

$$k_{b,c,t} = \lambda\, \hat{k}^{*}_{b,c,t} + (1-\lambda)\; k_{b,c,t-1} + \epsilon_{b,c,t}$$

  - $k_{b,c,t}$: actual capital ratio of bank *b* in country *c* at time *t* [$k_{b,c,t-1}$: in previous time *t*–1]
  - $\hat{k}^{*}_{b,c,t}$: bank- and time-specific target capital ratio [unobservable, to be estimated]

Partial adjustment model – econometric implementation

$$k_{b,c,t} = \lambda \sum_{n=1}^{N} \zeta_n x_{n,b,c,t-1} + (1-\lambda) k_{b,c,t-1} + v_{b,c,t}.$$

- $x_{n,b,c,t-1}$: bank-specific characteristics / macroeconomic controls, weighted by parameters ζ_n
- $(1-\lambda)$: stickiness of capital in one-period process, λ: adjustment speed towards the target
- $v_{b,c,t} = \varphi_b + \epsilon_{b,c,t}$ is a composition of
  - bank-specific fixed effects (φ_b)
  - and idiosyncratic, serially uncorrelated shocks $(\epsilon_{b,c,t})$.
- Two-Step System GMM estimator (Blundell and Bond, 1998) as the previous capital ratio $k_{b,c,t-1}$ is an endogenous regressor, applying Windmeijer's (2005) finite-sample correction

Partial adjustment model – estimation of target capital ratios

- The Stata output is used to determine the stickiness of bank capital, ie the dependency between capital ratios and their lagged values $(1-\lambda)$, and the adjustment speed λ.
  - Individual banks' fixed effects (φ_b) must be recovered from the disturbance term $(v_{b,c,t})$
  - Detailed description of this procedure documented in Appendix A2.2 of our report
- Derive estimates of target capital ratios $\hat{k}^*_{b,c,t}$ from the essential partial adjustment model
- Percentage capital ratio deviations from their target (de-Ramon, Francis and Harris, 2022):

$$\hat{Z}_{b,c,t} = 100 \times \left[\left(\frac{k_{b,c,t}}{\hat{k}^*_{b,c,t}}\right) - 1\right]$$

$\hat{Z}_{b,c,t} > 0$: capital ratio surplus from the target, $\hat{Z}_{b,c,t} < 0$: capital ratio shortage from target

Partial adjustment model:
2-step system GMM regressions for the dependent variable: reported CET1 ratio

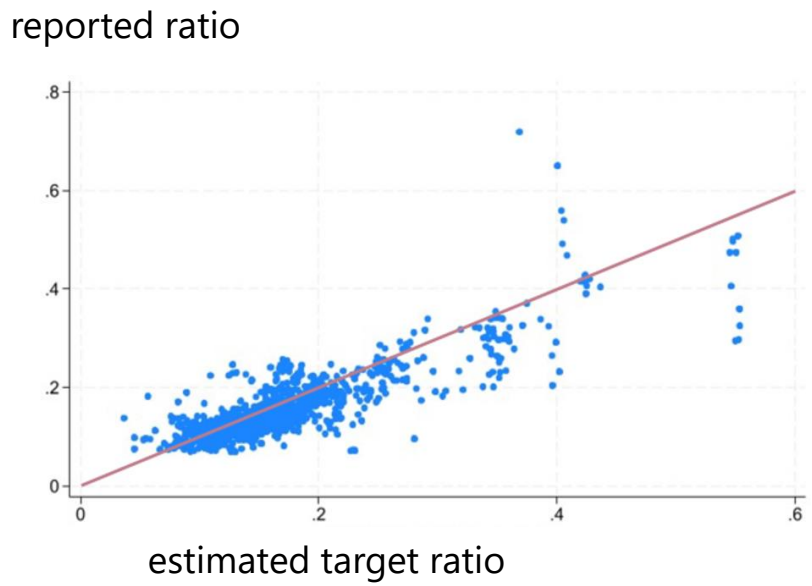
	(1)	(2)	(3)	(4)
t-1: reported CET1 ratio	0.857***	0.822***	0.926***	0.917***
	(0.105)	(0.134)	(0.210)	(0.171)
t-1: Basel III reform gap	-0.178***	-0.172***	-0.189***	-0.188***
	(0.055)	(0.056)	(0.059)	(0.067)
t-1: log of assets	-0.001**	-0.001*	-0.000	-0.000*
	(0.000)	(0.001)	(0.000)	(0.000)
t-1: log of LCR	0.002	0.002	0.001	0.002
	(0.003)	(0.003)	(0.003)	(0.002)
t-1: net income to assets	-0.052	0.177	-0.134	-0.134
	(0.189)	(0.407)	(0.290)	(0.334)
t-1: trading book to assets	-0.012	-0.013	-0.008	-0.008
	(0.008)	(0.008)	(0.017)	(0.017)
t-1: lending to assets	-0.014	-0.013*	-0.008	-0.009
	(0.009)	(0.007)	(0.022)	(0.017)
t-1: risk density		-0.014		
		(0.016)		
t-1: log of HP-filtered real GDP	-0.002	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.003)	(0.003)
t-1: inflation	-0.066*	-0.051**	-0.036	-0.052***
	(0.036)	(0.022)	(0.082)	(0.017)
t-1: change in log of market cap.				-0.001
				(0.003)
t-1: log of sov. CDS spread (5Y)				0.000
				(0.004)
Time Fixed Effects (semi-annual)	No	No	Yes	No
Observations	1,644	1,644	1,644	1,592
Number of banks	172	172	172	168
Number of instruments	11	12	21	13
AR1	0.000	0.000	0.000	0.000
AR2	0.362	0.358	0.292	0.313
Hansen	0.496	0.538	0.617	0.556

Partial adjustment model:
Robustness checks for the dependent variable: reported CET1 ratio

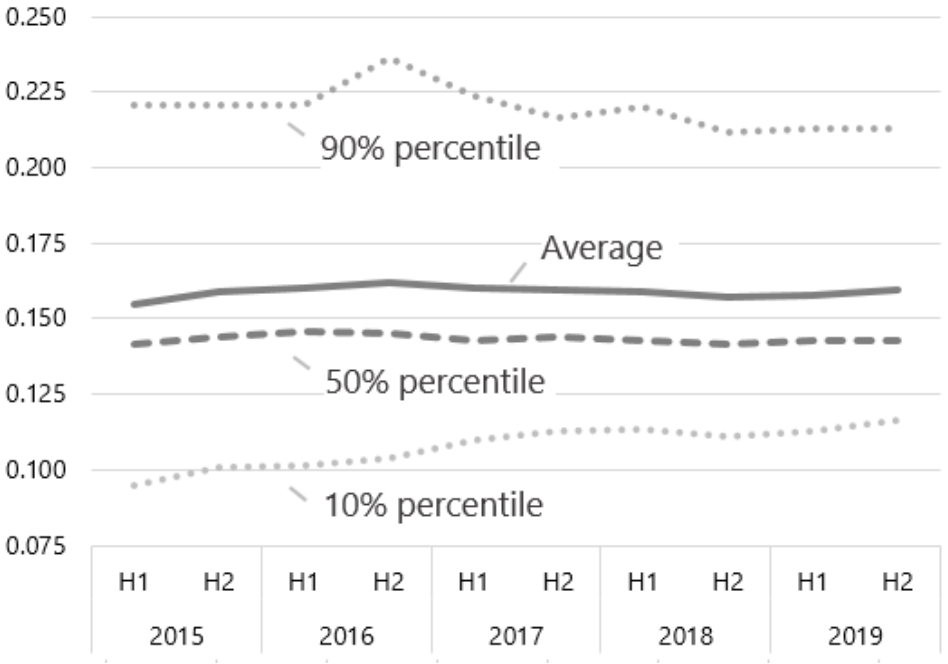
	(1)	(2)	(3)	(4)	(5)
	region: EUR	region: RoW	full sample	no interpolation	data extension
t-1: reported CET1 ratio	0.896***	0.708***	0.886***	0.851***	0.703***
	(0.130)	(0.090)	(0.156)	(0.074)	(0.076)
t-1: Basel III reform gap	-0.307***	-0.098	-0.113***	-0.307***	-0.205***
	(0.068)	(0.066)	(0.041)	(0.063)	(0.060)
t-1: log of assets	-0.000	-0.000	-0.001**	-0.001	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
t-1: log of LCR	-0.001	0.010***	0.002	0.004	0.007**
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
t-1: net income to assets	-0.371	0.556**	0.008	-0.108	0.274*
	(0.252)	(0.239)	(0.259)	(0.158)	(0.165)
t-1: trading book to assets	-0.030	0.005	-0.009	-0.006	-0.015**
	(0.024)	(0.005)	(0.011)	(0.006)	(0.006)
t-1: lending to assets	-0.017	-0.009	-0.010	-0.006	-0.020***
	(0.017)	(0.006)	(0.013)	(0.005)	(0.007)
t-1: log of HP-filtered real GDP	-0.000	-0.001	-0.001	-0.001	-0.003***
	(0.003)	(0.001)	(0.002)	(0.001)	(0.001)
t-1: inflation	-0.064**	-0.068*	-0.059	-0.031	-0.107***
	(0.032)	(0.041)	(0.051)	(0.036)	(0.024)
Observations	782	862	1,776	1,342	2,370
Number of banks	84	88	214	172	179
Number of instruments	11	11	11	11	11
AR1	0.000	0.000	0.000	0.000	0.000
AR2	0.893	0.0495	0.297	0.456	0.287
Hansen	0.619	0.954	0.546	0.617	0.0695

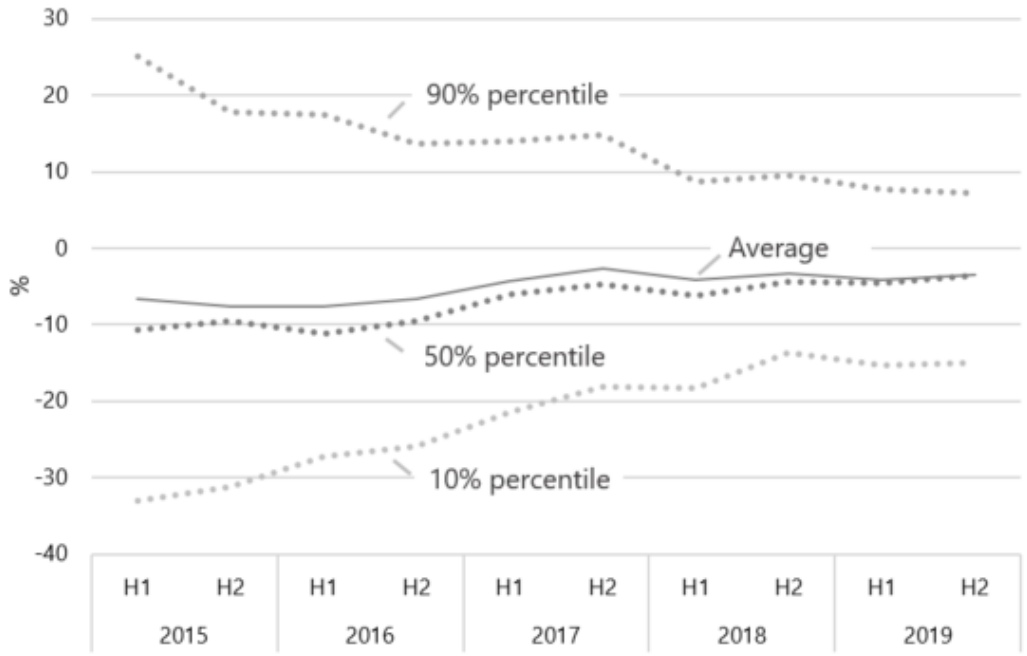
The partial adjustment model – Results

- Banks' annual speed of adjustment towards target is ~25%.
- When reported ratios are higher than under the Basel III fully loaded rules, banks lower their capital-asset ratios in the future at an average pass-through rate of 18% per semester.
- Banks which operate above their estimated capital target are on average larger, less liquid, more profitable, have higher trading activity and risk density, experience higher loan growth, and are headquartered in a country experiencing GDP growth and inflation.
- Results are robust to sample choices, time fixed effects, alternative data choices, adjustments for statistical bias.
- Banks are on average below their target capital-asset ratios.
- Larger banks have on average lower targets than the full sample.



Distribution of estimated capital targets (left) and distribution of deviation of reported capital ratio from target ratio in % (right)



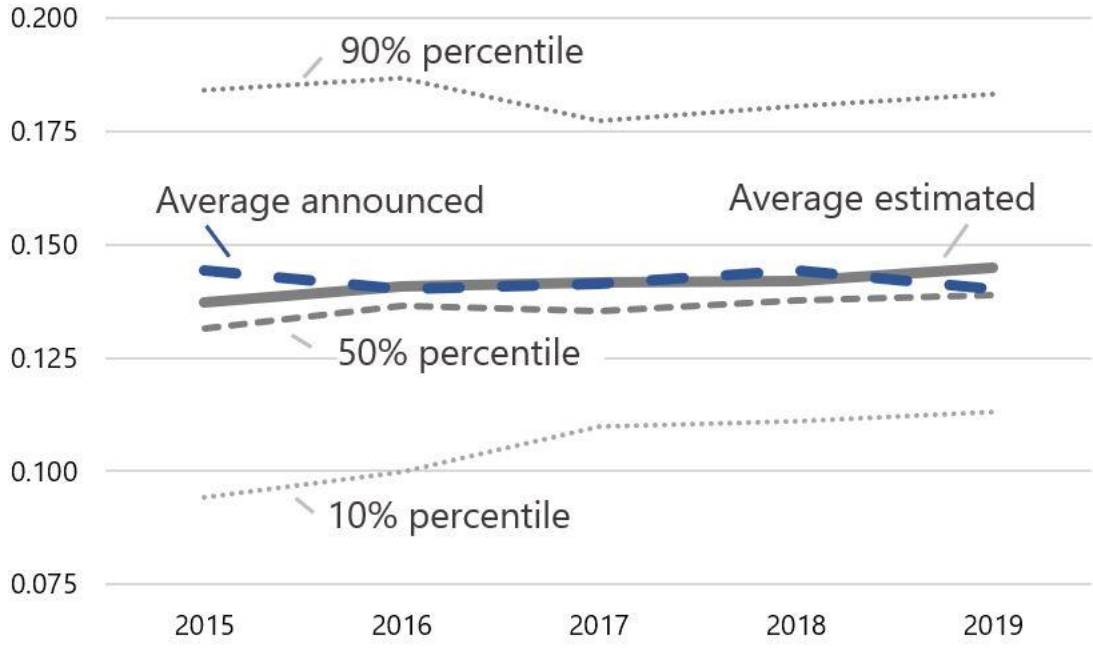


reported capital-asset ratios

Variable	N	Mean	SD	p5	p50	p95
CET1 target ratio	1,644	0.159	0.0652	0.0963	0.143	0.282
Deviation of reported capital ratio from target ratio in %	1,644	-4.771	20.39	-29.88	-6.221	22.76
Deviation of reported capital from target in bn €	1,643	-1.605	6.081	-12.300	-0.3216	3.326

Benchmarking the estimated targets with reported data

- The graph compares the estimated and publicly announced target capital-asset ratios for Group 1 banks.
- The average "estimated targets" are estimated with the baseline partial adjustment model using QIS data.
- The "announced targets" are the average publicly reported targets for a sample of banks that publicly announce their target capital-asset ratios



What determines management action on capital? (Single-equation approach)

Measurement of management action on capital (MAC)

Increasingly comprehensive

Variable	Definition	Formula
MAC_retained_ earnings	Management action on retained earnings: Deviation from the "do nothing payout ratio" by at least ±20% of profits after tax (PaT)	*= PaT×(0.8×Payout_ratio_Mean - Payout_ratio) if Payout_ratio < 0.8 ×Payout_ratio_Mean* *= PaT×(1.2×Payout_ratio_Mean - Payout_ratio) if Payout_ratio > 1.2 ×Payout_ratio_Mean* *= 0 if PaT < 0* *= 0 if (Payout_ratio < 1.2 * Payout_ratio_Mean) & (Payout_ratio > 0.8 * Payout_ratio_Mean)*
MAC_1L	CET1 issued plus management action on retained earnings plus lagged management action on retained earnings	*= CET1_ISSUED + MAC_ret_earnings + L.MAC_ret_earnings*
MAC_2	CET1 issued plus net issuance of additional Tier 1 (AT1_NET_ISSUED) and gross issuance of Tier 2 (T2_ISSUED) plus management action on retained earnings	*= CET1_ISSUED + AT1_NET_ISSUED + T2_ISSUED + MAC_ret_earnings*
MAC_3	First difference of CET1 (D.CET1) adjusted for the passive component of retained earnings	*= D.CET1 - CET1_ret_earnings + MAC_ret_earnings if (D.CET1 > 0) or ((D.CET1 ≤ 0) & (PaT > 0))* *= D.CET1 - PaT if (D.CET1 ≤ 0) & (PaT ≤ 0) & (D.CET1 > PaT)*
CET1_D_unexpl	Unexplained component of ΔCET1 after accounting for retained earnings, capital issued (CET1_ISSUED), changes of AOCI (AOCI_D) and changes of the sum of regulatory adjustments (Reg_Adj_D)	*= D.CET1 - CET1_ret_earnings - CET1_ISSUED - AOCI_D + Reg_Adj_D*

MAC_3: comprehensive measurement captures capital dynamics better

Relative frequencies of shocks to several components of CET1 change: management action on capital, changes of AOCI (*ΔAOCI*), changes of regulatory adjustments *(ΔReg_Adj)* and changes of the unexplained component of increases of CET1 *(ΔCET1 unexplained)* versus bank distress (Frequencies in %)

	s_prof_neg	
	N	Y
MAC_1L	42%	***67%***
MAC_2	41%	***59%***
MAC_3	21%	***72%***
MAC Payout R (< 80% of mean)	*42%*	***85%***
MAC Payout R (> 120% of mean)	*24%*	***3%***
ΔAOCI↑	41%	***56%***
ΔReg_Adj↓	26%	21%
ΔCET1 unexplained↑	73%	***95%***

Measurement of periods of distress: severe distress consistent w/ stock prices and CDS spreads

Intensity	Calibration	Frequency
distress_prof_neg	*= 1 if PaT < -5 % of CET1* *= 0 otherwise*	2.2%
Distress_I_pct	*Distress_I = (PaT_D_pct - PaT_D_pct_Mean)/PaT_D_pct_Std* *Distress_I_pct = (Distress_I - Distress_I_max)/(Distress_I_min - Distress_I_max)*	
Distress_I_sqd_pct	*Distress_I_sqd = Distress_I×Distress_I×sign((PaT_D_pct - PaT_D_pct_Mean)/PaT_D_pct_StD)* *Distress_I_sqd_pct = (Distress_I_sqd - Distress_I_sqd_max)/(Distress_I_sqd_min - Distress_I_sqd_max)*	

Relative frequencies of periods of distress per bank when (1) a real GDP shock occurs in the period in the country in which the reporting bank is domiciled, (2) a stock price shock, and (3) a CDS spread shock occurs for the respective bank in the same period (Frequencies in %)

		GDP↓	stock price↓	CDS spread↑
s_prof_neg	N	15%	15%	13%
	Y	10%	***86%***	***31%***

The single-equation approach

$$MAC\_3\_CET1\_w_{b,t} = \gamma_{M,j} + \beta_{M,j} LOG\_BS\_w_{j,b,t} + \tau_{M1,j} L.Z\_w_{b,t} + \tau_{M2,j} RD\_D\_w_{b,t} + \tau_{M3,j} ROA\_w_{b,t} + \tau_{M4,j} s\_prof\_neg_{b,t} + \epsilon_{j,b,t}$$

Explain a bank's Management Action on Capital (MAC) by

(a) its potential capital constraints,

(b) the change in its risk density,

(c) its profitability,

(d) a bank-specific distress dummy and

(e) the respective balance sheet items on the asset side

in a single-equation regression model (specified in line with prior literature):

Twelve different balance sheet items

We consider the following balance sheet items:

(1) risk weighted assets (*LOG_RWA_D*),
(2) total accounting assets (*LOG_ASSETS_D*),
(3) lending to the non-financial sector (corporates, retail, and sovereigns) (*LOG_LENDING_NF_D*),
(4) lending to non-financial corporates (NFCs) (*LOG_NFC_D*),
(5) lending to the non-financial private sector (NFCs and retail lending) (*LOG_RETAILNFC_D*).
(6) other exposure (eg equity and other non-credit obligation assets) (*LOG_OthExp_D*),
(7) total leverage ratio exposures (*LOG_LRExp_D*),
(8) total trading book exposures (*LOG_TBExp_D*),
(9) sovereign exposure (*LOG_SovExp_D*),
(10) retail exposure (*LOG_RetExp_D*),
(11) corporate exposure (*LOG_CorpExp_D*), and
(12) risk weighted assets (*LOG_RWA_D*) w/o changes of risk density (*RD_D*)

Regression results for the determinants of management action on capital – dependent variable *MAC_3_CET1*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
L.Z_w	**-0.000959*** **	**-0.000928*** **	**-0.000798*** **	**-0.000756*** **	**-0.000746*** **	**-0.000818*** **	**-0.000777*** **	**-0.000878*** **	**-0.000796*** **	**-0.000775*** **	**-0.000749*** **	**-0.00103*** **
	(0.000129)	(0.000138)	(0.000174)	(0.000187)	(0.000184)	(0.000180)	(0.000168)	(0.000205)	(0.000174)	(0.000186)	(0.000170)	(0.000121)
RD_D_w	**-0.442*** **	**0.716*** **	**0.234** **	**0.211***	0.180	0.205	**0.310** **	0.162	**0.226***	**0.174***	0.183	
	(0.108)	(0.107)	(0.101)	(0.105)	(0.107)	(0.121)	(0.120)	(0.117)	(0.121)	(0.102)	(0.111)	
ROA_w	**-5.318*** **	**-5.627*** **	**-5.138*** **	**-4.172*** **	**-4.765*** **	**-4.124*** **	**-5.252*** **	**-3.103** **	**-4.879*** **	**-3.837*** **	**-4.819*** **	**-5.430*** **
	(1.210)	(1.115)	(1.400)	(1.226)	(1.266)	(1.410)	(1.404)	(1.245)	(1.366)	(1.348)	(1.252)	(1.174)
s_prof_neg	**0.0445** **	**0.0405** **	**0.0389** **	**0.0451*** **	**0.0420*** **	0.0321	**0.0402** **	**0.0425***	0.0313	**0.0418** **	**0.0412** **	**0.0409** **
	(0.0167)	(0.0166)	(0.0162)	(0.0143)	(0.0143)	(0.0240)	(0.0168)	(0.0224)	(0.0195)	(0.0172)	(0.0151)	(0.0163)
LOG_RWA_D_w	**0.633*** **											**0.553*** **
	(0.0600)											(0.0579)
LOG_ASSETS_D_w		**0.616*** **										
		(0.0759)										
LOG_LENDING_NF_D_w			**0.128*** **									
			(0.0359)									
LOG_NFC_D_w				**0.0449** **								
				(0.0200)								
LOG_RETAILNFC_D_w					**0.0954*** **							
					(0.0276)							
LOG_OthExp_D_w						**0.0174** **						
						(0.00824)						
LOG_LRExp_D_w							**0.269*** **					
							(0.0594)					
LOG_TBExp_D_w								0.00216				
								(0.00442)				
LOG_SovExp_D_w									0.0217			
									(0.0169)			
LOG_RetExp_D_w										**0.0871*** **		
										(0.0303)		
LOG_CorpExp_D_w											**0.0679*** **	
											(0.0199)	
Constant	-0.00315	-0.00137	0.00262	0.000183	0.00188	0.000470	0.00303	-0.00426	0.00346	-0.00147	0.00277	-0.00118
	(0.00483)	(0.00447)	(0.00516)	(0.00466)	(0.00481)	(0.00539)	(0.00548)	(0.00524)	(0.00510)	(0.00523)	(0.00473)	(0.00446)
Observations	1,272	1,272	1,259	1,227	1,250	1,234	1,263	985	1,250	1,180	1,259	1,272
Banks	158	158	158	155	157	157	158	127	157	149	158	158
Countries	26	26	26	26	26	26	26	26	26	26	26	26
Degree of freedom	24	24	24	24	24	24	24	24	24	24	24	24
r2 overall	0.408	0.388	0.167	0.129	0.148	0.119	0.210	0.119	0.120	0.145	0.141	0.384
r2 within	0.388	0.371	0.108	0.0785	0.100	0.0706	0.181	0.0537	0.0613	0.0923	0.0941	0.359
r2 between	0.453	0.439	0.487	0.411	0.407	0.344	0.202	0.338	0.364	0.360	0.353	0.472

Interpretation: capital is endogenous

Banks that face profitable growth opportunities actively raise capital/take management action on capital, although it is costly. MAC is higher for banks that

- are more capital constrained (*L.Z*)
  → Marginal shadow price of capital/hurdle rate is higher → if there are growth opportunities with returns > hurdle rate → cost of MAC pays off
  → If growth can be funded out of available CET1 → no need to accept cost of MAC
- increase risk density (*RD_D*)
  → Higher risk density implies tighter capital constraint at given CET1
- are less profitable (*ROA*)
  → higher profitability allows funding growth w/o MAC out of "normal" retained earnings
- grow at higher rate (*LOG_BS_D*)
  → Banks that face profitable growth opportunities → engage in higher MAC to fund it
  → Results more pronounced for comprehensive balance sheet items due to substitution within balance sheet

Robustness checks

(1) Alternative measure of capital constraint: *L_CET1r_RWA*

(2) Alternative measure of distress: *Distress_I_sqd_pct*

(3) Dependent variable: only management action in capital ≠ 0 – sample shrinks by ca. 1/3

(4) Subsamples: G1 / G2 and EU / RoW

(5) Alternative measures of management action on capital: *MAC_1L_CET1* and *MAC_2_CET1*

Results robust

Model has no explanatory value

The endogeneity of management action on capital and RWA growth (simultaneous-equations approach)

The simultaneous equations approach

Specification of Management Action on Capital (*MAC_3*) equation as in single equation approach

$$MAC\_3\_CET1\_w_{b,t} = \gamma_M + \beta_M LOG\_RWA\_D\_w_{b,t} + \tau_{M1} L.Z\_w_{b,t} + \tau_{M2} RD\_D\_w_{b,t} + \tau_{M3j} s\_prof\_neg_{b,t} + \tau_{M4} ROA\_w_{b,t} + \epsilon_{b,t}$$

For Balance Sheet Items equation consider *LOG_RWA_D,* regressed on

- Management Action on Capital: *MAC_3_CET1*
- Lagged RWA growth: *L.LOG_RWA_D*
- Potential capital constraints: *L.Z* or *L.CET1r_RWA*
- Distress: s_prof_neg or Distress_I_sqd
- Macroeconomic factors (real GDP growth: *RGDP_HP_D*, yield curve: *YC_SLOPE;* sovereign CDS: *CDS5Y_D*)
- Bank-specific control variables (Liquidity: *LCR*, Business model: *TRADINGBOOK_TA*;)

$$LOG\_RWA\_D\_w_{b,t} = \gamma_{BS} + \beta_{BS} MAC\_3\_CET1\_w_{b,t} + \tau_{BS1} L.LOG\_RWA\_D\_w_{b,t} + \tau_{BS2} L.Z\_w_{b,t} + \tau_{BS3} TRADINGBOOK\_TA\_w_{b,t} + \tau_{BS4} LCR\_w_{b,t} + \tau_{BS5} RGDP\_HP\_D_{c,t} + \tau_{BS6} YC\_SLOPE\_noi\_w_{c,t} + \tau_{BS7} CDS5Y\_D\_w_{c,t} + \theta_{b,t}$$

Results

VARIABLES	LOG_RWA_D	MAC_3_CET1	LOG_RWA_D	MAC_3_CET1	LOG_RWA_D	MAC_3_CET1
MAC_3_CET1	**0.674*** **		**0.558*** **		**0.465*** **	
	(0.0967)		(0.0908)		(0.0814)	
L.Z	**0.00116*** **	**-0.00133*** **	**0.00118*** **	**-0.00143*** **		
	(0.000126)	(0.000113)	(0.000130)	(0.000113)		
L.LOG_RWA_D	0.000849		0.00155		0.0427**	
	(0.0152)		(0.0175)		(0.0205)	
RGDP_HP_D	0.0647		-0.0599		0.149	
	(0.149)		(0.167)		(0.194)	
TRADINGBOOK_TA	-0.0139		**-0.0230** **		**-0.0256** **	
	(0.00928)		(0.0104)		(0.0111)	
LCR	-0.000804		-0.000973		-0.00311***	
	(0.000886)		(0.000872)		(0.00107)	
CDS5Y_D	**-0.000180** **		**-0.000250*** **		**-0.000394*** **	
	(8.21e-05)		(7.94e-05)		(8.87e-05)	
YC_SLOPE	-0.234		**-0.435** **		**-0.440** **	
	(0.200)		(0.199)		(0.176)	
LOG_RWA_D		**1.040*** **		**0.960*** **		**0.704*** **
		(0.104)		(0.106)		(0.105)
RD_D		-0.116		-0.0647		0.0971
		(0.135)		(0.139)		(0.138)
ROA		**-2.781*** **		**-3.102*** **		**-5.004*** **
		(0.564)		(0.562)		(0.612)
Distress_I_sqd_pct		-0.0103				
		(0.0188)				
s_prof_neg				**0.0254** **		0.0107
				(0.0107)		(0.0125)
L.CET1r_RWA					**0.257*** **	**-0.289*** **
					(0.0509)	(0.0444)
Constant	0.0229***	-0.0108	0.0243***	-0.0137***	-0.0140*	0.0426***
	(0.00345)	(0.00992)	(0.00361)	(0.00275)	(0.00755)	(0.00674)
Observations	965	965	996	996	1,105	1,105
R-squared	0.348	0.215	0.339	0.273	0.305	0.338
Small-sample statistics	Yes	Yes	Yes	Yes	Yes	Yes
Banks	128	128	129	129	129	129
Countries	16	16	16	16	16	16
F statistic (eq1)	29.59		26.90		20.87	
F statistic (eq2)		142.2		115.7		75.29
Log likelihood	3898	3898	3582	3582	3467	3467
Parameters	15	15	15	15	15	15
Degrees of freedom	1915	1915	1977	1977	2195	2195

Robustness checks

(1) Alternative measure of capital constraint: *L.CET1r_RWA*

(2) Alternative measure of distress: *Distress_I_sqd_pct*

(3) Dependent variable: only management action in capital ≠ 0 – sample shrinks by ca. 1/3

(4) Subsamples: G1 / G2 and EU / RoW

Results robust

Interpretation: capital & asset growth endogenous and simultaneous

- Management action on capital is higher for banks that…
  - … are more capital constrained (*L.Z*)
  - … are less profitable (*ROA*)
  - … grow at higher rate (*LOG_RWA_D*)

  → results very similar to single equation approach
- RWA growth rate is higher for banks that…
  - … take more Management action on capital (*MAC_3*)
  - … are less capital constrained (*L.Z*)
  - … have lower increases of marginal funding costs (*CDS5y_D*)

- Banks that face profitable growth opportunities actively raise capital/take more Management action on capital, although it is costly.
- Banks that actively raise more capital/ take more Management action on capital, grow more.

Summary, implications, and conclusions

Summary

- We employ a two-step approach to address our main research question: *How do banks manage their equity capital in the short run and what effects does this have on their asset and liability structure, explicitly considering periods of bank-specific distress?*
  1. A partial adjustment model of bank capital ratios estimates each bank's target capital-asset ratio,
  2. A simultaneous equation model estimates the dynamics between management action on capital and growth of balance sheet items.
- The results of the partial adjustment model show that most banks operated below their estimated capital targets during the Basel III implementation phase, creating a positive impetus for increasing capital levels.
- In the simultaneous equation approach, we find a significant and simultaneous relationship between management action on capital and RWA growth.

Implications for traditional econometric models on the interaction between capitalization and lending growth (see Annex A1.1)

Identification problem: Model assumes that $CapitalConstraint_{i,t-1}$ is determined before and independently of $\Delta LogAssets_{s,i,t}$ – direction of causation only from $CapitalConstraint_{i,t-1}$ to $\Delta LogAssets_{s,i,t}$ but implausible and inconsistent w/supervisory requirements.
Reverse causality: Banks that want to exploit profitable growth opportunities manage their P&L and their balance sheet accordingly and have a different $CapitalConstraint_{i,t-1}$

causality

$$\Delta LogAssets_{s,i,t} = f(CapitalConstraint_{i,t-1}, BankControls_{i,t}, MacroControls_{t}, \varepsilon_t)$$

causality

Omitted variable bias: Model assumes that $\Delta CET1_{i,t} \equiv 0$ – banks cannot take management action on capital in *t*. This is a confounding variable related to, both, $\Delta Assets_{s,i,t}$ and $CapitalConstraint_{i,t-1}$. → Biased and unreliable results. The effect of the omitted variable is incorrectly attributed to the included variables, distorting the true relationship between the independent and dependent variables. Likely to increase the macro-financial feedback-effect, as banks w/ lower $CapitalConstraint_{i,t-1}$ have higher $\Delta CET1_{i,t}$.

Conclusions

- Existing studies that treat bank capital as fixed in the short run tend to underestimate the ability of banks to adjust to changes in their operating environment such as changes to regulatory requirements or bank-specific distress.
- While we are confident that our main findings are robust across several perspectives, more research is required to corroborate the results.

Backup Slides

Descriptive statistics, main sample (2013Q2–2019Q2)

Variable	Winsorised	N	Mean	SD	p5	p50	p95
Regulatory ratios							
reported CET1 ratio	No	1,644	0.148	0.0598	0.0924	0.132	0.252
full Basel III CET1 ratio	No	1,643	0.147	0.0612	0.0902	0.129	0.258
Basel III reform gap	No	1,643	0.00122	0.00980	-0.00731	0	0.0158
log of LCR	Yes	1,644	0.451	0.464	-0.0101	0.330	1.385
Bank financials							
log of assets	No	1,643	25.67	1.659	22.73	25.66	28.30
net income to assets	Yes	1,643	0.00374	0.00453	0	0.00266	0.0116
trading book to assets	Yes	1,633	0.0769	0.125	0	0.0199	0.367
lending to assets	No	1,635	0.573	0.217	0.0647	0.606	0.853
risk density	No	1,643	0.462	0.187	0.177	0.441	0.799
Macro-economic variables							
log of HP-filtered real GDP	No	1,644	6.096	1.017	4.503	6.116	8.086
inflation	Yes	1,644	0.0190	0.0242	-0.000775	0.0140	0.0567
change in log of market cap.	No	1,644	0.0295	0.0982	-0.148	0.0361	0.177
log of sov. CDS spread (5Y)	Yes	1,600	3.676	0.975	2.432	3.367	5.369