Credit Cycle and Balancing Capital Gap: Evidenced from the Korean Data

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In a nutshell, this paper is …

- Using Credit-to-GDP gap, we estimate target capital ratios and quantify the balance sheet adjustments of capital gap on the composition of Korean banks' balance sheet.
- The empirical study shows that the bank's RWA responds more sensitively compared to other balance sheet variables.
- Also, historical simulation illustrates that additional capital levy due to Basel's countercyclical capital buffer (CCCB) shouldn't be taken too restrictive considering the historical target capital level.

Background

- Two views on bank's capital
  - As the bank capital is costly, individual banks have an incentive to lower capital ratio
    - (Analogy) Capital is foundation of building and liabilities are building itself.
  - As a buffer to the losses, supervisory authorities regulate the minimum level of capital.
- As a compromise, Basel II accepted the banks' internal models on risk-weighted asset (RWA)
  - Also, it approved quasi-capital as a regulatory capital (RC)
- Macro policies based on the credit view take conciliatory stances towards regulations on core capital
- After the 2008 GFC, prevention and supervision of systemic risk emanating from credit cycles were globally discussed .
- Bank Capital Channel is added as a new transmission mechanism for monetary policies.

Objective

Bank Capital Channel

- Changes in capital regulations affect scale and composition of banks' assets and loans, and ultimately influence macroeconomic performances, such as output, inflation, and unemployment rate.
- Different from M-M theory, the compositions in bank's balance sheet affect not only the performance of bank itself, but also the economy as a whole.

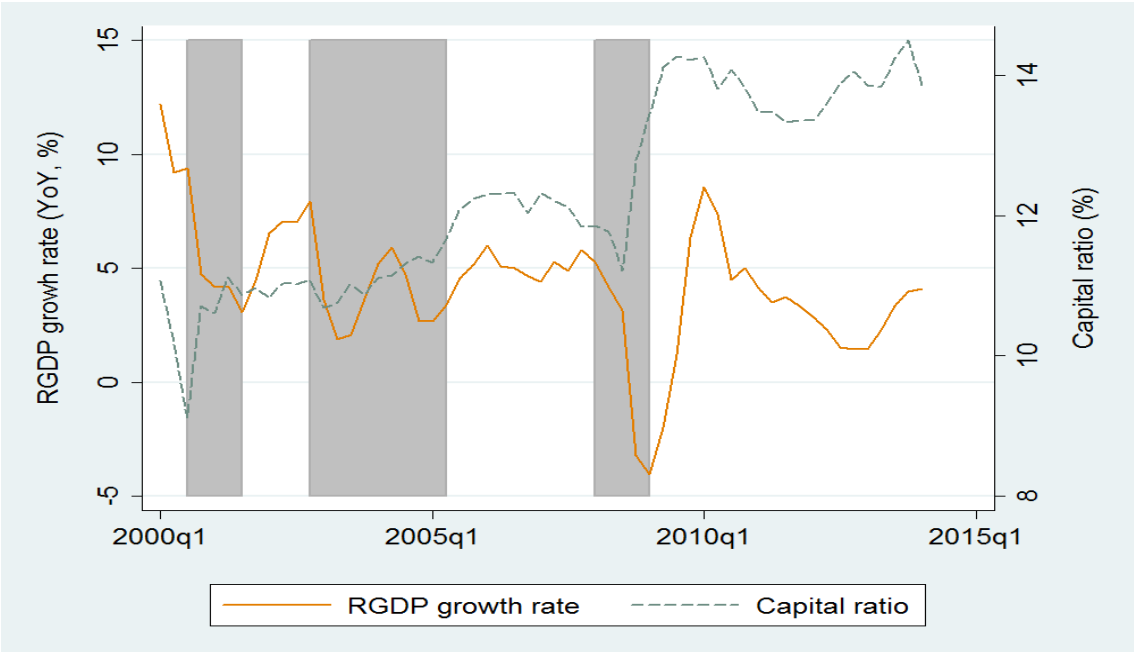
Main goal of this paper

- Quantifying the potential impacts of the new capital regulation (a.k.a.CCCB) opposed to credit cycles on the Korean banks beginning in 2016.
  - For this goal, firstly, we estimate the target capital ratio of banks allowing for the credit cycles.
  - Secondly, we study balance sheet adjustments to the capital gap (= actual – target capital)

Stylized Facts: CAR and RGDP

- CAR (Capital Adequacy Ratio) is acyclical.
  - CAR declines in the early stage of recession, but bounce back
  - Due to either (1) capital injections or (2) write-offs of RWA during the recession.

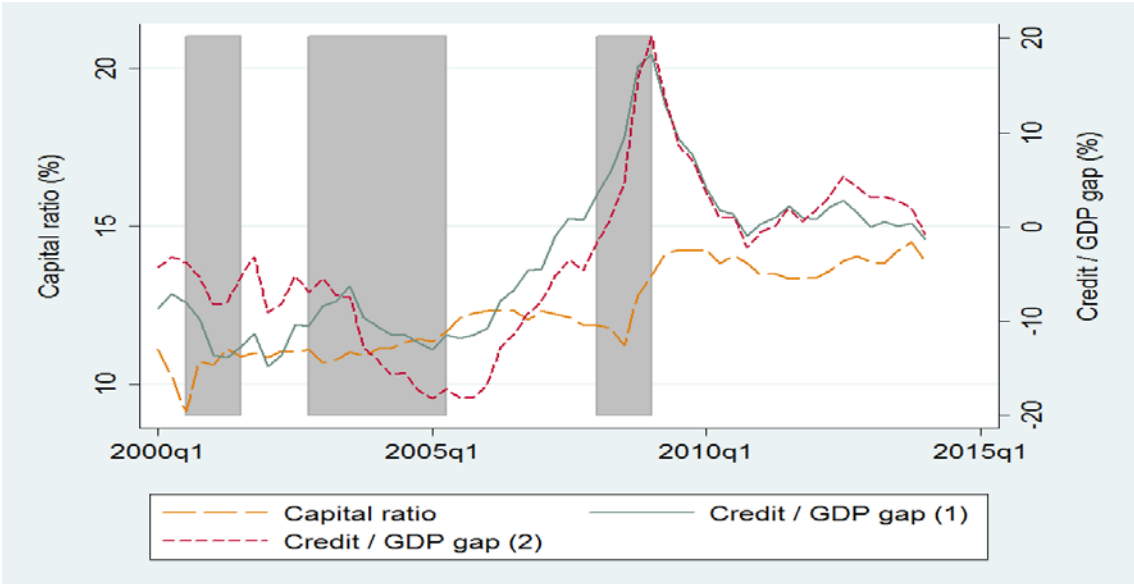
Figure 1 CAR and GDP growth rate



Stylized Fact: CAR and Credit/GDP Gap

- Credit/GDP Gap has increased since 2005 and declined after the end of the 9th cycle (2009Q1)
  - Credit (1) is the loans of depository banks and nonbank financial intermediaries
  - Credit (2) include Credit (1) and capital market funding such as corporate bonds and commercial papers.

Figure 2 Capital ratio and Credit / GDP gap



Model 1: Target Capital Ratio

- Koyck's partial adjustment model:

$$k_{i,t} - k_{i,t-1} = \rho(k^*_{i,t-1} - k_{i,t-1}) + \dot{\varepsilon}_{i,t}$$

  - where
    - k_{it} = actual capital adequacy ratio
    - k^*_{it-1} = target capital adequacy ratio

- Target capital ratio is assumed as follows:

$$k^*_{i,t} = \sum_{j=0}^{2} x_{it-j}\theta_j + \eta_i$$

  - where
    - x_{it-j} = a set of explanatory variables at time t-j
    - η_i = bank i's fixed effect

- Combining the two equations:

$$k_{it} = (1-\rho)k_{it-1} + \rho\sum_{j=0}^{2} x_{it-j}\theta_j + (\rho\eta_i + \dot{\varepsilon}_{it})$$

Estimation

- Standard differencing will lead to estimation bias due to the AR(1) in error term.
- Typical remedy is to use system-GMM proposed by Arellano-Bond.
- However, system-GMM is adequate for large N and small T.
  - In case of small N and large T, over-fitting issue is more problematic
  - Arellano-Bond recommend standard panel estimation under small N and large T
- In estimation, we rewrite the structural equation to avoid AR(1) problem

$$\Delta k_{it} = \rho(\Delta x_{it}\theta_0 - \Delta x_{it-1}\theta_2) - \rho[k_{it-1} - x_{it-1}(\theta_0 + \theta_2 + \theta_2)] + (\rho\eta_i + \dot{\upsilon}_{it})$$

- Reduced form:

$$\Delta k = \Delta x\pi_1 + \Delta x_{-1}\pi_2 + \pi_3 k_{-1} + x_{-1}\pi_4 + (\rho\eta_i + \dot{\upsilon})$$

$$\rho = -\pi_3$$

$$\theta_0 = \frac{\pi_1}{-\pi_3}$$

$$\theta_1 = \frac{\pi_4 - \pi_1 + \pi_2}{-\pi_3}$$

$$\theta_2 = \frac{\pi_2}{\pi_3}$$

Explanatory Variables (x_{it})

- *ROE* : Return on equity
- *RISK* : RWA / TA
- *ALLOW* : Loss provision / Asset
- *DEBT/ASSET* : Debt / Asset
- *ASSET* : (log) Asset
- *CREDIT/GDP* : Credit/GDP cap (HP filter λ=400,000)

Model 2: Capital Gap Adjustment

Notation

- Capital gap ($KGAP_{it}$) = actual – target CAR

Estimation

$$Y_{it} = \beta KGAP_{it} + \sum_{k=1}^{K}\sum_{j=0}^{2} X_{ikt-j}\delta_{kt-j} + \sum_{s=1}^{4} Q_s d_s + \eta_i + \varepsilon_{it}$$

Dependents

Set of balance sheet variable
- -Growth TA
- -Growth RWA
- -Growth Bank loans
- -CORE/RWA

Controls

- $KGAP_{it}$: capital gap
- X_{ikt} : macroeconomic or bank specific characteristic variables
  - –ΔAsset, ΔGDP
  - –Lending Attitude, Policy Rate
  - –CPI Inflation, Loss Provision

Dummy

- Qs : quarterly dummy
- η_i : fixed effect
- ε_{it} : error term

Data

- 8 Commercial banks and 6 regional banks from 2000:Q1 to 2014:Q1 culled from the FAIRS dataset by the BOK

Table 1 Summary statics

(In Billion Won, %)

Variables	Whole banks[1)]		Commercial Banks(8)		Regional Banks(6)		t-test
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	
Asset	71,087	72,373	113,500	69,944	14,570	10,412	0.0000
Liabilities	66,425	67,203	106,000	64,676	13,691	9,648	0.0000
Total Capital	4,661	5,310	7,498	5,486	879	784	0.0000
Core Capital	4,310	4,788	6,889	4,912	870	797	0.0000
Loans	49,503	54,094	79,440	54,673	9,586	7,369	0.0000
Loss Provision	893	1,031	1,455	1,056	143	97	0.0000
Subordinate Debts	1,402	1,743	2193	1958	363	318	0.0000
RWA	48,560	52,080	77,910	51,940	9,420	7,066	0.0000
Current Asset	22,790	21,470	36,430	19,140	4,611	2,885	0.0000
RWA/Asset	65.22	7.71	66.15	7.73	63.98	7.51	0.0001
Provision/Asset	1.25	0.73	1.35	0.80	1.11	0.60	0.0000
ROE	7.69	7.42	6.70	7.14	9.01	7.59	0.0001
Subordinate/Liabilities	2.17	1.14	1.81	0.87	2.64	1.28	0.0000
Core/Total Capital[2)]	95.61	10.41	93.75	9.48	98.09	11.06	0.0000
Current/Asset	35.05	10.22	35.60	11.64	34.31	7.91	0.0783
Liabilities/Asset	0.94	0.02	0.94	0.02	0.94	0.01	0.2396
Capital Adequacy Ratio	12.28	2.05	12.36	1.98	12.18	2.14	0.0000

Note: Based on the 8 commercial and 6 regional banks balance sheets.

Estimation Results

Table 4 Estimation Results

Reduced-Form	π		Structural	θ	
	coef.	s.e		coef.	s.e
ΔROE	-0.008***	(0.003)	ROE	-0.045**	(0.017)
ΔRISK	-0.148***	(0.009)	RISK	-0.841***	(0.125)
ΔALLOW	0.534***	(0.149)	ALLOW	3.039***	(0.933)
ΔSUBDEBT	0.735***	(0.060)	SUBDEBT	4.177***	(0.678)
ΔASSET	0.002***	(0.000)	ASSET	0.012***	(0.003)
ΔDEBT/ASSET	-0.809***	(0.061)	DEBT/ASSET	-4.598***	(0.661)
ΔCREDIT/GDP	0.029***	(0.011)	CREDIT/GDP	0.164**	(0.067)
ΔROE(-1)	-0.002	(0.003)	ROE(-1)	0.018	(0.017)
ΔRISK(-1)	0.012	(0.009)	RISK(-1)	0.751***	(0.136)
ΔALLOW(-1)	0.351**	(0.142)	ALLOW(-1)	-1.262	(1.085)
ΔSUBDEBT (-1)	-0.006	(0.061)	SUBDEBT(-1)	-3.663***	(0.728)
ΔASSET(-1)	-0.000	(0.000)	ASSET(-1)	-0.011**	(0.004)
ΔDEBT/ASSET(-1)	-0.052	(0.061)	DEBT/ASSET(-1)	3.402***	(0.718)
ΔCREDIT/GDP(-1)	0.009	(0.010)	CREDIT/GDP(-1)	0.005	(0.094)
ROE(-1)	-0.002	(0.004)	ROE(-2)	0.014	(0.016)
RISK(-1)	-0.028***	(0.006)	RISK(-2)	-0.068	(0.054)
ALLOW(-1)	-0.038	(0.092)	ALLOW(-2)	-1.994**	(0.844)
SUBDEBT(-1)	0.096***	(0.033)	SUBDEBT(-2)	0.032	(0.348)
ASSET(-1)	0.000***	(0.000)	ASSET(-2)	0.001	(0.003)
DEBT/ASSET(-1)	-0.159***	(0.032)	DEBT/ASSET(-2)	0.294	(0.347)
CREDIT/GDP(-1)	0.021***	(0.004)	CREDIT/GDP(-2)	-0.050	(0.060)
			ΣROE	-0.013	(0.024)
			ΣRISK	-0.158***	(0.031)
			ΣALLOW	-0.216	(0.531)
Long-run Effects			ΣSUBDEBT	0.547***	(0.187)
			ΣASSET	0.002***	(0.000)
			ΣDEBT_ASSET	-0.902***	(0.117)
			ΣCREDIT_GDP	0.120***	(0.021)
L.K	-0.176***	(0.023)	ρ	0.176***	(0.023)
CONSTANT	0.191***	(0.034)	CONSTANT	1.087***	(0.112)
Obs.			616		
R^2			0.563		

Actual vs. Target CAR (I)

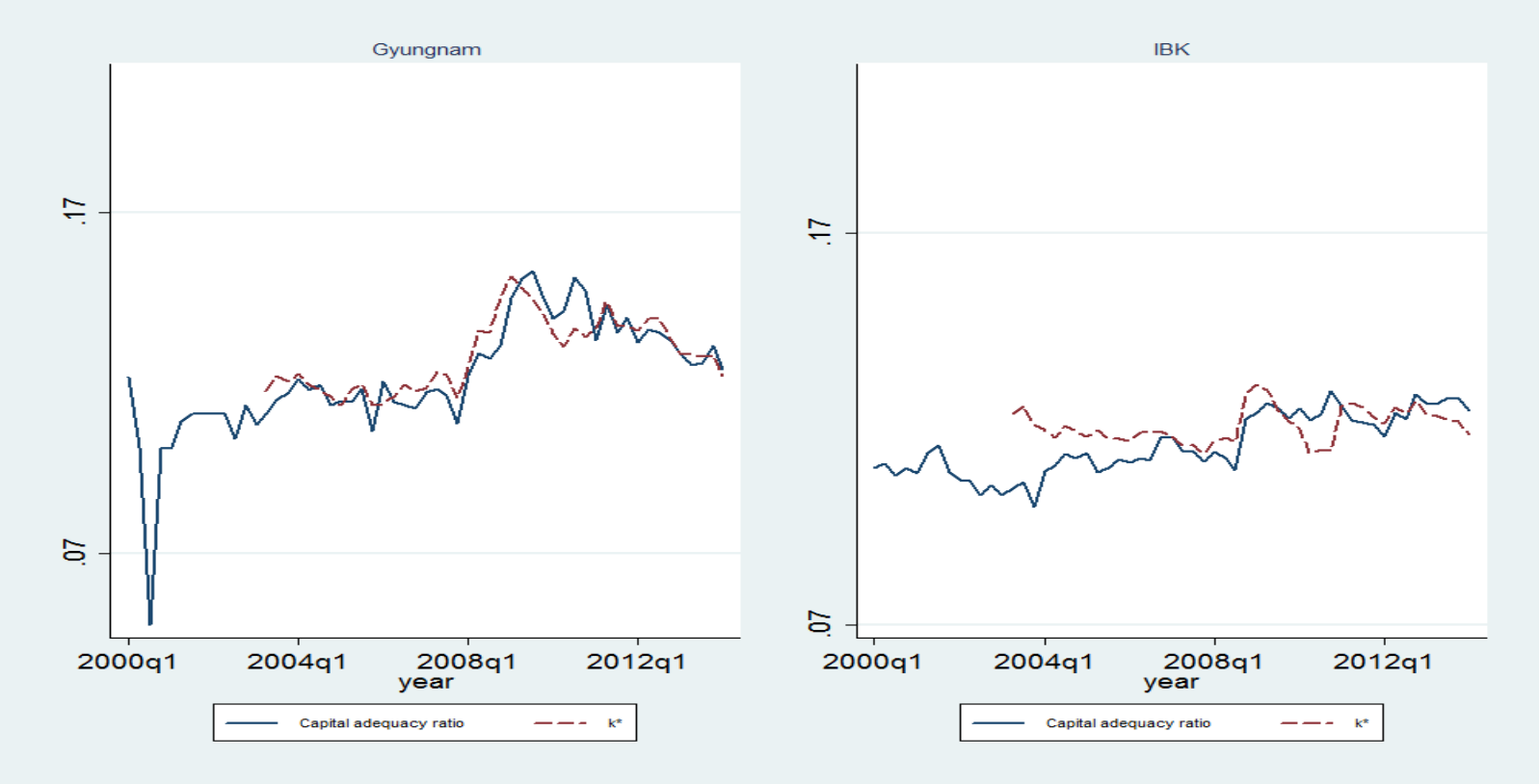
Figure 6 Actual vs. Target (k*) Capital Ratio

Actual vs. Target CAR (II)

Figure 6 Actual vs. Target (k*) Capital Ratio (Cont'd)

Actual vs. Target CAR (III)

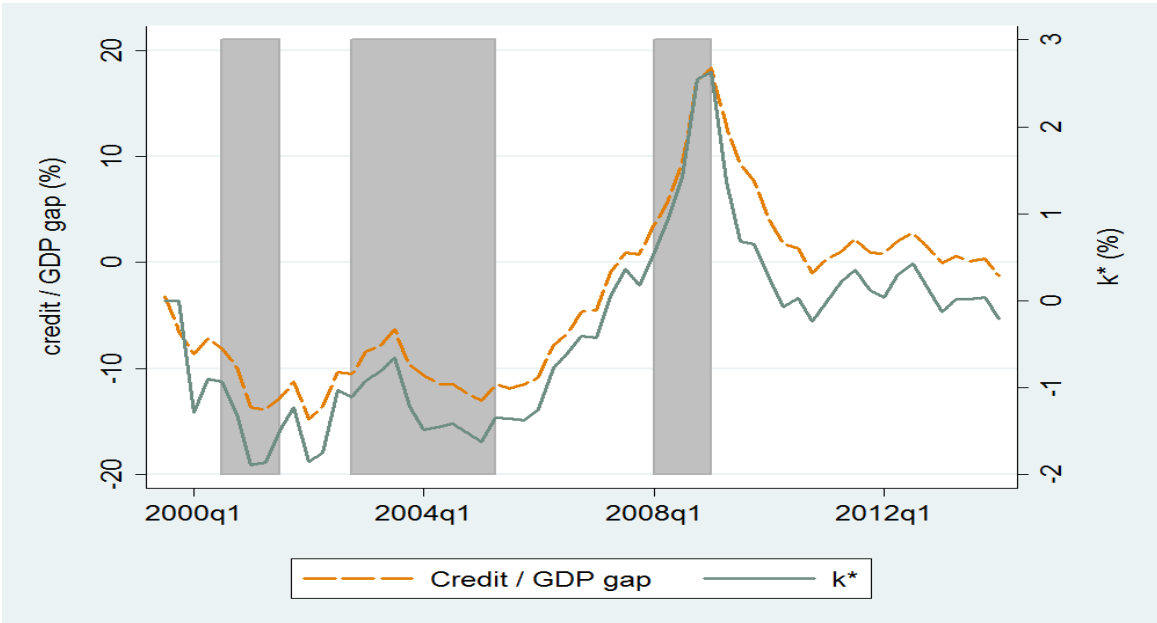
Figure 6 Actual vs. Target (k*) Capital Ratio (Cont'd)



Historical Simulation

- Feed the past data of Credit-to-GDP Gap into the regression equation to study its contribution to the target capital ratio
  - Contribution of Credit-to-GDP Gap topped at 2.62% in 2009Q1
  - Interestingly, this is a similar magnitude to the maximum level (2.5%) of CCCB proposed by Basel III

Figure 14 Historical Simulation



Estimation Results for B/S Adjustment

Table 5 B/S Adjustment to Capital Gap: Panel Regression

	ΔAssets	ΔRWA	ΔLoans	Core Capital/RWA
ΔAsset		0.611***	0.633***	0.0488***
ΔAsset(-1)	-0.129***	0.131***	0.092***	0.0103***
ΔGDP(-1)	0.595*	0.442	0.035	0.0143
Lending Attitude(-1)	0.001***	-0.000	-0.000	-0.0001**
Lending Attitude (-2)	-0.000	0.001*	0.000	0.0001*
Policy Rate(-1)	0.001	0.005	0.004	-0.0010
Policy Rate(-2)	0.018**	0.001	-0.002	0.0101
CPI Inflation(-1)	1.051*	-1.884***	-0.551*	-0.1931***
CPI Inflation(-2)	0.190	1.171*	0.151	0.1271**
Loss Provision(-1)	1.673	-1.087	-1.351	-0.0248
Loss Provision(-2)	-1.833	0.685	1.106	0.2156
KGAP1(-1)	0.485**	0.746***	0.404***	-0.1031***
Constant	-0.075***	-0.010	0.007	-0.0028
Quarterly Dummy	yes	yes	yes	yes
# Obs	615	615	615	615
R^2	0.140	0.332	0.656	0.351

Findings

1. RWA is most sensitive

- RWAs will grow 0.746% compared to 0.486% in total assets
- Most of growth in total assets comes from RWAs

$$\frac{dA}{A} = w_{RWA}\frac{d(RWA)}{RWA} + (1 - w_{RWA})\frac{d(NRWA)}{NRWA}$$

$$g_A = w_{RWA} g_{RWA} + (1 - w_{RWA}) g_{NRWA}$$

– g_A = 0.485, w_{RWA} g_{RWA} = 0.65 * 0.746 = 0.4849, hence (1-w_{RWA}) $g_{NRWA} \approx 0$

2. KGAP is instantly countervailed by CORE/RWA

- Changes in CORE/RWA can be expressed as the difference between g_{cc} and g_{RWA}

$$d\left(\frac{CC}{RWA}\right) = \frac{CC}{RWA}(g_{CC} - g_{RWA})$$

- From this g_{cc} = -0.415

Robustness

4 sets of variables as control variables for credit cycles

- Credit-to-GDP Gap (HP smoothing parameter λ= 25,000)
  - Suggested by Cho, Shim and Lee (2013)

- Non-core liabilities-to-Total Assets
  - Suggested by Shin and Shin (2010)
  - Core liabilities is to domestic household and non-financial claim holders
  - Non-core is the liabilities to financial intermediaries and foreign creditors.

- Non-core-to-Core Liabilities
  - Suggested by Shin and Shin(2010), Hahm, Shin and Shin (2013)

- Non-core-to-M2
  - Suggested by Shin (2011, 2012)

Summary for Model 1

Target Capital Ratio : Long-Run Effects

	Baseline		Robustness							
			(1) HP λ=25,000		(2) Non-Core/Assets		(3) Non-core / Core liabilities		(4) NCL/M2	
ΣROE	-0.013	(0.024)	-0.015	(0.024)	-0.024	(0.029)	-0.033	(0.027)	-0.031	(0.028)
ΣRISK	-0.158***	(0.031)	-0.154***	(0.031)	-0.132***	(0.033)	-0.135***	(0.031)	-0.130***	(0.033)
ΣALLOW	-0.216	(0.531)	-0.307	(0.547)	-0.537	(0.594)	-0.573	(0.559)	-0.539	(0.597)
ΣSUBDEBT	0.547***	(0.187)	0.641***	(0.195)	0.612***	(0.213)	0.620***	(0.199)	0.627***	(0.213)
ΣASSET	0.002***	(0.000)	0.002***	(0.000)	0.001***	(0.000)	0.001***	(0.000)	0.001**	(0.000)
ΣDEBT/ASSET	-0.902***	(0.117)	-1.039***	(0.117)	-1.039***	(0.132)	-1.046***	(0.122)	-1.103***	(0.134)
ΣCREDIT/GDP	0.120***	(0.021)	0.133***	(0.024)	0.301***	(0.089)	0.091***	(0.025)	0.217***	(0.065)

Summary for Model 2

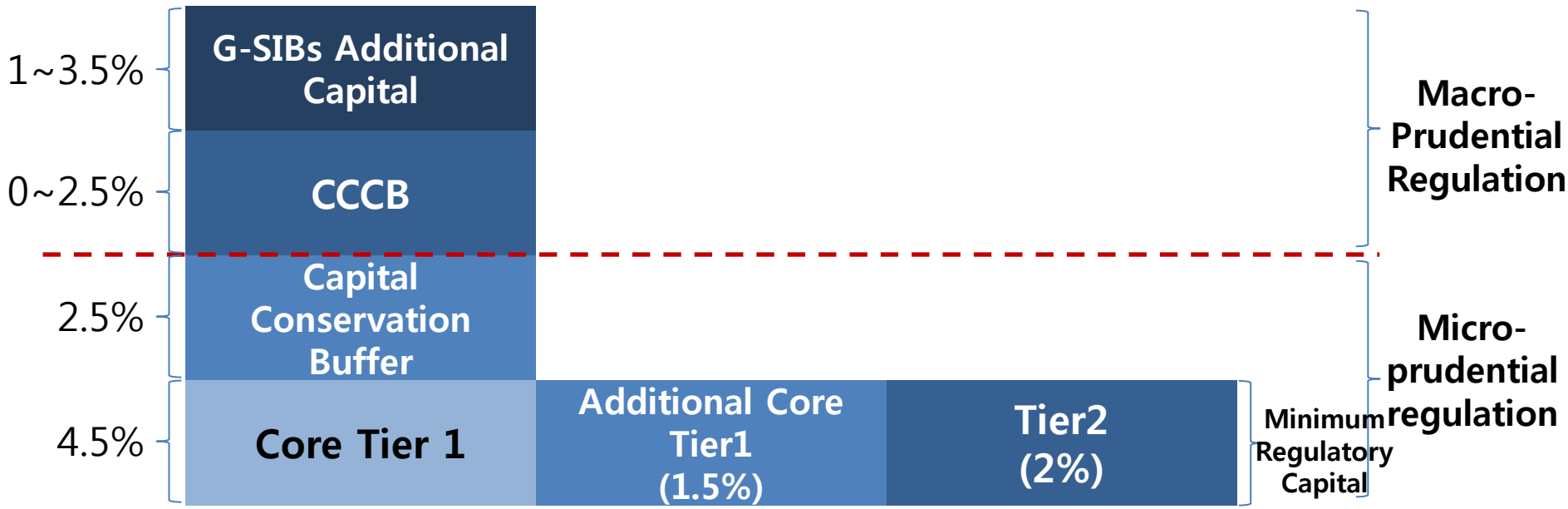
Balance Sheet Adjustment

	Baseline	Robustness			
		(1) HP λ=25,000	(2) Non-Core /Assets	(3) Non-core /Core liabilities	(4) NCL/M2
ΔAsset	0.485**	0.526**	0.543**	0.537**	0.531**
ΔRWA	0.746***	0.647***	0.403*	0.429*	0.399*
ΔLoan	0.404***	0.358***	0.239**	0.272**	0.226**
Core Capital /RWA	-0.1031***	-0.1131***	-0.1252***	-0.1244***	-0.1281***

5. . Conclusion

- Using Credit-to-GDP gap, we estimate target capital ratios and quantify the impact of the new capital regulation on the composition of Korean banks' balance sheet.
- The empirical study shows that the bank's RWAs respond more sensitively compared to other balance sheet variables.
- Also, historical simulation illustrates that additional capital levy due to Basel's CCCB regulation shouldn't be taken too restrictive considering the target capital level.

Regulatory Capital Structure of Basel III



Introduction Schedule of Basel III in Korea

Back

Types of Capital	2013	2014	2015	2016	2017	2018	2019	2020~
Minimum Common Equity (A)	3.5%	4.0%	4.5%					
Minimum Tier1 (B)	4.5%	5.5%	6.0%					
Minimum Capital (C=B+Tier2)	8.0%							
CCB (D)				0.625%	1.25%	1.875%	2.50%	
CCCB (E)				0.625%	1.25%	1.875%	2.50%	
Total Capital (F=C+D+E)	8.0%	8.0%	8.0%	9.25%	10.5%	11.75%	13.0%	
SIFI Additional (F+Max 3.5%)	8.0%	8.0%	8.0%	12.75%	14.0%	15.25%	16.5%	