

CAPITAL REGULATION AND SHADOW FINANCE: A QUANTITATIVE ANALYSIS

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INTRODUCTION

- Financial intermediation markets in the 2010s:
 - ▶ Decline in share of regulated banks
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 - ▶ Basel III: Higher bank capital requirements

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 - ▶ Decline in share of regulated banks
 - ▶ Increase in share of non-bank (“shadow”) lenders
- New bank regulation after 2007-2009 financial crisis:
 - ▶ Basel III: Higher bank capital requirements
- Corporate credit-level data from South Korea, 2013-2019:
 - ▶ 25% decrease in lending by regulated banks
 - ▶ Increase in shadow lending by similar magnitude
 - ▶ Coincides with the introduction of Basel III

RESEARCH QUESTIONS

What is the effect of bank capital requirements on:

1. regulated bank lending?
2. non-bank (shadow) lending?
3. broad macroeconomy?

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Not the focus of this paper: optimal regulation

PRESENTATION OUTLINE

- ➊ Data and background
- ➋ General equilibrium model with banks and shadow lenders
- ➌ Estimation at the micro level: model meets data

BACKGROUND

DATA

Panel of corporate credit accounts in South Korea, Q2:2013 - Q1:2019

- Observation: firm \times lender \times quarter (\times credit types)

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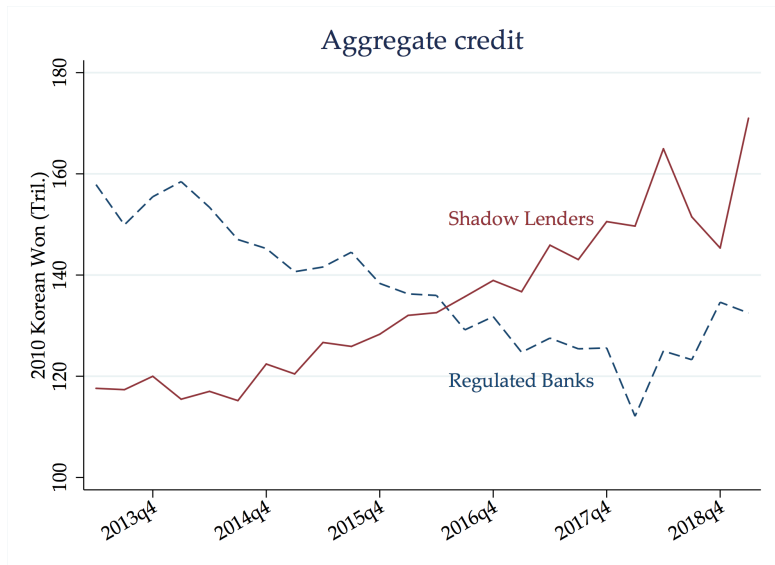
Summary stats

Details on non-bank lenders

Credit types

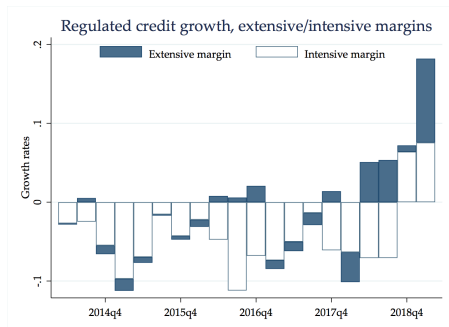
Prior trends

AGGREGATE CREDIT IN YEARS 2013-2019

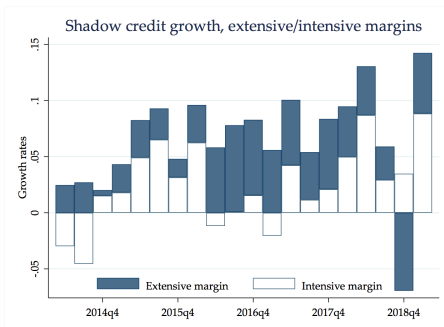


◀ Skip to analog in the model

INTENSIVE AND EXTENSIVE MARGINS



(a) Regulated bank credit

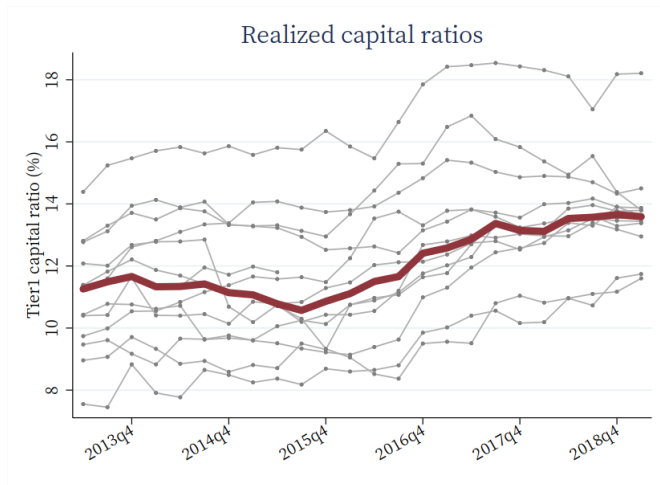


(b) Shadow credit

BASEL III

- Capital ratio = $\frac{\text{equity}}{\text{risk-weighted assets}}$
- Before Basel III (prior to 2010): $\geq 4\%$.
- Basel III (since 2010, subj. to implementation): $\geq 8.5\%$
- Additional buffer for Systemically Important Banks (SIB)
- Gradual increase over 2013-2019, binding from 2016 Reform schedule

BANK CAPITAL RATIOS

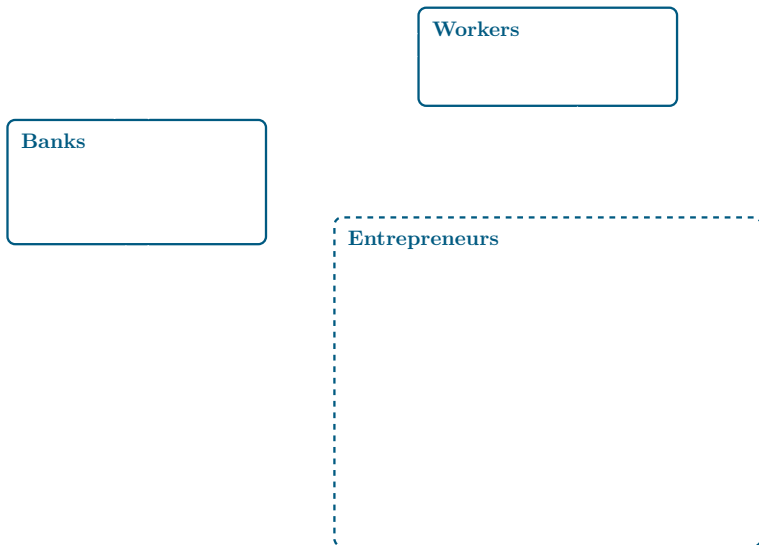


◀ Alternative measures of capital ratio

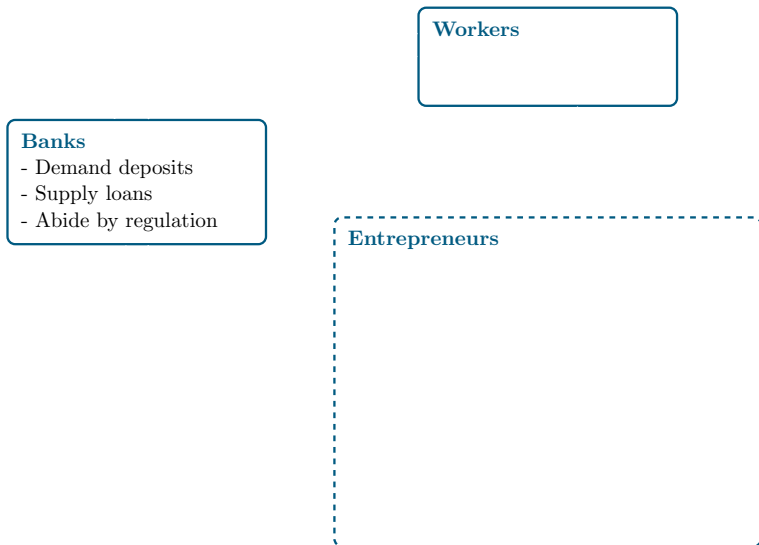
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MODEL

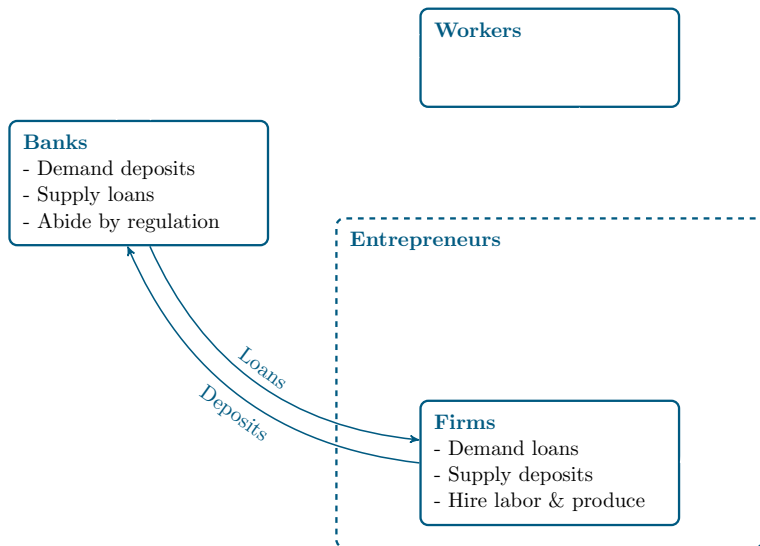
MODEL OVERVIEW



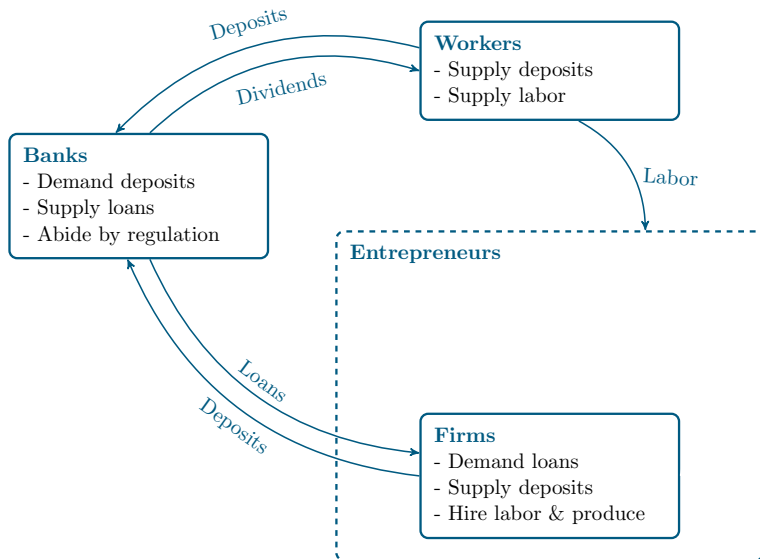
MODEL OVERVIEW



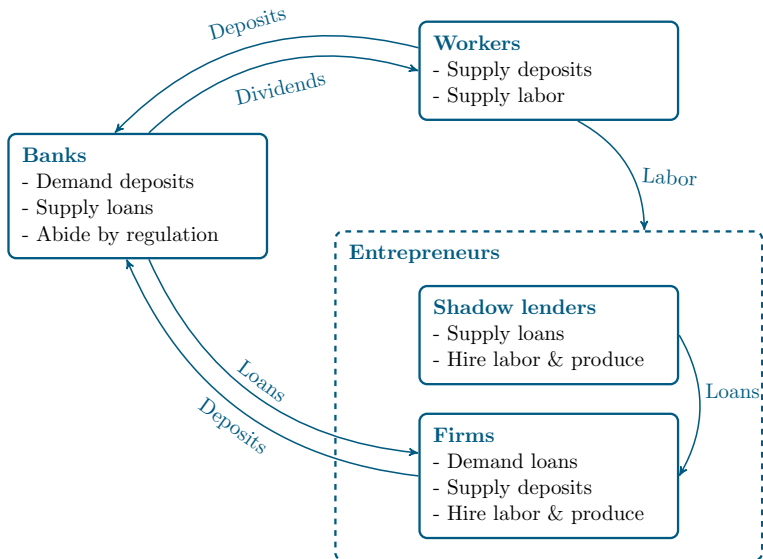
MODEL OVERVIEW



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MODEL OVERVIEW



BANK'S PROBLEM

Each bank chooses portfolio given equity:

$$V^B(e) = \max_{c,b',m',d'} u(c) + \beta E_{\omega'} V^B(e')$$

$$s.t. \quad c + b' + m' - d' = e$$

$$\textit{dividends} + \textit{loans} + \textit{reserves} - \textit{deposits} = \textit{equity}$$

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$$\textit{equity}' = \textit{returns on loans and reserves} - \textit{deposits}$$

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equity' = returns on loans and reserves - deposits

$$(\omega'b' + m' - d') / (\chi\omega'b') \geq \kappa$$

capital ratio greater than requirement

BANK'S PROBLEM

Each bank chooses portfolio given equity:

$$V^B(e, \mathbf{p}) = \max_{c, b', m', d'} u(c) - h(\mathbf{p}) + \beta E_{\omega'} V^B(e', \mathbf{p}')$$

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$$m' \geq \rho d'$$

reserve requirements

ENTREPRENEURS: REGULAR FIRM

Given cash-in-hand, regular firms decide on capital and asset holdings.

$$V^R(x, z) = \max_{c, k', a'} u(c) + \beta \mathbb{E}_{z', \Gamma'} [V(x', z') | z]$$

$$s.t. \quad x = c + a' + k'$$

$$a' \geq \underline{a}_e - \varphi k'$$

$$x' = w + \pi(k', z') + (1 - \delta)k' + (1 + r(a')) a'$$

where $\pi(k, z)$ is profit:

$$\pi(k, z) = \max_n \left\{ z^{1-\nu} (k^\alpha n^{1-\alpha})^\nu - wn \right\}$$

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$$x' = w + \pi(k', z') + (1 - \delta)k' + \left(1 + r(a')\right) \left(a' - s(\Gamma', a') \max\{a', \underline{a}_e\}\right)$$

$$r(a') = r^d \mathbb{1}\{a' \geq 0\} + r^b \mathbb{1}\{a' < 0\}$$

$$s(\Gamma', a') = \mathbb{1}\{\Gamma' = 1, a' < 0\}$$

where $\pi(k, z)$ is profit:

$$\pi(k, z) = \max_n \left\{ z^{1-\nu} (k^\alpha n^{1-\alpha})^\nu - wn \right\}$$

ENTREPRENEURS: SHADOW LENDERS

Given cash-in-hand, shadow lenders invest in capital and lend to firms.

$$V^S(x, z) = \max_{k' > 0, a' \geq 0} u(c) + \beta \mathbb{E}_{z', \omega'} [V(x', z') | z]$$

$$s.t. \quad c + a' + k' + \textcolor{red}{f}_S = x$$

$$x' = w + \pi(k', z') + (1 - \delta)k' + (\textcolor{red}{1} + \textcolor{red}{r}^b)\omega' a'$$

where

$$V = \max\{V^S, V^R\}$$

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where

$$V = \max\{V^S, V^R\}$$

Workers are based on Aiyagari (1994).

Worker's problem

Market clearing

QUANTITATIVE STRATEGY

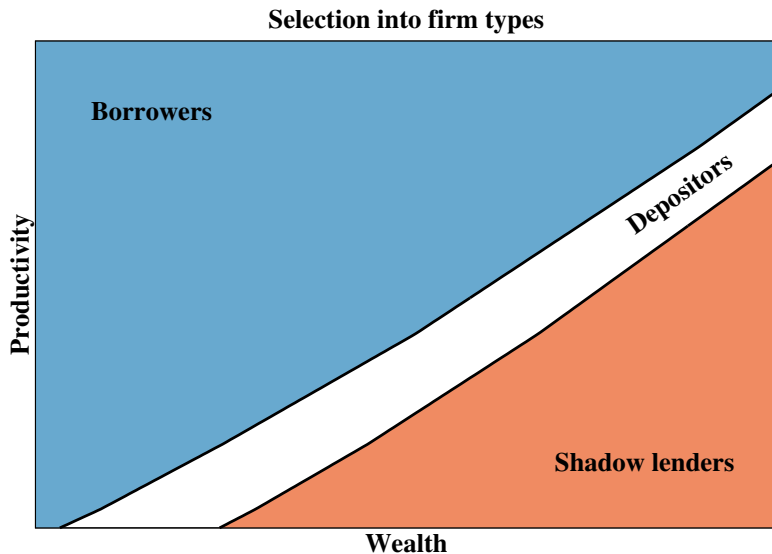
① Calibrate to Korea 2010-2013:

- ▶ Target key moments of Korean banking sector Banks calibration
- ▶ Target size and structure of regulated and shadow lending sectors Rest of economy calibration

② Conduct a Basel III reform experiment:

- ▶ Compare pre- and post-reform steady states
- ▶ Compute a deterministic transition path

ENTREPRENEUR'S CHOICE



INCREASE IN CAPITAL REQUIREMENT

	Before reform
Capital requirement	4%
Banks	
Equity	100.00
Loans	910.15
Capital ratio (%)	10.97
Shadow lenders	
Loans	684.74
Share in all loans (%)	42.93
Share in all firms (%)	7.05
Eqm prices ($\times 100$)	
r_b	3.44
r_d	1.64
w	30.84

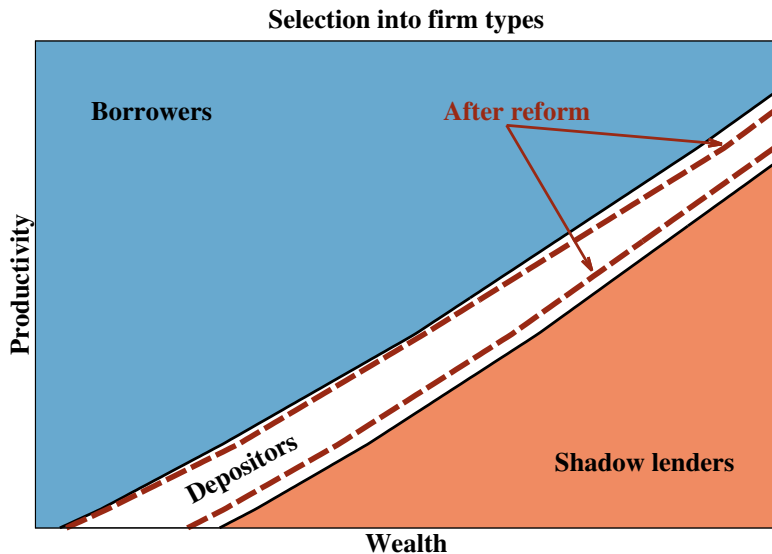
INCREASE IN CAPITAL REQUIREMENT

	Before reform	After (PE)
Capital requirement	4%	8.5%
Banks		
Equity	100.00	19.04
Loans	910.15	98.64
Capital ratio (%)	10.97	20.80
Shadow lenders		
Loans	684.74	684.74
Share in all loans (%)	42.93	87.41
Share in all firms (%)	7.05	7.05
Eqm prices ($\times 100$)		
r_b	3.44	3.44
r_d	1.64	1.64
w	30.84	30.84

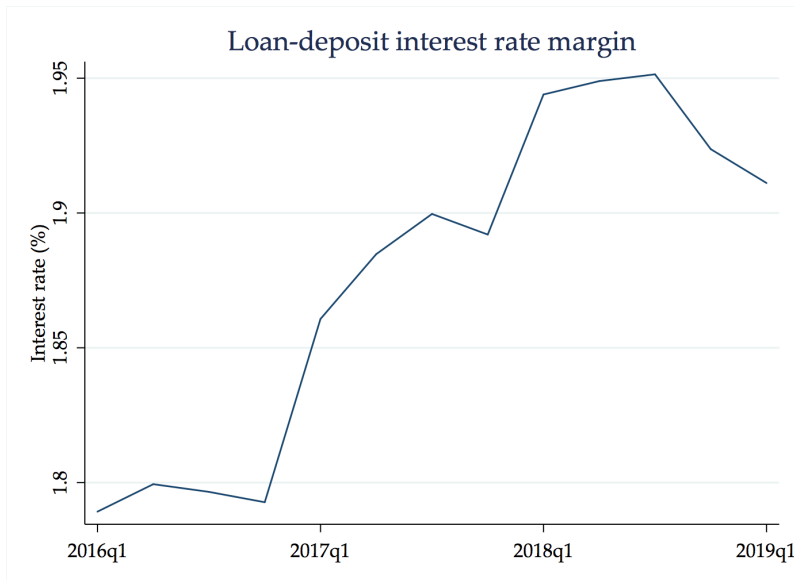
INCREASE IN CAPITAL REQUIREMENT

	Before reform	After (PE)	After (GE)
Capital requirement	4%	8.5%	8.5%
Banks			
Equity	100.00	19.04	115.54
Loans	910.15	98.64	780.29
Capital ratio (%)	10.97	20.80	16.01
Shadow lenders			
Loans	684.74	684.74	803.85
Share in all loans (%)	42.93	87.41	50.74
Share in all firms (%)	7.05	7.05	9.08
Eqm prices ($\times 100$)			
r_b	3.44	3.44	3.46
r_d	1.64	1.64	1.49
w	30.84	30.84	30.83

ENTREPRENEUR'S CHOICE AFTER REFORM

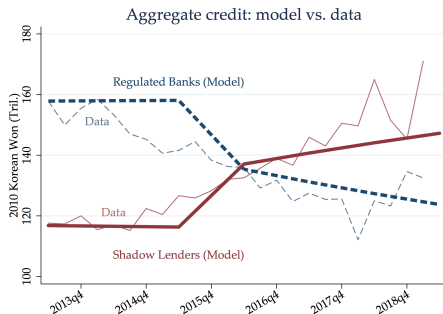


VALIDATION: INTEREST RATE SPREAD IN THE DATA

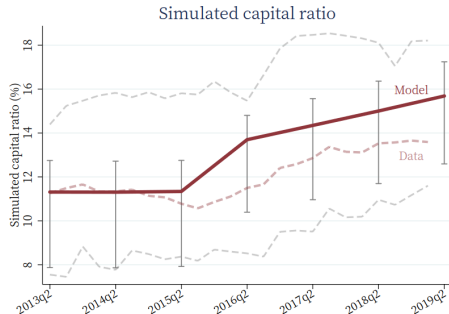


Interest rates

TRANSITION: AGGREGATE RESULTS



(c) Total credit by lender type



(d) Bank capital ratios

◀ Total credit - data analog

◀ Capital ratios - data analog

◀ Additional graphs

◀ Conclusion

MICRO ESTIMATION

ESTIMATION EQUATION

Identification strategy based on bank and firm fixed effects.

Baseline regression (regulated banks only):

$$\Delta \ln total_credit_{ijt} = f_i + f_j + \beta \ln min_cap_req_{jt} + \Psi X_{ijt} + \varepsilon_{ijt}$$

Reform implementation schedule

BANK CREDIT ELASTICITIES: DATA

VARIABLES	(1) $\Delta \ln \text{ total_credit}$	(2) $\Delta \ln \text{ total_credit}$	(3) $\Delta \ln \text{ total_credit}$	(4) $\Delta \ln \text{ total_credit}$
ln Tier1 ratio	-0.135*** (0.0433)	-0.138** (0.0469)	-0.140*** (0.0426)	-0.143*** (0.0461)
Constant	0.144* (0.0777)	0.143 (0.0841)	0.356*** (0.0822)	0.368*** (0.0891)
Observations	83,559	77,733	83,559	77,733
Fixed Effects	Firm, Bank	Firm, Bank	Firm, Bank	Firm, Bank
Relationship controls	No	No	Yes	Yes
Sample	All	Domestic	All	Domestic
R2	0.0699	0.0722	0.0919	0.0954

Robustness: guidelines only

Robustness: incl. guidelines

Robustness: D-SIB only

Robustness: foreign only

BANK CREDIT ELASTICITIES: MODEL

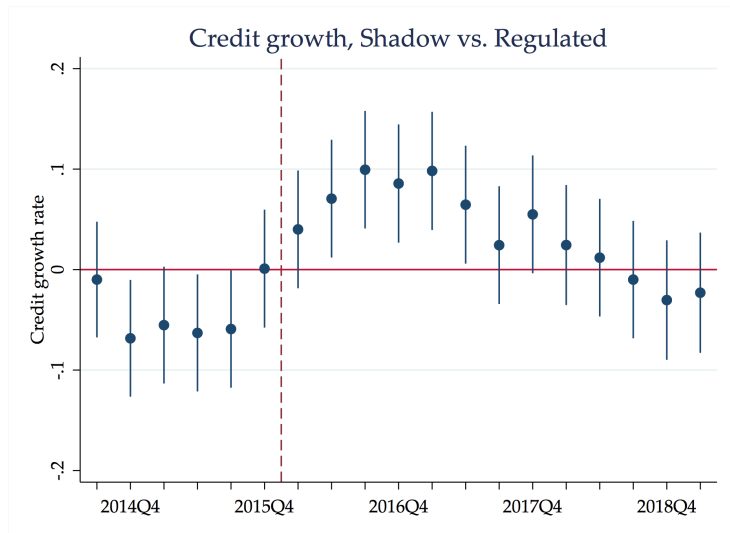
VARIABLES	(1) $\Delta \ln \text{ loans}$	(2) $\Delta \ln \text{ loans}$	(3) $\Delta \ln \text{ loans}$	(4) $\Delta \ln \text{ loans}$
$\ln \text{ capital req.}$	-0.118*** (0.00149)	-0.118*** (0.00138)	-0.118*** (0.00161)	-0.118*** (0.00137)
ω			-1.393*** (0.0467)	0.0237 (0.0416)
Constant	0.156*** (0.00244)	0.156*** (0.00233)	1.535*** (0.0459)	0.132*** (0.0410)
Observations	70,056	70,056	70,056	70,056
Fixed Effects	Bank	None	Bank	None
R2	0.189	0.0740	0.201	0.0740

SPILOVER EFFECT ON SHADOW LENDING

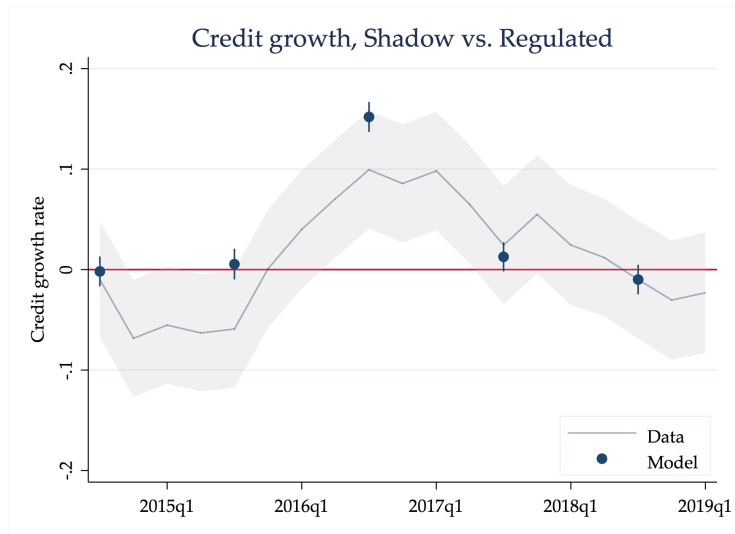
Include all lenders and modify the baseline regression:

$$\Delta \ln total_credit_{ijt} = f_i + f_j + f_t + \beta \cdot Shadow_j \\ + \gamma_t \cdot Shadow_j + \Psi X_{ijt} + \varepsilon_{ijt}$$

SPILLOVER EFFECT ON SHADOW LENDING: DATA



SPILLOVER EFFECT ON SHADOW LENDING: MODEL



CONCLUSION

- Main takeaway - in Korea, Basel III lead to:
 - ▶ sharp decline in corporate credit from regulated banks
 - ▶ similar increase in shadow lending
- GE model of regulated banks and *endogenous* shadow lenders
- Macro results quantitatively consistent with micro estimates
- A lot more in the paper:
 - ▶ effect of reform on broad macroeconomy
 - ▶ counterfactuals