Asset Securitization, Cross Holdings, and Systemic Risk in Banking

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■ 2019.04 申请国家级大学生创新训练项目

银行间交叉持有信贷资产证券化产品的动因及其对系统性风险的影响

申请人：肖书华 赵家楠 徐凤云 林楠 罗银燕

■ 2020.06 获优秀本科毕业论文

信贷资产证券化的效应及其对银行体系系统性风险的影响

中山大學
SUN YAT-SEN UNIVERSITY

中山大学 2020 届
校级优秀本科毕业论文获奖证书

论文题目：信贷资产证券化的效应及其对银行体系系统性风险的影响

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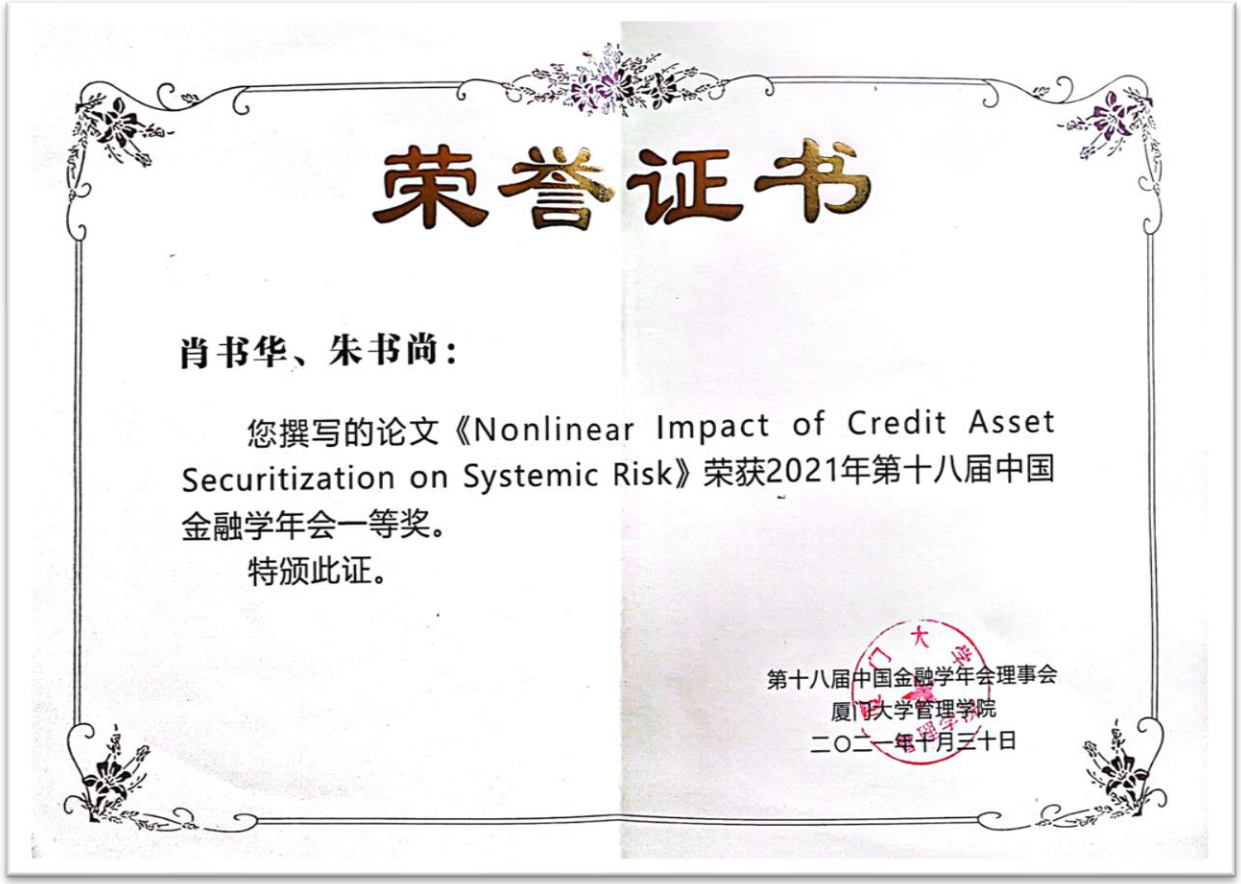
中山大学教务部

二〇二〇年六月

- 2021.10 获第十八届中国金融学年会一等奖



荣誉证书

肖书华、朱书尚：

您撰写的论文《Nonlinear Impact of Credit Asset Securitization on Systemic Risk》荣获2021年第十八届中国金融学年会一等奖。

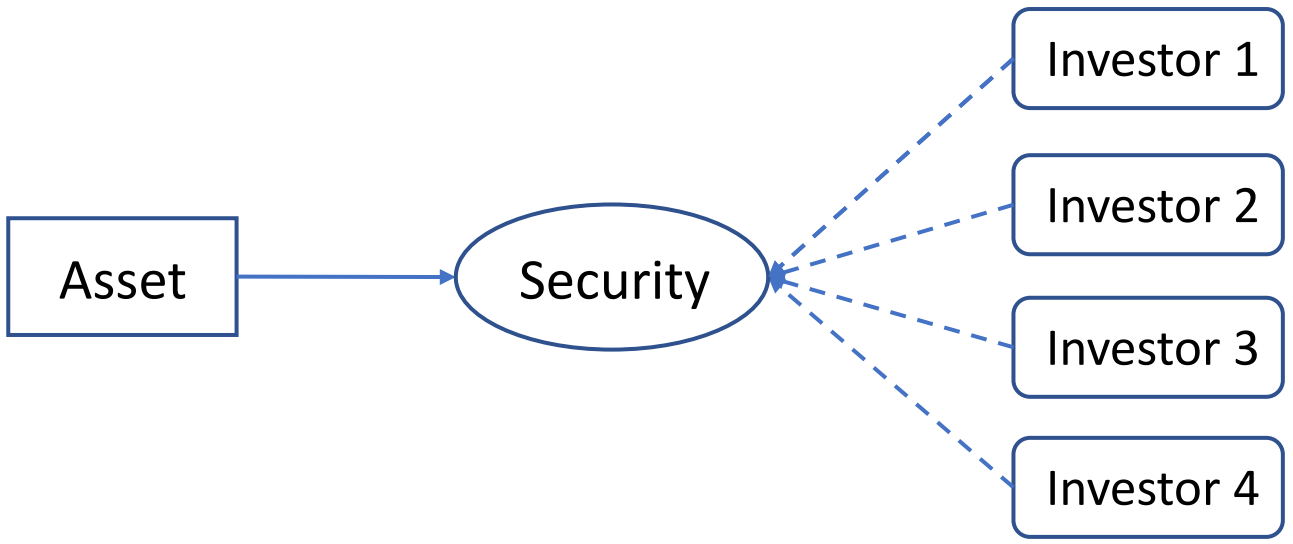
特颁此证。

第十八届中国金融学年会理事会
厦门大学管理学院
二〇二一年十月三十日

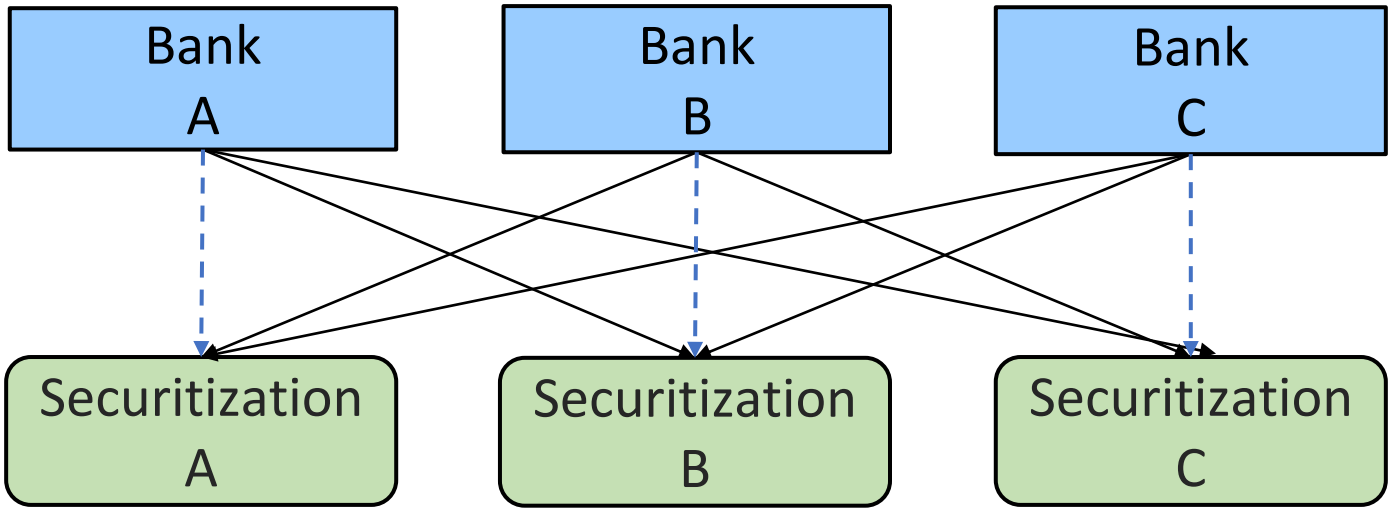
- 2021.10至今 修改投稿

- 1. Introduction
  - (Credit) Asset Securitization
  - Cross holdings
  - Systemic Risk
- 2. Modeling Framework
  - Basic Model $\Longrightarrow$ Securitized Model $\Longrightarrow$ Cross-holding Model
- 3. Cross-holding Behavior
  - Impacts of Cross-holding on Long-term Credit Creation
  - Impacts of Cross-holding on Regulation Circumvention
- 4. Nonmonotonic Impact of Securitization on Systemic Risk
- 5. Simulation & Empirical Test
- 6. Conclusions

1.1 (Credit) Asset Securitization



Cross-holding Structure of Banks



- In finance, **systemic risk** is the risk of collapse of an entire financial system or entire market, ……
- Risk imposed by **interlinkages** and **interdependencies** in financial system or market, where the failure of a single entity or cluster of entities can cause a cascading failure, ……
- It is also sometimes erroneously referred to as "**systematic risk**"

Source: Wikipedia

Motivation

…Given that (Banks')originators would have understood the deterioration of the underlying quality of mortgages, it is surprising that they held on to so many of the mortgage-backed securities (MBS) in their own portfolios…

Why banks cross-hold securitization products?

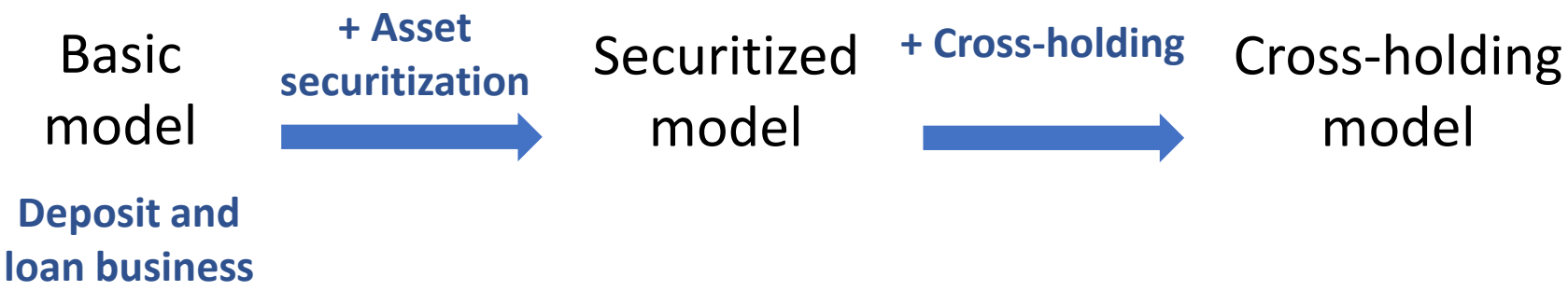
Considering Cross-holding, what's the impact of securitization on systemic risk?

Source: Diamond, D.W., Rajan, R.G., 2009. The credit crisis: Conjectures about causes and remedies. AER 99, 606–610.

Related literature

- **Phenomenon:** Deku et al.(2019)
- **Functions:** Cantor and Rouyer(2000); Instefjord(2005); Allen and Carletti(2006)
- **Consequence:** Shin(2009); Shleifer and Vishny(2010); Nijskens and Wagner(2011); Gong and Wang(2013); Slijkerman et al(2013)
- **Lasted empirical analysis:** Ivanov and Jiang(2020); Arif(2020)

2. Logic


Basic model
Deposit and loan business
+ Asset securitization
Securitized model
+ Cross-holding
Cross-holding model

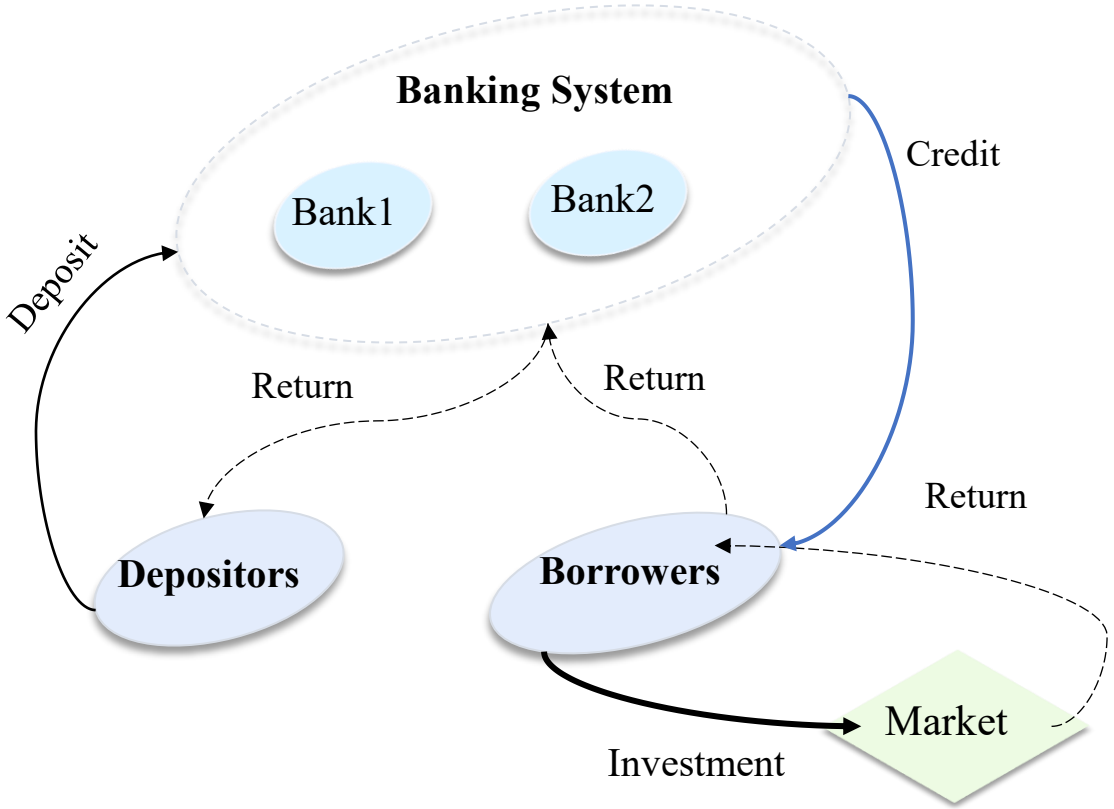


Figure 1: Schematic diagram of the Basic model.

Asset	A
Equity	E
Leverage	μ
Credit creation	B^b
Risk transfer	0
Expected profit	$E(\pi^b)$

Remark 1

$$\frac{\partial B^b}{\partial \mu} = \frac{E}{(1-\mu)^2}, \; and \; \frac{\partial B^b}{\partial E} = \frac{1}{1-\mu}.$$

Participation Constraint

$$E(\pi^b) \geq 0 \Longrightarrow p_b \leq p_b^b$$

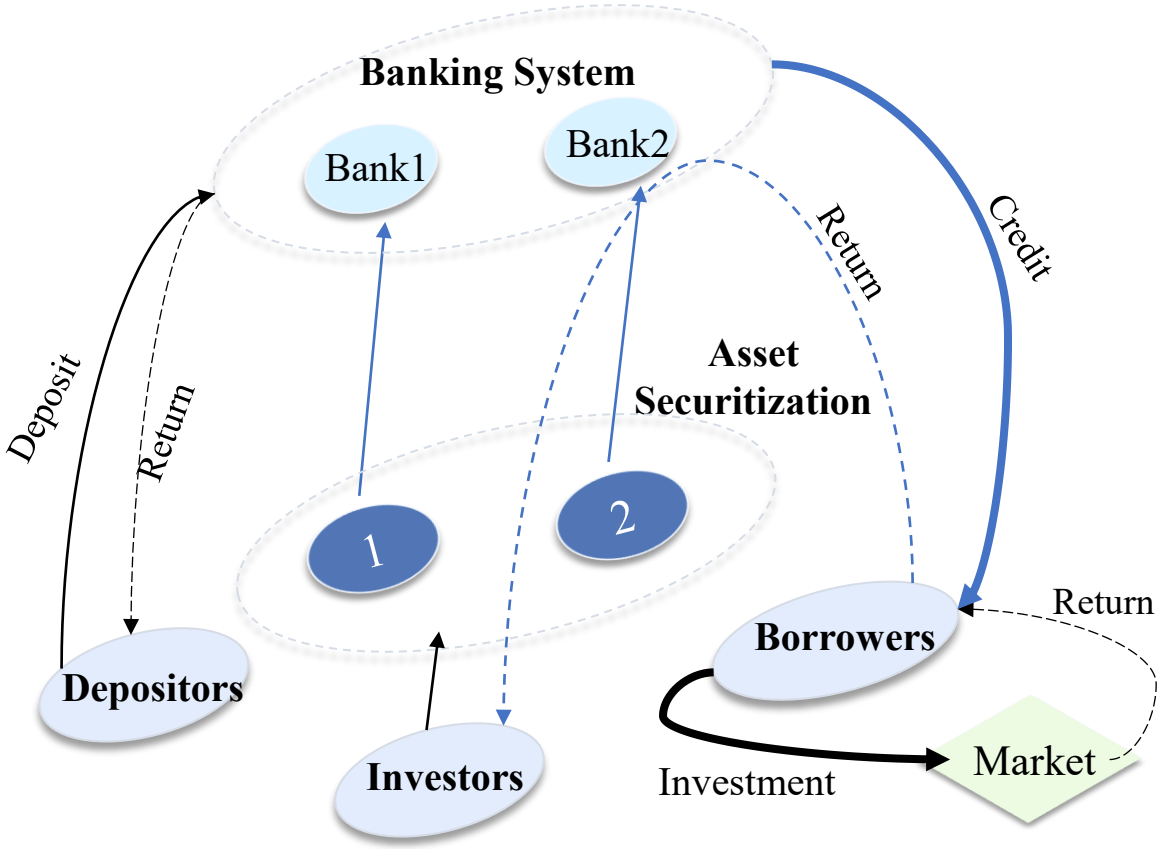


Figure 2: Schematic diagram of the Securitized model.

2.2 Securitized Model

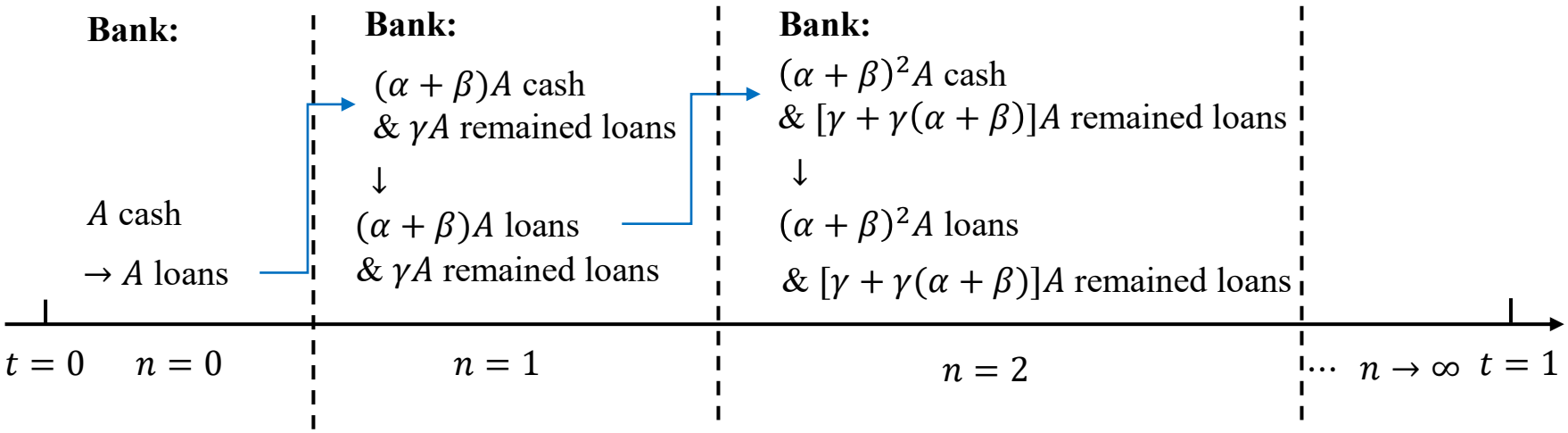


Figure: The schematic diagram of the process of CAS products insurance.

2.2 Securitized Model

Asset	A
Equity	E
Leverage	μ
Risk retention	γ
Credit creation	$B^s > B^b$
Expected profit	$E(\pi^s)$
Risk transfer	$\frac{1-\gamma}{\gamma}A$

Prop 1

$$\frac{\partial \Delta E(\pi^{s-b})}{\partial \mu} > 0 \ \textit{if and only if} \ F - r_d > 0.$$

Participation Constraint

$$E(\pi^s) \geq 0 \Longrightarrow p_b \leq p_b^s$$

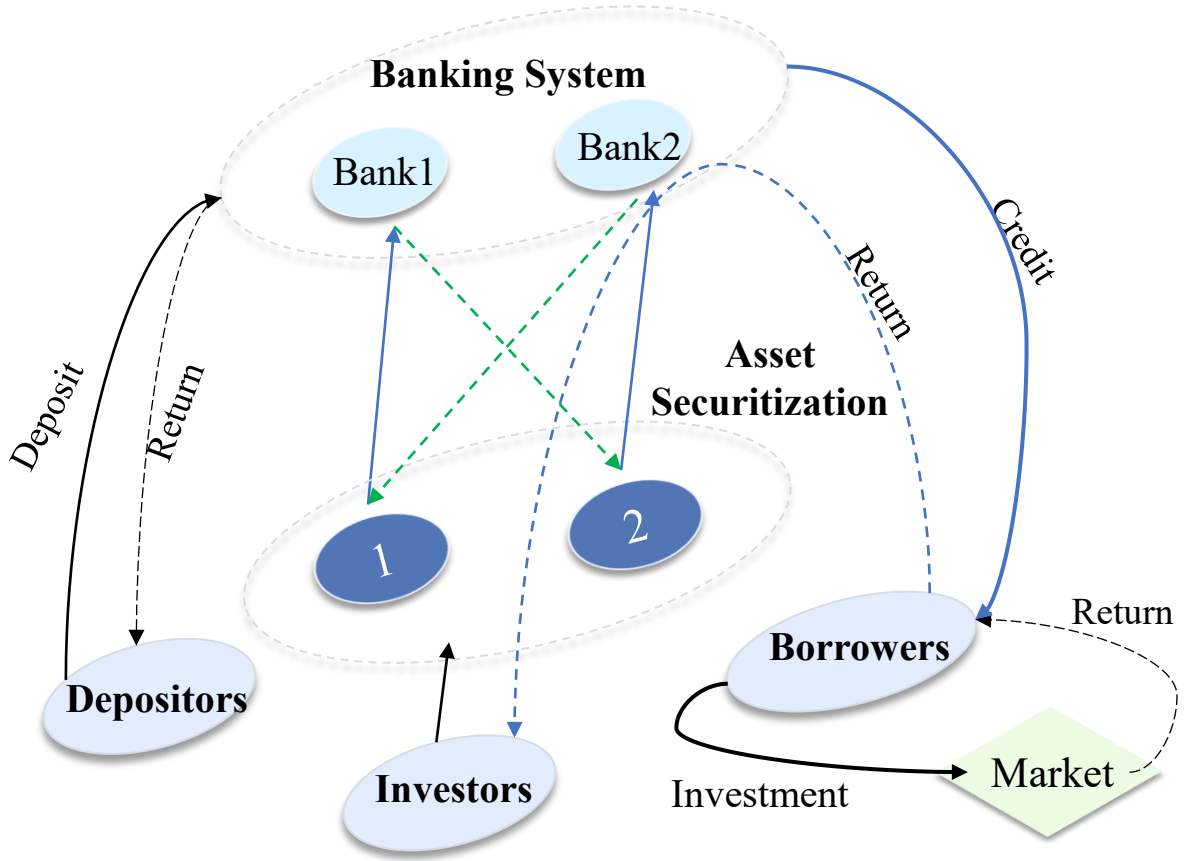


Figure 4: Schematic diagram of the Cross-holding model.

Asset	A
Equity	E
Leverage	μ
Risk retention	γ
Degree of cross-holding	θ
Credit creation	$B^s > B^c > B^b$
Risk transfer	$\frac{1-\gamma}{\theta+\gamma-\theta\gamma}A$
Expected profit	$E(\pi^c)$

Prop 1(con.)

$$\frac{\partial \Delta E(\pi^{c-b})}{\partial \mu} > 0 \text{ if and only if } F - r_d > 0.$$

Participation Constraint

$$E(\pi^c) \geq 0 \Longrightarrow p_b \leq p_b^c$$

2. Credit creation in different models

$B^s > B^c > B^b$

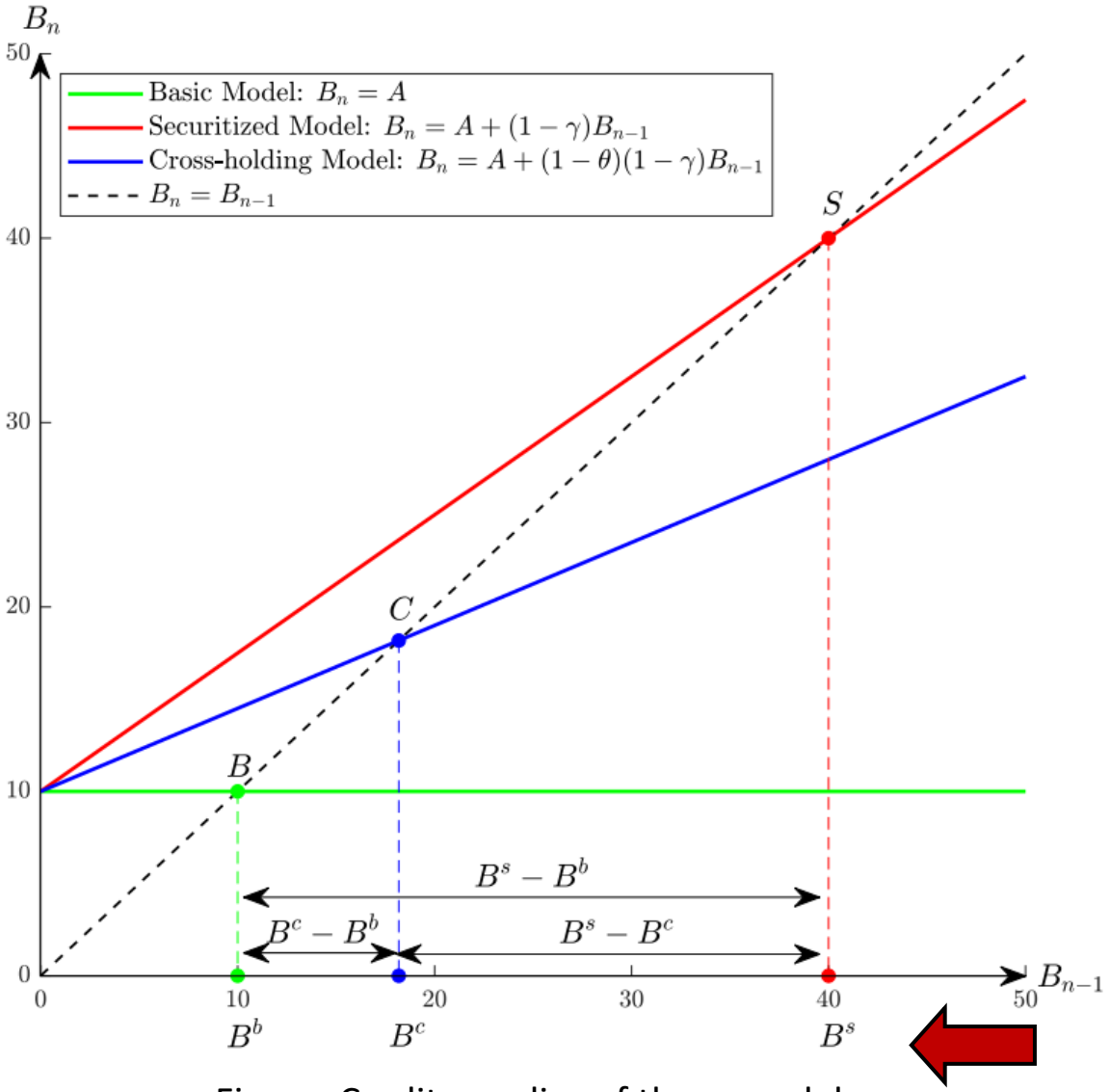


Figure: Credit supplies of three models.

2. Comparing (Props 2-3)

Securitized model — Cross-holding model

Prop 2 $\Delta E(\pi^{c-s}) > 0$ *if and only if* $F < r_d$, *and* $\dfrac{\partial \Delta E(\pi^{c-s})}{\partial \mu} > 0$ *if and only if* $F < r_d$.

Prop 3 *The probability thresholds satisfy* $p_b^d < p_b^s < p_b^c < p_b^b$. *Furthermore, if* $p_a = 0$, *then* $p_b^d > 0$.

2. Cut-off values of default probabilities

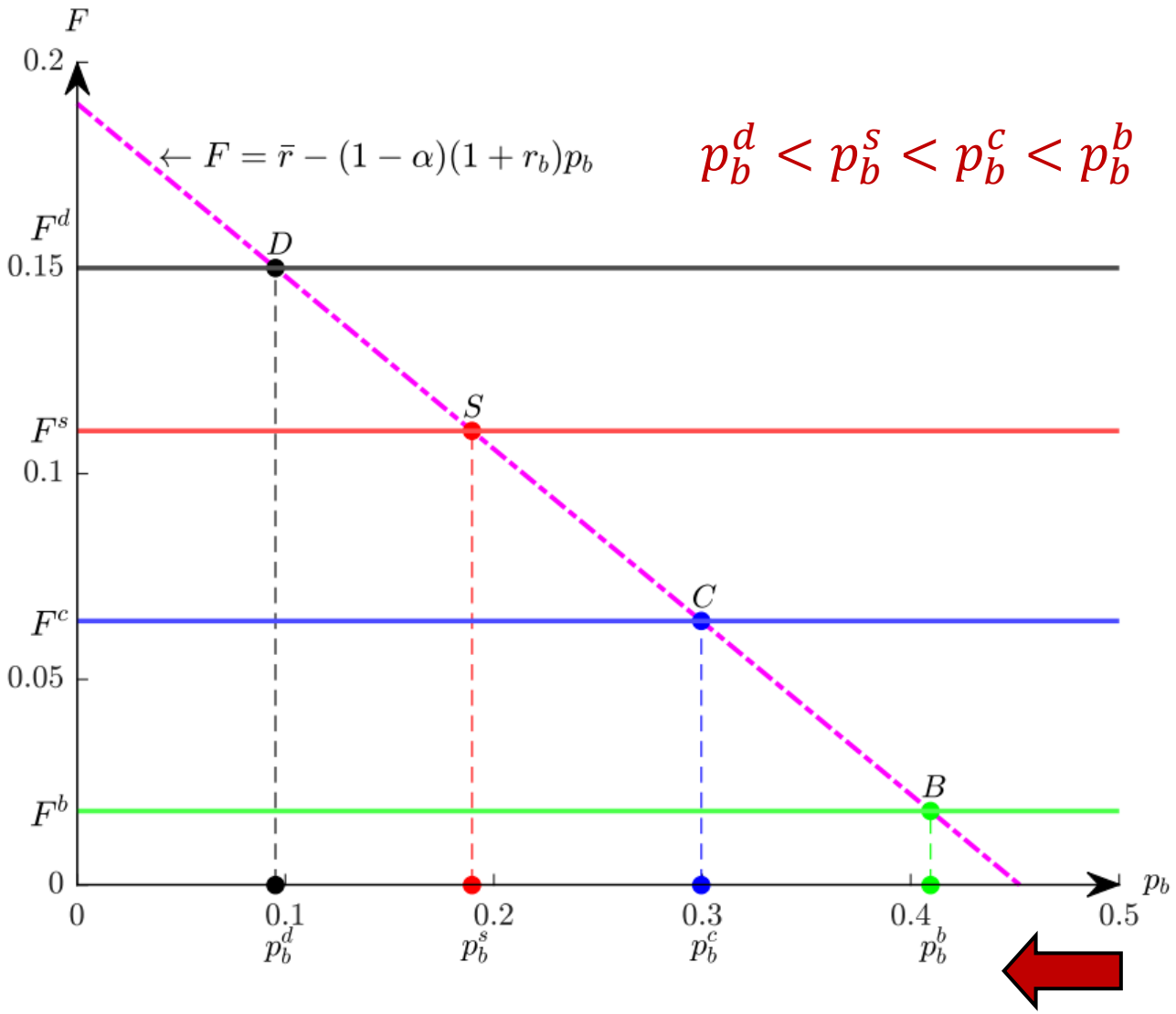


Figure: Cut-off values of default probabilities deduced from the business constraints.

Prop 4 $B_1^c > B_1^s$ *if and only if* $\Delta E(\pi^{c-s}) > \frac{\theta}{\gamma}\left[\Delta E(\pi^{s-b}) + (1-\gamma)(1-\mu-r_c\mu+r_d^s)A\right]$

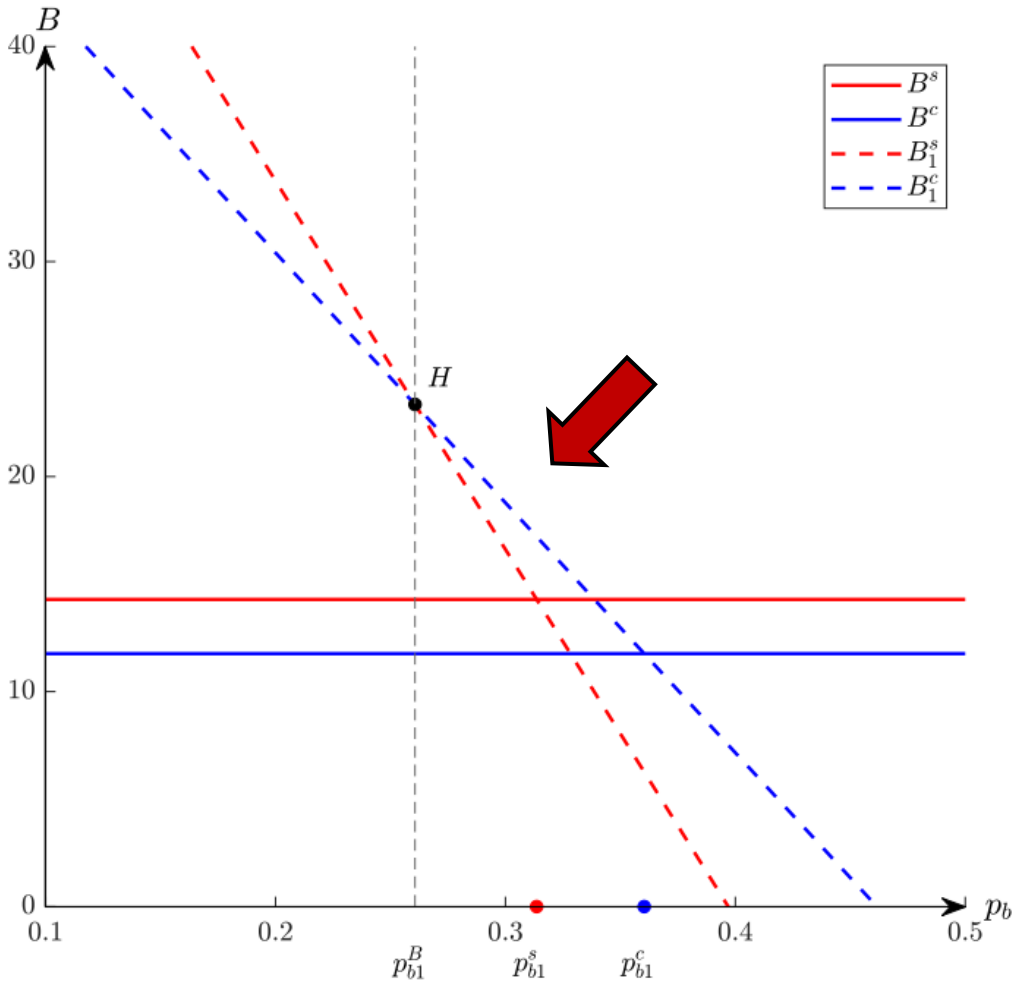


Figure: Expected profits in the current and the next terms.

Capital Adequacy Ratio (CAR)

$$K_1 = \left(\kappa^b - \kappa^c\right)A$$

$$K_2 = (\widetilde{w}^q - \kappa^c)A$$

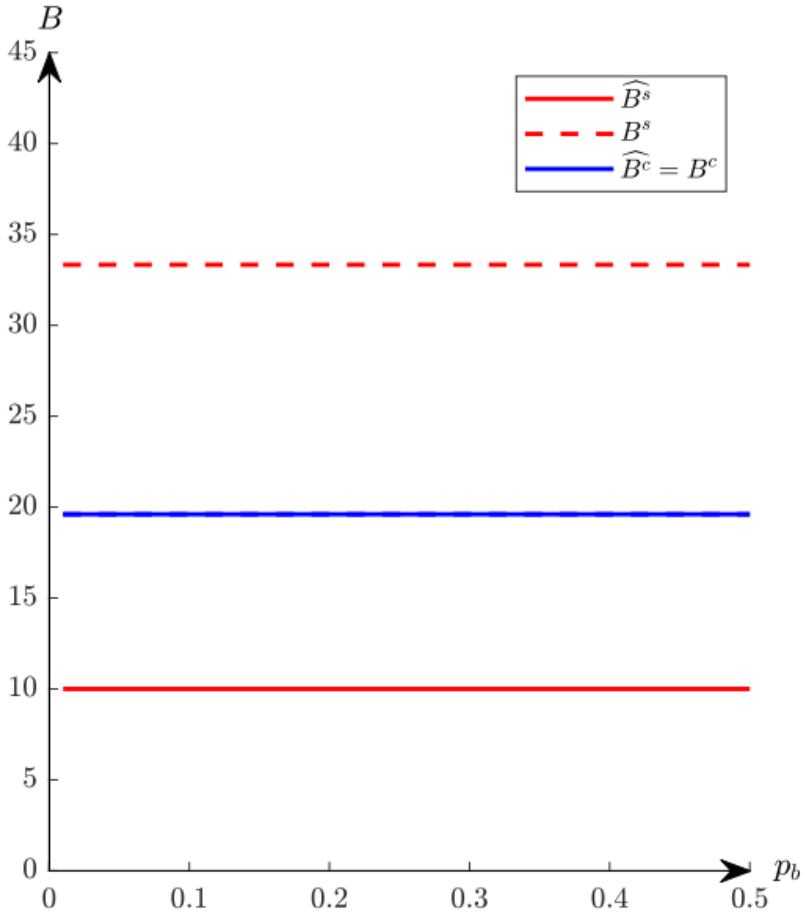
κ^b : the asset risk multiplier in the Basic model

κ^c : the asset risk multiplier in the unconstrained Cross-holding model

$\widetilde{w}^q$: the upper limit of the asset risk multiplier imposed by regulation

Prop 5 *If $K_2 > 0$, or $K_2 = 0$ and $K_1 \leq 0$, then the CAR constraint is invalid for the Cross-holding model.*

Prop 6 *Given an invalid CAR constraint for the Cross-holding model, which is valid in the Securitized model,* $\widehat{B^s} < \widehat{B^c}$ *holds under Condition (33) and* $E(\widehat{\pi^s}) < E(\widehat{\pi^c})$ *holds under Condition (38).*



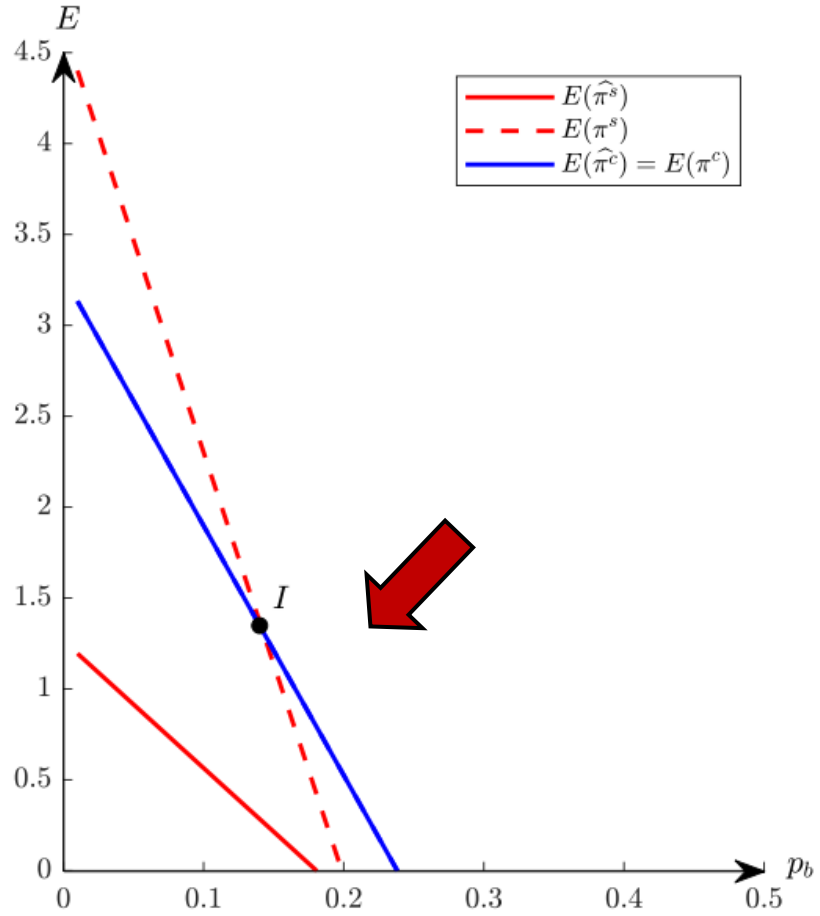


Figure: Credit supplies and expected profits with/without CAR constraint.

Until Now

- Why banks cross-hold securitization products?

4. Different Capital Loss Rates

Asset	A
Equity	E
Leverage	μ
Risk retention	γ
Degree of cross-holding	θ
Capital loss rates	v
Related asset	λ

Prop 7

$$v^b \ \& \ v^s$$

monotonically decreasing function of $(\lambda_2 + \lambda_3)$.

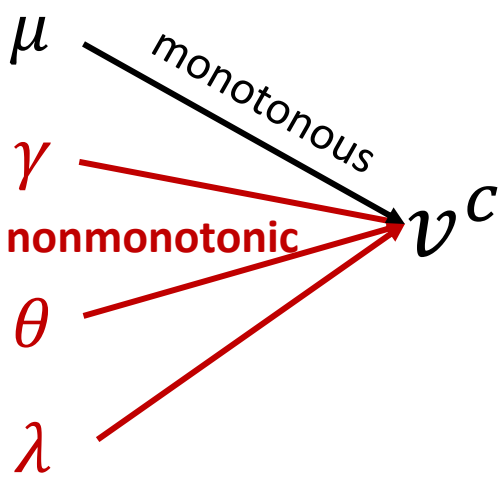
Prop 8

$$v^b \gtreqless v^c$$

$$\mu \ \lambda_2 \ \gamma \ \theta$$

4. Important Parameters (Props 9-11)

Asset	A
Equity	E
Leverage	μ
Risk retention	γ
Degree of cross-holding	θ
Capital loss rates	v
Related asset	λ



Theoretical Model

Result: Nonmonotonic Relationship

Theoretical Model

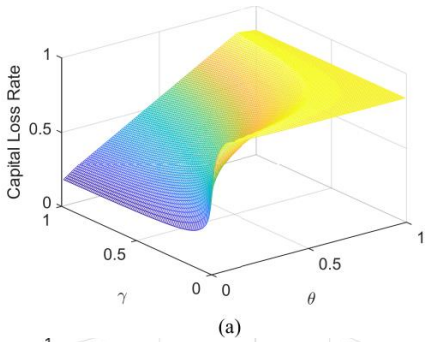
Result: Nonmonotonic Relationship

Simulation & Empirical Test

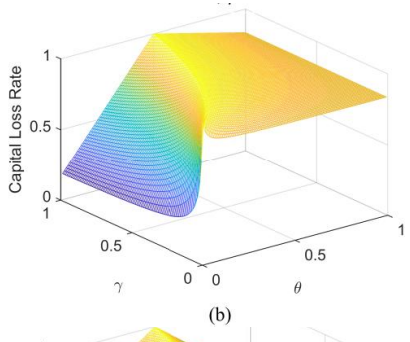
Goal: Nonmonotonic → Which shape ?

5.1 Capital Loss Rates in Different Conditions

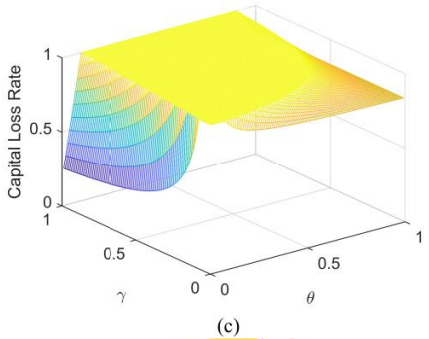
$\lambda = 0.2$
$\mu = 0.1$



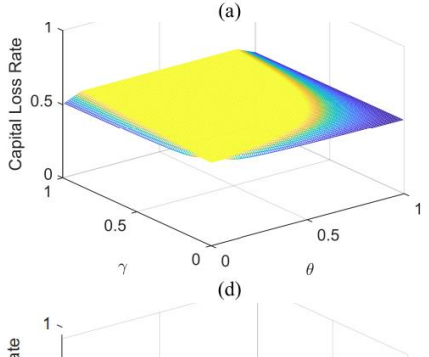
$\lambda = 0.2$
$\mu = 0.5$



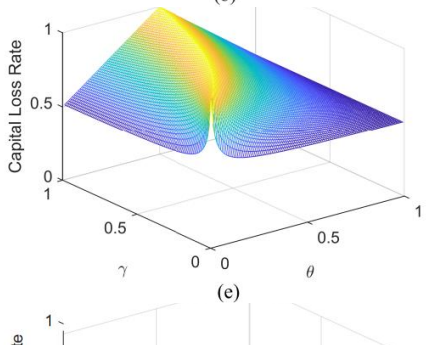
$\lambda = 0.2$
$\mu = 0.9$



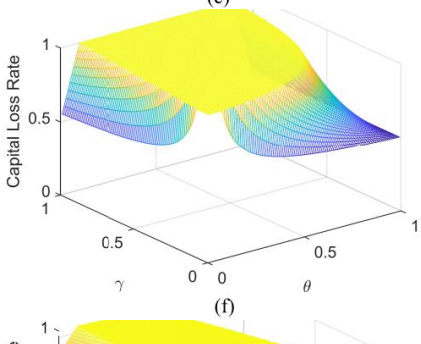
$\lambda = 1.0$
$\mu = 0.1$



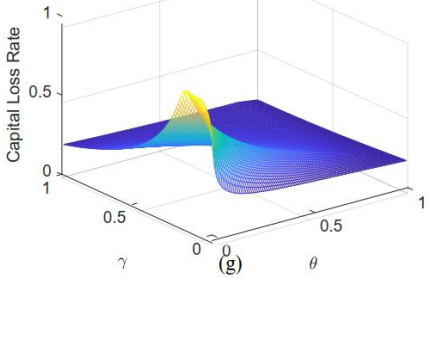
$\lambda = 1.0$
$\mu = 0.5$



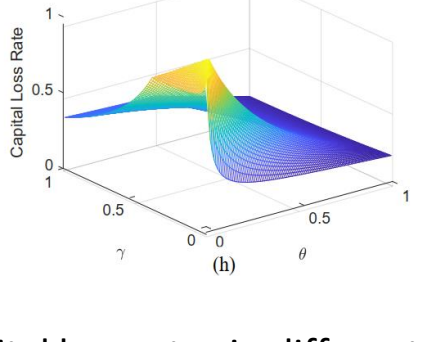
$\lambda = 1.0$
$\mu = 0.9$



$\lambda = 5.0$
$\mu = 0.1$



$\lambda = 5.0$
$\mu = 0.5$



$\lambda = 5.0$
$\mu = 0.9$

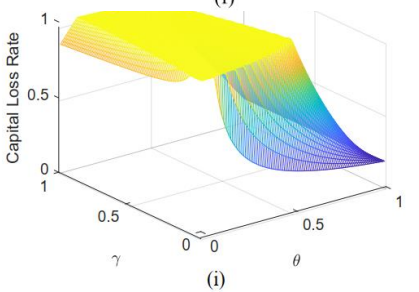


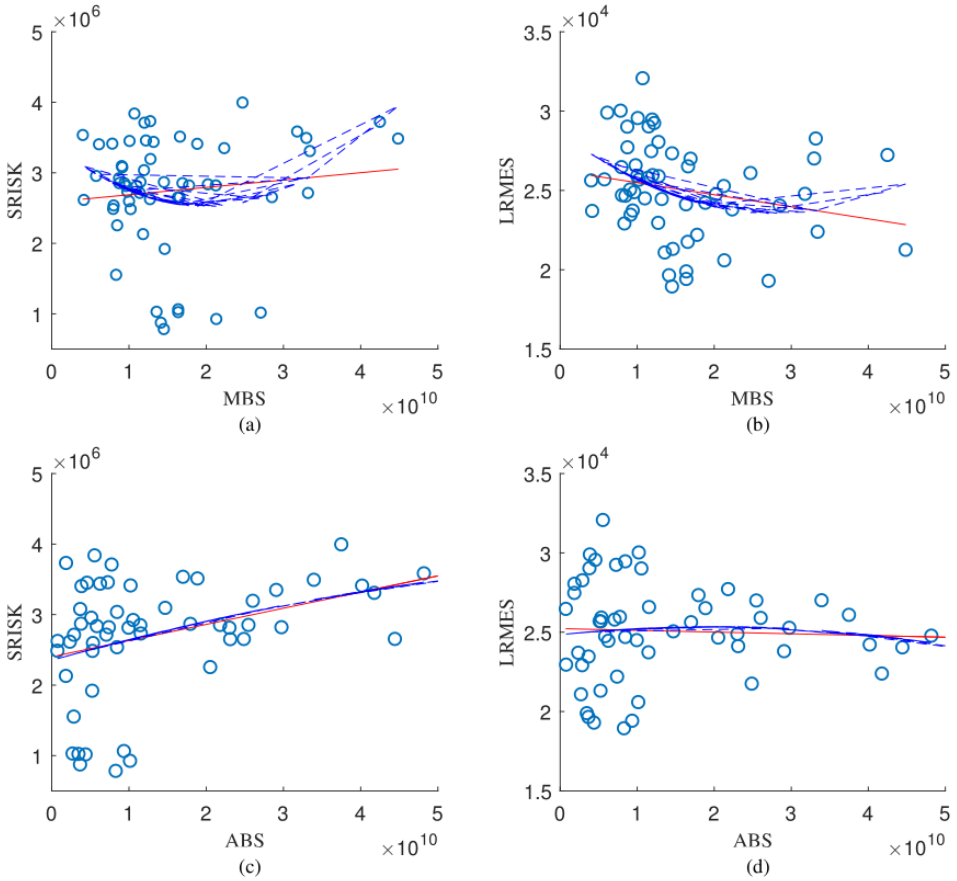
Figure: Capital loss rates in different conditions.

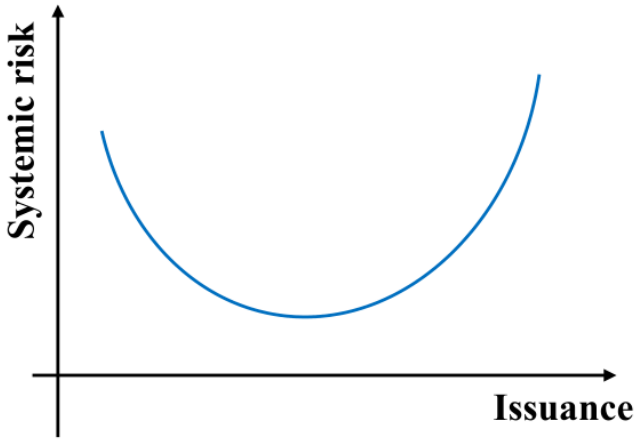
5.2 Data and Variables

- 27 Countries and Regions
- 2005Q4-2019Q4
- Quarterly Frequency
- SRISK & LRMES(Long Run Marginal Expected Shortfall)
- MBS & ABS

Countries and Regions	Stock Index	Countries and Regions	Stock Index
Global market	MSCI World Index	Japan	TPX
Argentina	MERV	Korea, Rep.	KS11
Australia	AS51	Malaysia	KLS
Belgium	BFX	Mexico	MXX
Brazil	MSCI Brazil	Netherlands	AEX
Canada	GSPTSE	New Zealand	NZSE.GI
China Mainland	000001.SH	Portugal	PSI
Finland	HEX	Russian Federation	MOEX
France	CAC40	South Africa	MSCI South Africa
Germany	DAX	Spain	IBEX
Greece	ASE	Sweden	OMXSPI
India	SENSEX	Switzerland	SMI
Ireland	ISEQ	United Kingdom	FTSE
Italy	MSCI Italy	United States	S&P500

5.2 Pre-analysis





5.2 Empirical Results

SRISK	(7)	(8)	(9)	(10)
MBS	−1.2799***			−1.2702***
MBS2	1.6209***			1.6003***
ABS		−0.5061*		0.1100
ABS2		0.5873*		−0.0908
OTHER			−0.3658**	−0.0944
OTHER2			0.4700**	0.1414
SIZE	0.6515***	0.4852***	0.4975***	0.6296***
NPL	0.0523***	0.0405***	0.0505***	0.0620***
LEND	−0.1169**	−0.0971**	−0.1287***	−0.1217***
M1	−0.0110	−0.0003	0.0018	−0.0111
M2	0.0350**	0.0272	0.0210	0.0354**
FINANCE	−0.2819***	−0.2672***	−0.2600***	−0.2823***
VOL	0.0401	0.0290	0.0251	0.0432
GDP	−0.0647***	−0.0784***	−0.0816***	−0.0636***
FIXEDI	0.0031	0.0042	0.0028	0.0017
EXCHANGE	−0.0689***	−0.0174	0.0012	−0.0710***
DEFLATOR	−0.0331	−0.0408	−0.0261	−0.0324
CREDIT	0.1969**	0.3071***	0.3185***	0.1913*
C	−0.0823**	−0.1032**	−0.1082***	−0.0830**
N	1,539	1,539	1,539	1,539
Time	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
F	282.3350	237.5083	489.4890	508.9313
R^2	0.3606	0.2957	0.2873	0.3647

5.2 Empirical Results

LRMES	(7)	(8)	(9)	(10)
MBS	−0.4225***			−0.3664***
MBS2	0.5242***			0.4532***
ABS		−0.2501***		−0.0997**
ABS2		0.2883***		0.1237**
OTHER			−0.0775**	0.0235
OTHER2			0.0887**	−0.0338
SIZE	0.3245***	0.2704***	0.2870***	0.3103***
NPL	−0.0020	−0.0039	−0.0062	−0.0022
LEND	−0.0198*	−0.0107	−0.0197*	−0.0130
M1	−0.0007	0.0021	0.0035	−0.0007
M2	0.0074	0.0055	0.0034	0.0081*
FINANCE	−0.0335*	−0.0311	−0.0257	−0.0338*
VOL	−0.0127	−0.0148	−0.0180*	−0.0116
GDP	−0.0211***	−0.0239***	−0.0266***	−0.0206***
FIXEDI	0.0065	0.0069	0.0068	0.0066
EXCHANGE	0.0293*	0.0392**	0.0515***	0.0267*
DEFLATOR	−0.0041	−0.0079	−0.0033	−0.0073
CREDIT	0.0970***	0.1212***	0.1382***	0.0956***
C	0.0023	−0.0039	−0.0052	0.0016
N	1,539	1,539	1,539	1,539
Time	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
F	40.6122	68.0656	49.2190	60.8523
R^2	0.4381	0.4095	0.3710	0.4492

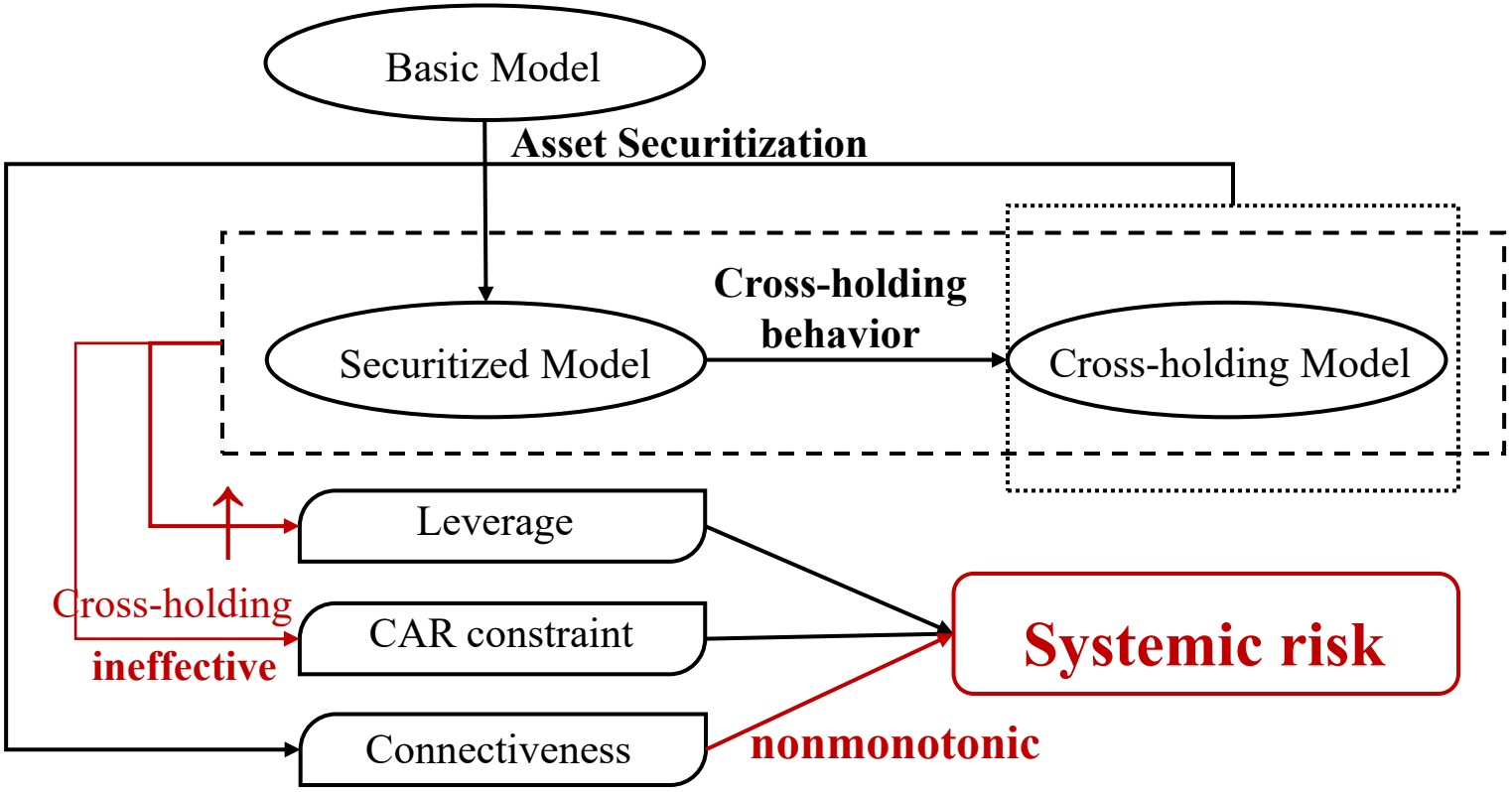
5.2 Empirical Results (Robust test)

Panel A: SRISK	(1)	(2)	(3)	(4)	(5)
MBS	−1.2589***	−1.2724***	−1.2187***	−1.2668***	−1.2783***
MBS2	1.5858***	1.6026***	1.5355***	1.5966***	1.6115***
ABS	0.1035	0.0990	0.1578	0.1106	0.1373
ABS2	−0.0847	−0.0791	−0.1422	−0.0903	−0.1183
OTHER	−0.0965	−0.0959	−0.1196	−0.1048	−0.1332
OTHER2	0.1434	0.1406	0.1727	0.1518	0.1887
SIZE	0.6107***	0.6412***	0.6325***	0.6161***	0.6396***
NPL	0.0609***	0.0575***	0.0135	0.0639***	0.0268
LEND	−0.1155**	−0.0950**	−0.1265***	−0.1222***	−0.1301***
M1	−0.0125	−0.0150	−0.0171	−0.0119	−0.0163
M2	0.0382**	0.0348**	0.0465***	0.0381**	0.0460**
FINANCE	−0.2961***	−0.2957***	−0.2831***	−0.2759***	−0.2825***
VOL		0.0432	0.0371	0.0421	0.0386
GDP	−0.0767***	−0.0651***	−0.0689***	−0.0617***	−0.0653***
FIXEDI	0.0009	0.0005	0.0001	0.0027	0.0009
EXCHANGE	−0.0737***	−0.0743***	−0.0528**	−0.0708***	−0.0602**
DEFLATOR	−0.0348		−0.0264	−0.0310	−0.0319
CREDIT	0.1946*	0.1851*		0.1823*	0.2008**
VOLG	0.0169				
CPIP		−0.0632**			
NF_CREDIT			0.3456***		
BUDGET				−0.0151	
PUBLICDEBT					0.1618*
C	−0.0768	−0.0848**	−0.0103	−0.0864**	−0.0377
N	1539	1539	1539	1539	1539
Time&Country	Yes	Yes	Yes	Yes	Yes
F	535.8506	518.7352	828.8722	477.9952	1049.6238
R^2	0.3620	0.3662	0.3791	0.3653	0.3700

5.2 Empirical Results (Robust test)

Panel B: LRMES	(1)	(2)	(3)	(4)	(5)
MBS	−0.3713***	−0.3668***	−0.3475***	−0.3679***	−0.3688***
MBS2	0.4592***	0.4537***	0.4299***	0.4548***	0.4565***
ABS	−0.0982**	−0.1000**	−0.0807*	−0.0999**	−0.0917*
ABS2	0.1227**	0.1239**	0.1033*	0.1235**	0.1157**
OTHER	0.0233	0.0228	0.0088	0.0280	0.0122
OTHER2	−0.0332	−0.0329	−0.0159	−0.0382	−0.0199
SIZE	0.3154***	0.3112***	0.3171***	0.3161***	0.3132***
NPL	−0.0020	−0.0022	−0.0221**	−0.0030	−0.0125
LEND	−0.0147*	−0.0147	−0.0152*	−0.0128	−0.0154*
M1	−0.0007	−0.0011	−0.0036	−0.0003	−0.0022
M2	0.0077	0.0075	0.0124***	0.0069*	0.0112**
FINANCE	−0.0282	−0.0340*	−0.0341*	−0.0366**	−0.0339*
VOL		−0.0115	−0.0139	−0.0112	−0.0130
GDP	−0.0165***	−0.0209***	−0.0229***	−0.0214***	−0.0210***
FIXEDI	0.0070	0.0064	0.0060	0.0062	0.0064
EXCHANGE	0.0275*	0.0265*	0.0336**	0.0266*	0.0298*
DEFLATOR	−0.0065		−0.0050	−0.0079	−0.0071
CREDIT	0.0937***	0.0955***		0.0995***	0.0984***
VOLG	−0.0015				
CPIP		−0.0044			
NF CREDIT			0.1493***		
BUDGET				0.0065	
PUBLICDEBT					0.0474***
C	−0.0014	0.0019	0.0320***	0.0031	0.0149
N	1539	1539	1539	1539	1539
Time&Country	Yes	Yes	Yes	Yes	Yes
F	65.3597	62.8910	56.1098	61.8122	60.3269
R^2	0.4472	0.4490	0.4690	0.4502	0.4532

6. Conclusion



Q & A