Financial innovation and systemic risk in the financial sector:

Some recent development

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The dark and bright sides of financial innovations (Beck et al., 2016)

The *innovation-growth hypothesis* suggests that financial innovations :

a. Improve the quality and variety of banking services (Merton, 1992; Berger, 2003)
b. Facilitate risk sharing (Allen and Gale, 1991, 1994),
c. Complete the market (Duffie and Rahi, 1995; Elul, 1995; Grinblatt and Longstaff, 2000),
d. Improve allocative efficiency (Ross, 1976; Houston et al., 2010)

The dark and bright sides of financial innovations (Beck et al., 2016)

On the contrary, the *innovation-fragility hypothesis* identified financial innovations as the root cause of the recent Global Financial Crisis:

a. by leading to an unprecedented credit expansion that helped feed the boom and subsequent bust in housing prices (Brunnermeier, 2009),
b. by engineering securities perceived to be safe but exposed to neglected risks (Gennaioli et al., 2012), and
c. by helping banks develop structured products to exploit investors' misunderstandings of financial markets (Henderson and Pearson, 2011).

Measuring financial innovation: No formal definition

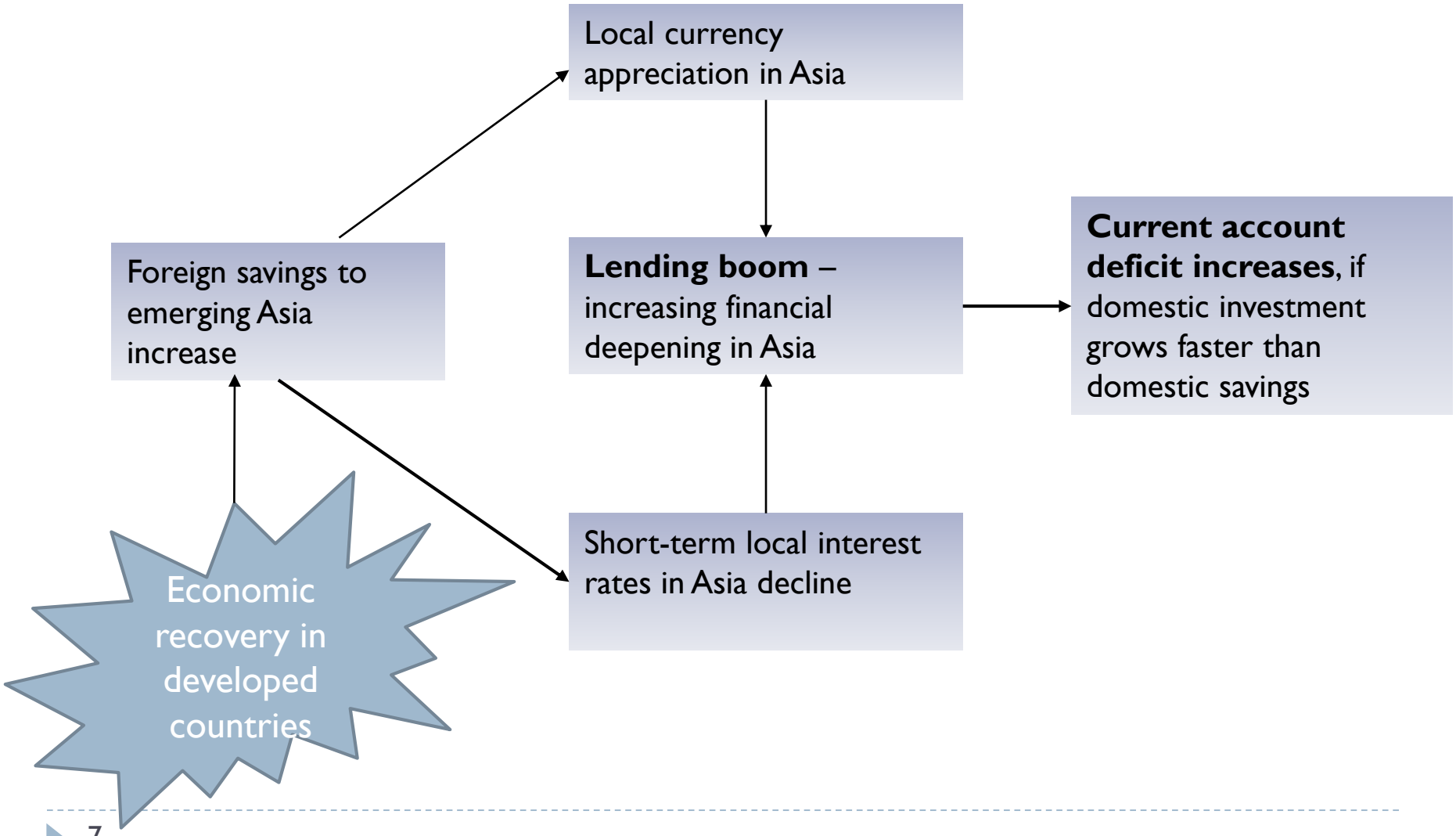
1. The existence of new forms of financial securities such as retail structured equity product and derivatives (e.g. Grinblatt and Longstaff, 2000; Schroth, 2003; Henderson and Pearson, 2011)
2. New credit scoring techniques (Frame and White, 2004, 2009; Akhavein et al., 2005)
3. New provisioning technique: a dynamic provisioning system (Fernandez de Lis, 2001)
4. New forms of mortgage lending (Gerardi et al., 2010)
5. New organizational forms, such as digital banking (e.g. DeYoung, 2001, 2005; DeYoung et al., 2007).
6. Share of off balance-sheet items to total assets (Beck et al., 2016)
7. Securitization to GDP (Beck et al., 2016)

I. FINANCIAL INNOVATION, LENDING BOOM AND MACROECONOMIC STABILITY

Financial innovation and macroeconomic stability: Effect of lending booms

- Just before the 2008 global financial crisis (GFC), several literature emerges, highlighting the role of global imbalance in exacerbating current account problems both in the US and global economy (Roubini and Setser, 2005; Obstfeld and Rogoff, 2007; Krugman, 2007).
- Such global imbalance issues have been referred to as a 'global saving glut' that initially occurred in the US, in which a ballooning US current account deficit is due to an excess of saving from emerging Asian countries – especially China – invested in US riskless assets (Bernanke, 2005; Clarida, 2005; Hubbard, 2005).
- Higher capital inflows into the US in turn reduces US interest rates and spread, which contributes to spur financial innovation and credit boom in the US housing market (Brunnermeier, 2009)

Testing potential impact on macroeconomic stability of financial innovation related lending boom: Evidence from RCEP countries



Empirical methodology

Data: World Development Indicators (World Bank)
Period: 1990-2015
Country: Indonesia, Malaysia, Brunei, Cambodia, Thailand, Vietnam, Singapore, Laos, Philippines, India, Australia, China, Japan, South Korea, New Zealand

Empirical methodology

- **Dependent variables:**
  1. Ratio of current account to GDP (CAGDP)
  2. Ratio of savings to GDP (SAVING)
  3. Ratio of gross capital formation to GDP (INV)

- **Independent variables:**
  1. Ratio of credit to GDP (FIN)
  2. Log of GDP (LGDP)
  3. Growth of real GDP (GDPG)
  4. Dependency ratio (DEPEND)

Results

- **Short-term impact of financial deepening on current account**

Dependent Variable: CAGDP
Method: Panel Least Squares
Date: 03/16/17 Time: 00:38
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 342

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	-0.028180	0.012402	-2.272210	0.0238
DEPEND	-0.029444	0.055068	-0.534685	0.5933
LGDP	-0.981832	1.151458	-0.852686	0.3945
GDPG	-0.393470	0.096331	-4.084569	0.0001
C	34.28108	31.14944	1.100536	0.2720

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.864531	Mean dependent var	2.620925
Adjusted R-squared	0.844984	S.D. dependent var	9.843967
S.E. of regression	3.875778	Akaike info criterion	5.666963
Sum squared resid	4476.453	Schwarz criterion	6.160330
Log likelihood	-925.0506	Hannan-Quinn criter.	5.863507
F-statistic	44.22716	Durbin-Watson stat	0.761086
Prob(F-statistic)	0.000000		

Results

- **Short-term impact of financial deepening on savings**

Dependent Variable: SAVING
Method: Panel Least Squares
Date: 03/16/17 Time: 02:12
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 331

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	-0.012168	0.015874	-0.766532	0.4440
DEPEND	-0.164888	0.072654	-2.269486	0.0240
LGDP	3.779180	1.480955	2.551854	0.0112
GDPG	0.544081	0.123888	4.391730	0.0000
C	-59.49648	40.32021	-1.475599	0.1411

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.847446	Mean dependent var	31.76436
Adjusted R-squared	0.824589	S.D. dependent var	11.78474
S.E. of regression	4.935690	Akaike info criterion	6.154087
Sum squared resid	6991.617	Schwarz criterion	6.659504
Log likelihood	-974.5014	Hannan-Quinn criter.	6.355669
F-statistic	37.07676	Durbin-Watson stat	0.440622
Prob(F-statistic)	0.000000		

Results

- **Short-term impact of financial deepening on investment**

Dependent Variable: INV
Method: Panel Least Squares
Date: 03/16/17 Time: 02:11
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 354

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	0.040616	0.013789	2.945437	0.0035
DEPEND	-0.000656	0.060047	-0.010919	0.9913
LGDP	7.986677	1.259017	6.343582	0.0000
GDPG	0.708897	0.106602	6.649968	0.0000
C	-187.2690	34.45871	-5.434590	0.0000

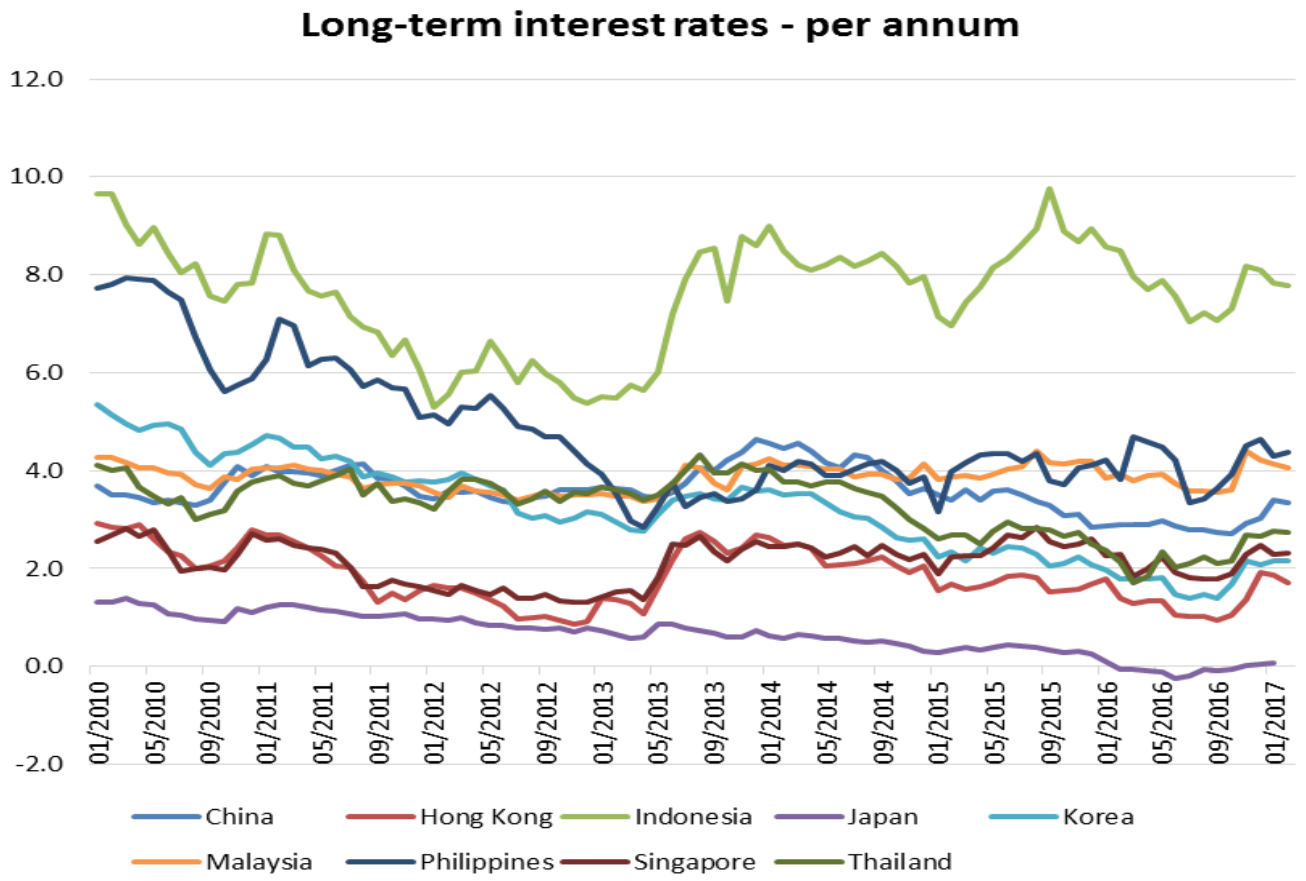
Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.705736	Mean dependent var	27.62411
Adjusted R-squared	0.664918	S.D. dependent var	7.595302
S.E. of regression	4.396634	Akaike info criterion	5.915419
Sum squared resid	5992.422	Schwarz criterion	6.396348
Log likelihood	-1003.029	Hannan-Quinn criter.	6.106765
F-statistic	17.29011	Durbin-Watson stat	0.534315
Prob(F-statistic)	0.000000		

Results: Indonesia vs. other countries

- **Why focusing on Indonesia does matter?**



Results: Indonesia vs. other countries

- **Short term impact of FIN on CAD for Indonesia**

Dependent Variable: CAGDP
Method: Panel Least Squares
Date: 03/16/17 Time: 00:38
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 342
White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	-0.034154	0.013734	-2.486809	0.0134
FIN*IDN	0.170696	0.079357	2.150987	0.0323
DEPEND	-0.007124	0.059045	-0.120651	0.9040
LGDP	-0.490235	1.139001	-0.430408	0.6672
GDPG	-0.383081	0.098412	-3.892631	0.0001
C	20.23972	31.65850	0.639314	0.5231

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.865580	Mean dependent var	2.620925
Adjusted R-squared	0.845666	S.D. dependent var	9.843967
S.E. of regression	3.867238	Akaike info criterion	5.665038
Sum squared resid	4441.793	Schwarz criterion	6.169618
Log likelihood	-923.7214	Hannan-Quinn criter.	5.866049
F-statistic	43.46577	Durbin-Watson stat	0.761693
Prob(F-statistic)	0.000000		

Results: Indonesia vs. other countries

- **Short term impact of FIN on savings for Indonesia**

Dependent Variable: SAVING
Method: Panel Least Squares
Date: 03/16/17 Time: 02:21
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 331
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	-0.015914	0.014648	-1.086454	0.2782
FIN*IDN	0.104861	0.154667	0.677977	0.4983
DEPEND	-0.150974	0.061949	-2.437083	0.0154
LGDP	4.086798	1.004537	4.068340	0.0001
GDPG	0.550296	0.255749	2.151701	0.0323
C	-68.30357	27.02550	-2.527375	0.0120

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.847730	Mean dependent var	31.76436
Adjusted R-squared	0.824303	S.D. dependent var	11.78474
S.E. of regression	4.939713	Akaike info criterion	6.158268
Sum squared resid	6978.620	Schwarz criterion	6.675173
Log likelihood	-974.1934	Hannan-Quinn criter.	6.364432
F-statistic	36.18720	Durbin-Watson stat	0.445738
Prob(F-statistic)	0.000000		

Results: Indonesia vs. other countries

- **Short term impact of FIN on investment for Indonesia**

Dependent Variable: INV
Method: Panel Least Squares
Date: 03/16/17 Time: 02:20
Sample: 1990 2015
Periods included: 26
Cross-sections included: 15
Total panel (unbalanced) observations: 354
White cross-section standard errors & covariance (d.f. corrected)
WARNING: estimated coefficient covariance matrix is of reduced rank

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIN	0.046083	0.018676	2.467426	0.0142
FIN*IDN	-0.160025	0.088459	-1.809037	0.0714
DEPEND	-0.020694	0.047525	-0.435429	0.6636
LGDP	7.530291	1.285710	5.856913	0.0000
GDPG	0.698330	0.163695	4.266035	0.0000
C	-174.2690	35.11139	-4.963318	0.0000

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.707240	Mean dependent var	27.62411
Adjusted R-squared	0.665552	S.D. dependent var	7.595302
S.E. of regression	4.392475	Akaike info criterion	5.915945
Sum squared resid	5961.797	Schwarz criterion	6.407804
Log likelihood	-1002.122	Hannan-Quinn criter.	6.111640
F-statistic	16.96524	Durbin-Watson stat	0.529310
Prob(F-statistic)	0.000000		

Concluding remarks

- **Higher financial deepening exacerbates current account deficit** and macroeconomic instability due to ***over-investment*.**
- However, Indonesia experiences a stabilizing effect of financial deepening, because **higher financial deepening increases current account balance** and hence, macroeconomic stability. Unfortunately, this is due to **depressed investment, not an increase in savings**.

II. FINANCIAL INNOVATION, LENDING BOOM AND SYSTEMIC RISK IN BANKING

Definition of bank systemic risk

- Despite the importance of preserving bank soundness, the 2008 global financial meltdown has highlighted increasing needs to prevent the contagion of bank failures and the buildup of bank systemic risk (Arnold et al., 2013).
- No formal definition of bank systemic risk, but it is widely accepted that bank systemic risk is linked to the co-movement of bank riskiness.

Measuring bank systemic risk

- Adrian and Brunnermeier (2011) measure bank systemic risk by computing the co-movement of banks' *value at risk* (VaR)
- Anginer et al. (2014) consider the co-movement of banks' distance-to-default.
- Some papers use the time-varying correlation of bank-specific risk derived from the exponentially-weighted moving average pairwise correlation of idiosyncratic risk among banks (De Nicolo and Kwast, 2002; Bautista et al. 2008), and Patro et al., 2013).

Measuring bank systemic risk

- However, measuring bank systemic risk using the correlation approach has advantages over other measures including ΔCoVaR.
- The correlation of bank-specific risk can avoid volatility bias that may underestimate bank systemic risk, particularly in good times (Anginer et al., 2014; Pukhtuanthong and Roll, 2009; Bekaert and Wang, 2009).
- Billio et al. (2012) assert that during economic booms, financial innovation emerges and the risk codependence of banks also increases. Meanwhile, substantial bank losses may have not yet materialized in this phase. Using the ΔCoVaR approach to account for bank losses in good times results in low levels of ΔCoVaR and hence, the high risk codependence among financial institutions that reflects the systemic risk of banks cannot be accurately determined

Testing the nexus between lending boom and systemic risk in Asian banks

Soedarmono, W., Sitorus, D., Tarazi, A., 2017. Abnormal loan growth, credit information sharing and systemic risk in Asian banks. *Research in International Business and Finance* (Forthcoming, Elsevier).

Testing the nexus between lending boom and systemic risk in Asian banks

The time-varying correlation of bank idiosyncratic risk is constructed in three stages. In the first stage, we construct a standard market model as follows:

$$R_{i,t} = \beta R_{M,t} + \varepsilon_{i,t} \quad (1)$$

From Eq. (1), $R_{i,t}$ is bank i's stock return at week t, while $R_{M,t}$ stands for weekly stock market returns. We calculate bank stock returns and market returns as follows:

$$R_{i,t} = \log\left(\frac{p_t}{p_{t-1}}\right) \quad R_{M,t} = \log\left(\frac{m_t}{m_{t-1}}\right) \quad (2)$$

In Eq. (2), p and m are defined as weekly bank stock prices and market indexes, respectively.

Systemic risk measure

$$\rho_{i,j,t} = \frac{\sum_{s=0}^{k} \lambda^s \varepsilon_{i,t-s} \varepsilon_{j,t-s}}{\left[\left(\sum_{s=0}^{k} \lambda^s \varepsilon_{i,t-s}^2\right)\left(\sum_{s=0}^{k} \lambda^s \varepsilon_{j,t-s}^2\right)\right]^{\frac{1}{2}}}$$

Abnormal loan growth

$$ALG_{i,t} = LG_{i,t} - AgLG_{j,t}$$

AgLG denotes the aggregate loan growth measured by the annual growth of total loans in the banking system for each country. *LG* denotes loan growth at the bank level measured by either *DLOAN* or *LOANG*. *DLOAN* is defined as the actual change in the ratio of total loans (*L*) to total assets (*TA*) following Bouvatier and Lepetit (2008), while *LOANG* is simply the annual growth rate of total loans for each bank. Specifically, *DLOAN* and *LOANG* are calculated as follows.

$$DLOAN_{i,t} = \left(L_{i,t} - L_{i,t-1}\right) / 0.5\left(TA_{i,t} + TA_{i,t-1}\right)$$

$$LOANG_{i,t} = \left(L_{i,t} - L_{i,t-1}\right) / L_{i,t-1}$$

Methodology

$$SRISK_{i,t} = \beta_0 SRISK_{i,t-1} + \beta_1 ALG_{i,t-1} + \beta_2 ALG_{i,t-2} + \\ + \beta_3 EQTA_{i,t} + \beta_4 LIQ_{i,t} + \beta_5 LLP_{i,t} + \beta_6 SIZE_{i,t} \\ + \beta_7 TOBIN_{i,t} + \beta_8 ECO_{j,t} + \beta_9 LGDPC_{j,t}$$

$$RCORR_{i,t} = \beta_0 RCORR_{i,t-1} + \beta_1 ALG_{i,t-1} + \beta_2 ALG_{i,t-2} + \\ + \beta_3 EQTA_{i,t} + \beta_4 LIQ_{i,t} + \beta_5 LLP_{i,t} + \beta_6 SIZE_{i,t} \\ + \beta_7 TOBIN_{i,t} + \beta_8 ECO_{j,t} + \beta_9 LGDPC_{j,t}$$

Results:
Abnormal loan growth and systemic risk

Explanatory variables	Dependent variables			
	SRISK	*RCORR*	*SRISK*	*RCORR*
	ALG = ADLOAN		*ALG = ALOANG*	
Dependent var. (-1)	0.53606***	0.60895***	0.52617***	0.59054***
	(0.073)	(0.055)	(0.070)	(0.057)
ALG (-1)	0.00097	0.09693***	0.03625***	0.04712***
	(0.047)	(0.038)	(0.018)	(0.019)
ALG (-2)	-0.05613	0.01734	0.01982	0.01373
	(0.027)	(0.029)	(0.017)	(0.021)
EQTA	-0.00118	0.00093	-0.00180	0.00081
	(0.002)	(0.001)	(0.002)	(0.001)
LIQ	-0.07957**	-0.09169**	-0.08808*	-0.12376***
	(0.039)	(0.041)	(0.052)	(0.047)
LLP	-0.92668*	-0.37571	-0.98270**	-0.40934
	(0.534)	(0.462)	(0.496)	(0.418)
SIZE	0.02299***	0.03195***	0.02351***	0.03313***
	(0.005)	(0.005)	(0.004)	(0.005)
TOBIN	-0.13596**	-0.11154*	-0.14124**	-0.10440
	(0.061)	(0.060)	(0.058)	(0.065)
ECOFREE	-0.03581	0.46407***	-0.01685	0.46427***
	(0.098)	(0.106)	(0.091)	(0.100)
LGDPC	0.01922***	-0.02060***	0.01624**	-0.01854***
	(0.007)	(0.007)	(0.006)	(0.007)
Observations	1,032	1,028	1,036	1,032
Number of banks	133	133	132	132
AR(2) test: *p*-Val	0.338	0.772	0.312	0.513
Hansen-J test : *p*-Val	0.069	0.138	0.139	0.170

Notes: *** indicates significance at the 1% level, while ** and * indicate significance at the 5% and 10% levels, respectively.

Results:
Abnormal loan growth, information sharing and systemic risk

Explanatory variables	Dependent variables: SRISK					
	ALG = ADLOAN	*ALG = ALOANG*	*ALG = ADLOAN*	*ALG = ALOANG*	*ALG = ADLOAN*	*ALG = ALOANG*
Dependent var. (-1)	0.55943***	0.57736***	0.36216***	0.34445***	0.57239***	0.57860***
	(0.072)	(0.073)	(0.057)	(0.054)	(0.070)	(0.069)
ALG (-1)	0.31600***	0.06202	0.13511***	0.06157***	0.01641	0.02877
	(0.110)	(0.059)	(0.043)	(0.023)	(0.044)	(0.025)
ALG(-1) x CRINDEX(-1)	-0.06428***	-0.33200				
	(0.02454)	(0.01497)				
ALG(-1) x PRIVBUR(-1)			-0.41000***	-0.13098**		
			(0.144)	(0.090)		
ALG(-1) x PUBREG(-1)					0.52334	0.40341
					(0.326)	(0.178)
CRINDEX(-1)	0.28533	0.70723				
	(0.572)	(0.579)				
PRIVBUR(-1)			0.11553**	0.15045***		
			(0.049)	(0.047)		
PUBREG(-1)					0.02055	-0.04098
					(0.068)	(0.051)
EQTA	-0.00057	-0.00113	-0.00158	-0.00186	-0.00112	-0.00134
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
LIQ	-0.02367	-0.05388	-0.05906*	-0.06454**	-0.03936	-0.07056*
	(0.033)	(0.040)	(0.031)	(0.026)	(0.031)	(0.042)
LLP	-0.72622	-0.90012*	-0.62084	-0.86689*	-0.75062	-0.82490*
	(0.505)	(0.496)	(0.429)	(0.472)	(0.473)	(0.436)
SIZE	0.02258***	0.02115***	0.02950***	0.02910***	0.02139***	0.02050***
	(0.004)	(0.004)	(0.005)	(0.006)	(0.004)	(0.004)
TOBIN	-0.12923**	-0.11095*	-0.14082***	-0.13611**	-0.12479*	-0.10212
	(0.060)	(0.065)	(0.051)	(0.056)	(0.067)	(0.067)
ECOFREE	-0.05491	0.02971	-0.21251**	-0.13315	-0.01518	-0.00396
	(0.082)	(0.073)	(0.099)	(0.095)	(0.097)	(0.095)
LGDPC	0.01575**	0.00741	0.00636	-0.00136	0.01474**	0.01279**
	(0.007)	(0.007)	(0.011)	(0.010)	(0.006)	(0.006)
Observations	1,145	1,147	1,145	1,147	1,145	1,147
Number of banks	136	135	136	135	136	135
AR(2) test: *p*-Val	0.108	0.175	0.297	0.559	0.136	0.160
Hansen-J test : *p*-Val	0.051	0.057	0.572	0.054	0.030	0.046

Results:
Abnormal loan growth, information sharing and systemic risk

	RCORR					
Explanatory variables	*ALG = ADLOAN*	*ALG = ALOANG*	*ALG = ADLOAN*	*ALG = ALOANG*	*ALG = ADLOAN*	*ALG = ALOANG*
Dependent var. (-1)	0.40775***	0.61763***	0.58730***	0.44272***	0.60112***	0.60243***
	(0.066)	(0.057)	(0.062)	(0.055)	(0.067)	(0.064)
ALG (-1)	0.41273***	0.06935	0.22021***	0.04117	0.12370***	0.05419**
	(0.112)	(0.063)	(0.056)	(0.028)	(0.039)	(0.022)
ALG(-1) x CRINDEX(-1)	-0.0735***	-0.00296				
	(0.02467)	(0.01544)				
ALG(-1) x PRIVBUR(-1)			-0.32954**	-0.06171*		
			(0.147)	(0.070)		
ALG(-1) x PUBREG(-1)					-0.06526	0.08540
					(0.323)	(0.215)
CRINDEX(-1)	1.46466**	1.61701***				
	(0.691)	(0.611)				
PRIVBUR(-1)			0.13335***	0.18894***		
			(0.037)	(0.044)		
PUBREG(-1)					-0.1748***	-0.1672***
					(0.066)	(0.061)
EQTA	0.00309*	0.00085	0.00216	0.00305	0.00155	0.00119
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
LIQ	-0.1059***	-0.11239**	-0.04062	-0.1219***	-0.06459**	-0.1174***
	(0.040)	(0.044)	(0.028)	(0.046)	(0.033)	(0.041)
LLP	-0.46588	-0.50037	-0.41063	-0.77823*	-0.22061	-0.27085
	(0.577)	(0.523)	(0.371)	(0.443)	(0.403)	(0.421)
SIZE	0.05123***	0.03223***	0.03630***	0.05103***	0.03325***	0.03263***
	(0.008)	(0.005)	(0.005)	(0.007)	(0.005)	(0.005)
TOBIN	-0.2599***	-0.11379	-0.12352**	-0.12364*	-0.10567	-0.06615
	(0.074)	(0.069)	(0.056)	(0.068)	(0.069)	(0.072)
ECOFREE	0.75880***	0.51496***	0.28627***	0.60510***	0.33841***	0.35444***
	(0.113)	(0.097)	(0.082)	(0.107)	(0.095)	(0.094)
LGDPC	-0.0551***	-0.0373***	-0.0418***	-0.0716***	-0.0193***	-0.0191***
	(0.012)	(0.009)	(0.010)	(0.013)	(0.007)	(0.007)
Observations	1,140	1,142	1,140	1,142	1,140	1,142
Number of banks	136	135	136	135	136	135
AR(2) test: *p*-Val	0.299	0.585	0.708	0.805	0.801	0.657
Hansen-J test : *p*-Val	0.109	0.063	0.137	0.382	0.097	0.139

Conclusion

- From a sample of publicly traded commercial banks in the Asia-Pacific region, higher abnormal loan growth increases bank systemic risk one year ahead.
- However, these results are conditional on the quality of credit information sharing at the country level. In countries with a higher credit information index and better private credit bureaus, the positive impact of the one-year-lagged value of abnormal loan growth on systemic risk is reversed.
- The adverse impact of abnormal loan growth on bank systemic stability only occurs in countries with lower quality of credit information sharing, especially if private credit bureaus have lower quality.
- The development of private credit bureaus is necessary to overcome the adverse impact of abnormal loan growth on bank systemic risk
- Higher bank market power exacerbates systemic risk in Asian banking. Higher bank competition is encouraged.