

Bank Supply Shock and Firm Investment: **A Granular View from the Thai Credit Registry Data**

Nasha Ananchotikul
Vorada Limjaroenrat

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Background

- The role of “financial frictions” in the real business cycle
 - Bernanke, Gertler, Gilchrist (1999)
 - Credit market frictions (‘financial accelerator’) can have a significant influence on business cycle dynamics
 - Kiyotaki and Moore (2008)
 - Small shocks can be amplified by credit limits in the financial market, giving rise to large fluctuations in the real business cycle
- The “granular hypothesis” in explaining aggregate fluctuations
 - Gabaix (2011)
 - The distribution of firm sizes is fat-tailed (not normally-distributed as usually assumed in standard theory)
 - Thus, idiosyncratic shocks to large firms do not die out in aggregate
 - These firm-level shocks can lead to nontrivial aggregate shocks that affect economic-wide outcomes

What this paper does

Main research questions:

- Does finance matter for real economic activity?
 - Do bank supply shocks affect firm-level investment?
 - How much do bank shocks matter for economy-wide investment?

Problems in past literature:

- How to disentangle bank-loan supply shocks from firm-demand shocks
- Fixed-effects approach has several limitations and drawbacks

New methodology:

- Pioneered by Amiti and Weinstein (2013)
- Exploits micro-level, matched bank-firm loan data
- Exactly decomposes bank-level and firm-level loan growth into 4 components:
 - (1) Bank shock (2) Firm shock (3) Industry shock (4) Common shock

Data Overview

1. BOT's **Loan arrangement database (LAR)**
2. Ministry of Commerce's **Corporate Profile and Financial Statement (CPFS)**

Number of firms (Matched LAR-CPFS)

LAR-CPFS	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Small	10,340	11,210	11,152	11,805	12,407	11,841	12,252	13,130	14,037	15,371	16,931
Medium	3,864	4,199	4,303	4,568	4,968	4,942	5,143	5,210	5,465	5,922	6,449
Large	2,361	2,557	2,617	2,797	3,089	3,097	3,336	3,360	3,628	4,071	4,326
Total	16,565	17,966	18,072	19,170	20,461	19,880	20,731	21,700	23,130	25,364	27,688

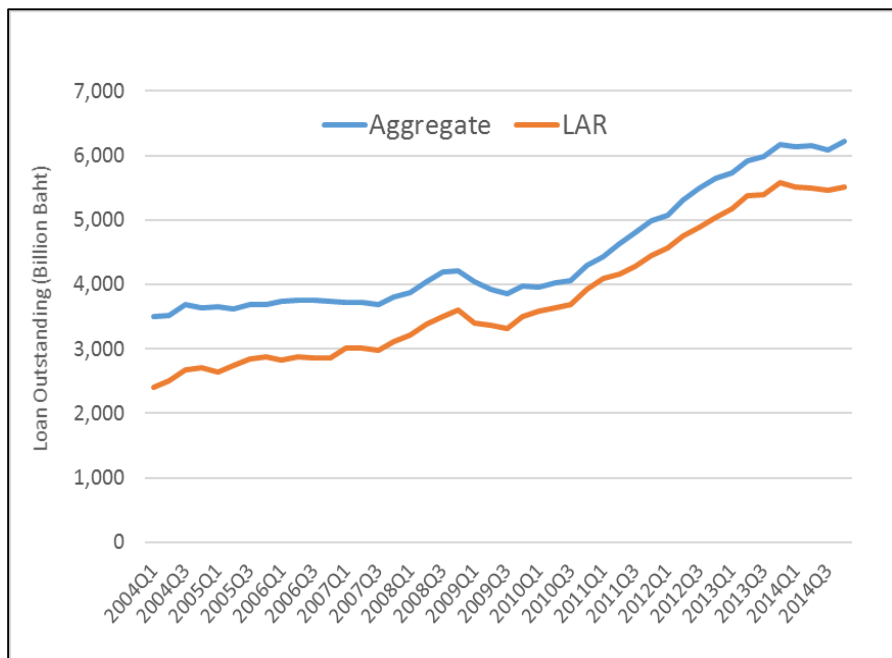
Number of banks (LAR)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
All financial institutions	55	47	43	41	41	38	38	41	40	41	40	44
Banks only	33	33	33	33	34	32	32	35	35	35	34	38

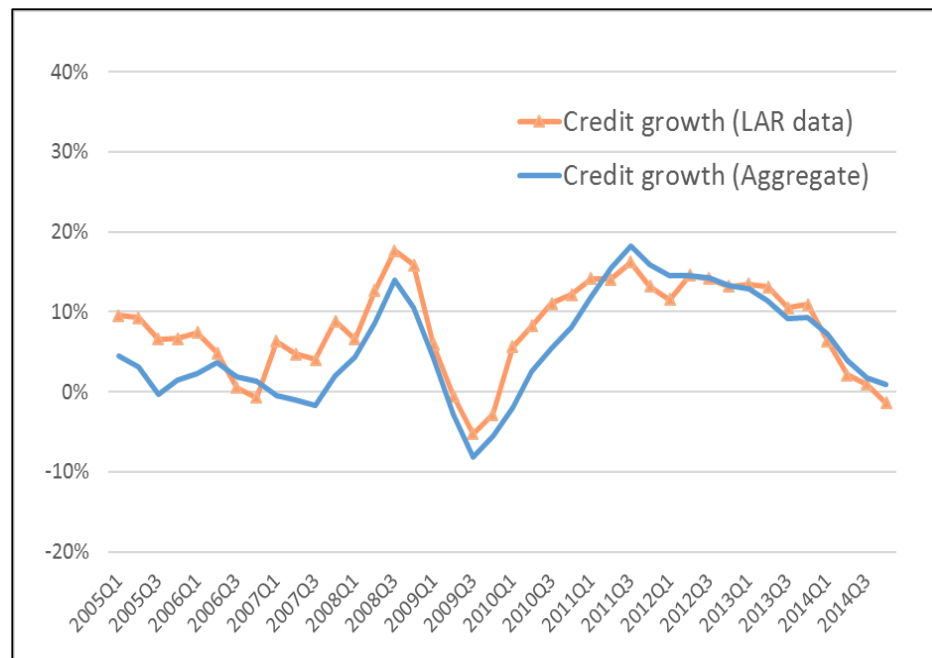
Aggregate loans vs. LAR data

- LAR data covers 75-90 percent of aggregate corporate lending
- LAR loan growth rate traces closely the aggregate lending growth

Loan Outstanding

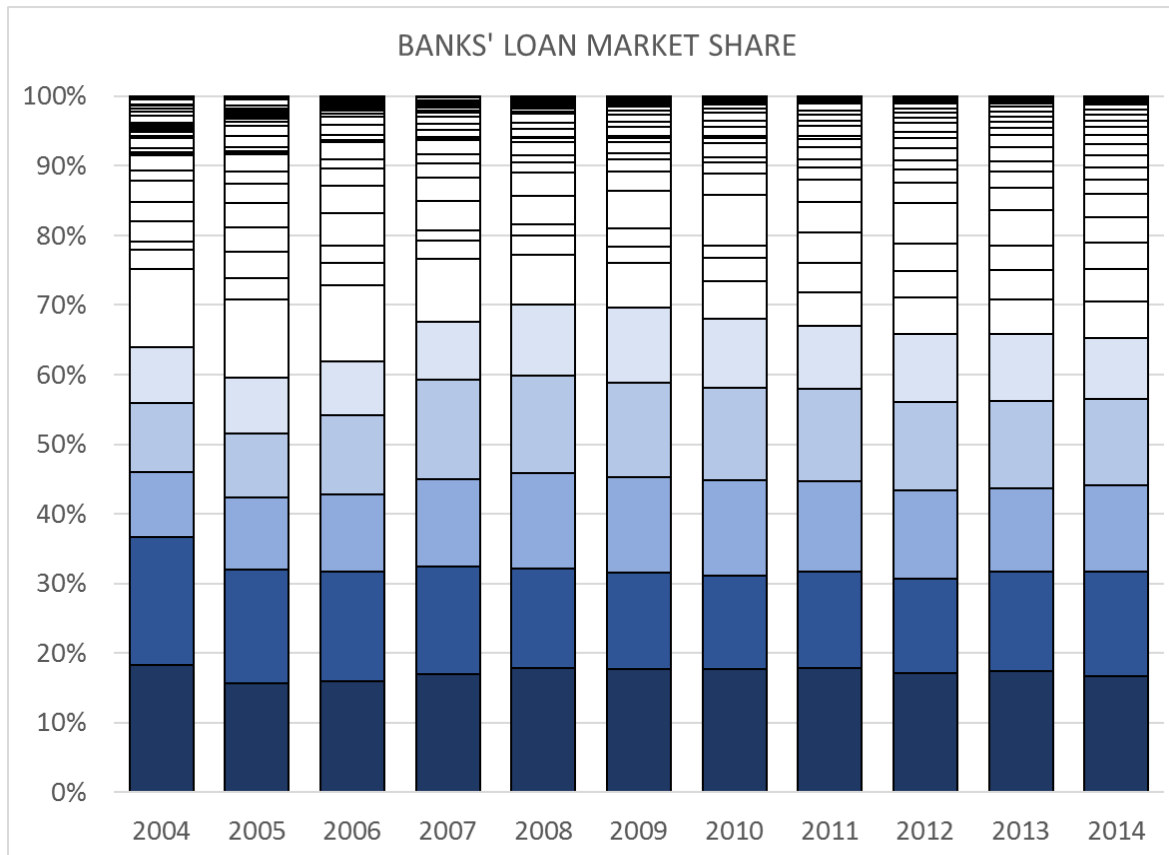


Loan Growth



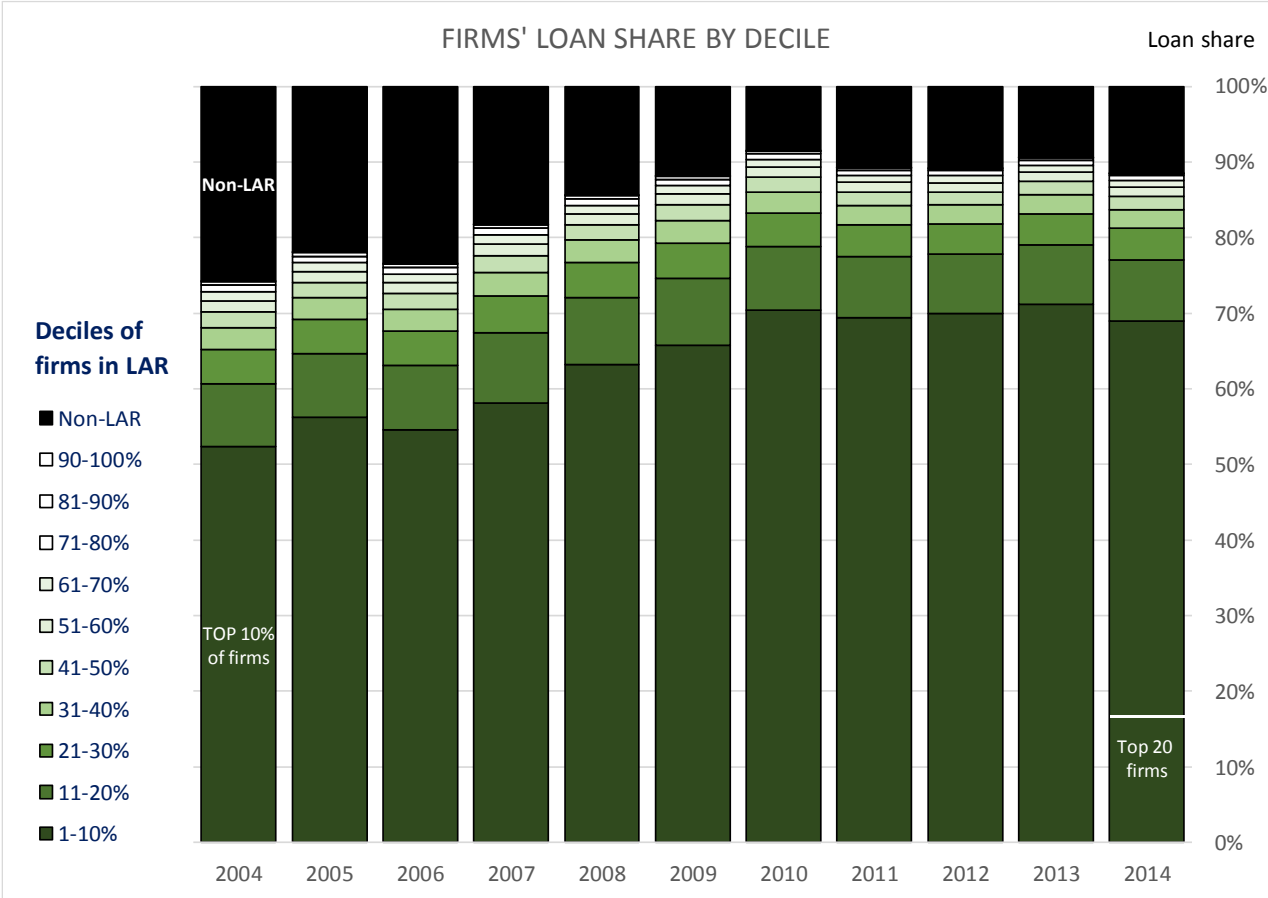
Credit Market Concentration: Bank Side

- Thai credit market highly concentrated
- Top 5 banks account for over 60 percent of loan market share



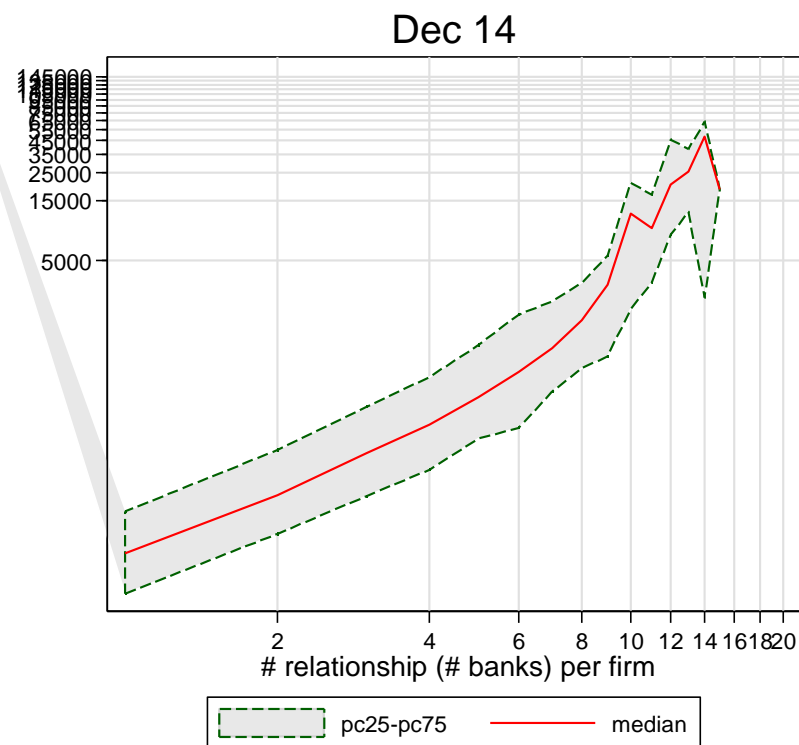
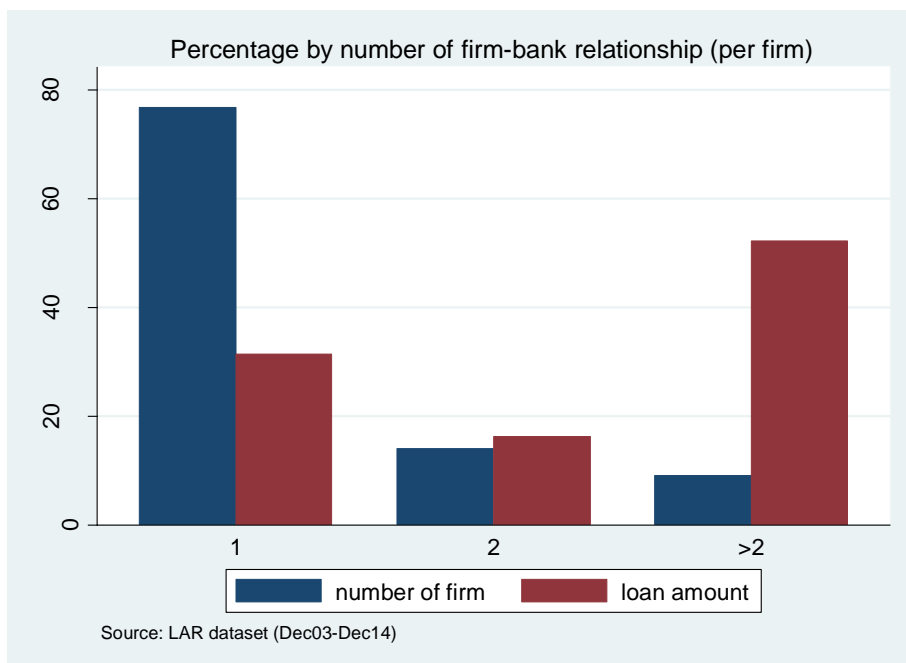
Credit Market Concentration: Borrower Side

- Very high concentration from the borrowers' perspective as well
- Top 10 percent of firms take more than 60 percent of total corporate lending



Firm-Bank Relationships

- A majority of firms borrow from only one bank at a time
- But single-bank firms account for only 30 percent of total loan volume
- Larger borrowers tend to have more bank relationships



Firm-Bank Relationships

- More than half of the firms never switched bank

Share of firms out of total 35,265 firms								
Number of bank relationships in the <u>first year</u>	Number of <u>new</u> bank relationships over <u>life time</u>							Total
	0	1	2	3	4	5	> 5	
1	55.0%	19.9%	6.9%	2.5%	1.1%	0.5%	0.0%	85.9%
2	3.9%	2.3%	1.3%	0.6%	0.3%	0.2%	0.0%	8.7%
3	0.8%	0.6%	0.4%	0.2%	0.1%	0.1%	0.0%	2.3%
4	0.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.0%	0.9%
5	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.0%	0.4%
> 5	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.8%
Total	60.2%	23.2%	9.0%	3.7%	1.8%	1.0%	1.2%	100.0%

Methodology (Amiti and Weinstein, 2017)

Bank-level and firm-level loan growth can be written as:

$$D_{f,t} = \text{firmshock}_{f,t} + \sum_b \theta_{fb,t-1} \text{bankshock}_{b,t}$$

$$D_{b,t} = \text{bankshock}_{b,t} + \sum_f \phi_{fb,t-1} \text{firmshock}_{f,t}$$

where $D_{f,t}$ = firm-level loan growth ($f = 1, 2, \dots, F$)

$D_{b,t}$ = bank-level loan growth ($b = 1, 2, \dots, B$)

$\theta_{fb,t-1}$ = loan share of each bank in each firm' loan portfolio

$\phi_{fb,t-1}$ = loan share of each firm in each bank' loan portfolio

$$\sum_b \theta_{fb,t-1} = 1 \text{ and } \sum_f \phi_{fb,t-1} = 1$$

With $F+B$ equations and $F+B$ unknowns, we can solve for a unique set of firm and bank shocks (up to a numeraire) in each time period.

Shock Decomposition

- After obtaining firm and bank shocks, we extract common and industry shock as follows:

$$\text{Commonshock}_t = \text{median}(\text{Firmshock}_{f,t}) + \text{median}(\text{Bankshock}_{b,t})$$

$$\text{Industryshock}_{n,t} = \text{median}(\widetilde{\text{Firmshock}}_{f,t})_{f \in N}$$

and the residual firm and bank shocks:

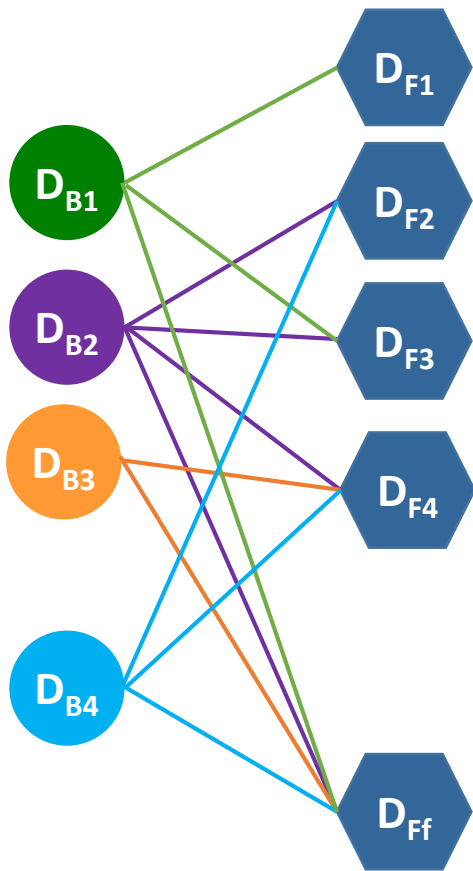
$$\text{Firm-specific shock}_{f,t} = \text{Firmshock}_{f,t} - \text{median}(\text{Firmshock}_{f,t}) - \text{Industry}_{n,t}$$

$$\text{Bank-specific shock}_{b,t} = \text{Bankshock}_{b,t} - \text{median}(\text{Bankshock}_{b,t})$$

That is, each bank's aggregate lending can be exactly decomposed into four terms:

$$D_{b,t} = \text{Commonshock}_t + \text{Bank-specific shock}_{b,t} + \sum \phi_{fb,t-1} \text{Industry}_{n,t} + \sum \phi_{fb,t-1} \text{Firm-specific shock}_{f,t}$$

Input:
 Loan growth and loan portfolio
 of each bank and firm



F1
 F2
 F3
 .
 .
 .
 Ff

B1
 B2
 B3
 .
 .
 .
 Bb



Firm shock + Industry shock

$F1 - \bar{F}$
 $F2 - \bar{F}$
 $F3 - \bar{F}$
 .
 .
 .
 $Ff - \bar{F}$



$B1 - \bar{B}$
 $B2 - \bar{B}$
 $B3 - \bar{B}$
 .
 .
 .
 $Bb - \bar{B}$

Bank shock

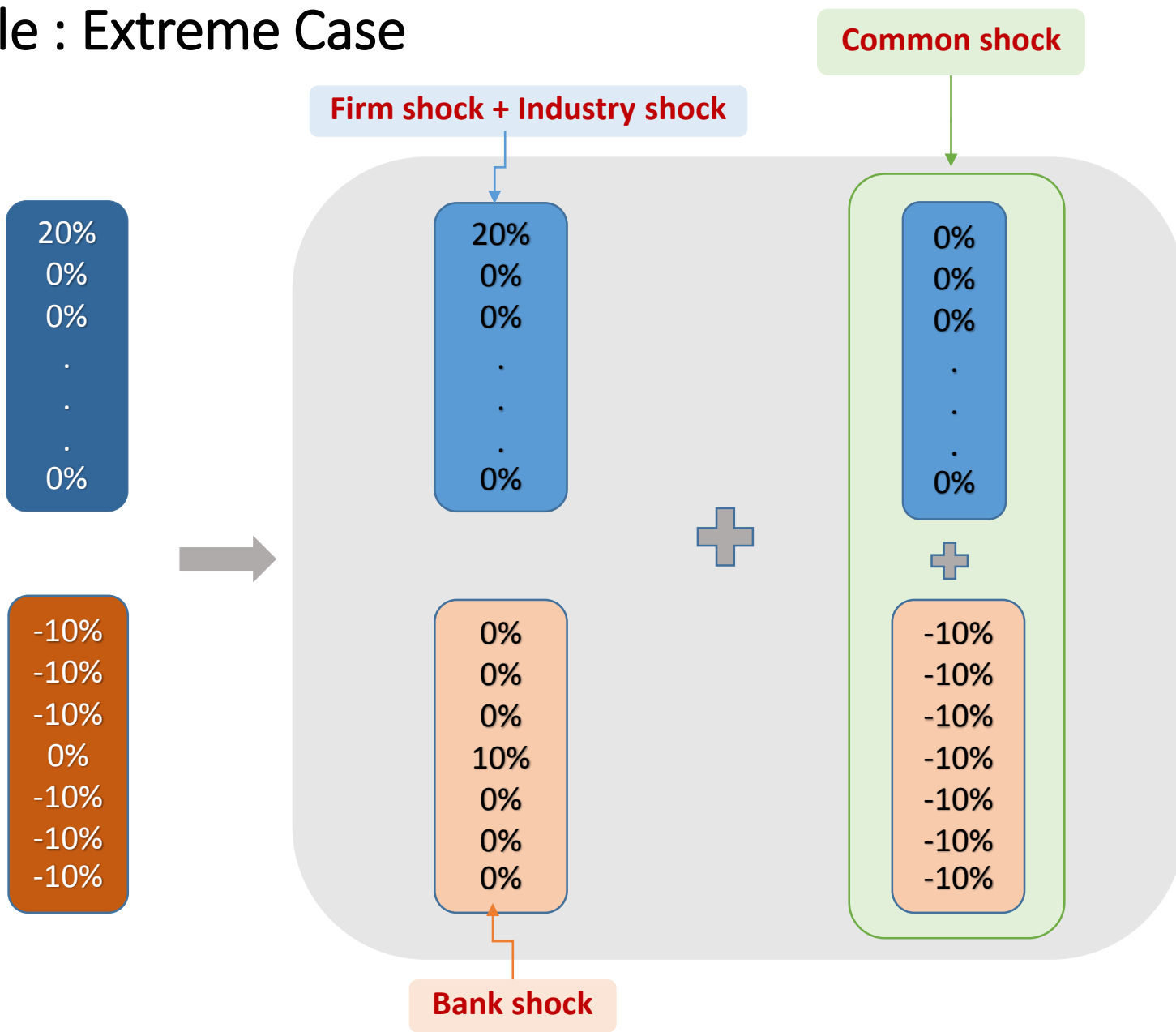
Common shock

\bar{F}
 \bar{F}
 \bar{F}
 .
 .
 .
 \bar{F}

+

\bar{B}
 \bar{B}
 \bar{B}
 .
 .
 .
 \bar{B}

Example : Extreme Case

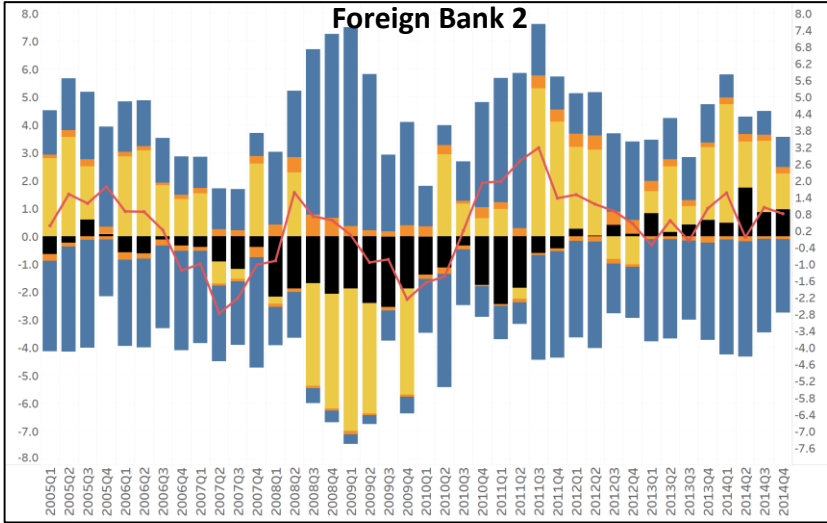
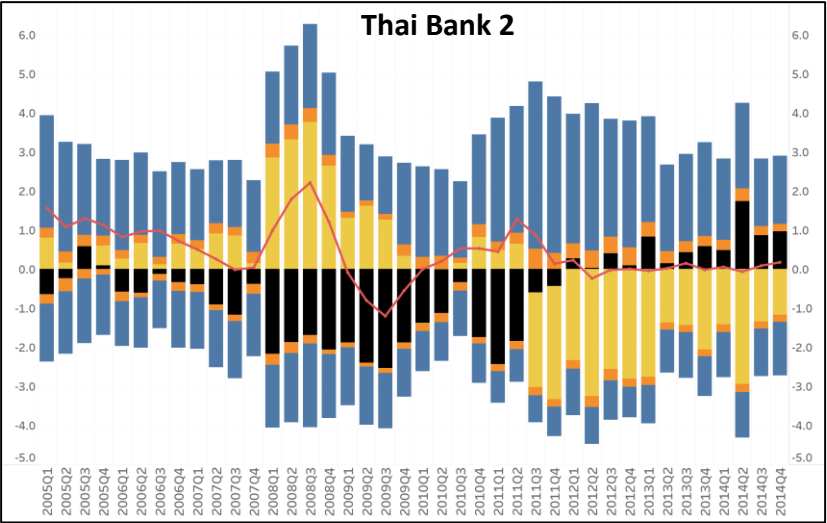
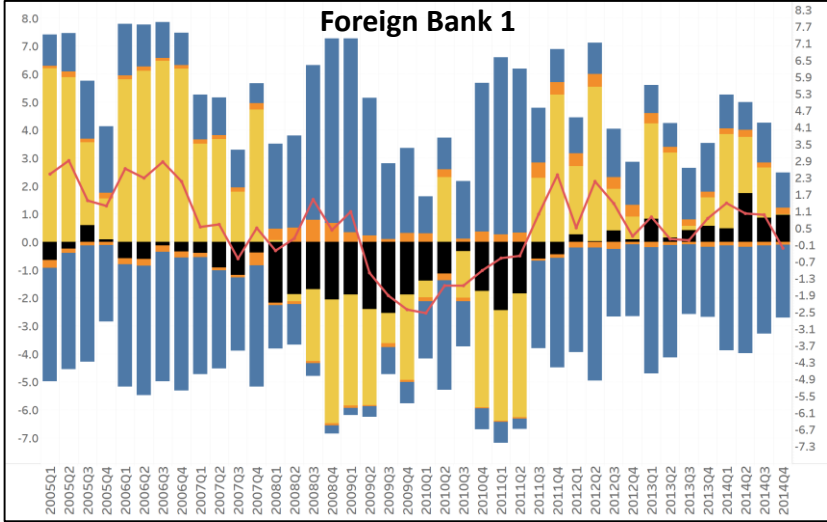
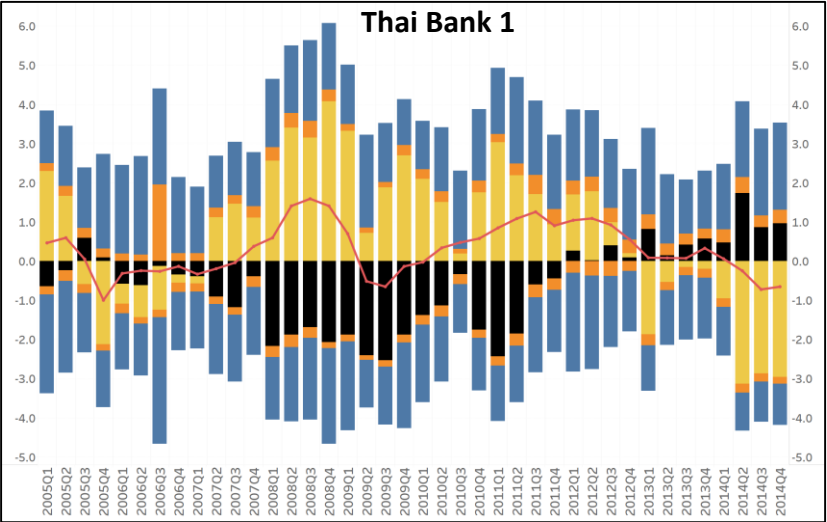


Interpretation of shock components

- **Common shock:** changes in loan growth that are common across all bank-firm lending pairs, e.g. monetary policy shock, global shock
- **Industry shock:** changes in loan growth that may arise due to bank's loan portfolio that is skewed towards certain industries experiencing shocks
- **Firm-borrowing shock:** changes in loan growth that arise due to idiosyncratic changes in firms' borrowing demand, firm-level productivity shocks, firm-level credit constrained, etc.
- **Bank supply shock:** changes in loan growth due to idiosyncratic changes in bank's loan supply (relative to the median bank shock) that could be driven by changes in the cost of capital, liquidity, balance sheet health, etc.

Bank Supply Shock: Selected Banks

- Firm Shock
- Industry Shock
- Bank Shock
- Common Shock
- Bank loan growth



Aggregate-Level Granular Shocks

- We now can obtain a decomposition of *aggregate* loan growth into “granular shocks” using the previous bank-level shocks:

$$\begin{aligned} D_t &= \sum_b W_{b,t-1} D_{b,t} \\ &= \text{common}_t + \sum_b W_{b,t-1} \text{industryshock}_{b,t} + \sum_b W_{b,t-1} \text{bankshock}_{b,t} + \sum_b W_{b,t-1} \text{firmshock}_{b,t} \end{aligned}$$

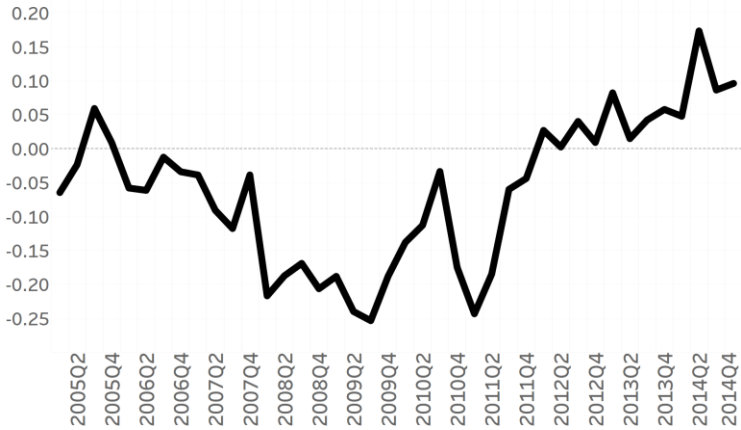
where D_t = country-level aggregate loan growth,

$W_{b,t}$ = the average share of each bank b in aggregate lending in year t

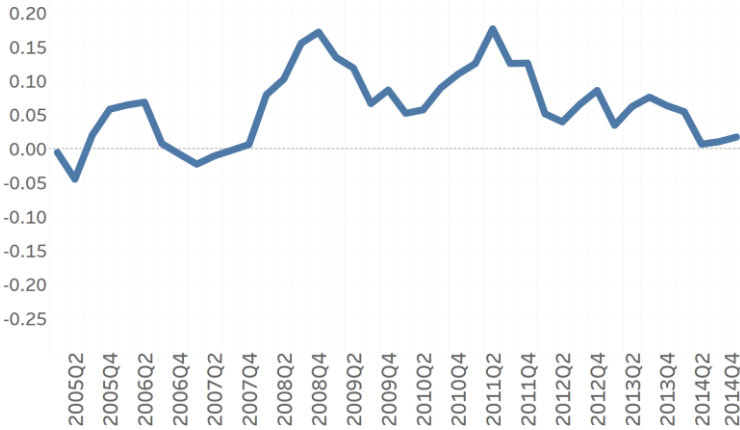
- These time-varying granular shocks can be used to study how different shocks affect the real variables at the aggregate level

Granular Shock Decomposition of Aggregate Loan Growth

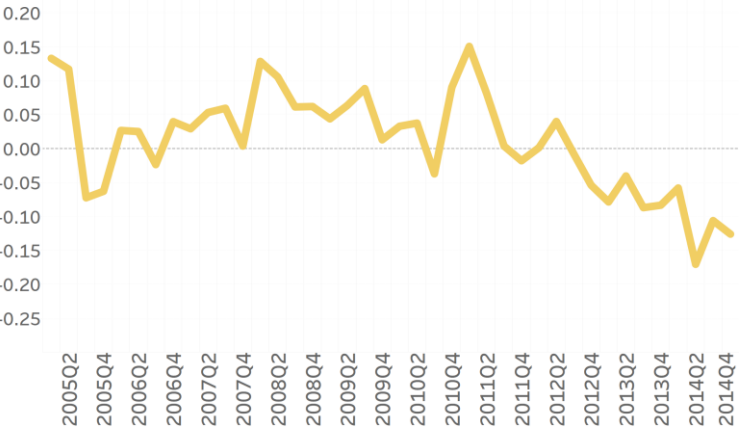
Granular Common Shock



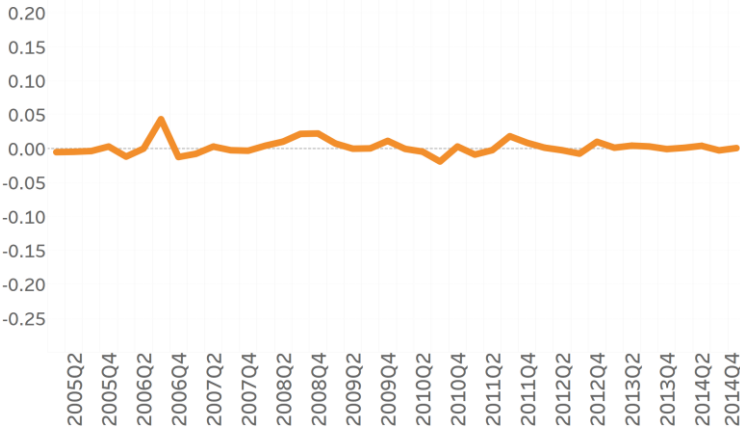
Granular Firm Shock



Granular Bank Shock



Granular Industry Shock



Result 1: Bank Shocks and Aggregate Investment

- Bank shock has significant influence on aggregate-level outcomes
 - Accounting for about 40 percent of the variance in aggregate lending growth
 - Explaining 16 percent of aggregate investment fluctuations

Variable	Aggregate loan growth				Aggregate investment growth			
	(1)		(2)		(3)		(4)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Common shock_t	0.372 ***	0.092	1.145 ***	0.077	0.047	0.163	0.732 ***	0.254
Firm shock_t	0.985 ***	0.142	1.436 ***	0.085	-0.201	0.284	0.199	0.244
Industry shock_t	0.115	0.518	0.895 ***	0.295	-1.603 **	0.733	-0.912	0.763
Bank shock_t			1.108 ***	0.109			0.982 ***	0.258
Constant	0.019 *	0.011	0.024 ***	0.007	0.056 ***	0.018	0.060 ***	0.014
Observations	40		40		40		40	
R ²	0.508		0.875		0.085		0.248	

Shapley-Owen R-squared decomposition

Common shock_t	31.03	35.59
Firm shock_t	50.87	11.04
Industry shock_t	2.85	14.30
Bank shock_t	15.25	39.07

Result 2: Bank Shocks and Firm-Level Investment

- Bank shocks do matter for firm investment, particularly for (1) firms with greater reliance on bank loans (2) firms with single bank relationship

Dependent var: Investment _{f,t} / Capital _{f,t-1}	Full Sample				
	(1)	(2)	(3)	(4)	(5)
Net income _{f,t} /Capital _{f,t-1}	0.006***	0.006***	0.006***	0.006***	0.006***
Current asset _{f,t} /Capital _{f,t-1}	0.093***	0.093***	0.094***	0.093***	0.094***
ROA _{f,t-1}	0.213***	0.168***	0.159***	0.169***	0.160***
Bank Shock _{f,t}		0.082***	0.054***	0.097***	0.070***
Firm Shock _{f,t}		0.068***	0.037***	0.074***	0.042***
Industry Shock _{f,t}		0.115***	0.117***	0.116***	0.118***
Bank Shock _{f,t} * Loan-to-Asset Ratio _f			0.087***		0.081***
Firm Shock _{f,t} * Loan-to-Asset Ratio _f			0.093***		0.092***
Bank Shock _{f,t} * More than one bank _{f,t}				-0.041***	-0.036***
Firm Shock _{f,t} * More than one banks _{f,t}				-0.015***	-0.011***
Constant	0.097***	0.079***	0.074***	0.078***	0.074***
Observations	145,823	145,823	145,823	145,823	145,823
R-squared	0.067	0.099	0.104	0.099	0.104
Number of firms	32,353	32,353	32,353	32,353	32,353
Firm FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

Result 3: Asymmetric Effects of Bank Shocks

- The effects of negative bank shocks are milder in the case of large firms
- Multiple relationships help mitigate impact of negative bank shocks for small and medium firms, but not for large firms

Dependent var: Investment _{f,t} / Capital _{f,t-1}	Full Sample		Small & Medium Firms		Large Firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Net income _{f,t} /Capital _{f,t-1}	0.006***	0.006***	0.007***	0.007***	0.035***	0.035***
Current asset _{f,t} /Capital _{f,t-1}	0.094***	0.094***	0.098***	0.098***	0.139***	0.139***
ROA _{f,t-1}	0.160***	0.160***	0.155***	0.155***	-0.052	-0.054
Bank Shock _{f,t}	0.070***	0.077***	0.066***	0.063***	0.068***	0.144***
Bank Shock _{f,t} * NegativeShocks _{f,t}		-0.013		0.007		-0.153**
Firm Shock _{f,t}	0.042***	0.043***	0.042***	0.042***	0.020***	0.019***
Industry Shock _{f,t}	0.118***	0.117***	0.120***	0.120***	0.127***	0.126***
Bank Shock _{f,t} * Loan-to-Asset Ratio _f	0.081***	0.085***	0.070***	0.083**	0.220***	0.237***
Bank Shock _{f,t} * Loan-to-Asset Ratio _f * NegativeShocks _{f,t}		-0.008		-0.025		-0.030
Firm Shock _{f,t} * Loan-to-Asset Ratio _f	0.092***	0.092***	0.075***	0.075***	0.282***	0.282***
Bank Shock _{f,t} * More than one bank _{f,t}	-0.036***	-0.006	-0.036**	0.005	-0.036*	-0.101***
Bank Shock _{f,t} * More than one bank _{f,t} * NegativeShocks _{f,t}		-0.057*		-0.078**		0.130**
Firm Shock _{f,t} * More than one banks _{f,t}	-0.011***	-0.012***	-0.017***	-0.017***	-0.014**	-0.013*
Constant	0.074***	0.073***	0.044***	0.042***	0.282***	0.277***
Observations	145,823	145,823	121,102	121,102	24,721	24,721
R-squared	0.104	0.104	0.094	0.094	0.287	0.288
Number of firms	32,353	32,353	28,787	28,787	5,621	5,621

*** p<0.01, ** p<0.05, * p<0.1. All specifications include firm and time fixed effects.

Result 4: Bank-Switching Effects

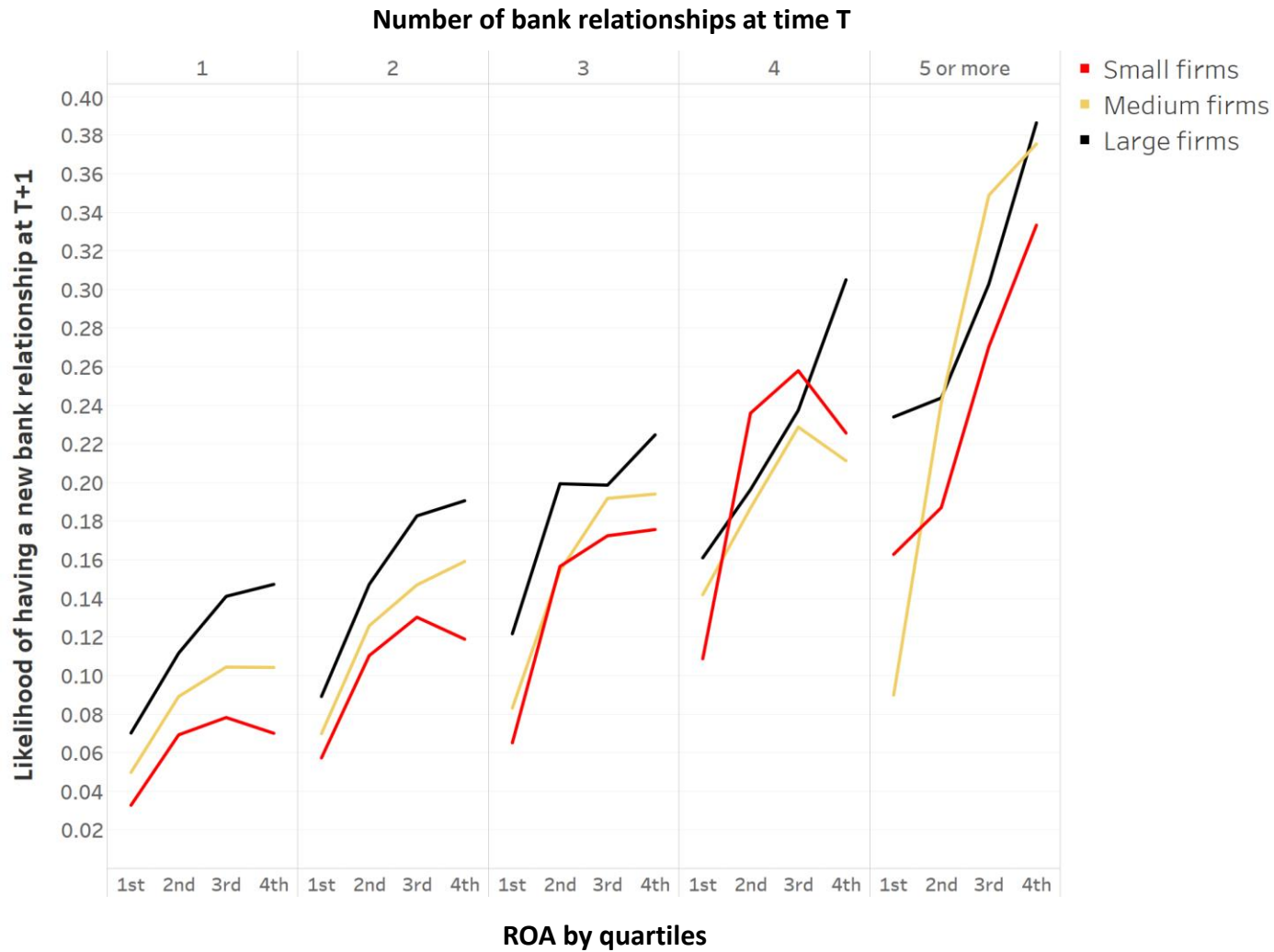
- Firms that are able to switch to a new lending bank are less affected by negative bank shocks

Dependent var:	(1)	(2)	(3)
Investment _{f,t} / Capital _{f,t-1}	Full Sample	Negative Bank Shock	Positive Bank Shock
Net income _{f,t} /Capital _{f,t-1}	0.007***	0.007***	0.007***
Current asset _{f,t} /Capital _{f,t-1}	0.100***	0.097***	0.112***
ROA _{f,t-1}	0.153***	0.185***	0.090***
Bank Shock _{f,t}	0.086***	0.078***	0.106***
Firm Shock _{f,t}	0.071***	0.075***	0.069***
Industry Shock _{f,t}	0.103***	0.080**	0.122***
Bank Shock _{f,t} * SwitchBank _{f,t}	-0.006	-0.093***	0.074**
Firm Shock _{f,t} * SwitchBank _{f,t}	-0.015***	-0.022***	-0.016**
Constant	0.074***	0.064***	0.074***
Observations	126,992	59,920	67,072
R-squared	0.103	0.105	0.107
Number of firms	29,764	25,610	24,033

All specifications include firm and time fixed effects

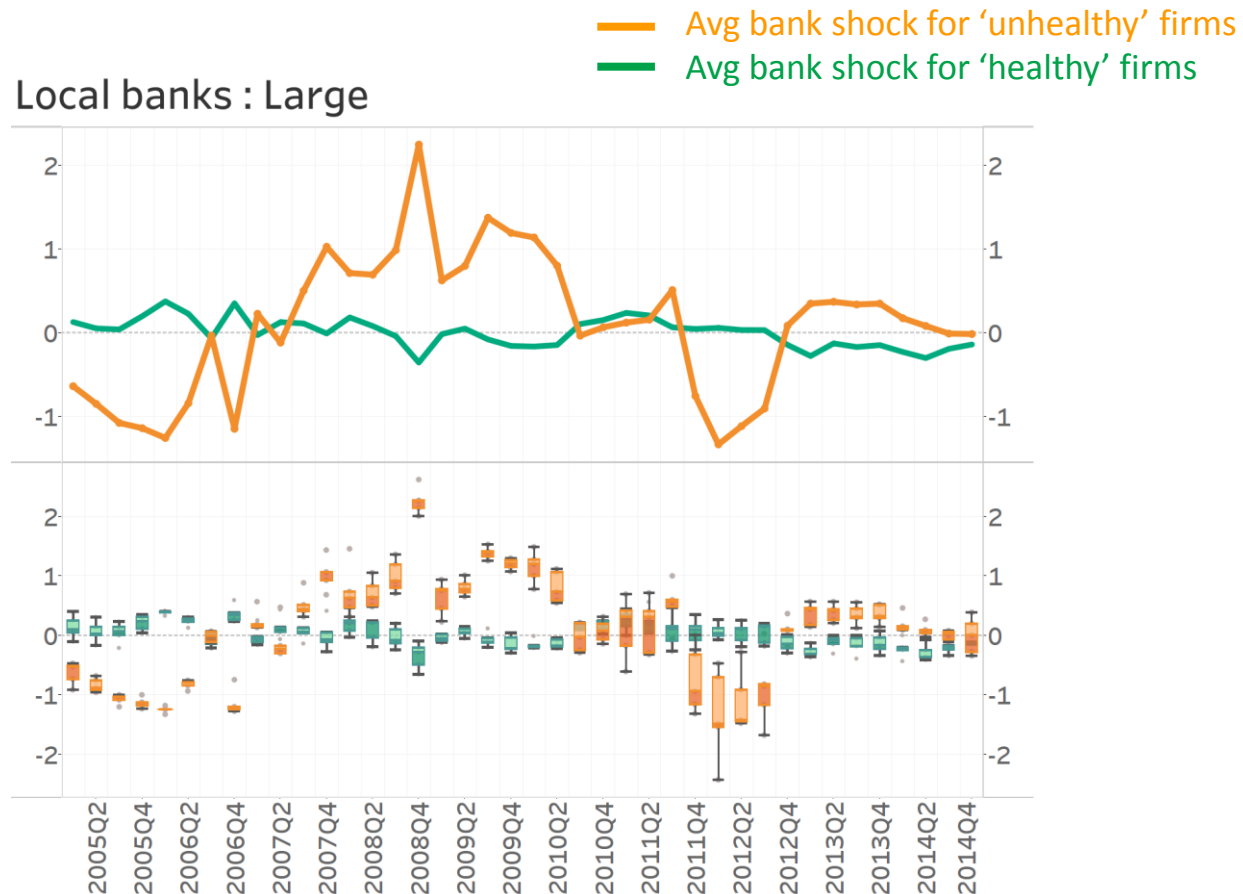
Which firms are more able to switch banks?

➔ Larger, higher-profitability firms with multiple bank relationships



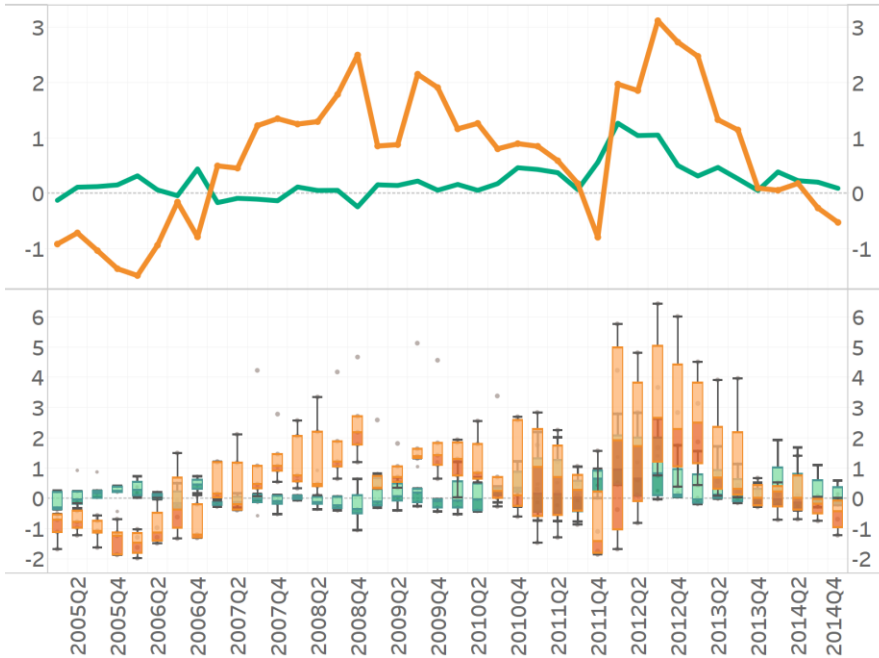
Result 5: Differential Bank Shocks within a Bank

- Bank appear to have different lending policy towards different customer groups
- Bank shocks to 'unhealthy' firms more volatile than those faced by 'healthy' firms

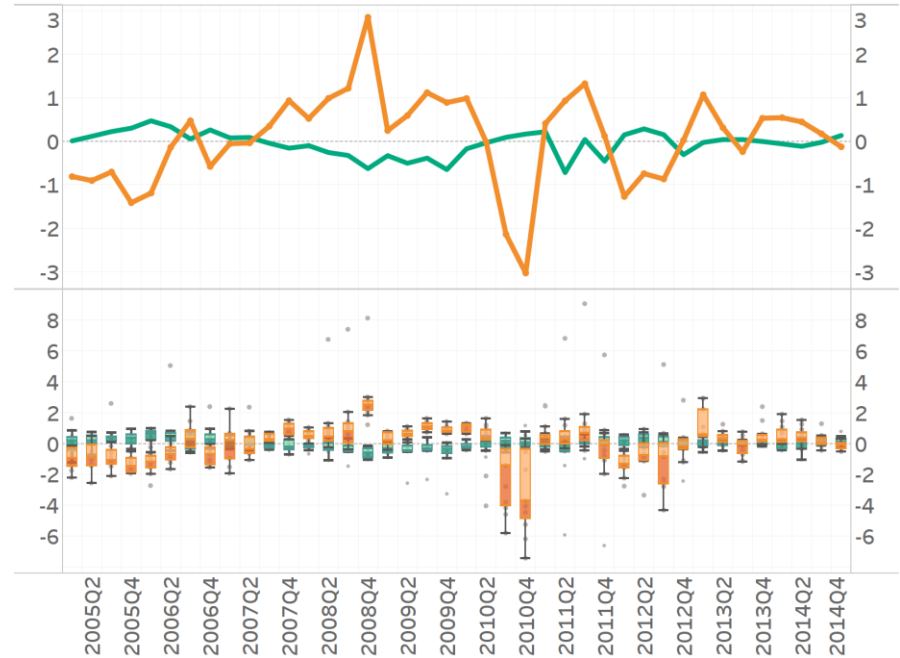


- Avg bank shock for 'unhealthy' firms
- Avg bank shock for 'healthy' firms

Local banks : Medium & Small



Foreign bank subsidiaries & branches



Summary of results

Aggregate level

- ❑ *Bank supply shocks have nontrivial effects* on the aggregate economy, accounting for around 40 percent of aggregate lending growth variation, and 16 percent of aggregate investment fluctuations

Firm level

- ❑ Bank shocks affect firm investment across all sizes of firms. The effect is stronger for firms with *heavy reliance on bank loan* and firms with *single bank relationship*
- ❑ Banks apply different lending policy towards different types of firms eg. *healthy* vs. *unhealthy* firms
- ❑ *Small firms* are more vulnerable to negative bank shocks. But having *more banking relationships* or the *ability to switch* to alternative banks helps shield their investment from these shocks.

Policy implications

Monitoring

- ✓ **Shocks from large players** matter for macroeconomic variations, especially given the highly concentrated Thai loan market
- ✓ **Aggregate data masks a lot of heterogeneity**; disaggregate data important for understanding distributional effects of shocks
 - Across-bank heterogeneity
 - Within-bank (across-customer) heterogeneity

Policy to enhance resiliency against bank supply shocks

- ✓ **Promote more diverse bank relationships**
 - Policy to reduce supply-side informational frictions