Interbank Trading, Collusion, and Financial Regulation

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Motivation

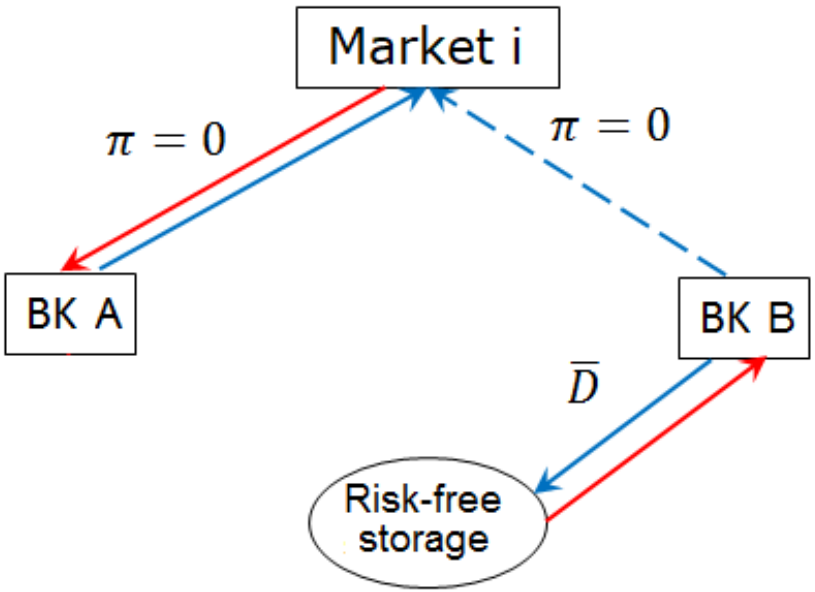
- **Why do banks provide interbank loans? The standard answer is: liquidity sharing.**
  - Trade-off: regulation that reduces interbank trading (exposures) helps stability, but hurts efficiency.

- **This paper: banks can use the interbank market to collude in the market for business loans.**
  - No trade-off: regulation that reduces interbank trading (exposures) can help both to improve financial stability and efficiency.

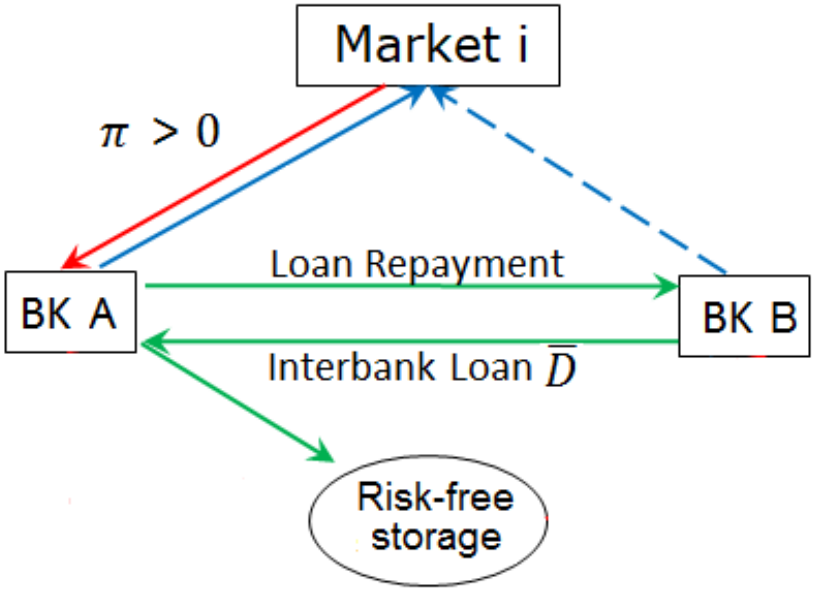
- **What we do:**
  - Provide a simple decentralized model to illustrate the mechanism.
  - Provide empirical evidence supportive of the model's predictions.
  - Identify sources of inefficiency by solving the planner's problem.
  - Examine how financial regulation (e.g., Basel III large exposures framework) can be used to mitigate welfare losses from collusion.

Key insights for collusion

Planner's Solution and
Decentralized Solution w/o Interbank Market



Decentralized Solution with
Interbank Market



- Key insights:
  1. Interaction between the interbank market and the market for loans is important
  2. Interbank market allows banks to commit not to compete (endogenous capacity constraint)
  3. Interest rate on the interbank loans allows banks to split surplus from (tacit) collusion

Environment Overview

- **Bankers:** 2 risk neutral bankers (BK) each of whom can make a costly effort to study a market for business loans. Studying a market is necessary for provision of loans and is equivalent to market entry. The "cost of entry" equals I units of consumption.

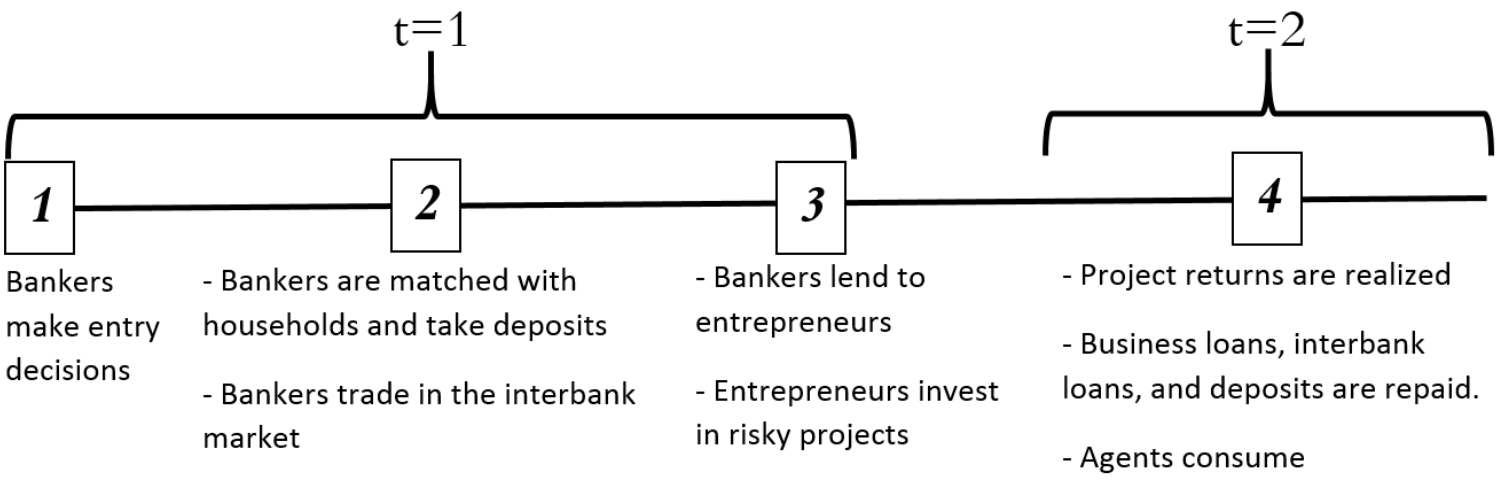
- **Market for business loans:** A monopolistic banker makes profit π^M in the market for business loans.
  - Measure $M \geq 1$ of risk neutral entrepreneurs (ENT) each have a risky project that requires 1 unit of investment.
  - Project returns R^P with probability p, 0 otherwise.
  - Outside option: if do not invest in the project, ENT derive an unobservable utility ω drawn from a uniform distribution.

- **Liquidity shocks:**
  - With probability γ a banker is matched with risk-averse households (HH) who make deposits sufficient to fund all $NPV > 0$ projects ($D = \overline{D}$). With probability $1 - \gamma$ a banker is not matched with HH and does not have liquidity ($D = 0$).
  - Liquidity shocks are i.i.d. across bankers.

Interbank market

- Allows bankers to transfer funds prior to making business loans.
- Bankers bargain both over the size of an interbank loan and the interest rate on the interbank loan.
  - A lender in the interbank market receives profit of $\theta \cdot \pi^M$ where θ is the bargaining power of the lender (we assume $\frac{1}{2}$).
- Depending on the distribution of liquidity, the interbank market may:
  - transfer funds from high to low liquidity banks (Liquidity Sharing)
  - allow banks to commit not to compete (Collusion)

Timeline



We solve for a SPE:

- Subperiod 3: bankers maximize profits by optimally choosing lending rates in Bertrand competition with capacity constraints.
- Subperiod 2: bankers choose an interbank loan that maximizes their joint profits. Interbank rate splits the surplus.
- Subperiod 1: bankers entry decisions are a Nash equilibrium of the underlying entry game.

Subperiod 3: Bertrand Competition for Business Loans

There are three cases to consider:

- Pure strategy NE. One banker has **full lending capacity** and the second one has **no lending capacity**. Monopolist's profit is π^M. The second banker's profit is 0.
- Mixed strategy NE. One banker has **full lending capacity** and the second one has **restricted lending capacity**. Aggregate profits are smaller than π^M.
- Pure strategy NE. Both bankers have **full lending capacity**. Both bankers maker zero profits like in the standard Bertrand competition.

Conclusion: Aggregate profits are maximized when one banker has no lending capacity and therefore the second lender is a monopolist.

Subperiod 2: Payoffs summary

	A & B enter Prob: q^2	A enters $q(1-q)$	B enters $(1-q)q$	No entry $(1-q)^2$
Both have liquidity Prob: γ^2	Collusion $\{\frac{\pi^M}{2}, \frac{\pi^M}{2}\}$	A Monopolist $\{\pi^M, 0\}$	B Monopolist $\{0, \pi^M\}$	No lending $\{0, 0\}$
A has liquidity Prob: $\gamma(1-\gamma)$	A Monopolist $\{\pi^M, 0\}$	A Monopolist $\{\pi^M, 0\}$	Liquidity sharing $\{\frac{\pi^M}{2}, \frac{\pi^M}{2}\}$	No lending $\{0, 0\}$
B has liquidity Prob: $(1-\gamma)\gamma$	B Monopolist $\{0, \pi^M\}$	Liquidity sharing $\{\frac{\pi^M}{2}, \frac{\pi^M}{2}\}$	B Monopolist $\{0, \pi^M\}$	No lending $\{0, 0\}$
No liquidity Prob: $(1-\gamma)^2$	No lending $\{0, 0\}$	No lending $\{0, 0\}$	No lending $\{0, 0\}$	No lending $\{0, 0\}$

▸ Details

Subperiod 1: Optimal entry decisions

- If $\frac{\pi^M}{I} > \frac{2}{\gamma}$ then both bankers enter a market and it is a unique equilibrium in dominant strategies.
- If $\frac{2}{\gamma(3-\gamma)} < \frac{\pi^M}{I} < \frac{2}{\gamma}$ then there is a unique mixed strategy symmetric Nash equilibrium. Each banker enters the market with probability

$$q^* = \frac{1}{2-\gamma}\left((3-\gamma) - \frac{2}{\gamma}\left(\frac{I}{\pi^M}\right)\right).$$

- If $\frac{\pi^M}{I} < \frac{2}{\gamma(3-\gamma)}$ then both bankers do not enter a market and it is a unique equilibrium in dominant strategies.

Lemma

Bankers are more likely to enter a market for business loans when the probability of a positive liquidity shock (γ) is higher or when the profitability ratio ($\frac{\pi^M}{I}$) of the market is higher.

Intensive Margin Predictions

1. **Positive relationship between spreads on business loans and collusion**
   - Intuition: Bankers are more likely to enter markets with high profit margins. More entry is likely to lead to collusion.
   - Find that firms pay 31bp higher spreads on $239B of loans when the lender borrows from a competitor bank.

2. **In case of collusion, a positive relationship between spreads on business loans and spreads in the interbank market**
   - Intuition: when bankers bargain on the interbank loan rate they take into account the high interest rate on business loans, which is the goal of collusion.
   - Find a strong empirical support for this prediction.

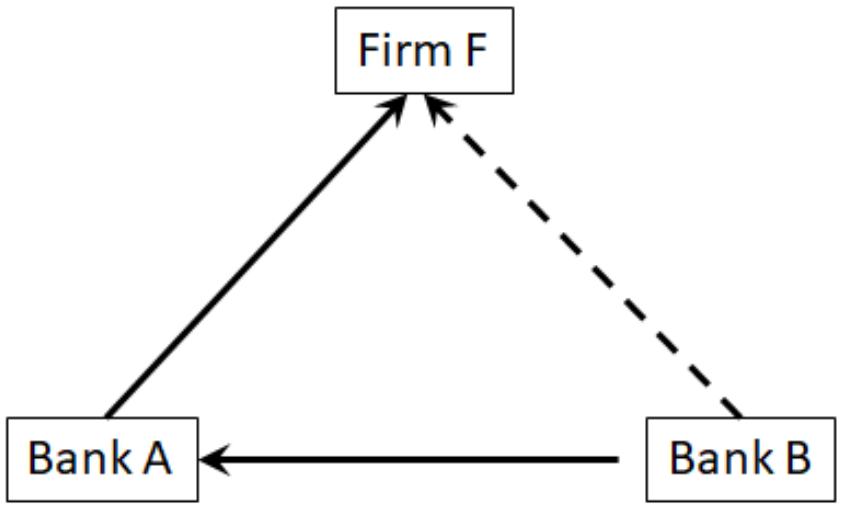
3. **Collusion does not require repeated interactions as an interbank loan allows a lending bank to commit not to compete.**
   - Indeed, we do not find a significantly higher interest rate on the "colluded loans" when banks have past interaction.

Data

- We use DealScan syndicated loans data (merged to S&P credit ratings and Compustat) that includes identities of the lender(s), the borrower, and the terms of the loan for a global panel of firms *and* banks.
- Period: June 1982 - April 2018
- Volume: 172,032 syndicated loans to businesses; 4,315 interbank syndicated loans
- Value: $34.5 trillion of corporate loans; $3.8 trillion of interbank loans (in 2018 USD)
- Ideal for our tests because we can see both bank-to-firm and **bank-to-bank** loans

Collusion Dummy

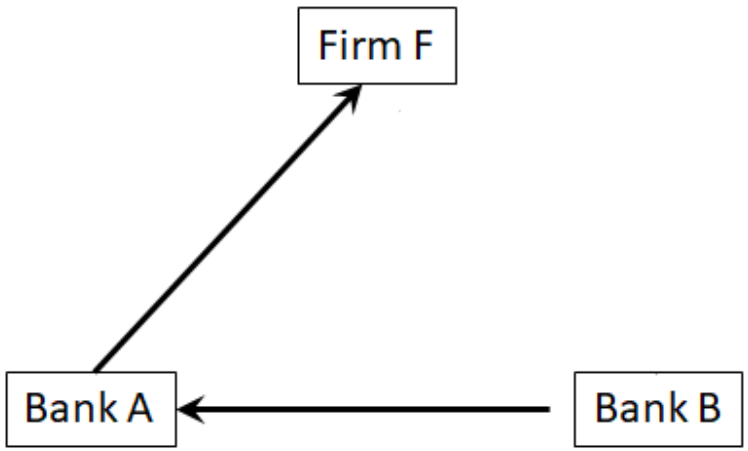
- We define a **Collusion Dummy = 1** if
  1. Bank A is a lead arranger in a syndicated loan to firm F
  2. At the time of origination, bank A has an outstanding loan from a syndicate J of banks
  3. $\exists$ a Bank B $\in J$ which was a lead arranger in a syndicated loan to firm F and this loan was repaid within 5 years from the loan provided by bank A (i.e. bank B has a technology to compete but has "committed" funds away).



- We test whether the interest on the business loan from bank A to firm F is higher when Collusion Dummy = 1

Chain (Liquidity Sharing) Dummy

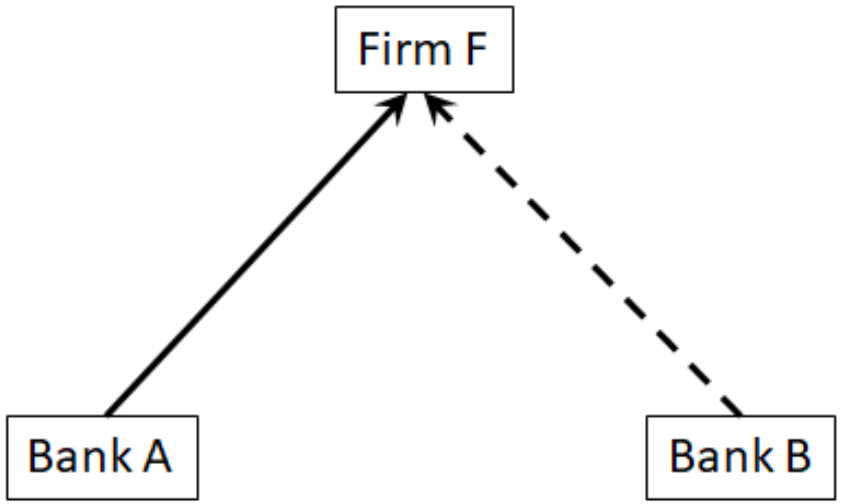
- We define a **Chain Dummy = 1** if
  1. Bank A is a lead arranger in a syndicated loan to firm F
  2. At the time of the loan origination, bank A has an outstanding loan from a syndicate J
  3. $\nexists$ any bank $\in J$ which was a lead arranger in a syndicated loan to firm F and this loan was repaid within 5 years from the loan provided by bank A (i.e. bank B $\in J$ shared liquidity with A but does not have a technology to compete).



- We use the Chain Dummy to show that our results are driven by collusion and not intermediation. Business loans with Chain Dummy=1 should not be priced higher.

Switch (Adverse Selection) Dummy

- We define a **Switch Dummy = 1** if
  1. Bank A is a lead arranger in a syndicated loan to firm F
  2. Bank B was a lead arranger in a syndicated loan to firm F and the loan was repaid within the last 5 years.
  3. Bank A does not have an outstanding loan from Bank B



- We use the switch dummy to show that our results are driven by collusion and not adverse selection. Business loans with switch dummy=1 should not be priced higher.

Summary Statistics: Loans to Firms

Panel A: Full Sample	Mean	StDev	p10	p50	p90	Obs.
Collusion Dummy	0.01	0.11	0.00	0.00	0.00	107,605
Chain Dummy	0.32	0.47	0.00	0.00	1.00	107,605
Switch Dummy	0.03	0.17	0.00	0.00	0.00	107,605
Number of competitors	1.15	1.81	0.00	1.00	3.00	107,605
Loan Characteristics						
All-in-drawn	259.40	174.16	70.00	225.00	475.00	103,582
Facility amount (mm USD)	257.29	683.84	10.00	80.00	600.00	107,566
Maturity	54.91	28.37	13.00	60.00	84.00	102,733
Collateral	0.85	0.36	0.00	1.00	1.00	64,923
Firm Characteristics						
Public	0.36	0.48	0.00	0.00	1.00	92,413
Previous lending relationship	0.37	0.48	0.00	0.00	1.00	107,605
First time borrower	0.39	0.49	0.00	0.00	1.00	107,605
Sales at close (mm USD)	3662	20255	63	530	6881	56,862
Assets (mm USD)	9285	72101	104	1025	13982	53,458
Leverage	0.40	4.84	0.06	0.33	0.66	53,304
ROA	0.12	0.49	0.04	0.13	0.24	50,747

▸ Regression sample ▸ Figure: Num. of Competitors

Summary Statistics: Interbank Loans

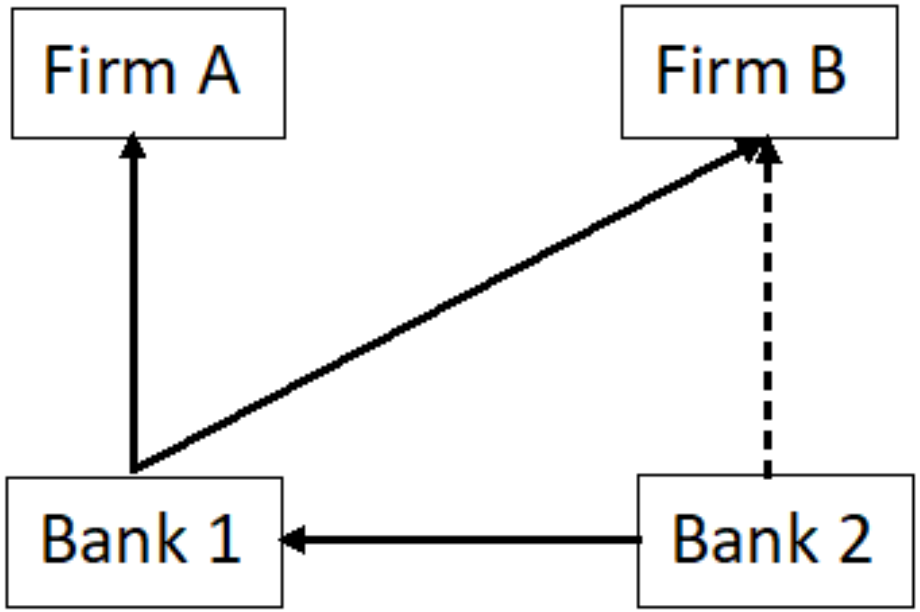
Panel A: Interbank loans that trigger collusion dummy = 1						
	Mean	StDev	p10	p50	p90	Obs.
Loan Characteristics						
All-in-drawn	91***	88	25	50	200	198
Facility amount(mm USD)	1,386***	2,942	80	545	2,800	213
Maturity	35	21	12	36	60	211
Collateral	0.55	0.50	0	1	1	51
Borrower Characteristics						
Public	0.63***	0.48	0	1	1	186
Assets(bn USD)	161***	273	5	33	567	193
Lender Characteristics						
Assets(bn USD)	733	751	60	501	2,005	198
Total loans value (mm USD)	390,699	Number of loans	213			

Panel B: Interbank loans that trigger chain dummy = 1						
	Mean	StDev	p10	p50	p90	Obs.
Loan Characteristics						
All-in-drawn	115	114	23	75	275	3,836
Facility amount(mm USD)	630	1,097	25	205	1,650	4,101
Maturity	36	32	12	36	60	3,879
Collateral	0.46	0.50	0	0	1	1,481
Borrower Characteristics						
Public	0.52	0.50	0	1	1	3,399
Assets(bn USD)	74	173	1	15	191	2,394
Lender Characteristics						
Assets(bn USD)	736	752	50	407	2,005	3,143
Total loans value (mm USD)	3,391,028	Number of loans	4,102			

Intensive Margin Results

	(1)	(2)	(3)	(4)	(5)	(6)
Collusion Dummy	29.17**	-206.0***	31.24***	36.11**	-7.676	-0.669
Collusion × Competitor's capacity		23.43***				
Competitor's capacity (%)		-14.02				
Chain Dummy			6.636	0.755	7.653	1.362
Switch Dummy			4.021	4.132	4.671	4.898
Repeated interactions × collusion				-0.154		-0.238
Repeated interactions × chain				0.0146		0.0120
Interbank spread × collusion					0.264***	0.264***
Interbank spread × chain					0.00184	0.0108
Borrower Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Loan Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
S&P Rating FEs	Yes	Yes	Yes	Yes	Yes	Yes
Loan Purpose FEs	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Country FEs	Yes	Yes	Yes	Yes	Yes	Yes
Loan Type FEs	Yes	Yes	Yes	Yes	Yes	Yes
industry FEs	Yes	Yes	Yes	Yes	Yes	Yes
Lender × Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,905	1,249	12,905	12,905	12,607	12,607
Adj. R-squared	0.680	0.624	0.680	0.681	0.681	0.681

Identification



- Bank 1 has an outstanding loan from Bank 2
- Both Firms A and B borrow from Bank 1 in a given year (Lender x Year FE)
- The only difference between them is that Firm B borrowed in the past from Bank 2 and repaid the loan within 5 years
- Firm B pays 31bp higher interest on the loan from Bank 1 than Firm A

Extensive Margin Analysis - Staggered Introduction of Leniency Programs

- Price-setting collusion: banks coordinate rates prior to lending
  - Profitable, but illegal
  - 56 cartels in finance/insurance/banking industry between 1990-2012 according to Connor (2017).

- Empirical prediction: if the cost of the classic collusion ↑, we should see more collusion using interbank market.

- We use staggered introduction of a leniency program in 54 countries as an exogenous shock to cost of the standard collusion. ▸ Country by Year
  - Leniency programs apply to all industries, not only to finance
  - If firms are engaged in a standard collusion and one of the firms reports it to anti-trust authority then it will not face fines and jail time.
  - Considered to be the most effective tool to break cartels

- After a leniency program is introduced (Treated $= 1$) we should expect more collusion on business loans using interbank lending.

Extensive margin: Leniency Program Results

Dependent variable: Collusion Dummy							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treated	0.0267***	0.0726***	0.0838***	0.0842***	0.0872***	0.0881***	
	(4.01)	(3.43)	(3.98)	(3.91)	(4.10)	(4.15)	
Collateral		-0.0333***	-0.0339***	-0.0344***	-0.0337***	-0.0342***	-0.0344***
		(-5.01)	(-3.85)	(-4.16)	(-3.97)	(-3.83)	(-3.72)
Maturity			-0.000119	-0.000101	-0.000144	-0.000133	-0.000133
			(-0.61)	(-0.54)	(-0.73)	(-0.66)	(-0.64)
Log(Facility amount)				-0.00174	-0.000935	-0.000965	-0.000982
				(-0.79)	(-0.35)	(-0.34)	(-0.32)
ROA					-0.0337	-0.0168	-0.0167
					(-0.96)	(-0.58)	(-0.49)
Leverage						-0.0334	-0.0332
						(-1.34)	(-1.33)
Before^{-2}							0.0142
							(0.47)
Before^{-1}							-0.000980
							(-0.01)
Before^{0}							0.0948**
							(2.38)
After^{1}							0.0821***
							(3.32)
After^{2+}							0.0919***
							(3.08)
Lender Country FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
S&P rating FEs	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35,673	3,409	3,307	3,306	3,123	3,113	3,113
Adj. R-squared	0.008	0.028	0.027	0.027	0.031	0.031	0.030

▸ Figure: Parallel trends ▸ Placibo test

Summary of the empirical results

- 5% of interbank loans trigger collusion dummy =1. These loans are 9% of interbank loans value ($391 billions of loans).
- There are $239 billion of business loans by a lender who has an outstanding loan from a competitor (1.2% of all loans).
- When the interbank loan constitutes a larger fraction of competitor's Tier 1 capital, the spread that a firm pays is larger
- On the intensive margin, colluded loans are overpriced by 31 basis points. This spread is equivalent to pricing A rated borrowers as if they were BBB rated borrowers (three notches down).
- On the extensive margin, we find more collusion using interbank lending after staggered introduction of leniency programs.
- Robust to multiple alternative specifications ▸ Robustness

Welfare Analysis

- We compare planner's solution to decentralized solution.
- Expected welfare is higher in the planner's solution, but bankers are worse off relative to the decentralized solution.
- Two sources of inefficiency in the decentralized solution:
  - **Inefficient entry**
    - ⋆ Bankers underinvest in monitoring (0 bankers enter)
    - ⋆ Bankers overinvest in monitoring (2 bankers enter)
  - **Inefficient lending**
    - ⋆ Conditional on entry, more lending takes place under the planner's solution (monopolistic bankers ration the supply of loans in the decentralized eqm)

Can restrictions on the interbank lending help?

Post-entry:

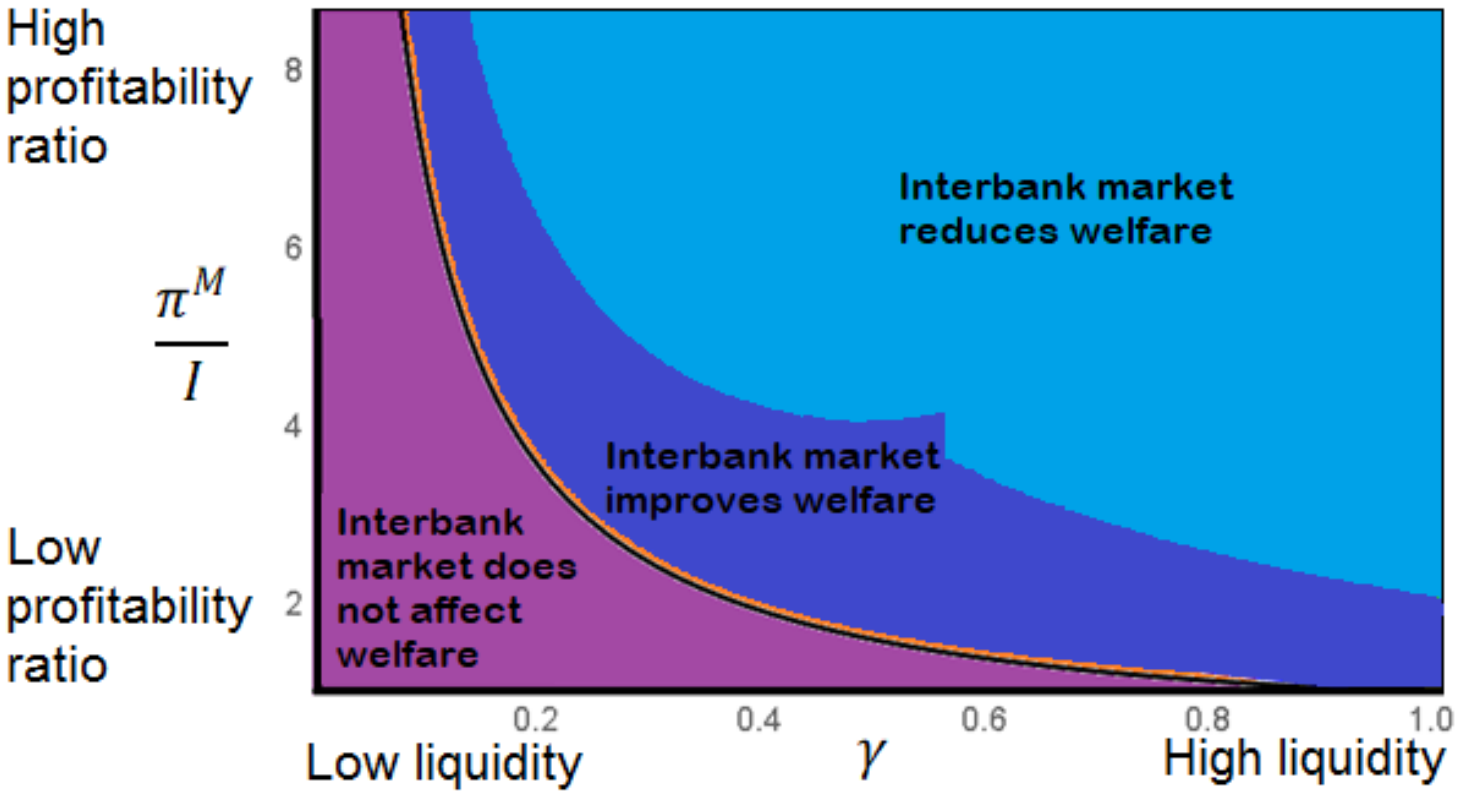
- Benefit: eliminates collusion (increasing business loans and lowering bank profits)
- Cost: eliminates liquidity sharing (leads to less lending)

Entry:

- Cost: competition makes entry less likely (lowers banker profits)
- Benefit: lack of liquidity sharing makes entry more likely (entry is a necessary condition for profits)

Welfare Effects of Interbank Lending

- Welfare can increase, decrease or stay the same.



Policy Implications

- The trade-off between efficiency and stability of interbank exposures might not exist.
  - Restricting interbank trading (e.g., Basel III large exposures regulation) improves not only stability, but also efficiency because banks are forced to compete.

- The collusion mechanism also applies to the interbank markets for swaps and derivatives (≈700 trillion of notinal).

Conclusion

- We build a model that combines loan market competition and interbank trading.
- We show that opening an interbank market for trade can reduce welfare (similar to Hart (1975)).
  - When a bank provides an interbank loan to a competitor, it commits not to compete in the market for loans (does not require repeated interactions as in IO literature).
  - Bank can split surplus from collusion in business loan market via interest payment in the interbank loan market (effectively connecting two markets similar to Bernheim and Whinston (1990) and Cole and Kehoe (1998)).
- We find empirical support for our theory using syndicated loan data
  - Spreads are higher when lenders borrow from competitors
  - Economically as large as the difference in spreads on loans to BBB and A rated borrowers.
  - More collusion using interbank lending after introduction of leniency programs.
- Provide a full characterization of when interbank markets reduce welfare.

Subperiod 2: Interbank lending

There are three cases to consider:

- Interbank market for liquidity sharing (2 states).
  - One banker entered the market, but does not have liquidity. Another one did not enter, but has liquidity.
  - Interbank loan is equal to the amount needed for monopolistic lending.
  - Each banker receives $\frac{\pi^M}{2}$.
- Interbank market for collusion (1 state).
  - Both bankers enter and both have liquidity.
  - Interbank loan size is equal to $\overline{D}$, which is all deposits of one of the bankers.
  - Each banker receives $\frac{\pi^M}{2}$.
- Interbank market is not used in equilibrium (13 states).
  - Both banker didn't enter. Both bankers get 0.
  - Both bankers don't have liquidity. Both bankers get 0.
  - Only one banker entered and she has liquidity. The monopolist gets π^M. The other banker 0.

Conclusion: Interbank market is used for liquidity sharing and for collusion.

Back

Summary Statistics (Regression Sample)

Panel B: Regression Sample	Mean	StDev	p10	p50	p90	Obs.
Collusion Dummy	0.01	0.11	0.00	0.00	0.00	13,630
Chain Dummy	0.16	0.37	0.00	0.00	1.00	13,630
Loan Characteristics						
All-in-drawn	220.06	150.46	50.00	200.00	400.00	13,630
Facility amount (mm USD)	555.41	1077.47	50.00	266.67	1250.00	13,630
Maturity	53.74	23.04	12.00	60.00	84.00	13,630
Collateral	0.70	0.46	0.00	1.00	1.00	13,630
Firm Characteristics						
Public	0.62	0.49	0.00	1.00	1.00	13,630
Previous lending relationship	0.57	0.50	0.00	1.00	1.00	13,630
First time borrower	0.10	0.30	0.00	0.00	1.00	13,630
Sales at close (mm USD)	5137	17278	236	1596	11031	13,630
Assets (mm USD)	10591	76675	396	2100	16606	13,630
Leverage	0.43	0.28	0.16	0.39	0.74	13,630
ROA	0.14	0.08	0.06	0.13	0.23	13,630

Back

Interbank Loans Maturity (Months)

Loan Type	Mean	StDev	p10	p50	p90	Obs.
Revolver/Line >= 1 Yr.	48.15	16.77	24.00	58.00	60.00	1536
364-Day Facility	12.05	1.29	12.00	12.00	12.00	1156
Term Loan	51.53	48.15	12.00	48.00	84.00	874
Standby Letter of Credit	24.55	18.33	12.00	12.00	60.00	148
Revolver/Line < 1 Yr.	7.24	3.41	3.00	6.00	12.00	84
FRN (Loan-Style)	44.08	20.49	14.10	36.00	60.90	52
Bridge Loan	17.98	36.81	3.20	12.00	21.20	43
Other Loan	33.63	29.33	6.10	26.00	60.00	32
Revolver/Term Loan	55.45	21.63	24.00	60.00	84.00	31
Guarantee	36.83	11.97	36.00	36.00	36.00	29
Floating Rate CD (loan-style)	35.63	14.37	15.60	36.00	60.00	24
Delay Draw Term Loan	46.58	20.28	12.90	57.00	63.70	24
Multi-Option Facility	44.31	12.68	36.00	36.00	60.00	13
Trade Letter of Credit	37.82	44.64	12.00	12.00	104.00	11
Lease	92.57	43.66	50.40	84.00	144.00	7
Murabaha	24.00	13.86	12.00	24.00	36.00	4
Synthetic Lease	60.00	19.60	43.20	60.00	76.80	4
Undisclosed	24.00	12.00	14.40	24.00	33.60	3
Acquisition Facility	19.00	2.83	17.40	19.00	20.60	2
Performance Standby Letter of Credit	33.00	4.24	30.60	33.00	35.40	2
Leagues/Other	12.00	0.00	12.00	12.00	12.00	2
Musharaka	84.00		84.00	84.00	84.00	1
Fixed-Rate Bond	48.00		48.00	48.00	48.00	1
FRN (Bond-Style)	132.00		132.00	132.00	132.00	1
Export Credit	57.00		57.00	57.00	57.00	1
Step-Payment Lease	12.00		12.00	12.00	12.00	1
Demand Loan	240.00		240.00	240.00	240.00	1
CAPEX Facility	84.00		84.00	84.00	84.00	1
Bankers Acceptance	12.00		12.00	12.00	12.00	1
Limited Line	35.00		35.00	35.00	35.00	1

Back

Robustness

	Benchmark	2010-2018	Only Term Loans	3 years
Collusion Dummy	44.40***	50.54***	54.76***	35.06**
	(12.71)	(19.31)	(18.80)	(14.73)
Chain Dummy	18.55***	-8.513	23.65***	19.55***
	(5.160)	(6.787)	(6.790)	(5.246)
Public	-19.30***	-20.89***	-25.87***	-19.26***
	(3.526)	(3.634)	(5.781)	(3.528)
Previous lending relationship	-11.50***	-36.21***	-16.89***	-11.66***
	(3.152)	(7.036)	(5.446)	(3.181)
First time borrower	-1.455	15.62	0.296	-1.737
	(5.043)	(17.63)	(9.248)	(5.041)
Log(Sales at close)	-6.467***	-19.21***	-3.443	-6.427***
	(1.912)	(3.625)	(2.838)	(1.909)
Log(Assets)	19.52***	15.12***	6.553	19.47***
	(2.268)	(4.478)	(4.164)	(2.257)
Leverage	9.857	-16.51	-22.75**	9.787
	(7.286)	(13.58)	(11.20)	(7.269)
ROA	-55.38***	30.47	-125.8***	-55.69***
	(20.53)	(36.08)	(37.51)	(20.51)
Log(Facility amount)	-12.51***	-2.391	-5.519*	-12.54***
	(2.369)	(2.467)	(3.266)	(2.371)
Maturity	-0.00838	0.555**	-0.409**	-0.00841
	(0.0659)	(0.239)	(0.163)	(0.0660)
Collateral	75.01***	15.94	105.7***	74.93***
	(6.724)	(11.73)	(11.49)	(6.716)
Constant	52.31***	165.6***	222.3***	52.78***
	(15.08)	(26.09)	(40.67)	(15.08)
S&P rating FEs	Yes	Yes	Yes	Yes
Observations	13,630	3,695	4,591	13,630
Adj. R^2	0.457	0.508	0.317	0.457

Robust to Alternative Specifications

Robust to:

- Period: 1981-2007
- Period: 2010-2018
- Term loans only
- Only US borrowers or US lenders
- Only loans to private firms
- Collusion and chain dummies defined using 3 years window instead of 5 years
- Collusion and chain dummies defined using 4-digit SIC code. Collusion dummy $= 1$ if competitor bank lent to another firm in the same 4-digit SIC code as the current firm that borrows.

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Alternative Explanations

- What if Firm F is a lemon. Bank B knows it, decides not to lend again. Bank A does not know it. Willing to lend, but charges a premium for adverse selection. Implicit assumption: credit rating, collateral and other controls do not capture credit risk of the loan.

- How do we address it?
  1. Condition that bank A also has a relationship with firm F
  2. Use credit rating within two years after the deal
  3. Results are stronger when the loan to Bank B is repaid within 5 years versus within 3 years
  4. Construct collusion dummy at the industry level, so Bank B lent to another firm in the same 4-digit SIC x country
  5. Construct a switch dummy $= 1$ if Firm F switched lenders, but these lenders do not have an interbank loan to bank A
  6. Does not explain a positive relationship between the spreads on the interbank loan and the business loan

Leniency Programs Introduction by Year

Country	Year		Country	Year		Country	Year
USA	1993		New Zealand	2004		Denmark	2007
Korea	1997		Poland	2004		Russia	2007
UK	1998		Romania	2004		Italy	2007
Brazil	2000		Finland	2004		Lithuania	2008
Canada	2000		South Africa	2004		China	2008
Germany	2000		Switzerland	2004		Spain	2008
Czech Republic	2001		Latvia	2004		Chile	2009
France	2001		Norway	2005		Colombia	2009
Slovakia	2001		Peru	2005		Philippines	2009
Ireland	2001		Iceland	2005		India	2009
Netherlands	2002		Israel	2005		Turkey	2009
Estonia	2002		Japan	2005		Malaysia	2010
Sweden	2002		Austria	2006		Croatia	2010
Australia	2003		Mexico	2006		Slovenia	2010
Bulgaria	2003		Portugal	2006		Cyprus	2011
Hungary	2003		Singapore	2006		Ecuador	2011
Luxembourg	2004		Greece	2006		Taiwan	2012
Belgium	2004		Pakistan	2007		Ukraine	2012

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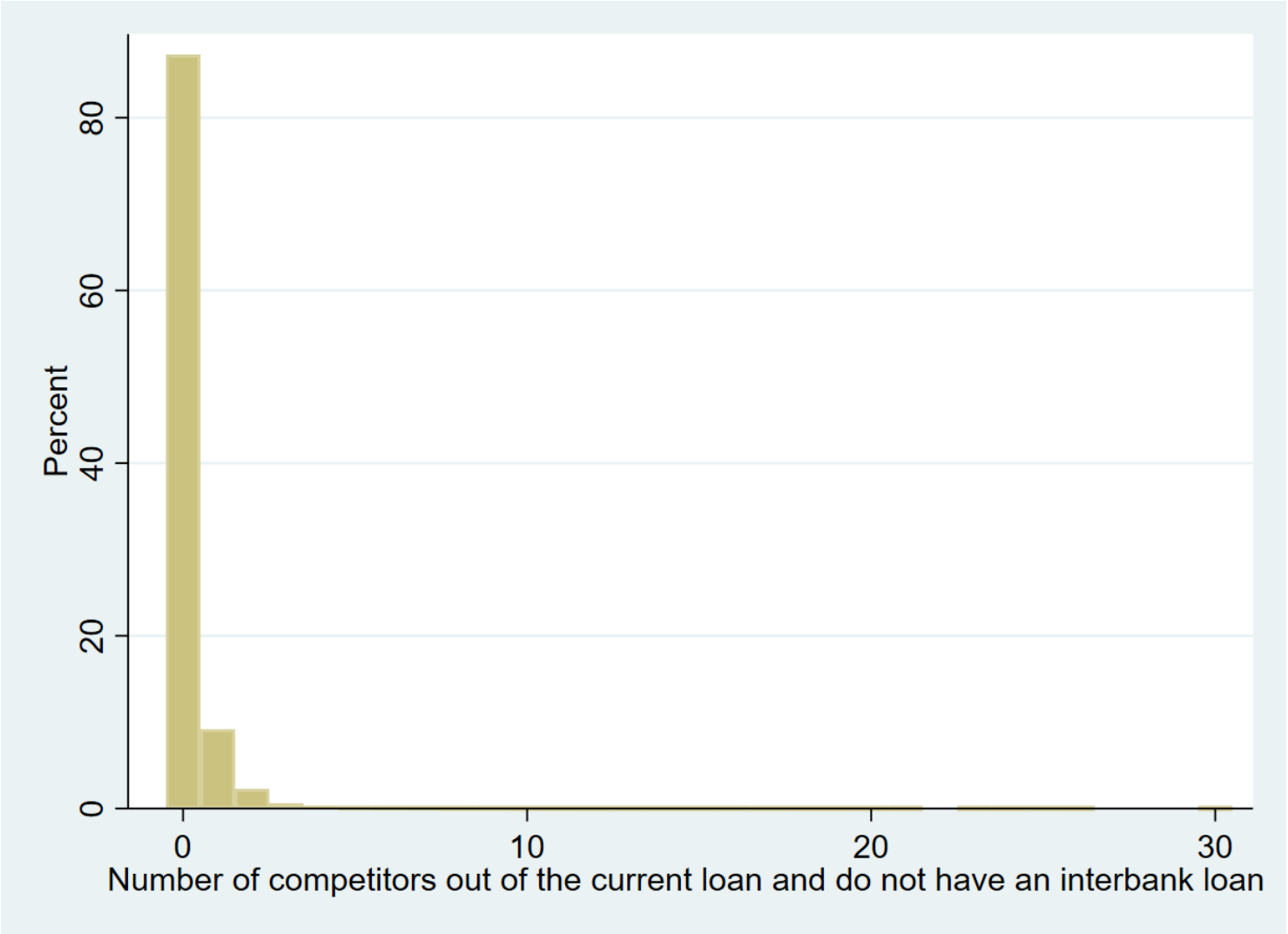
Distribution of the number of competitors



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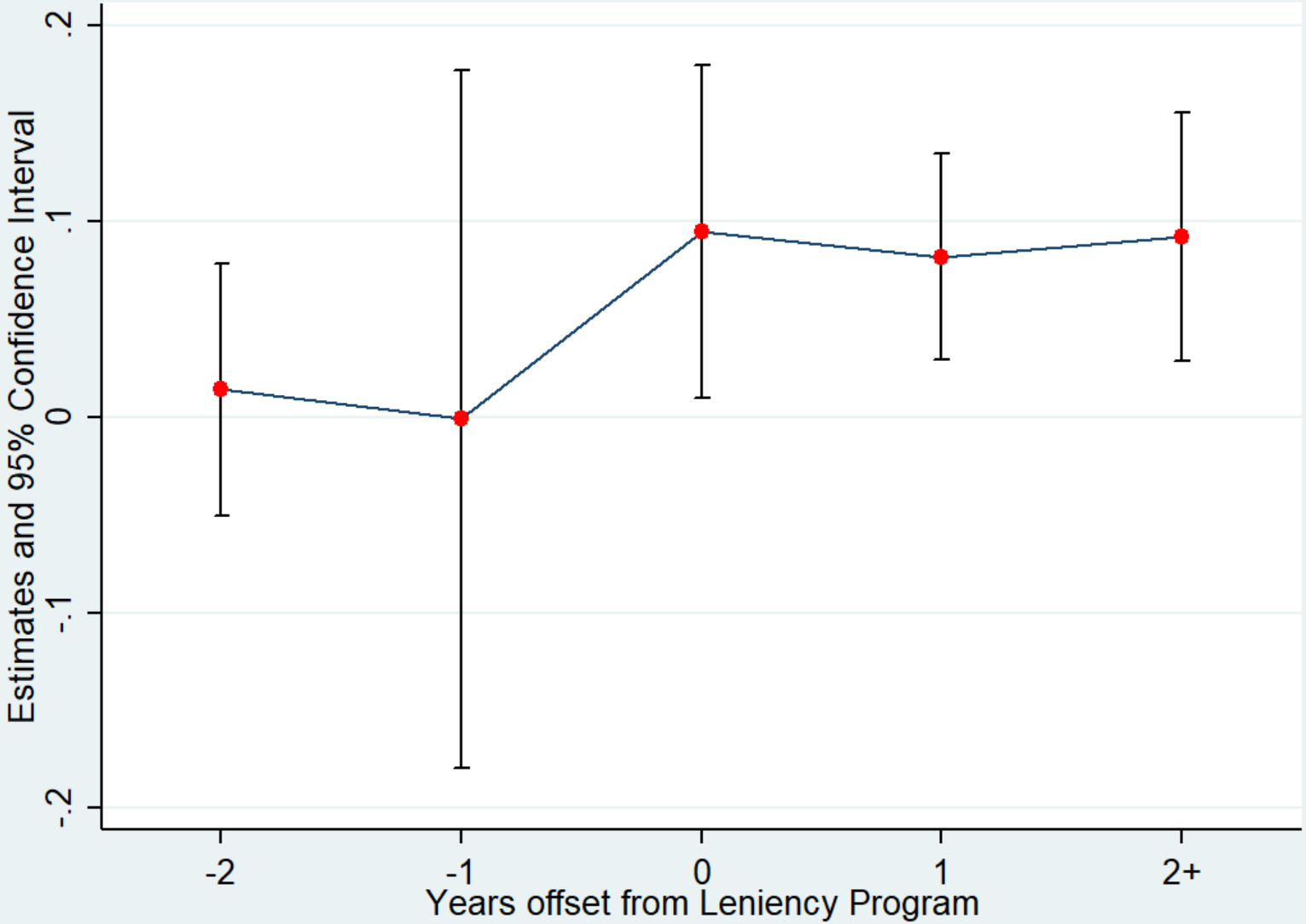
Extensive Margin - Parallel Trends Figure



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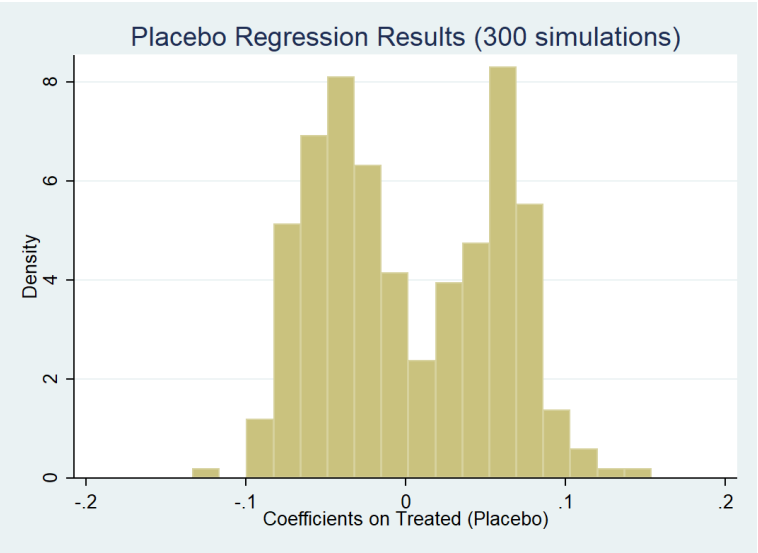
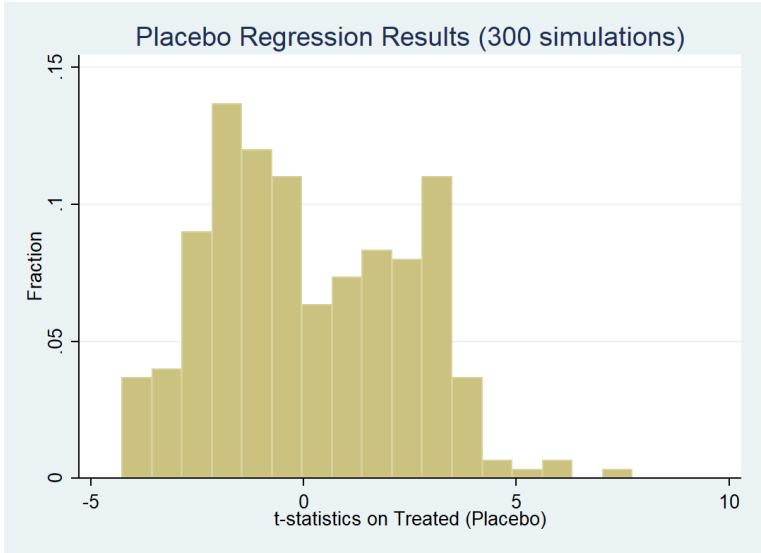
Extensive Margin - Placebo Treatment





- We reshuffle the start year of the leniency program across the countries.
- We estimate the coefficient on the Treated variable in specification (6) 300 times for each reshuffle.
- In 291 out 300 simulations (3%), the estimated coefficient was smaller than the factual coefficient of 0.0881.
- In 293 out of 300 simulations (2.3%), the t-stat of the Treated coefficient was smaller than the 4.15 t-stat for the factual treatment.

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