Liquidity Hoarding in the Interbank Market

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BANCO DE MÉXICO

Motivation

- Granovetter (1985), Economic Action and Social Structure: The Problem of Embeddedness, The American Journal of Sociology, Vol. 91, No. 3, pp. 481-510.
- Granovetter (2005), The Impact of Social Structure on Economic Outcomes, Journal of Economic Perspectives, Vol. 19, No. 1, pp. 33-50.

Social structure, especially in the form of social networks, affects economic outcomes for three main reasons:

1. Social networks affect the flow and the quality of information,
2. Social networks are an important source of reward and punishment,
3. Trust emerges, if it does, in the context of a social network.

Motivation

van der Leij (2006) The economics of networks: Theory and empirics

...Granovetter argued that seemingly irrational behavior can be rationalized once we take into account the social relations agents are embedded in. The problem was the “neglect of social structure”.

When we analyze the role of networks in economics, it is useful to structure the analysis around the following three questions:

1. What structural properties does the network have?
2. How does the network structure influence economic decision-making?
3. What role do economic incentives play in the formation of the network structure?

Outline

Introduction

A focal point of the study of systemic risk and the Global Financial Crisis has been the interbank lending market. This inspired research on contagion in financial networks, both by economists and non-economists

- Financial contagion: Alan & Gale (2000)
- Ecology of banking system: Haldane & May (Nature, 2011)
- Many others

Introduction

Most financial network research has focused on potential *cascades of insolvency defaults* through *exposures on unsecured loans*. However, such cascades never took place.

More relevant in the Global Financial Crisis seems to have been *liquidity contagion* in *(secured) repo lending markets*.

- Run on Repo market (Gorton & Metrick, 2012)

Introduction

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- Run on Repo market (Gorton & Metrick, 2012)
- Cascade of Liquidity Hoarding (Gai, Haldane & Kapadia, 2011)
  - Bank A gets hit by a negative shock and reduces or withdraws interbank lending to B and C.
  - Banks B and C then reduce or withdraw interbank lending to D, E.
  - This lending withdrawal process may cascade.

Introduction

Evidence is still sparse, in particular on contagion in the interbank market:

- Unsecured Interbank Lending
  - Filtered from large value payment system transactions, such as Fedwire or TARGET2 (Furfine, 1999). Doubts about reliability (Armantier & Copeland, 2012)
  - Or transactions from only a part of the market (eMid)
- Secured lending through repurchase agreements: Repo market
  - U.S. Tri-party Repo Market (Copeland et al. 2011)
  - Central Counterparty Euro Repo (Mancini et al. 2014)
  - Bilateral Repo between Money Market Funds and banks (Krishnamurthy et al. 2013)
- No data on both unsecured and secured (repo) interbank loans
- No data on bilateral interbank repo transactions

Introduction

A complete picture is missing. One of the few exceptions is Mexico

- The Mexican government tightened banking regulation after the Tequilla crisis in 1994
- The Mexican Central Bank, Banco de México, set up a data warehouse to which all banks are obliged to report data
- since 2005 **daily data on transactions** on **unsecured interbank loans, repo transactions, security and derivative holdings** in other banks.

In this project we consider

- Daily data on volume and interest rates
- on unsecured and secured (repo) interbank overnight loan transactions
- between commercial banks in Mexico
- from 2005 to 2013

Introduction

We asked ourselves the following questions:

- How do banks in the interbank overnight loan market respond to a general negative shock in external repo and wholesale funding?
- How do banks respond to individual negative wholesale funding shocks?
- Is there a transmission of the shocks to neighborhoods beyond the immediate one?

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Preliminary results

- Banks that are highly dependent on external repo funding increase their repo borrowing *and* decrease their repo lending to other banks
- Some evidence that this effect spills over to the unsecured market as well
- No effect on interest rates

The Mexican Banking Market

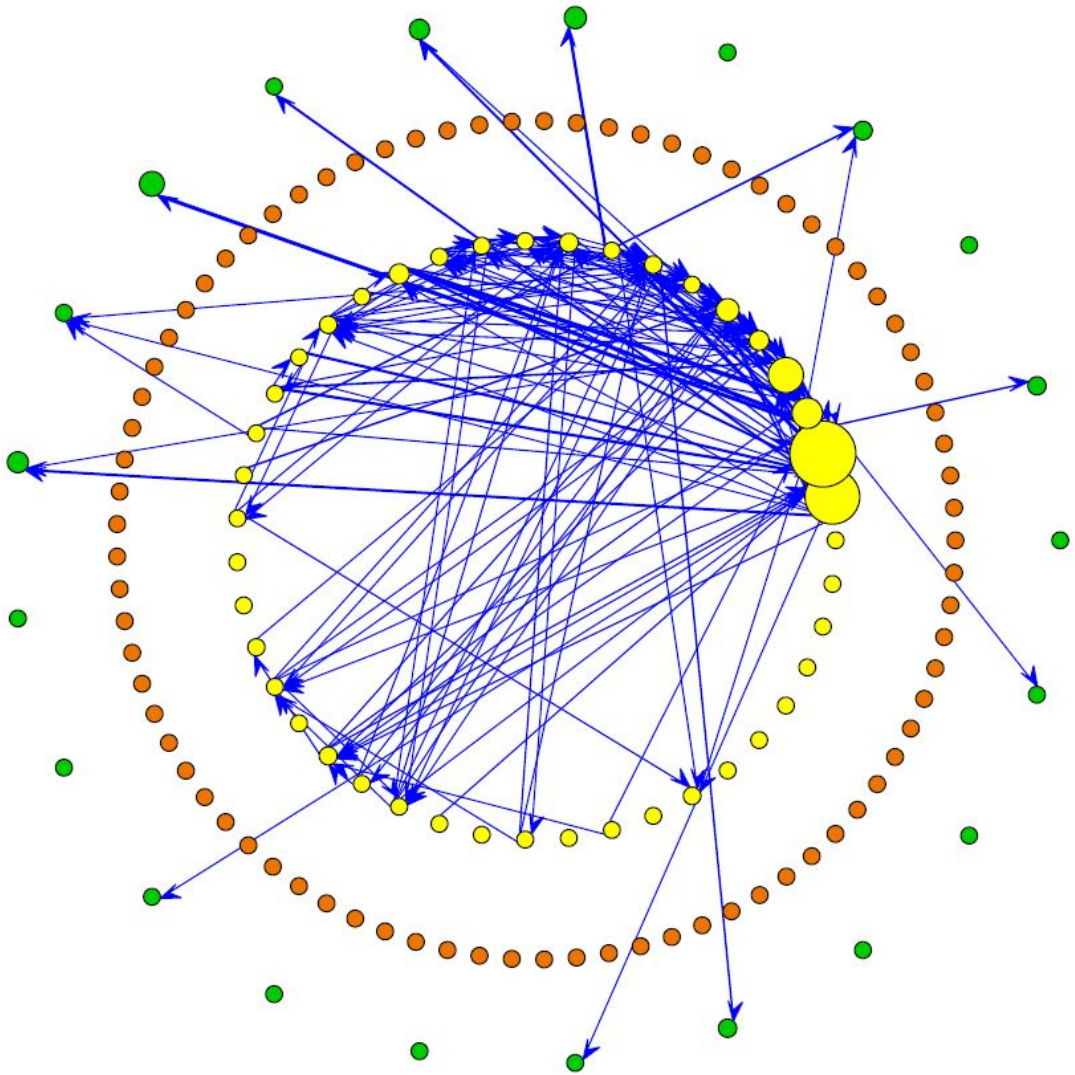
Structure of the unsecured interbank loan market

- commercial banks, brokerage houses, regional development banks, foreign banks and the central bank can participate
  - We consider only the interbank market between commercial banks: 27 commercial banks in 2005 to 40 in 2013.
  - only Mexican peso
  - only overnight transactions (92%)

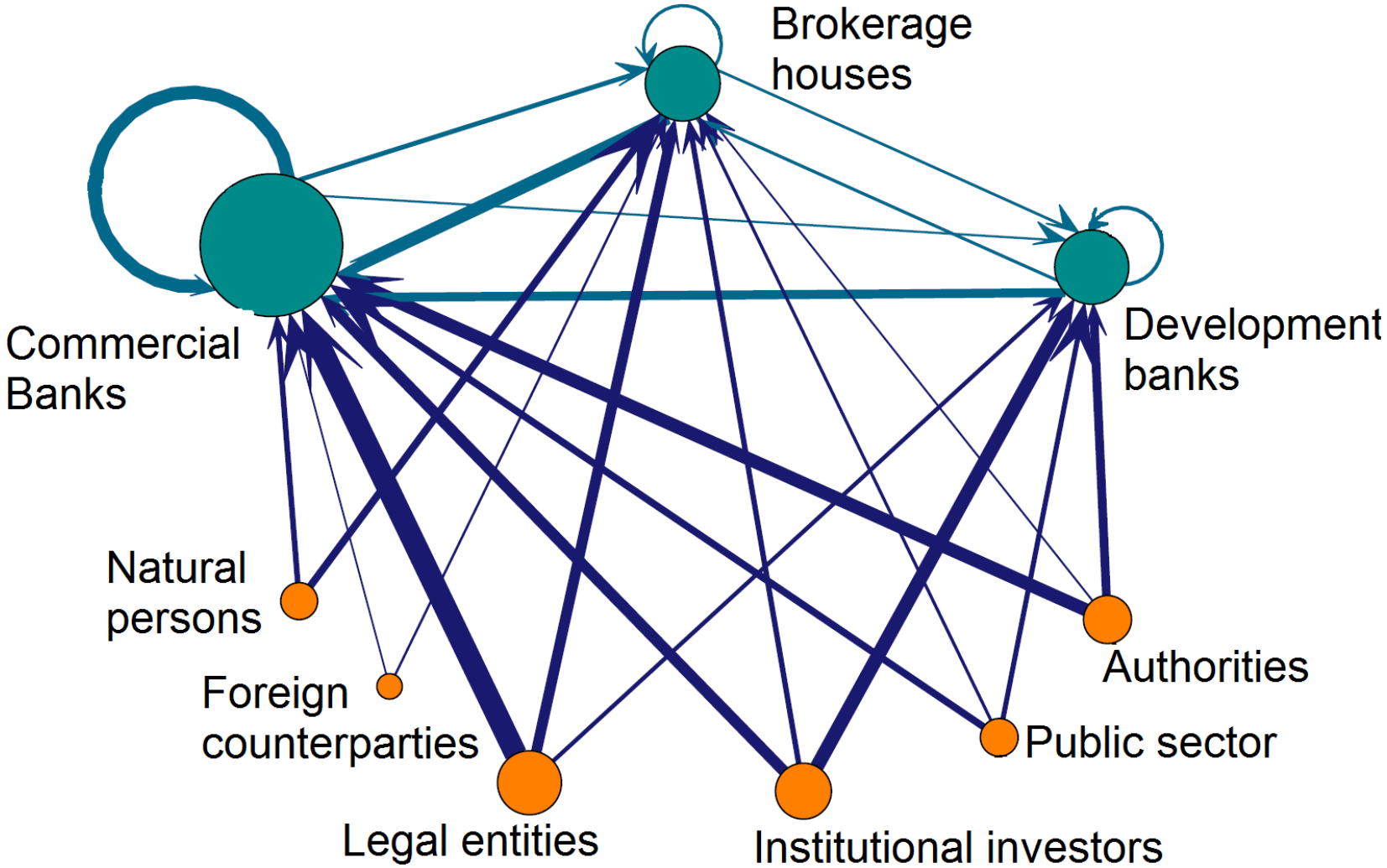
Repo market

- Only commercial banks, brokerage houses and regional development banks can borrow on the repo market. Anyone can lend.
- Legal requirement on collateral. No repo on asset-backed securities
- We consider only commercial banks, repos in Mexican pesos and overnight transactions

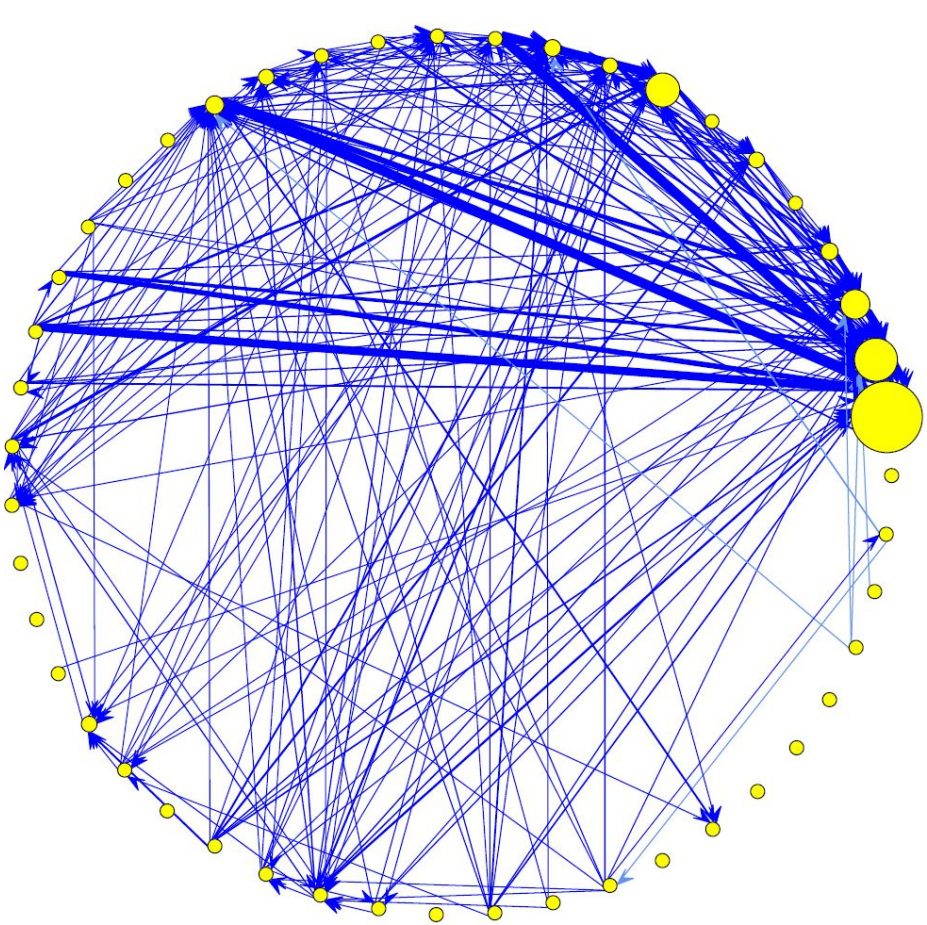
The Unsecured Market Network



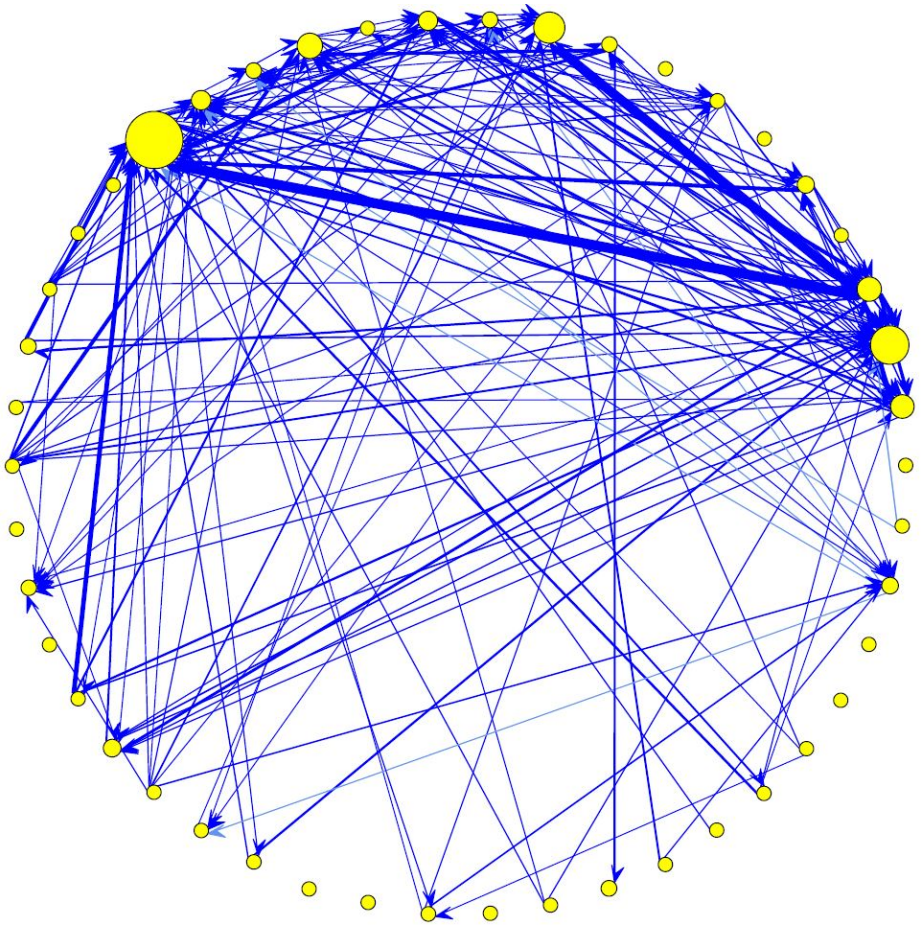
Repo Network



The Interbank Unsecured and Repo Networks

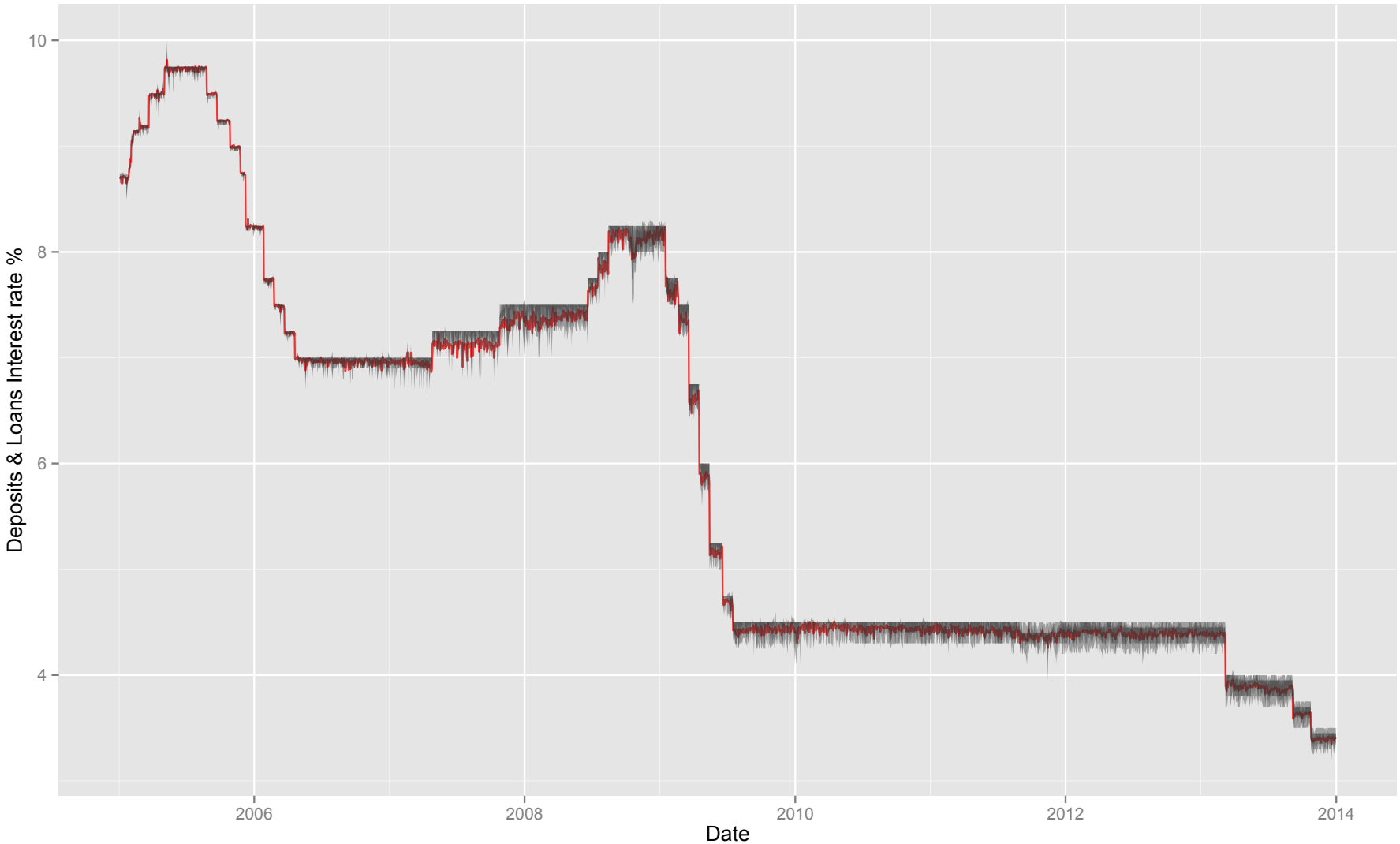


(a) Unsecured

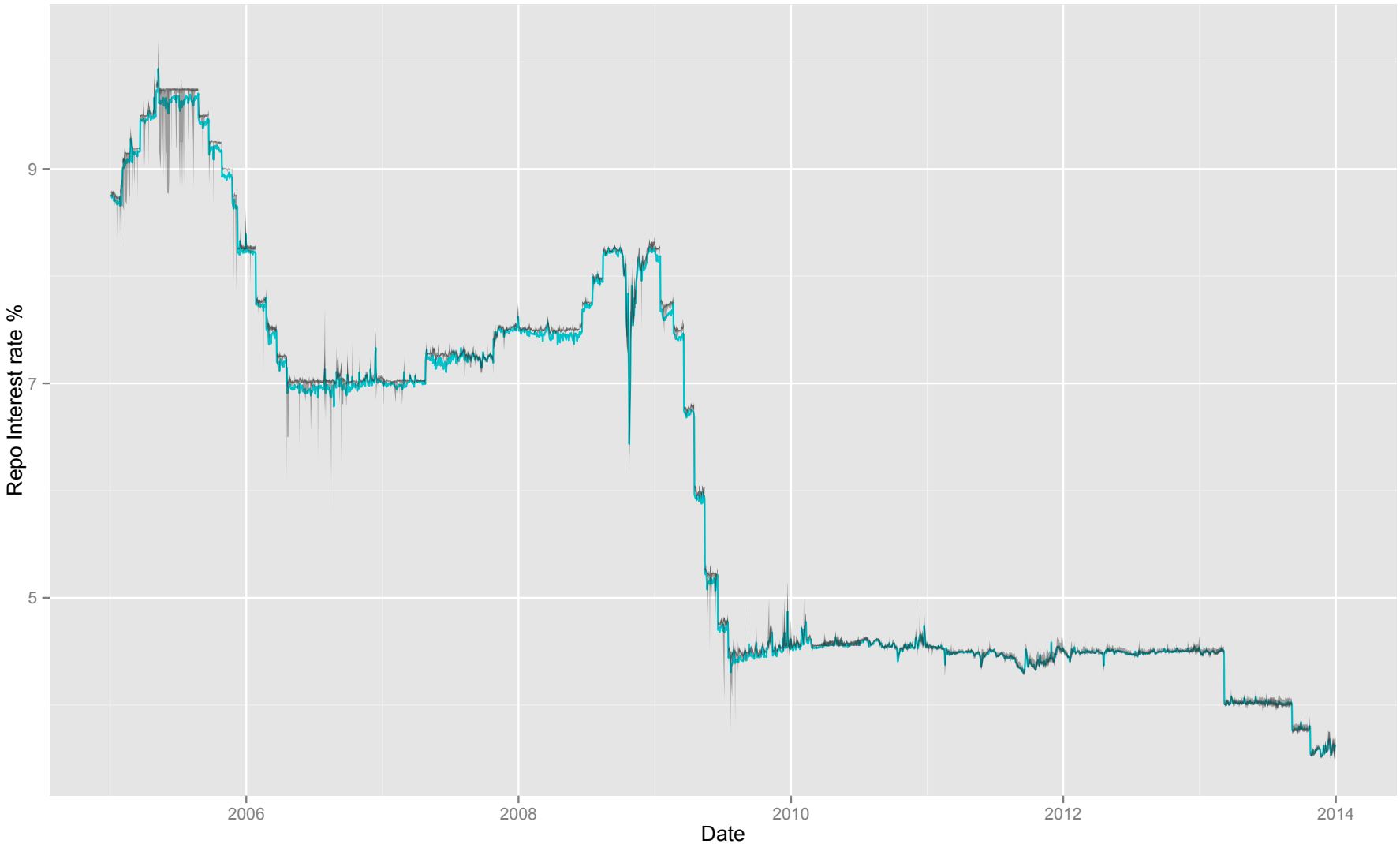


(b) Repo

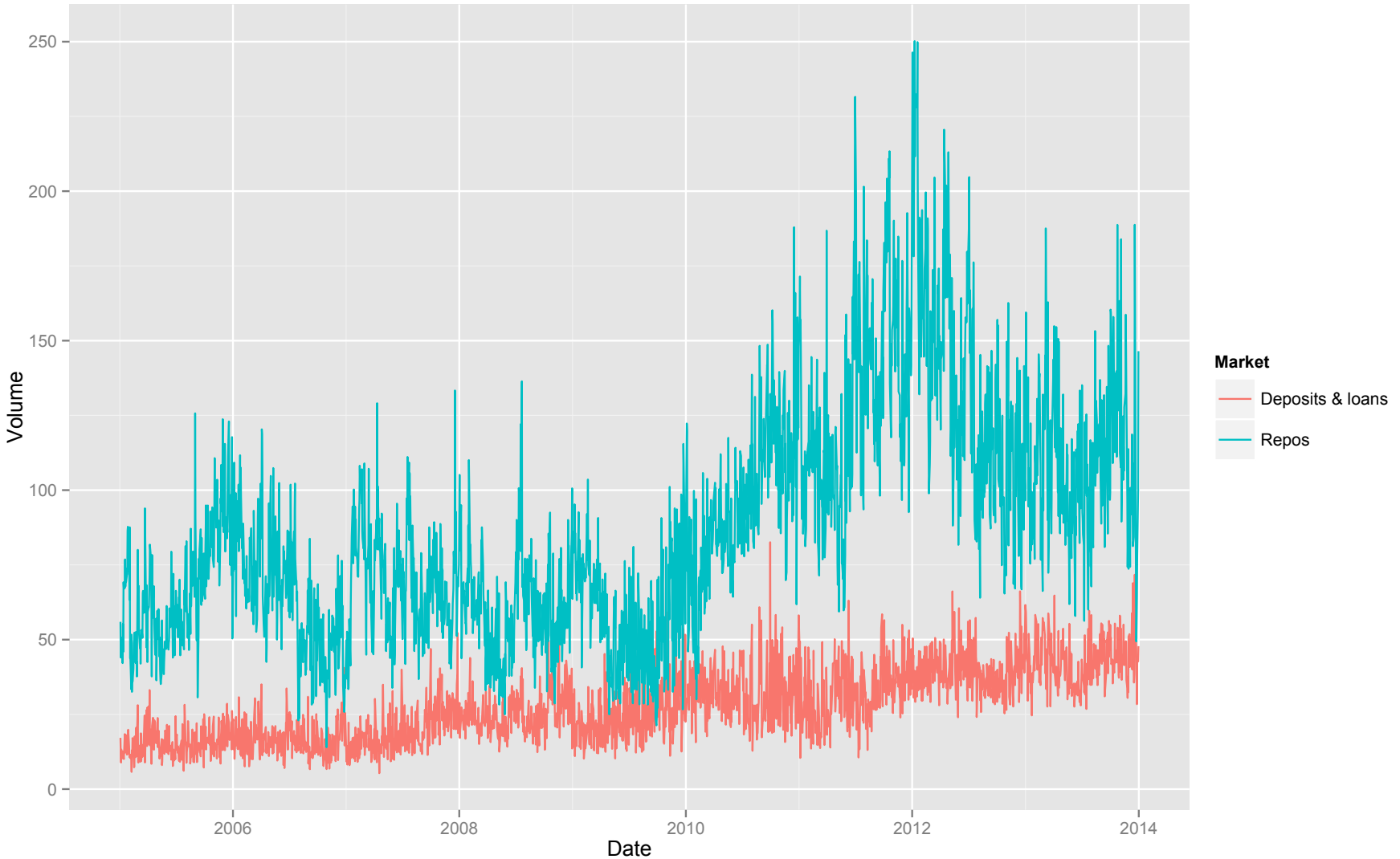
Unsecured Interbank Loan Rates



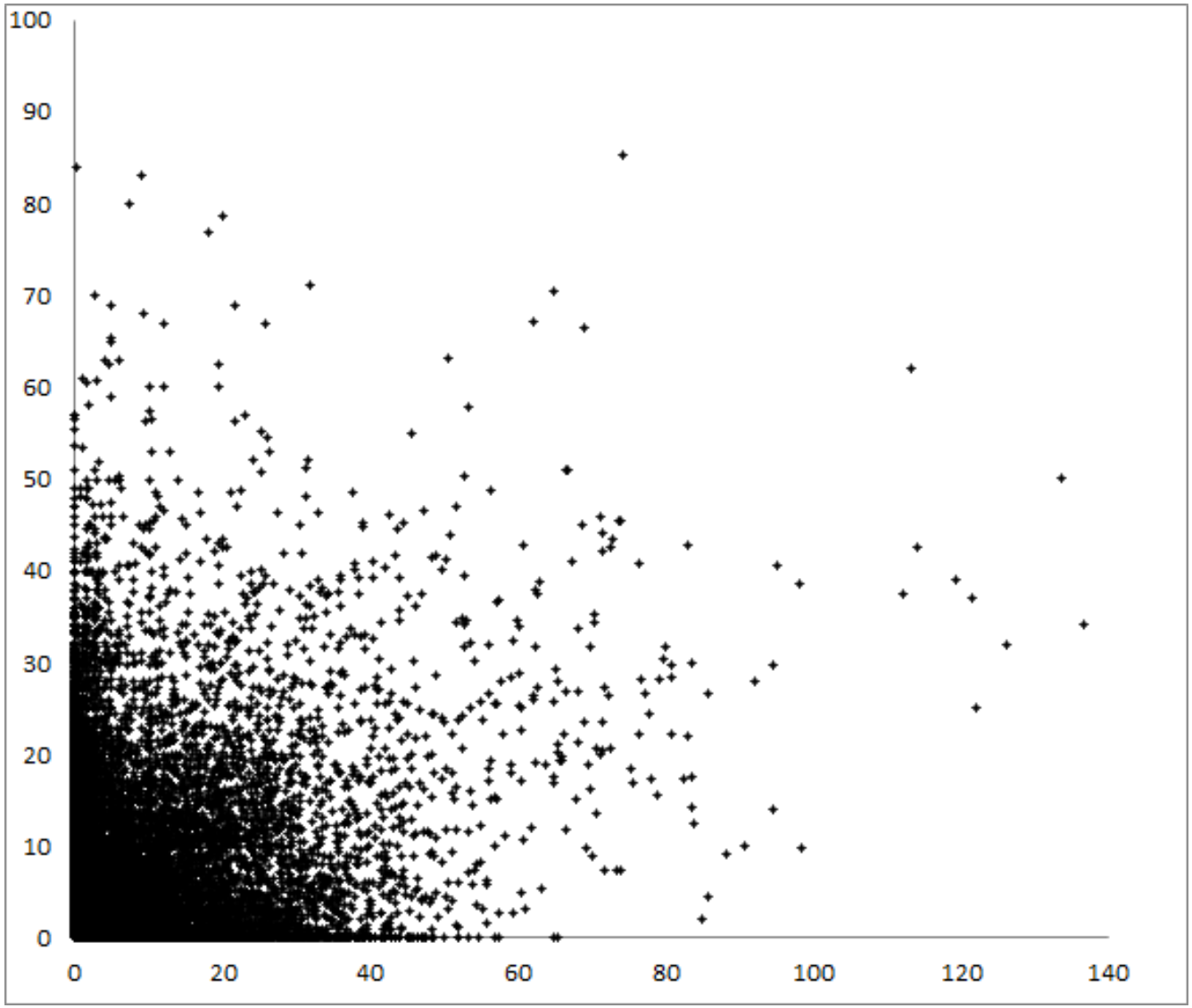
Repo Rates



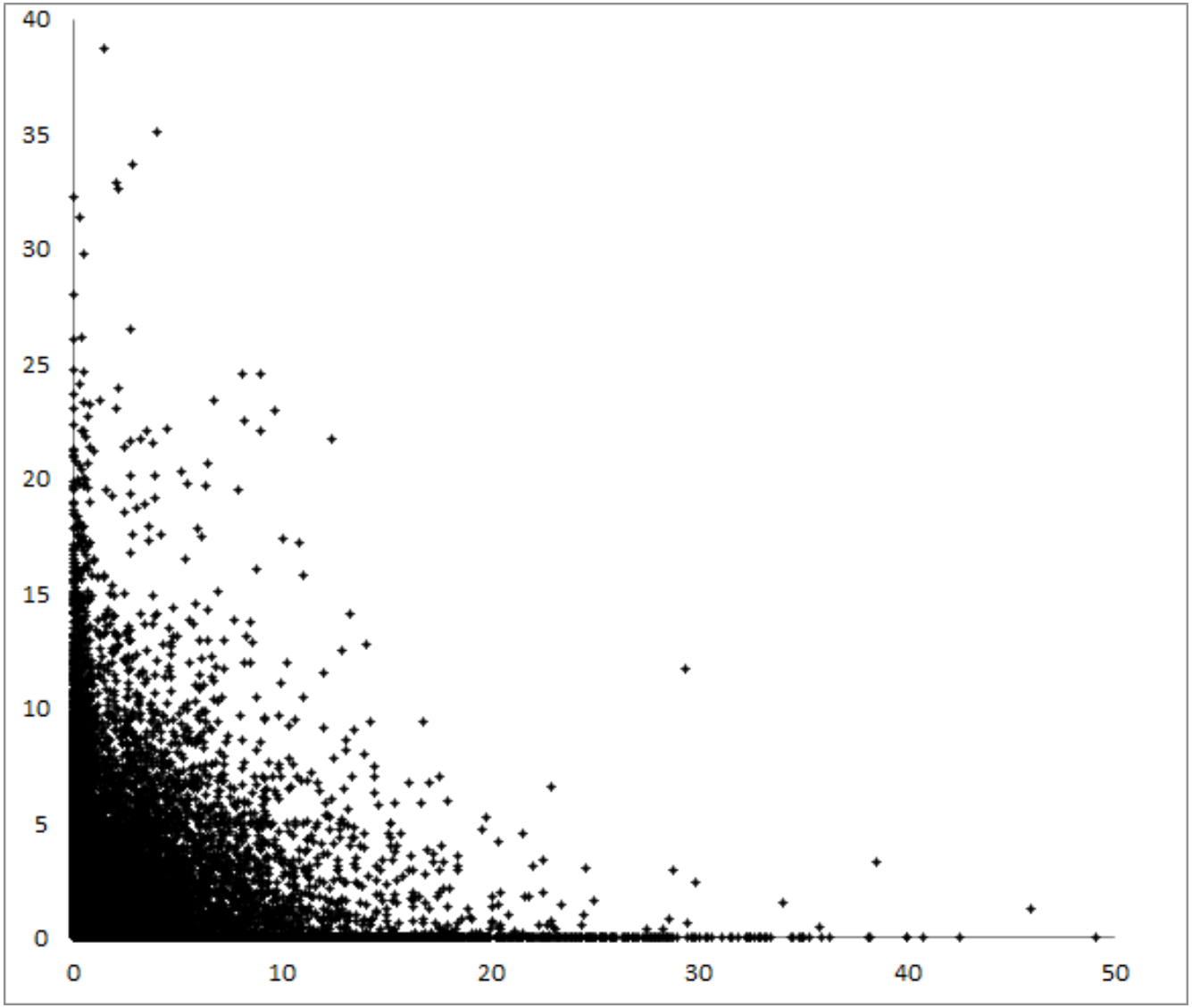
Unsecured Loan and Repo Volumes



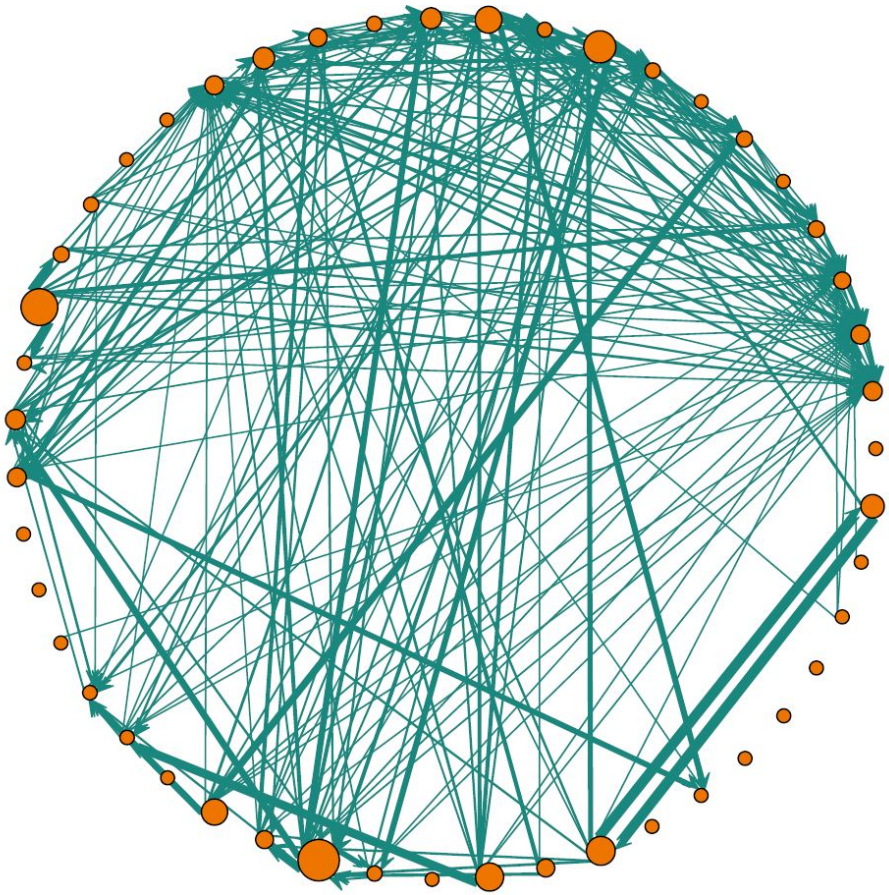
Borrowing and lending in repo market



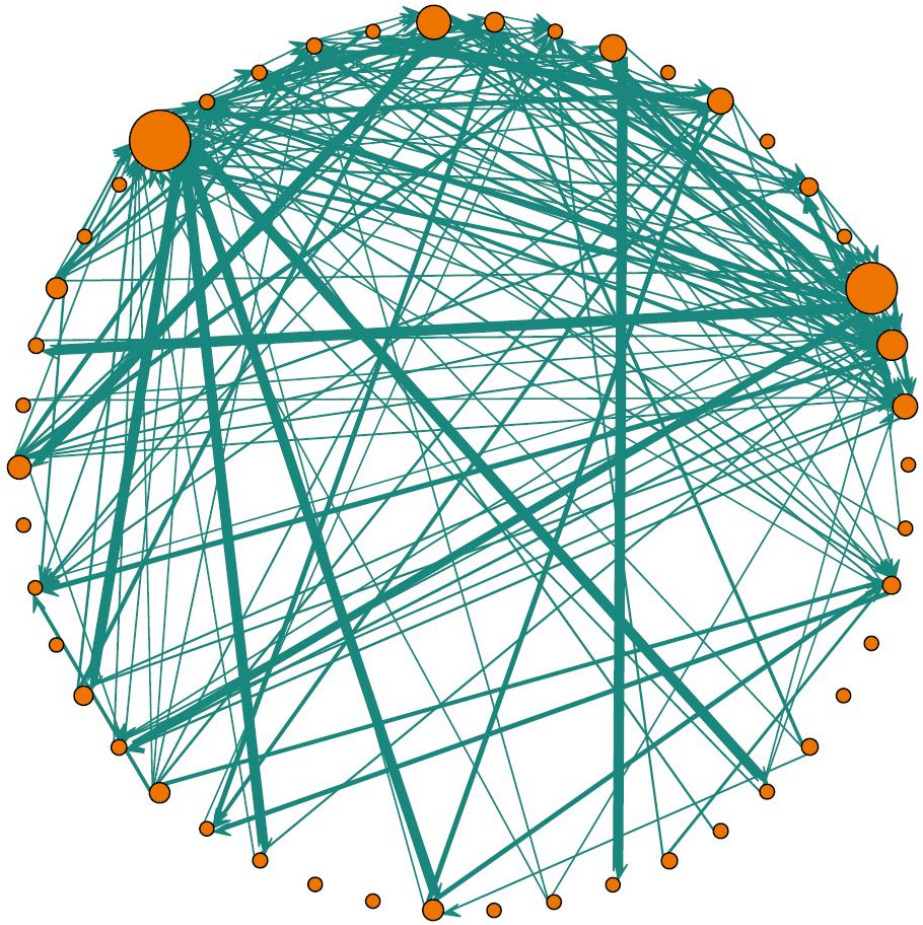
Borrowing and lending in unsecured market



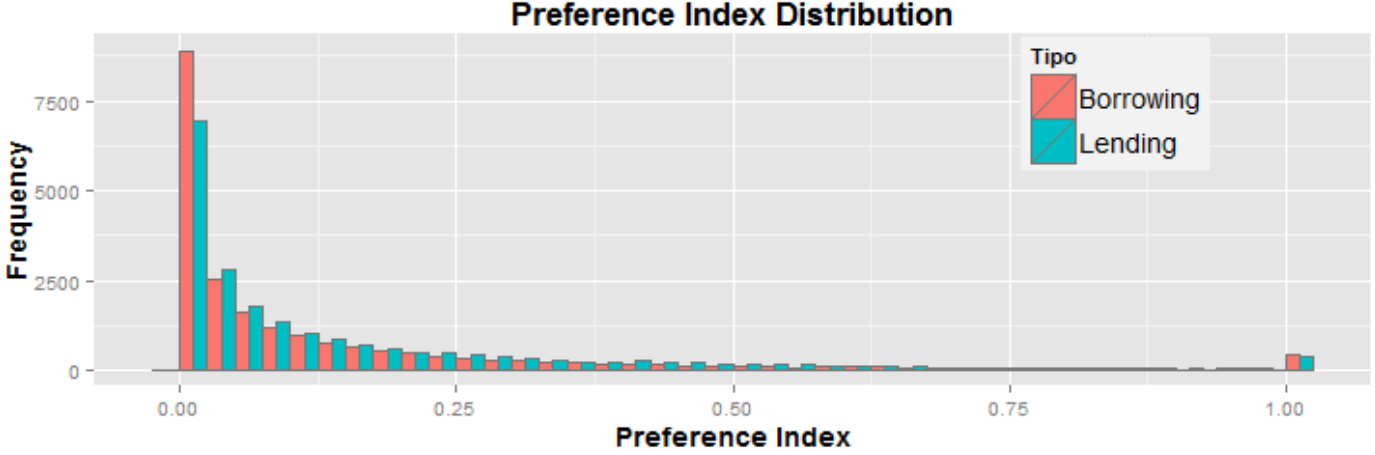
Preference Index Networks



(c) Unsecured



(d) Repo


Preference Index Distribution
Tipo
Borrowing
Lending
Frequency
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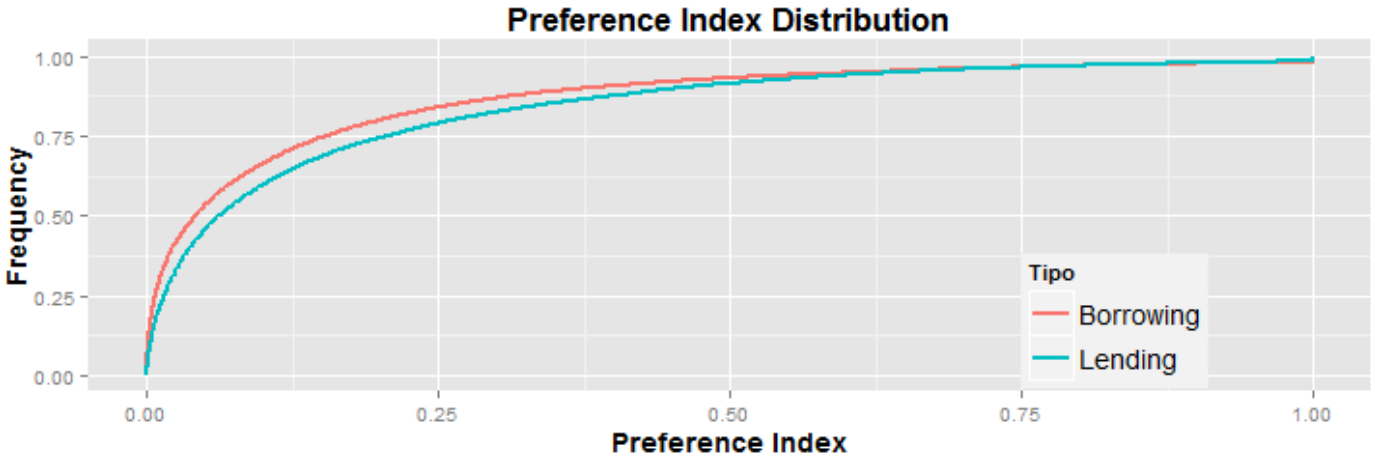
2500
0
0.00
0.25
0.50
0.75
1.00
Preference Index


Preference Index Distribution
Frequency
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0.00
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Borrowing
Lending
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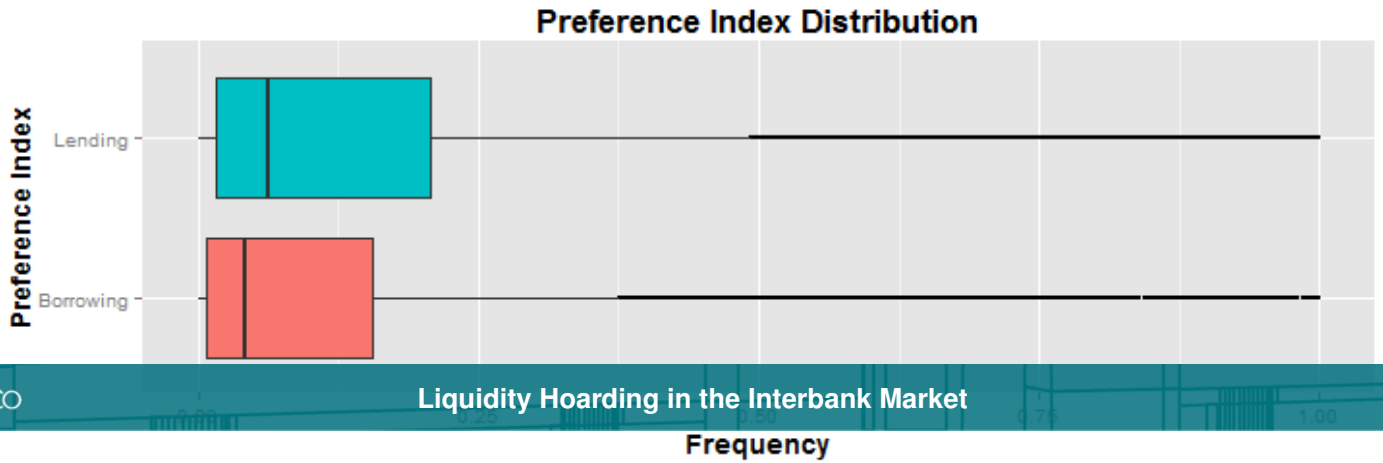
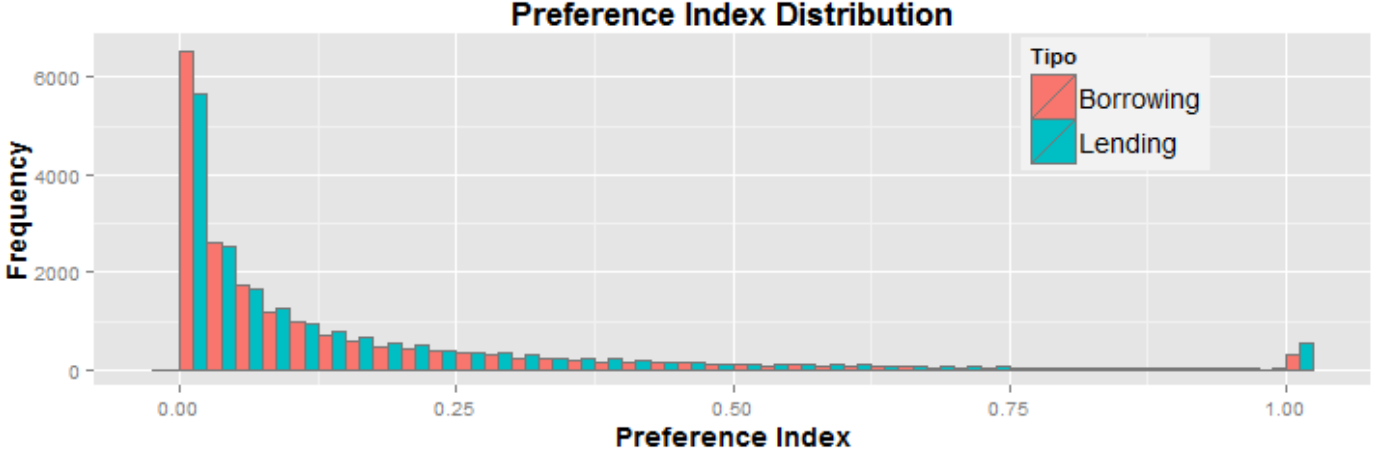
0.75
1.00
Preference Index


Preference Index Distribution
Preference Index
Lending
Borrowing
Frequency


Preference Index Distribution
Tipo
Borrowing
Lending
Frequency
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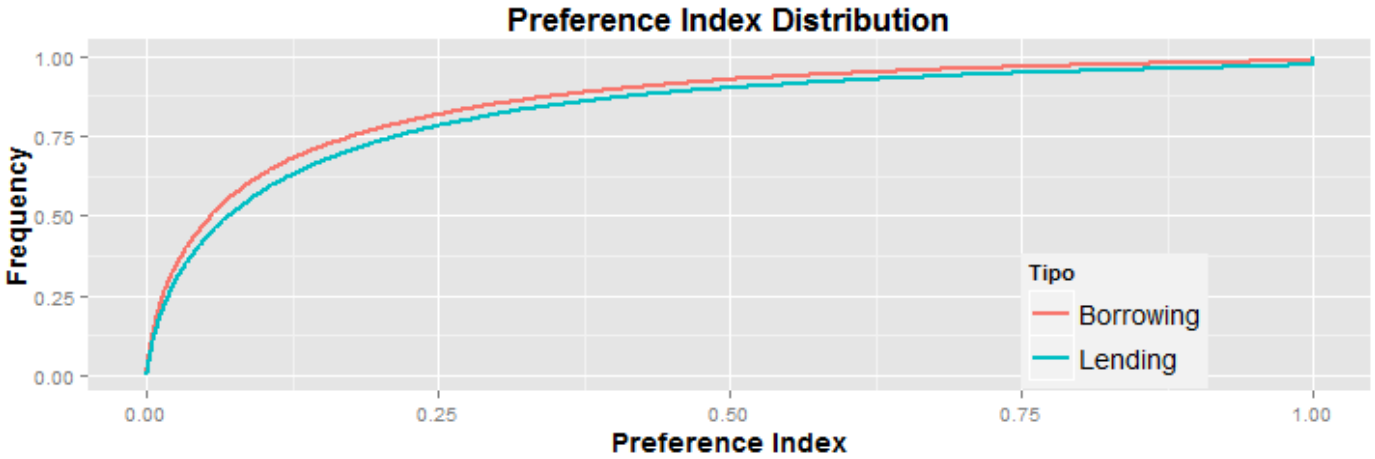
4000
2000
0
0.00
0.25
0.50
0.75
1.00
Preference Index


Preference Index Distribution
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Lending
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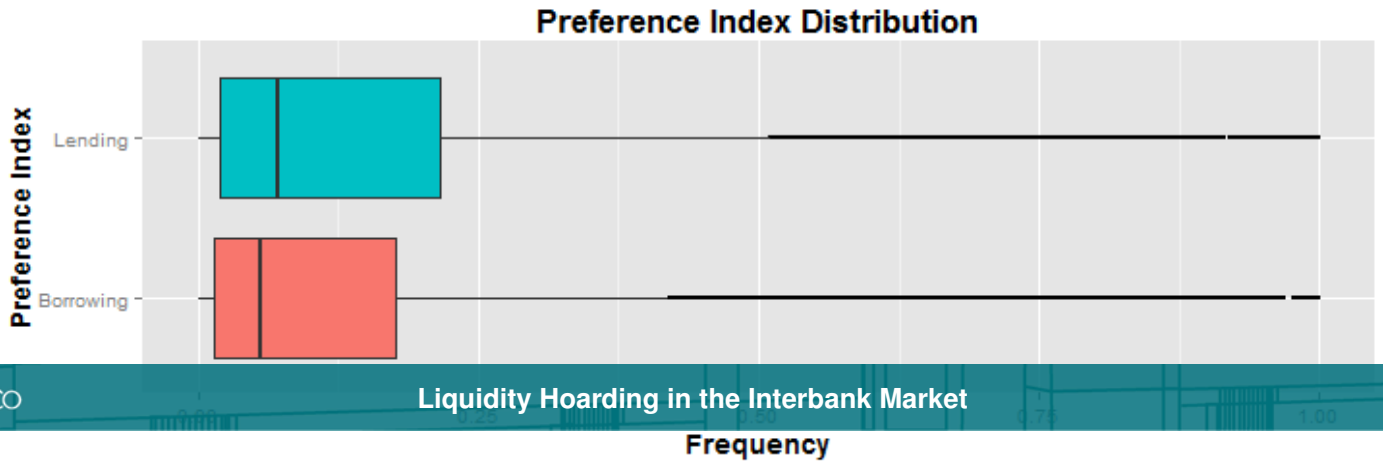
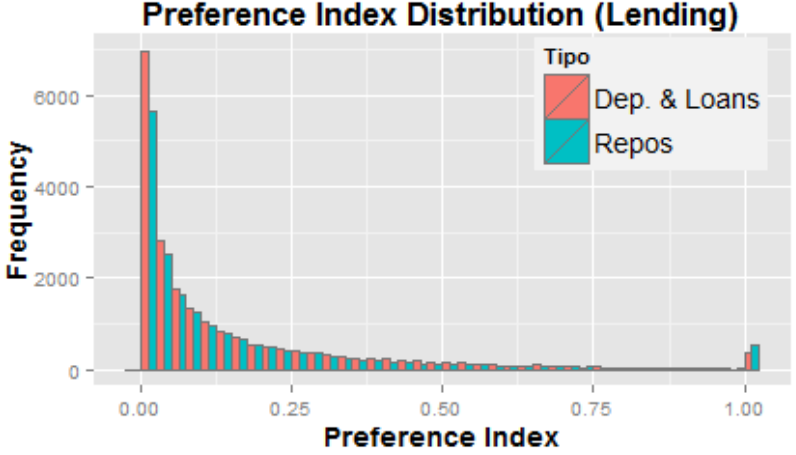
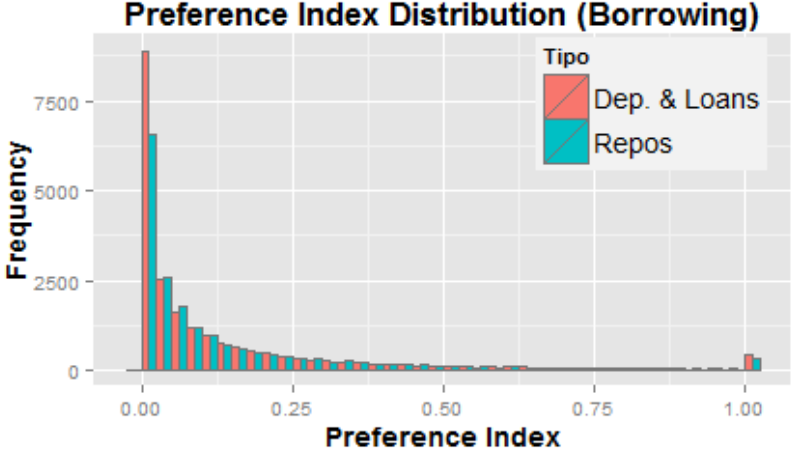

Preference Index Distribution
Preference Index
Lending
Borrowing
Frequency


Preference Index Distribution (Lending)
Tipo
Dep. & Loans
Repos
Frequency
6000
4000
2000
0
0.00
0.25
0.50
0.75
1.00
Preference Index


Preference Index Distribution (Borrowing)
Tipo
Dep. & Loans
Repos
Frequency
7500
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2500
0
0.00
0.25
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0.75
1.00
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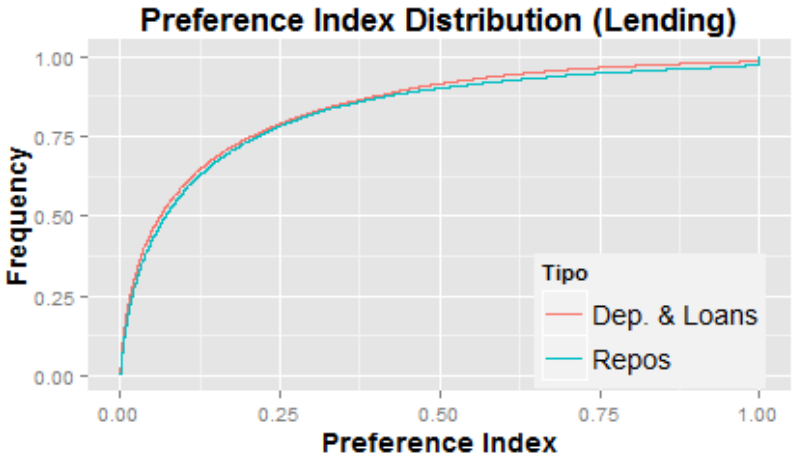
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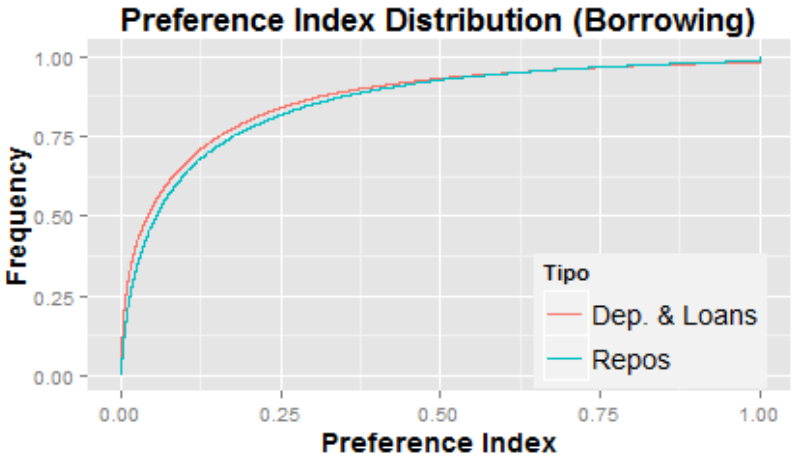
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Repos
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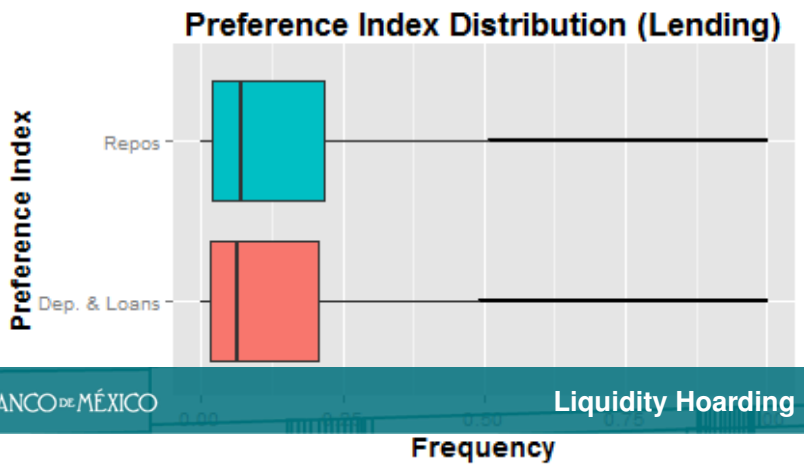
Preference Index Distribution (Lending)
Preference Index
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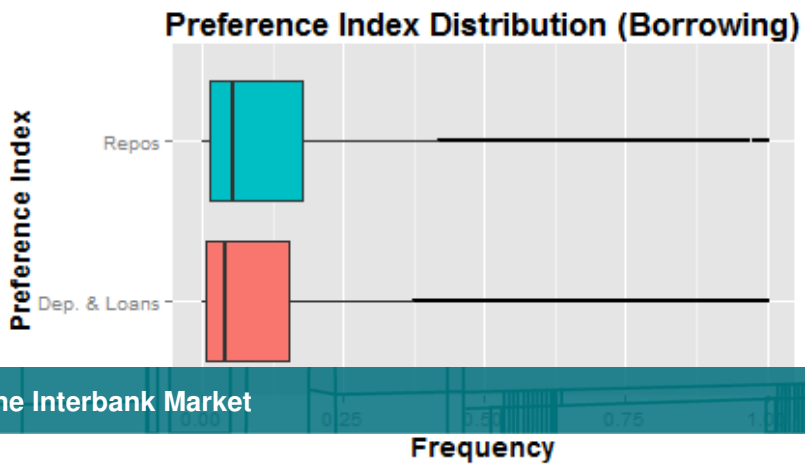

Preference Index Distribution (Borrowing)
Preference Index
Repos
Dep. & Loans
Frequency

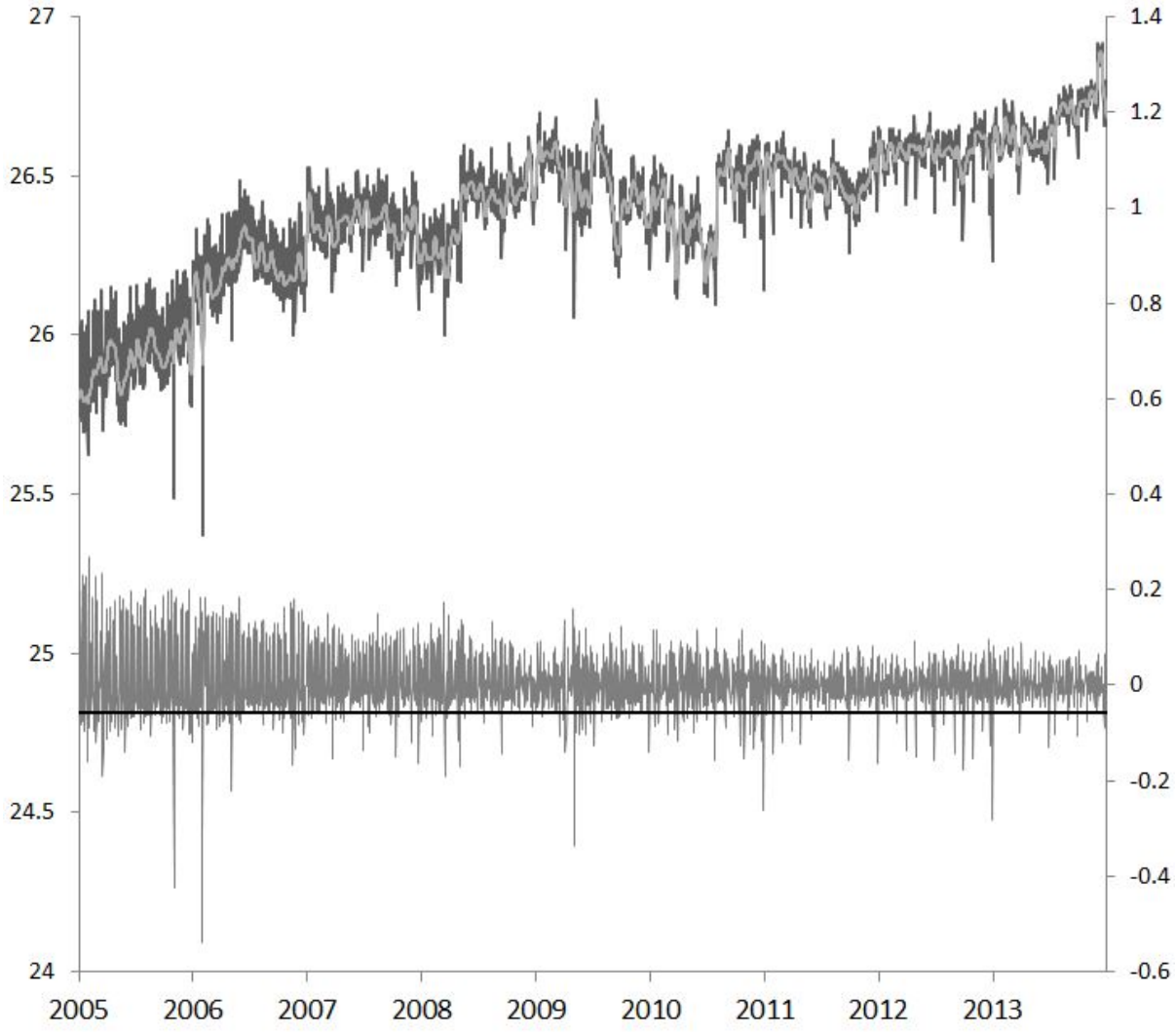
Shock identification

We identify a negative shock to external repo funding as follows

- We consider the total log amount of daily **repo funding from legal entities and physical persons** to commercial banks
- We take the 10% days with lowest total funding relative to a Hodrick-Prescott filter with a 21-day window (we are now working with a 2000-day window)
- Shock dummy variable w_t is 1 if day t is one of the 10% lowest funding days

This variable seems to measure supply shocks rather than demand shocks.

Construction shock variable



Methodology

We study the **response in borrowing/lending of banks that are dependent on external repo funding** of a negative shock in total external repo funding relative to those banks that are not dependent on external repo funding

- dependent variable: for bank i at day d
  - Log Transaction Volume or Weighted average interest rate
  - Borrowing or Lending
  - Secured Repo or unsecured loans

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- regressors
  - assets, dependence on external repo funding, shock dummy, interaction variables
  - Regressor of interest: **dependence on external repo funding X shock dummy**

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  - Regressor of interest: **dependence on external repo funding X shock dummy**
- Models: OLS, Fixed effects with lag dependent variable, Heckman sample selection model with fixed effects dummies and lag dependent variable

Borrowers' variables for the unsecured market

Borrower's spread (today) (Deposits & Loans)
Borrower's spread (t+1, t+2) (Deposits & Loans)
Borrower's spread (t+3, t+4) (Deposits & Loans)
Neighbours' spread (today) (Deposits & Loans)
Neighbours' spread (t+1, t+2) (Deposits & Loans)
Neighbours' spread (t+3, t+4) (Deposits & Loans)
Borrower's borrowed amount (today) (Deposits & Loans)
Borrower's borrowed amount (t+1, t+2) (Deposits & Loans)
Borrower's borrowed amount (t+3, t+4) (Deposits & Loans)
Neighbours' borrowed amount (today) (Deposits & Loans)
Neighbours' borrowed amount (t+1, t+2) (Deposits & Loans)
Neighbours' borrowed amount (t+3, t+4) (Deposits & Loans)
Active borrowing days (t-21,t-1) (Deposits & Loans)
Average borrower's spread (t-21,t-1) (Deposits & Loans)
Mean borrower's spread (t-21,t-1) (Deposits & Loans)
Borrowed amount (t-21,t-1) (Deposits & Loans)
Average number of partners (t-21,t-1) (Deposits & Loans)
Median number of partners (t-21,t-1) (Deposits & Loans)
Number of partners (t) (Deposits & Loans)

Borrowers' variables for the repo market

Borrower's spread (today) (Repos)
Borrower's spread (t+1, t+2) (Repos)
Borrower's spread (t+3, t+4) (Repos)
Neighbours' spread (today) (Repos)
Neighbours' spread (t+1, t+2) (Repos)
Neighbours' spread (t+3, t+4) (Repos)
Borrower's borrowed amount (today) (Repos)
Borrower's borrowed amount (t+1, t+2) (Repos)
Borrower's borrowed amount (t+3, t+4) (Repos)
Neighbours' borrowed amount (today) (Repos)
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Average borrower's spread (t-21,t-1) (Repos)
Mean borrower's spread (t-21,t-1) (Repos)
Borrowed amount (t-21,t-1) (Repos)
Average number of partners (t-21,t-1) (Repos)
Median number of partners (t-21,t-1) (Repos)
Number of partners (t) (Repos)

Borrowers' independent variables

Month
Month_number
Day
Day_number
Shock (larger 10% neg. Deviations)
Shock (larger 10% neg. Deviations)
Deviation (relative) from trend (legal/natural persons funding)
Deviation from trend (term deposits: new minus maturing)
Borrower
Share of Natural/Legal entities for this borrower (last 21 days)
Borrower's assets (last month)
3-firm-HHI repos (last month)
3-firm-HHI DL (last month)
Borrower's centrality repos (t-21, t-1)
Borrower's centrality DL (t-21, t-1)

Effect on Log Amount of Repo Borrowing

	OLS	FE LS	Heckman 2-step	
Share External Repo	-1.873***	0.301***	-0.132**	-0.0336
	(0.0278)	(0.0551)	(0.0463)	(0.0774)
Assets (Normalized)	13.98***	2.721***	5.038***	2.621***
	(0.103)	(0.466)	(1.182)	(0.549)
Shock indicator	-0.102**	-0.00192	-0.0812*	-0.0658
	(0.0342)	(0.0297)	(0.0378)	(0.0360)
Shock X	**0.193***	**0.0987**	**0.178***	**0.312****
Share External Repo	**(0.0828)**	**(0.0707)**	**(0.0813)**	**(0.106)**
Shock X Assets	-0.454	-0.0126	1.614**	0.404
	(0.300)	(0.257)	(0.570)	(0.338)
Log Borrowed Amount		0.671***	0.488***	1.127***
$(d-21$ to $d-1)$		(0.00842)	(0.00747)	(0.0156)
Inverse Mills				2.146***
				(0.0772)
Borrower dummies	No	Yes	Yes	Yes
Month dummies	No	Yes	Yes	Yes
Observations	37403	37403	53028	37403

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Effect on Log Amount of Repo Lending

	OLS	FE LS	Heckman 2-step	
Share External Repo	0.353***	0.136***	0.347***	0.463***
	(0.0219)	(0.0326)	(0.0423)	(0.0483)
Assets (Normalized)	10.32***	-1.490*	7.694***	5.901***
	(0.105)	(0.696)	(1.030)	(0.808)
Shock indicator	0.0770	0.108***	0.0416	0.109*
	(0.0418)	(0.0317)	(0.0335)	(0.0483)
Shock X	**-0.408*** **	**-0.222*** **	**-0.0757**	**-0.216** **
Share External Repo	**(0.0774)**	**(0.0513)**	**(0.0757)**	**(0.0824)**
Shock X Assets	-0.258	0.0231	1.050**	0.729*
	(0.303)	(0.254)	(0.403)	(0.343)
Log Lent Amount		0.637***	0.483***	1.116***
(day $d-21$ to $d-1$)		(0.00648)	(0.00729)	(0.0150)
Inverse Mills Ratio				2.113***
				(0.0733)
Borrower dummies	No	Yes	Yes	Yes
Month dummies	No	Yes	Yes	Yes
Observations	34423	34423	51816	34423

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Effect on Log Amount of Unsecured Borrowing

	OLS	FE LS	Heckman 2-step	
Share External Repo	0.156***	0.374***	0.420***	0.654***
	(0.0361)	(0.0819)	(0.0638)	(0.0904)
Assets (Normalized)	18.01***	-1.403	7.714***	6.384***
	(0.118)	(0.894)	(1.116)	(1.178)
Shock indicator	-0.322***	-0.0726	-0.0686	-0.199*
	(0.0806)	(0.0641)	(0.0421)	(0.0982)
Shock X	**0.236**	**0.0874**	**0.00949**	**0.196**
Share External Repo	**(0.131)**	**(0.106)**	**(0.0887)**	**(0.173)**
Shock X Assets	0.749	0.502	0.998*	1.371**
	(0.394)	(0.341)	(0.454)	(0.465)
Log Borrowed Amount		0.563***	0.357***	1.136***
(day $d-21$ to $d-1$)		(0.0140)	(0.00942)	(0.0351)
Inverse Mills Ratio				2.762***
				(0.162)
Borrower dummies	No	Yes	Yes	Yes
Month dummies	No	Yes	Yes	Yes
Observations	19585	19585	40860	19585

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Effect on Log Amount of Unsecured Lending

	OLS	FE LS	Heckman 2-step	
Share External Repo	0.579***	0.631***	0.120	0.594**
	(0.0387)	(0.0958)	(0.0614)	(0.183)
Assets (Normalized)	16.72***	13.87***	14.40***	-12.97**
	(0.158)	(1.282)	(0.925)	(4.231)
Shock indicator	-0.257**	-0.115	-0.0314	-0.0289
	(0.0980)	(0.0798)	(0.0439)	(0.121)
Shock X	**0.0125**	**-0.00155**	**0.149**	**-0.343***
Share External Repo	**(0.159)**	**(0.128)**	**(0.0874)**	**(0.170)**
Shock X Assets	1.484**	1.437**	0.890**	-0.222
	(0.535)	(0.493)	(0.320)	(0.748)
Log Lent Amount		-0.194***	0.102***	-0.404***
(day $d-21$ to $d-1$)		(0.0152)	(0.00777)	(0.0313)
Inverse Mills				-3.337***
				(0.447)
Borrower dummies	No	Yes	Yes	Yes
Month dummies	No	Yes	Yes	Yes
Observations	16398	16398	44004	16398

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Effect on Borrowing Interest Rate

	Repo		Unsecured	
Share External Repo	-0.00675*	-0.0193***	0.0102***	-0.00333
	(0.00299)	(0.00477)	(0.00186)	(0.00443)
Assets (Normalized)	-0.334***	0.244***	-0.216***	-0.485***
	(0.0116)	(0.0536)	(0.0128)	(0.0819)
Shock indicator	0.0122*	0.0124***	0.0187***	0.00451
	(0.00599)	(0.00333)	(0.00427)	(0.00249)
Shock X	**-0.0142**	**-0.0103**	**-0.00100**	**-0.00275**
Share External Repo	**(0.00976)**	**(0.00826)**	**(0.00595)**	**(0.00473)**
Shock X Assets	-0.111**	-0.00551	0.0261	-0.00432
	(0.0379)	(0.0357)	(0.0250)	(0.0275)
Median Borrower Spread		0.727***		0.319***
(day $d-21$ to $d-1$)		(0.0126)		(0.0178)
Inverse Mills Ratio		-0.00380		-0.00937
		(0.00333)		(0.00251)
Borrower dummies	No	Yes	No	Yes
Month dummies	No	Yes	No	Yes
Observations	37403	37403	19584	19584

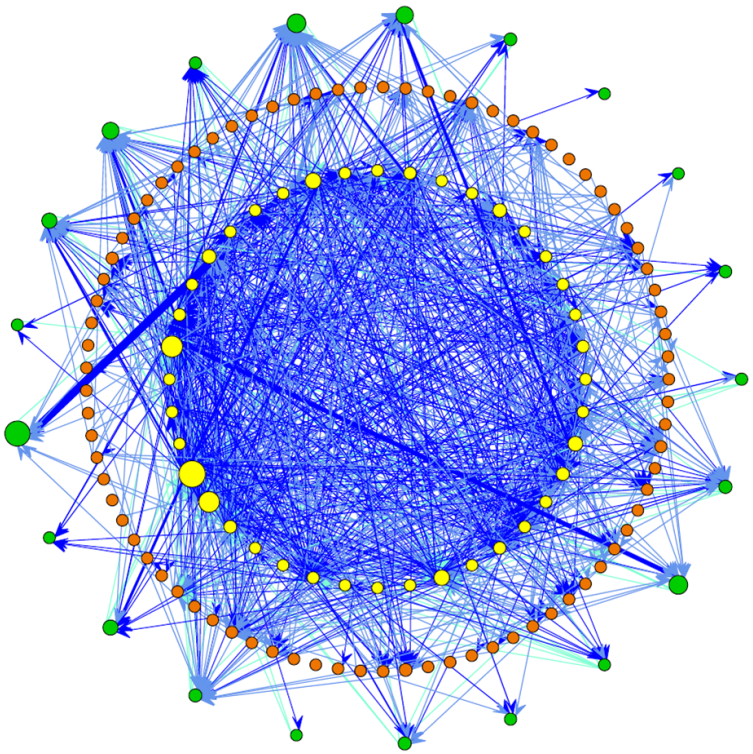
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Effect on Lending Interest Rate

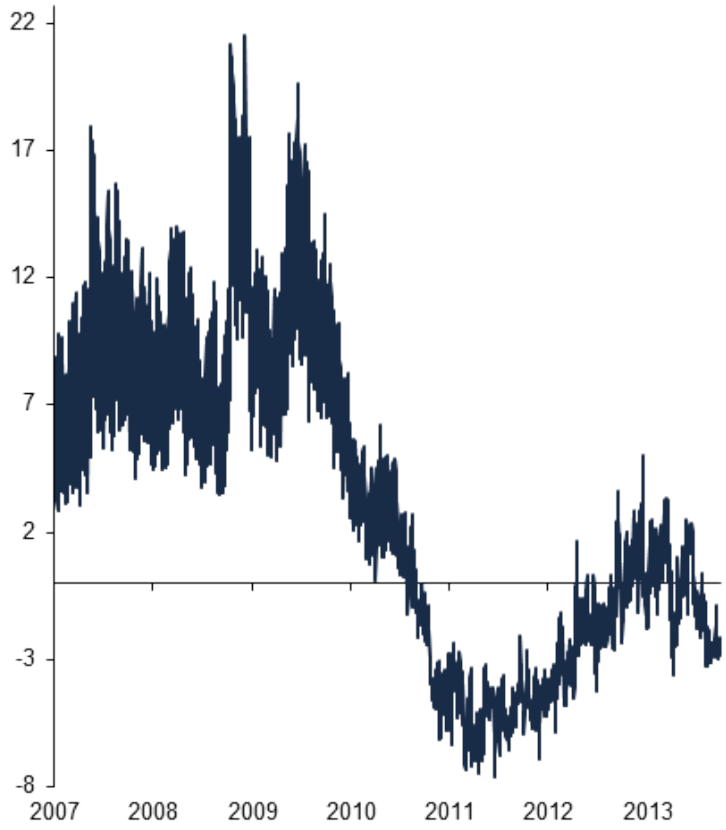
	Repo		Unsecured	
Share External Repo	0.0397***	0.0214***	-0.0304***	0.00437
	(0.00243)	(0.00394)	(0.00283)	(0.00620)
Assets (Normalized)	7.694***	-0.276**	0.508***	-0.967***
	(0.0167)	(0.0998)	(0.0102)	(0.131)
Shock indicator	0.00782	0.000716	0.00173	-0.00248
	(0.00807)	(0.00588)	(0.00566)	(0.00505)
Shock X	**-0.0206***	**0.00734**	**0.00185**	**-0.00776**
Share External Repo	**(0.00957)**	**(0.00888)**	**(0.00850)**	**(0.0101)**
Shock X Assets	-0.00971	-0.0122	-0.0889	-0.0573*
	(0.0510)	(0.0433)	(0.0294)	(0.0272)
Median Lender Spread		0.752***		0.471***
(day $d-21$ to $d-1$)		(0.00967)		(0.0251)
Inverse Mills Ratio		0.000305		-0.0453***
		(0.00312)		(0.0127)
Borrower dummies	No	Yes	No	Yes
Month dummies	No	Yes	No	Yes
Observations	34424	34424	16395	16395

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

More data but, why?



(e) Full Interbank Exposures Network



(f) Mexican Banking system's net position

Conclusions and further work

- Study of the Mexican interbank overnight market
- First results: Banks that are affected by a negative external repo shock reduce their interbank lending
- Does this reduction spill over to other banks?

Future work

- How do lending relationships matter?
- Is there a spill over in terms of volume (or prices) beyond the immediate neighborhood?
- We are splitting the sample in order to study the pre and post crisis periods
- Include more data to understand banks' strategy on liquidity

The end product