The Information contained in Money Market Interactions: Unsecured vs. Collateralized Lending

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Abstract

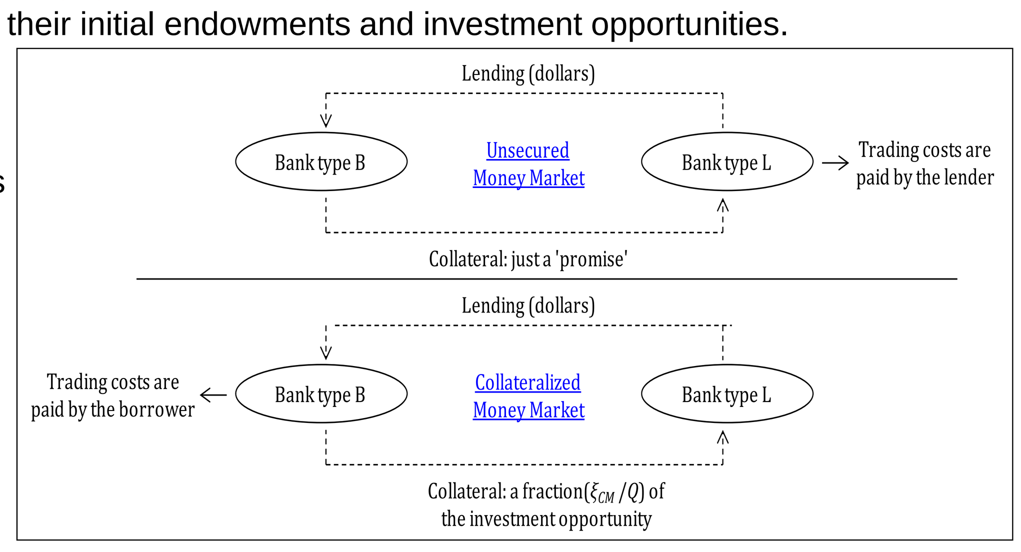
- Financial institutions rely globally on money markets to manage liquidity allocations. Money markets allow investors to efficiently exploit their liquidity surpluses though lending,
- Two relevant segments that have been commonly investigated are the unsecured money market (uncollateralized lending) and the collateralized money market (in which lending is protected through the use (and re-use) of collateral).
- Unsecured and collateralized money markets are not independent of each other. In fact, interactions in lending segments can be especially relevant during periods of high uncertainty.
- Nevertheless, the vast majority of the existing literature focuses its analysis independently either on the unsecured segment or on collateralized lending.
- The objective of this study is to fill this gap by studying the information contained in interactions between unsecured and collateralized channels.

Structure of the Paper

- We present three-period model to describe interaction in unsecured and collateralized lending segments.
- We use a dataset of collateralized and uncollateralized lending activity in the Euro zone between June 2, 2008 and July 30, 2013.
- We model trading activity in each segment in a given day according to a Poisson process. Markets may move in the same direction (liquidity shocks) or in the opposite direction (migration event).
- We extract parameters of the distribution from trading data to signal different source of stress in money markets.
- We use such parameters to perform regression on the spread between the unsecured and secured market.

The Theoretical Model

- We consider a three-period horizon. Dates are denoted by {0, 1, 2}.
  A single consumption good.
  We assume that there is no uncertainty of any kind, and the discount rate is equal to zero.
  Two types of firms (or banks): Lenders, L, and borrowers, B.
  Banks are risk neutral and differ in their initial endowments and investment opportunities.



- Bank type B at t=0:
  No endowment.
  Investment opportunity (only if Q is invested) delivers:
  - Dividend d at t=1.
  - Return R at t=2.
- Bank type L at t=0:
  M dollars (M ≥ Q).
  No investment opportunity.
- Unsecured money market (UM).
  Bank B can borrow for two periods at t=0 an amount of dollars ξ_{UM} from bank L.
  Interest rate r_{UM} .
  No collateral.
  There is a (quadratic) cost paid by the lender: k_{UM} $(\xi_{UM})^2/2$ with $k_{UM} \geq 0$.
  - E.g., all the costs associated to counterparty risk.
  - No default in this market.
- Collateralized money market (CM).
  Bank B can borrow (for two periods) at t=0 an amount of dollars ξ_{CM} from bank L.
  Interest rate r_{CM}.
  Collateral: Bank B pays a fraction, ξ_{CM} /Q, of the dividend d.
  There is a quadratic cost paid by the borrower: k_{CM} $(\xi_{CM})^2/2$ with $k_{CM} \geq 0$.
  - E.g., the opportunity cost of holding collateral, the risk of collateral depreciation

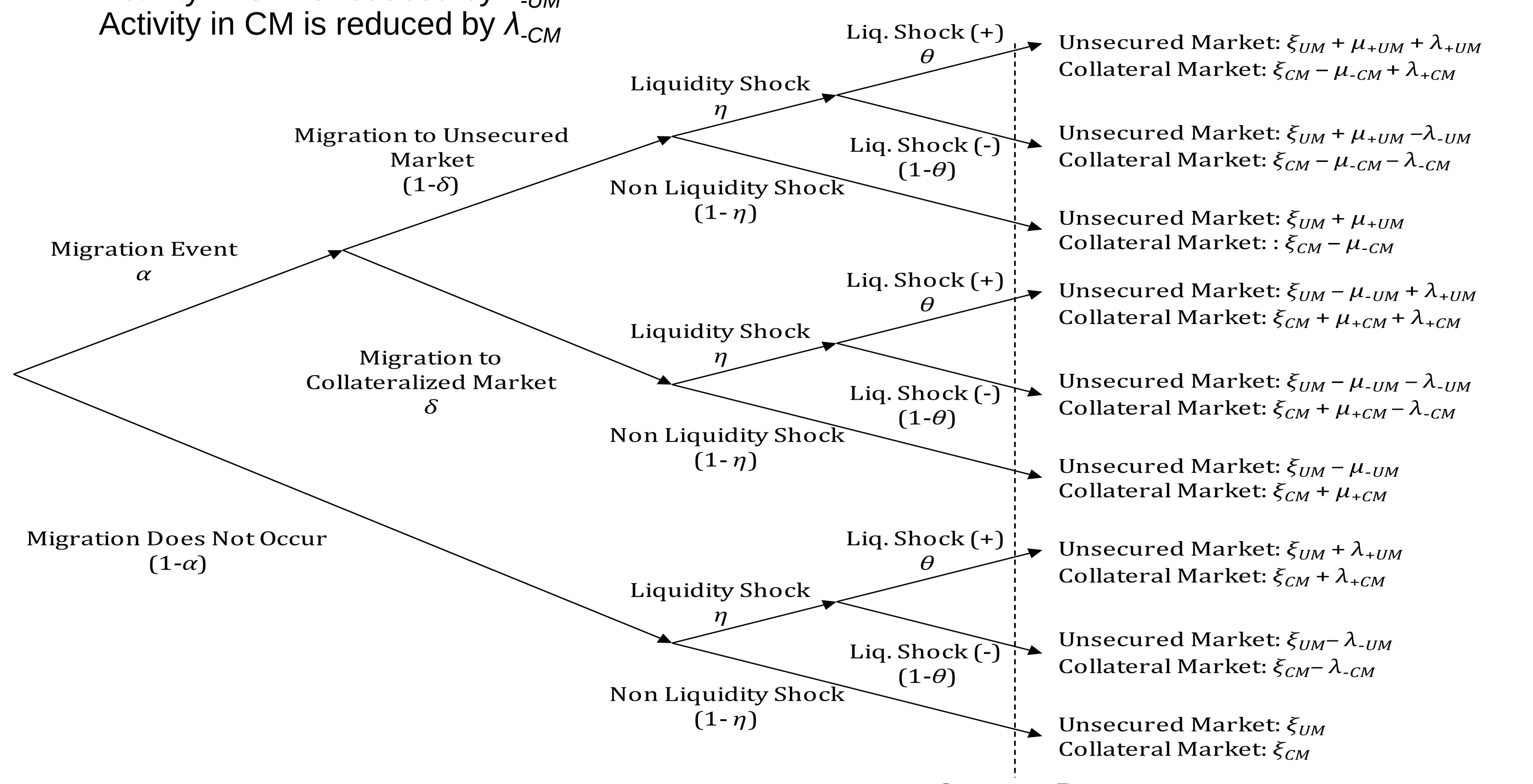
- In equilibrium, the optimal amount of trading is:
  $$\xi^*_{UM} = (1-h)Q; \quad \xi^*_{CM} = hQ$$
  $$h = k_{UM}/(k_{CM} + k_{UM})$$
- h is the relative cost of trading in the UM;
  - If k_{UM} increases (i.e. increase in counterparty risk) and/or k_{CM} decreases (increase in collateral value and availability) there will be a trading migration from UM to CM
- The interest rate spread between unsecured and collateralized markets is obtained by market clearing and given by:
  $$r^*_{UM} - r^*_{CM} = k_{CM}hQ + \frac{d}{Q},$$
- An increase in h (migration from UM to CM) determines an increase in the spread if solely caused by an increase in k_{UM}

The Empirical Model

- We introduce a model that captures daily market dynamics
- There is a set of risk-neutral banks and two money markets:
  Unsecured money market (UM) and Collateralized money market (CM).
- Trading activity arrives according to two Poisson processes with rates ξ_{UM} and ξ_{CM} for UM and CM, respectively.
- Both markets have activity over i = 1,…,I trading days.
  Time evolving continuously within each single day and represented by $t \in [0,T]$.
- A migration event (divergent-sign variation in trading) takes place on each day and with probability $\alpha \in (0,1)$:
  UM → CM with probability δ:
  Activity in UM is reduced by μ_{-UM}
  Activity in CM increases by μ_{+CM}
  CM → UM with probability (1-δ)
  Activity in UM increases by μ_{+UM}
  Activity in CM is reduced by μ_{-CM}
- A liquidity shock (same –sign variation in trading) takes place on each day and with probability $\eta \in (0,1)$:

  Positive liquidity shock with probability θ:
  Activity in UM increases by λ_{+UM}
  Activity in CM increases by λ_{+CM}

  Negative liquidity shock with probability (1-θ):
  Activity in UM is reduced by λ_{-UM}
  Activity in CM is reduced by λ_{-CM}



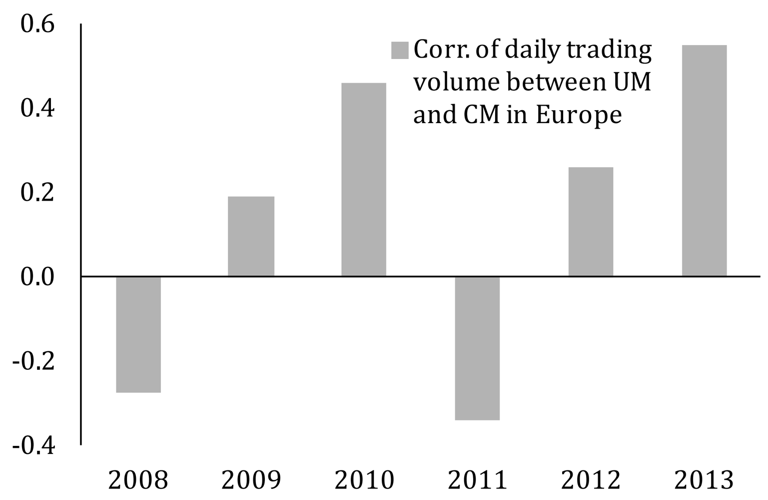
Across the I days the total Likelihood Function is: $L(\varphi|M) = \prod_{i=1}^{I} L(\varphi|UM_i, CM_i)$

Motivation

To study the interaction of two important bank funding markets:
- The interbank market for central bank reserves (i.e. uncollateralized lending); and
- The repo market (i.e. bank lending through the use (and re-use) of collateral)

Questions:
- To which extent are unsecured and secured market substitutes?
- Can trading activity migrate between funding segments and, in doing so, provide meaningful information about the state of health of the banking system and the money market?

Hypotheses:
- During periods of stress due to increased counterparty risk and/or increased uncertainty we should observe a migration in funding from the unsecured to the secured market (repo).
- During periods of stress due to increased uncertainty over the quality of collateral we should observe a migration in funding from the secured to the unsecured market.



Annual Correlations of trading volumes between the unsecured market (UM) and in the collateralized marker (CM) in Europe

Correlation of trading activity between UM and CM have changed over time in Europe.
- In 2008 and 2011 (turbulent years) UM and CM move in opposite direction.
- In 2009, 2010, 2012, and 2013 both markets move in the same direction.

The Data

- We use daily data of money markets in Europe between June 2, 2008 and July 30, 2013 (1,325 trading days).
- Unsecured money market (UM):
  Unsecured interbank loans with maturities ranging from one day (overnight) up to one year.
  Data from TARGET2, the real-time gross settlement payment system owned and managed by the Euro system.
- Collateralized money market (CM):
  We use repurchase agreement (repo) loans data.
  Repo loans with maturities that range from overnight to one year.
  Data from Eurex Repo:
  - One of the major Central Counterparty Clearing Houses (CCP) in Europe.
  - Almost 70% of interbank repo transactions in Europe are conducted via CCP platforms.

For UM:

Sudden decrease (2008 Q3 -Q4)

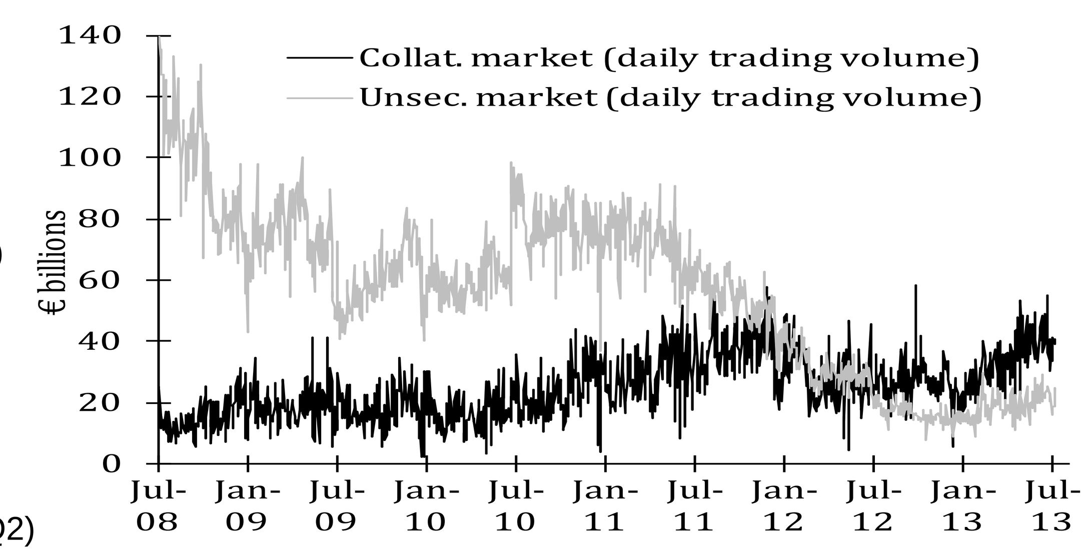
Partial recovery (2009 Q1 – 2011 Q2)

Further decrease (2011 Q3 - 2013 Q1)

Tepid increase (2013 Q2)

For CM:

Constant growth, except (2012 Q1 – Q2)



Daily trading volume in the unsecured market (UM) and in the collateralized marker (CM) in Europe.

The Empirical Model - results

- Using φ, UM and CM we compute 4 conditional probabilities, on a daily basis
  - $P[MIG, CM \rightarrow UM / (UM, CM, \varphi)] = \frac{P[MIG] * Prob[CM \rightarrow UM]}{P[CM, UM]}$
  - $P[MIG, UM \rightarrow CM / (UM, CM, \varphi)] = \frac{P[MIG] * Prob[UM \rightarrow CM]}{P[CM, UM]}$
  - $P[LIQ+ / (UM, CM, \varphi)] = \frac{P[LIQ] * Prob[LIQ+]}{P[CM, UM]}$
  - $P[LIQ- / (UM, CM, \varphi)] = \frac{P[LIQ] * Prob[LIQ-]}{P[CM, UM]}$

Do Posterior Probabilities Explain Market Spreads?

- We compute spread between Unsecured and Secured Rates
- $R_{UM,t} - R_{CM,t} = \frac{r_t^{UM} - r_t^{CM}}{r_t^{ECB,lending} - r_t^{ECB,deposit}}$
- We regress the interest rate spread on 1-day lagged
  - posterior probabilities of migration and liquidity shocks and on:
  - Prob of simultaneous defaults of two or more large banks
  - Composite Indicator of Systemic Stress (CISS)
  - Excess Liquidity in the Eurosystem (CA-RR+NSF)
  - UM/CM Volume ratio
- We run least-squares regressions with heteroskedasticity and autocorrelation-consistent (HAC) standard errors

	$R_{UM,t} - R_{CM,t}$											
	Daily						Weekly					
const.	-0.01*	0.00	-0.01	-0.01***	-0.01***	-0.01***	-0.02**	0.00	-0.01	-0.04***	-0.02***	-0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
$R_{UM,t-1} - R_{CM,t-1}$	0.58***	0.61***	0.58***	0.57***	0.62***	0.58***	0.54***	0.61***	0.58***	0.55***	0.64***	0.57***
	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.08)
$P_{Mig,CM \rightarrow UM,t-1}$	-0.01***	-0.01***	-0.01***				-0.01	-0.02***	-0.02**			
	(0.00)	(0.00)	(0.00)				(0.01)	(0.01)	(0.01)			
$P_{Mig,UM \rightarrow CM,t-1}$				0.02***	0.01*	0.02***				0.02	0.03**	0.03**
				(0.01)	(0.00)	(0.00)				(0.01)	(0.01)	(0.01)
$P_{l+,t-1}$	0.00	-0.02***	0.00				-0.01**	-0.02**	-0.01*			
	(0.00)	(0.00)	(0.00)				(0.01)	(0.01)	(0.01)			
$P_{l-,t-1}$				0.00	0.01***	0.00				0.01**	0.01**	0.01**
				(0.00)	(0.00)	(0.00)				(0.01)	(0.01)	(0.01)
$Vol_{CM,t-1}/Vol_{UM,t-1}$	0.00	0.01***		0.00	0.01***		0.01**	0.01**		0.01**	0.01**	
	(0.00)	(0.00)		(0.00)	(0.00)		(0.01)	(0.00)		(0.00)	(0.00)	
$ProbSimult_{t-1}$	-0.08**		-0.08**	-0.12***		-0.12***						
	(0.03)		(0.03)	(0.04)		(0.04)						
$CISS_{t-1}$							0.04*		0.02	0.03*		0.02
							(0.02)		(0.02)	(0.02)		(0.02)
EL_{t-1}	0.04***		0.05***	0.06***		0.06***	0.02		0.03***	0.03***		0.04***
	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)
Adj. R^2	0.50	0.48	0.49	0.51	0.48	0.50	0.57	0.56	0.56	0.58	0.56	0.57

Results

- Conditional probabilities of migration are strongly significant
- Increase in probabilities of migration to CM is associated to increase in spread UM-CM
- Increase in probabilities of migration to UM is associated to decrease in spread UM-CM
- Consistent with the model, an increase in kUM increases h and the spread
- $h = \frac{k_{UM}}{(k_{UM} + k_{CM})}$; $\xi^*_{UM} = (1-h)Q$; $\xi^*_{CM} = hQ$; $r^*_{UM} - r^*_{CM} = k_{CM}hQ + \frac{d}{Q}$