The Cost of Collateralized Borrowing in the Colombian Money Market: Does Connectedness Matter?

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Introduction

- Money market operations are mostly explained by the collateralized borrowing (León, 2012):
  - Repos with the Central Bank (60.3%)
  - Sell/buy-backs transactions *(*32.9%).
- Non-collateralized borrowing barely contributes with the money market liquidity (6.5%).

Introduction

- Borrowing cost has been analysed with institution-metrics of credit risk: leverage, assets and liquidity.

- Connectedness is as a risk factor worth including:
  - Understanding the financial system requires including its complexity (Casti, 1979).
  - Coincides with Barabási (2003) in that the market is a weighted and directed network of institutions.
  - Macro-prudential view of financial stability.

Introduction

The most appropriate source of money market information for inferring credit quality is sell/buy backs transactions, because:

- In cross section, their cost widely differ among financial entities.
- Imply counterparty risk quotas imposed by the participants of the transactions.
- In the sense of Rochet and Tirole (1996) and Calomiris (2003), similar entities can identify peer’s risk best.

- Traditional metrics of institutions' credit risk do not suffice to explain the cost of collateralized borrowing between financial institutions.

- However, including their connectivity (spatial effects) as an explanatory variable suggest the existence of borrowing spreads that vary across financial institutions.

Spatial dependence

Consist in the mutual affectation that could potentially exist between two entities (LeSage and Pace, 2009).

Suppose a connectivity matrix (C) :

$$C = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{bmatrix} \rightarrow W = \begin{bmatrix} 0 & 1 & 0 & 0 \\ ½ & 0 & ½ & 0 \\ 0 & ½ & 0 & ½ \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

Spatial Durbin Model (SDM)

$$y = \rho W y + X\beta + WX\theta + \varepsilon \qquad (1)$$

$$\varepsilon \sim N(0, \sigma^2 I_n)$$

y	vector of dependent variables, $(n \times 1)$
ρ	spatial parameter of the dependent variable
β	vector of parameters
W	matrix of spatial weights, $(n \times n)$
X	$(n \times k)$ matrix of explanatory variables
ε	$(n \times 1)$ vector of residuals

Spatial Durbin Model (SDM)

The DGP:

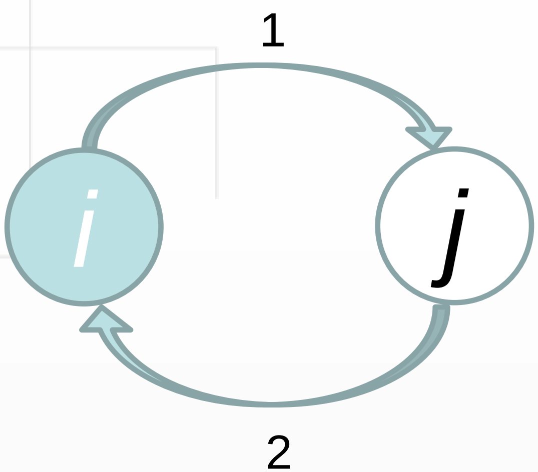
$$y = \underbrace{\underbrace{(I_n - \rho W)^{-1}}_{V(W)} (I_n\beta + W\theta)}_{S_r(W)} X + \underbrace{(I_n - \rho W)^{-1}}_{V(W)} \varepsilon \quad (2)$$

And in matrix form:

$$\begin{pmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{pmatrix} = \sum_{r=1}^{k} \underbrace{\begin{bmatrix} S_r(W)_{11} & S_r(W)_{12} & \dots & S_r(W)_{1n} \\ S_r(W)_{21} & S_r(W)_{22} & \dots & S_r(W)_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ S_r(W)_{n1} & S_r(W)_{n2} & \dots & S_r(W)_{nn} \end{bmatrix}}_{S_r(W)} \begin{bmatrix} x_{1r} \\ x_{2r} \\ \vdots \\ x_{nr} \end{bmatrix} + V(W)\varepsilon$$

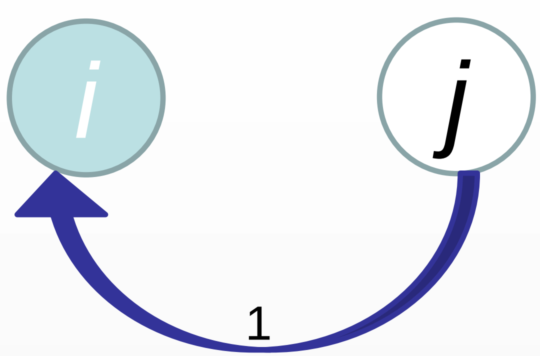
Direct effect

$$\frac{\partial y_i}{\partial x_{ir}} = S_r(W)_{ii}$$



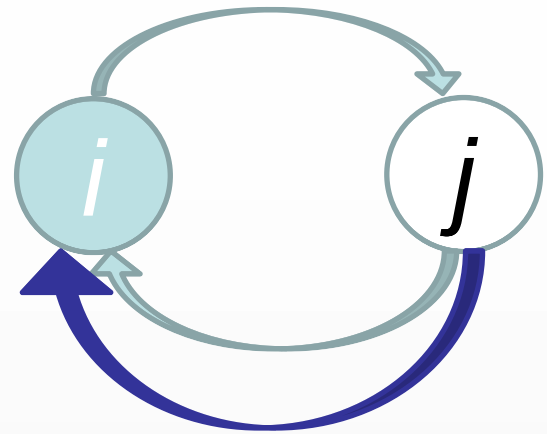
Indirect effect

$$\frac{\partial y_i}{\partial x_{jr}} = S_r(W)_{ij}$$



Total effect

$$\frac{\partial y_i}{\partial x_r}$$



Data description

- The collateralized borrowing spread per entity is the value-weighted average of the sell/buy backs' margin over the Central Bank's intervention rate.

- This corresponds to short-term (1-3 days) sell/buy backs transactions (November 2011 – May 2012) collateralized with local sovereign securities (TES).

- TES is an homogeneous and most liquid asset (sovereign security)

Data description

Traditional entity’s factors were also included:

- Financial leverage.
- Total value of assets (SIZE).
- Total value of sell/buy back borrowing.

Omitting the network dependence…

	OLS	
	Coefficient	Standard error
Financial leverage	0.34	0.876
Total assets	0.00	1.18E-08
Borrowing	0.00	2.75E-04
W_financial leverage		
W_total assets		
W_total borrowing		
Constant	6.57	0.481***
R2h	0.096	
TEST	**Value**	**Probability**
Heteroscedasticity Tests		
Cameron and Trivedi	5.82	(0.758)
Jarque-Bera LM Test		
Skewness	3.21	(0.359)
Kurtosis	2.13	(0.145)
Ramsey Specification Test	0.72	(0.555)

Source: authors' calculations

Including the network dependence…

A weights matrix was constructed with the value of the sell/buy backs transactions

Figure 1a.
Adjacency matrix
(binary, 1 or 0)

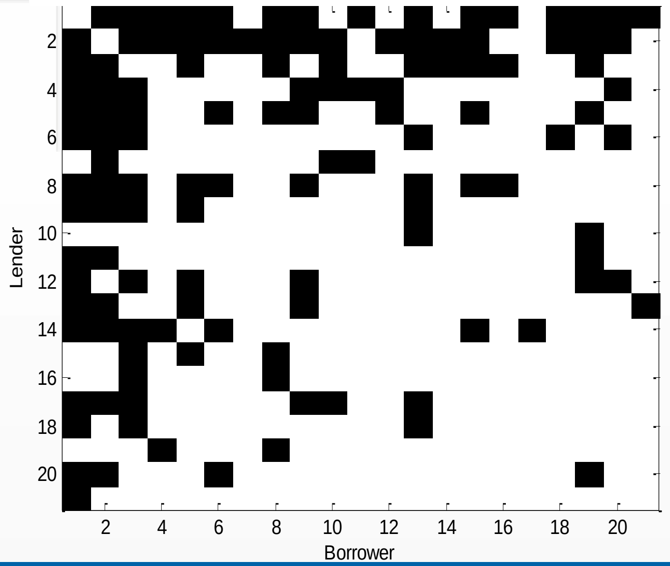
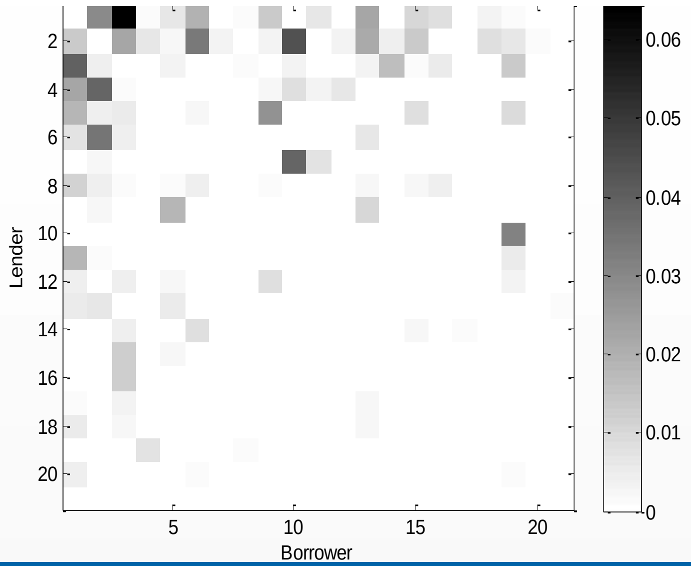


Figure 1b.
Weights matrix
(as % of the total value)



Including the network dependence…

	SAR model		SDM	
	Coefficient	Standard error	Coefficient	Standard error
Financial leverage	0.22	0.615	-0.26	0.584
Total assets	0.00	8.31E-09	0.00	6.55E-09**
Borrowing	0.00	1.93E-04	0.00	0.0002
W_financial leverage			-4.80	1.349***
W_total assets			7.20E-09	1.36E-08
W_total borrowing			6.5E-04	0.0003**
Constant	1.31	1.191	5.67	2.38**
Rho	0.80	0.174***	0.63	0.262**
Acceptable Range for Rho:	-1.9745 < Rho < 1		-1.9745 < Rho < 1	
R2h	0.155		0.659	
R2h Adj	0.061		0.545	
TEST	**Value**	**Probability**	**Value**	**Probability**
Spatial Error Correlation				
GLOBAL Moran MI	0.30	(0.003)***	0.12	(0.153)
Heteroscedasticity Tests				
Hall-Pagan LM Test: E2 = Yh	1.78	(0.182)	2.00	(0.158)
Jarque-Bera LM Test	2.61	(0.271)	1.63	(0.443)
Ramsey Specification Test	0.83	(0.376)	3.43	(0.087)

Source: authors' calculations

Estimation results

For both models:

- The spatial dependence parameter ($\hat{\rho}$) lies within the estimated acceptable range [-1.97, 1].
- This suggests the existence of spill-over effects and positive feedbacks in the funding costs across entities.
- These results about $\hat{\rho}$ and those from the spatial tests suggest that general spatial correlation is mainly attributable to the borrowing cost.

Marginal effects from the SDM

	Estimated Beta	Total effect	Direct effect	Indirect effect
Financial leverage	-0.26	-0.24	-0.09	-0.15
Total assets	**0.00****	0.00	0.00	0.00
Borrowing	0.00	0.00	0.00	0.00
W_financial leverage	**-4.80*****	-4.50	-1.76	-2.74
W_total assets	0.00	0.00	0.00	0.00
W_borrowing	**6.5E-04****	6.0E-04	2.0E-04	4.0E-04

Statistical significance at 5%(**) and 1%(***)

Source: authors' calculations

Estimation results

Spatially affected leverage explains the borrowing cost:

- [T.E]: The more leveraged an entity is, the less costly it is to lend in the market. Consistent with WACC, →Debt is always cheaper than equity.
- [D.E]: A more leveraged entity will be able to provide less costly liquidity to other entities. Thus, this entity will also have access to cheaper liquidity.
- [I.E]: Increments in the leverage of an entity could yield reductions in the borrowing cost of the remaining entities in the market (local effect).

Estimation results

Borrowing cost also depends on spatially affected total borrowing…

But the size of the estimated parameter suggests no gains from using the analysis of impact decomposition.

Conclusions

- Leverage, size and borrowing levels are of low explanatory power by themselves.
- But their spatial-effects explain borrowing spreads that vary across financial institutions.
- Spatial-effects of financial leverage (direct and indirect) determine the cost of collateralized borrowing the most.

Further work

- Including other sources of liquidity (Central Bank's collateralized liquidity facilities, non-collateralized, non-TES collateralized).
- Analyzing the dynamics of $\hat{\rho}$
- TES as ideal collateral (i.e. information invariance)

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