Do central counterparties reduce counterparty and liquidity risk? Empirical results

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Contents

Take home message

- A central counterparty (CCP) interposes itself between buyers and sellers of financial contracts to extinguish their bilateral exposures.
- Central clearing and settlement through **a CCP should affect how financial institutions engage** in financial markets.
- This article compares—for the first time—networks of transactions agreed to be cleared and settled by the CCP with those to be cleared and settled bilaterally.
- Networks to be centrally cleared and settled show significantly higher connectivity and lower distances among financial institutions. This suggests that **agreeing on central clearing and settlement reduces liquidity risk**.
- After CCP interposition, exposure networks show significantly lower connectivity and higher distances. This suggets that **central clearing and settlement reduces counterparty risk**.
- Evidence shows **CCPs induce a change of behavior in financial institutions that emerges as two distinctive economic structures for the same market, which corresponds to CCP's intended reduction of liquidity and counterparty risks.**

Contents

Literature review

- Central clearing and settlement through CCPs (i.e., hereafter central clearing) **aims at mitigating counterparty risk** while increasing operational efficiency and reducing opacity and complexity in financial markets (Ripatti, 2004; Bliss & Steigerwald, 2006; Manning, et al., 2009; Cecchetti, et al., 2009; Duffie & Zhu, 2011; Yellen, 2013; Acharya & Bisin, 2013; Wendt, 2015; Deng, 2017).
- Operating in a market that has agreed on central clearing should increase the availability of potential counterparties (Ripatti, 2004; Bliss & Steigerwald, 2006; Wendt, 2015) and thus **should reduce liquidity risk.**
- Central clearing through CCPs has been studied from theoretical and modeling viewpoints (Jackson & Manning, 2007; Acharya & Bisin, 2013; Galbiati & Soramäki, 2013; Yellen, 2013; Garratt & Zimmerman, 2015; Deng, 2017).
- However, data corresponding to financial institutions interacting with the option to use central or bilateral clearing in the same market (i.e., the same jurisdiction, the same underlying asset, the same period) are elusive.

Literature review

- **Empirical studies of the effects caused by CCPs are scarce** (Loon & Zhong, 2016; Akari, et al., 2021).
- From an econometric viewpoint, regarding CDS and bond trades in the United States, Loon & Zhong (2014, 2016) and Mayordomo & Posch (2016) **find that CCPs reduce counterparty and liquidity risk**, whereas Akari, et al. (2021) find that they reduce liquidity risk only.
- But… **financial markets are complex systems** (Farmer, et al., 2012; Caldarelli, 2020). Visualizing and describing the networks that result from financial institutions' interactions is critical to understanding financial markets.
- We implement network analysis methods to **visualize and quantify the effects (i.e., the emerging connective structures) caused by the interposition of CCPs**.
- Based on León & Sarmiento (2021), **we study the connectedness and distance of transactional and exposure networks** corresponding to the over-the-counter (OTC) Colombian peso non-delivery forward market to empirically address a question: **How does CCP clearing affect counterparty risk and liquidity risk in an OTC derivatives market?**

Contents

Methodology

First, some intuition…

- A *hypothetical* (silly) case: taking the elevator to your office—seen from above.
- People want to avoid flu contagion but want to make friends (chit chat) while they get to their office.
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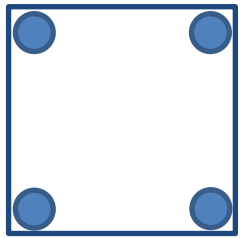

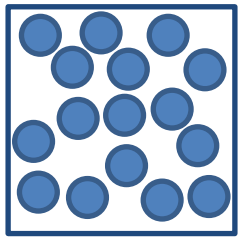

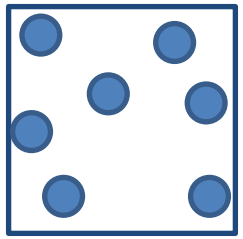

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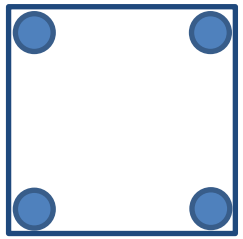

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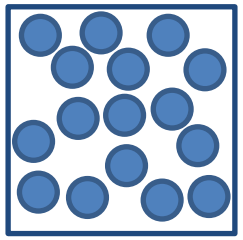
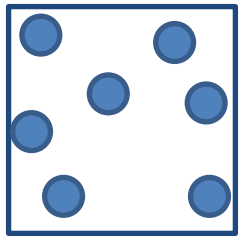


- Strong effects from contagion.



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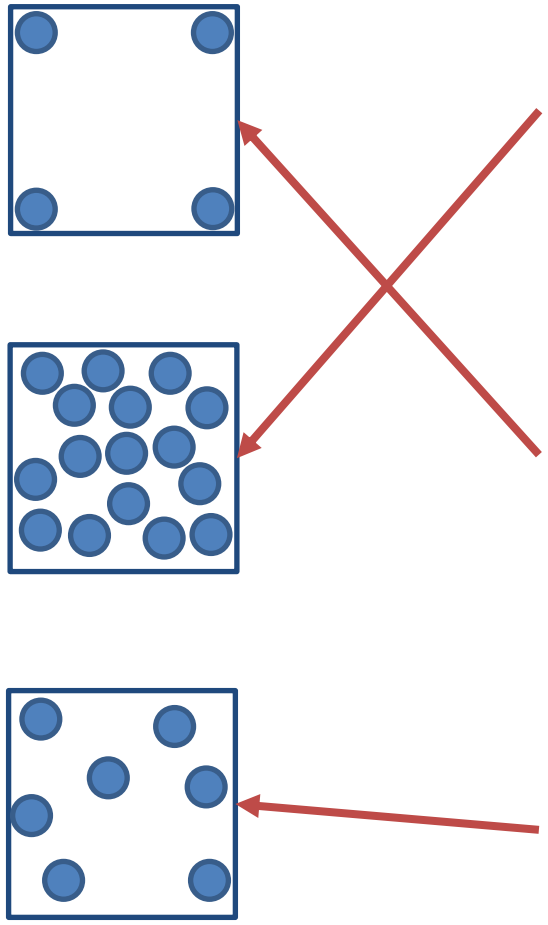

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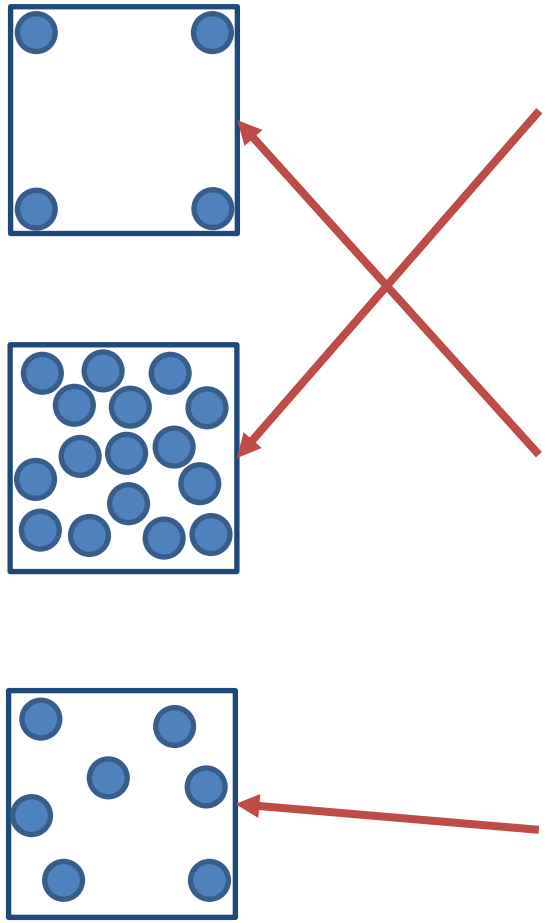
- Strong effects from contagion.
- Mild effects from contagion.

Methodology

- *Expectation of trivial effects attains a **dense ride** with many **potential friends close by**.*
- *Expectation of strong effects causes a **sparse ride** with **far-off potential friends**.*
- In our case, the interposition of the CCP determines the extent of effects.
- When agreeing on CCP interposition…
  - Before interposition, we expect **denser transactional networks with closer participants**—than with bilateral clearing. **Lower counterparty risk aversion and lower liquidity risk.**
  - After, we expect **sparser exposure networks with distant participants**. **Lower counterparty risk.**



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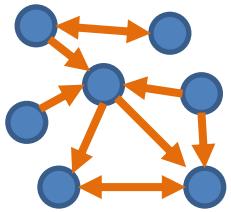
Methodology

Network analysis—a network is…



Nodes correspond to financial institutions

Arrows correspond to long USD positions held by the receiving nodes

$$A_{ij} = \begin{cases} 1 \text{ if there is a connection from } i \text{ to } j, \\ 0 \text{ otherwise.} \end{cases}$$

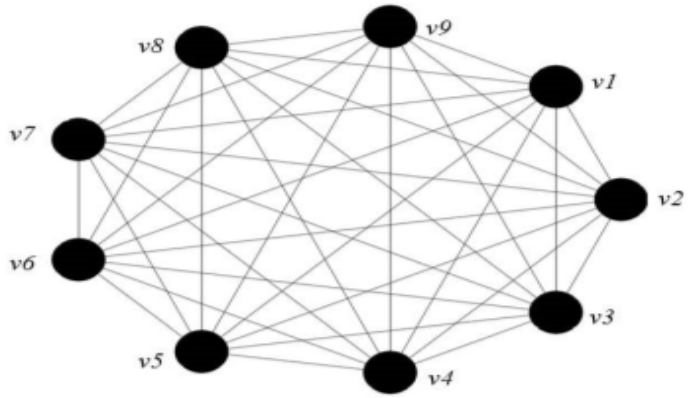
Methodology

Network analysis—what determines its structure?

- The network structure is related to the outcome of **a general optimization process that balances two opposing objectives: connectedness and distance** between participants (Ferrer i Cancho & Solé, 2003; Gastner & Newman, 2006; Hojman & Szeidl, 2008; Newman, 2010; León & Sarmiento, 2021).
- Connections benefit participants by providing access to other participants. However, connections entail costs and their benefits decrease with distance.
- **Minimizing distances and costs of connectedness generate different types of network structures** depending on the weight assigned to each objective.
- Under this general framework, **two limit cases of network structure are available: complete networks and star networks**.

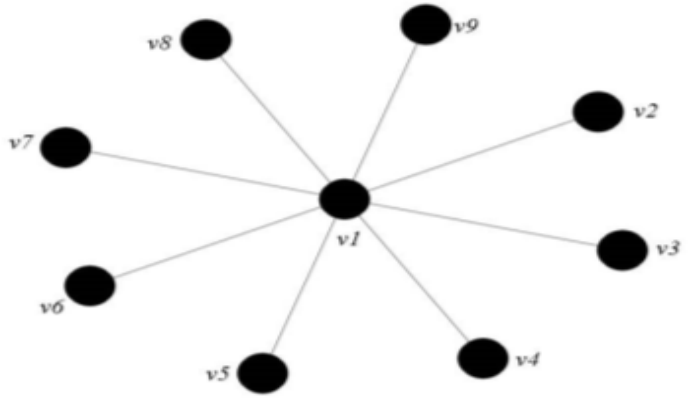
Methodology

The complete network



- When connections entail no cost, a fully connected network (i.e., a complete network) achieves the **minimal distance between all participants**.
- Complete networks correspond to systems in which every element is connected to each other in a feedback loop, and thus they are hopelessly unstable (Simon, 1962; Anderson, 1999)

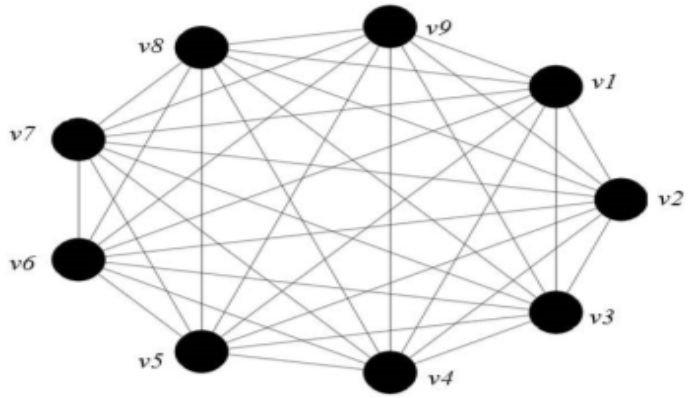
The star network



- When connections entail a cost, but no participant is to be unconnected, a **star network minimizes connectedness**.
- Real networks are not centralized as a star. There are hierarchies of hubs that keep networks together. (Barabasi, 2003).

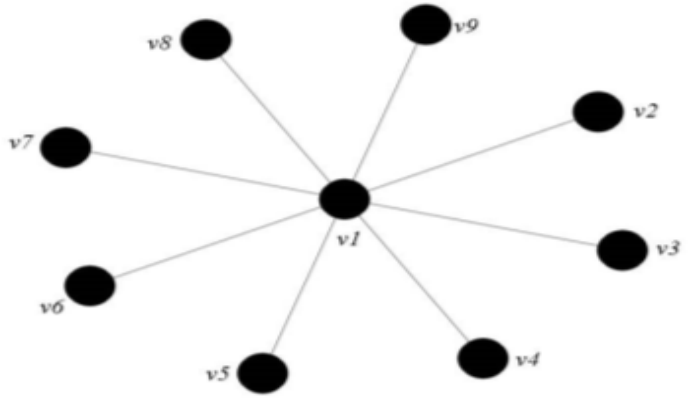
Methodology

The complete network



- **Distance is minimal. Liquidity risk is minimal. Plenty of counterparties to change positions into others.**
- Absent any cost related to exchanging liquidity among financial institutions, a complete network is the most efficient network (Castiglionesi & Eboli, 2018).
- Complete or quasi-complete networks are rare. But very-high-density networks result from anonymous trading platforms or when financial institutions execute clients' orders (i.e., *blind* participants).

The star network



- **Connectedness is minimal. Cost related to exposures is minimal. Each financial institution has a dedicated counterparty.**
- Financial institutions avoid excessive counterparty risk by establishing a few dedicated lending relationships (Cocco, et al., 2009; Afonso, et al., 2013; Temizsoy, et al., 2015).
- Star networks are rare. Two examples: central banks' liquidity networks and CCPs.

Methodology

	Network analysis—measures we use	We expect…
Connectedness	**Density (*d*)**: measures connectedness as the ratio of observed to possible connections; it measures the cohesion of the network. **Reciprocity (*r*):** measures the frequency with which a transfer from *i* to *j* is complemented by a transfer from *j* to *i*. **Transitivity (*c*):** commonly referred to as clustering, measures the frequency with which relations between *i* and *k* and *j* and *k* are complemented with a relation between *i* and *j*.	Connectedness reflects counterparty risk aversion: • Lower connectedness when bilateral clearing is agreed. • Higher connectedness when CCPs central clearing is agreed.
Distance	**Mean geodesic distance (*l*):** measures distance as the average shortest path between participants (l_i); unlike density, mean geodesic distance is determined by how connections are organized, and a closed-form solution is unavailable.	Distance reflects availability of counterparties to transact with: • Higher distance when bilateral clearing is agreed. • Lower distance when CCPs central clearing is agreed.

Data

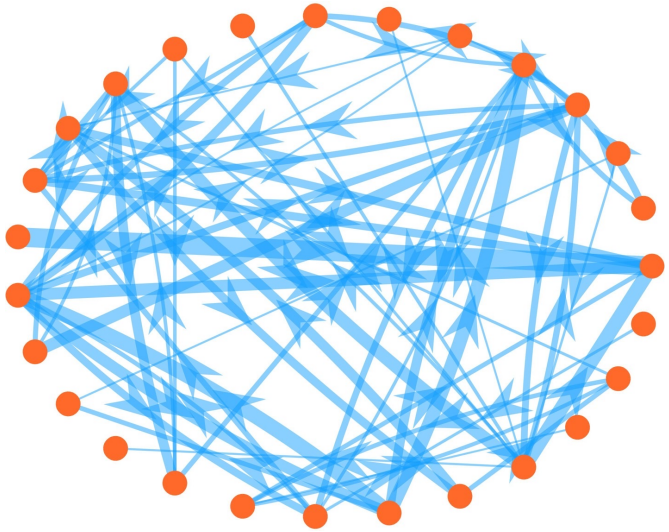
- A unique dataset: **transactions and exposures from the OTC Colombian peso non-delivery forward market, in US dollars**, monthly from October 2011 to December 2018 (i.e., 87 observations).
- It is unique because the dataset is **built by conciliating two different non-publicly available datasets** from Banco de la República (Central Bank of Colombia) and the sole local CCP (i.e., Cámara de Riesgo Central de Contraparte de Colombia S.A).
- We choose the Colombian peso non-delivery forward market because it contributes the most to the open interest of the CCP (42,0 percent as of 2018) and **financial institutions may simultaneously operate under the options of bilateral or central clearing**.
- Then, we build three networks:
  - Transactions to be cleared bilaterally.*
  - Transactions to be (centrally) cleared and settled by the CCP.
  - Exposures after the CCPs interposition.

(*) When bilateral clearing is chosen, the network structure for the transactions and exposures network is the same.

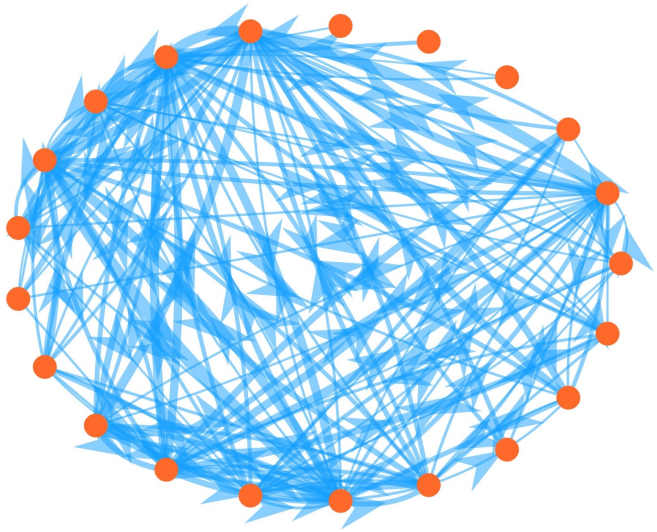
Contents

Main results

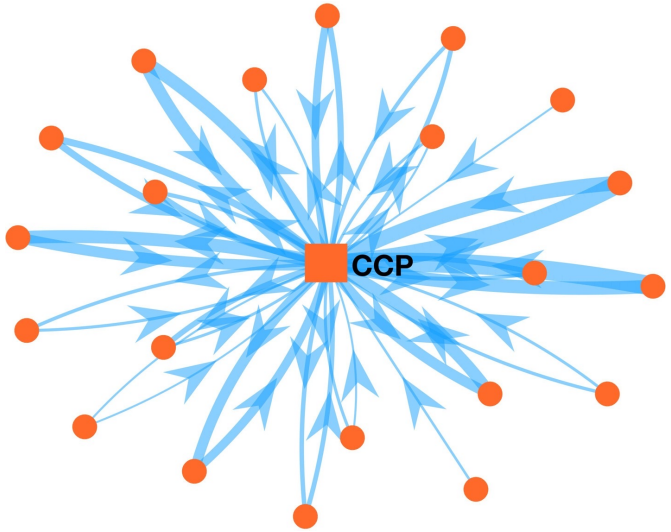
Network of transactions (and exposures) to be cleared and settled bilaterally



Network of transactions to be cleared and settled by CCP

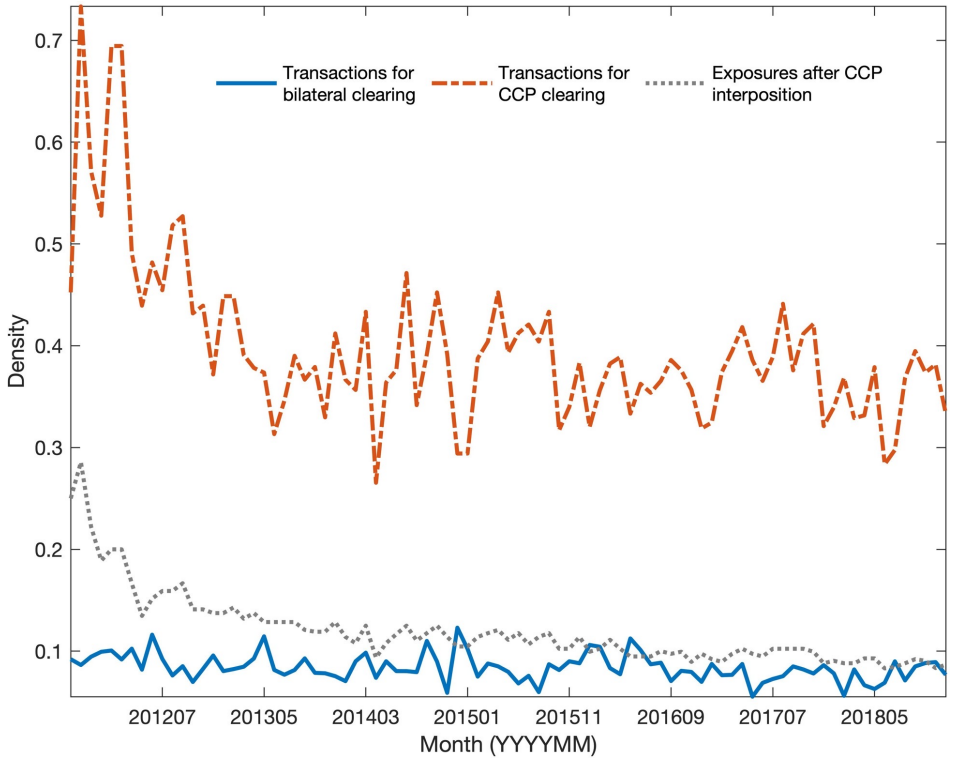


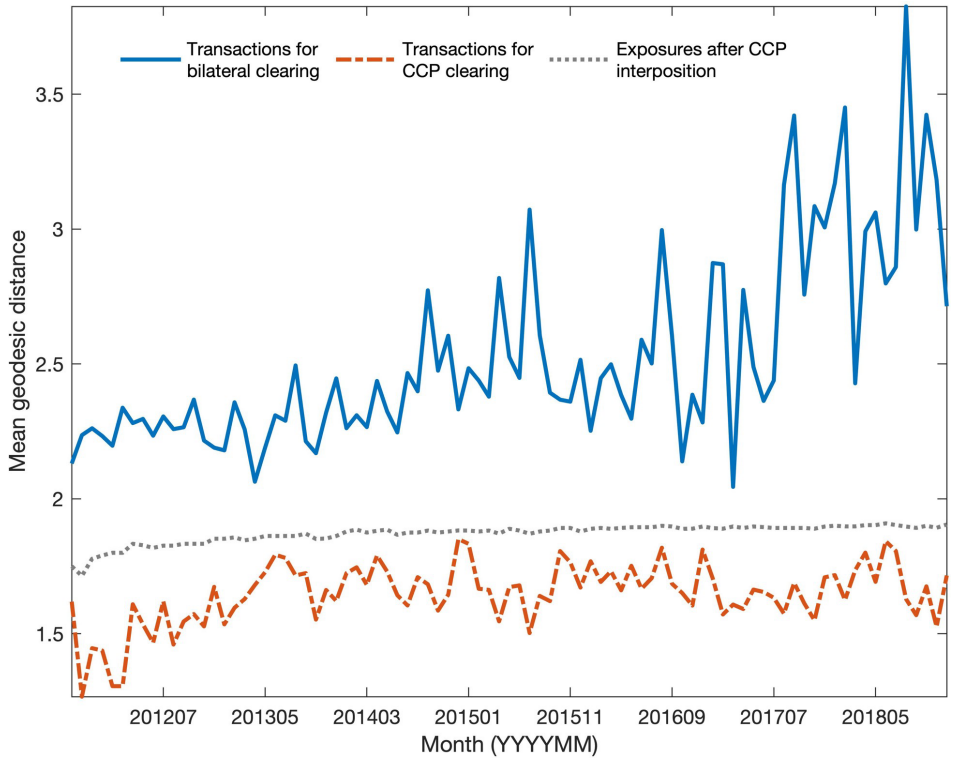
Network of exposures to be cleared and settled by CCP



December 2018. Nodes represent financial institutions (circles) and the CCP (square). Arrows represent transactions/exposures, pointing to the counterparty holding a long US dollar position; width represents the contribution to the sum of all transactions. Networks in a. and b. use a circular layout, whereas c. uses a force (gravitational) layout.

Main results





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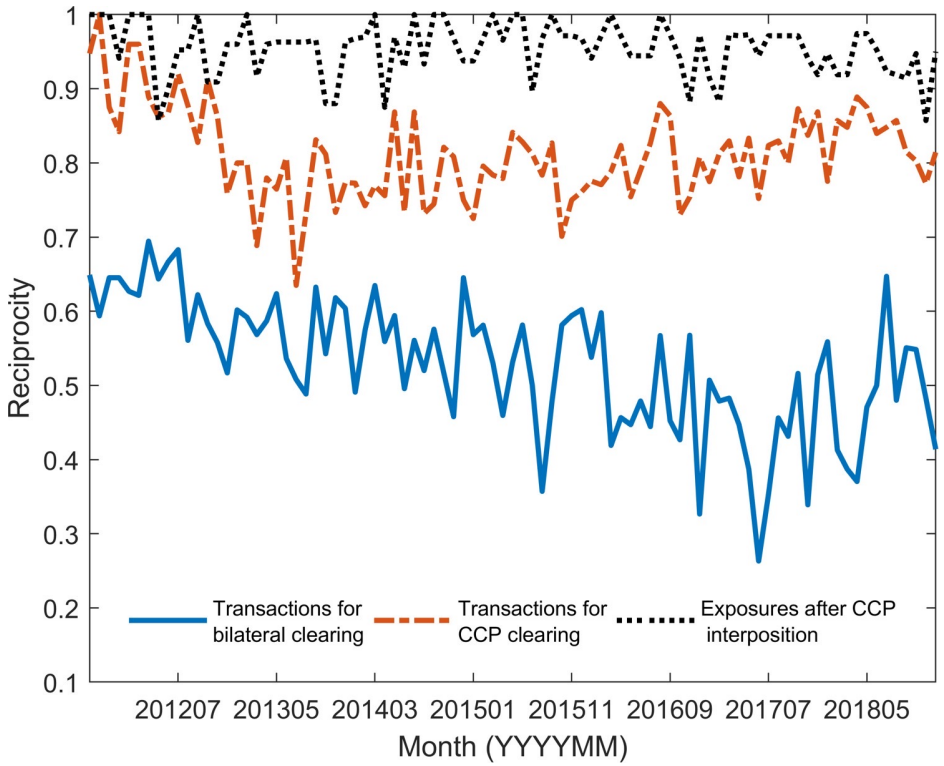

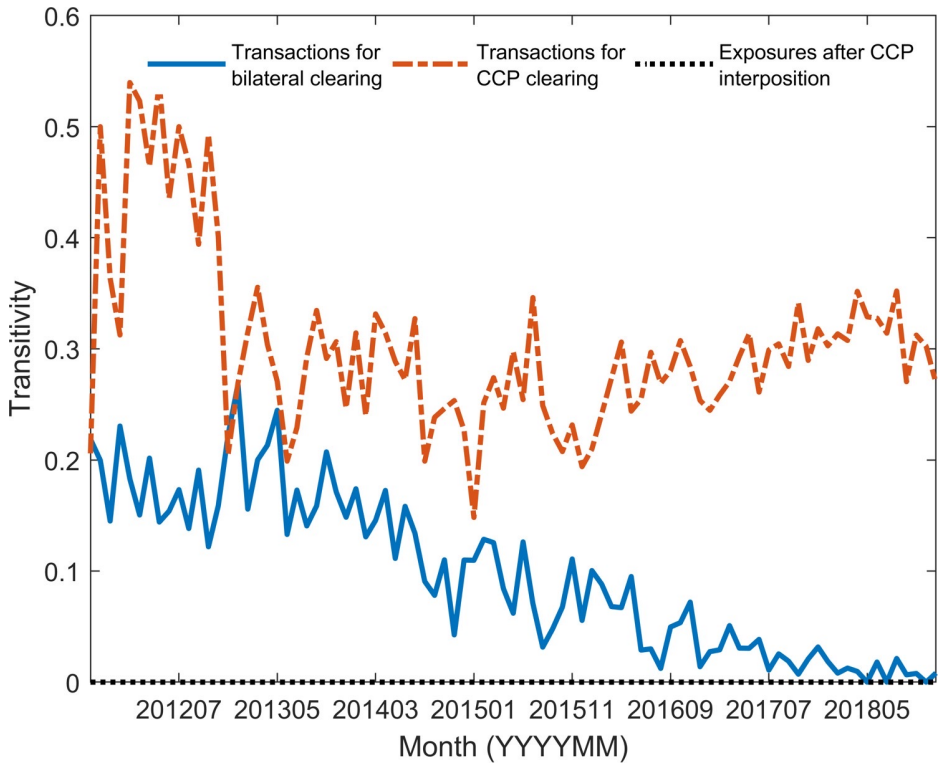

Main results

- **Central clearing through the CCP reduces liquidity risk in the transactional stage**: finding a counterparty is easier as the network is more interconnected and financial institutions are closer.
- **The interposition of CCP significantly reduces counterparty risk**: the significantly lower connectedness (i.e., density and transitivity) and higher distance reveals that exposures between financial institutions decrease manifestly after the transaction stage.
  - However, reciprocity is higher after CCP interposition, which is expected as all positions (buy and sell) are novated by CCP to mitigate counterparty risk by neglecting any exposure between financial institutions—in the form of null transitivity.
- Numerical results support this too…

Main results

	Transactions for bilateral clearing	Transactions for CCP clearing	Exposures after CCP interposition
Density (d) ($\times 100$)	8.41 [1.31]	39.84* [8.16]	11.92 [3.59]
Mean geodesic distance (l)	2.53 [0.36]	1.65* [0.12]	1.87* [0.04]
Reciprocity (r) ($\times 100$)	52.78 [8.96]	81.20* [6.29]	95.45 [3.66]
Transitivity (c) ($\times 100$)	9.70 [7.17]	30.33* [8.05]	0.00* [0.00]

Table 1. Mean and standard deviation (in brackets) of density, mean geodesic distance, reciprocity, and transitivity. Rejection of the null hypothesis of distributional equality with respect to bilateral clearing is marked with * (Kolmogorov-Smirnov non-parametric two-sample test at 5 percent significance level). The series of transaction networks for central clearing display significantly higher density, reciprocity, and transitivity, and significantly lower mean geodesic distance than those corresponding to the series for bilateral clearing. Therefore, central clearing through the CCP reduces liquidity risk in the transactional stage. Exposure networks after CCP interposition display a density and transitivity that are visibly lower than those corresponding to the transaction stage. The density after CCP interposition is not significantly different from that corresponding to networks for bilateral clearing. However, reciprocity is higher after CCP interposition, which is expected as all positions (buy and sell) are novated by CCP. Consequently, with respect to networks of transactions for central clearing, we conclude that the interposition of CCP significantly reduces counterparty risk. Source: authors' calculations.

Contents

Discussion

- Results show that **the option to clear bilaterally or centrally creates two alternate emerging economic structures** within the same market. **Financial institutions interacting under the central clearing option behave differently** from those that interact under the bilateral clearing option.
- From a network optimization framework, the structure corresponding to central clearing shows that **the interposition of the CCP reduces liquidity risk in the transaction stage while reducing counterparty risk afterward**. This agrees with what is expected from CCPs.
- Results agree with Loon & Zhong (2014, 2016) and Mayordomo & Posch (2016)—but with a (very) different methodological approach and dataset.
- The CCP interposition does not achieve a complete network in the transactional stage. Macro risk (Deng, 2017) and remaining incentives to monitor each other (Antinolfi et al., 2018) may explain this.
- **Results provide new elements for existing theoretical and modeling approaches** to the study of CCPs—despite the idiosyncrasies the Colombian case may entail.

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