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journal homepage: www.elsevier.com/locate/jfecEndogenous intermediation in over-the-counter markets[☆]Ana Babus^{a,*}, Tai-Wei Hu^b^a Federal Reserve Bank of Chicago, 230 S LaSalle St., Chicago, IL 60604, United States^b Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Jacobs Center 548, Evanston, IL 60208, United States

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ABSTRACT

We provide a theory of trading through intermediaries in over-the-counter markets. The role of intermediaries is to sustain trade. In our model, traders are connected through an informational network. Agents observe their neighbors' actions and can trade with their counterparty in a given period through a path of intermediaries in the network. Nevertheless, agents can renege on their obligations. We show that trading through an informational network is essential to support trade when agents infrequently meet the same counterparty. However, intermediaries must receive fees to implement trades. Concentrated intermediation, as represented by a star network, is both constrained efficient and stable when agents incur linking costs. The center agent in a star can receive higher fees as well.

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1. Introduction

Many financial transactions take place in over-the-counter (OTC) markets in which counterparties can choose whom they trade with. Often, markets participants develop long-lived trading relationships. For instance, [Afonso, Kovner, and Schoar \(2014\)](#) find evidence that participants in the federal funds market frequently choose to interact with the same counterparty over time. Moreover, in various markets a relatively small group of dealers persistently intermediate the majority of trades. This concentrated intermediation structure has been shown in markets for CDS contracts ([Duffie, Scheicher, and Vuillemeay, 2015](#)), muni bonds ([Li and Schürhoff, 2014](#)), and securitized products ([Hollifield, Neklyudov, and Spatt, 2014](#)). These regularities

lead to questions about the role of intermediation and its connection to relationship trading in OTC markets.

This paper proposes a theory of endogenous intermediation in OTC markets. We study the impact of trading through a network of intermediaries on the efficiency of trade, in an environment with limited commitment and limited information about agents' past actions. Intermediaries in our model can alleviate these frictions and sustain (unsecured) trade. However, intermediaries affect the division of the surplus. We show that intermediaries must be compensated to ensure that they have the incentive to implement trades. The share of surplus that accrues to intermediaries is endogenously determined to incentivize agents to meet their obligations and depends on the network structure. Our main results state that star networks, in which one agent intermediates all transactions, are both constrained efficient and stable structures in large economies, even as traders incur small linking costs.

To study relationship trading, we consider a dynamic setting in which agents trade bilaterally. At each date half of the agents have liquidity surpluses and half have investment opportunities. An agent with a liquidity surplus

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* Corresponding author.

E-mail address: Ana.babus@chi.frb.org (A. Babus).

is randomly paired with an agent with an investment opportunity at each period. The liquidity agent is endowed with one unit of cash that can be lent to the paired investment agent to finance his investment opportunity. The return depends on the amount of the borrowing.

In this environment, we consider two frictions. First, we assume that there is limited commitment, and that agents can renege on due payments at the end of the period. This friction captures the fact that agents in financial markets can strategically default and, as a result, benefit at the expense of their counterparties. For instance, in the federal funds market, banks can delay the delivery of overnight loaned funds until the afternoon hours, while in the repo markets agents strategically postpone both delivering the collateral (failure to deliver) and repaying the loan (failure to receive).¹ More generally, agents can use the funds borrowed to engage in excessive risk taking activities that would preclude them from repaying their debts.

Second, we consider that agents have limited access to information about other agents' past behavior. This assumption is motivated by the fact that, while OTC markets are opaque and information about the terms of trade is not public, financial institutions could have access to soft information about their long-term trading partners.² In particular, we consider that traders are connected through an informational network that allows each agent to observe the repayments that his neighbors make.

In the presence of limited commitment, agents have to rely on self-enforcing contracts to implement trades. Repayments can be enforced if agents are threatened with exclusion from the market in case they default on their obligations. The information observed through the network allows agents to implement such threats. For this, however, transactions must take place through intermediaries in the network. Unless contracts are self-enforcing, trade breaks down.³

We obtain three sets of results. The first set highlights the role of intermediaries in sustaining trade. We start by showing that trade is not sustainable in large economies in which no agent is linked to any other agent. At the same time, we show that a star network can sustain trade, no matter how large the number of market participants. However, the center agent in the star must be compensated to ensure that he has the incentive to intermediate trades. In particular, because the center agent transfers funds between liquidity and investment agents, he must receive appropriate fees to overcome the temptation to retain the funds for himself. The fees in our model are endogenously determined to provide incentives for agents

to meet their obligations. The incentive compatibility constraint for agents who use the intermediation service sets an upper bound for the fees that the center agent receives, and the incentive compatibility constraint for the center agent himself sets a lower bound. In addition, by comparing different network structures, we highlight the relative advantage that network positions offer some agents over others. We find that the center agent in a star network can receive a higher fee than any intermediary in other classes of networks we study.

The second set of results focuses on welfare improvements that trading through an informational network can bring in the presence of linking costs. When taking linking costs into account, maximizing expected welfare involves a trade-off. On the one hand, a higher level of investment increases welfare. On the other hand, a network that implements a high level of investment can involve a higher linking cost. We show that the star network is a constrained efficient network when it can sustain a level of investment sufficiently close to the first-best, provided that the linking costs are not too high and that the market size is large.

The third set of results concerns network formation and stability, when agents incur linking costs. We investigate whether agents have an incentive to participate in an informational network and identify structures that are stable when traders are allowed to change their links. We propose a dynamic network formation game and introduce an appropriate stability concept. We show that a star network is stable.

The paper is organized as follows. Section 2 discusses the related literature and puts our work in context. Section 3 introduces the model setup. In Section 4, we describe in detail the trading protocol and analyze when unsecured trade is implementable, as well as the efficiency of trading through networks. We propose concepts for network formation and show which networks are stable in Section 5. Section 6 concludes.

2. Related literature

This paper relates to several strands of literature. The more relevant studies are those on intermediation in OTC markets, trading in networks, and contract enforcement.

A series of papers, starting with Duffie, Garleanu, and Pedersen (2005), has studied trading in OTC markets. While initially these studies have been concerned with explaining asset prices through trading frictions, several additions to the literature are interested in the role of intermediaries in OTC markets. Hugonnier, Lester, and Weill (2014); Neklyudov (2014), and Chang and Zhang (2015) propose models in which intermediaries facilitate trade between counterparties that otherwise would need to wait a long time to trade. In our model, agents also trade through intermediaries to overcome frictions that arise from search. However, our focus is on informational frictions, as is Fainmesser (2014) and Glode and Opp (2016). In Fainmesser (2014), intermediaries can informally enforce the repayment of loans by borrowers, as in our model. However, intermediaries are exogenously determined. In contrast, in our model, certain agents

¹ Bartolini, Hilton, and Mc Andrews (2010) find settlement delays in the money market, and Gorton and Muir (2015) present evidence of fails in repo markets.

² For instance, Du, Gadgil, Gordy, and Vega (2015) show that participants in the CDS market choose their counterparties based on their risk profile.

³ A credit bureau that collects and makes credit records public can make intermediaries redundant. However, significant difficulties are associated with creating such institution. Typically, financial market participants are reluctant to disclose to regulators not only information about themselves, but also information about their counterparties. Financial institutions see putting a counterparty into default as a very serious step.

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