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Trading networks and liquidity provision ☆

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ABSTRACT

We study the profitability of traders in two fully electronic and highly liquid markets: the Dow and Standard & Poor's 500 e-mini futures markets. Using unique information that identify counterparties to a transaction, we show and seek to explain the fact that the network pattern of trades captures the relations between behavior in the market and returns. Our approach includes a simple representation of how much a shock is amplified by the network and how widely it is transmitted. This representation provides a possible shorthand for understanding the consequences of a fat-finger trade, a withdrawing of liquidity, or other market shock.

1. Introduction

In this paper, we analyze a unique data set of transactions from two financial futures contracts traded on the Chicago Mercantile Exchange (CME). The dataset contains information about transactions from the month of August for the September 2008 e-mini Standard & Poor's (S&P) 500 and Dow contracts. The data set has time-stamped transaction-level quantities, prices and counterparty identifiers for all transactions during August 2008. This includes more than seven million trades across more than 30 thousand accounts for the S&P 500 and more than one million trades across more than seven thousand accounts for the Dow.

The unique feature of the data is the availability of precise counterparty information. We are able to identify who traded, when, and with whom. We exploit this feature of the data to discuss the relation between the counterparty connections and a variety of market features of interest to financial economists. We characterize the topology of a trading network to help understand how traders' positions in the network influence their profitability and how shocks are transmitted across the market.

In spite of a growing literature on financial interconnections and a widespread belief in the importance of financial linkages, no consensus has been reached on how network

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structure is related to liquidity or risk. A growing understanding exists of extreme cases such as repo runs (Brunnermeier and Pederson, 2009; Brunnermeier, 2009) or sequential default (Allen and Gale, 2000) or linkages in outcome across types of firms (Billio, Getmansky, Lo, and Pellizon, 2012), but these successes remain relatively rare in the literature.

We estimate the importance of market topology on trader-level returns using an approach that captures the correlation in returns between counterparties, the actual network topology of the entire market, and the importance of each transaction. Central to this approach is the introduction of the Bonacich centrality measure (Bonacich, 1987, 2007) to the financial economics literature. We believe that this network centrality measure is particularly salient in financial markets as it provides a way to understand the relative importance of direct and indirect links and thus helps explain the propagation of shocks in the system. As shown in Liu and Lee (2010), a close link exists between a spatial autoregressive model with network data and Bonacich centrality. This type of regression model captures recursively the network effects at any degree of separation (see also Lee, Liu, and Lin, 2010). In our application, a network regression model can explain more than 70% of the cross section of trader-level returns.

Why do networks emerge in this context? And why do they explain returns and shock amplification? We show that the (observed) network of trades is a characterization of the (unobserved) strategic interactions at work in the market. Traders with similar strategies trade amongst themselves as well as with others. As they do so, and form links with one another, correlation in trading strategies leads to a connection between strategies and network position. That is, certain types of traders are more frequently central in the network and other types are more frequently peripheral. A trader's network position thus predicts profitability and the network topology drives the transmission of shocks.

In Section 2, we present data and institutional features of the markets that we study. Section 3 contains the empirics of trader-level returns and highlights the role of network position for a better understanding of markets and trader profitability. Section 4 is devoted to describing our estimation results, and Section 5 discusses the causal nature of our empirical work. Section 6 extends the work to implement a policy experiment on the impact of trading limits. We discuss our contribution to the existing literature in Section 7 and conclude in Section 8.

2. Data and institutional features

Our data of interest are the actual trades completed on the CME for two contracts, the S&P 500 and Dow futures. The trades we observe are the result of orders placed by traders that have been matched by a trading algorithm implemented by the CME. Using the audit trail from the two markets, we uniquely identify two trading accounts for each transaction: one for the trader who booked a buy and the opposite for the trader who booked a sale. For these two markets, First In, First Out (FIFO) is used. FIFO uses price and time as the only criteria for filling an order: all orders at the same price level are filled according to time priority.

Each financial transaction has two parties, a direction (buy or sell), a transaction identification number, a time stamp, a quantity, and a price. We have transaction-level data for all regular transactions that took place in August 2008 for the September 2008 e-mini S&P 500 futures and the Dow futures contracts. The transactions take place during August 2008, when the markets for stocks underlying the indices are open. Both markets are highly liquid, are fully electronic, and have cash-settled contracts traded on the CME GLOBEX trading platform.

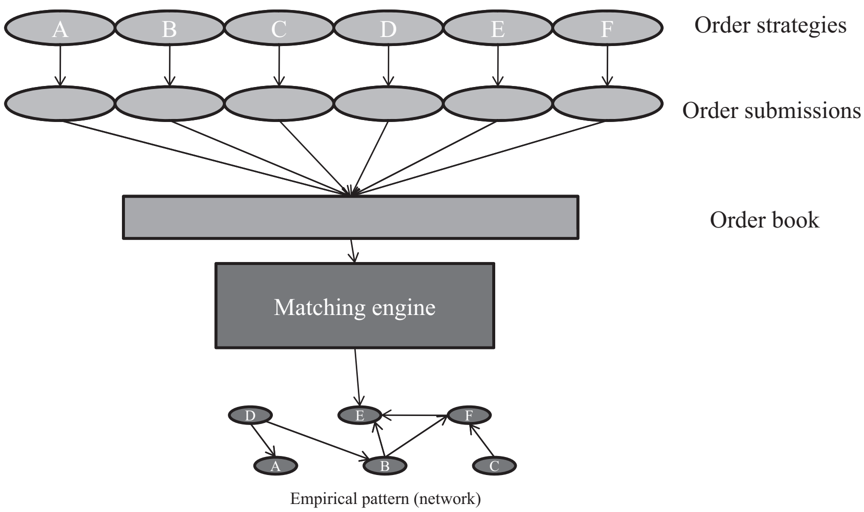

Fig. 1. Each node in the section labeled “order strategies” represents a single trader's plans for trading. The ovals beneath each trader, next to the label “order submissions,” represent actual placed orders. Below this, we denote with a box the complete order book. This is the aggregation at each time of all the orders submitted by traders. This order book is passed through the box beneath it, which we have labeled a “matching engine.” This computer matches orders based on price and time priority. Finally, beneath the matching engine, we provide a sample representation of the network patterns that could emerge from a set of six completed transactions.