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Over-the-counter markets vs. double auctions: A comparative experimental study☆

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ABSTRACT

We study an electronic over-the-counter (OTC) market, in which each agent looks for the best counterpart through bilateral negotiations. We compare its performance with the standard electronic double-auction (DA) market, in which traders post their quotes publicly. We show that the lack of information in the OTC market induces an efficiency loss, characterized by an average closing price below the competitive price and by a traded quantity below the competitive quantity. We further test the robustness of these findings when exogenous shocks modify the competitive equilibrium. Among other things, we show that supply shocks increasing the competitive quantity improve OTC's efficiency.

1. Introduction

Over-the-counter (OTC) markets are decentralized trading mechanisms in which each trader looks for the best counterpart through private, and typically bilateral, negotiations. There exist many types of OTC markets, which differ in features such as the exact process through which each trader searches for a counterpart, the possible presence of intermediating traders such as brokers, or the nature of the traded commodity. There are, however, two main features characterizing all OTC markets. First, traders are price makers, and different buyers and sellers (typically) trade the same commodity at different prices. Therefore, OTC markets are not competitive markets. Second, OTC traders have less information than traders operating in other non-competitive but more centralized markets, such as auction markets. More precisely, while in auctions potential buyers and sellers are made aware of the trade opportunities available in the market – be it by an auctioneer, an easily accessible order book, or some other market institution – this does not happen in OTC markets. As Duffie (2012, p. 1) aptly remarks, OTC traders are "somewhat in the dark about the most attractive available terms and about whom to contact for attractive terms." This lack of public information influences the functioning of OTC markets and, as we will argue, makes them less efficient than more centralized trading mechanisms such as auctions.

OTC markets are economically relevant because many assets – such as government and corporate bonds, derivatives, currencies, real estate, and bulk commodities – are often traded on a private, bilateral basis. Despite their importance, however, the study of OTC mechanisms is "still underdeveloped in comparison to the available research on central market mechanisms" (Duffie, 2012, p. xiii).

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In this paper, we contribute to the filling of this gap by studying the functioning of an experimental OTC market that can be seen as an extension of the pit market designed by Chamberlin (1948) in a seminal contribution to the experimental literature on market institutions. We compare its performance to that of a centralized market, namely the well-known experimental double-auction (DA) market introduced by Smith (1962) (for a review of the experimental research on DA markets, see Friedman and Rust, 1993; Plott, 2008; Cason and Friedman, 2008).

Duffie and his co-authors have constructed theoretical models for a number of OTC markets (Duffie, 2010; 2012; Ashcraft and Duffie, 2007; Duffie et al., 2005; 2007; Duffie and Manso, 2007; Duffie et al., 2010a; 2009; 2010b; 2014). We adopt a different but complementary perspective, and study OTC markets experimentally. In particular, our OTC and DA experimental markets are electronic, in the sense that our traders interact only via computer. This allows us to rule out information spillovers that may occur when OTC bargaining is conducted orally. To the best of our knowledge, our paper is the first study of an electronic OTC market from an experimental perspective.[1]

Our OTC and DA experimental markets share some common features (more details in Section 2). In both settings, each experimental session involves 40 subjects who are equally divided into buyers and sellers. Each of the 20 sellers is exogenously assigned one unit of an imaginary homogeneous good, and a valuation indicating the minimum amount he/she has to receive for his/her unit. Each of the 20 buyers is exogenously assigned a valuation indicating the maximum amount he/she can spend for one unit of the good. Each experimental session consists of nine trading periods during which buyers and sellers have to trade the good by posting bid quotes (buyers) or ask quotes (sellers). As already noted, buyers and sellers interact only electronically: they post their quotes using their computer's keyboard, and all the information they receive about what is happening in the market is the information appearing on their computer's screen.

What is different between our OTC and DA experimental markets is the way traders post their quotes, and the information they receive about the quotes posted by other traders in the market. In our DA market, buyers and sellers post their quotes publicly in the sense that each buyer (seller) addresses his/her bids (asks) to all sellers (buyers) in the market, and these quotes are disclosed to all traders in the market by appearing on their screens. Thus in the DA market at each moment each buyer (seller) is informed about the best bid (ask) currently present in the market, but also knows the entire previous history of public bids and asks. This feature of the DA market is called *pre-trade price transparency*. In actual OTC markets, pre-trade price transparency and the relevant public information associated with it are absent. Therefore, in our OTC setting, buyers and sellers post their quotes privately, that is, each trader can make/receive only one electronic quote at a time to/from a single counterpart, and only the sender and the receivers of the quote observe it on their screens. Therefore, in our OTC market each buyer (seller) is informed only about the bids (asks) he/she makes and has made, and about the asks (bids) he/she receives and has received.

In the DA market, when a buyer accepts a public ask, or a seller accepts a public bid, a transaction is enacted, and the closing price appears on the screens of all traders. This market feature is called *post-trade price transparency*. In a number of actual OTC markets, such as those for U.S. corporate and municipal bonds, financial regulators have mandated post-trade price transparency, often implemented through a program called the Trade Reporting and Compliance Engine (TRACE). We impose post-trade price transparency also in our OTC experimental market: when a buyer (seller) accepts an ask (bid) privately made to him/her by a seller (buyer) in the market, the closing price and the identification numbers of the two traders are made public by appearing on the screens of all traders in the market.[2]

In order to study the functioning of our OTC market and compare its efficiency to that of a DA market, we ran a series of classroom experiments. The experiments involved more than 3300 undergraduate students of almost the same age (19 or 20 years old when performing the experiment), nationality (around 80% Italians), and field of study (economics), and were performed over a period of six years, namely from 2009 to 2014, inclusive. Because the exceptionally large number of students involved in our setting would make paying them too expensive, and as is indeed common in many classroom experiments (see Holt, 1996; 1999), we did not use monetary incentives. Rather, we incentivized students to play effectively by publicly praising the best performing traders among them (more details in Section 2).

Our main research hypothesis was that the information disadvantage of the OTC mechanism, where only post-trade price transparency is implemented, with respect to the DA mechanism, where both pre-trade and post-trade transparency are implemented, makes the OTC market less efficient than the DA market. Our experimental findings validate this research hypothesis: our OTC market is less efficient than our DA market. We take as our index of efficiency the ratio between the total surplus actually obtained in the market and the total surplus that could have been obtained if the market were perfectly competitive. We find that, while in DA markets the average efficiency index is about 93 over 100, in OTC markets the efficiency index is about 85 over 100. Thus the information gap between the OTC and the DA settings determines a loss of efficiency of almost 8 efficiency points. We show that changes in subjects' learning and reduction in trading period time do not change this result.[3]

To better understand how the lack of pre-trade price transparency – i.e., the lack of information about the entire history of bids and asks – affects negatively the efficiency of the OTC mechanism, we study the pattern of closing prices and traded quantity in both the OTC and the DA settings. We find that, because of its informational features, in the OTC mechanism closing prices

[1] Holt (1996) provides a description of classroom experiments based on an OTC market where buyer-seller bargaining is conducted orally. Hendershott and Madhavan (2015) study traditional OTC trading based on telephone and voice communications. In particular, they use data on corporate bond trades between 2010 and 2011 to investigate which factors influence the transition from voice-based OTC trading to DA trading based on electronic platforms such as MarketAxess. Among other things, they find that bond liquidity enhances the transition from voice-based OTC to electronic DA.

[2] As mentioned above, if regarded in historical perspective, the design of our DA market follows Smith (1962), while our OTC mechanism takes inspiration from Chamberlin (1948). However, Chamberlin did not always make public the price of closed transactions, while we always implement post-trade price transparency. Furthermore, Chamberlin let experimental subjects trade for one single market period while we follow Smith (1962) and subsequent standard practice in market classroom experiments (see, e.g., Holt, 1996; Cason and Friedman, 2008), and allow experimental subjects to trade for several periods so that they can gain experience about how the trading mechanism works.

[3] Recently, a trading mechanism in the spirit of Chamberlin (1948) has been investigated by List (2002, 2004) in field experiments involving a sports card market and a collector pin market. As in Chamberlin's setting, but differently from ours, in List's experiment the buyer-seller bargaining is conducted orally rather than via computer. Like us and differently from Chamberlin, however, List allows subjects to trade for multiple periods (four), rather than for a single period. One key feature of List's experimental design is that subjects choose endogenously their role as buyers or sellers; by contrast, we follow Chamberlin (1948) and Smith (1962) in assigning subjects to one of the two roles exogenously and randomly. More generally, the focus of List's experiments is to examine how the experience of buyers and sellers influences the outcomes of an OTC market. Our main goal, by contrast, is to compare the performances of an OTC market and a DA market under the assumption that traders have similar market experience.