

# CURRENT ISSUES

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IN ECONOMICS AND FINANCE

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October 2000

Volume 6 Number 12

## The Emergence of Electronic Communications Networks in the U.S. Equity Markets

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*Recent regulatory and technological changes have spurred the development of automated trading systems known as ECNs, or electronic communications networks. Proponents of the networks contend that ECNs can cut transaction costs, accelerate trade execution, and expand the price information available to investors. While some critics have questioned the effects of the ECNs on market integration, it is clear that the networks are poised to play an increasingly important role in the new electronic environment.*

The U.S. equity markets are in the midst of a technological revolution that could redefine their structure and operation. In recent years, electronic communications networks (ECNs)—innovative stock-trading systems that rely on computer software to match buy and sell orders—have developed rapidly and captured a sizable share of the dollar volume of certain trades. The operators of the networks claim that ECNs can outperform traditional market centers by providing faster trade execution, lower transaction costs, and more complete price information.

ECNs first entered the equity markets in the mid-1990s to display and communicate customer buy and sell orders publicly. However, it soon became clear that these networks could directly match orders and thereby execute transactions in a manner similar to that of traditional stock exchanges. Today, ECNs are relying on their technology to position themselves as automated gateways to certain equity markets. Meanwhile, the market centers themselves—faced with the growing challenge of ECNs—have also been investing in and incorporating increased levels of automation in their trading systems.

In this edition of *Current Issues*, we offer an in-depth look at electronic communications networks—their origins, their regulatory and technological implications, and their diverse structures and strategies. We also

examine the future role of ECNs in the equity markets. In particular, we consider the possibility that the efficiencies provided by these networks will enable stock trading to migrate from a single site, such as an exchange floor, to highly interlinked market centers, where orders flow quickly between centers in pursuit of the best available prices.

### The Evolution of ECNs

Over the past few years, an alternative to the conventional equity trading arrangements (see box) has emerged: the electronic communications network. An ECN is an automated trading system that disseminates orders to third parties and dealers and can execute such orders within the network itself.<sup>1</sup> Most ECNs are regulated as brokers and, as brokers, they receive orders from customers. ECNs typically do not serve individual investors, but instead focus on other brokers and institutional investors. The networks post the price and size of limit orders—orders to buy or sell specific quantities of stock at a specific price—received from clients and automatically complete transactions internally when they find appropriate matches. When an internal match for a given order is not found, the ECNs post the order on the National Association of Securities Dealers Automated Quotation (Nasdaq) system as soon as it becomes the network's best bid or offer for a stock.

*Regulatory Developments*

The rise of ECNs can be attributed in large part to certain regulatory actions that helped create a favorable environment for the networks' entry into the equity markets.

In the Nasdaq system, each dealer in a stock announces a bid and an offer: prices at which the dealer is willing to buy and sell the stock. Before 1994, a dealer could ignore public limit orders, refusing to execute an order that put forward a better price than the dealer presented. In the absence of direct competition from public limit orders, dealers could potentially post lower bid or higher offer prices for stocks, earning excess profits at the expense of investors.

However, in a series of rules that culminated in the 1997 order display rule, the Securities and Exchange Commission ensured that dealers took public limit orders into full account. The rules give a dealer three possible courses of action: limit orders must be fully reflected in the dealer's quote, the orders must be immediately executed against the dealer's inventory, or they must be forwarded to another dealer or ECN. The rules

have thus led to greater transparency and heightened interaction of limit orders—an outcome that in turn has spurred the development of ECNs, whose liquidity is based largely on limit-order flow.<sup>2</sup>

More important, the Securities and Exchange Commission gave ECNs complete access to the Nasdaq in 1997. Before then, dealers sometimes placed on proprietary systems orders that were better priced than their quotes in the public market. These systems gave very little price information to the public. In 1997, however, the commission adopted its quote rule, which requires dealers to display publicly their most competitive quotes. The rule prevents a dealer from placing a more competitive quote in an ECN unless the price is viewable by, and accessible to, all market participants.

Together, the order display and quote rules helped to end ECN privacy, effectively inducing the networks to post their quotes on the Nasdaq. Opening the Nasdaq to ECNs proved to be a crucial step in their evolution: a network with such access needs to provide only one party to a transaction; the counterparty can come from anywhere else in the system. By contrast, a proprietary

**The U.S. Equity Markets**

In the United States, equity shares are traded in stock exchanges as well as in the over-the-counter (OTC) market. In organized exchanges such as the New York Stock Exchange (NYSE) and the American Stock Exchange, buyers and sellers of securities meet in one central location to execute trades. In the OTC market, dealers at various locations trade shares of a stock with anyone who accepts their price. The OTC market is organized by the National Association of Securities Dealers (NASD), which arranges trades mainly through its Nasdaq automated quotation system.

*The New York Stock Exchange*

The NYSE is the largest organized stock exchange in the United States. Its 1,366 members represent three groups of roughly equal size: commission brokers, independent brokers, and specialists (Ip and Smith 1999). Trading on the NYSE is structured around the specialist. For each stock, one specialist has an exclusive franchise, functioning as both agent and dealer. As agent, he or she matches buy and sell orders and handles limit orders placed with brokers. The specialist therefore maintains the limit-order book, which records all of the unexecuted limit orders received. As dealer, the specialist sometimes posts his or her own price quotes on the market and trades from his or her own inventory, providing liquidity when the normal order flow is inadequate.

The NYSE has an electronic transmission system for small orders—SuperDot—through which member firms

can place market orders for up to 2,099 shares or limit orders for up to 30,099 shares. SuperDot delivers 85 percent of all NYSE orders (Reilly and Brown 1997). Orders are executed manually by the specialist. The specialist's limit-order book contains proprietary information to which brokers have very limited access.

*The Over-the-Counter Market*

The OTC market mainly involves trading in stocks not listed on an exchange. All purchases and sales of shares occur through a dealer. Thus, a broker with access to the Nasdaq system can identify the dealer with the best quote before making a sale or purchase. In January 2000, there were approximately eleven dealers for each Nasdaq stock (Nasdaq 2000a). This multiple-dealer structure is a key feature distinguishing the OTC market from the NYSE and its single-specialist structure.

In the over-the-counter market, brokers can route orders to NASD dealers through a telephone line or by using either the Small Order Execution System or SelectNet. The Small Order Execution System automatically executes orders of less than 1,000 shares at the best price available on the Nasdaq. SelectNet allows dealers to negotiate the terms of large orders with other dealers. As in a traditional exchange, a dealer's limit-order book generally contains proprietary information not available to individual investors.

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system needs to attract both a buyer and a seller to complete a transaction.

### *Technological Advances*

ECNs have also evolved naturally from the major advances in telecommunications and computer technology in recent years. After the boom experienced by on-line brokerage and financial services firms, the development of ECNs appeared to be an obvious next step. Since 1997, several ECNs have entered the market, seizing the opportunities created by technological (and regulatory) change.<sup>3</sup> Today, the networks capture approximately 26 percent of the dollar volume of Nasdaq trading, but some practitioners predict that their market share could rise to 50 percent over the next few years (Nasdaq 2000a).

Such a rise could stem largely from four technological advantages potentially offered by ECNs. First, their automated communication and matching systems could lead to less expensive trade execution. By matching buyers and sellers directly, the networks can bypass dealers, saving on dealer rents and minimizing trading costs. Dealers on the New York Stock Exchange (NYSE) and the Nasdaq have average operating margins of 55 percent and 25 percent, respectively (Vinzant 1999).<sup>4</sup> ECNs offer the opportunity to undercut these margins and reduce transaction costs. Indeed, since the adoption of the Securities and Exchange Commission rules in 1997, the average Nasdaq spread—the difference between the bid and offer price—has declined by more than 40 percent (Nasdaq 2000b). The emergence of ECNs has very likely contributed to the reduction in trading costs (Weston 2000).

Swifter trade execution is another potential advantage of ECNs. State-of-the-art technology generally allows the networks to execute orders significantly faster than the trading systems of established market centers. For example, the average turnaround time for an ECN-executed order is two to three seconds, compared with twenty-two seconds for an order processed through an exchange (Smith, Ip, and Gasparino 1999).

Furthermore, several ECNs provide investors with more complete price information than traditional market centers by allowing them to see the network limit-order books. An investor with access to this information is better positioned to assess market depth and to decide how to place an order.

Finally, by listing only the price and size of an order, rather than the trader's identity, ECNs provide trader anonymity. Anonymity is potentially important for informed institutional investors, whose transactions may serve as signals to less informed traders. Anonymity also protects institutional investors against front running, the practice of trading in front of an

investor when the trader possesses prior knowledge of an upcoming transaction. In the equity markets, information leakage and front running are serious concerns.<sup>5</sup>

### **ECN Strategies**

ECNs distinguish themselves from each other by targeting different clienteles and following different strategies. Some networks, for example, handle limit orders exclusively and are destination-only ECNs (that is, orders do not leave the network until they are canceled). A destination-only ECN conducts its own price discovery: when it receives a limit order, it immediately searches for an internal match in its order book; if a match is not found, the ECN posts the order on the Nasdaq as soon as it becomes the network's best quote and waits for an outside party to express interest in trading at its price.

Other ECNs take both market orders—orders to buy or sell a stock immediately at the best available price—and limit orders and route them to the Nasdaq in search of the optimal price. These outbound-routing ECNs actively seek liquidity outside their networks: when the national best bid or offer—the best price available in the entire market—can be obtained from another dealer or network, outbound-routing ECNs send their orders there. Interestingly, destination-only ECNs often consider outbound-routing networks some of their best customers.

ECNs also differentiate themselves in other ways. For example, each ECN that routes orders to other market centers has its own method (or algorithm) for selecting the center that is likely to provide a particular combination of speed, quality, price, and certainty of execution. Other ECNs batch orders for short periods and conduct regular “call markets” to establish a stock price,<sup>6</sup> while still others engage in price discovery continuously. Furthermore, ECNs vary in the type of information they provide investors: some post their limit-order books on the Internet, while others grant individual investors more limited access to price information. These different approaches to price discovery, quality of execution, and order information are likely to attract diverse clients with diverse trading needs.

### **ECNs Compared with Traditional Market Centers**

Market participants continue to debate the advantages of ECNs relative to those of traditional market centers. Advocates of electronic communications networks argue that they offer potentially lower transaction costs, achieve faster execution, provide more information to investors, and protect trader anonymity more efficiently.

However, proponents of the traditional market centers contend that the existence of dealers and specialists leads to greater liquidity. Dealers and specialists supply immediacy by continuously standing ready to buy and sell

using their own inventory. In contrast, in an automated trading system, buyers and sellers arriving sporadically might not find each other at once. Another advantage cited by those favoring a dealer- or a specialist-centric system is greater price stability. Experienced dealers can often use their inventory to accommodate large orders with minimal price impact. As some advocates of conventional market centers point out, the dealer's role is to provide liquidity while investors provide liquidity only as a by-product of portfolio trading. In addition, they note that traditional exchanges may offer more precise price discovery because all orders are funneled through the specialist, thereby concentrating, rather than fragmenting, order flow.

Nevertheless, for smaller orders and more active stocks, it is debatable how much liquidity specialists and dealers provide in modern equity markets. In active stock trading, the flow of orders itself may be sufficient to supply liquidity. As a result, automated trading systems could work well for active stocks, even in tumultuous environments. One market participant, for instance, observes that specialists may not be needed to trade the 1,000 most active NYSE stocks (Smith 1999). Rather, they may be required only for the less liquid issues.

## The Future of Electronic Communications Networks

### *Expansion Initiatives*

Thus far, ECNs have been limited mainly to handling shares traded over the counter (OTC) on the Nasdaq. Yet despite being important players in the OTC market, the networks account for only 4 percent of NYSE volume (Vinzant 1999). Nevertheless, ECNs believe that they maintain a technological edge, and have launched ambitious expansion initiatives—some of which are aimed at executing more transactions of exchange-traded stocks.

However, the current regulatory structure could potentially thwart the efforts of ECNs to establish interconnections with established stock exchanges. Specifically, equity markets in the United States were interlinked in the late 1970s through a national market system that includes the Consolidated Quotation System and the Intermarket Trading System. The Consolidated Quotation System displays stock quotes in each participating market center; brokers at one exchange can then commit to buy or sell the stock at another exchange through the Intermarket Trading System.

This arrangement poses two key problems for ECNs. First, they can be linked to the intermarket system only via the National Association of Securities Dealers' gateway to the network: the Computer Assisted Execution System. Because this system interface was built for

dealers, it is not very suitable for pure matching engines like ECNs. Second, ECNs consider the Intermarket Trading System to be relatively slow, a drawback that would prevent the networks from taking full advantage of their advanced technology.

For these reasons, several ECNs have recently applied to the Securities and Exchange Commission to become full-fledged stock exchanges. Such a designation has several potential advantages. For one, as an exchange, an ECN can become a self-regulatory organization. Currently, ECNs are subject to the regulatory apparatus of the National Association of Securities Dealers, with whose members many ECNs compete. In addition, by becoming an exchange, an ECN would gain unrestricted access to the Intermarket Trading System. Furthermore, ECNs would have a say in the governance of this system and could influence the direction of investments in system improvements.

### *Competition from Incumbents*

In the new technological environment, established equity markets like the NYSE and Nasdaq are also investing in enhanced electronic systems. In addition, each has discussed becoming a shareholder-owned, for-profit company (the two markets currently are member-owned collectives).<sup>7</sup>

These developments have important implications. First, analysts point out that the membership of the traditional market centers may be divided over the adoption of newer automation (Dwyer 1999). Some members, for example, may be reluctant to accept changes that could eventually eliminate their jobs. Nevertheless, several major financial institutions are pushing for more innovation and larger investments in the market centers' automated trading systems. Second, if the market centers went public, they might expect to overcome existing disagreements between their members, gain greater flexibility in decision making, and raise capital for technological investment.

Despite these implications, ECNs feel comfortable coexisting with traditional market centers. They indicate that even if established markets were to become more automated and agile after altering their governance structure, the new automation would still not be as comprehensive as ECN technology. Electronic communications networks expect that their nimble structure and state-of-the-art efficiencies will enable them to prosper even after traditional exchanges have embraced increased automation.

### *Consolidation or Proliferation?*

Some analysts believe that the primary activity of ECNs, trade matching, is relatively unprofitable—particularly in

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light of the growing number of networks. Noting that trade matching is a business in which large economies of scale are possible, these analysts predict that the number of networks will eventually decline as the industry consolidates to achieve scale economies (Ip 1999).

Other analysts, however, argue that trade matching is not necessarily unprofitable. They contend that once an ECN builds a customer base, it can find new products and services to generate revenues. The uses of the networks extend beyond the matching of stock buyers and sellers (Ip 1999). ECNs can earn profits by providing market data, analytical information, and nonequity services such as bond trading. They may also be able to use their web sites to earn advertising revenue or sell their technology and expertise to exchanges overseas.

Moreover, although pressures to achieve scale economies through consolidation may emerge, the diverse services and strategies of the existing ECNs suggest that the networks offer sufficiently customized products to attract a small but profitable client base. For example, ECNs that take orders and transmit them to the Nasdaq may obtain good returns on the routing services they offer to a limited group of customers.

The success of such small-scale efforts provides some basis for believing that stock trading in the future could potentially be conducted by several interconnected market centers, instead of on the floor of a single exchange. ECNs could play a variety of roles in this environment—displaying, routing, and executing orders. Such an interconnected market structure would lead to the proliferation—rather than the consolidation—of ECNs.

#### *Achieving Integration in the Securities Market*

In an interconnected market environment, the way in which orders are handled will be crucial for the continued success of ECNs. How brokers process orders reflects their legal obligation to provide clients with “best execution.” Best execution primarily means securing the most favorable prices available, but it also refers to the speed of execution and other considerations. In this respect, the Intermarket Trading System and other methods of market interconnection enable a broker to identify the best price for clients by investigating whether the NYSE, the American Stock Exchange, the regional exchanges, or the OTC market offers this price.

Many practitioners believe that the current level of market interconnection and price transparency is insufficient to achieve a truly competitive market.<sup>8</sup> In addition to stressing the technological and administrative limitations of the Intermarket Trading System, they point to ECN operations and other arrangements in which brokers clear

trades internally as practices that fragment the market and lead to price variation among dealers.

In this vein, several market participants indicate that integration in the securities market cannot be complete unless a virtual “central limit-order book” is created. Such a book would pull together electronically all limit orders and quotes displayed internally in the various exchanges, executing limit orders on a first-come, first-served basis. By ensuring full interaction of all orders, the book would lead to competition among orders, rather than among order handlers. The central limit-order book would be visible to everyone, allowing investors to evaluate liquidity across the markets more effectively.

Yet other market participants suggest that a central limit-order book could restrain competition from ECNs and other market centers, because all trades would ultimately be displayed and executed by the central mechanism. A monolithic central mechanism, they argue, might discourage those with new ideas for market interconnection and price transparency.

Accordingly, some participants suggest that other ways to interconnect markets may achieve the benefits of the central limit-order book without stifling the ability of new firms to compete for orders. For example, they observe that ECNs using outbound routing provide a means for orders to be quickly directed to the market center with the best price or likelihood of execution. Furthermore, destination-only ECNs in some cases provide full transparency of the limit orders received in their system, allowing investors to assess the likelihood of receiving a good price at these ECNs and to route their orders to the best market center. The most optimistic scenarios suggest that some combination of outbound routing and transparency in order information could achieve many of the benefits of a central limit-order book. Whether such an outcome is likely, however, remains an open question.

#### **Conclusion**

Electronic communications networks are redefining the U.S. equity markets. While established market centers are seeking to maintain their edge chiefly by investing in new technology and trading systems, ECNs appear confident that they have the automated capabilities to be major players in the new electronic environment. This confidence is borne out by the ECNs’ strong dollar share of Nasdaq trading volume.

Nevertheless, a potential drawback arising from the growth of ECNs is the risk that multiple trading platforms will fragment the market, leading to situations in which the pricing of securities varies from one market center to the next. To solve this problem, some market participants stress that market centers must be interconnected.

Accordingly, they have suggested the creation of a central limit-order book, in which all limit orders and quotes from different market centers can interact. Others contend that the ECNs themselves might be a force for, rather than against, market integration. In this view, outbound routing and the full transparency of limit orders achieved by some networks could bring about an interconnected market as effectively as a central limit-order book.

Overall, it is too early to predict exactly how the revolution brought about by ECNs will reshape the equity markets. In our judgment, however, the competition spawned by these vehicles is already encouraging faster order execution, lower prices, and better customer service. Moreover, the innovative and diverse methods used by ECNs to set stock prices and locate the best market center for settling a trade should continue to have wide-ranging customer appeal.

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## Notes

1. ECNs rely on algorithms—essentially a mechanical set of rules—to route orders to dealers and execute trades.
2. Liquidity is the ability to buy or sell an asset quickly and at a price not substantially different from the prices of previous transactions, assuming no new information is available.
3. Nine ECNs were registered with the Nasdaq in January 2000: Archipelago, Attain, Brut, B-Trade, Instinet, Island, NexTrade, Redibook, and Strike (Brut and Strike have announced merger plans).
4. An operating margin can be defined as profits before depreciation, interest, and taxes as a percentage of revenues.
5. Although ECNs guarantee trader anonymity, disproportionate use of the networks by institutional investors could lead to higher information costs for uninformed liquidity providers. In this case, the benefits of anonymity might be reduced.
6. In a call market, buy and sell orders are gathered for a period and aggregated at one time for simultaneous execution at one price.
7. See Sarkar and Tozzi (1998) for a discussion of electronic trading on futures exchanges.

8. The various viewpoints in this section are summarized from the testimony reported in U.S. Senate Committee on Banking, Housing, and Urban Affairs (2000).

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*Current Issues in Economics and Finance* is published by the Research and Market Analysis Group of the Federal Reserve Bank of New York. Dorothy Meadow Sobol is the editor.

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